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Analyzing the international competitiveness of the industry in Portugal, Ireland, Greece and Spain using revealed comparative advantages (RCA) indicators

CAWM Discussion Paper No. 61

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Abstract

This paper sheds light on the export structure of the four European countries Portugal, Ireland, Greece and Spain, the so called PIGS countries. These countries were all hit by the economic downturn in the course of the financial crisis and have been struggling with the national debt crisis and recession. One way to identify sectoral international competitiveness is provided by the revealed comparative advantage index developed by Balassa (RCA 1). This indicator evolved through several studies, for example by the German council of experts (RCA 2). Both indicators suggest that the dominant advantages of Portugal and Greece can be found within agriculture and natural resources. The dominant export sectors are also located there. Ireland stands out from the other PIGS, as high-tech and medical/chemical products occur in the top sectors. Spain's top export sectors do not have the competitiveness that one might expect. Furthermore, the Balassa-Index is transformed to a standardized and symmetric index RSCA, which has values ranging from minus one to plus one and is plotted against the trade balance index (TBI). Thus, information on country trade structure can be depicted. Ireland is to a certain extent dependent on the world market, without having a sound national industry as a basis. Gaining from the global economy through export growth will not have a major impact in Greece and Portugal. Spain does have competitive sectors and a degree of specialization, but the most important sectors are less competitive. Finally, the level of specialization (β -specialization) and the specialization-process (σ -specialization) are identified by a short OLS-estimation. The β -specialization does not indicate high degrees of specialization in those countries. According to the σ -specialization, there do not seem to be significant specialization or de-specialization trends since 1995.

Key-Words: Revealed Comparative Advantages, Trade Specialization, Product Mapping

JEL-Classifications: F14

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1. Introduction

The economic turmoil in 2008, followed by the national debt crisis, hit the European countries to a varying degree. Among the countries struggling most were Portugal, Ireland, Greece and Spain - the so-called PIGS. Each had diverse economic structures and their initial economic situation was very different at the beginning of the crisis. A similar problem in all countries at the time of writing is the collapse of national demand. Both, private and the national consumption have been weakened chronically, due to high unemployment rates and/or mandatory spending gaps since budgetary consolidations are required. This applies especially to Greece and Portugal and to some extent to Spain. The Greek and Portuguese economies are dominated by the tertiary and the public sector, and Spain benefited until the crisis from the building sector and private consumption. The situation of Ireland is slightly different, as they had attracted substantial foreign direct investments (chemical, pharmaceutical and bio-tech industry) in recent years, but the bursting real estate bubble hit the Irish economy hard. Foreign trade might seem a logical way to restore economic strength, but little is known about the international competitiveness of the PIGS' industries. This paper provides some information in this context, on which of these four countries might benefit from exports in the short term.

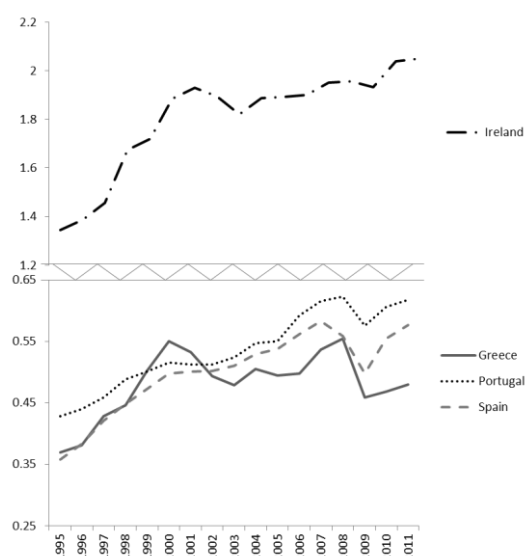
It is evident that foreign trade is more or less important to these countries. The following analysis sheds some light on the PIGS' export structures. To do so, the so-called Revealed Comparative Advantage (*RCA*)-indicator is used. *RCA*-analysis is widespread in the economic literature² and somewhat discussed critically.³ Nonetheless, helpful information emerges on the economic situation and addresses some problems which might constrain economic upswings. First of all, the degree of openness of the four countries, i.e. the trade volume (exports + imports) as a share of total gross domestic product, is presented in Figure 1. As can be seen, the level of openness increased in all four countries since 1995.⁴ Greece, Portugal and Spain have rather similar values and face similar developments, whereas Ireland is outstanding in this sample. Here, the openness increased dramatically till 2001, with foreign trade being a significant part of the Irish economy.

² See, for example, J. Hinloopen, C. van Marrewijk: On the empirical distribution of the Balassa index, in: *Weltwirtschaftliches Archiv*, Volume 137, Issue 1, 2001, p. 1-35 and the literature there cited in.

³ For a comparison of several indices, see especially T. Vollrath: A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage, in: *Weltwirtschaftliches Archiv*, Volume 127, Issue 2, 1991, pp. 265-280, or H. Bowen: On the theoretical interpretation of indices of trade intensity and revealed comparative advantage, in: *Weltwirtschaftliches Archiv* 119, 3, 1993, pp. 464-72 and H. Bowen: On measuring comparative advantage: A reply and extensions, in: *Weltwirtschaftliches Archiv* 121, 2, 1985, pp. 351-354.

