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TECHNOLOGICAL ENCLAVES AND INDUSTRIAL DISTRICTS. AN ANALYSIS OF THE REGIONAL DISTRIBUTION OF INNOVATIVE ACTIVITY IN EUROPE

Abstract: This paper explores the spatial distribution of innovative and productive activity across 109 regions of the European Union, thanks to an original databank on regional patents statistics.
The main results worth highlighting are as follows. The technological activity in the EU appears to be highly concentrated, although concentration tends to decline over the eighties. This results from the huge differences between southern and northern Europe. As expected, there is a positive association between the regional distribution of innovative activity and labour productivity. Further, contrary to previous evidence on the United States, our data show a significant link between the specialisation in innovation and in production both at the country and at the industry level. This suggests that localised knowledge spillovers and agglomeration economies foster a local economic system towards a specialisation in both production and technology.
More surprisingly there appears a negative correlation between technological concentration and aggregate productivity, that is the European regions which enjoy a more homogeneous distribution of their technological capability across different industrial sectors appear to be also characterised by a higher productivity level. This outcome may suggest the presence of positive inter-industry externalities that favour those regions which succeed in covering a broader range of technological activities.

JEL: O31, R12, O34, O52

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1. Introduction[*]

The debate on the existence of agglomeration economies is a long and rich one. In brief, it suggests that industries are bound to cluster in specific localities where firms benefit from being near other firms. However, the intuitive arguments of Marshall (1890) and Weber (1909) have only recently found strong theoretical foundations [Arthur (1988) and Krugman (1991)]. Such foundations are mainly based on the belief that there exist self reinforcing mechanisms, that is increasing returns, which are spatially bounded. In practice, as firms gather in a locality, this is likely to gain useful infrastructures, an appropriate specialisation and diversification pattern facilitating the provision of specific goods and services, more convenient relative prices and qualities of the labour force and of primary and intermediate goods[1]. Moreover**-** according to Arthur (1994, p. 52)**-** "social networks come in to being where information, expertise and contracts can be easily exchanged". Information and expertise that, according to von Hipple (1995), despite the great progress in information technologies, is still costly and difficult to transmit across areas. Proximity, as a result, is still very important because such a sticky knowledge, which is the prime base of technological change, is locally non rival and can thus be easily appropriated by firms in a specific area[2]. This is to say that parallel to agglomeration economies which contribute to the creation of industrial districts, there exist other increasing returns in spatial form which favour the formation of technological enclaves.

This observation is not anew in the industrial economics literature, where there has been an extensive amount of research on "local production systems" and "industrial districts" [Brusco (1982), Pyke *et al.* (1990), Sabel (1989)] and also on "spatial innovation networks" and "innovative milieu" [Camagni 1991, Pecqueur and Rousier (1992), Cook and Morgan (1994)]. This literature usually grounds its research on case studies of specific areas which allow for very detailed analysis of the complex interacting forces that shape the development

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[1] There may, obviously, be also agglomeration disecomies due most of all from congestion effects. It should be, however, remarked that such effects are likely when externalities operate through physical infrastructure rather than when they operate through knowledge channels, which are central in our research. For simplicity sake, we refer to increasing returns to indicate all those cases when net benefits between economies and diseconomies are positive.

[2] On the other hand, there is an important stream of the literature [see Coe and Helpman (1995) and Verspagen (1997) amongst the latest contributions] which emphasises the nature of technological progress as a public good- that is indivisible and non rival. According to this perspective R&D spillovers goes across borders and may contrast the appearance of spatial patterns of innovative specialisation. In conclusion, there exist countervailing forces – those ones which facilitate spatial diffusion of knowledge, experience and technologies and those ones which enhance local increasing returns – which are both in action.

of a local system (i.e. a combination of economic, social, and cultural elements). However, as it has been recently shown by some studies on the spatial distribution of innovation and production in the United States [Jaffe *et al.* (1993) and Audretsch and Feldman (1996), among others], there is much to be learned also from the spatial analysis of technological and productive specialisation in larger economic systems.

So far this line of research at the European level has been hindered by the absence of comparable disaggregated data both at the geographical and sectoral level, especially with regard to the technological indicators. Such a lack has not allowed to construct a map of the innovative activity at the regional level in Europe, despite this is now essential since national markets, thanks to several European Union policies, are getting more and more integrated and a spatial reallocation of firms is likely. In the light of this need, some studies have, actually, started appearing but none, to our knowledge, addresses explicitly the issue of both technological and productive specialisation. In particular, Verspagen (1997) explores the existence of clubs of European regions on the basis of both economic and technological variables, even though at the aggregate level, while Caniels (1997) examines the geographical and sectoral distribution of innovative activity across 72 European regions in just 5 countries (France, Italy, Netherlands, Spain and United Kingdom).

The main aim of this paper is twofold. First, we intend to widen the analysis of spatial distribution of aggregate innovative activity to all the regions of the European Union.[3] More specifically, we aim at evaluating to which extent the regional distribution of innovative activity in Europe is characterised by the presence of technological enclaves and how such a presence, if any, has changed along the eighties. To achieve this goal we have set up an original databank on regional patent statistics based on the data collected by the European Patent Office (EPO) and rearranged by assigning each patent to its region of origin through the postal code of the inventor's residence. More precisely, our series refer to 53,270 patent applications for the years 1980, 1985 and 1990, classified by the inventor's region and covering 109 territorial units belonging to the twelve countries members of the European Union during the eighties.

Second, we analyse the innovative activity at the sectoral level. This split will allow us to evaluate what is the degree of association between innovative and productive specialisation at the regional level in Europe. Moreover, we attempt to examine whether it is technological specialisation or diversification which is more conducive to growth.

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[3] Some studies have documented the spatial distribution of innovative activity across regions within a single country. Boitani and Ciciotti (1990), among others, deal with the Italian regions; Buswell *et al.* (1985) and Guerrero and Serò (1997) examine the United Kingdom and Spanish regions, respectively.

The paper is organised as follows. Section 2 presents the new data-base on regional innovative activity and discusses some measurement issues. Section 3 documents the spatial distribution of aggregate innovative activity. Section 4 examines the innovative activity across the European regions at the sectoral level and its association with the distribution of productive activity. Section 5 concludes.

2. Some measurement issues

No single measure of innovative activity is perfect. As a result, there is an ongoing debate [see, for instance, Pavitt (1982) and Griliches (1994)] on which technological indicator provides the best representation of innovative activity within an economic unit (country, sector, firm). Starting from the concept of knowledge production function [Pakes and Griliches (1984)], two types of indicators have been identified: technology input measures (such as R&D expenditure and employees) and technology output measures (such as patents and new product announcements).[4] The main drawback of the former indicators is that they include firms' effort for both innovation and imitation activities. Moreover, they do not take into account for informal technological activity, such as learning, and, as a consequence, tend to underestimate the amount of innovative activity of medium and small firms. On the contrary, patent and product announcement represent the outcome of the inventive process that is expected to be economically valuable, although such a "value" is highly heterogeneous and the propensity to patent or to announce can vary across countries and sectors [Evenson (1993) and Sassu and Usai (1996)]. With respect to the object of our research, patent statistics seem particularly suitable given that they are a more reliable indicator for innovative activity of medium and small firms which form the bulk of industrial districts. Other than this analytical justification patents are chosen because they are the only available indicator with some useful characteristics, such as: (a) they give information on the residence of the inventor and proponent and can thus be grouped regionally while R&D statistics are available just for some regions or at the national level; (b) they record the technological content of the invention and can, thus, be classified according to the industrial sectors, (c) they are available for a long time span and this allow for some tentative dynamic analysis[5].

Therefore, our analysis of the innovative activity across the European regions is based on patents information provided by the European Patent Office (EPO). More precisely, our series refer to patent applications, classified

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[4] It is worth recalling that both indicators have the limit that not all innovative activity comes from a formal research effort and is patented (e.g. learning by doing). For a comprehensive review of the use of patents statistics as indicators of innovative activity see Griliches (1990).

[5] Inter-temporal analysis of patents is a critical issue (see Griliches, 1990).

by the inventor's region, for the twelve countries members of the European Community over the eighties. We have examined three years - 1980, 1985 and 1990 – and a total of 53,270 patents.[6]

The classification by inventor's region has been chosen given that the location of the patent's proponent, which usually corresponds to the firm's headquarters, may provide a incorrect information whenever the invention has been developed in a firm's subsidiary located in another region. For instance, Enichem, the Italian petroleum and chemical multinational, is located in Milan (Lombardia) but the innovative activity (as indicated by residence of the inventors) is much more dispersed due to the presence of several plants in other regions (e.g. Veneto, Sicilia, Liguria and Sardegna). The region of residence of the inventors, on the contrary, gives a more precise measure on the exact geographic origin of the inventive and innovative activity. It is worth noting, however, that the regional distributions of the two patent series (inventors and proponents) are quite similar (r=0.94).

