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Explaining the location of knowledge intensive services: a cross-Europe regional analysis

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ABSTRACT:

This paper focuses on explanatory factors conducting knowledge intensive services (KIS) location patterns at the regional level in Europe. Firstly, it explores empirically the unequal geographical distribution of these activities across European regions. Secondly, it analyzes through statistical and regression analysis the role that certain comprehensive components play in potentially determining KIS location. The results highlight the prominent position of the regional innovation framework and the economic performance conditions in terms of productivity and GDP per capita. The level of accessibility of the different regions included in the analysis is also a significant factor, though to a lesser extent. Furthermore, remarkable differences are shown across EU-15 regions and across different types of knowledge intensive service sectors.

KEYWORDS:

Knowledge intensive services; Economic geography; Industry concentration; Productive specialization; European Union

CLASIFICACIÓN JEL: L89; O18; R12; R15

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Introduction

The combination of the new international trade theory with traditional economic geography led Krugman (1991a, 1991b, 1998a, 1998b), among others, to develop and formulate the new economic geography[1] domain. This discipline recently discussed the issue of productive specialization of regions, business local concentration and agglomeration processes within economies and their particular role in economic development. Recent works regarding industrial specialization in Europe have concluded with different results on these issues. According to Combes and Overman (2003), such differences arise depending on the spatial and temporal scales, data bases and statistical instruments used in each case.

Various works developed to the analysis of industry spatial distribution in Europe indicate a significative process of industrial concentration and production differentiation among countries. In this respect, the analysis developed by Midelfart-Knarvik et al. (2000) indicates that from the early 1980s onwards the industrial structures of EU economies have become more dissimilar. The results obtained by Ezcurra el al. (2006) also reveal an increasing geographical concentration process in most industrial activities between 1977 and 1999. Other works with related results are those by Haaland et al. (1998) and Amiti (1999). In turn, more sectoral and territorial disaggregated analysis point out different outcomes. Hallet (2000) highlights a slight reduction in geographical specialization in aggregated terms among EU regions between 1980 and 1995. Molle (1996) also identifies a process of convergence in regional productive structures during last decades.

Several studies, that have traditionally emphasized manufacturing activities over services, have come out regarding regional specialization patterns in Europe. However, production and consumption have shifted away from physical objects towards information and services (Cameron 1998) within advanced economies, turning service sector into a key driver in the creation of competitiveness, employment and economic growth (Daniels 2004). Recently, a

[1] For a revision see Fujita and Krugman (2004).

particular group of activities within the heterogenic service sector attained notable attention on the basis of its particular relation to knowledge and information processes. The so-called knowledge intensive services, particularly those activities with an important technological base, are increasingly considered fundamental to the development of regional innovation systems (Fisher et al. 2001) and to the boosting of regional economic growth of advances economies.

Knowledge intensity may be approached by the pattern of R&D, personnel skills and new equipment intensity developed in an organization (Hauknes and Antonelli 1999). In other words, this is the process of application of knowledge within a particular economic agent. Knowledge intensity may result from various sources, such as the application of non-routine technology or the need to work in particularly complex social or technical environments (Miles et al. 1995). As key users, facilitators and diffusers of knowledge, KIS include many forms of technical, including computer, management consultancy, and diverse types of specialist such as marketing and advertising, staff recruitment and development, property acquisition and management, and trade promotion or distribution logistics (Wood 2002). Those KIS more related to technology are considered 'industry brains' that lead to increased competitive advantage and economic development of those organizations and regions with easy access to them. KIBS are major users, originators and transfer agents of technological and non-technological innovations, playing a major role in creating, gathering and diffusing organizational, institutional and social knowledge (Hauknes and Antonelli 1999). KIBS facilitate, adopt, transfer and generate useful innovation for the rest of the economic agents (den Hertog 2002).

With regard to the macroeconomic impacts in the economy, employment in knowledge intensive services (particularly business services) has more than tripled in OECD countries since the 1970s. These activities currently account for more than 30 per cent of total employment and added value generated in the European Union (EU25). The growth of KIS has been supported by the increasing participation of knowledge in most economic production

processes, the pace of technological change, a major inclusion of skilled workers, the introduction of new information and communication technologies (ICT), and the key role provided to intangible inputs in the generation of weightless output. This growth opened up new avenues for dissemination of knowledge and experience, what to a certain extent has affected the way clients manage change, and therefore, their competitiveness and innovativeness (Wood 2002).

