THE SPECIALISATION IN KIBS ACROSS EUROPEAN REGIONS:

DOES GEOGRAPHICAL PROXIMITY STILL MATTER?

Abstract: Further efforts are needed to extend our knowledge on the spatial research dimension of KIBS. The question of whether geographical proximity remains a key determinant of KIBS localisation patterns is approached. Given the recent increase in the possibilities of long-distance interaction, we primarily test whether the accessibility of regions turns into a crucial factor that considerably reinforces the regional specialisation in KIBS. The analysis embraces 230 NUTS-2 regions from 18 European countries for the period 2000–2007. We perform 2SLS estimations with spatial lags of the endogenous variables as regards of SAR models. We acknowledge a further step in the analysis of the between these activities and their spatial distribution, KIBS increasingly localising in more-hinterland European areas. Finally, the results also underline the reinforcement of the role of the nodes of transport and communication networks as a key determinant for KIBS attraction.

Key words: Knowledge-Intensive Business Services (KIBS); Specialisation; Geographical proximity; Region; Europe.

JEL codes: R12, R30, R58, O52.

1. Introduction

The New Economic Geography[1] has drawn attention to the issues of productive specialisation of regions and agglomeration processes within regional economies. A broad number of studies have stressed on the role of knowledge-intensive business services (KIBS) in encouraging innovation and growth processes of regions (COOKE and LEYDERSDORFF, 2006; CZARNITZKI and SPIELKAMP, 2003). As intermediate providers of knowledge-intensive services, the local presence of KIBS is frequently maintained to be important for the long-term competitiveness of regional industry (ANDERSSON and HELLERSTEDT, 2009; BAILY et al., 1987; BEYERS, 2005; HARRINGTON and DANIELS, 2006; ILLERIS and PHILLIPHE, 1993). Accordingly, they have recently attained notable attention within the academic and economic-policy debate.

A key focus of their attention regards the uneven spatial development that seems to be reinforced by the spatial agglomeration of these services toward the top of the urban hierarchy (ASLESEN and ISAKSEN, 2004; SHEARMUR and DOLOREUX, 2008). The acknowledgement of the tendency and propensity of KIBS to localise in large urban areas constitutes the key reason for the increasing interest of specialised literature in these activities, and the first step in the analysis of the relationships between these activities and their spatial distribution (WOOD et al., 1993).

The spatial research dimension has been, compared to other conceptual fields (i.e., knowledge and innovation), under-explored in the current literature (MULLER and DOLOREUX, 2007; WOOD, 2002) and there seems not to be a common agreement about which possible elements produce an influence in KIBS employment at a regional level (SHEARMUR et al., 2007). Most existent evidence is limited to certain European Union (EU) regions or countries (BRYSON et al., 2004). In this context, disentangling the factors that drive the increasing KIBS

1 For a revision, see: FUJITA and KRUGMAN (2004).

specialisation at a regional level is therefore of great importance to shed light on the ongoing divergence of growth rates across regions in the EU and appropriately target industrial and innovation policy at the sub-national level (MELICIANI and SAVONA, 2011).

Accordingly, the paper seeks to provide a contribution to this debate, bridging the gap of under-exploration of this particular research domain, while enlarging the spatial scope and the temporal scale. Our analysis embraces 230 regions from 18 European countries for the period 2000–2007. What factors are behind the patterns of regional specialisation in KIBS at regional level? In relation to this matter, some academics have recently argued that, given the increase in the possibilities of long-distance interaction, the role of nodes of transport and communication networks is reinforced as a key factor of agglomeration even for activities where physical interaction plays a key role (i.e., TORRE and RALLET, 2005). To this respect, our main research question more concretely turns into: Does geographical proximity between economic actors still matter? If so, does it imply that economic actors need to be co-located? We mainly test this by introducing into the analysis a regional accessibility indicator, which measures the minimum travel time to reach one region from any other one. The econometric approach is based on 2SLS estimations with spatial lags of the endogenous variables as regards of SAR models.

The analysis is built on seven sections. After the current introduction, the second section raises the theoretical framework of the analysis. The third section presents the data used. Section 4 provides a descriptive picture of KIBS specialisation across the EU regions. The methodological techniques are introduced in Section 5. In the sixth section we present the results. Finally, the work concludes with a number of closing remarks.

2. Theoretical discussion

2.1 KIBS

The term knowledge-intensity refers to an exceptional and valuable stock of expertise (STARBUCK, 1992). It is the process of accumulation of knowledge within a particular economic agent, may result from various sources –such as the need to work in particularly complex social or technical environments (MILES et al., 1995), and may be explained by the pattern of research and development (R&D), personnel skills and new equipment intensity developed in an organisation (HAUKNES and ANTONELLI 1999). Knowledge-intensive organisations, we identify, refer to economic agents who are specialised in transferring, exchanging and/or selling knowledge onto the market, while continuously learning in networking.

Accordingly, much of the attention conferred by literature to KIBS focused on the institutional formation of an actual market for knowledge and the innovative influence KIBS may have on their clients. A number of definitions have emerged throughout the last decade to approach the KIBS term. These definitions are complementary in nature since all of them stress their high proportion of expert labour, their contribution to knowledge formation processes, and their potential facilitation of innovative changes as co-producers of innovation. KIBS firms represent organisations that rely heavily upon professional knowledge (MILES et al., 1995) or expertise relating to a specific technical or functional domain (WINDRUM and TOMLINSON, 1999), to supply intermediate services that are knowledge-based (DEN HERTOG, 2000), in which the core of the service is contributing to knowledge formation processes (TOIVONEN, 2004) or placing capabilities for processing information and knowledge at the disposition of their clients (GALLOUJ, 2002).

Therefore, KIBS primary value-added activities consist of the accumulation, transformation, creation and dissemination of knowledge (BETTENCOURT et al., 2002). Their specialisation in the knowledge field constitutes the specific mode of production adopted by them (ANTONELLI, 1999; WINDRUM and TOMLINSON, 1999), which contributes to fostering their client's knowledge base (BETTENCOURT et al., 2002; DEN HERTOG, 2000; MULLER and ZENKER, 2001; STRAMBACH, 2008; WOOD, 2002) and to facilitating the introduction of innovative changes within their clients operations (COOKE and LEYDESDORFF, 2006; WOOD et al., 1993). Consequently, KIBS may act as users, originators and transfer agents of innovations, playing a major role in creating, gathering and diffusing organisational, institutional and social knowledge and generating positive externalities through the transfer and creation of useful innovations for the rest of the economic agents (DEN HERTOG, 2002; MILES et al., 1995).

2.2 Research hypotheses

The provision of KIBS is thought to much rely on strong supplier-customer interactions (MILES, 2005) and it is said that there is a local character of such relationships (WOOD, 2002). Given the particular tacit nature of the inputs they provide, it is argued that inter-regional trade in KIBS is not possible in the majority of cases because of the need to establish face-to-face contacts in order to exchange knowledge. The face-to-face transmission of knowledge crucially requires geographical proximity amongst economic actors and, thus, influences KIBS localisation patterns (HOWELLS, 2002).

KIBS particular reliance upon knowledge makes them also to agglomerate in large urban areas (SHEARMUR and DOLOREUX, 2008; WERNERHEIM and SHARPE, 2003), as they benefit from the existence of various positive externalities (KARLSSON et al., 2009). The spatial organisation of KIBS follows the logic of economic externalities offered by top-tier urban agglomerations integrated in wide-area networks (MOULAERT and DJELLAL, 1995). ANTONIETTI and CANIELLI (2008) recently emphasised the role of agglomeration externalities in affecting the decision to relocate knowledge-intensive activities on a domestic or local scale, where geographic proximity, knowledge spillovers and closer interaction among agents make it easier for firms to manage complex transactions and to increase their competitiveness even in the face of the increasing globalisation of production. In this respect, large urban areas are important in their own right to the extent that:

1. KIBS are sensitive to spatial agglomerations, which remain important for their success and competitiveness (AUDRETSCH, 1998; SCOTT, 1988);
2. KIBS benefit from proximity to sources of information (PORTER, 1990) and to knowledge spillovers (HENDERSON, 2000; KRUGMAN, 1991) that would be more difficult to attain in more-hinterland areas (DREJER and VINDING, 2003; FELDMAN, 1999);
3. KIBS get access to a labour force with good competences and skills (COFFEY and SHEARMUR, 1997) and major expertise, which has been traditionally associated with the development of advanced services (ILLERIS, 1996). As a matter of fact, the connection between the knowledge base of human capital, through the quality of human resources and their level of capabilities and qualifications (COFFEY and SHEARMUR, 2002), and the regional economic structure is considered of major relevance (GLAESER et al., 1995; MATTHIESSEN et al., 2002);
4. Most KIBS clients –other knowledge-intensive industries (FRANCOIS and WOERZ, 2007) in particular– also localise there (SHEARMUR and DOLOREUX, 2008). KIBS localise in high-density areas near customers (GLAESER and KOHLHASE, 2004; KEEBLE and NACHUM, 2002), which favour firms' access to the market to undertake the necessary exchanges (DURANTON and PUGA, 2002; 2005; KRUGMAN, 1991; PUGA, 1998). To this respect, GUERRIERI and MELICIANI (2005) found that a number of knowledge-intensive manufacturing activities (namely, office and computing machinery, professional goods, electrical apparatus and radio, TV and communication equipment, and chemicals and drugs industries) are the main demanding economic agents of advanced services.

