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EMU's Impact on the European Productive Structure, Increased Divergence? Empirical Data on Finland, France, Ireland, and Portugal

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Abstract

With the launching of the European Monetary Union came fears of increased specialization, and potential industry-specific shocks that would endanger the stability within the common currency area. We investigate the impact of the introduction of the euro on the spatial distribution (specialization) of economic activities in four euro zone countries: France, Ireland, Portugal, and Finland. Evidence of a statistical significant increase in specialization is found after the introduction of the euro, in several manufacturing industries, with services playing a downward pressure on countries' specialization level. At the regional level there is evidence of an increase in similarity between regions and the countries they belong to, and the EU15.

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Key words: European Integration, Euro, Specialization, Regions.

JEL Classification: F14, F15, R12, R15.

1. Introduction

Since the formation of the European Coal and Steel Community in 1951, the European productive structure has changed, with the increased economic integration of the European countries. The introduction of a common currency has deepened this integration, with important consequences on Europe's economic geography.

One of the most spectacular outcomes of the European integration has been the increase in trade flows among the European countries (as we will briefly survey), mainly due to the lowering of trade costs, as a result of the deepened product market integration (evolution from a free-trade area to a common market). The introduction of the euro has led to an even further decrease of trade costs with a decrease in uncertainty, due to the irrevocable fixed exchange rates and enhanced price transparency. Besides, it has also led to an integration of payment and banking services, and of financial markets in general, facilitating trade and enhancing aggregate welfare.

In most trade and geography models, specialization is due to economic integration. It can occur, *inter alia*, due to comparative advantage, proximity to markets and agglomeration or clustering of activities. According to the classical trade models of Ricardo and Hecksher-Ohlin, countries can exploit their comparative advantage given their differences in technological capacities, and on endowments of labour and capital (exogenous characteristics of regions and countries). The 'new' trade models incorporate increasing returns and imperfectly competitive markets, while the 'new' economic geography (NEG) models explain the importance of proximity to markets (with firms locating in regions with good market access – the centre rather than the periphery), vertical linkages, and how integration enables the agglomeration or clustering of activities.[1]

There are benefits and costs associated with specialization. The benefits come from countries specializing in sectors in which they have a comparative advantage, from efficiency gains associated with the clustering of activities (as firms interact with their neighbours, sharing pools of common labour skills and being exposed to knowledge spillovers), and from enhanced consumption opportunities resulting in net gains of combined producer and consumer surplus. But as specialization increases, so does the vulnerability of countries or regions to industry-specific shocks, a problem that depends on the effectiveness of international (or inter-regional) adjustment mechanisms, which can be worsened in the presence of a monetary union (without the exchange rate mechanism).

While stimulating trade, the increased European integration has also led to an increase in countries' specialization (until 1998), and their

[1] See Combes *et al.* (2006) and Fujita *et al.* (1999) for a formalization of NEG's main models.

vulnerability to industry-specific shocks.[2] Two viewpoints have emerged on this subject: the European Commission's (EC) and Krugman's (1993). The EC believed that increased integration would encourage 'intra-industry' trade, leading to less specialization, and the convergence of the European Union (EU) economies, with asymmetric shocks occurring less frequently. Krugman argued that increased integration would increase specialization and, as a result, the inter-industry trade (rather than 'intra-industry' trade), with countries becoming more subject to asymmetric shocks, endangering the stability within the common currency area.[3]

This paper seeks to study the EMU's (European Monetary Union) impact on the spatial distribution (specialization) of economic activities in four countries that joined the EU at different moments in time. The importance of this discussion is highlighted by Brülhart (2001, p. 169), when the author stresses that, 'if EMU [fosters] divergence of industrial structures and greater asymmetry of shocks across euro zone regions, then the need for alternative macroeconomic stabilizers will become acute'.[4] Besides, the (dis)similarity of countries amongst the euro area is one of the key conditions to evaluate its performance as an Optimum Currency Area.[5]

From the *founding six*, France was the chosen country, and from the enlargements of 1973, 1986, and 1995, Ireland, Portugal, and Finland, respectively. We use the Herfindahl Index, the Krugman Index, and the Gini Coefficients to study specialization, with a subsequent econometric analysis using a cross-section fixed effect panel data model inspired by Stirböck (2004).

We found that the long-term specialization trend can be divided into two periods: decreasing from 1979 until the beginning of the 1990s, and increasing from there until 2003 (Portugal being the exception). We also corroborate the literature insights that, when including services in the analysis, the specialization patterns become similar. Following the increase displayed by the specialization indices after 1999, we found positive statistical significance of the introduction of the euro on the specialization of several manufacturing industries. At the regional level, we found that regions are becoming more in line with the specialization pattern of the countries they belong to, and that of the EU15.

The paper is structured as follows: Section 2 surveys the evolution of 'intra-industry' trade, and the euro's impact on EMU's trade, while Section 3 surveys the empirical literature on specialization in the EU. Section 4

[2] On the increase of countries' specialization until 1998, see the articles by Amiti (1999), Brülhart (2001), Midelfart-Knarvik *et al.* (2000), and WIFO (1999).

[3] For a discussion of the debate between Krugman's and the European Commission's viewpoints, see De Grauwe (2005).

[4] For a review of the literature on the relationship between specialization and monetary integration, see Brülhart (2001).

[5] For an overview of the Optimum Currency Area theory, and its application to euro area, see Baldwin and Wyplosz (2004).

describes the indices' methodology, and Section 5 the data used. The indices results' are illustrated and discussed in Section 6, and the econometric study is presented in Section 7. Conclusions are drawn in Section 8.

In an attempt to limit the extent of the text, we only present the main results. The complete set of results and data are available upon request to the author.

2. Integration and Trade

The growth in trade can be measured by the evolution of 'intra-industry' trade (IIT) and inter-industry trade.[6] Table 1 reports the Grubel-Lloyd Index (GL) of 'intra-industry' trade for our studied group of countries from 1980 until 2001, presenting also the changes between 1980-2001, and 1995-2001.[7]

Table 1: *Evolution of the 'intra-industry' trade (1980-2001)*

	1980	1985	1990	1995	2001	Δ 1980-2001	Δ 1995-2001
France	0.58	0.56	0.62	0.64	0.68	0.10	0.04
Ireland	0.33	0.32	0.32	0.28	0.37	0.04	0.09
Portugal	0.09	0.13	0.23	0.26	0.32	0.23	0.06
Finland	0.20	0.22	0.26	0.25	0.25	0.05	0

Source: European Commission (2004, p. 150).

'Intra-industry' trade gained importance in every country over the last two decades, but the intensity of the increase has slowed in recent years.[8]

The currency union effect on trade has led to an intense debate in the literature, after Rose's (2000) early findings of an increase in bilateral trade by

[6] 'Intra-industry' trade refers to trade of goods within the same sector and inter-industry trade to trade between sectors. For a study on 'intra-industry' trade, see Grubel and Lloyd (2003).

[7] The GL Index measures the absolute difference between exports and imports for an industry *i* ('intra-industry' trade), as a proportion of total trade in that industry. It varies between 0, for complete inter-industry trade, and 1, for complete 'intra-industry' trade. See Greenaway and Milner (1986) for a discussion on measurement, statistical properties and problems associated with the GL Index.