The academic literature provides some explanation for this notable development on the basis of a changing demand perspective. On the one hand, the increasing complexity of organizational processes and the major global competitiveness among enterprises have lead to growing levels of KIS requirement, both by the manufacturing and by other service activities. Services related to knowledge management are considered as a means to enhance companies' dynamism and adaptation to change. On the other hand, different knowledge intensive functions previously carried out in-house by manufacturing and service organizations are presently externalized and outsourced to knowledge intensive service companies.

A particular reason for the increasing interest in knowledge services is the distinctive localization pattern of the sector, which is highly concentrated in large urban areas (Aslesen and Isaksen 2004), and its implications for regional economic growth. This has only been partially tested (Wood 2002), and the evidence is limited to the regional stage across European countries (Bryson et al. 2004). Grounds for this phenomenon are not evident as an important number of factors are involved and influence it. Significant previous works that dealt with the services location issue are those by Daniels (1985; 1993; and Moulaert 1991), Marshall et al. (1987), Illeris (1991; and Phillipe 1993), Bailly et al. (1987; 1992), Senn (1993), Moulaert and Gallouj (1993), Rubalcaba (1999) among others. More recent contributions are those by Bryson et al. (2004), Beyers (2005), Bryson and Rusten (2005) or Harrington and Daniels (2006). On the basis of the different outcomes extracted from these and other analogous works, we will provide new empirical evidence for the EU-15 case and will also attempt to explore and evaluate the

hypothesis that suggests the influence of major factors to explain geographical location of knowledge intensive services.

Then, this paper is an attempt to clarify recent trends in the distribution of KIS which have emerged during the last decade as key agents for sustaining local and regional competitiveness. The article is organized in three main sections. After this brief introduction, in section one, particular attention is paid to the definition of the variables and items used, and methodology approaches implemented are discussed. Section two analyzes descriptively (on the basis of database Regio from Eurostat) the concentration that KIS exhibit in Europe, at both national and regional levels. The third section presents a large number of likely explanatory variables that on the basis of previous literature may conduct such an industry concentration in Europe, and reduces these variables into a shorter set of components by means of exploratory multivariate techniques. Furthermore, this section three undertakes multivariate regression analyses and data panel modeling to evaluate the statistical significance of these factors in explaining KIS location patterns in Europe both at static and dynamic level. The paper ends with a summary of conclusions.

1 Data and methodology

This paper explores some major driving factors that may determine KIS concentration in Europe. Reasons behind this business location are not evident, as a notable range of potential factors influence it. For that reason, and given the complexity in discerning these likely components, we apply a statistical exploratory technique, by means of a principal component analysis (PCA). Secondly, regression analyses are developed to assess the particular condition of the different components, derived from the previous multivariate procedure, to explain KIS location in Europe. Finally, data panel modeling will be undertaken to compare previous static results with respect to a dynamic approach. Both multivariate static and dynamic data panel approaches are used to deep into the factors explaining KIS concentration in Europe.

The present research work will consider three types of disaggregated KIS sectors followed through the Eurostat database[2], as a means of exploring differences that arise among different types of these services sectors. Those sectors refer to: 1) High-technological services; 2) Financial activities; and 3) an important number of business services comprising consultancy and other professional services labeled as Market services. Available literature frequently deals with the terms 'knowledge intensive services' and 'producer services' as one and the same, although (depending on the approach assumed) the latter includes distributive trade and energy sectors, as well as other services used by enterprises such as traveling. Throughout this paper, the term KIS will mostly be used.

The statistical analysis is based on a range of ten variables from Eurostat-Regio database that present information for 205 EU-15 regions at NUTS2 level. In this respect, we will tackle the hypothesis that accessibility, innovation and productivity potentials influence KIS location patterns in different European regions. Criteria for variables selection are based on previous academic background on service activities location, and are explored in the following paragraphs:

- *Innovation related indicators.* Close spatial proximity or high business density promote information spillovers amongst producers and more efficiently functioning labor markets (Henderson 2000). The location of KIS in urban centers leads to better exchange, as they learn from information and ideas that are harder to find in hinterland regions. Proximity to sources of information leads advanced services to concentrate in knowledge intense environments (Porter 1990). The importance of the request and use of knowledge in conducting KIS regional concentration patterns is represented in the analysis through four different variables: 1) the R&D business expenditure as

2 High technological KIS: Postal services and telecommunications (NACE 64), Computing services (NACE 72), Research and development (NACE 73); Financial KIS: Financial intermediation (NACE 65), Assurances and funds (NACE 66), Auxiliary activities to financial intermediation (NACE 67); Market KIS: Maritime transport (NACE 61), Air transport (NACE 62), Real states (NACE 70), Machinery and equipment renting (NACE 71), Other business services (NACE 74); Total KIS includes other services such as Education (NACE 80), Health and social services (NACE 85), Cultural, leisure and sport activities (NACE 92).

percentage of GDP (knowledge input); 2) the number of patent applications to the European Patent Office, per one million inhabitants (knowledge output); 3) the regional summary innovation index as a certain proxy of the regional knowledge formation; and 4) the share of human resources in science and technology as a percentage of total population, as easy access to highly skilled and experienced labor force is considered essential for the development of high-technological and advanced activities (Illeris 1996).