As for the geographical split, we have considered 109 national and sub-national units selected in order to ensure a certain degree of economic homogeneity and administrative functionality. Needless to say, this choice is only partially consistent with the ideal spatial unit of observation which would be probably smaller. However, the selected units of observation correspond to Eurostat's classification of NUTS (Nomenclature des Unites Territoriales Statistiques) which is the main source for comparable spatial data in Europe. The selection is as follows (the complete list is reported in the Appendix's tables): NUTS-0 (countries) for Denmark, Luxembourg, Ireland; NUTS-1 for Belgium (3 Régions), Germany BR (11 Lander), Netherlands (4 Landsdelen), United Kingdom (11 Standard regions); NUTS-2 for Greece (13 Development regions), France (22 Régions), Spain (17 Comunidades Autònomas), Italy (20 Regioni), Portugal (5 Commissaoes de Coordenacao Regional).

Before discussing the main descriptive features of the data it seems important to highlight some caveats. Patent applications to a foreign institution (through either the EPO or the national patent office) represent only a fraction of the total number of patents filed domestically by residents [Sassu and Paci (1997)]. Indeed, the high costs of application and implementation of patenting abroad imply that several domestic patents with scarce economic relevance and mainly owned by individual inventors are not extended to foreign markets [Soete and Wyatt (1983)]. At the same time, the increasing commercial integration across the European countries requires firms to protect their profitable innovations not only domestically but also in the foreign markets where they are willing to trade. A patent granted by EPO may have a

[6] The primary source of data is Espace: European Patent Bulletin Information on CD-ROM, Munich, EPO.

simultaneous validity over several European countries, therefore this organisation is gaining in importance since it was formed in 1978 and now grants almost the totality of external cross-patents among the European countries [Paci *et al*. (1997)]. In a nutshell, patent applications to EPO represent a subset of the total domestic innovative capability of each region which can, indeed, be considered the component with the highest quality and economic potential and, as a result, a rather good proxy for the regional innovative activity.

A summary of the patents included in the database, divided by country of origin, is reported in Table 1. It is immediately evident that the number of patent applications to EPO by the twelve countries under exam has remarkably increased during the eighties: from 10 thousands in 1980 to 25 thousands in 1990. However, rather than an indication of an explosive growth of innovative activity in European regions, this should be interpreted primarily as the result of the growing propensity to patent at EPO. Such a growth, in other words, is mostly attributable to the fact that along time European innovators have become both aware of the advantages achievable by patenting at EPO and accustomed to the different procedures (at least for non-Germans inventors) for obtaining a patent by the office in Munich. The highest share (about 47% in 1990), not surprisingly, refers to the inventors located in Germany, followed by France (19%) and United Kingdom (14%).[7] At a glance, the patenting activity appears largely dispersed: almost 9 thousand localities in Europe result as places of origin of a patent in 1990. Furthermore, the ratio between the number of patents singled out by inventors' residence and those classified thanks to proponents' location is higher than unity (1.05). In other words, European inventors registered at EPO are more than European applicants. This is mainly due to the presence of a relevant number of company headquarters outside the EU (e.g., United States, Switzerland and Sweden) that act as patents' proponents when inventors (and the plants where they are probably employed) are actually located inside the European countries. This result validates our choice to use the inventor's location to analyse the geographical distribution of innovative activity, and accordingly technological capacity, within Europe. The only countries where the ratio between inventors and proponents is smaller than unity are Luxembourg (0.76) and Netherlands (0.97), most probably because these countries host a number of headquarters of multinational corporations. At the other extreme, one finds Greece where for every three inventions attributed to a Greek resident only one turns out as a Greek application to EPO.

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[7] The high share of German patents is not only due to the well known high technological capacity of German firms, but also to the fact that EPO regulations closely follow the granting procedures of the German national system. Therefore, especially in the early eighties, it was easier for German companies to apply directly to EPO.

3. The regional distribution of aggregate innovative activity

This section presents a description of the aggregate innovative activity across the regions of the European Union. Such a description is mainly based on the comparison of the number of patents normalised by the size of the geographic unit, expressed by number of potential inventors. As a result, all data presented here refer to the number of patent applications per million of inhabitants[8]. An effective overview of the spatial distribution of technological capacity among European regions in 1990 is presented in Figure 1. The innovative activity appears mostly concentrated in the German regions, while some other relevant clusters result in the South of the United Kingdom, in central France, and in northern Italy. It is worth remarking that there is a group of 22 regions, all belonging to southern Europe (that is, Greece, Italy, Portugal and Spain), where there has been no patenting activity through EPO in 1990. Moreover, another 19 regions show a very low innovative activity - less than 6 patents per million of inhabitants – and it consists of other southern European regions plus Corsica and Northern Ireland.[9] In conclusion, there appears to be a clear dualistic structure in the innovative activity within the European regions. It is, therefore, spontaneous to ask how much of such a structure is a by-product of the differences in the economic performance of the productive system or vice-versa. Unfortunately the available information do not allow for any rigorous statistical testing of causality, nevertheless it is interesting to evaluate whether the innovative activity is associated to the level of productivity.[10] A first evaluation can be derived from Figure 2, which reports an overview of the labour productivity level across the European regions in 1990.[11] Such an overview displays a less clear-cut picture than that provided by the previous figure. The most productive regions are now more dispersed around several countries: the top 25 regions (with GDP per worker higher more than 8% of the average EU value) consists of 10 French regions, 6 Italian ones, 5 German ones, two Belgian ones, a Spanish one and a Dutch one.

Although the comparison of Figures 1 and 2 gives some interesting information, quantitative measures are needed to corroborate our initial

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[8] A complete list of patents per capita for the 109 regions is provided in the first column of Table A1 in the Appendix.

[9] It should be however noted that these two territorial units belong to the backward regions' group (objective 1) defined by the European Union, so that they can be correctly joined to the southern European regions from an economic point of view.

[10] The relationship between technology and economic performance at the European regional level has been studied by Verspagen (1997) which explores the existence of regional clubs for five European countries (Germany, France, Italy, Spain and United Kingdom). Moreover, Fagerberg and Verspagen (1996) analyse the effects of R&D expenditures on the catching up process for a group of 49 European regions.

[11] The labour productivity data are from CRENoS database on the European regions. See Paci (1997) for details.

evaluations. Such measures are provided in Table 2, where the dispersion of labour productivity and of innovative activity (measured by the coefficient of variation[12]) are reported for the European Union and the largest countries. As far as the regional distribution of the innovative activity in the whole EU is concerned, this appears to be highly concentrated (CV = 1.28 in 1990) mainly because of the huge differences between southern and northern Europe that we have already remarked. As a result, the innovative activity appears more equally distributed within each country. The highest dispersion (1.02 in 1990) is recorded in Italy, where the North-South disparities do not show any clear tendency to decline over the decade. On the other hand, Germany and United Kingdom display the lowest spatial concentration of technology (around 0.5). Another interesting stylised fact to be noted is the presence of a clear declining trend of the regional dispersion of innovative activity over the decade under exam (from 1.51 in 1980 to 1.28 in 1990). It must be remembered, however, that this result is only partially attributable to a growing similarity of the regional innovative potential displayed by European regions. Actually, such a change can be due to the growing propensity to patent at EPO by the peripheral countries and regions of southern Europe[13]. Unfortunately the available information do not allow for a precise distinction between the two effects. However, it is reasonable that the "propensity to patent" effect has been predominant in the first half of the decade and that the "innovative convergence" has grown in importance in the latest years with the decline of transaction costs associated to patenting at EPO.

As for the labour productivity, it is evident that its level of dispersion is much lower with respect to innovative activity both at the European and at the country level. This seems to imply that spatial increasing returns and localised spillovers are more important for the innovative rather than the productive activity. Furthermore, there appears just a weak sign of convergence in productivity levels across European regions (the dispersion goes from 0.28 in 1980 to 0.26 in 1990). At the country level, it is worth noting that Italy has, again, the highest degree of regional concentration (0.13), while Great Britain shows the most homogenous structure (0.05). These findings confirm the patterns of the convergence process across the European countries shown by Paci (1997).

Finally, the last two columns of Table 2 attempt to offer an answer to the question put forward above about the degree of association between the regional distribution of innovative activity and labour productivity. The two

[12] The results do not change if we use Gini and Herfindal indices as measure of concentration. Therefore, throughout the paper, we present the results based only on the coefficient of variation.

[13] It should be also considered that Greece was admitted to the European Community in 1981 and Spain and Portugal only five years later in 1986.

series turn out to be positively and significantly associated for the whole European Union; most importantly the correlation is increasing (from 0.43 in 1980 to 0.49 in 1990). Considering the correlation within the boundaries of each country, there appears to be a positive and strong association for France, Italy and United Kingdom. Conversely, there is no association between the distribution of innovative activity and labour productivity for the case of the German regions. This may be attributed to the fact that the beneficial effects of inventions (as detected by our indicator) spill over several regions, for example thanks to both a more diffused network of plants around the country and a social network which carries information and expertise over regional borders. Such a result deserves a more detailed investigation to understand to which extent this feature represents a point of strength of the German economic and industrial structure which distinguished it from the other European ones.