[8] Brülhart and Elliot (1998) surveyed the evolution of IIT in the EU12 from 1961 until 1992. The authors found 'a certain stagnation of intra-EU IIT between 1977 and 1990, but average IIT increased in ten of [the] 11 sample countries between 1990 and 1992', (p. 233). Storper *et al.* (2002) regressed the GL index across 1970-1994, in both EU and the OECD, on a year-by-year index, and found that ''intra-industry' trade [increased] with remarkable constancy, across nearly all industries', (p. 83).

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a factor of three for countries sharing the same currency.[9] Regarding the EMU, Table 2 summarizes the early findings of the euro's impact on trade. The impact's magnitude is small when compared to Rose's (2000) first estimates because the euro zone countries already enjoyed close trade and political ties, with the majority of the benefits having already been gained due to the high degree of integration.

Table 2: *The Euro impact on trade (a survey)*

Studies	Main Findings
Bun and Klaassen (2002)	Total accumulating euro effect: 3.9% in 1999; 6.9% in 2000; 9.6% in 2001, and 37.8% in the long-run.
De Nardis and Vicarelli (2003)	Short-run effect of 8.9% and long-run effect of 16% (9.7% and 18.7% after controlling for endogeneity, respectively).
Micco *et al.* (2003)	On bilateral trade between EMU countries: 4 to 10% (compared to trade between all other pairs of countries), and 8 to 16% (compared to trade among non-euro zone countries).
Baldwin (2006)	Pro-trade effect between 5% and 15%, with 9% being the best estimate (within the euro zone, and between the euro zone and the rest of the world).

3. Literature Review

With the increased integration of the EU economies, and the theoretical developments of the 'new' economic geography, European specialization patterns have taken a central role in the empirical studies of the field. Here we survey the main recent studies on the subject. The reader is referred to Aiginger (2000), for a summary of the previous empirical literature on specialization in Europe.

Amiti (1999) found evidence of an increase in specialization in some EU countries from 1968 to 1990. Computing Gini Coefficients with production and employment data from EUROSTAT (Statistical Office of the European Communities) and UNIDO (United Nations National Accounts Statistics Database), Amiti found that specialization fell or had no significant change in Portugal, Spain and the UK between 1968 and 1990, but increased in all the countries analysed between 1980 and 1990.[10]

[9] For a survey on the empirical literature on the currency union effect on trade, see Baldwin (2006), De Nardis and Vicarelli (2003), and Micco *et al.* (2003).

[10] The EUROSTAT data used by Amiti (1999) consisted of 65 manufacturing industries classified according to NACE 3 (Nomenclature Statistique des Activités Économiques dans la Communauté Européenne) for Belgium, France, Germany, Italy and the UK, covering the period 1976–1989. While the UNIDO data set included all manufacturing industries classified

Using a composite indicator (composed of the Concentration Ratios, the Herfindahl Index, the Standard Deviations of Shares, the Specialization Rates, the Dissimilarity Index, and the Gini Coefficients) on value added data of manufacturing industries (NACE: 15–36), between 1985 and 1998, WIFO (1999) found that the data do not reveal a single dominant tendency. Specialization decreased from 1985 until the beginning of the 1990s, but increased thereafter. Over the entire period, on average, it rose only marginally.[11] WIFO found that Ireland stands out as the most specialized country, with Portugal being the exception to the increasing trend.[12]

A 'weak tendency towards less specialization in manufacturing (...) in the 1970s and a slight reversal (...) since the 1980s' in the EU15, was found by Hallet (2000, p. 4), using a dissimilarity index with gross value added data from EUROSTAT's REGIO database. The index decreased from 14% in 1980 to below 13% in 1995.

Midelfart-Knarvik *et al.*'s (2000) results are in line with those of WIFO (1999) and Hallet (2000). The authors computed Krugman indices and Gini Coefficients for 14 EU countries and 36 manufacturing industries between 1970 and 1997, also performing bilateral comparisons (91 distinct pairs), using gross production value data.[13] The main contribution of Midelfart-Knarvik *et al.*'s study is the econometric approach provided, showing that a 'high proportion of the cross-country variation in industrial structure can be explained by a combination of factor cost and geographical considerations', (p. 2). They were the first authors to study the services sector, looking at their geographical concentration (in five aggregate sectors), using the OECD's Services database from 1982 until 1995.

Computing Gini Coefficients between 1972 and 1996, Brülhart (2001) found an increasing specialization trend in employment for 13 EU countries (EU15 minus Belgium, Ireland and Luxembourg plus Norway).[14] The author used annual employment data from OECD's STAN database for 32 ISIC

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according to ISIC 3 (International Standard Industrial Classification) for Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, and the United Kingdom, for the period of 1968–1990.

[11] WIFO (1999) studied the EU15 minus Luxembourg, using data from the EUROSTAT's Structural Business Statistics database. The EU15 corresponds to all Member States until 2004's enlargement: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and United Kingdom.

[12] WIFO (1999) also studied the exports specialization, using the EUROSTAT's ComExt database between 1988 and 1998, and found a decreasing tendency overall.

[13] The authors used the OECD's (Organisation for Economic Co-operation and Development) STAN (Statistical Analysis) database for 13 EU countries, and the UNIDO database for Ireland, compiling data on 14 EU countries (the EU15 minus Luxembourg), cross-checking their results using the EUROSTAT's DAISIE database from 1985 until 1997. Midelfart-Knarvik *et al.* (2000) performed the same exercise of WIFO (1999), on the exports specialization pattern, and found the same conclusions. They used the United Nations Com Trade database, for the EU15 on 104 manufacturing sectors between 1970 and 1997.

[14] Brülhart (2001) performed the same exercise using exports data, and found that export specialization has trended downwards, a result consistent with WIFO's (1999) findings.

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manufacturing sectors (two to four-digit). He found that the unweighted Gini-average increased from 0.26 in 1972–4 to 0.28 in 1994–6. Brülhart also performed country pair dissimilarity comparisons, and found that dissimilarity of employment structure increased in 53 out of 78 country pairs, between the early 1970s and mid-1990s, a result consistent with Midelfart-Knarvik *et al.*'s (2000) findings.

4. Methodology

Specialization is defined in relation to production structures, and can be assessed using absolute and relative measures. It refers to the distribution of shares of an industry *i*, in total activity of a specific region/country *j*, as compared to a uniform benchmark (absolute specialization), or overall economic activity (relative specialization). A region/country *j* is said to be specialized if a small number of industries has a disproportionate weight in its production. In this study, we use the country and/or the EU15 as benchmarks for the relative specialization computations.

The literature proposes several indicators to measure specialization, though as Combes *et al.* (2006, p. 272) state, 'l'indice idéal (...) ne semble pas encore avoir été découvert'.[15] Given the inexistence of a perfect indicator, and with the purpose of robustness checking, we compute three indicators—Herfindahl Index, Krugman Index and the Gini Coefficients of Specialization. Each indicator's limitations will be made clear by stating the ideal properties (as presented by Combes and Overman (2004) and Combes *et al.* (2006)) they violate.[16]

In our paper we chose to use Value Added (VA) and Employment as units of analysis of the activity level. In the literature, trade statistics have been widely used due to the highly disaggregated data on hundreds of industries (see, amongst others, Brülhart (1998) and the references therein, Brülhart (2001), and Storper *et al.* (2002)), but trade flows are not necessarily a reliable proxy for industry size in terms of production variables, because, as Amiti (1999, p. 575) stresses, 'exports may change due to a change in domestic consumption and without any change in production'.