- *Economic-performance related indicators.* A significant number of organizations are localized in high reputation and prestige areas, leading to an approach and a continuation of the conduct described by large enterprises (Daniels 1993). The dependence held by KIS on increasingly complex information requires the proximity between client and provider to be exchanged. The necessity of advanced services to be positioned close to their clients influences business concentration within main metropolitan cities, where access to clients and agglomeration economies are of great importance (Rubalcaba and Gago 2003). Since an important number of KIS seems to be located within high economic performance profile areas, three other variables have been integrated in the analysis: the population density rate of the different regions; and the GDP (Gross Domestic Product) per capita and the total productivity rates of different regions, as the most productive and profitable services tend to concentrate either in the most developed regions or where productivity is highest (Rubalcaba 1999).
- *Territorial accessibility indicators.* Marshall and Wood (1995), among others, also suggested territorial accessibility, by means of transport and communication facilities, as one of the main criteria for firms to concentrate in a determined region. In this respect, three variables representing a proxy for the levels of accessibility by road, rail and air to the different regions have been incorporated.

In order to comprehend and simplify the information contained in the previous items, we undertake a principal components analysis (PCA) and, after checking the right output from the covariance matrix and the Bartlett test, we identify the likely components (CP_j, $j = 1,\ldots, p$) as linear combinations of the x_i original variables, where $a'_j = a_{ij}, a_{2j}, \ldots, a_{pj}$ is a vector of constants.

$$CP_j = a_{j1}x_1 + a_{j2}x_2 + \ldots + a_{jp}x_p = a'_j\, x \qquad (1)$$

In a second stage of estimation, we link KIS concentration to the explaining factors derived from the PCA analysis, using multiple linear regressions. They attempt to evaluate the significance of the extracted components in explaining KIS location in Europe. The different regression models estimated are variants of equation (2), where the dependent *variable y* means a measure of employment in KIS as percentage of total regional employment, and independent variables (CP_j) refer to the three components previously obtained. Finally, e is a random error term assumed to be uncorrelated with explanatory components.

$$y_i = a_0 + a_1 CP_{1i} + a_2 CP_{2i} + a_3 CP_{3i} + e_i \qquad (2)$$

Finally, dynamic analyses on the factors explaining KIS concentration in Europe are implemented. We assess some panel data models, presenting the results of the estimation of the dynamic approach. Suppose that we have a panel of N regions. We observe the endogenous variable y_i (KIS concentration), and a vector of three explanatory variables (x_{it}), in each time period. Let us consider the following linear equation (3),

$$y_i = a + b_1 EcPerformance_{it} + b_2 Innovation_{it} + b_3 Accessibility_{it} + u_i + e_{it} \qquad (3)$$

where $i = 1.2,...,N$ are the regions in the sample (with $N = 205$), L is the length of the period considered (with maximum $L = 11$[3]), *Ecperformance*, *Innovation* and *Accessibility* are the chosen exogenous variables. Finally, u_i is the random effects component[4], and e_{it} the residue of the model. These exogenous variables are based on results of the previous static multivariate approach. Thus, we include three indexes referring economic performance, innovation potential and accessibility. *'Economic performance'* variable consists of a weighted[5] index of GDP per capita, density and productivity. *'Innovation potential'* is a weighted index of GERD, HRST and patents[6]; and, finally, '*Accessibility'* is a weighted index of accessibility by road and air.

2 Shaping urban concentration of business services in Europe

Knowledge intensive services present an unbalanced geographical distribution among European regions. This section shows, by means of a descriptive analysis, the relative weight of these activities in the European territory firstly on the basis of a cross-national comparison (NUTS0 and NUTS1)[7] and, secondly, with reference to the intra-national concentration of the different types of KIS within a number of city regions (NUTS2).

Talking in terms of KIS as a whole, it should be noted the influence of services related to education, health and culture, which represent more than double the relative weight of total KIS in the economy. Thus, differences among the various KIS sector desegregations should be taken into consideration. In this respect, *Technological KIS* and *financial KIS* denote (on average) similar shares of employment in the European economy of about 3 per cent. In turn, *market KIS* account for around 7.5 per cent (on average) of the total employment in Europe.