It may be interesting, at this point, to get a closer look at the top twenty innovative regions identified in Figure 1. Table 3 shows that half of them belong to Germany, while 4 pertain to France, 3 to Italy, 2 to United Kingdom and one to Netherlands. The European region with the highest technological activity is Baden Wurttemberg, with 278 patents per million inhabitants. The success of this Land is based on an oft-studied "innovation network" where many different institutions support the activity of several large and small enterprises in the automotive and electronic industries (Cook and Morgan, 1994). The second position is obtained by a Dutch region, Zuid Nederland with 242 patents per million inhabitants[14]. Both regions were preceded in the 1980 ranking by another German region, Hessen, which has declined to the third position in 1990. In general the rank correlation between the initial and the final year is quite high (r=0.92). However, it is possible to highlight several up and down movements in the top positions. For instance, Luxembourg has descended from the 8th to the 25th position, Bruxelles from 11th to 22nd. At the same time some regions, especially Italian ones, have greatly improved their ranking, for instance Lombardia (from 36th to 12th), Friuli Venezia-Giulia (from 49th to 17th) and Piemonte (from 48th to 19th). Again such oscillations may be interpreted either as a result of a real reshuffle in innovative capacity across European regions or, most likely, as a consequence of a mutated propensity to patent. On this point, let recall that some European regions (especially in Italy) were in great trouble during the early eighties in the aftermath of the two oil shocks.[15] At that time, such industrial regions could not afford risky and costly

[14] Zuid Nederland is the region which hosts Philips' headquarters. It is worth noting that Philips plays an extremely relevant role in shaping Netherlands's technological activity given that almost one third of its patenting activity at EPO is to be attributed to the electrical and electronic multinational.

[15] As a matter of fact, some areas of these regions have not managed to get over the crises and are now subsidised by the European Union as areas of industrial decline (objective 2).

investments as the expenditure in R&D. In other words, technological progress in those years was achieved mainly through industrial reorganisation, learning and imitation instead of innovation. This may explain why there appears more turbulence in the innovative ranking rather than in the productivity ranking. As a matter of fact the average number of changed positions is 7.8 in the former ranking (column 3) and 4.3 in the latter one (column 6). However, if one excludes Italian regions such numbers become identical for both ranking (4.2) and, as a consequence, more persistence than turbulence is found also among top regions' innovative activity.

4. The regional specialisation in innovation and production

An interesting feature of the database under exam is that it allows to illustrate the sectoral technological specialisation of each region. The EPO arranges patent series according to the International Patent Classification (IPC) which reflects the invention's function rather than its industrial contents. To allow for comparison between patent statistics and other economic variables (e.g., value added, employment) we have, therefore, converted the original IPC data (over 600 sub-categories) to the NACE classification at the three digit level. As a measure of sectoral specialisation we use the index of Revealed Technological Advantage (RTA) which gives information on the specialisation of a region compared to other areas.[16] This index has the advantage to be double weighted so that the resulting description of technological specialisation is not influenced by sectoral or national differences in the "propensity to patent". We start examining the regional distribution of the innovative activity at the industry level (section 4.1), then we analyse the relationship between productive and technological specialisation (section 4.2).

4.1. The sectoral innovative specialisation of the European regions

A preliminary effective picture of the distribution of innovative activity is shown in Table 4 where the six most innovative sectors at the two digit level (NACE) for 1990 are reported. It is quite clear that innovative activity is not only clustered in some advanced regions but that it is also spatially grouped within specific industries. For example, almost 20% of innovations in drugs is attributable to Nordhrein-Westfalen (where Bayer operates among others) and Bayern, Ile de France and Zuid Nederland account for almost 40% of European innovations in electric and electronics thanks to the innovations of

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[16] The index of comparative technological specialisation is calculated as $RTA = P_{ij}\, SSP_{ij} / (S_iP_{ij}S_jP_{ij})$ where P_{ij} are the patents demanded by inventors resident of region j in sector i. The index is greater than one when the country has a comparative advantage in that sector and is less than one when it has a disadvantage. In section 4.2 we use a similar index which is based on sectoral employment – the Revealed Productive Advantage (RPA) - to analyse the comparative industrial specialisation.

Siemens, Thomson and Philips respectively. Table 4 provides just a sketchy but significant picture which is confirmed in the following Figures 3-6 by the overview of the sectoral technological specialisation of the European regions in 1990 obtained by disaggregating the industrial activities in four sectors as suggested by Pavitt (1984).[17]

The first sector, which holds only a small fraction of total patenting activity in Europe (5%), includes the traditional activities such as textiles and apparel, wood and constructions. Figure 3 reveals that especially French and Italian regions are among the highly specialised areas in traditional activities, while most of the German and the Dutch regions show a relative despecialisation. This is the cluster with the highest dispersion (CV=1.2) due to the presence of most of the southern regions with very high RTA's, given that they hold almost no patent in the other sectors.

The largest group (57% of total patents) is the scale intensive one, which consists of energy and chemical products, metal industries, food, transport equipment and consumer machinery. In Figure 4 this sector appears to be more evenly distributed in Europe (CV=0.6) and, as a matter of fact, no region has a specialisation index higher than 1.5. A relevant cluster of regions with a comparative advantage in the scale intensive industries can be detected in northern Europe.

Figure 5 reports the regional specialisation in the specialised suppliers sector (industrial machinery, printing and railroad) which represents 22% of total patents. It is interesting to notice that all Italian regions belonging to the successful Adriatic Belt display a high specialisation in this sector, mainly due to their growing industrial machinery and printing sectors.

Finally, Figure 6 displays the specialisation pattern in the science based sector which includes the pharmaceuticals, office and precision instruments and aerospace (which represent 16% of total patenting). This cluster, not surprisingly, includes most of the capital town regions where one finds the main government research centres and the most important universities[18], which are crucial in this sector (Ile de France, Madrid, South East, Lazio[19]).

An even more detailed analysis of the sectoral specialisation regional pattern based on 11 industrial sectors is provided in Table 5 which reports the top specialised sectors for the 20 most innovative regions described above.[20] It

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[17] For each sector, we have classified the European regions in three groups, based on the value of *RTA*: high, low and "neutral" specialisation. Moreover, we have identified a fourth group of 33 regions which in 1990 hold less than 5 patents.

[18] Universities in the United Kingdom play a particularly important role in innovative activity (about 600 patent application to EPO since 1978); not surprisingly, most British regions are specialised in science based sectors.

[19] For Germany, Berlin is identified as a specialised region in science based sectors.

[20] The specialisation index for all the 109 regions with respect to 11 sectors is reported in Table A2.

is interesting to note that the specialisation pattern for these regions appears to be quite heterogeneous given that nine out of eleven sectors appear as the main sector in different regions (just are building and construction and non-electrical machinery missing).

Another interesting fact worth highlighting refers to the sectoral dispersion of the innovative activity within each region. The last but one column of Table 5 shows that the degree of dispersion, measured by the variation coefficient of RTA, is quite heterogeneous across regions. Indeed it spans from the very concentrated technological structure of Zuid-Nederland (coefficient of variation equal to 1.7) and Rheinland-Pfalz (1.69), to a situation where the innovative activity is more evenly distributed across industries, as in Bourgogne (0.82) and Ile de France (0.90). As it is shown in the last column, such a structure appears rather stable along time given that the correlation of RTA distribution in 1980 and 1990 is usually positive (with the only exception of Schleswig-Holsten (-0.09) and Niedersachsen (-0.5)).

Let us now turn to the analysis of the degree of spatial dispersion of the technological activity of each industrial sector. Table 6 displays the coefficient of variation for the whole European Union and within the four largest countries. Considering the entire European Union, one notes that in 1990 the industries with the strongest spatial heterogeneity of the innovative activity are Transport equipment (CV=2.82) and Electrical machinery (2.80) (the same sectors proves to be the most concentrated in the United States, see Audretsch and Feldman, 1996). At the other extreme, the technological capability of Food (2.05) and Wood (2.10) appears to be more evenly distributed. More importantly, the degree of concentration over the eighties shows a tendency to decline in all sectors – with the exception of Metal industries - and this trend is particularly evident in Chemicals and Electrical machinery.

Considering the spatial concentration within the largest European countries it is possible to remark the following common features. First, as expected, the within-country concentration is usually lower for all sectors with respect to the European one. Second, the average degree of concentration tends to decline over time in all countries, with very few local exceptions.[21] The profile of technological concentration at the national level appears quite homogeneous, few sectors tend to be highly concentrated in all countries: Electrical machinery, Transport equipment, Energy. Local peculiarities are the high spatial concentration of innovative activity in the Food sector in United Kingdom and in the Textile industries in Italy. To sum up, the spatial concentration of the innovative activities seems to follow a pattern similar to

[21] The only local industries that increase their concentration are: Transport and Building in Germany, Energy and Food in France, Electrical machinery in Italy, Energy and Transport in the United Kingdom.

the one of industrial concentration of the production. Consequently, we have a high concentration in the scale intensive sectors usually dominated by few "national champion" firms while the traditional industries characterised by a more relevant presence of small and medium firms show also a more dispersed spatial distribution of the innovative activities.