Value Added is used because it captures the overall importance of economic activity of an industry or a country, and it is closely related to the goal of competitiveness, contributing to rising factor incomes and welfare.

[15] For a complete discussion of the existing indices, their problems and the ideal criteria by which these measures must be assessed, see Combes and Overman (2004) and Combes *et al.* (2006).

[16] New indices have been put forward in the literature in order to solve some of the problems associated with the indices used, the two most popular being the Ellison and Glaeser's (1997), and the Duranton and Overman's (2002). Nevertheless, these indices will not be used due to the inexistence of comparable data from the same statistical source.

Employment is used as a robustness check of the results obtained with Value Added.[17]

In and effort to keep the presentation light, we show only the VA results in the main text. Employment results are called upon when the results for the two variables diverge.

Taking $x_{i,j}$ as a measurement of the activity level of industry *i* in region/country *j*, with $i = 1,...I$, and $x_j = \sum_{i=1}^{I} x_{i,j}$ as the total activity in region/country *j*, $s_{i,j} = \frac{x_{i,j}}{x_j}$ is industry *i*'s share in total activity in region/country *j*.[18]

The Herfindahl Index of region/country *j* is computed as the sum of squares of industry shares in local activity:

$$H_j^S = \sum_{i=1}^{I} \left(s_{i,j}\right)^2 \tag{1}$$

It varies between 0, a high degree of diversification, and 1, complete specialization in one industry. It is an absolute measure of specialization, but its usefulness is doubtful, because it cannot be compared across sectors of activity or across spatial scales; additionally, it is biased with respect to changes to the spatial or industrial classification, and is highly influenced by the largest shares.[19] The Herfindahl Index is only used to understand the evolution of each region/country specialization.

The Krugman Index (also known as Dissimilarity Index), proposed by Krugman (1991), in his seminal work, is one of the most used indices in the measurement of specialization. It is a relative measure of specialization, computed as the sum of absolute differences of industry *i*'s share in region/country *j* relative to total industry *i*'s share in total country/EU15 activity (s_i^*):

$$K_j^S = \sum_{i=1}^{I} \left| s_{i,j} - s_i^* \right| \tag{2}$$

[17] Value Added is measured in current prices (in millions of euros), and employment in thousands of persons engaged. As WIFO (1999, p. 8) note, 'value added in nominal terms is not ideal for all questions, but problems of price adjustment and holding quality constant for [56] industries in each [country] are nearly insoluble'.

[18] For simplicity of presentation, time subscripts are omitted.

[19] The Herfindahl Index violates properties 1, 2, 4 and 5 of Combes and Overman (2004) and properties 1 to 4 of Combes *et al.* (2006). The desirable properties are not met because it was borrowed from statistics and industrial organization, and was not developed as an 'economic geography' tool.

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It takes values from 0, if the region/country *j* has an industrial structure identical to that of the country/EU15, to an upper bound of 2.[20] The Krugman Index tells us what fraction of activity would have to change sector in order to make the particular regions/nations sector-shares align with the sector-shares of the average of the country or of all other EU15 nations.[21] This index can be used for bilateral comparisons of locations or industries, but it also does not meet all the ideal criteria. As Combes and Overman (2004, p. 2862) note, it 'can be difficult to interpret when some industries are growing faster than others because magnification of existing initial differences changes the value of the index'.

In order to compute the relative Gini Coefficients, we begin by computing the Balassa Index as $B_{i,j} = \frac{s_{i,j}}{s_i^*}$.[22] Then, the Balassa Index is ranked in descending order, and the cumulative of the numerator is plotted on the vertical axis against the cumulative of the denominator on the horizontal axis, in order to get the Lorenz Curve. The Gini Coefficient is equal to twice the area between the Lorenz Curve and the 45-degrees line. It varies from 0, if the industrial structure of region/country *j* matches that of the country/European average (reflecting 'intra-industry' specialization), and 1, when it is extremely unequal. The higher the coefficient, the more specialized the region/country is, as compared to the country/EU15 average, suggesting a higher degree of inter-industry specialization.

As Amiti (1999, p. 577) notes, there are problems associated with the use of Gini Coefficients as a measure of specialization because it 'places implicit relative value on changes in the middle parts of the distribution'. Being a relative measure, if the 'reference region' (country average or EU15 average) is completely specialized, and the individual region/country is a little bit less, then the Gini reveals the latter as not specialized, a problem that may interfere with the analysis. In addition, comparisons across locations or time can be problematic.

5. Data and their Problems

As Combes and Overman (2004, p. 2848) nicely summarize, 'European data are a mess', and the existing data are variable and poor, with EU-wide data being only available for aggregate sectoral classifications. At the regional

[20] As Combes and Overman (2004, p. 2862) argue, the maximum value of the Krugman Index is not known, it 'approaches two as the industry becomes infinitely small with respect to overall [activity]'.

[21] This is accomplished by dividing the Krugman Index by two, because it counts both positive and negative deviations.

[22] The exposition follows closely Amiti (1999), Combes and Overman (2004) and Krugman (1991).

level, the situation is worse with 'no widely available, suitably detailed EU regional data set [having] yet emerged' (p. 2851).

The existing databases vary considerably in the extent of availability and comparability, as illustrated by Table 3.[23]

In order to compare the evolution of the countries' productive structure (specialization study at the national level), we used the *60-Industry Database* of the Groningen Growth and Development Centre (GGDC) (2006).[24] For a more detailed analysis of the regional specialization, we used EUROSTAT's (2007) REGIO database.

Table 3: *Data summary*

Source	Data	Problems
Country level		
OECD STAN	ISIC Rev. 3, 2-digit industry level	Different degrees of availability
UNIDO	ISIC Rev. 2, 3-digit industry level	Different degrees of availability
EUROSTAT	Industrial statistics	Missing data
GGDC	56 industries, ISIC Rev. 3, 26 countries, 1979–2003 (wide variety of indicators provided)	
Regional level		
EUROSTAT REGIO	Employment data, NACE Rev. 1 for NUTS 1 and 2, 1999-2005	Highly aggregated data; Low spectrum of years

6. Results

6.1. Country level

We now turn to investigate the specialization patterns of France, Ireland, Portugal, and Finland from 1979 until 2003. Looking at the Herfindahl Index, we conclude that absolute specialization increased in France and Finland (a result obtained with both VA and Employment). In Ireland and Portugal according to the employment figures, absolute specialization decreased, but looking at the VA results, we see that it has not varied much.[25]

[23] For a complete discussion on the available data, the evolution of the various statistical databases, and their problems, see Combes and Overman (2004).

[24] The *60-Industry Database* provides a comparable data set on the industrial performance of 56 industries (list presented in Appendix A) classified according to ISIC Revision 3 (1–99).

[25] Given the previously discussed limitations of the Herfindahl values, they are not presented in the main text.