Accordingly, we expect that regional specialisation in KIBS to be positively and considerably supported by:

1. The regional urbanisation state;
2. KIBS immediacy to knowledge spillovers;
3. KIBS availability of a highly skilled labour force;
4. KIBS closeness to key customers.

However, according to TORRE and RALLET (2005), geographical proximity implies less and less that firms agglomerate or are necessarily localised near each other. These authors review the concept of proximity and relativise the implicit postulate underlying that the search for geographical proximity is presently a crucial factor of localisation patterns of firms. They state that the professional mobility of individuals has increased with the development of transports and the technological revolution in telecommunications. On the one hand, TORRE and RALLET (2005) underline how the rapid diffusion of information and communication technologies (ICT) contributes to increasing the potential of long-distance interaction and makes the long-distance sharing or co-producing of tacit knowledge possible thanks to the technological evolution of computer sciences which offer possibilities such as informal or visual communication or written communication that has become close to oral communication.

On the other, TORRE and RALLET (2005) suggest that the increase in mobility multiplies the possibilities of long-distance interaction as it provides a way of maintaining face-to-face relationships even between actors who are localised in geographically distant areas. As a result, permanent co-localisation is not necessary even for activities such as KIBS, which much rely on physical interaction. In this case, KIBS would agglomerate geographically because of their access to infrastructures (airport, high-speed railway station, highways, etc.). According to SIMMIE (2002), long-distance face-to-face communication and knowledge exchange are considerably facilitated by international hub airports. Thus, large urban areas would function like hubs paradoxically making long-distance access easier than local access.

All in all, regional accessibility is a relevant criterion followed by advanced services when localising in a certain area (MARSHALL and WOOD, 1995; VICKERMAN, 1996), thinking of the accessibility concept as the potential of opportunities for interaction between economic agents (BRUINSMA and RIETVELD, 1998) or to access to wider international markets (SASSEN, 2001), as an important number of KIBS undertake their external relationships beyond the local context (BRYSON and RUSTEN, 2005). Therefore, our core research hypothesis proposes that the role of the nodes of transport and communication networks is increasingly reinforced to be considered a key factor of agglomeration. We expect regional specialisation in KIBS to be positively and significantly influenced by the regional transport accessibility. Before turning to this question, the following section describes the data used in the analysis.

3. Data

Although there is no standard approach and accepted definition of KIBS (WOOD 2002), there is a fairly wide consensus on the inclusion of the following service categories in KIBS (TOIVONEN, 2004): computer and related activities; R&D services; legal, financial and management consultancy; advertising and marketing services; and technical services. However, when conceptual classifications are applied in practice, problems arise in the use of statistics. Statistical categories and conceptual distinctions are difficult to trace exactly. In this respect, our empirical investigation has been influenced by present conceptualisations, but also by the available data. Accordingly, the characterisation of KIBS used throughout the analysis is based on the Eurostat statistical sorting and strictly relates to the NACE[2] classification, which is of common use in Europe.

In order to cover the broad spectrum of KIBS, as considered above, but also to make the sample as accurate as possible, the latter is restricted to include NACE codes: computer and related activities (NACE-72), research and development (73) and other business activities (74). The inclusion of the aggregate sector 'other business activities' leads us to account for a number of business services such as labour recruitment (74.5), investigation activities (74.6), industrial cleaning (74.7) and other miscellaneous business activities (74.8), such as industrial design, which are not clearly identified as KIBS. However, this study limitation cannot be fully evoked, as some previous works (e.g., MILES et al., 1995; OECD, 1999) suggest them to be regarded within the KIBS category. Finally, the analysis follows the institutional approach (GALLOUJ, 2002); that is, the observations in the sample regard organisations, instead of intra-firm knowledge-intensive activities as tracked in the functional approach. The data used in the analysis aims to cover information for 230 regions from 18 European countries (see Table A1 in the Appendix) at NUTS-2[3] level.

Dependent variable

We calculate the regional specialisation in KIBS for any of the European NUTS-2 regions that we include in the analysis. In doing so, we apply the Localisation Quotient (LQ) technique, as it is one of the most commonly utilised economic base analysis methods. The resulted ratios indicate whether or not a certain regional economy has a greater share of KIBS activity than expected when compared with a

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2 *Nomenclature des Activités économiques dans la Communauté Européenne*; Available at: http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_CLS_DLD&StrNom=NACE_1_1&StrLanguageCode=EN&StrLayoutCode=EN#

3 The term NUTS (Nomenclatura Unité Territorial Statistique) refers to the official classification of regions adopted by the European Union.

reference economy. The Eurostat REGIO database provides information on the number of persons employed in KIBS (*KEMP*) and the total employment (*TEMP*) at both regional (*REG*) and European (*EU*) levels. The equation (1) below is applied, where *i* and *t* are the region and the time respectively:

$$LQ_{it} = \frac{REGKEMP_{it} / REGTEMP_{it}}{EUKEMP_{t} / EUTEMP_{t}} \qquad (1).$$

Therefore, a *LQ* ratio that is equal to 1 means that the NUTS-2 region under consideration has the same percentage of employment in KIBS as the total European reference area does. *LQ* ratios which are below or above the value 1 indicate that the regional employment in KIBS is, respectively, less or greater than expected in comparison to the reference level. The resulting values are discussed in Section 4.1.

Independent variables

The evidence presented in Section 2 allows us to introduce a set of determinants, which typically influence the regional specialisation in KIBS. These determinants are identified as follows: urbanisation, knowledge spillovers, human capital, intermediate demand, and accessibility factors. Each of these factors is associated with different potential explanatory variables, as presented in Table 1. For any of these variables, the availability of data through time is indicated.

Table 1: **Factors associated to regional specialisation in KIBS**

N	*Factors*	*Variables*	*Code*	*Time*
1	*Urbanisation*	Population density	POP	2000-2007
2	*Knowledge spillovers*	Total R&D expenditure	R&D	2000-2007
3	*Human capital*	Population in science and technology	S&T	2000-2007
4	*Intermediate demand*	Employment in knowledge-intensive manufacturing	MAN	2000-2007
5	*Transport accessibility*	Travel effort to reach a region	TRT	2001/2006
6	*ICT accessibility*	Population with access to the Internet	ICT	2008

KIBS are said to cluster in regions with large urban areas. We approach the urbanisation factor by accounting for a population density indicator –following those considerations exposed by CICCONE (2002)– which specifies the share of population over the regional area (in square kilometres). KIBS are also said to tend to cluster in order to benefit from knowledge spillovers that would be more difficult to attain in more-hinterland areas. Accordingly, the knowledge spillovers factor is approached by the share of total R&D expenditure over the GDP of regions. The regional setting of skilled human capital is another key attribute that influences KIBS agglomeration within a particular area. We measure this determinant by the educational profiles of individuals in any given year, through the share of population who have successfully completed a tertiary level education. Moreover, the localisation of KIBS is thought to be influenced by the closeness to their clients as it facilitates the transfer of tacit knowledge. Since other knowledge-intensive activities have been underlined in Section 2.2 as the most important users of KIBS, a demand factor is approached by the share of employment in high-technology manufacturing industries over the total employment of the region. The referred sectors include: manufacture of pharmaceuticals, medicinal chemicals and botanical products (NACE-24.4); manufacture of office machinery and computers (30); manufacture of radio, television and communication equipment and apparatus (32);

manufacture of medical, precision and optical instruments, watches and clocks (33); and manufacture of aircraft and spacecraft (35.3).