Finally, it is worth remarking that the average regional dispersion of the sectoral distributions appears higher than the regional dispersion of the aggregate innovative activity discussed in the previous Table 2 and reported also in Table 6. It means that the sectoral specialisation of each region is substantial, even though the aggregate technological activity is more equally distributed across regions. Looking at the ratio between these two measures (last row of Table 6) some interesting differences among countries emerge. For instance, Italy exhibits the lowest ratio (1.9) implying that its sectoral specialisation of technological activity across regions is relatively low compared to its (high) regional inequality in the distribution of the aggregate innovative capability. On the opposite extreme we find France (2.7) characterised by very specialised regions that results more similar in the aggregate. This is probably the result of public policies that have fostered the development of very specialised "technopole" in several regions of the country [Longhi and Quere (1991)]. These findings highlight the importance of examining both the sectoral and spatial distributions of the technological activity within each country.[22]

4.2. Technological and productive specialisation

To which extent is the technological specialisation of European regions associated to their productive specialisation? To answer this relevant question, we firstly estimate the sectoral specialisation of the industrial system by computing for each region the index of Revealed Productive Advantage (RPA) based on data on sectoral employment in 1990.[23] Secondly, we compare the sectoral patterns of technological specialisation of each region (as it emerges from the RTA index described above) with the productive one. Table 7 reports the correlation coefficients (Pearson and Spearman's rank correlation) for the whole Europe and across countries and sectors.

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[22] The role of sectoral specialisation and structural change –at a much more aggregated level – on the growth process of the European regions has been studied by Paci and Pigliaru (1998).

[23] For the definition of the RPA index see footnote 16. We have excluded from our analysis Spain, Greece and Portugal because their technological activity is too low to allow sectoral comparison. For the same reasons we have excluded 5 other regions which hold less than 5 patents in 1990. Therefore we are considering here a total of 69 European regions. Sectoral employment comes from Eurostat's *Regio*. For Germany and United Kingdom data have been kindly provided by De Nardis *et al.* (1996) who have studied the manufacturing specialisation of 56 territorial units in Europe in the context of the optimal currency area's debate. To make technology and employment sectoral data comparable we have limited the analysis to 9 industrial sectors listed in Table 7.

The first result to be remarked is that there is a positive and significant association between the spatial and sectoral specialisation of the innovative and productive activities in contrast to what found by Audretsch and Feldman (1996) for the United States.[24] This outcome confirms the idea that there are spatially defined and self-reinforcing mechanisms (i.e. localised knowledge spillovers, agglomeration economies) that leads a local economic system towards a specialisation both in production and technology.

The result for the entire Europe is confirmed, with few exceptions, by the correlations computed at the national and sectoral level. All countries present a positive and significant association between technology and productive specialisation, displaying very high levels of significance.[25] Only for the small countries - like Belgium and Netherlands - the significance is less than 10% for the Pearson correlation. In this case the territorial split is too limited and it prevents a precise evaluation of the spatial specialisation. As regards to the correlation for each industrial sector over the 69 regions, it appears that 7 out of 9 sectors show a positive and significant association between innovative and productive specialisation. This association results particularly strong in the highly integrated and scale intensive sectors like Energy, Chemicals and Transport equipment, and also in more traditional industries as Textiles and apparel.[26] The results are more controversial in sector 8, probably due to the high heterogeneity of the productions here included: wood, paper and other manufacturing industries. Moreover, the spatial correlation between technology and production is non existent in the case of Building and construction, since this particular activity is obviously rather evenly spread throughout all areas.

Finally, the last issue worth examining concerns another interesting association, that is the one between aggregate productivity levels and the degree of sectoral dispersion of technology. Indeed, the data highlight the presence of a negative and significant correlation ($r=-0.45$) between the degree of concentration (again the variation coefficient of RTA's) of sectoral innovative activity in each region and its productivity level. In other words, the European regions which enjoy a more homogeneous distribution of their

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[24] Actually, Audretsch and Feldman (1996) have a different purpose, that is to test the hypothesis that innovative activity will tend to cluster in industries where new economic knowledge plays an especially important role. No explanation is, therefore, given for the insignificance of the link between production and innovation specialisation. Our reading is that this result depends on the indicator of innovative activity (new product announcements) which is likely either to overlook or to underestimate marginal improvements and process innovations typical of medium and small firms.

[25] Due to the limited number of observations, we have considered together the mono-region countries – Ireland, Denmark, Luxembourg.

[26] For the Textiles and Apparel sector the correlation between technological and productive specialisation appears particularly high in the Italian regions, where this industry is organised, as it is well known, by locally integrated "industrial districts".

technological capability across different industrial sectors appear to be also characterised by a higher productivity level. This outcome suggests the presence of positive inter-industries externalities which favour those regions that succeed in covering a broader range of technological activities. However, there may be alternative explanations due to the fact that this relationship is very much endogenous in nature. In other words, it may be that those regions which becomes richer, are, for this very reason, able to attract entrepreneurs and firms in different sectors. Cross section analysis do not allow for an assessment of the relative strength of such alternative explanations. Assessment which should be addressed by future research if more reliable data on the temporal dimensions become available.

5. Conclusion

Europe is becoming more and more integrated. Several policies are aiming at decreasing the core of the transaction costs which, for instance, still make labour mobility across Europe almost negligible and make medium and small firms very much immobile across European countries. How is the current pattern of regional industrial specialisation going to change due to such a process of integration? To propitiate a correct answer to this question, this paper starts constructing the map of the spatial distribution of innovative and productive activity in Europe and assessing the level of integration between them. Such an analysis is made possible thanks to an original databank on regional patents statistics based on the data collected by the European Patent Office (EPO) rearranged by assigning each patent to its region of origin through the postal code of the inventor's residence.

The main results of the aggregate analysis worth highlighting are as follows. First, the technological activity in the EU appears to be highly concentrated, although concentration tends to decline over the period. This results from the huge differences between southern and northern Europe. Secondly, as expected, the degree of disparities in the productivity distribution appears much lower with respect to innovative activity both at the European and at the country level. Nonetheless, the correlation coefficients between the regional distribution of innovative activity and labour productivity turns out to be positive and significant (around 0.49).

The disaggregated analysis at the sectoral level has remarked that innovative activity is spatially clustered within specific industries. In other words there is a tendency towards the formation in Europe of highly specialised technological enclaves, especially in some sectors - Electrical machinery, Transport equipment, Energy. Moreover we have documented how the spatial and sectoral specialisation of innovative and productive activities is positively and significantly correlated. This suggests that localised knowledge spillovers and agglomeration economies foster a local economic system towards a specialisation in both production and technology. Finally, the last outcome concerns the existence of a significant and robust link between productive and innovative specialisation. There also exists a weak negative correlation between technological concentration and aggregate productivity. This implies that the European regions which enjoy a more homogeneous distribution of their technological capability across different industrial sectors appear to be also characterised by higher productivity levels.

This paper has provided a first recognition of the spatial dimension of innovative and productive activity at the regional level in Europe. Such a study has been mostly descriptive in nature and considerable progress is still to be made in order to identify, and test appropriately, the main determinants of the self reinforcing mechanisms which lead to innovative and productive clusters. Such a progress is very relevant since, as already said, the aforementioned mechanisms are likely to be affected in the near future by the process of European integration. This “historical accident”, as shown by Arthur (1994), may lead to multiple equilibria, not all Pareto optimal ones. In such circumstances governments, according to David (1987), resemble "blind giants" with "narrow windows of opportunities", and therefore timely information is needed in order to avoid that the "policy window" slams shut before the "giants" manage to take their bearings through darkness.

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Table 1. Patent applications at the European Patent Office by European countries

Country	Distribution of patents by inventor (percentage values)			Number of locations	Ratio inventor / proponent	Patents per location
	1980	1985	1990	1990	1990	1990
Belgium	2.5	2.4	2.2	280	1.35	2.0
Germany	50.0	47.2	47.0	2492	1.03	4.8
Denmark	1.0	1.2	0.9	114	1.04	1.9
Spain	0.3	0.5	1.0	89	1.09	2.7
France	20.9	18.5	19.4	1679	1.04	2.9
Greece	0.0	0.1	0.0	2	3.00	1.5
Ireland	0.1	0.2	0.3	41	1.14	1.6
Italy	3.7	6.9	9.1	789	1.07	2.9
Luxembourg	0.2	0.1	0.1	18	0.76	1.4
Netherlands	5.0	6.2	6.3	434	0.97	3.7
Portugal	0.0	0.0	0.0	4	1.25	1.3
United Kingdom	16.4	16.7	13.8	2874	1.12	1.2
European Union	100.0	100.0	100.0	8816	1.05	2.9
(absolute value)	(10,426)	(17,511)	(25,333)			

Table 2. Regional dispersion of innovative activity and labour productivity

Country	Num. of obs	Innovative activity (a)		Labour productivity (b)		Correlation (c)	
		1980	1990	1980	1990	1980	1990
Germany	11	0.61	0.51	0.11	0.11	-0.18	0.00
France	22	1.04	0.77	0.12	0.11	0.60	0.76
Italy	20	1.08	1.02	0.13	0.13	0.76	0.78
United Kingdom	11	0.53	0.55	0.05	0.05	0.72	0.60
European Union	109	1.51	1.28	0.28	0.26	0.43	0.49

Notes:
(a) coefficient of variation of patents per capita
(b) coefficient of variation of GDP per worker
(c) correlation coefficient between the spatial distribution of innovative activity and labour productivity

Table 3. Innovative activity and labour productivity of the top twenty innovative regions. 1990