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3 Time period ranges from 1995 to 2005.

4 The idea of fixed effects is discarded despite its generalized use in panel data models, as this does not admit within-group constant variables, such as the case of the initial weight of the KIS sector or the initial productivity level in our analysis. Hausman test results have been taken into account.

5 Weights have been chosen according to the factor loadings of the PCA analysis.

6 DSII Regional Innovation Index has not been considered due to the lack of time information on this item in international statistics.

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

As observed in Table 1, northern countries from countries such as Sweden, Denmark, United Kingdom and Netherlands present the highest levels of specialization in KIS, where the employment rates for these activities are above 42 per cent of total employment. In turn, countries from the south of Europe (such as Italy, Spain, Greece and Portugal) show a lower presence of KIS within their economies registering levels around and below 30 per cent. In this respect, the percentage of employment in KIS in Sweden (47.5 per cent) is more than double the volume that those services represent in the economy of Portugal (22.7 per cent).

Table 1. Most specialized regions in KIS, 2006, NUTS0 and NUTS1, EU-15, (%)

Rank	*NUTS0*	*TOT*	*TEC*	*MKT*	*FIN*	*NUTS1*		*TOT*	*TEC*	*MKT*	*FIN*
1	Sweden	47.5	5.1	10.9	1.9	London	UK	53.63	5.27	15.18	6.62
2	Denmark	43.8	4.2	8.7	3.4	Berlin	DE	49.35	5.6	14.48	2.94
3	United Kingdom	43.0	4.2	9.6	4.3	Brussels	BE	48.22	4.01	16.01	4.8
4	Netherlands	42.3	4.1	10.4	3.4	Sweden	SE	47.67	5.06	10.91	1.9
5	Luxembourg	42.0	3.3	8.9	11.3	Île de France	FR	46.72	7.18	13.98	5.63
6	Finland	41.1	4.6	9.8	2.0	South East	UK	45.57	5.97	10.83	4.88
7	Belgium	38.6	4.0	7.9	3.5	West Nederland	NL	45.55	4.46	12.53	3.82
8	France	36.4	3.7	8.8	3.1	Denmark	DK	43.5	4.39	8.31	3.32
9	Ireland	34.9	3.9	7.6	4.3	Luxembourg	LU	43.49	3.28	9.46	11.32
10	Germany	34.3	3.5	8.5	3.5	Scotland	UK	43.47	3.56	8.09	5.12
11	Austria	30.4	2.9	7.8	3.3	Eastern	UK	42.77	5.26	9.43	5.27
12	Italy	30.1	3.0	9.2	2.9	Hamburg	DE	42.47	5.14	13.91	4.37
13	Spain	27.0	2.7	8.4	2.4	North West	UK	41.59	3.34	9.57	3.95
14	Greece	24.9	2.0	6.4	2.6	Noord-Nederland	NL	41.16	2.93	8.3	2.65
15	Portugal	22.7	1.9	5.5	1.8	Manner-Suomi	FI	41.05	4.58	9.77	2.01

Note: TOT=Total KIS; TEC= Technological KIS; MKT=Market KIS; and FIN=Financial KIS
Source: Based on the EUROSTAT database

Sweden, Denmark, the United Kingdom, the Netherlands and Finland present some of the highest shares of employment in *high-tech and market* KIS. Luxembourg stands over the rest of regions considering the exceptional participation of financial services within its economy. Differences among regions point out the somewhat dissimilar presence of KIS in various geographical areas, thus presuming the idea of a national component to explain KIS activity concentration. In this sense, it should be possible to distinguish between those northern regions

characterized by a significant participation of KIS within their economies, and those countries mainly from the south of Europe, where the mentioned participation is notably more reduced.

In addition, the share of KIS in the above-mentioned northern countries is larger than in other important European economies, such as those from Germany or Austria. This fact may have an explanation in the industrial structure of these two latter countries. Industrial firms localized in northern regions tend to carry out superior externalization processes of their knowledge intensive activities, which in turn leads to a major development of KIS organizations. In contrast, the industrial structure from Germany and Austria place greater stress on the integration and development of those knowledge intensive activities in-house (Preissl 2000), thus reducing the potential formation and growth capacity of advanced service firms.

At NUTS1 level, the region of London presents the highest share of employment in *total KIS* in Europe, followed by the regions of Berlin, Brussels, Sweden and Île de France. These particular areas are characterized by including some of the most relevant European capital-cities (London, Berlin, Brussels, Stockholm and Paris). In addition, Île de France, Brussels, and London, together with other capital-regions such as Comunidad de Madrid show the greatest levels of specialization on *technological KIS* within the whole European economy. Business concentration is particularly relevant with regard to *financial KIS*. Luxembourg and London present the largest specialization indexes (more than doubling the European employment average in this sector), followed to a lesser extent by the regions of Hessen, Eastern and Île de France. This large specialization pattern is also denoted by the relatively high value of the distribution variation coefficient (0.45).