We also introduce two proxy indicators of the regional transport and ICT accessibility. Data on transport accessibility is taken from European Spatial Planning Observation Network (ESPON), whose indicator measures the minimum travel time (effort) to reach one region from any other European region.[4] The potential accessibility of a particular region is calculated by summing up the population in all other European regions, weighted by the travel time to go there. It is calculated for rail, road and air transport modes separately. In order to detect the overall effect of transport accessibility on the regional specialisation in KIBS, we use a multimodal accessibility indicator which combines the three previously mentioned accessibility modes. The absolute levels for each region refer to standardised values with the EU average (EU-27=100). Since available data refers to NUTS-3 areas, we calculate a new weighted index for the whole set of NUTS-2 regions, which takes the value of the GDP per capita of the NUTS-3 areas as the weight to aggregate. Lastly, since there is no data on expenditure in ICT at the regional level, we approach the ICT accessibility factor by the regional share of individuals regularly having access to the Internet. It is based on Eurostat annual model surveys on ICT, which aims to collect and disseminate harmonised and comparable information on the use of ICT at European level. Data for this proxy indicator refers to year 2008 as regional information has been provided on a voluntary basis for previous years.

Finally, we also construct a control variable (CAP), by means of a dummy indicator, which takes the value of 1 when the observation refers to a region where a capital city is localised, and 0 otherwise. We expect this variable to be positively related to the dependent variable.

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[4] Further information about the measuring of potential transport accessibility is available at: www.espon.eu.

4. Preliminary analysis

4.1 Descriptives

Descriptive statistics on the maximum, minimum, mean values, standard deviations of the dependent and independent variables, and partial correlations between these variables are presented in Table A2 in the Appendix. Data refer to the year 2007. On average, the *LQ* index value is less than 1. Most European regions in the analysis present lower specialisation levels in KIBS than expected. Thus, in these regions, it is assumed that KIBS industry is not meeting the local demand. On the other hand, 30% of the total number of regions take *LQ* values greater than 1 and, thus, are assumed to be selling their knowledge-intensive services beyond their region boundaries.[5]

In accordance with the theoretical propositions as exposed in Section 2, most specialised regions in KIBS are characterised by including large urban areas. In particular, 4 out of the 5 most specialised regions include the capital cities of: London, Madrid, Brussels, Amsterdam and Paris (Table 2). Moreover, the evidence suggests the existence of a likely national component as the one suggested, among others, by ARMSTRONG (1995), BORRÁS-ALOMAR et al. (1994), CHESHIRE and CARBONARO (1995), DEWHURST and MUTIS-GAITAN (1995), RODÍGUEZ-POSE (1994, 1996) or QUAH (1996). Accordingly, those regions in a given country tend to present similar structural features. In this respect, regardless of the effect of the European capital-regions, any of the top-40 most specialised regions are found within four particular countries, namely the Netherlands, United Kingdom, Germany and Belgium. The national component is also depicted at the bottom of the ranking, with a predominance of regions from Eastern Europe.

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[5] The whole set of LQ ratio values for the 230 European NUTS-2 regions are available upon request.

Table 2: **Regional specialisation in KIBS, LQ levels, 2007**

Rank1	NUTS2	CODE	KIBS	72	73	74
1	London	UKI0	2.60	2.54	1.91	2.62
2	Comunidad de Madrid	ES30	2.54	2.95	0.55	2.53
3	Région de Bruxelles-Capitale	BE10	2.38	1.87	1.02	2.49
4	Utrecht	NL31	2.27	4.20	2.61	1.98
5	Noord-Holland	NL32	2.20	1.64	2.31	2.28
6	Berkshire, Buckinghamshire and Oxfordshire	UKJ1	2.16	4.36	6.22	1.76
7	Flevoland	NL23	2.13	2.39	5.35	2.03
8	Île de France	FR10	2.02	3.01	1.85	1.88
9	Zuid-Holland	NL33	2.00	1.42	2.71	2.06
10	Noord-Brabant	NL41	1.96	1.28	2.90	2.04
…	…	…	…	…	…	…
221	Sud-Est	RO22	0.27	0.16	0.44	0.28
222	Sterea Ellada	GR24	0.26	0.05	0.11	0.29
223	Swietokrzyskie	PL33	0.26	0.17	0.02	0.27
224	Západné Slovensko	SK02	0.23	0.16	0.91	0.22
225	Stredné Slovensko	SK03	0.23	0.28	0.74	0.21
226	Peloponnisos	GR25	0.22	0.04	0.30	0.25
227	Lubelskie	PL31	0.21	0.19	0.05	0.22
228	Sud-Vest Oltenia	RO41	0.20	0.18	0.45	0.20
229	Sud - Muntenia	RO31	0.20	0.13	0.70	0.20
230	Nord-Est	RO21	0.15	0.15	0.28	0.15

Source: Based on Regio database, Eurostat.

After introducing this classification, we wondered whether the specialisation levels in KIBS of those regions ranked at the top of the list have increased the most since 2000. The respective growth rate values for the whole set of NUTS-2 areas are shown in Table 3. Among the regions that have increased more importantly their relative specialisation levels, we find six Romanian counties. This suggests a change in productive structures of European regions. In particular, the Romanian regions of Sud-Vest Oltenia, Sud-Muntenia and Sud-Est, which ranked at the bottom of Table 2, show a rate of change above 150% levels (Table 3). For some regions, there appears to be a catching-up process with regards to their relative specialisation levels in KIBS.

Nevertheless, as suggested by (BRYSON and RUSTEN, 2005), the different KIBS branches follow dissimilar responses to determined economic processes. This fact is sustained by the evidence displayed in Table 3. Accordingly, the levels of specialisation in R&D activities (NACE-73) in the six top-ranked Romanian regions diminished between 2000 and 2007. On the contrary, along the same period of time, a number of UK regions (Bedfordshire and Hertfordshire, Cornwall and Isles of Scilly, West Wales and The Valleys, and Essex), with negative overall growth rates in KIBS, have importantly increased their levels of specialisation in R&D activities.

Table 3: **Regional specialisation in KIBS, LQ growth rates, 2000-2007, %**

Rank2	NUTS2	CODE	KIBS	72	73	74
1	Centru	RO12	235.7	366.2	-59.1	273.7
2	Nord-Vest	RO11	230.7	423.4	-33.9	261.3
3	Sud-Vest Oltenia	RO41	205.2	568.5	-39.9	261.2
4	Vest	RO42	203.7	229.1	-23.6	240.5
5	Sud-Muntenia	RO31	183.6	243.2	-52.9	396.4
6	Sud-Est	RO22	150.7	316.6	-55.4	192.7
7	Norte	PT11	140.2	119.5	2,877.2	138.8
8	Centro	PT16	106.7	278.9	1,803.0	97.2
9	Bremen	DE50	105.6	168.2	530.0	94.9
10	Kassel	DE73	88.5	-36.9	4,246.5	95.3
…	…	…	…	…	…	…
222	Bedfordshire and Hertfordshire	UKH2	-37.0	-55,3	148.5	-34.5
223	La Rioja	ES23	-38.8	-52,6	-45.6	-38.9
224	Prov. Luxembourg	BE34	-39.2	-32,6	716.1	-41.7
225	Cornwall and Isles of Scilly	UKK3	-40.8	-36,9	288.4	-43.4
226	Cumbria	UKD1	-41.4	-33,4	-61.1	-42.0
227	Prov. Limburg	BE22	-41.4	7,1	-64.6	-44.6
228	Comunidad Foral de Navarra	ES22	-42.3	33,6	14.1	-46.0
229	Principado de Asturias	ES12	-42.8	-20,0	-43.3	-44.6
230	West Wales and The Valleys	UKL1	-43.7	-39,7	23.5	-45.2
230	Essex	UKH3	-55.2	-70,0	298.3	-53.7

Source: Based on Regio database, Eurostat.

4.2 Spatial correlation

In order to account for the existence of spatial correlation as regards of the regional localisation of KIBS, we specify the pattern of spatial interactions among regions as captured by the spatial weight matrix. Due to the fact that some regions might not share borders with any other region (as in the case of islands), we rely on a distance based matrix instead of a contiguity one. Following, among others, DALL'ERBA and LE GALLO (2007) and MELICIANI and SAVONA (2011), we use the great circle distance between regional centroids. In particular, each element of the spatial weight matrix is defined as follows:

$w_{ij} = 0$, if $i=j$;