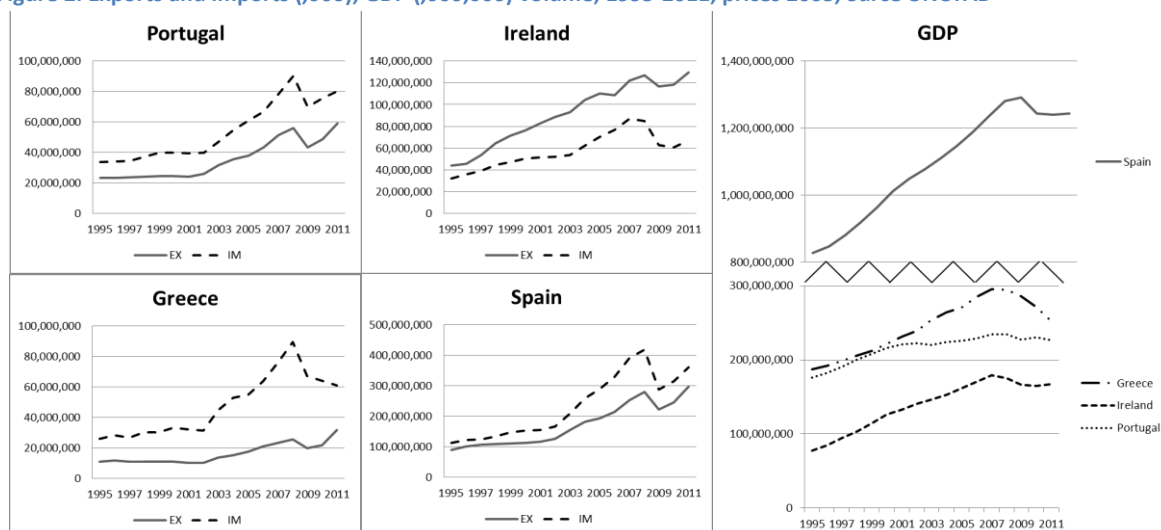
⁴ The trade openness ratio of these countries from 1960 to 2005 is discussed in J. Amador, S. Cabral, J. Maria: International trade patterns over the last four decades: How does Portugal compare with other cohesion countries? Banco de Portugal, Working Papers 14/2007.

Figure 1: Trade Openness: (EX+IM)/GDP in prices of 2005. Source: OECD, own calculation.



The elements of trade openness are presented separately in Figure 2. With respect to the subsequent calculations, trade volumes are presented for commodities only. Ireland is the only country with export surplus. The impact of the economic crisis is clearly evident from the drop in imports, showing a breakdown of national consumption. The introduction of the Euro is also clearly reflected in the imports. Besides Ireland, all countries reveal increasing imports. The exports however increased relatively less, especially evident for Spain and Portugal. The negative trade-balance in Greece rose dramatically after 2002. Total GDP is plotted in the right part of figure two; Spain is by far the largest economy of these four countries. All experienced continuous rise in GDP till the great recession in 2008.

Figure 2: Exports and Imports (,000); GDP (,000,000) volume; 1995-2011, prices 2005, Surce UNCTAD



To sum up this brief description, the export orientation of Greece, Portugal and Spain is rather weak, with only Ireland being a net-exporter. Thus, the number of sectors with comparative cost advantages should be fairly low and besides Ireland, these sectors should be of less importance to the total exports.

The analysis commences with two RCA-measures (RCA 1 and RCA 2) and their results, which are discussed briefly in 2.1. The data are from the United Nations Conference on Trade and Development (UNCTAD) and include the years 1995 to 2011. This enables identifying the effects of the Euro-introduction in 2002 and the impact of the financial crisis in 2008/2009. The economy of the investigated countries is divided into 255 products and goods which were traded in the years 1995-2011. The service sectors have not been taken into account, due to a lack of data and as is traditional in RCA-analysis concentrating on manufacturing sectors. In Section 2.2, the Balassa-Index (RCA 1) is transformed to a standardized and symmetric index RSCA, which has values ranging from minus one to plus one. This indicator is plotted against the trade balance index (TBI) in order to determine whether the competitive sectors do indeed have an export surplus. This yields information on trade structure and specialization. Finally, two types of specialization are presented in 2.3, where the level of specialization (β -specialization) and the specialization-process (σ -specialization) are identified by a short OLS-estimation. Section 3 concludes.

2. Measurement

2.1. RCA-measurement

Many investigations aimed at identifying international competitiveness and trade performance are available in the literature. A common issue in this debate is identifying the weaknesses and strengths of various national sectors and goods in international trade. This is done mainly with revealed comparative advantages measurements, using trade data and “post-trade equilibria” (Vollrath, 1991). The specifications of these measurements are manifold. In this present study two, broadly used RCA-indices are chosen. The first RCA-Indicator “RCA1”, preferred by Vollrath (1991), was developed by Balassa⁵. It compares the relationship of national exports X of a single commodity i to total exports of all commodities, with the ratio of worldwide (w) exports of that commodity X_i^w to total exports per annum:

$$RCA\ 1 = \frac{X_i / \sum_i X_i}{X_i^w / \sum_i X_i^w} \quad [1]$$

The critical value in this case is 1. Values above 1 indicate comparative advantages, whereas values between zero and one indicate comparative disadvantages. This indicator is one of the most commonly used⁶ as its calculation is quite simple. The level of awareness helps in discussing the results and comparing them with previous studies. Nonetheless, there are several associated problems, because, for example, the distribution of RCA-values ranks from zero to infinity and is therefore asymmetric. Furthermore, the results apply only to the country in question: a comparison of the RCA-value of Sector X in Country Y is not directly comparable to the parallel sector result in Country Z (apart from the question of whether it is greater or less than one).⁷

⁵ B. Balassa: Trade Liberalization and 'Revealed' Comparative Advantage, in: Manchester School of Economic and Social Studies, Vol. 23, 1965, pp. 99-123.

⁶ See A. Yeats: On the appropriate interpretation of the revealed comparative advantage index: implications of a methodology based on industry sector analysis, in: Weltwirtschaftliches Archiv, 121, 1985, pp. 267-282.

⁷ Further critical aspects are discussed in E. Sanidas, Y. Shin: Comparison of Revealed Comparative Advantage Indices with Application to Trade Tendencies of East Asian Countries, in: Department of Economics, Seoul National University, 2010, pp. 1-57.

Note that imports are omitted, but this lack of information is dealt with by adding another RCA-index from the German Council of Experts.⁸ Here, the exports of one commodity i in year t is related to the imports M of that commodity i in year t . This quotient is divided by the relationship of total exports to total imports in year t :

$$RCA\ 2 = 100 * \ln \left(\frac{X_{it}/M_{it}}{\sum_i X_{it}/\sum_i M_{it}} \right) \quad [2]$$

The critical value is zero: Positive (negative) values indicate comparative (dis-) advantages.