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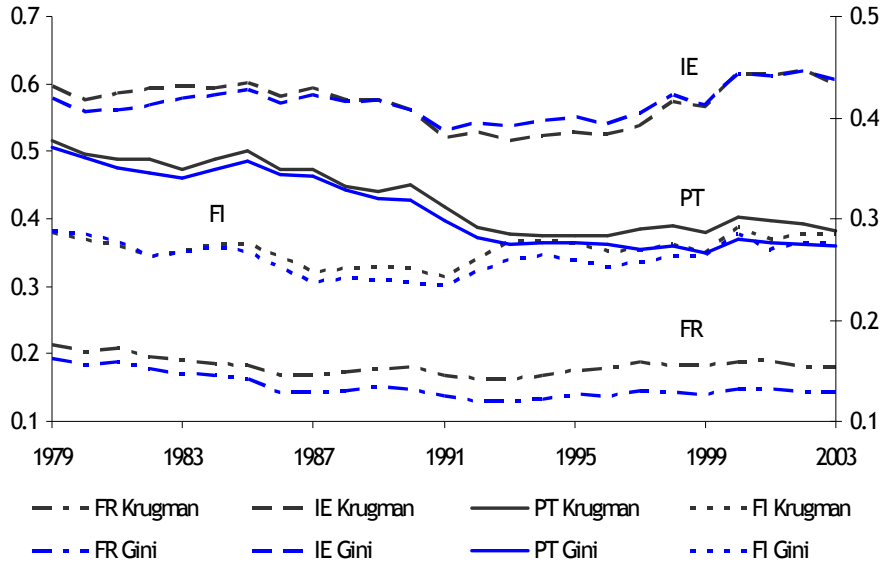
Figure 1 reports the Value Added Krugman Index and Gini Coefficients of Specialization defined across all industries (ISIC 3: 1–99) for the four countries analysed between 1979 and 2003, using the EU15 as benchmark. Both specialization measures report the same trend for each country, allowing us to draw conclusions with a higher degree of confidence.

Figure 1: *Value Added Krugman Index and Gini Coefficients of Specialization*



Notes: Author's computations on the *60 Industry Database*; Krugman Index values measured on the left axis and Gini Coefficients on the right; FR = France, IE = Ireland, PT = Portugal, and FI = Finland.

The first feature revealed by Figure 1 is the existence of marked differences in the specialization levels that vary with the dimensions of the countries, a result previously found by Midelfart-Knarvik *et al.* (2000).[26] The largest economy, France is the least specialized, while the smallest countries, Ireland and Portugal, display higher indices and coefficients (i.e. higher specialization). As Brülhart (2001, p. 177) stresses, 'this is not surprising, since large countries are likely to have more heterogeneous economic and natural endowments, and scale economies may be exhausted for a larger number of industries'.

We can divide the long-term specialization trend into two periods: from 1979 until the beginning of the 1990s, where specialization of each country decreased, and from there until the end of the sample, where it took

[26] WIFO (1999) and Brülhart (2001) also found this result. Our ranking of the specialization levels is in line with WIFO's (1999) results, with Ireland as the most specialized country.

the opposite direction (Portugal being the exception), with a clear increase in all countries after 1999.[27]

Employment figures give the same conclusions for Ireland, Portugal and Finland, but are different for France (they point to an increase in specialization from 1983 until 1998, decreasing afterwards until the end of the sample).

Taking into account the adhesion dates of each country to the European Union, we see that specialization decreased in Portugal after 1986, a result in line with Amiti's (1999, p. 579) conclusions that 'with integration, specialization may initially fall during structural adjustment'. Amiti (1999) explains that countries may have had high trade barriers protecting industries in which they did not have a comparative advantage, but the increased competitive pressures (caused by the elimination of trade barriers within the EU) to expand production in industries in which each country had a comparative advantage led to structural changes.[28] Specialization increased in Finland after 1995, a result in line with the theoretical predictions of the 'new' economic geography models.[29] The specialization patterns of the early entrants (France and Ireland) are less volatile, a result that indicates that structural changes may have already taken place.[30]

Focusing on the period after the introduction of the euro, we see that specialization increased in all countries after 1999, but started to decline in 2001/2. All countries were converging toward the EU15's average in the years before the introduction of the euro, but after 1999 all increased their dissimilarity. This pattern is common to the four countries (both measures and both indices report it), so we are fairly confident about the euro's impact.

Regressing the annual value added indices on a time trend (as performed by Brülhart (2001)), we found statistical evidence of a decreasing trend in France (using the Gini Coefficients) and in Portugal (with both

[27] The increase in specialization in the beginning of the 1990s is referred to in the literature as being due to the effects of the Single Market Programme. The Portuguese decreasing trend was previously found by WIFO (1999).

[28] Portugal was one of the founding members of the European Free Trade Association (EFTA) in 1960, with special conditions (the famous Annex G of the Stockholm Treaty, that treated Portugal as an industrial country) protecting specific industries from foreign competition. The existence of industrial conditioning laws restricted the industries' development (limiting the competition between the enterprises, and the creation of new activities, allowing the existence and maintenance of monopolies and oligopolies). With EFTA came the foreign demand, and the international direct investment, with multinational companies installing new factories, in order to enjoy the country's comparative advantages (natural resources and relative lower wages). In 1974, the Portuguese dictatorship regime ended, and with it came the end of the industrial conditioning laws. The adhesion to the European Union in 1986 stimulated the international investment (the adoption of new technologies), and the foreign competition, acting as a further structural adjustment driver. For a complete discussion of these topics see Lopes (2004).

[29] Finland was also a member of EFTA, the country joined the association in 1961.

[30] The specialization level of France is also influenced by its relative size in the indices' computations.

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indices). Ireland and Finland did not display a clear pattern, a result strengthened by their non-statistically significant econometric coefficients.

Applying the same procedure to the annual employment indices, we found statistical evidence of an increasing trend in France (with both indices), and a decreasing one in Ireland and Portugal (reported by the Gini Coefficients, and by both indices, respectively).[31] Both Finnish indices are positive, but non-statistically significant.

Our results are broadly consistent with the literature that we surveyed, the differences being our definition of specialization (across all industries), the data and time period studied, and the measurement techniques used.

6.2. Impact of Services

With services accounting for an increasing share of the economy (68.8% of employment in the EU15, according to the European Commission, quoted by Ardy *et al.* (2002, p. 67)), any trends in this sector will dominate the developments of countries' specialization. Ardy *et al.* (2002, p. 67) argued that, 'as services become more important there is an automatic tendency for structural similarity to increase', while Hallet (2000) found that when including services, the region's specialization patterns become increasingly similar.

In order to test the impact of including services, we replicated the construction of the indices, this time using only Services (ISIC 3: 40–99) and Manufacturing (ISIC 3: 15–37) separately. We have found that services drive down the specialization levels of Ireland, Portugal and Finland (with both measures and both indices reporting it), while for France, there is a mixed picture (they are an upward force according to the VA Krugman Index, but a downward one according to the VA Gini Coefficients).[32]

Our results are consistent with Hallet's (2000) findings, and support Ardy *et al.*'s (2002) insight, that with services countries' specialization patterns become similar.[33] As transport costs decrease with economic integration, manufacturing industries can more easily (re)localize than services, in order to exploit the cost advantages. In the services sector the main impact is felt in financial (and related) markets. As all countries need locally provided services, the specialization patterns, when studied over all the economic sectors of the economy, tend to become similar among countries. Indeed, one may think of services as having arbitrarily large transport costs

[31] One must be careful about the French case, given the opposite results of Employment and VA.