Regions located in countries of southern Europe (Portugal, Greece and Spain) present a minor number of knowledge intensive activities within the economy. Thus, differences observed in regions at NUTS1 level do not only mean the result of the fundamental role played by capital-regions, but also the effect of a national component as indicated beforehand. In this respect, nine regions from the United Kingdom (London, South East, Scotland, Eastern, North West, South

West, West Midlands, Wales, and Yorkshire and the Humber) are included among the twenty leading areas regarding the proportion of KIS comprised within their productive structures.

Differences arising from the respective country features could influence knowledge services location trends. These disparities among countries may rely not only on the economic position and dynamic of the various state members, but also on legal, regulatory and institutional issues. Since legislation similarities are larger among regions from the same country, the relative specialization index (RSI) of each region with respect to its country has been calculated. It aims to analyze the extent to which European regions at NUTS2 level are KIS specialized with regard to their country averages.

Table 2. Regional level of KIS specialization, 2006, NUTS2, EU-15

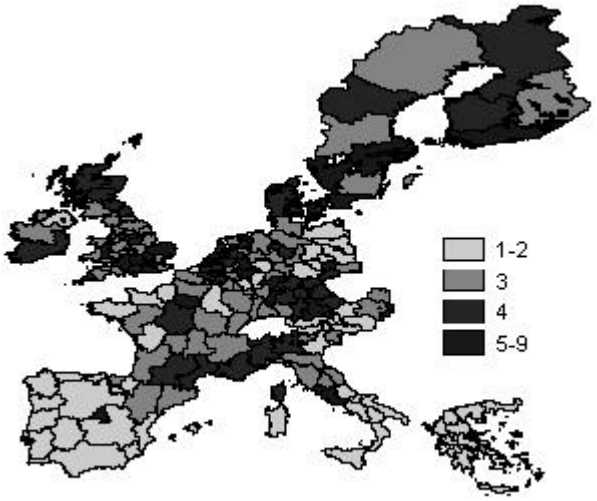
	NUTS 2		*RSI Total KIS*	*NUTS 2*		*RSI Tech KIS*
1	Lisboa	PT	1.50	Lisboa	PT	2.43
2	C. de Madrid	ES	1.40	Berkshire, B&O	UK	2.18
3	Berlin	DE	1.39	C. de Madrid	ES	2.07
4	Wien	AT	1.38	Wien	AT	1.87
5	Hamburg	DE	1.33	Île de France	FR	1.86
6	Île de France	FR	1.33	Darmstadt	DE	1.77
7	Bruxelles-Capitale	BE	1.32	Lazio	IT	1.67
8	Inner London	UK	1.32	Attiki	GR	1.67
9	Attiki	GR	1.27	Stockholm	SE	1.64
10	Darmstadt	DE	1.24	Karlsruhe	DE	1.55

Note: The value of the Relative Specialization Index for a *region i* in a *sector s* is defined as $RSI(s)_i=SI(s)_i / SI(s)_C$, where $RSI(s)_i=1$ means that the productive specialization of a *region i* remains the same that the specialization of *country C* where it is included.
Source: Based on the EUROSTAT database

The results that come out of this approach (Table 2) lead to a pair of consistent remarks. Firstly, those particular areas largely specialized in knowledge intensive services within their respective countries refer primarily to capital-regions. Furthermore, the superior level of activity concentration in countries in southern Europe (Portugal and Spain) is remarkable. Thus, KIS location does not seem to rely solely on the prominent position of particular advanced European economies (such as Sweden, Denmark or United Kingdom), but also on the role played by principal urban centers in their respective countries. Secondly, as suggested by Feldman (1994),

the more knowledge intensive an economic activity is, the more this activity tends to concentrate geographically. *Technological KIS* (those more related to information driving processes) show for the analysis a higher trend to geographical concentration, particularly within international-profile regions, than the KIS average (Map 1).

Map 1. Distribution of technological knowledge intensive services in Europe, % of total employment, 2006, NUTS2 regions



Source: Based on the EUROSTAT database.