Code	Region	Innovative acticvity			Labour productivity		
		Value (a)	Rank	Rank var. 1980-90	Value (b)	Rank	Rank var. 1980-90
D1	BADEN-WURTTEMBERG	279	1	4	31326	25	2
N4	ZUID-NEDERLAND	242	2	5	44124	1	0
D6	HESSEN	239	3	-2	35046	4	9
D2	BAYERN	224	4	-1	29164	43	2
D9	RHEINLAND-PFALZ	204	5	-1	29730	37	-2
F1	ILE DE FRANCE	203	6	-4	42280	2	1
D8	NORDRHEIN-WESTFALEN	176	7	-1	30788	26	-4
F18	RHONE-ALPES	155	8	1	32107	15	8
D3	BERLIN	116	9	1	33894	8	2
U4	EAST ANGLIA	107	10	3	25303	71	2
F10	ALSACE	104	11	16	33426	10	-2
I4	LOMBARDIA	96	12	24	34488	7	0
D11	SCHLESWIG-HOLSTEIN	93	13	7	28426	48	-8
D5	HAMBURG	91	14	11	40889	3	-1
D7	NIEDERSACHSEN	86	15	4	27704	55	-8
U5	SOUTH EAST	85	16	-4	28107	50	7
I7	FRIULI-VENEZIA GIULIA	85	17	32	31534	22	6
F7	BOURGOGNE	81	18	-3	30330	30	8
I1	PIEMONTE	81	19	29	31791	17	8
D10	SAARLAND	81	20	4	28759	45	6

Notes:
(a) patents per million inhabitants
(b) GDP per worker, millions of PPS

Table 4. Regional distribution of innovative activity for the most innovative industries. 1990

NACE code	Industry	Region	Number of patents	Share on industry patents
32	Non electrical machinery	Nordrhein-Westfalen	710	13.4%
	(n=5288)	Baden-Wurttemberg	693	13.1%
		Bayern	511	9.7%
		Ile de France	344	6.5%
		Hessen	271	5.1%
		Lombardy	174	3.3%
25	Drugs	Nordrhein-Westfalen	949	19.3%
	(n=4905)	Hessen	429	8.7%
		South-East	383	7.8%
		Rheinland	378	7.7%
		Ile de France	304	6.2%
34	Electrics and electronics	Bayern	791	18.1%
	(n=4371)	Ile de France	530	12.1%
		Zuid Nederland	423	9.7%
		Baden-Wurttemberg	419	9.6%
		South-East	288	6.6%
37	Precision instruments	Baden-Wurttemberg	394	13.4%
	(n=2940)	Bayern	353	12.0%
		Ile de France	289	9.8%
		South-East	244	8.3%
		Hessen	169	5.7%
31	Metal products	Nordrhein-Westfalen	375	17.0%
	(n=2211)	Baden-Wurttemberg	258	11.7%
		Bayern	178	8.1%
		Ile de France	156	7.1%
		Hessen	132	6.0%
35	Motor vehicles	Baden-Wurttemberg	310	12.7%
	(n=1337)	Bayern	170	12.3%
		Ile de France	164	6.4%
		Nordrhein-Westfalen	85	5.2%
		Piemonte	69	4.6%

Table 5 Specialisation of the top twenty regions. 1990

Code	Region	Top sectors of higher specialisation				Degree of concentration (coeff. of variation)	Correlation between RTA in 1980 and 1990
		First sector	RTA	Second sector	RTA		
D1	BADEN-WURTTEMBERG	Transport equipment	1.82	Non-elect. Machinery	1.24	0.92	0.72
N4	ZUID-NEDERLAND	Electrical machinery	3.06	-		1.70	0.61
D6	HESSEN	Chemicals	1.59	Metal, non-metal ind.	1.09	1.16	0.42
D2	BAYERN	Electrical machinery	1.81	Office, precision inst.	1.22	1.10	0.74
D9	RHEINLAND-PFALZ	Chemicals	2.47	Textiles, apparel	1.22	1.69	0.35
F1	ILE DE FRANCE	Energy	1.84	Electrical machinery	1.41	0.90	0.36
D8	NORDRHEIN-WESTFALEN	Chemicals	1.59	Metal, non-metal ind.	1.52	1.23	0.81
F18	RHONE-ALPES	Textiles, apparel	2.72	Wood, paper	1.61	0.94	0.53
D3	BERLIN	Electrical machinery	1.81	Office, precision inst.	1.37	1.27	0.53
U4	EAST ANGLIA	Food	3.01	Energy	2.66	1.03	0.19
F10	ALSACE	Wood, paper	2.39	Chemicals	1.34	1.01	0.59
I4	LOMBARDIA	Wood, paper	1.34	Chemicals	1.27	1.03	0.35
D11	SCHLESWIG-HOLSTEIN	Food	1.82	Office, precision inst.	1.58	1.01	-0.09
D5	HAMBURG	Food	2.23	Wood, paper	1.68	0.95	0.47
D7	NIEDERSACHSEN	Energy	2.05	Food	1.75	0.91	-0.50
U5	SOUTH EAST	Office, precision inst.	1.53	Food	1.45	1.02	0.60
I7	FRIULI-VENEZIA GIULIA	Metal, non-metal ind.	2.99	Energy	2.29	1.41	0.04
F7	BOURGOGNE	Transport equipment	2.76	Building, construction	2.40	0.82	0.08
I1	PIEMONTE	Transport equipment	3.03	Textiles, apparel	1.46	0.93	0.43
D10	SAARLAND	Energy	5.42	Transport equipment	1.92	1.20	0.69

Table 6 Dispersion of innovative activity across European regions for industrial sectors (coefficient of variation).

	Sectors	European Union		Germany		France		Italy		United Kingdom	
		1980	1990	1980	1990	1980	1990	1980	1990	1980	1990
1	Energy	2.94	2.69	1.68	1.33	2.26	3.05	4.47	2.94	1.20	1.32
2	Metal and non-metal ind.	2.36	2.54	1.29	1.28	1.84	1.75	1.72	1.50	1.23	1.07
3	Chemicals	3.30	2.59	1.39	1.27	2.08	2.02	3.15	2.25	1.73	1.48
4	Non-electrical machinery	2.38	2.39	1.19	1.14	2.13	1.85	1.84	1.63	1.13	0.83
5	Electrical machinery	3.45	2.80	1.51	1.40	3.32	2.53	1.87	2.20	1.56	1.58
6	Transport equipment	2.84	2.82	1.26	1.40	2.79	2.45	1.99	1.93	1.08	1.22
7	Office, precision instruments	3.09	2.44	1.21	1.15	3.49	2.37	2.03	1.84	2.04	1.56
8	Food	2.78	2.05	1.12	0.86	1.54	2.01	2.44	1.74	1.98	1.56
9	Textiles, apparel	2.56	2.21	1.33	1.15	2.15	1.90	2.87	2.55	1.13	0.97
10	Wood, paper, other manuf. ind.	2.32	2.10	1.05	1.19	2.02	1.47	1.95	1.59	1.44	1.37
11	Building and construction	2.21	2.15	1.05	1.20	2.34	1.83	1.34	1.40	1.00	0.88
	A. Unweighted average	2.75	2.44	1.28	1.22	2.36	2.11	2.33	1.96	1.41	1.26
	B. Aggregate CV (Table 2)	1.51	1.28	0.61	0.51	1.04	0.77	1.08	1.02	0.53	0.55
	Ratio A/B	1.82	1.90	2.09	2.40	2.28	2.73	2.16	1.92	2.69	2.31

Table 7. Correlation coefficients between innovative and productive specialisation. 1990

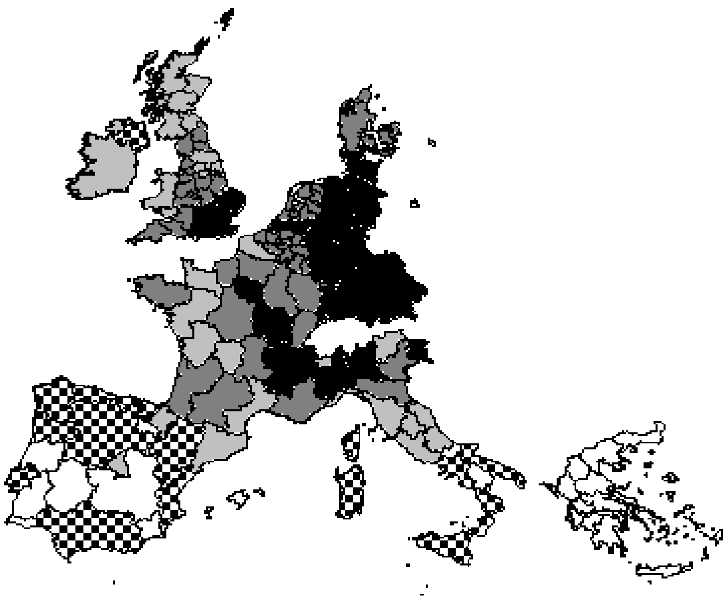
(Coefficient / 2-tailed Significance)

Within countries		
Country	Pearson	Spearman
Europe	0.31	0.30
(621 obs)	0.00	0.00
Germany	0.44	0.39
(99 obs)	0.00	0.00
France	0.30	0.27
(189 obs)	0.00	0.00
Italy	0.31	0.22
(144 obs)	0.00	0.01
United Kingdom	0.35	0.22
(99 obs)	0.00	0.03
Netherland	0.26	0.41
(36 obs)	0.13	0.01
Belgium	0.30	0.35
(27 obs)	0.13	0.07
Other (IR, DK, LU)	0.52	0.42
(27 obs)	0.01	0.03