[32] Employment indices show that services are an upward driving force of specialization in France.

[33] The regressions' results of the VA and Employment indices of Services and Manufacturing on a time trend reinforce our conclusions. A note of caution is regarded to the French case, given the opposite trends displayed by the data.

(being non-tradables), playing a downward pressure on countries' specialization.

6.3. Regional level

At the regional level, the data display a mixed pattern. From the Herfindahl Index we are unable to distinguish a clear pattern of regional specialization.[34]

Are regions becoming more or less specialized than the country average or the EU15 average?[35] To understand the evolution of the dissimilarity between the regions and the countries they belong to, and between the regions and the EU15 average, we computed the Krugman Index and the Gini Coefficients of Specialization using each average as benchmark.

In order to answer the above question, we summed all the indices/coefficients of each country for each year, dividing the total by the number of regions that were considered in the analysis of each country. We thus obtained a simple average of the dissimilarity between regions and the country, and between regions and the EU15. If the measure increases, it means that, on average, the dissimilarity has increased; if it decreases, it gives the opposite conclusion. This is presented in Figure 2.

Having as a benchmark the country to which the regions belong, we can observe that the dissimilarity has decreased in France (overall when we look at the Krugman-average, and clearly from the Gini-average), and in Ireland (both measures show a clear decreasing pattern), but when we look at the graphs of Portugal and Finland we cannot distinguish a clear pattern. The graphs also reveal that Portugal's average dissimilarity between regions is the highest of all countries.[36]

Regarding the EU15 average as benchmark, we can conclude that, overall, France and Ireland saw a decrease in their average dissimilarity (both measures indicate so). Portugal's Krugman-average show a decrease in dissimilarity, but the Ginis do not show a clear pattern. Looking at Finland,

[34] In France absolute specialization increased in seven regions, decreased in six, and eight showed an unclear (noisy) pattern, while for Ireland it increased in both regions. Absolute specialization increased in four regions in Portugal, decreased in two, and Algarve displayed an unclear pattern. In Finland absolute specialization increased in three regions, and decreased in Länsi-Suomi.

[35] For a previous study on regional convergence/divergence, see Martin (2001).

[36] Observing the evolution of the individual regions, we found that specialization decreased in 18 regions when compared to the 1999 value, and increased in only two. Specialization increased in two regions in the beginning of the period but has started to decline. It decreased in Pohjois-Suomi in the beginning, but has started to increase. Ten regions showed an erratic behaviour, while Lisboa behaved constantly. We define erratic behaviour as a noisy evolution of the indices, with no clear trend: both measures increasing and decreasing rapidly from year to year; or measures pointing to opposite conclusions.

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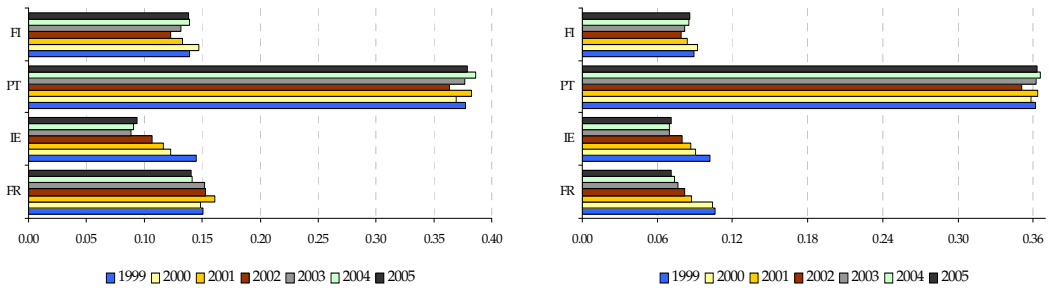
both measures show a decrease in dissimilarity. Portugal's regional dissimilarity toward the EU15 average is the highest of all countries.[37]

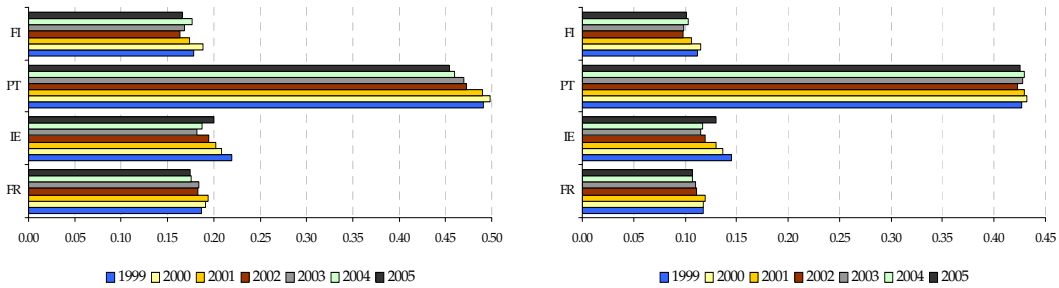
Overall we can conclude that regions are becoming more in line with the specialization pattern of the countries they belong to, and that of the EU15.[38] As regions (as a whole) become more similar, their vulnerability to industry-specific shocks decreases. A positive contribution toward the optimality of the European Union as a currency area.

Figure 2: *Average regional dissimilarity*

i) Between regions and respective country



ii) Between regions and EU15



Notes: Author's computations on the EUROSTAT's REGIO Database—composite indicator corresponding to the unweighted average of the specialization measures for each year, computed for the regions with available data. Average Krugman Indices presented on the left, and average Gini Coefficients on the right; FR = France, IE = Ireland, PT = Portugal, and FI = Finland.

[37] Repeating the previous exercise, looking at the individual regions, we found that specialization decreased in 16 regions when compared to the 1999 value, and increased in only four. The specialization increased in four regions in the beginning, but started to decline afterwards, whilst three regions showed the opposite pattern. Seven regions displayed an erratic behaviour.

[38] A result that updates Hallet's (2000, p. 7) findings that 'between the years 1980 and 1995, only 34 regions have become more specialized while 85 regions have become less specialized'.

7. Econometric Study

The few existing empirical studies that test the 'new' economic geography predictions have neglected the explanations of countries' specialization, focusing on the study of geographic concentration of industries.[39]

Inspired by Stirböck (2004), we estimate a cross-section fixed effects panel data model on the sectoral indices of relative specialization ($SPE_{i,jt}$), computed for the four countries at the manufacturing level.[40] $SPE_{i,jt}$ is the relative specialization of employment in industry *i* of country *j* in relation to industry *i*'s share of EU VA:

$$SPE_{i,jt} = \frac{\dfrac{Empl_{i,jt}}{\sum_i Empl_{i,jt}}}{\dfrac{VA_{i,\mathrm{EU15}t}}{\sum_i VA_{i,\mathrm{EU15}t}}} \tag{3}$$

The first variable we use is the (annual) deviation of countries productivity of industry *i* (value added relative to its employment) from the EU15 mean ($DPROD_{i,jt}$) as a proxy for Ricardian comparative advantage forces:

$$DPROD_{i,jt} = \frac{VA_{i,jt}}{Empl_{i,jt}} - \frac{VA_{i,\mathrm{EU15}t}}{Empl_{i,\mathrm{EU15}t}} \tag{4}$$

In classical trade theory, Ricardian comparative advantages, based on differences of relative productivity, act as a locational driver of industries. A significant positive sign of $DPROD_{i,jt}$ provides evidence that specialization is in line with comparative advantages.