3 Factors determining KIS location patterns

3.1 A static approach

The total volume of information contained in the whole of original variables[8] has been condensed into a smaller set of dimensions with a minimum loss of information. This leads to detection of the structure in the relationships among the ten variables, thus explaining these variables by means of their shared underlying dimensions (Hair et al. 1992). The structure in the relationships among the ten original variables, observed through the Pearson correlation matrix, shows the existence of significant correlation among some of these indicators. Three principal components are extracted throughout the analysis. After checking the Bartlett test, the scree-plot

[8] Figures refer to 2003

suggests three selected factors with associated eigenvalues above one that account for 77.4 per cent of total variance explained (Table 3). Furthermore, the evaluation of the communalities suggests that the three components provide an acceptable explanation for almost every variable in the analysis. In order to obtain a better interpretation of the results, a *varimax normalized* rotation was realized. The resulting factor loadings are shown in the table below.

Table 3. Result loadings of the factor analysis

Variables	*Communality*	*Component 1*	*Component 2*	*Component 3*
ROAD	0.970	0.960	0.151	0.136
RAIL	0.973	0.946	0.187	0.182
AIR	0.643	0.678	0.252	0.474
DSII	0.759	0.140	0.896	0.173
GERD	0.617	0.063	0.881	0.075
HRST	0.656	0.159	0.738	0.372
PATENT	0.554	0.359	0.732	0.055
GDP	0.674	0.166	0.285	0.838
DENSITY	0.476	0.110	-0.032	0.822
PTV	0.597	0.290	0.310	0.630
Eigenvalues		4.917	1.613	1.235
% of variance explained		49.171	16.126	12.348
Cumulative % of variance explained			65.297	77.644

Note: Principal component analysis through varimax normalized rotation. Resulting components are normalized and are orthogonal among them.
Source: Based on the EUROSTAT database.

The first component accounts for a remarkable percentage of the total variance extracted (49.17 per cent) and it is clearly related to regions accessibility by road, rail and air. The second component presents superior loadings when considering the innovation index of the various regions, along with those factors that represent the levels of knowledge input (business expenditure in R&D and number of human resources in science and technology) and output (the volume of patents applied) of the different regions. Loadings for component three are particularly notable for those variables referred to the regional economic performance profile (productivity and GDP per capita) along with the regional population density. This third factor may suggest the effect of European international profile- and capital-regions that present a important number of resident population as well as superior economic performance conditions.

To better deal with these three components, they will be named as: Accessibility (CP1); Innovation potential (CP2); and Economic performance profile (CP3).

As stated previously, for research purposes a series of multiple regression analyses have been carried out. They attempt to evaluate the significance of the extracted components in explaining KIS location in Europe. With regard to the regression models, the proposed components (significant at 1 per cent) explain to a notable extent the concentration of KIS activities in Europe, since they account for 60 per cent of the dependent variable explanation (Table 4).

Table 4. Regression coefficients from components explaining the relative weight of knowledge intensive services, 2003, NUTS2

	Total KIS	Technological KIS	Market KIS	Financial KIS
ACCESSIBILITY	1.311 (0.000)	0.269 (0.000)	0.382 (0.000)	0.613 (0.000)
INNOVATION POTENTIAL	4.740 (0.001)	0.799 (0.000)	1.091 (0.000)	0.299 (0.000)
ECONOMIC PERFORMANCE	4.362 (0.000)	0.659 (0.000)	1.893 (0.000)	0.743 (0.000)
CONSTANT	32.589 (0.000)	3.115 (0.000)	7.241 (0.000)	3.090 (0.000)
Number of observations	205	205	205	205
Adjusted R^2	*0.60*	*0.56*	*0.68*	*0.44*

Note: p-values are given in parenthesis
Source: Based on the EUROSTAT database.

However, the regression fit differs depending on the sort of sector comprised. It ranges from 0.68 for *market KIS* to 0.44 for *financial KIS*. Considering the coefficients reported in the model, the components innovation and economic performance are those providing a better explanation of KIS location in the European regions. They are significant at 1 per cent for any activity sector considered, and are particularly relevant in the case of *market KIS*. Concerning the component innovation, the great importance that information and knowledge keep in the formation and the development of these sorts of activities, together with the role they play in adopting and applying valuable advances in their productive processes, lead regional innovation potential to become an outstanding element in explaining KIS location trends. In turn, the

component comprising the level of accessibility in the various regions, though significant, exerts a lesser impact on the model explanation. This component presents a particular influence for *financial KIS*.

Therefore, with regard to the multiple regression analysis, KIS activities are located largely in those regions with i) high innovation standards, ii) important population, productivity and GDP per capita rates, and iii) good communication and transport resources.