Within sectors (69 obs)		
Sector	Pearson	Spearman
1 Energy	0.38	0.42
	0.00	0.00
2 Metal and non-metal ind.	0.26	0.25
	0.03	0.04
3 Chemicals	0.52	0.53
	0.00	0.00
4 Machinery	0.25	0.31
	0.04	0.01
5 Transport equipment	0.31	0.33
	0.01	0.01
6 Food	0.23	0.22
	0.06	0.07
7 Textiles, apparel	0.44	0.36
	0.00	0.00
8 Wood, paper, other manuf	0.24	0.17
	0.05	0.17
9 Building and construction	0.00	-0.08
	1.00	0.54

Figure 1. Innovative activity in the European regions. 1990

p: number of patents per million of inhabitants



Range:

p = 0 | 0 < p < 6 | 6 ≤ p < 40

40 ≤ p < 80 | p ≥ 80

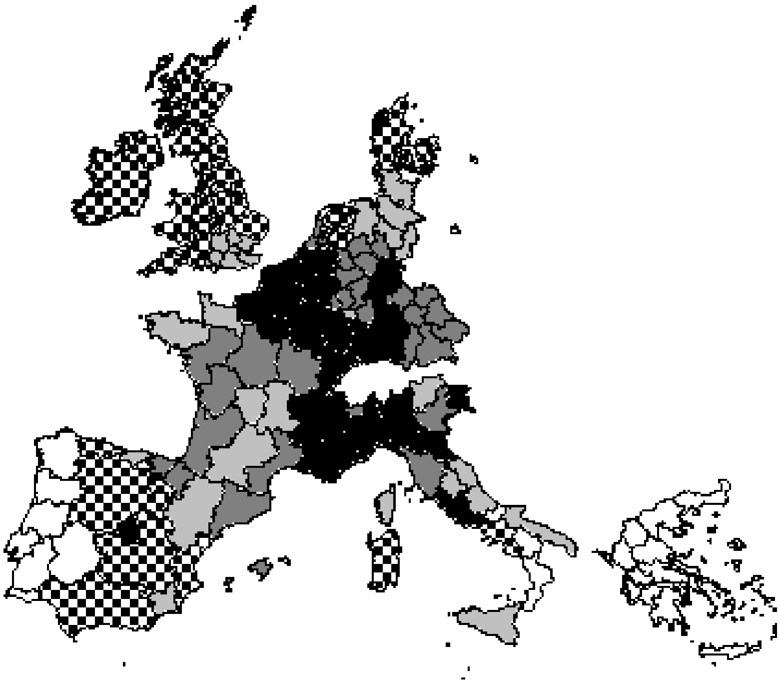
Frequency:

= 22 | = 19 | = 21

= 27 | = 20

Figure 2. Labour productivity in the European regions. 1990

Y: index of Gross Domestic Product per worker, European Union = 100



Range:

0 ≤ Y < 80 | 80 ≤ Y < 90 | 90 ≤ Y < 100

100 ≤ Y < 108 | Y ≥ 108

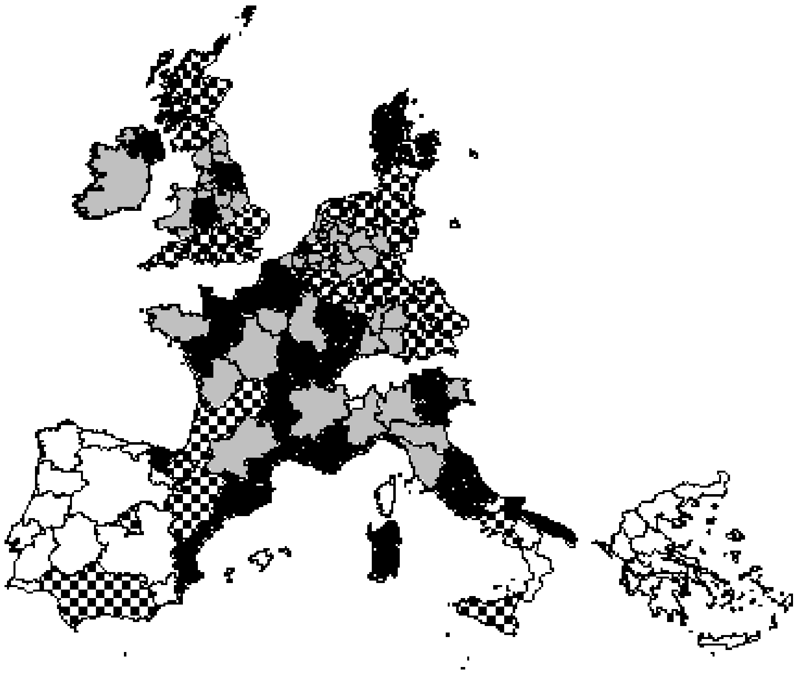
Frequency:

= 23 | = 22 | = 20

= 19 | = 25

Figure 3. Technological specialisation in traditional and construction industries. 1990

RTA1 = revealed tecnological advantage in the first Pavitt's sector



Range:

0 ≤ RTA1 < 0.8　　0.8 ≤ RTA1 < 1.5

RTA1 ≥ 1.5　　RTA1 not included

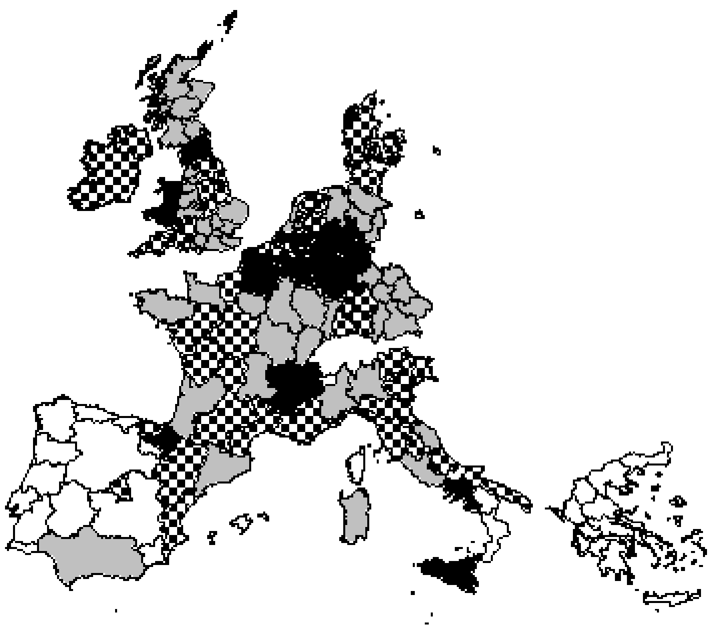
Frequency:

= 22　　= 25

= 29　　= 33

Figure 4. Technological specialisation in scale intensive and energy industries. 1990

RTA2 = revealed tecnological advantage in the second Pavitt's sector



Range:

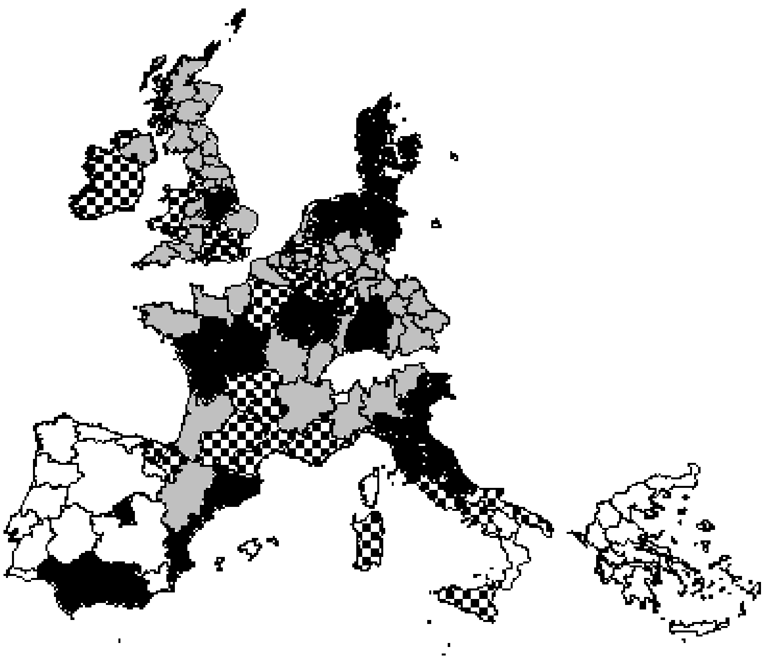
$0 \leq RTA2 < 0.9$	$0.9 \leq RTA2 < 1.05$
$RTA2 \geq 1.05$	RTA2 not included

Frequency:

f = 33	f = 26
f = 17	f = 33

Figure 5. Technological specialisation in specialised suppliers industries. 1990

RTA3 = revealed tecnological advantage in the third Pavitt's sector



Range:

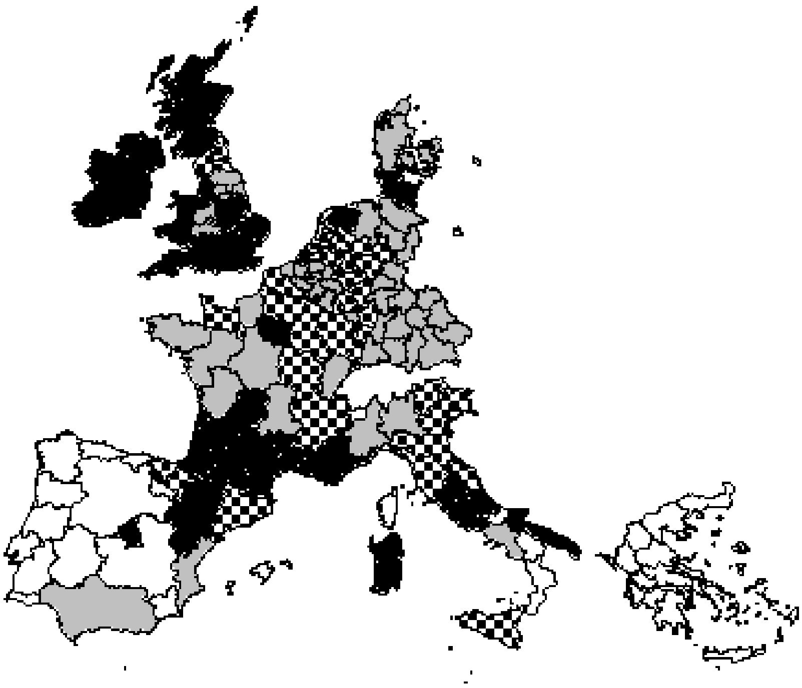
0 ≤ RTA3 < 0.85 (chequered)	0.85 ≤ RTA3 < 1.15 (grey)
RTA3 ≥ 1.15 (black)	RTA3 not included (white)

Frequency:

(chequered) = 24	(grey) = 27
(black) = 25	(white) = 33

Figure 6. Technological specialisation in science based industries. 1990

RTA4 = revealed tecnological advantage in the fourth Pavitt's sector



Range:

0 ≤ RTA4 < 0.85   0.85 ≤ RTA4 < 1.15

RTA4 ≥ 1.15   RTA4 not included

Frequency:

= 27   = 22

= 27   = 33

APPENDIX

Table 1A. Innovative activity in the European regions. Average 1980-90

		Summary statistics		**Standardised RTA**										
CODE	REGIONS	Average number of patents per capita	Share of total patents (%)	Energy	Metal and non-metal industries and products	Chemicals	Non-electrical machinery	Electrical machinery and electronics	Transport	Office, precision instr.	Food drink and tobacco	Textiles, apparel	Wood, paper, and other manuf. industries	Building and constr.
BE1	VLAAMS GEWEST	41	1.2	-0.06	0.11	-0.06	0.05	-0.36	0.00	-0.35	0.36	0.41	0.18	0.19
BE2	REGION WALLONNE	36	1.0	-1.00	0.14	0.22	0.00	-0.37	-0.11	-0.38	-0.04	-0.25	0.41	-0.18
BE3	REG.BRUXELLES-	64	1.9	-1.00	0.21	0.04	0.04	-0.37	-0.29	-0.38	-1.00	-0.11	0.27	0.11
DK0	DANMARK	35	1.0	0.01	0.04	0.02	0.22	-0.41	-0.02	-0.32	0.05	0.38	0.14	0.06
DE1	BADEN-WUERTTEMBERG	189	5.5	-0.50	-0.07	-0.01	0.10	0.00	0.07	0.00	-0.19	0.05	0.01	0.02
DE2	BAYERN	165	4.8	-0.11	-0.24	-0.11	-0.09	0.25	0.06	0.25	-0.10	-0.08	-0.28	-0.30
DE3	BERLIN	90	2.6	-1.00	-0.19	-0.33	-0.38	0.31	0.04	0.31	0.04	-0.61	-0.13	0.05
DE4	BREMEN	42	1.2	-1.00	-0.38	0.47	-0.17	-0.16	0.44	-0.17	-0.16	-1.00	0.52	0.46
DE5	HAMBURG	60	1.8	-1.00	-0.14	-0.03	-0.07	0.03	0.31	0.03	0.18	0.14	-0.30	-0.44
DE6	HESSEN	185	5.4	-0.66	0.14	0.00	-0.01	-0.24	0.04	-0.25	-0.02	-0.38	-0.09	-0.14
DE7	NIEDERSACHSEN	57	1.7	0.32	0.00	-0.02	0.14	-0.14	0.01	-0.13	0.20	0.13	0.06	-0.10
DE8	NORDRHEIN-WESTFALEN	130	3.8	0.23	0.19	0.13	0.05	-0.37	-0.37	-0.38	0.00	-0.03	-0.02	-0.02
DE9	RHEINLAND-PFALZ	150	4.4	-1.00	0.28	-0.18	-0.16	-0.39	-0.28	-0.39	0.04	0.04	-0.26	-0.54
DE10	SAARLAND	50	1.5	0.84	0.05	0.08	0.23	-0.49	-0.01	-0.50	-0.13	-0.04	0.40	0.18
DE11	SCHLESWIG-HOLSTEIN	64	1.9	0.07	-0.15	0.06	0.06	-0.04	0.29	-0.01	0.12	-0.37	-0.18	-0.22
GR1	ANATOLIKI MAKEDONIA,	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR2	KENTRIKI MAKEDONIA	0	0.0	-1.00	-1.00	0.86	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00

GR3	DYTIKI MAKEDONIA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR4	THESSALIA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR5	IPEIROS	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR6	IONIA NISIA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR7	DYTIKI ELLADA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR8	STEREA ELLADA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR9	PELOPONNISOS	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR10	ATTIKI	1	0.0	-1.00	-0.11	-1.00	-1.00	0.16	-0.06	0.15	0.86	-1.00	0.71	-1.00
GR11	VOREIO AIGAIO	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR12	NOTIO AIGAIO	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GR13	KRITI	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ES1	GALICIA	0	0.0	-1.00	0.19	-1.00	0.51	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
ES2	ASTURIAS	1	0.0	-1.00	-0.16	-1.00	0.22	-1.00	0.66	-1.00	-1.00	-1.00	-1.00	-1.00
ES3	CANTABRIA	2	0.1	-1.00	-1.00	0.80	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.91	-1.00
ES4	PAIS VASCO	2	0.1	-1.00	-0.20	0.63	0.06	-0.19	-1.00	-0.19	-1.00	-1.00	0.50	0.73
ES5	NAVARRA	7	0.2	-1.00	-0.01	0.64	0.02	-1.00	-0.11	-1.00	-1.00	-1.00	0.69	-1.00
ES6	RIOJA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ES7	ARAGON	2	0.1	-1.00	-0.47	-1.00	-0.12	-0.03	0.41	0.30	0.81	-1.00	-1.00	-1.00
ES8	MADRID	6	0.2	-1.00	0.05	-0.04	0.07	-0.14	0.06	-0.14	0.12	0.35	-1.00	-1.00
ES9	CASTILLA-LEON	1	0.0	-1.00	-0.01	0.64	-1.00	-1.00	0.53	-1.00	-1.00	-1.00	-1.00	-1.00
ES10	CASTILLA-LA MANCHA	0	0.0	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.97	-1.00	-1.00	-1.00
ES11	EXTREMADURA	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ES12	CATALUNA	9	0.3	0.58	0.08	0.35	0.14	-0.49	-0.35	-0.50	0.06	0.36	0.14	0.48
ES13	COMUNIDAD VALENCIANA	1	0.0	-1.00	-0.29	0.53	-0.06	-0.16	-0.04	-0.17	-1.00	0.49	0.52	0.74