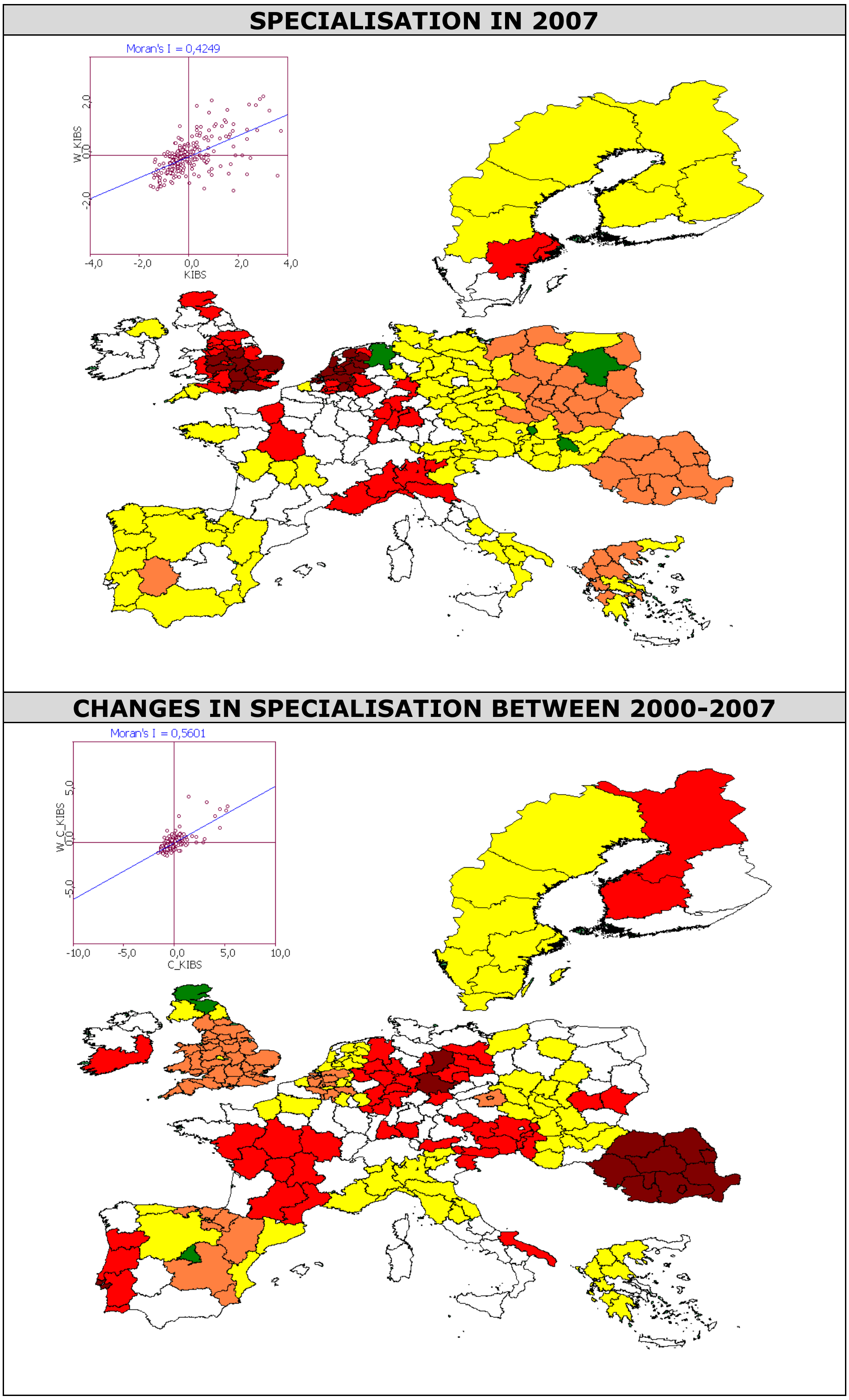
$w_{ij} = 1/(d_{ij}^{k})$, if $d_{ij} <= D$

$w_{ij} = 0$, if $d_{ij} > D$

where: w_{ij} is an element of the row standardised weight matrix W (with row standardisation spatially weighted variables representing an average across neighbouring regions); d_{ij} is the great circle distance between centroids of regions i and j; k defines the functional form; and D is the cut-off parameter above which spatial interactions are assumed to be negligible. When selecting the functional form and the cut-off distance we rely on a priori considerations on the scope of spatial spillovers in our sample and on comparisons of the overall explanatory power of the model (as measured by the R-squared and Log-likelihood). Since our regions are already large (NUTS-2), we choose the minimum bandwidth allowing each region to have at least one neighbour and we take the inverse of the distance. We test for robustness using larger distance bands and the inverse of the squared distance ($K=2$).

Spatial correlation, following authors such as ERTUR and KOCH (2006), is assessed by means of the Moran's I statistic, the Moran scatterplot and by the Moran Local Indicator of Spatial Association 'LISA' (ANSELIN, 1995; 1996). The first one gives a formal indication of the degree of linear association between the vector z_t of observed values and the vector W_{zt} of spatially weighted averages of neighbouring values, namely the spatially lagged vector. The Moran function attempts to illustrate the strength of spatial autocorrelation using a scatterplot of the relation between a variable vector (measured in deviations from the mean) and the spatial lag of this variable. Statistical inference is based on the permutation approach with 10,000 permutations (ANSELIN, 1995). This indicator helps to assess whether there are local spatial clusters of high or low values. All statistics are computed for the year 2007.

Figure 1: **Moran scatterplot and cluster map for specialization in KIBS**
(Global Moran's index in the scatter; LISA significance in the map)



Note: Brown-marked regions illustrate high-high correlations (at 1%); red-marked regions illustrate high-high correlations (at 5%); yellow-marked regions illustrate low-low correlations (at 5%); orange-marked regions illustrate low-low correlations (at 1%); green-marked illustrate low-high correlations (at 1%). Finally, white-marked regions illustrate no significant correlations.

Figure 1 shows the global Moran's scatterplot and reports the associated local Moran's coefficient (LISA) based on the distance matrix. These indicators allow us to evaluate whether the spatial pattern of the variations is clustered, dispersed, or random. Given the likely catching-up process suggested in Section 4.1, they have been univariately estimated for both KIBS *LQ* ratio in 2007 and its change between 2000 and 2007. Additionally, Figure 1 displays maps which easily summarise the information behind local Moran's coefficient. These maps show those regions highly specialised in KIBS nearest other highly specialised ones (in red) and similarly with those lowly specialised (in yellow).

The results reported in Figure 1 show positive and significant statistical values, confirming the spatial clustering of the specialisation patterns underlined in the preliminary descriptive analysis in Section 4.1. This is further corroborated in maps where the values of the local Moran's index are represented. Concretely, the degree of spatial correlation in the localisation of KIBS across Europe is high. In particular, the global Moran coefficient is 0.425 (significant at 1%). There appear to be important clustering effects with most regions localised in the upper right or bottom left quadrants (indicating positive spatial correlations of high and low values, respectively), while only a few regions are localised in the upper left or bottom right quadrants (indicating negative spatial correlation of low (high) KIBS regions surrounded by high (low) KIBS regions, respectively). The spatial interlinkages are even higher when changes in the specialisation patterns are analysed (with Moran value of 0.560 also significant at 1%).

As shown by the LISA statistics, clusters of high specialised regions in KIBS (see upper graph in Figure 1) include Central and South UK regions, the Netherlands and North Belgium regions, Northern Italy (surrounded by the French region of Provence-Alps-Cote d'Azur), some German regions such as Nordrhein-Westfalen, Baden Wurttemberg (surrounded by the French region of Alsace) and Bayern (surrounded by Western Austrian regions), and some capital regions, as, for instance, Stockholm or Paris. On the other hand, clusters of low specialised regions in KIBS mostly include Eastern regions (especially from Poland, Slovakia and Romania), Greece, Southern Italy, North Sweden and Finland, and an important number of Spanish and Portuguese geographical areas.

However, the picture radically evolves when changes in KIBS localisation are displayed (see bottom graph in Figure 1). Clusters of high growth since 2000 include: Portugal (Lisbon in particular), Southern Ireland, Northern Finland, Romania, Slovenia, Hungary, Central Germany, and Central and Southern France regions. Most of all these areas belongs to low specialised clusters, with only a few specialised regions, such as Paris or some German regions, also reaching high growths during the period analysed.

Furthermore, being the regional accessibility our main factor of interest, we test whether transport and ICT accessibility play a key role in spreading positive spillovers from specialised regions to surrounding ones. This may be corroborated when bivariate global and local Moran's indexes[6] are estimated. A significant positive correlation arises when transport accessibility (0.353) and ICT accessibility (0.402) are linked to KIBS localisation. Thus, the more accessible the regions are, the higher their relative productive specialisation in KIBS. In addition, the spatial correlation between changes in *LQ* ratios and in accessibility is positive but low (0.025). However, there are regions with a faster development in KIBS, such as Central and South Ireland, most Romanian and Polish regions, some Hungarian ones and certain Spanish (Murcia), Portuguese (Alentejo) and Greek (Sterea Ellada) geographical areas, where deeper improvements in accessibility have also been implemented (see Figures A1 and A2 in the Appendix for a cluster map with bivariate LISA estimations).