3.2 A dynamic approach.

This second part of section three presents an attempt to explore the extent in which those components resulted from the previous static analysis are relevant in the concentration of knowledge intensive services when a dynamic horizon (1995-2005) is taken into account. In order to empirically analyze this fact, we have carried out regressions of the KIS concentration (in terms of KIS employment) over the economic performance, innovation potential and accessibility variables, previously analyzed. Table 5 shows the results of implementing the dynamic model for the baseline or pooled regression and data panel regression.

Table 5. Factors explaining the relative weight of knowledge intensive services, 1995-2005

	Baseline or Pooled Model (OLS)				***Random Effects Model***			
	Total KIS	***Technological KIS***	***Market KIS***	***Financial KIS***	***Total KIS***	***Technological KIS***	***Market KIS***	***Financial KIS***
ACCESSIBILITY	0.0431 (0.000)	0.0159 (0.000)	0.0504 (0.000)	0.0171 (0.000)	0.0090 (0.415)	0.0101 (0.001)	0.0221 (0.000)	0.0057 (0.048)
INNOVATION POTENTIAL	0.4455 (0.000)	0.0750 (0.000)	0.1150 (0.000)	0.0312 (0.000)	0.2989 (0.000)	0.0501 (0.000)	0.1189 (0.000)	0.0060 (0.215)
ECONOMIC PERFORMANCE	0.3091 (0.000)	0.0346 (0.000)	0.0875 (0.000)	0.0662 (0.000)	0.1802 (0.000)	0.0468 (0.000)	0.0835 (0.000)	-0.0036 (0.362)
CONSTANT	14.9525 (0.000)	0.5020 (0.000)	2.0053 (0.000)	1.1140 (0.000)	21.1148 (0.000)	0.9147 (0.000)	2.3521 (0.000)	3.1204 (0.000)
Number of observations	1485	1305	1327	1450	1485	1305	1327	1450
Adjusted R^2	*0.57*	*0.58*	*0.58*	*0.41*	*0.56*	*0.57*	*0.60*	*0.31*

Note: p-values are given in parenthesis
Source: Based on the EUROSTAT database.

The three factors explain to a notable extent the concentration of KIS activities in Europe, since they account around 60 per cent of the dependent variable explanation (with the only exception of market KIS). Every coefficient, both in the baseline model and data panel one, is highly statistical significant (with the only exception of the financial KIS in the random effects model). Considering the coefficients reported in the model, the innovation potential and the regional economic performance position are those elements providing a better explanation of KIS location in EU-15. Accessibility also has a positive effect on the concentration of KIS employment, but to lower extent than the one observed for the other two explanatory variables. In addition, if we have a look to disaggregated KIS sectors these results appear at a great extent again. So results provided in the static approach are mostly translated into the dynamic analysis. KIS activities are located largely in the regions with high innovation potential (in terms of higher R&D investment, number of patents and human resources), important economic levels (in terms of GDP per capita and productivity achievements), high population density, and superior levels of accessibility by air and road transport.

Conclusions and final remarks

This paper explains the particular location of knowledge service activities within the EU-15 territory. Descriptive analysis shows that knowledge intensive services as a whole mostly concentrate in northern European countries. In turn, southern regions present lower levels of business dissemination, suggesting the influence of a likely national component. In addition, KIS present a trend of locating in EU capital-regions, or in other areas with high international profiles. Furthermore, this industry concentration within main urban centers is superior in southern and eastern member states, where capital-regions are largely specialized with regard to their respective national averages.

Reasons for such a pattern in KIS location are not clearly evident, as a large set of likely factors influence it. On the basis of results provided by previous literature and data availability, we have selected ten variables that might explain business concentration trends. Among the set of variables included in an exploratory principal components analysis, three representative summary factors have been obtained leading to a remarkable extraction of the total variance explained. These components are namely the level of regional accessibility; the innovation standards; and the economic performance condition of each different region included in the study. As observed through the proposed regression analysis, these three components exert a notable influence on KIS organizations location pattern, since they account for 60 per cent of total model explanation. Similar results are obtained through a dynamic approach (based on panel data modeling) that suggest the important role of the innovation and economic performance profile of the different regions in explaining KIS concentration patterns in EU-15.

It is worth remarking on the differences that arise in the proposed models depending on the type of sector analyzed. In this respect, the regression fit from the static approach is superior for *market* and *technological KIS* than for *financial* services. The three coefficients in the model are significant at 1 per cent for *total KIS* industry, although their influence varies among the different disaggregated sectors. In this respect, *technological KIS* tend to concentrate primarily in those regions that present a prominent innovation standard in terms of knowledge inputs and outputs. In turn, *market and financial KIS* location is largely affected by the economic performance profile of the different EU-15 regions.