Perfectly free trade is the assumption underlying these results, that post-trade data indicate the cost structure and cost relationships. In reality, however, the results are distorted by several different aspects. Besides trade-policies, taxes, tariffs and subsidies, changes in consumer demand or exchange rates impact on the indices. Intra-industrial trade is a further point of criticism. Especially tariffs and trade barriers affect imports more than exports, which is a disadvantage for RCA 2 compared to RCA 1. Excluding the imports, however, would not reflect the international trade adequately. Thus, both indicators do have their disadvantages, but should nonetheless deliver interesting insights of the trade situation of the PIGS.

The results of RCA 1 and RCA 2, the indicators, are presented in Table 1. For reasons of clarity, the top 10 sectors of each country are presented. The results are not given for each year, but are pooled over four to seven years. We divided the years from 1995 to 2011 into three periods:

- a) 1995 to 2001, the years before the Euro introduction
- b) 2002 to 2007, the years after the Euro introduction and before the beginning of the recession
- c) 2008 to 2011, the period of the economic downturn and national debt crisis.

Portugal's sectors with the highest RCA-values are beverages/tobacco [1xx]⁹, crude materials [2xx] and non-mineral manufactures [66x]. Radio receivers are the only "products of machinery" [7xx] within the Top 10 of all four countries. As the world market leader in cork, the RCAs are unambiguously "high" and these RCA 1 values are by far the highest of all considered sectors of the PIGS.

Ireland's best performing sectors in the context of RCA-values are some of the products categorized as food and live animals [0xx], crude materials [2xx], chemical-related products [5xx] and manufactured articles [8xx]. Note that the chemical-related products are predominant in the RCA-1 ranking, whereas crude materials head the RCA-2 ranking.

⁸ This indicator is used broadly; e.g.: J. Matthes: Deutschlands Handelsspezialisierung auf forschungsintensive Güter, in: IW-Trend – Vierteljahresschrift zur empirischen Wirtschaftsforschung, 33. Jhrg. Heft 3/2006; or K. Aiginger: Specialization of European manufacturing, in: Austrian Economic Quarterly, 2000. V. Serin, A. Civan: Revealed Comparative Advantages and Competitiveness: A Case Study for Turkey towards the EU, in: Journal of Economic and Social Research 10 (2), 2008, pp. 25-41, chose a slightly modified version of this indicator.

⁹ The numbers and product labels are from the Standard International Trade Classification (SITC) Revision 3 of the UNCTAD, which can be downloaded here: http://unctadstat.unctad.org/UnctadStatMetadata/Classifications/UnctadStat.SitcRev3Products.Official.Classification_En.pdf.

The Greek top-RCA sectors are manifold, with sectors including foodstuff and tobacco [0xx & 1xx] crude materials and manufactured goods [6xx]. In this context, products from natural resources lead the RCA-rankings.

Spain's revealed comparative advantages are in producing foodstuff and animals [0xx & 4xx], crude materials and manufacturing of natural resources [6xx]. Especially clay construction should be emphasized.

It is worth noting that chemical (besides Ireland) and machinery [7xx] is underrepresented in the list. The total number of sectors with comparative advantages increased in Portugal, Greece and Spain or remains at a low level, as in Ireland. This can be interpreted (with caution) as a positive restructuring of factor allocation and the export orientation. However, half of the sectors with RCA-1 values have values between one and two.¹⁰ These sectors are regarded as having "weak" advantages, see Hinloopen/van Marrewijk (2000).

¹⁰ For 2008-2011 the amounts of sectors with $RCA_1 > 2$ are 57 (Portugal), 27 (Ireland), 43 (Greece), 37 (Spain).