6 Local and global Moran coefficients and their significance levels for bivariate analyses are available upon request.

5. Econometric approach

5.1 The regional specialisation in KIBS

In a first stage, we estimate cross-section models that correspond to variants of equation (2). The dependent variable y_{ic}^{07} means a measure of the *LQ* ratio of KIBS in 2007 for region *i* in country *c*. The accessibility factor is approached by both the transport- (TRT) and the communication-related (ICT) variables. The matrix *Z* includes, on the one hand, other explanatory factors as displayed in our base model (see Table 1) and, on the other, the dummy variable *CAP*, which aims at capturing the effect of capital regions. E_{ic} is a stochastic residual that captures unexplained within-regions differences in KIBS specialisation and is assumed to be uncorrelated with the explanatory components. We test for robustness using contiguity matrixes, such as Rook and Queen, taking into account different contiguity levels (1 and 2). Results do not significantly differ from those presented in the paper.

$$y_{ic}^{07} = \alpha_c + \beta_1 TRT_{ic}^{07} + \beta_2 ICT_{ic}^{07} + \phi Z_{ic}^{07} + \varepsilon_{ic} \qquad (2)$$

Due to the existence of spatial correlation in our dependent variable (y_{ic}^{07}), as argued in Section 4.2, the regional specialisation in KIBS is estimated following a spatial lag or Spatial Autoregressive (SAR) model (ANSELIN, 1988). It includes amongst the regressors not only those specified in equation (2), but also the spatial lagged dependent variable. Moran's I test for spatially auto-correlated residuals after Ordinary Least Squares (OLS) estimates seems to indicate that spatial autocorrelation remains. Additionally, robust Lagrange multiplier tests clearly discriminate where the spatial process is allocated, as a spatial lag of the endogenous variable. In this context, our models can be represented as variants of equation (3):

$$y_{ic}^{07} = \alpha_c + \rho W y_{ic}^{07} + \beta_1 TRT_{ic}^{07} + \beta_2 ICT_{ic}^{07} + \phi Z_{ic}^{07} + \varepsilon_{ic} \qquad (3)$$

where W is a non-negative spatial weights matrix with zeros on the diagonal that formalises the regional network structure, Wy_{ic}^{07} represents the spatial lagged LQ ratio of KIBS, and ρ is the spatial autoregressive parameter. Lagrange multiplier tests and their robust versions have been used to test the OLS versus the SAR model. We keep the latter for consistency reasons.

Moreover, the potential endogeneity of matrix Z raises the risk that OLS estimates of Φ are influenced by reverse causation matters and are upward biased. In order to test the existence of endogeneity in our model, we use a Hausman specification test that allows us to choose between the OLS estimation and an alternative Two-Stage Least-Squares (2SLS) estimation using instrumental variables. The HAUSMAN (1978) test is based on the idea that the covariance of an efficient estimator and its difference with respect to an inefficient estimator is zero. The statistic, under the null hypothesis of endogeneity of the regressors, is asymptotically distributed as a X^2 with as many degrees of freedom as non-exogenous regressors are present in the specification. In our case, the Hausman statistic is 7.24. Thus the null hypothesis cannot be rejected.

In order to perform the instrumental variables estimation, we use, following other papers on regional specialisation, a proxy for regional scale economies (ratio between employment and number of firms) (i.e., PALUZIÉ et al., 2001), and the total land area of the region (i.e., ARTIS et al., 2009; BRÜLHART and MATHYS, 2008; CICCONE, 2002), the centre of which is localised within each of our great distance circles. We use two instruments to enable the performing of over-identification tests as well, which indicate that endogeneity is a problem as regards of the year 2007. We therefore deal with this issue by performing 2SLS estimations.

5.2 Changes in the regional specialisation in KIBS

Nevertheless, through the descriptive analysis in Section 4 we have underlined recent changes in the regional specialisation in KIBS in Europe between 2000 and 2007. For this reason, in a second stage, changes in the localisation patterns observed among European regions will econometrically analysed relating growth in the *LQ* ratio of KIBS ($l\_y_{ic}^{00-07}$) to changes in relative accessibility[7] and in the rest of the explanatory factors (urbanisation, R&D spillovers, human capital, and intermediate demand); the latter are defined as matrix $l\_Z_{ic}^{00-07}$ in equation (4). All variables are in logarithms. Additionally, the initial regional specialisation in KIBS (y_{ic}^{2000}) is included in order to capture a likely 'catching-up' effect. Again, η_{ic} is a random error term assumed to be uncorrelated with the explanatory components.

$$l\_y_{ic}^{00-07} = \alpha_c + \gamma_1 l\_TRT_{ic}^{00-07} + \psi l\_Z_{ic}^{00-07} + \zeta y_{ic}^{2000} + \eta_{ic} \quad (4)$$

Again, given the existence of spatial correlation in our dependent variable ($l\_y_{ic}^{00-07}$) and reversal causality matters, we undertake 2SLS estimations to a spatial lag or spatial autoregressive (SAR) model, as identified in equation (5):

$$l\_y_{ic}^{00-07} = \alpha_c + \rho W l\_y_{ic}^{00-07} + \gamma_1 l\_TRT_{ic}^{00-07} + \psi l\_Z_{ic}^{00-07} + \zeta y_{ic}^{2000} + \eta_{ic} \quad (5)$$

6. The econometric results

The results for the 2SLS estimation of equation (3) with a spatial lag of the endogenous variable are displayed in Table 4. Coefficients with their asymptotic *t*-values are reported. Sargan statistics for mutual consistency of the available

[7] The accessibility measure is to be restricted to transport accessibility ($l\_TRT_{ic}^{00-07}$). The ICT accessibility variable has dropped from the model since there is no available data for this component previous to the year 2008.

instruments are provided, and we cannot reject the null hypothesis of an under-identification of instruments in the model. Pagan-Hall tests are also provided, and the null hypothesis of homoskedasticity in the instrumental variables estimations cannot be rejected, so Generalized Method of Moment (GMM) estimators are not applied. A Moran's I test for 2SLS residuals proposed by ANSELIN and KELEJIAN (1997) is performed, since the usual Moran's I based on OLS residuals is not appropriate. Finally, robust standard errors are reported. In this respect, it is worth remarking that the results are quite robust to specifications in which variables with non-significant coefficients were removed from the list of regressors. Coefficient estimates experienced only minor changes.

Table 4: **Specialization in KIBS** (Dependent variable: LQ y_{ic}^{07})

	Total KIBS	**NACE 72**	**NACE 73**	**NACE 74**
KIBS specialization in neighbour regions (WY)	0.40433*** (0.0601)	0.36858*** (0.0668)	0.25788*** (0.0762)	0.41907*** (0.0599)
TRT	0.00282*** (0.0008)	0.0332*** (0.0012)	0.00211*** (0.0022)	0.00272*** (0.0007)
ICT	0.00159** (0.0110)	0.00143 (0.0629)	0.00052* (0.0429)	0.00161* (0.0350)
POP	$8.085e^{-5}$** ($3.44e^{-5}$)	$3.981e^{-5}$** ($5.14e^{-5}$)	$1.028e^{-5}$** ($1.44e^{-5}$)	$1.001e^{-5}$*** ($2.99e^{-5}$)
S&T	0.01013*** (0.0038)	0.01325** (0.0061)	0.02870** (0.0115)	0.00927*** (0.0033)
MAN	0.00250** (0.0041)	0.01108*** (0.1456)	0.018846*** (0.0211)	0.00118 (0.0066)
R&D	0.02437* (0.0044)	0.10911*** (0.0309)	0.25729*** (0.0579)	0.00828 (0.0170)
CAP	0.55500*** (0.0848)	1.01620*** (0.1346)	0.45923* (0.2519)	0.49357*** (0.0756)
Observations	230	230	230	230
Adjusted R-squared	0.70	0.57	0.54	0.69
Log-likelihood	-136.91	-153.25	-302.77	-112.23
Moran's I statistic	0.060 (*0.813*)	0.011 (*0.914*)	0.043 (*0.382*)	0.012 (*0.911*)
Sargan statistic	0.934 (*0.618*)	0.625 (*0.451*)	0.838 (*0.657*)	0.544 (*0.785*)
Pagan-Hall statistic	19.120 (*0.542*)	15.124 (*0.423*)	21.211 (*0.515*)	19.872 (*0.598*)

Note: 2SLS estimates with several levels of significance: 1%***, 5%**, 10%*. Standard errors are presented in parenthesis below each associated parameter.

The results displayed in Table 4 show that a substantial part of the variation in KIBS specialisation across European regions can be explained by the model (adjusted *R*-squared around 70%). All the coefficients have the expected (positive) signs and are significant with no exceptions. The dummy for regions with capital cities is highly and positively related to regional specialisation in KIBS. Urbanisation, knowledge spillovers, human capital and intermediate demand factors also display positive significant coefficients. Transport and ICT accessibility measures are both relevant and have a positive influence, although the former has a slightly higher effect on the presence of KIBS at regional level. We can also notice that the externalities arising from neighbouring regions –summarised through the spatial lag of the dependent variable– matter. As previously announced, the highly significant positive coefficient of this regressor suggests the presence of clustering effects behind the determinants of KIBS specialisation.