Similarly, the regression fit from the panel data estimation is higher for *market* and *technological KIS*, than for *financial* services. The coefficients in the model are significant al 1 per cent for every analyzed KIS branch (with the only exception of the financial sector). Although the effect of the exogenous variables varies among the different disaggregated sectors, the main conclusions derived from the static analysis can be translated into the dynamic approach. Innovation potential and economic performance are the two key factors explaining

KIS concentration in European regions since mid-1990s to nowadays, while accessibility plays a minor role.

Thus, according to the model outcomes, knowledge services as a whole mainly concentrate in: high-innovative environments so that information and knowledge may spread more effectively; largely populated EU-15 regions with good productivity and GDP per capita profiles; and regions with important communication and transport facilities. In this way, the paper suggests the need of a multifactor and multiagent framework to understand the different linkages between KIS economy and regional development in Europe. Some explanatory factors such as the innovative framework, the role of productivity, the availability of qualified skills or the international regional profile deserve further research. The same applies to the accessibility concept that becomes more intangible and service-related, beyond the physical infrastructure or distance. Knowledge intensive services rely on a mix set of factors and environments in which national differences play a significative role. Thus, further research on this issue should be necessary, mostly to explore territorial dependence among regions through spatial econometric estimations, and to contemplate the interactions between agents promoting regional development and KIS economy concurrently. For example, the role of public support to KIS, in association, partnership or competition with private KIS, merits more attention. In this respect, certain regions might benefit from regional policies performing successful measures towards KIS.

Annex A. 205 regions included in the analysis, NUTS2

Country	Regions
Austria	Burgenland, Niederösterreich, Wien, Kärnten, Steiermark, Oberösterreich, Salzburg, Tirol, Vorarlberg
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
Germany	Stuttgart, Karlsruhe, Freiburg, Tübingen, Oberbayern, Niederbayern, Oberpfalz, Oberfranken, Mittelfranken, Unterfranken, Schwaben, Berlin, Brandenburg – Nordost, Hamburg, Darmstadt, Gießen, Kassel, Mecklenburg-Vorpommern, Braunschweig, Hannover, Lüneburg, Weser-Ems, Düsseldorf, Köln, Münster, Detmold, Arnsberg, Koblenz, Rheinhessen-Pfalz, Saarland, Chemnitz, Dresden, Leipzig, Magdeburg, Schleswig-Holstein, Thüringen
Denmark	Denmark
Spain	Galicia, Principado de Asturias, Cantabria, Pais Vasco, Comunidad Foral de Navarra, Aragón, Comunidad de Madrid, Castilla y León, Castilla-la Mancha, Extremadura, Cataluña, Comunidad Valenciana, Illes Balears, Andalucia, Región de Murcia
Finland	Itä-Suomi, Etelä-Suomi, Länsi-Suomi, Pohjois-Suomi
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, Languedoc-Roussillon, Provence-Alpes-Côte d'Azur
Greece	Anatoliki Makedonia – Thraki, Kentriki Makedonia, Dytiki Makedonia, Thessalia, Ipeiros, Ionia Nisia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki, Voreio Aigaio, Notio Aigaio, Kriti
Ireland	Border, Midlands and Western, Southern and Eastern
Italy	Piemonte, Liguria, Lombardia, Provincia Autonoma Trento, Veneto, Friuli-Venezia Giulia, Emilia-Romagna, Toscaza, Umbria, Marche, Lazio, Abruzzo, Campania, Puglia, Calabria, Sicilia, Sardegna
Luxembourg	Luxembourg
Netherlands	Groningen, Friesland, Drenthe, Overijssel, Gelderland, Utrecht, Noord-Holland, Zuid-Holland, Noord-Brabant, Limburg
Portugal	Norte, Centro, Lisboa
Sweden	Stockholm, Östra Mellansverige, Sydsverige, Norra Mellansverige, Mellersta Norrland, Övre Norrland, Småland med öarna, Västsverige
United Kingdom	Tees Valley and Durham, Northumberland Tyne and Wear, Cheshire, Greater Manchester, Lancashire, Merseyside, North Yorkshire, South Yorkshire, West Yorkshire, Derbyshire and Nottinghamshire, Leicestershire Rutland and Northants, Herefordshire Worcestershire and Warks, Shropshire and Staffordshire, West Midlands, East Anglia, Bedfordshire Hertfordshire, Essex, Inner London, Outer London, Berkshire Bucks and Oxfordshire, Surrey East and West Sussex, Hampshire and Isle of Wight, Kent, Gloucestershire Wiltshire and North Somerset, Dorset and Somerset, Devon, West Wales and The Valleys, East Wales, Eastern Scotland, South Western Scotland, Northern Ireland

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