Table 1: RCA 1 and RCA 2 values for the Top 10 sectors

RCA 1		2008 - 2011	2002 - 2007	1995 - 2001	RCA 2		2008 - 2011	2002 - 2007	1995 - 2001
Portugal	[633] Cork manufactures	186.05	162.35	150.06	[283] Copper ores and concentrates; copper mattes, cemen		900.36	888.00	768.67
	[762] Radio-broadcast receivers, whether or not combined	18.13	13.47	7.85	[289] Ores & concentrates of precious metals; waste, scrap		451.23	636.18	432.12
	[666] Pottery	8.91	11.00	12.00	[633] Cork manufactures		367.53	356.37	395.95
	[851] Footwear	6.00	6.73	8.45	[762] Radio-broadcast receivers, whether or not combined		344.81	307.98	253.37
	[665] Glassware	5.98	4.67	4.08	[251] Pulp and waste paper		297.45	280.01	265.60
	[266] Synthetic fibres suitable for spinning	5.92	3.66	2.26	[344] Petroleum gases, other gaseous hydrocarbons, n.e.s.		251.74	146.55	175.65
	[035] Fish, dried, salted or in brine; smoked fish	5.66	4.23	1.64	[666] Pottery		213.64	233.96	241.37
	[122] Tobacco, manufactured	5.36	3.39	0.30	[971] Gold, non-monetary (excluding gold ores and concentrates)		203.97	-297.19	-232.15
	[251] Pulp and waste paper	5.29	5.02	6.39	[122] Tobacco, manufactured		200.13	136.92	-86.58
	[112] Alcoholic beverages	5.10	4.51	4.45	[661] Lime, cement, fabrica. constr. mat. (excluding glass, clay)		195.76	128.23	112.65
Number Sectors with RCA 1 > 1		107	86	64	Number Sectors with RCA 2 > 0		97	84	71
Ireland	[551] Essential oils, perfume & flavour materials	39.81	31.42	16.55	[212] Furskins, raw, other than hides & skins of group 211		628.73	401.77	516.70
	[515] Organo-inorganic, heterocycl. compounds, nucl. acids	28.52	22.01	19.20	[211] Hides and skins (except furskins), raw		512.29	295.95	237.38
	[023] Butter and other fats and oils derived from milk	10.55	9.85	11.75	[287] Ores and concentrates of base metals, n.e.s.		403.96	378.50	284.88
	[542] Medicaments (incl. veterinary medicaments)	8.89	7.08	4.58	[282] Ferrous waste, scrap; remelting ingots, iron, steel		328.38	371.08	-120.47
	[899] Miscellaneous manufactured articles, n.e.s.	7.70	5.79	5.79	[289] Ores & concentrates of precious metals; waste, scrap		284.92	163.29	1.19
	[541] Medicinal and pharmaceutical products, excluding 542	7.54	3.97	3.97	[269] Worn clothing and other worn textile articles		271.06	232.35	54.84
	[011] Meat of bovine animals, fresh, chilled or frozen	6.99	6.14	6.25	[023] Butter and other fats and oils derived from milk		254.39	288.91	329.80
	[872] Instruments & appliances, n.e.s., for medical, etc.	5.63	5.67	4.16	[551] Essential oils, perfume & flavour materials		249.75	260.35	182.69
	[098] Edible products and preparations, n.e.s.	4.78	5.33	8.56	[011] Meat of bovine animals, fresh, chilled or frozen		207.30	273.08	345.68
	[017] Meat, edible meat offal, prepared, preserved, n.e.s.	4.63	5.18	3.63	[515] Organo-inorganic, heterocycl. compounds, nucl. acids		202.74	233.61	230.89
Number Sectors with RCA 1 > 1		40	36	41	Number Sectors with RCA 2 > 0		41	47	54
Greece	[121] Tobacco, unmanufactured; tobacco refuse	18.24	25.08	25.64	[263] Cotton		451.31	481.75	420.78
	[058] Fruit, preserved, and fruit preparations (no juice)	18.21	20.38	24.88	[211] Hides and skins (except furskins), raw		352.74	294.02	193.28
	[263] Cotton	17.33	17.92	18.34	[284] Nickel ores & concentrates; nickel mattes, etc.		337.88	73.68	0.00
	[613] Furskins, tanned or dressed, excluding those of 8483	15.74	15.14	12.84	[058] Fruit, preserved, and fruit preparations (no juice)		283.09	289.16	342.34
	[056] Vegetables, roots, tubers, prepared, preserved, n.e.s.	12.72	12.31	13.04	[285] Aluminium ores and concentrates (incl. alumina)		252.35	303.57	492.93
	[661] Lime, cement, fabrica. constr. mat. (excluding glass, clay)	8.35	8.56	13.63	[661] Lime, cement, fabrica. constr. mat. (excluding glass, clay)		250.88	287.61	396.00
	[034] Fish, fresh (live or dead), chilled or frozen	7.71	6.09	4.36	[056] Vegetables, roots, tubers, prepared, preserved, n.e.s.		217.24	219.10	242.74
	[848] Articles of apparel, clothing access., excluding textile	7.41	8.42	8.79	[278] Other crude minerals		208.21	214.71	207.35
	[421] Fixed vegetable fats & oils, crude, refined, fractio.	7.31	12.84	19.74	[277] Natural abrasives, n.e.s. (incl. industri. diamonds)		203.25	115.89	51.63
	[024] Cheese and curd	7.02	5.41	4.15	[679] Tubes, pipes & hollow profiles, fittings, iron, steel		201.97	178.49	70.64
Number Sectors with RCA 1 > 1		91	87	73	Number Sectors with RCA 2 > 0		94	81	69
Spain	[662] Clay construction, refracto. construction materials	7.63	8.54	8.47	[284] Nickel ores & concentrates; nickel mattes, etc.		617.08	162.99	-152.71
	[633] Cork manufactures	7.43	6.65	6.29	[662] Clay construction, refracto. construction materials		273.33	282.67	293.89
	[054] Vegetables	6.33	6.63	6.37	[212] Furskins, raw, other than hides & skins of group 211		248.81	4.60	-160.20
	[421] Fixed vegetable fats & oils, crude, refined, fractio.	6.02	6.70	5.38	[686] Zinc		222.68	229.73	209.61
	[057] Fruits and nuts (excluding oil nuts), fresh or dried	6.02	6.25	6.59	[613] Furskins, tanned or dressed, excluding those of 8483		220.64	237.69	282.81
	[016] Meat, edible meat offal, salted, dried; flours, meals	4.46	2.41	3.92	[016] Meat, edible meat offal, salted, dried; flours, meals		209.28	226.42	235.56
	[532] Dyeing & tanning extracts, synth. tanning materials	4.16	3.59	3.74	[421] Fixed vegetable fats & oils, crude, refined, fractio.		183.11	224.91	189.67
	[056] Vegetables, roots, tubers, prepared, preserved, n.e.s.	4.02	3.99	3.53	[012] Other meat and edible meat offal		180.49	147.97	78.89
	[676] Iron & steel bars, rods, angles, shapes & sections	3.83	2.39	2.59	[054] Vegetables		178.08	180.11	165.68
	[686] Zinc	3.70	2.01	3.09	[325] Coke & semi-coke of coal, lign., peat; retort carbon		172.90	249.35	77.12
Number Sectors with RCA 1 > 1		115	111	97	Number Sectors with RCA 2 > 0		126	116	93

Furthermore, the RCA values for the 10 most important export-sectors of the last period are listed in Table 2, together with the values of the RCA 1 and RCA 2 estimation. Values indicating disadvantages are highlighted in grey; those indicating “weak” advantages are underlined.¹¹ Most of the important export sectors do have comparative advantages. Portuguese exports are not clearly dominated by a single sector, and the weak RCA values of the two leading export sectors in Portugal represent the heterogeneous export structure. In Ireland, there are two main sectors, which both have unambiguous comparative cost advantages [542, 515]. Over 50% of exports are from the chemical industries and all yield relatively high RCA values, indicating fairly sound export structures. Besides petroleum, the export shares of Greece are quite equal in several sectors. The RCA 2 value for “Medicaments” products indicates disadvantages (with “medium” advantages in the context of the RCA 1 index), all other sectors reveal cost advantages. Similar to Portugal (and Spain) a specialized

¹¹ As this classification for the RCA 2 indicator is not realizable without further ado, values lower than ten are underlined as a suggestion.

export orientation is not visible. The sector structure of this list is widespread. Spain's most important export sector is the automobile sector [78x]. Besides these products the structure of exports does not show any specialization. Some of the sectors reveal comparative disadvantages or merely weak advantages.