The population density in inhabitants/km^2 ($PDENS_{jt}$) is used as an indicator of peripherality of the country, with each country's distance to the centre being captured by the fixed effects (given their time invariance). A positive sign of $PDENS_{jt}$ supports the NEG theory of potential agglomeration in the centre.

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[39] Amiti (1999) studied the level of spatial concentration of industries across EU countries, while Paluzie *et al.* (2001) performed the same analysis across Spanish NUTS 3 regions. Midelfart-Knarvik *et al.* (2000) studied the determinants of location of industries, analyzing gross production value data; for a discussion of their econometric results, see Combes and Overman (2004).

[40] Stirböck (2004) alerts us to the possibility of biases in the relative specialization patterns, as 'measures of relative allocation are influenced by the sectoral patterns of either the economy of reference or the average pattern of the group of countries included', (p. 4).

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Gross Domestic Product (GDP_{jt}) is used as a measure of market size, to predict if scale-intensive industries concentrate their production close to large markets.[41]

We also include the unemployment rate (UNM_{jt}), and a proxy of country research intensity ($RDINT_{jt}$) as further control variables of the countries' characteristics and economic performance, which may impact their productive structure. The research intensity is proxied by the number of country patent applications relative to GDP.

Three time dummies are included in order to capture the adhesion impact to the European Union (DEU_{jt}), and the impact of the introduction of the euro in 1999 ($DEUR_t$).[42] These time dummies may capture the reductions in trade barriers (e.g., the removal of tariffs and quotas and the harmonization of product standards), the free movement of factors of production, and the increased economic openness of the countries, with the euro dummy capturing the impact of the fixed exchange rate.

The fixed effects ($\beta_{i,0}$) capture the countries' specific invariant characteristics, such as their size and the distance to the core of European activity.

We want to make an inference on the following specification for each sector:[43]

$$\begin{aligned} SPE_{i,jt} = \beta_{i,0} + \beta_{ij} + \beta_{i,1}DPROD_{i,jt} + \beta_{i,2}PDENS_{jt} + \beta_{i,3}GDP_{jt} + \beta_{i,4}UNM_{jt} \\ + \beta_{i,5}RDINT_{jt} + \beta_{i,6}DEU_{jt} + \beta_{i,7}DEUR_t + \varepsilon_{i,jt} \end{aligned} \tag{5}$$

with $\sum_{j=1}^{4}\beta_{ij} = 0$ (identification restriction).

Inference is valid under the following assumptions: 1) the regressors are stationary (have no unit roots); 2) conditionally on the past, the present and the future of the regressors: (a) the expectation of the errors is zero (strict exogeneity of regressors); (b) the errors are independent across time and across countries ($\varepsilon_{i,jt}$ is uncorrelated with $\varepsilon_{i,ks}$, $j \neq k$ or $t \neq s$).

If the assumptions are violated, with roots close to unity (1) the standard errors underestimate the uncertainty. Nonetheless we use a stringent

[41] An economies of scale proxy interacted with GDP would be a better regressor, but unavailability of data does not allow us to perform such exercise.

[42] The dummies were set to one after the adhesion date of Portugal (1986) and Finland (1995); and after the euro's introduction in 1999. We did not include adhesion dummies for France and Ireland, because they were already in the EU in 1979, their impact is captured by the fixed effects.

[43] The data for Value Added and Employment were collected from GGDC (2006), and GGDC and the Conference Board (2007) was used for gathering data on countries' total GDP (in billions of 2006 US$) and population size. The number of patent applications and countries' area size were obtained from EUROSTAT (2007), while the unemployment rate data were collected from the European Commission (2007).

significance level (1%). If exogeneity is violated (2a), the estimators are inconsistent and have no causal interpretation, being only useful for predictions. If the disturbances are correlated in space and/or time (2b), the standard errors are wrong, a problem that can be corrected if the time period and the number of countries are large. A variety of tests enable such correction, but proceeding with them might entail losses of information, as we study a small number of countries within a small time period. We use only White-adjusted standard errors, being careful with the significance level.

Table 4 presents the qualitative results of the model estimated for the four countries using data for 25 years.[44] The results are displayed in case of at least 5% significance (though significance is achieved at the 1% level in most cases).[45]

From the qualitative results, we can see that the manufacturing industries' specialization patterns are driven by comparative advantage forces (with the exception of Food, drink & tobacco, Clothing, Insulated wire, Other electrical machinery industries, and Building and repairing of ships and boats). Concerning the population density impact, we can see that most of the industries seem to locate in the periphery rather than in the centre (a result partially explained by the peripherality of the countries studied, and by the relatively small changes of the variable). The positive GDP signs were those expected in some of the scale intensive industries, such as Textiles, Rubber and Plastics, and Building and repairing of ships and boats. While the unemployment results point to the location of low-skilled industries, such as Food, drink & tobacco, and Textiles, in countries with higher unemployment. The signs of the research intensity proxy were the ones expected for the industries that are investigation intensive, such as Fabricated metal products and Mechanical engineering.

Regarding the adhesion dummies, most of the signs are negative, implying a decrease in specialization, a result highly influenced by Portugal's negative specialization trend (reported by the specialization indices).

Looking at the euro dummy results, we observe that specialization increased in nine of the 27 analysed industries. A statistically significant result that enables us to conclude that the introduction of the euro led to an increase in the manufacturing specialization (as no industry displays a significant negative sign). This result is also coherent with the specialization indices study performed before.

[44] Stirböck (2004) conducted instrumental-variable estimates in order to control for potential endogeneity. We do not explore this in order to limit the paper's size. The interested reader is referred to Stirböck (2004).

[45] See Appendix B for the complete econometric results.

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Table 4: *Influence of countries' characteristics on industries' specialization patterns*

Industry\Regressor	C	DPROD	PDENS	GDP	UNM	RDINT	DEU	DEUR
15-16: Food, Dr., Tob.		–,*		+,*	+		–,*	
17: Textiles	+,*	+	–,*	+,*	+,*	+	–,*	+,*
18: Clothing		–				–		
19: Leather, foot.							+	
20: Wood, cork	+,*					–,*	–,*	+
21: Pulp, paper	+,*		–			–,*		+,*
22: Print. & publ.			+		–,*			
23: Min. oil ref.								
24: Chemicals	+	+,*			+,*		–,*	
25: Rub. & plast.	+,*		–,*	+,*			–,*	+,*
26: Non-met. min.	+							
27: Basic metals	+,*		–,*					+,*
28: F. met. prod.	+,*		–,*			+,*		+,*
29: Mech. eng.					+,*	+		
30: Office mach.								
313: Insul. Wire		–			–,*			
31-313: O. elect. mach.	–,*	–,*	+,*	–,*	+,*			+,*
321: Elect. Valves		+,*						
322: Telecom. equip.		+		–,*			+,*	+,*
323: Radio, TV rec.	–,*		+,*	–,*	–			
331: Scient. instr.		+,*						
33-331: Other instr.						+		
34: Motor veh.		+						
351: B&R ships	+,*	–,*	–,*	+,*			–,*	+
353: Air., Space.				–				
352+359: Railr. equip.				–,*				
36-37: Furn., misc. m.								