Data reported in Table 4 also shows that the regression fit and significance of the explaining factors depends on the sort of KIBS subsector we analyse. Thus, the adjusted *R*-squared ranges from 0.54 for R&D services to 0.69 for other business services. Whereas transport accessibility has a higher influence on computer services, ICT accessibility is more relevant for other business services. The remaining factors display positive and significant statistical coefficients, the level of significance varying among categories. As regards of the spatially lagged dependent variable, the results show that clustering effects are higher in computer and other business services, while the lower coefficient is found in R&D services.

As previously underlined, some of the least specialised regions in KIBS in the year 2000 –such as some Eastern and Southern European regions– have reached dynamic growth rates during the past decade. On the other hand, although some capital regions and metropolitan centres have maintained their dominant role in Europe, some other highly specialised regions –including some British, German and Dutch ones– have slightly decreased their specialisation patterns during this period. Given the changing behaviours that have arisen from the data, Table 5 displays the

2SLS estimation results for equation (5) in terms of specialisation changes within the temporal framework 2000-2007. Different regressions for each KIBS subsector are also reported, as well as significant tests and statistics in order to validate the fit and robustness of the model.

Again, Sargan statistics for mutual consistency of the available instruments are provided, and we cannot reject the null hypothesis of an under-identification of instruments in the model. Pagan-Hall tests are provided as well, and the null hypothesis of homoskedasticity in the instrumental variables estimations cannot be rejected. Each test presents its p-value in parenthesis. A Moran's I test for 2SLS residuals proposed by ANSELIN and KELEJIAN (1997) is performed, since the usual Moran's I based on OLS residuals is not appropriate.

Table 5: **Changing specialisation in KIBS**
(Dependent variable: LQ growth $l\_y_{ic}^{00-07}$)

	Total KIBS	**NACE-72**	**NACE-73**	**NACE-74**
KIBS specialisation in neighbour regions (WY)	0.443^{***} (0.057)	0.511^{***} (0.059)	0.149^{**} (0.084)	0.540^{***} (0.057)
TRT	0.082^{***} (0.054)	0.160^{*} (0.093)	0.361^{**} (0.672)	0.066^{**} (0.063)
Initial specialization level (*catching-up*)	-0.006^{***} (0.065)	-0.011^{***} (0.059)	-0.001^{**} (0.035)	-0.004^{***} (0.061)
POP	-1.114^{**} (0.550)	-2.360 (0.950)	-5.830 (0.670)	-1.030^{**} (0.639)
S&T	0.122^{**} (0.149)	0.131 (0.484)	0.283^{*} (0.613)	0.093 (0.507)
MAN	0.023^{**} (0.099)	0.049^{**} (0.179)	0.187^{*} (0.123)	0.017^{**} (0.119)
R&D	0.132^{***} (0.046)	0.189^{**} (0.050)	0.448 (0.058)	0.151^{***} (0.054)
CAP	0.354^{***} (0.586)	0.250^{***} (0.675)	0.315^{***} (0.702)	0.124^{***} (0.054)
Observations	230	230	230	230
Adjusted R-squared	0.38	0.42	0.21	0.44
Log-likelihood	-111.59	-217.52	-387.89	-125.22
Moran's I statistic	0.635 (*0.425*)	0.431 (*0.377*)	0.423 (*0.515*)	0.230 (*0.129*)
Sargan statistic	9.562 (*0.475*)	8.223 (*0.245*)	11.298 (*0.398*)	10.546 (*0.558*)
Pagan-Hall statistic	17.018 (*0.978*)	21.213 (*0.899*)	19.852 (*0.918*)	11.783 (*0.945*)

Note: 2SLS estimates with several levels of significance: 1%***, 5%**, 10%*. Standard errors are presented in parenthesis below each associated parameter.

The results indicate that increases in regional R&D investments, human capital qualifications, and intermediate demanding flows along time positively and significantly influence the increasing specialisation patterns in KIBS. More importantly, changes in regional accessibility matter when changes in KIBS specialisation are discussed. Thus, those regions which have become more accessible during recent years have also increased their levels of KIBS specialisation within their productive structure.

Spatial dependence also plays an important role. Neighbouring externalities and positive spillovers may support lagged regions to increase their KIBS activity. Additionally, the catching-up effect (approximate for the level of KIBS specialisation in 2000) is also statistically significant, with a negative coefficient, as predicted by the traditional theories. Those regions which started with higher *LQ* ratios have seen how their overall growth rates were below those which were further behind at the beginning 2000. Finally, the capital-city dummy has a significant and positive coefficient. However, the negative sign of the urbanisation factor coefficient suggests that, from the year 2000, the higher the growth of the regional population density, the less the level of regional specialisation in KIBS.

7. Discussion and final remarks

Most specialised European regions in KIBS are characterised by including large urban areas, be they either capital cities or other metropolitan centres. As expected, agglomeration economies do affect KIBS localisation strategies, so do the emerging agglomeration externalities. KIBS benefit from their immediacy to knowledge spillovers, availability of a highly skilled labour force, and closeness to their customers. Geographical proximity and close interaction among economic agents do matter, while the nodes of transport and communication networks are increasingly crucial for KIBS localisation decision making and play a key role in spreading positive spillovers to other neighbouring areas. The more accessible the regions are, the higher their relative productive specialisation in KIBS.

Nevertheless, the evidence presented suggests both a progressive change in productive structures of European regions and a catching-up process with regards to the regional relative specialisation levels in KIBS. As a matter of fact, between 2000 and 2007, a broad number of highly specialised regions in KIBS have decreased their relative specialisation levels. On the other hand, some of the least specialised regions in KIBS in the year 2000 have reached dynamic growth rates during the past decade. What is then driving these specialisation shifts along time? First, increases in intra-regional knowledge externalities –measured by regional R&D spillovers, the educational profiles of individuals and the high-technology nature of domestic intermediate demand– remain fundamental in raising the regional specialisation patterns in KIBS; second, improvements in accessibility of regions does matter when changes in KIBS regional specialisation are discussed; third, inter-region (neighbouring) externalities from highly-specialised areas support lagged regions' increases in their KIBS activity intensity.

Moreover, the results suggest that, from the year 2000, the higher the growth of the regional population density, the less the level of regional specialisation in KIBS. This fact suggests that KIBS are more and more prone to localise in areas where decreasing agglomeration economies are taking place. This is, for instance, the case of a broad number of Romanian peripheral regions. Thus, although agglomeration economies remain important for KIBS localisation strategies, it seems they are not fundamental any longer. Therefore, beyond KIBS tendency to agglomerate in large urban areas, we acknowledge a further step in the analysis of the between these activities and their spatial distribution, KIBS increasingly localising in more-hinterland European areas.

On the other hand, co-localisation remains necessary for KIBS, where face-to-face interactions play an important role in the coordination of activities. However, in accordance with the proximity school postulates, the geographical proximity concept should be more broadly understood. First, the rapid diffusion of ICT has created new ways of service provision over distance, relaxing the requirement of face-to face communication between KIBS and their clients, and favouring KIBS tradability. This is consistent with the current path of externalisation and outsourcing of specialised knowledge functions to different intra- and inter-national markets. However, these aspects should be further investigated, given the existent constrains to approach an appropriate ICT accessibility measure, in particular over time.

Second, the improvements in transport accessibility of regions are reducing the protection that distance offered to more-hinterland areas, thus relaxing the need for KIBS to settle near their clients. This suggests the reinforcement of the role of the nodes of transport networks as a key determinant for KIBS attraction. As discussed by TORRE AND RALLET (2005), rather than claiming that the phenomenon of agglomeration no longer has a reason for being, it is more relevant to analyse how the foundations of the agglomeration process itself are evolving. Regional transport infrastructure is then acting, as sustained by traditional theory (e.g., MARSHALL, 1920), as a channel for the generation of local agglomerations.

Finally, KIBS are increasingly considered fundamental to the development of regional innovation systems (FISHER et al., 2001) and to the boosting of regional economic growth of advanced economies. Given the recognition of KIBS in supporting regional growth processes, there is room for policy action. From a policy perspective, public initiatives may be addressed to influence regional attractiveness of KIBS by promoting knowledge externalities from a multi-factor and multi-agent perspective.