Table 2: RCA-values of the ten most important Export-sectors 2011

2008-2011				% Exporte	RCA 1	RCA 2	2008-2011				% Exporte	RCA 1	RCA 2	
Portugal	[334] Petroleum oils or bituminous minerals > 70 % oil	5.16	1.07	80.04	Greece	[334] Petroleum oils or bituminous minerals > 70 % oil	15.66	3.00	99.92	Spain	[334] Petroleum oils or bituminous minerals > 70 % oil	3.64	0.89	-10.43
	[781] Motor vehicles for the transport of persons	4.62	1.25	-9.23		[542] Medicaments (incl. veterinary medicaments)	5.35	2.47	-15.17		[542] Medicaments (incl. veterinary medicaments)	5.35	2.47	-15.17
	[784] Parts & accessories of vehicles of 722, 781, 782, 783	4.40	2.24	36.46		[684] Aluminium	4.38	6.20	149.90		[684] Aluminium	4.38	6.20	149.90
	[851] Footwear	3.74	6.00	140.62		[057] Fruits and nuts (excluding oil nuts), fresh or dried	3.42	6.87	173.69		[057] Fruits and nuts (excluding oil nuts), fresh or dried	3.42	6.87	173.69
	[641] Paper and paperboard	2.86	3.52	76.62		[034] Fish, fresh (live or dead), chilled or frozen	2.65	7.71	194.89		[034] Fish, fresh (live or dead), chilled or frozen	2.65	7.71	194.89
	[845] Articles of apparel, of textile fabrics, n.e.s.	2.82	3.46	92.94		[056] Vegetables, roots, tubers, prepared, preserved, n.e.s.	2.18	12.72	217.24		[056] Vegetables, roots, tubers, prepared, preserved, n.e.s.	2.18	12.72	217.24
	[821] Furniture & parts	2.53	2.91	85.10		[682] Copper	1.94	2.76	103.04		[682] Copper	1.94	2.76	103.04
	[112] Alcoholic beverages	2.23	5.10	163.57		[263] Cotton	1.87	17.33	451.31		[263] Cotton	1.87	17.33	451.31
	[762] Radio-broadcast receivers, whether or not combined	1.82	18.13	344.81		[058] Fruit, preserved, and fruit preparations (no juice)	1.87	18.21	283.09		[058] Fruit, preserved, and fruit preparations (no juice)	1.87	18.21	283.09
[633] Cork manufactures	1.82	186.05	367.53	[676] Iron & steel bars, rods, angles, shapes & sections	1.85	3.52	166.83	[676] Iron & steel bars, rods, angles, shapes & sections	1.85	3.52	166.83			
Ireland	[542] Medicaments (incl. veterinary medicaments)	19.80	8.89	134.69	Spain	[781] Motor vehicles for the transport of persons	10.94	2.99	91.10	Spain	[781] Motor vehicles for the transport of persons	10.94	2.99	91.10
	[515] Organo-inorganic, heterocycl. compounds, nucl. acids	18.95	28.52	202.74		[784] Parts & accessories of vehicles of 722, 781, 782, 783	4.22	2.25	-4.24		[784] Parts & accessories of vehicles of 722, 781, 782, 783	4.22	2.25	-4.24
	[541] Medicinal and pharmaceutical products, excluding 542	7.18	7.54	115.44		[542] Medicaments (incl. veterinary medicaments)	3.93	1.81	9.11		[542] Medicaments (incl. veterinary medicaments)	3.93	1.81	9.11
	[551] Essential oils, perfume & flavour materials	5.50	39.81	249.75		[334] Petroleum oils or bituminous minerals > 70 % oil	3.64	0.89	-10.43		[334] Petroleum oils or bituminous minerals > 70 % oil	3.64	0.89	-10.43
	[899] Miscellaneous manufactured articles, n.e.s.	3.77	7.70	111.14		[057] Fruits and nuts (excluding oil nuts), fresh or dried	2.99	6.02	158.56		[057] Fruits and nuts (excluding oil nuts), fresh or dried	2.99	6.02	158.56
	[752] Automatic data processing machines, n.e.s.	3.47	2.20	11.34		[054] Vegetables	2.35	6.33	178.08		[054] Vegetables	2.35	6.33	178.08
	[598] Miscellaneous chemical products, n.e.s.	2.91	4.39	143.98		[782] Motor vehic. for transport of goods, special purpo.	2.01	3.05	152.96		[782] Motor vehic. for transport of goods, special purpo.	2.01	3.05	152.96
	[872] Instruments & appliances, n.e.s., for medical, etc.	2.90	5.63	93.83		[676] Iron & steel bars, rods, angles, shapes & sections	1.94	3.83	168.98		[676] Iron & steel bars, rods, angles, shapes & sections	1.94	3.83	168.98
	[776] Cathode valves & tubes	2.26	0.87	44.98		[792] Aircraft & associated equipment; spacecraft, etc.	1.44	1.45	50.58		[792] Aircraft & associated equipment; spacecraft, etc.	1.44	1.45	50.58
[759] Parts, accessories for machines of groups 751, 752	2.21	1.98	-38.16	[112] Alcoholic beverages	1.34	3.08	89.06	[112] Alcoholic beverages	1.34	3.08	89.06			

To sum it up, it is clear that the export structure of Ireland is different to those of the other three countries, as dominant trade sectors can be identified. The minor importance of foreign trade in Portugal, Greece and Spain is evident from the total lack of sectors with a high share of exports. The automobile industry in Spain is an exception. Most sectors with a more or less high level of economic power do have cost advantages. Here, however, Spain reveals some problems. Reviving the economy through improving exports will be difficult for these countries, as only few powerful sectors with unique selling propositions can be identified. Besides Ireland, the sectors with revealed cost advantages are part of the low or medium-low technology products, which is reflected in the export structure.¹² This will be investigated further in the product mapping below.

2.2. Product Mapping

In a next step, the comparative advantages, i.e. competitiveness on international markets, are directly compared with the degree of export specialization of these products. Therefore few changes in RCA 1 are made and a Trade Balance Index (TBI) is introduced to develop a product map. First of all, RCA 1 is modified so as to obtain a symmetric index with values from -1 to +1. The Index¹³ is called Revealed Symmetric Comparative Advantage (RSCA), is neutral at zero and takes the form

$$RCSA_i = (RCA\ 1_i - 1) / (RCA\ 1_i + 1) \quad [3].$$

The trade balance reveals whether the country is a net exporter or a net importer for each commodity i, by comparing the net exports with the total trade volume:

¹² These results are in line with Amador/Cabral/Maria (2007).