Note: The signs denote significance at least at the 5% level, and * at the 1% level.

8. Conclusion

With the continuous integration process of the European Union came the EMU and the launch of a single common currency in 1999. With the euro, and in light of the 'new' economic geography and trade models, came fears of an increase in countries' specialization that would endanger the stability within the euro zone (in case of asymmetric shocks). Opposing views emerged, but even looking back to the integration process, the literature has not been unanimous regarding the specialization patterns within the EU.

In this paper we investigated the specialization patterns of France, Ireland, Portugal, and Finland. Studying specialization patterns, defined across all economic sectors, we found that the long-term specialization trend can be divided into two periods: decreasing from 1979 until the beginning of the 1990s, and increasing from there until 2003 (Portugal being the exception). Evaluating the euro's impact, we found positive statistical significance of an increase in specialization in nine of 27 manufacturing industries, a coherent result with the increase of the specialization indices after 1999—results that alerts us to the potential need of new adjustment mechanisms within the EU.

As services gain importance in the economy, so does their impact on countries' specialization. Disaggregating the data, we found that services act as a bumper to the increased specialization of Ireland, Portugal and Finland, a consistent result with the literature insights, mainly explained by services' high transport costs and non-tradability.

Looking at the regional level (within the four countries studied), we found evidence of an increase in similarity between regions and the EU15 average (and also between regions and the countries they belong to), a positive contribution to the EU's potential as an Optimum Currency Area.

We cannot give a clear answer to the question posed in the title of the paper. Nonetheless we can state that our results favour the increased divergence, but caution must be paid to the increasing importance of services, and their downward pressure on the specialization levels.

Given the few years elapsed since the introduction of the euro, more data are needed. Also, more countries must be studied, and econometric studies incorporating economies of scale and 'new' economic geography effects (backward and forward linkages) are needed. Research is called for in the coming years, as regional policy gains importance in the European political debate.

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Appendix A: *56 Industries of GGDC's* 60 Industry Database

ISIC 3	Industry Name
01	Agriculture
02	Forestry
05	Fishing
10-14	Mining and quarrying
15-16	Food, drink & tobacco
17	Textiles
18	Clothing
19	Leather and footwear
20	Wood & products of wood and cork
21	Pulp, paper & paper products
22	Printing & publishing
23	Mineral oil refining, coke & nuclear fuel
24	Chemicals
25	Rubber & plastics
26	Non-metallic mineral products
27	Basic metals
28	Fabricated metal products
29	Mechanical engineering
30	Office machinery
313	Insulated wire
31-313	Other electrical machinery and apparatus nec
321	Electronic valves and tubes
322	Telecommunication equipment
323	Radio and television receivers
331	Scientific instruments
33-331	Other instruments
34	Motor vehicles
351	Building and repairing of ships and boats
353	Aircraft and spacecraft
352+359	Railroad equipment and transport equipment nec
36-37	Furniture, miscellaneous manufacturing; recycling

40-41	Electricity, gas and water supply
45	Construction
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55	Hotels & catering
60	Inland transport
61	Water transport
62	Air transport
63	Supporting and auxiliary transport activities; activities of travel agencies
64	Communications
65	Financial intermediation, except insurance and pension funding
66	Insurance and pension funding, except compulsory social security
67	Activities auxiliary to financial intermediation
70	Real estate activities
71	Renting of machinery and equipment
72	Computer and related activities
73	Research and development
741-3	Legal, technical and advertising
749	Other business activities, nec
75	Public administration and defence; compulsory social security
80	Education
85	Health and social work
90-93	Other community, social and personal services
95	Private households with employed persons
99	Extra-territorial organizations and bodies

Source: GGDC (2006).

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Appendix B: *Econometric study output: Cross-section fixed effects panel data model*

	Food, Dr., Tob.		Textiles		Clothing		Leather, foot.		Wood, cork		Pulp, paper		Print. & publ.	
C	1.1322		19.1032 ***		-1.1186		-1.7756		7.2164 ***		4.2704 ***		-0.9799	
	0.644		3.580		9.529		2.728		2.290		0.890		0.727	
DPROD	-0.0126 ***		0.0368 **		-0.1816 **		0.0247 *		-0.0151		0.0007		-0.0006	
	0.001		0.013		0.075		0.012		0.025		0.003		0.001	
PDENS	0.0047		-0.2629 ***		0.0476		0.0533		-0.0697		-0.0410 **		0.0360 **	
	0.010		0.056		0.163		0.047		0.037		0.016		0.013	
GDP	0.0004 ***		0.0020 ***		0.0002		-0.0005		0.0004		0.0003		-0.0004 *	
	0.000		0.000		0.002		0.001		0.000		0.000		0.000	
UNM	0.4252 **		2.0349 ***		-1.4347		-2.0412		-1.4470 *		0.0917		-1.2327 ***	
	0.175		0.598		7.121		1.194		0.679		0.448		0.380	
RDINT	0.0001		0.0053 **		-0.0327 **		-0.0093 *		-0.0062 ***		-0.0066 ***		-0.0013	
	0.000		0.002		0.014		0.004		0.001		0.001		0.001	
DEU	-0.1741 ***		-0.9389 ***		0.8263		0.8590 **		-0.5981 ***		-0.2836		-0.1379	
	0.015		0.231		0.693		0.370		0.143		0.244		0.108	
DEUR	0.0261		0.6240 ***		-0.1818		0.0098		0.3198 **		0.1264 ***		-0.0528	
	0.076		0.183		0.739		0.175		0.125		0.027		0.046	
R^2	0.9604		0.9435		0.7462		0.9005		0.9069		0.9531		0.9244	
Cross-section fixed effects														
Finland	-0.1644		-14.5286		2.9985		2.2400		-1.9825		-0.0891		2.0549	
France	-0.6720		2.8991		-0.2760		-1.5454		0.6324		0.2675		-0.4211	
Ireland	1.1777		-3.3924		-0.7998		-0.5409		-1.8829		-1.0529		0.5788	
Portugal	-0.3412		15.0218		-1.9227		-0.1537		3.2331		0.8744		-2.2126	
F (3,89)	203.105	0.0000	20.527	0.0000	6.554	0.0005	37.924	0.0000	65.760	0.0000	17.670	0.0000	7.867	0.0001
Chi-sqr (3)	206.003	0.0000	52.586	0.0000	19.960	0.0002	82.345	0.0000	116.834	0.0000	46.726	0.0000	23.521	0.0000

Notes: Below coefficients the White-adjusted standard errors are presented; Next to the *F* and *Chi-sqr* statistics their *p-values* are presented; * Denotes significance at the 10% level; ** Denote significance at the 5% level; *** Denote significance at the 1% level.