ES14	BALEARES	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ES15	ANDALUCIA	1	0.0	-1.00	0.10	0.64	0.02	-1.00	-0.11	-1.00	-1.00	-1.00	-1.00	-1.00
ES16	MURCIA	1	0.0	-1.00	-0.01	0.64	0.35	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
ES17	CANARIAS	2	0.1	-1.00	0.08	0.61	0.30	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
FR1	ILE DE FRANCE	156	4.6	0.09	-0.17	-0.12	-0.12	0.20	0.12	0.19	-0.26	-0.24	0.03	0.08
FR2	CHAMPAGNE-ARDENNE	30	0.9	-1.00	-0.02	0.44	0.22	-0.39	-0.49	-0.39	0.51	0.04	-0.13	-0.09
FR3	PICARDIE	40	1.2	-1.00	0.07	0.21	0.15	-0.32	-0.35	-0.31	0.42	0.21	0.08	0.34
FR4	HAUTE-NORMANDIE	36	1.1	-1.00	0.09	0.07	0.12	-0.40	-0.01	-0.40	0.00	0.31	0.27	0.30
FR5	CENTRE	34	1.0	-1.00	-0.07	0.29	0.16	-0.29	0.09	-0.28	0.10	-0.12	0.19	0.46
FR6	BASSE-NORMANDIE	19	0.6	-1.00	0.01	0.38	0.15	-0.51	-0.03	-0.51	0.24	-0.20	0.36	0.51
FR7	BOURGOGNE	53	1.6	0.39	-0.15	0.31	-0.01	-0.01	0.13	-0.02	-0.37	-0.04	0.09	0.44
FR8	NORD-PAS-DE-CALAIS	19	0.6	-1.00	0.08	0.04	0.07	-0.32	-0.26	-0.25	0.44	0.19	0.56	0.32
FR9	LORRAINE	34	1.0	0.44	-0.05	0.55	0.09	-0.60	-0.13	-0.60	-1.00	-0.24	0.51	0.72
FR10	ALSACE	65	1.9	-1.00	0.10	0.04	0.12	-0.24	-0.20	-0.25	-0.46	0.46	-0.35	0.02
FR11	FRANCHE-COMTE	40	1.2	-1.00	-0.27	0.37	-0.01	0.07	0.01	0.10	-1.00	0.48	-0.39	-0.03
FR12	PAYS DE LA LOIRE	21	0.6	-1.00	0.00	0.10	0.29	-0.41	-0.04	-0.39	0.05	0.34	0.09	0.02
FR13	BRETAGNE	28	0.8	-1.00	-0.34	-0.40	-0.16	0.36	-0.28	0.36	0.31	-0.32	0.12	-0.12
FR14	POITOU-CHARENTES	19	0.6	-1.00	-0.11	-0.06	0.13	0.04	0.00	0.03	-1.00	0.32	0.22	0.06
FR15	AQUITAINE	28	0.8	-1.00	0.06	-0.07	0.08	-0.17	0.11	-0.16	-0.11	0.13	-0.37	-1.00
FR16	MIDI-PYRENEES	37	1.1	0.36	-0.06	-0.26	-0.07	0.04	0.18	0.03	0.03	0.16	0.25	0.23
FR17	LIMOUSIN	17	0.5	-1.00	-0.38	0.36	-0.02	0.07	0.30	0.07	-1.00	0.40	-1.00	-1.00
FR18	RHONE-ALPES	104	3.0	0.18	0.01	0.09	-0.03	0.01	-0.12	0.01	0.05	0.11	-0.17	-0.20
FR19	AUVERGNE	29	0.9	-1.00	-0.13	0.17	-0.19	0.06	-0.19	0.05	0.41	0.65	0.34	0.38
FR20	LANGUEDOC-ROUSSILLON	25	0.7	-1.00	0.15	-0.15	-0.15	-0.31	0.02	-0.25	0.34	-0.01	0.48	0.39

FR21	PROVENCE-ALPES-C. D'AZ.	41	1.2	0.08	-0.12	-0.09	-0.10	0.01	0.27	0.01	-0.26	0.07	0.40	0.53
FR22	CORSE	4	0.1	-1.00	0.19	-1.00	0.22	-1.00	0.41	-1.00	-1.00	-1.00	-1.00	-1.00
IR0	IRELAND	12	0.4	-1.00	-0.02	0.22	-0.03	-0.10	0.10	-0.11	0.31	0.40	-1.00	-1.00
IT1	PIEMONTE	47	1.4	0.05	-0.09	0.04	0.09	0.03	0.06	0.03	0.05	-0.11	-0.27	-0.24
IT2	VALLE D'AOSTA	6	0.2	-1.00	-1.00	-1.00	-1.00	0.43	-1.00	0.42	-1.00	0.91	-1.00	-1.00
IT3	LIGURIA	17	0.5	-1.00	0.06	0.10	-0.16	-0.07	0.06	-0.08	-0.19	-0.29	0.28	0.43
IT4	LOMBARDIA	55	1.6	-0.11	0.06	-0.07	0.03	-0.03	-0.17	-0.03	0.09	0.18	-0.26	-0.09
IT5	TRENTINO-ALTO ADIGE	14	0.4	-1.00	-0.27	0.20	0.04	-1.00	0.36	-1.00	-1.00	0.78	0.70	0.85
IT6	VENETO	29	0.8	-1.00	0.01	0.18	0.15	-0.43	-0.14	-0.42	0.22	0.73	-0.11	-0.07
IT7	FRIULI-VENEZIA GIULIA	44	1.3	0.86	-0.02	0.14	0.16	-0.11	-0.11	-0.12	-1.00	0.24	-0.27	-0.23
IT8	EMILIA-ROMAGNA	38	1.1	0.43	0.06	0.02	0.22	-0.40	-0.15	-0.39	0.16	0.27	0.30	0.36
IT9	TOSCANA	21	0.6	-1.00	0.06	-0.02	0.24	-0.29	-0.17	-0.28	-0.02	0.15	0.02	0.15
IT10	UMBRIA	13	0.4	-1.00	-0.16	-0.03	0.12	-0.19	0.14	-0.19	0.27	0.47	0.50	0.73
IT11	MARCHE	13	0.4	-1.00	-0.26	0.19	0.05	0.20	-0.37	0.19	-1.00	0.57	-0.13	-1.00
IT12	LAZIO	16	0.5	0.43	-0.06	0.07	-0.20	0.00	0.16	0.02	-0.14	0.18	0.33	0.48
IT13	CAMPANIA	2	0.0	-1.00	-0.05	0.48	-1.00	0.22	-0.20	0.21	-1.00	-1.00	-1.00	-1.00
IT14	ABRUZZO	6	0.2	-1.00	-0.07	-0.04	0.25	-0.33	0.23	-0.34	-1.00	0.61	-1.00	-1.00
IT15	MOLISE	1	0.0	-1.00	0.49	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
IT16	PUGLIA	1	0.0	-1.00	-0.21	0.21	-1.00	-0.09	0.04	-0.10	-1.00	0.86	0.57	0.77
IT17	BASILICATA	1	0.0	-1.00	-1.00	-1.00	-1.00	-1.00	0.81	-1.00	-1.00	-1.00	-1.00	-1.00
IT18	CALABRIA	1	0.0	-1.00	-0.35	-1.00	0.02	-1.00	0.23	-1.00	0.85	0.91	-1.00	-1.00
IT19	SICILIA	2	0.1	-1.00	-0.45	-0.59	-0.49	0.45	-0.30	0.45	0.47	-1.00	-1.00	-1.00
IT20	SARDEGNA	3	0.1	0.97	-0.05	0.52	-1.00	-1.00	0.50	-1.00	-1.00	-1.00	0.67	-1.00
LU0	LUXEMBOURG	62	1.8	0.84	0.19	-0.10	0.22	-0.80	-0.08	-0.80	0.05	-1.00	0.49	-1.00

NL1B	NOORD-NEDERLAND -	37	1.1	-1.00	0.05	-0.06	0.27	-0.68	0.27	-0.62	0.18	-0.44	-0.09	-0.05
NL2	OOST-NEDERLAND	52	1.5	-1.00	0.02	0.14	0.22	-0.31	-0.01	-0.28	-0.78	-0.25	0.26	0.23
NL3	WEST-NEDERLAND	50	1.5	0.09	0.13	-0.11	0.05	-0.42	-0.03	-0.27	0.33	0.01	0.41	0.29
NL4	ZUID-NEDERLAND	163	4.8	-0.53	-0.34	-0.32	-0.27	0.40	-0.27	0.39	-0.37	-0.49	-0.41	-0.28
PO1	NORTE	0	0.0	-1.00	-1.00	-1.00	-1.00	-1.00	0.76	-1.00	0.90	-1.00	-1.00	-1.00
PO2	CENTRO (P)	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
PO3	LISBOA E VALE DO TEJO	1	0.0	-1.00	-0.01	0.21	-1.00	-1.00	0.37	-1.00	-1.00	0.74	0.76	0.88
PO4	ALENTEJO	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
PO5	ALGARVE	0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
UK1	NORTH	32	0.9	-1.00	0.16	-0.25	0.07	-0.21	-0.25	-0.17	-0.24	0.00	0.11	0.07
UK2	YORKSHIRE, HUMBERSIDE	30	0.9	0.49	0.15	0.15	0.10	-0.61	0.02	-0.59	0.13	0.08	0.11	0.24
UK3	EAST MIDLANDS	37	1.1	0.45	0.00	-0.04	0.17	-0.22	0.06	-0.22	0.43	0.04	0.12	0.20
UK4	EAST ANGLIA	81	2.4	-1.00	-0.10	-0.39	-0.10	0.21	0.04	0.20	0.30	-0.83	-0.33	-0.64
UK5	SOUTH EAST (UK)	69	2.0	-0.07	-0.02	-0.08	-0.19	0.07	0.19	0.07	0.08	-0.20	-0.14	-0.32
UK6	SOUTH WEST (UK)	49	1.4	-0.04	-0.12	0.03	0.01	0.03	0.21	0.03	-0.16	-0.02	0.15	-0.32
UK7	WEST MIDLANDS	46	1.3	0.45	-0.05	0.21	0.16	-0.12	-0.11	-0.12	0.06	-0.13	0.09	0.19
UK8	NORTH WEST (UK)	46	1.3	0.19	0.17	-0.06	-0.11	-0.21	-0.04	-0.22	0.23	-0.26	-0.06	0.04
UK9	WALES	22	0.6	0.53	-0.02	0.08	0.03	-0.15	0.14	-0.16	0.13	0.02	0.32	0.29
UK10	SCOTLAND	21	0.6	-1.00	0.02	-0.09	0.11	-0.14	0.15	-0.15	-0.14	-0.37	0.07	-0.17
UK11	NORTHERN IRELAND	8	0.2	-1.00	-0.04	-0.06	0.19	-0.22	0.11	-0.23	0.66	0.13	-1.00	-1.00