¹³ This Index is provided by B. Dalum, K. Larsen, G. Villumsen: Structural Change in OECD Export Specialisation Patterns: de-specialization and 'stickiness', in: International Review of Applied Economics, Vol. 12, No. 3, 1998, pp. 423-443.

$$TBI_i = (X_i - M_i)/(X_i + M_i) \quad [4].$$

Both indicators yield symmetric values, where the critical value is zero for each. By plotting these indicators into a matrix¹⁴, the commodities can be divided into four main groups, as presented in Table 1:

Table 3: Product Mapping

Revealed Symmetric Comparative Advantage	RCSA > 0	Group 1: Comparative Advantage and Net-Importer	Group 2: Comparative Advantage and Net-Exporter
	RCSA < 0	Group 3: Comparative Disadvantage and Net Importer	Group 4: Comparative Disadvantage and Net Exporter
		TBI < 0	TBI > 0
Trade Balance Index			

Groups 2 and 3 are the most intuitive constellations. In sectors with comparative advantages, there should be an export surplus, whereas in sectors with comparative disadvantages, exports should play a minor role. Especially Group 4 is contra-intuitive. Here, only a few sectors should be identified and the same applies to Group 1. When allocating the sectors to this map, information on country trade structure can be depicted. If most sectors are indeed placed in Groups 3 and 4, the assumption of export-specialization by those sectors with international competitiveness, and imports of those goods with low competitiveness, can be assumed. Especially sectors in Group 1, with relatively high competitiveness but without good export-performance, offer further potential for developing economic strength. The number of sectors in each group for the four countries is presented in Table 4. The share of this number as a proportion of all sectors is given as well. Indeed, the majority of sectors is located within Groups 2 and 3 (75-88%). Besides Ireland, Group 4 is only of minor interest. Group 1 includes a remarkable number of sectors in Spain and especially in Greece. Here, some sectors could obviously expand their export performance, due to comparative advantages.

¹⁴ The matrix follows T. Widodo: Dynamic changes in comparative advantage: Japan's "flying geese" model and its implications for China, in: Journal of Chinese Economic and Foreign Trade Studies, 2008, 1, (3), pp. 200-213 and T. Widodo: Comparative advantage: Theory, empirical measures and case studies, in: Review of Economic and Business Studies, Vol. II, Issue 2, 2009, pp. 57-82. This mapping, the so called flying geese concept, is used, for instance, in E. Sanidas: Patterns and distances of catch-up in trade: China and East Asia, in: China Economic Journal, Vol. 2, No. 1, 2009, pp. 105-118, to identify the catch-up process of China and East Asian countries.

Table 4: Average number of sectors in each group and *share of total sectors*

Portugal				Ireland			
Group 1		Group 2		Group 1		Group 2	
1995-2001	25 0.098	1995-2001	37 0.146	1995-2001	4 0.016	1995-2001	35 0.138
2002-2007	42 0.165	2002-2007	41 0.161	2002-2007	6 0.024	2002-2007	30 0.118
2008-2011	50 0.197	2008-2011	56 0.220	2008-2011	3 0.012	2008-2011	36 0.143
Group 3		Group 4		Group 3		Group 4	
1995-2001	184 0.724	1995-2001	8 0.031	1995-2001	187 0.736	1995-2001	28 0.110
2002-2007	164 0.646	2002-2007	7 0.028	2002-2007	189 0.741	2002-2007	30 0.118
2008-2011	142 0.559	2008-2011	6 0.024	2008-2011	183 0.726	2008-2011	30 0.119

Greece				Spain			
Group 1		Group 2		Group 1		Group 2	
1995-2001	41 0.163	1995-2001	29 0.115	1995-2001	35 0.137	1995-2001	60 0.235
2002-2007	55 0.217	2002-2007	29 0.114	2002-2007	54 0.212	2002-2007	57 0.224
2008-2011	56 0.221	2008-2011	33 0.130	2008-2011	43 0.169	2008-2011	71 0.278
Group 3		Group 4		Group 3		Group 4	
1995-2001	181 0.718	1995-2001	1 0.004	1995-2001	150 0.588	1995-2001	10 0.039
2002-2007	169 0.665	2002-2007	1 0.004	2002-2007	135 0.529	2002-2007	9 0.035
2008-2011	159 0.628	2008-2011	5 0.020	2008-2011	127 0.498	2008-2011	14 0.055

The sectoral trade-performance in Ireland did not change notably during the last 16 years, at least regarding the indicators used here. Portugal and Greece however, managed to place some sectors in Group 1, in comparison to the pre-Euro period. The international competitiveness of Spain's sectors increased since the Euro-introduction, but the import/export-situation changed in several sectors. The increase of 19 sectors on average which became net exporters from 2002-2007 (57+9) to 2008-2011 (71+14) can be interpreted as export specialization. More probable as a cause, however, is the decreasing national income, due to the enormous economic downturn and rising unemployment rate, resulting in decreasing national income. As imports are dependent on national consumption and hence on national income the changes in trade balance more or less signal national economic turmoil.

The product mapping for 1995 and 2011 are presented in Table 2, where the "top sectors" (Sum of RCSA and TBI) of 2011 are listed. Furthermore, their ranking in 1995 and their average share of Exports (2009-2011) are presented as well.

Table 5: Product Mapping of *Portugal* with Top 10 Sectors 2011, Rank in 1995, share of GDP and Exports in 2011

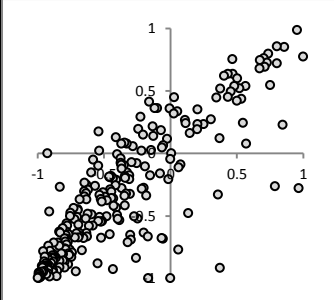
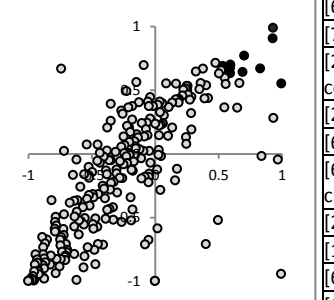
1995	2011	Sector Rank 1995 %EX (2008-2011)	
		[633] Cork manufactures	1 1,8
		[762] Radio-broadcast receivers, whether or not combined	10 1,8
		[283] Copper ores and concentrates; copper mattes, cement	2 1,0
		[251] Pulp and waste paper	6 1,4
		[666] Pottery	4 0,4
		[661] Lime, cement, fabrica. constr. mat. (excluding glass, clay)	12 0,8
		[266] Synthetic fibres suitable for spinning	31 0,3
		[112] Alcoholic beverages	18 2,2
		[665] Glassware	14 1,0
		[662] Clay construction, refracto. construction materials	36 0,7