	Min. oil ref.		Chemicals		Rub. & plast.		Non-met. min.		Basic metals		F. met. prod.		Mech. eng.	
C	-0.2996		1.1879 **		3.2202 ***		4.1696 **		3.5042 ***		2.2975 ***		-0.2767	
	0.582		0.494		0.379		1.572		0.478		0.464		0.390	
DPROD	-0.0005		0.0009 ***		-0.0051		-0.0043		-0.0013		-0.0013		0.0026	
	0.001		0.000		0.004		0.005		0.001		0.003		0.004	
PDENS	0.0087		-0.0116		-0.0404 ***		-0.0496		-0.0476 ***		-0.0255 ***		0.0132	
	0.010		0.008		0.006		0.026		0.009		0.008		0.006	
GDP	-0.0001		0.0001		0.0003 ***		0.0003		0.0003		0.0001		-0.0001	
	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
UNM	0.5005		0.5835 ***		0.7687		0.4078		1.5521 *		0.0999		0.8882 ***	
	0.495		0.125		0.452		1.314		0.701		0.177		0.127	
RDINT	0.0006		0.0006		-0.0003		-0.0022		0.0004		0.0009 ***		0.0016 **	
	0.000		0.000		0.000		0.002		0.000		0.000		0.001	
DEU	0.0368		-0.0418 ***		-0.0683 ***		-0.0671		-0.0566		0.0554		0.0470	
	0.063		0.013		0.023		0.083		0.043		0.046		0.041	
DEUR	0.0355		-0.0236		0.1987 ***		0.1407		0.2535 ***		0.1104 ***		-0.0014	
	0.046		0.020		0.010		0.084		0.042		0.023		0.021	
R^2	0.7460		0.9488		0.8260		0.6546		0.9072		0.9802		0.9840	
Cross-section fixed effects														
Finland	0.5377		-0.6339		-1.9830		-2.5537		-1.9897		-1.2676		1.0572	
France	0.1574		0.1274		0.9368		0.8205		1.0328		0.9296		-0.0906	
Ireland	-0.1477		0.0570		-0.4537		-0.5626		-0.9209		-0.5539		-0.0222	
Portugal	-0.5474		0.4495		1.4999		2.2959		1.8778		0.8919		-0.9445	
F (3,89)	7.188	0.0002	49.064	0.0000	11.480	0.0000	3.967	0.0105	33.743	0.0000	62.161	0.0000	84.994	0.0000
Chi-sqr (3)	21.695	0.0001	97.601	0.0000	32.712	0.0000	12.552	0.0057	75.959	0.0000	112.989	0.0000	135.196	0.0000

Notes: Below coefficients the White-adjusted standard errors are presented; Next to the *F* and *Chi-sqr* statistics their *p-values* are presented; * Denotes significance at the 10% level; ** Denote significance at the 5% level; *** Denote significance at the 1% level.

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	Office mach.		Insul. wire		O. elect. mach.		Elect. valves		Telecom. equip.		Radio, TV rec.		Scient. instr.	
C	-34.2146 *		-5.9846		-3.6833 ***		-0.4728		2.0506		-4.4114 ***		-3.4158	
	17.205		6.285		0.694		7.014		2.128		1.243		2.236	
DPROD	-0.0043		-0.0275 **		-0.0022 ***		0.0140 ***		0.0171 **		-0.0044		0.0177 ***	
	0.002		0.011		0.001		0.003		0.006		0.003		0.005	
PDENS	0.6157 *		0.1286		0.0709 ***		0.0269		-0.0249		0.0864 ***		0.0700	
	0.291		0.105		0.011		0.119		0.034		0.020		0.038	
GDP	-0.0081		-0.0015		-0.0009 ***		-0.0001		-0.0016 ***		-0.0010 ***		-0.0007	
	0.005		0.002		0.000		0.002		0.000		0.000		0.001	
UNM	-13.9422		-6.8459 ***		0.8382 ***		-0.0430		6.1481 *		-1.6442 **		-2.1167	
	8.483		1.923		0.141		2.483		2.916		0.615		1.134	
RDINT	0.0155		0.0031		0.0008		0.0063		0.0056		-0.0001		0.0006	
	0.011		0.005		0.001		0.005		0.006		0.001		0.000	
DEU	-1.0410 *		-0.3513		-0.0545		-0.1095		0.7289 ***		-0.1085		-0.1266	
	0.458		0.200		0.030		0.232		0.196		0.068		0.080	
DEUR	0.1870		0.2595		0.1861 ***		0.1153		0.8945 ***		0.0097		0.0891	
	0.558		0.171		0.019		0.200		0.172		0.088		0.080	
R^2	0.8179		0.4638		0.6689		0.6881		0.8679		0.6914		0.8933	
Cross-section fixed effects														
Finland	26.4259		6.0518		3.1888		0.6038		-0.6881		3.9285		2.6535	
France	-6.3854		-1.2260		-0.5696		-0.6938		1.7708		-0.9021		-0.7137	
Ireland	9.2666		1.6098		0.7698		0.9818		-1.6858		0.6018		1.3426	
Portugal	-29.3071		-6.4356		-3.3890		-0.8918		0.6032		-3.6282		-3.2823	
F (3,89)	74.242	0.0000	4.842	0.0036	15.870	0.0000	6.523	0.0005	26.691	0.0000	8.920	0.0000	45.471	0.0000
Chi-sqr (3)	125.349	0.0000	15.119	0.0017	42.850	0.0000	19.874	0.0002	64.170	0.0000	26.288	0.0000	92.930	0.0000

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	Other instr.		Motor veh.		B&R ships		Air., Space.		Railr. equip.		Furn., misc. m.	
C	0.4958		0.9962		18.8990***		-0.7347		-2.0073		0.6575	
	8.668		0.791		2.529		1.264		3.472		0.941	
DPROD	-0.0102		0.0057**		-0.0226***		-0.0045		0.0011		-0.0120	
	0.019		0.002		0.008		0.004		0.005		0.009	
PDENS	0.0359		-0.0057		-0.2710***		0.0239		0.0639		0.0104	
	0.142		0.013		0.043		0.021		0.053		0.016	
GDP	-0.0027		-0.0003		0.0028***		-0.0010**		-0.0018***		-0.0005*	
	0.002		0.000		0.001		0.000		0.001		0.000	
UNM	1.0200		-0.4031		-0.5876		0.6825		7.9761		-0.3137	
	1.755		0.225		1.769		0.942		7.500		0.997	
RDINT	0.0083**		-0.0007		-0.0014		0.0003		-0.0100		-0.0026	
	0.003		0.001		0.001		0.000		0.005		0.002	
DEU	0.0625		0.1081		-0.3301***		-0.0073		-0.1549		-0.0112	
	0.132		0.058		0.070		0.070		0.311		0.100	
DEUR	0.8418		0.0279		0.2804***		-0.0652		0.3825		0.0625	
	0.472		0.028		0.020		0.034		0.344		0.061	
R^2	0.8032		0.9563		0.8724		0.9257		0.8518		0.4374	
Cross-section fixed effects												
Finland	0.9698		-0.5484		-10.8761		0.8235		2.6849		0.2787	
France	1.4080		0.7480		3.3097		1.4148		-0.2419		0.4872	
Ireland	1.5468		-0.2694		-4.2998		-0.5119		2.1752		-0.0517	
Portugal	-3.9245		0.0698		11.8662		-1.7264		-4.6183		-0.7142	
F (3,89)	25.280	0.0000	38.289	0.0000	48.171	0.0000	27.275	0.0000	36.580	0.0000	2.993	0.0351
Chi-sqr (3)	61.633	0.0000	82.883	0.0000	96.460	0.0000	65.200	0.0000	80.336	0.0000	9.612	0.0222

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