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Appendix:

Table A1. Regions in the analysis, NUTS-2 level

No.	Country	Regions
1	Austria	Burgenland, Niederösterreich, Wien, Kärnten, Steiermark, Oberösterreich, Salzburg, Tirol, Vorarlberg.
2	Belgium	Région de Bruxelles-Capitale, Prov. Antwerpen, Prov. Limburg, Prov. Oost-Vlaanderen, Prov. Vlaams-Brabant, Prov. West-Vlaanderen, Prov. Brabant Wallon, Prov. Hainaut, Prov. Liège, Prov. Luxembourg, Prov. Namur.
3	Czech Republic	Praha, Strední Cechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Strední Morava, Moravskoslezsko.
4	Germany	Stuttgart, Karlsruhe, Freiburg, Tübingen, Oberbayern, Niederbayern Oberpfalz, Oberfranken, Mittelfranken, Unterfranken, Schwaben, Berlin, Brandenburg-Nordost, Brandenburg-Südwest, Bremen, Hamburg, Darmstadt, Gießen, Kassel, Mecklenburg-Vorpommern, Braunschweig, Hannover, Lüneburg, Weser-Ems, Düsseldorf, Köln, Münster, Detmold, Arnsberg, Koblenz, Trier, Rheinhessen-Pfalz, Saarland, Chemnitz, Dresden, Leipzig, Sachsen-Anhalt, Schleswig-Holstein, Thüringen.
5	Spain	Galicia, Principado de Asturias, Cantabria, País Vasco, Comunidad Foral de Navarra, La Rioja, Aragón, Comunidad de Madrid, Castilla y León, Castilla-la Mancha, Extremadura, Cataluña, Comunidad Valenciana, Illes Balears, Andalucía, Región de Murcia
6	Finland	Itä-Suomi, Etelä-Suomi, Länsi-Suomi, Pohjois-Suomi
7	France	Île de France, Champagne-Ardenne, Picardie, Haute-Normandie, Centre, Basse-Normandie, Bourgogne, Nord - Pas-de-Calais, Lorraine, Alsace, Franche-Comté, Pays de la Loire, Bretagne, Poitou-Charentes, Aquitaine, Midi-Pyrénées, Limousin, Rhône-Alpes, Auvergne, Languedoc-Roussillon, Provence-Alpes-Côte d'Azur
8	Greece	Anatoliki Makedonia Thraki, Kentriki Makedonia, Thessalia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki
9	Hungary	Közép-Magyarország, Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország, Észak-Alföld, Dél-Alföld
10	Ireland	Border Midland and Western, Southern and Eastern
11	Italy	Piemonte, Liguria, Lombardia, Provincia Autonoma Bolzano, Provincia Autonoma Trento, Veneto, Friuli-Venezia Giulia, Emilia-Romagna, Toscana, Umbria, Marche, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, Sardegna
12	Netherlands	Groningen, Friesland, Drenthe, Overijssel, Gelderland, Flevoland, Utrecht, Noord-Holland, Zuid-Holland, Zeeland, Noord-Brabant, Limburg
13	Poland	Lódzkie, Mazowieckie, Malopolskie, Slaskie, Lubelskie, Podkarpackie, Swietokrzyskie, Podlaskie, Wielkopolskie, Zachodniopomorskie, Lubuskie, Dolnoslaskie, Opolskie, Kujawsko-Pomorskie, Warminsko-Mazurskie, Pomorskie
14	Portugal	Norte, Centro, Lisboa, Alentejo
15	Romania	Nord-Vest, Centru, Nord-Est, Sud-Est, Sud – Muntenia, Bucuresti – Ilfov, Sud-Vest Oltenia, Vest
16	Sweden	Stockholm, Östra Mellansverige, Småland med öarna, Sydsverige, Västsverige, Norra Mellansverige, Mellersta Norrland, Övre Norrland
17	Slovakia	Bratislavský kraj, Západné Slovensko, Stredné Slovensko, Východné Slovensko
18	United Kingdom	Tees Valley and Durham, Northumberland and Tyne and Wear, Cumbria, Cheshire, Greater Manchester, Lancashire, Merseyside, East Yorkshire and Northern Lincolnshire, North Yorkshire, South Yorkshire, West Yorkshire, Derbyshire and Nottinghamshire, Leicestershire Rutland and Northamptonshire, Lincolnshire, Herefordshire Worcestershire and Warwickshire, Shropshire and Staffordshire, West Midlands, East Anglia, Bedfordshire and Hertfordshire, Essex, London, Berkshire Buckinghamshire and Oxfordshire, Surrey East and West Sussex, Hampshire and Isle of Wight, Kent, Gloucestershire Wiltshire and Bristol/Bath area, Dorset and Somerset, Cornwall and Isles of Scilly, Devon, West Wales and The Valleys, East Wales, Eastern Scotland, South Western Scotland, Northern Ireland

Table A2. Descriptive statistics and partial correlation coefficients on dependent and independent variables

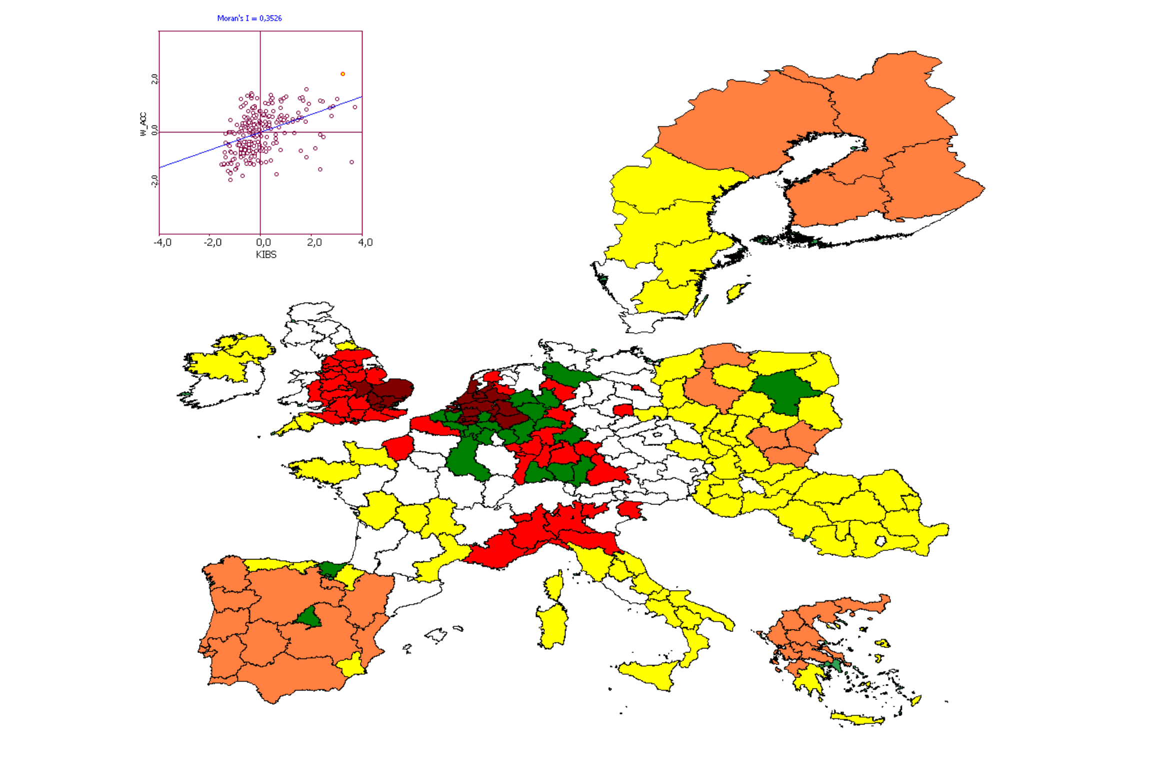
	Variable	N	Mean	Min.	Max.	Std. Deviation	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1.	KIBS	230	0.88	0.15	2.60	0.47	1										
2.	72	230	0.81	0.04	4.36	0.69	0.82 (0.00)	1									
3.	73	230	0.90	0.01	6.44	1.06	0.56 (0.00)	0.58 (0.00)	1								
4.	74	230	0.89	0.15	2.62	0.45	0.99 (0.00)	0.74 (0.00)	0.50 (0.00)	1							
5.	POP	230	350.75	3.30	6,458.70	728.48	0.54 (0.00)	0.38 (0.00)	0.21 (0.00)	0.55 (0.00)	1						
6.	S&T	230	18.92	6.00	38.90	6.61	0.57 (0.00)	0.50 (0.00)	0.44 (0.00)	0.55 (0.00)	0.28 (0.00)	1					
7.	MAN	230	1.18	0.07	5.22	0.88	0.01 (0.82)	0.07 (0.26)	0.06 (0.34)	0.00 (0.98)	-0.09 (0.15)	-0.07 (0.30)	1				
8.	R&D	230	1.49	0.09	7.51	1.19	0.41 (0.00)	0.48 (0.00)	0.47 (0.00)	0.37 (0.00)	0.14 (0.00)	0.49 (0.00)	0.30 (0.00)	1			
9.	TRT	230	99.89	30.18	201.10	35.66	0.66 (0.00)	0.51 (0.00)	0.37 (0.00)	0.66 (0.00)	0.52 (0.00)	0.43 (0.00)	0.20 (0.00)	0.45 (0.00)	1		
10.	ICT	230	58.25	22.00	92.00	16.42	0.57 (0.00)	0.47 (0.00)	0.40 (0.00)	0.56 (0.00)	0.22 (0.00)	0.59 (0.00)	0.23 (0.00)	0.51 (0.00)	0.59 (0.00)	1	
11.	CAP	230	0.08	0.00	1.00	0.27	0.48 (0.00)	0.48 (0.00)	0.22 (0.00)	0.46 (0.00)	0.51 (0.00)	0.32 (0.00)	-0.03 (0.63)	0.12 (0.06)	0.28 (0.00)	0.12 (0.07)	1

Note: p-values are in parenthesis.