Table 6: Product Mapping of Ireland with Top 10 Sectors 2011, Rank in 1995, share of GDP and Exports in 2011

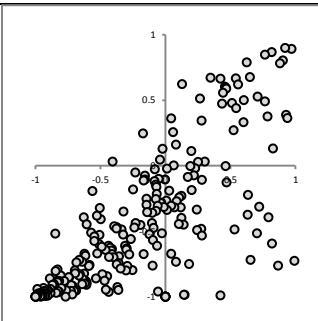
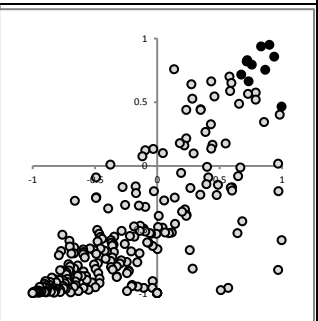
1995	2011	Sector Rank 1995 %EX (2008-2011)	
		[551] Essential oils, perfume & flavor materials	7 5,6
		[023] Butter and other fats and oils derived from milk	1 0,5
		[515] Organo-inorganic, heterocycl. compounds, nucl. acids	4 18,8
		[011] Meat of bovine animals, fresh, chilled or frozen	3 1,5
		[899] Miscellaneous manufactured articles, n.e.s.	38 3,5
		[542] Medicaments (incl. veterinary medicaments)	14 18,5
		[541] Medicinal and pharmaceutical products, excluding 542	31 6,5
		[211] Hides and skins (except furskins), raw	10 0,1
		[898] Musical instruments, parts; records, tapes & similar	6 1,5
		[872] Instruments & appliances, n.e.s., for medical, etc.	19 2,9

Table 7: Product Mapping of Greece with Top 10 Sectors 2011, Rank in 1995, share of GDP and Exports in 2011

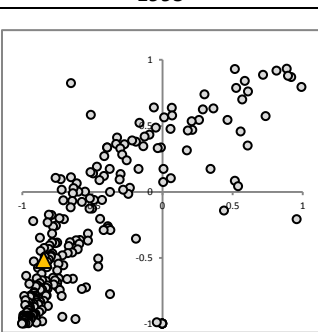
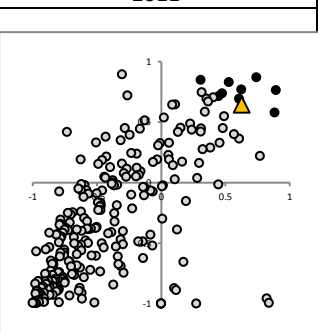
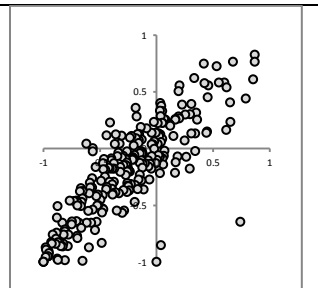
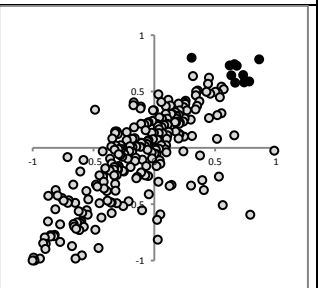
1995	2011	Sector Rank 1995 %EX (2008-2011)	
		[263] Cotton	4 1,7
		[058] Fruit, preserved, and fruit preparations (no juice)	1 1,9
		[211] Hides and skins (except furskins), raw	24 0,1
		[273] Stone, sand and gravel	15 0,4
		[056] Vegetables, roots, tubers, prepared, preserved, n.e.s.	8 2,1
		[661] Lime, cement, fabrica. constr. mat. (excluding glass, clay)	2 1,5
		[676] Iron & steel bars, rods, angles, shapes & sections	146
		[034] Fish, fresh (live or dead), chilled or frozen	23 2,5
		[848] Articles of apparel, clothing access., excluding textile	9 1,2
		[121] Tobacco, unmanufactured; tobacco refuse	7 1,4

Table 8: Product Mapping of Spain with Top 10 Sectors 2011, Rank in 1995, share of GDP and Exports in 2011

1995	2011	Sector Rank 1995 %EX (2008-2011)	
		[662] Clay construction, refracto. construction materials	2 1,2
		[421] Fixed vegetable fats & oils, crude, refined, fraction	14 1,3
		[054] Vegetables	5 2,3
		[016] Meat, edible meat offal, salted, dried; flours, meals	16 0,1
		[613] Fur skins, tanned or dressed, excluding those of 8483	1 0,0
		[057] Fruits and nuts (excluding oil nuts), fresh or dried	9 2,9
		[686] Zinc	6 0,3
		[676] Iron & steel bars, rods, angles, shapes & sections	15 2,0
		[012] Other meat and edible meat offal	78 1,3
		[633] Cork manufactures	8 0,1

The sectoral position in this ranking does not change significantly for the “top sectors”. Only the sectors “Iron and steel bars” (▲) in Greece experienced a major change in position, from 146 in 1995 to 7 in 2011. Besides its rank, it is notable that in 1995, this sector had unambiguously negative values for both the RSCA and TBI indicators. Note that most sectors of the PIGS with high RSCA and TBI values are dominated by the premier sectors (fruits, meat, vegetables) and natural resources (cork, skins zinc, copper, clay). The machinery sector is [7xx] underrepresented; some chemical products [5xx] and high-tech instruments [87x] can be found in Ireland. As mentioned above, the dominant sectors of Greece and Portugal and to a certain degree of Spain, can be attributed to the low and medium-low technology sectors in the country. The small number of sectors with comparative advantages shown in section 2.1, is also evident, as most dots are below the abscissa. With respect to a rather short period of 16 years, there seems to be minimal trade-specialization

dynamics. The Greek economy as net-importer shows for most commodities negative trade-balance, similar to Portugal. Thus, the investigations of section 2.1 can be confirmed.

2.3 Trends of specialization

Finally, the indication for revealed (symmetric) comparative advantages will be used to reveal whether an export-specialization of PIGS-countries had in fact taken place. To obtain information on this issue, the methodology of Dalum et al (1998) is chosen, as they regress the RSCA-values of country j and commodity i at time t_2 against the RSCA-value of a previous year t_1 .¹⁵

$$RSCA_{ij}^{t_2} = \alpha_i + \beta_i * RSCA_{ij}^{t_1} + \varepsilon_{ij} \quad [5]$$

Here, 2011 (t_2) and 1995 (t_1) are chosen. There are two main interpretations of the regressions results, referred to as β -specialization (regression effect) and σ -specialization (mobility effect).

β -specialization: The country became more (*less*) specialized in 2011 in sectors with relatively high (*low*) specialization in 1995, if $\beta_i > 1$. If sectors with high (*low*) RSCA-values in 1995 turn out to become low (*high*) in 2011, β_i will be between zero and one. This can be interpreted as de-specialization on average. This specialization-measure, is called β -specialization.

σ -specialization: Here, the process of specialization is shown by comparing the estimator β and the R^2 , i.e. $m = |\beta|/|R|$. Thus, if $m > 1$ the dispersion increased and the degree of specialization increased, whereas with $m < 1$, it is the other way round.¹⁶

The results are presented in Table 6. The β -specialization does not indicate high degrees of specialization in those countries. According to the σ -specialization, there do not seem to be significant specialization or de-specialization trends since 1995¹⁷, as m is not notably below or above one.¹⁸

Table 9: Estimation results: Stability and development of export specialization (1995-2011)

	α	β	R^2	$m = \beta/ R $
Portugal	-0.226	0.766	0.608	0.982
Ireland	-0.050	0.817	0.678	0.992
Greece	-0.108	0.837	0.613	1.069
Spain	-0.137	0.798	0.623	1.010

¹⁵ Lee (2011) chose this methodology to identify specialization trends with in view to technology intensity. He investigates the effect of export specialization on economic performance using the Balassa index. See J. Lee: Export specialization and economic growth around the world, in: Economic Systems, Volume 35, Issue 1, 2011, pp. 45–63.

¹⁶ See Dalum et al. (1998) and K. Laursen: Revealed Comparative Advantage and the Alternatives as Measures of International Specialization, Danish Research Unit for Industrial Dynamics, DRUID Working Paper No. 98–30, 1998.

¹⁷ Specialization and competitiveness in manufacturing sectors before 1995 for European countries is discussed in K. Aiginger (2000).

¹⁸ The results for the years 1995-2007 yield similar results. As the European Union is the most important market for all countries, the estimation was conducted with focus on export to the EU. Again, the estimation results show β -specialization –degree below 1 and no specialization-trend, as σ -specialization is not above one (values range from 0.950 to 1.000), for the period 1995-2011, as well as for 1995-2007.

Note that specialization and structural reforms take time. A longer estimation period would therefore be of interest in further research. However, this short-term regression confirms the assumptions made above, as all four countries obviously have a minimal export orientation. The main export sectors, however, are dominated by foreign investment, especially in Spain and Ireland. The traditional sectors with international competitiveness, predominantly located in agricultural, beverages and foodstuff industries are of minor impact. The national economies of Greece and Portugal focus on the tertiary sector, Spain's industry has been dominated by construction and the automobile sector in recent years. Thus, a concentration and export orientation of the production capacities did not take place to any significant extent. The core competences of these countries can therefore barely be detected by investigating their foreign trade situation.

3. Conclusion

This paper sheds light on the export structure of the four European countries Portugal, Ireland, Greece and Spain, the so called PIGS countries. These countries were all hit by the economic downturn in the course of the financial crisis and have been struggling with the national debt crisis and recession. The economic situation, however, is different for each country. Especially Greece has to face the possibility of departure from the Euro and therefore establishing their economy in international competition with their own currency. Thus, the question arises (not only for Greece, but also for the other countries in trouble), as to where the advantages and strengths of these countries are located. One way to identify sectoral international competitiveness is provided by the revealed comparative advantage index developed by Balassa (RCA 1). This indicator evolved through several studies, for example by the German council of experts (RCA 2). Both indicators suggest that the dominant advantages of Portugal and Greece can be found within agriculture and natural resources. The dominant export sectors are also located there. Ireland stands out from the other PIGS, as high-tech and medical/chemical products occur in the top sectors. Spain's top export sectors do not have the competitiveness that one might expect.

To sum it up, the economic structure of Greece is the most problematic. Regarding the structure of exports and the competitiveness of most sectors, the international standing is far from solid. As the national demand is weak and will not recover in the next few years, the export sectors do not seem to have enough power to help the Greek economy in the short-term. Clearly, enormous efforts have to take place to restructure the factor allocation and strengthen the nation's economy. This problematic structure existed before the Euro introduction and has not changed significantly. The recovery of the Greek economy will be a truly long-term process. Gaining from the global economy through export growth will not have a major impact, given the prevailing economy structure. The same holds true for Portugal with its dominant tertiary sector. Ireland seems to have a more balanced and specialized export structure, but the dominant industries are part of international companies and foreign direct investments. The original industries with an export orientation are secondary. Thus, Ireland is to a certain extent dependent on the world market, without having a sound national industry as a basis. Spain does have competitive sectors and a degree of specialization, but the most important sectors are less competitive. Improvements in factor allocation and structural reforms should take place to exploit the potential of the economy.

Building up powerful industries with a dynamic and adequately educated labor force and a more flexible economy will entail a major and long-lasting reform-process, which may take decades. Ireland seems to participate directly, and Spain to a certain degree, in globalization, while Portugal

and especially Greece do not. Internationally competitive sectors with a high level of importance for the domestic economy are barely evident in Greece. It is necessary to ascertain potential fields of this nature and pool all available forces to expand them. National production factors have to be allocated efficiently and foreign investments attracted and integrated. Therefore, stable institutional conditions and lean structures with low bureaucratic hurdles are necessary.

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