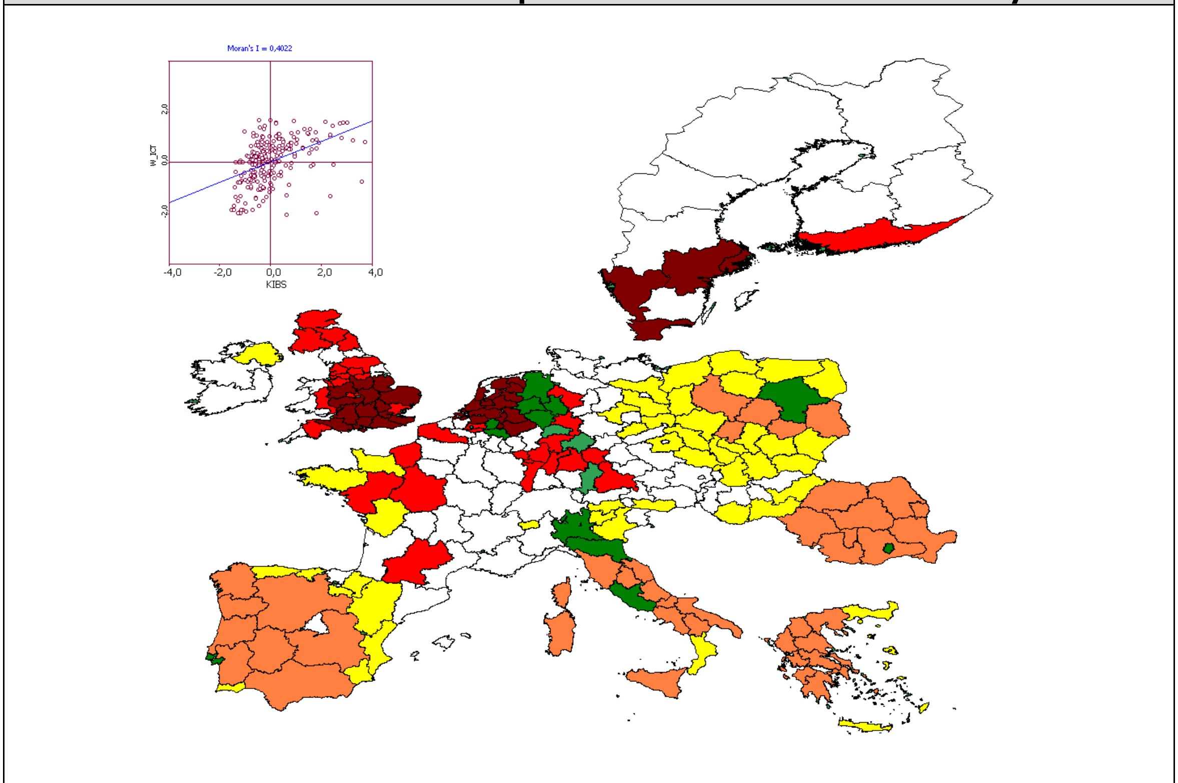
Figure A1: **Moran scatterplot and cluster map for spatial relationship between specialisation in KIBS and accessibility**

(Global Moran's index in the scatter; LISA significance in the map)

Bivariate results: KIBS specialisation and transport accessibility



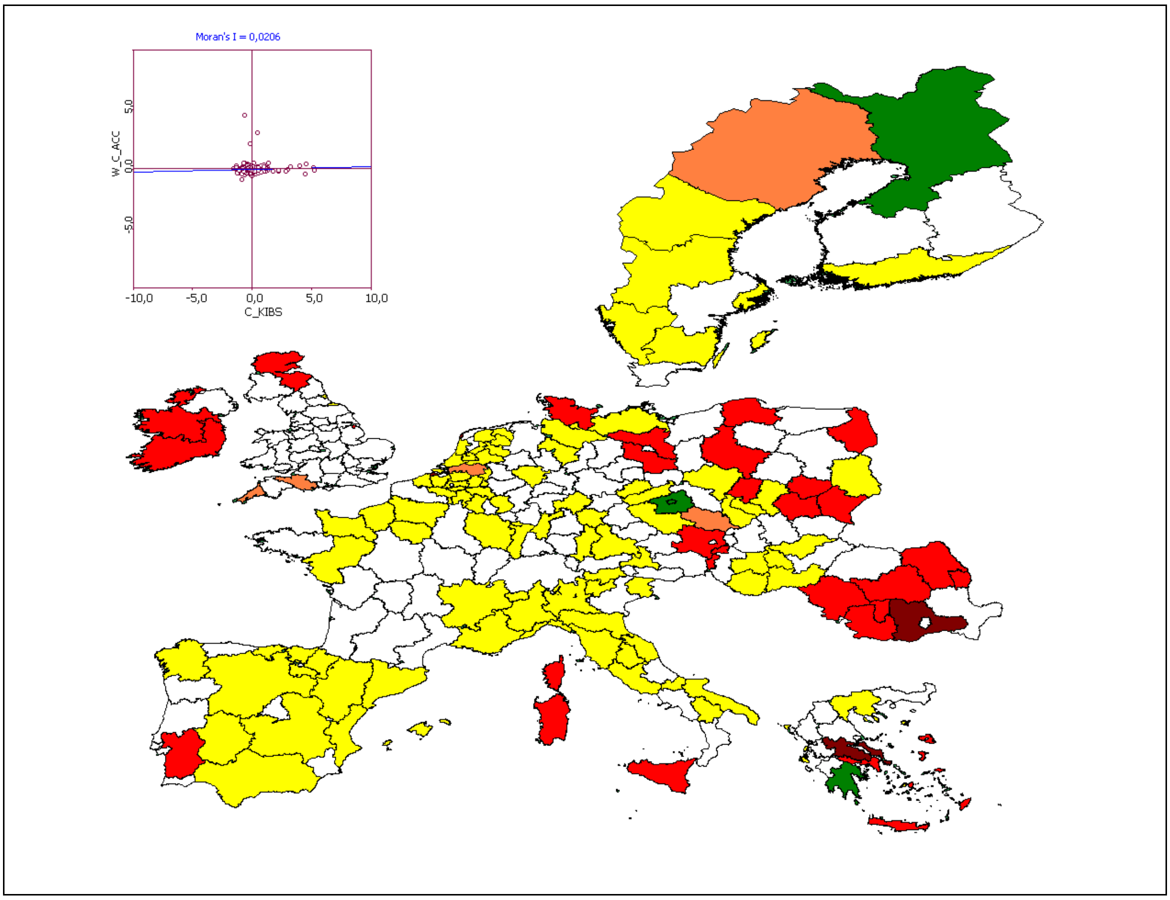
Bivariate results: KIBS specialisation and ICT accessibility



Note: Brown-marked regions illustrate high-high correlations (at 1%); red-marked regions illustrate high-high correlations (at 5%); yellow-marked regions illustrate low-low correlations (at 5%); orange-marked regions illustrate low-low correlations (at 1%); green-marked illustrate low-high correlations (at 1%). Finally, white-marked regions illustrate no significant correlations.

Figure A2: **Moran scatterplot and cluster map for spatial relationship between change in specialisation in KIBS and change in transport accessibility**

(Global Moran's index in the scatter; LISA significance in the map)



Note: Brown-marked regions illustrate high-high correlations (at 1%); red-marked regions illustrate high-high correlations (at 5%); yellow-marked regions illustrate low-low correlations (at 5%); orange-marked regions illustrate low-low correlations (at 1%); green-marked illustrate low-high correlations (at 1%). Finally, white-marked regions illustrate no significant correlations.