Agglomeration, Vertical Integration and Specialization in KIBS in the aftermath of the digital revolution: a spatial econometric analysis on Italian provinces

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Abstract

This paper accounts for the determinants of sectoral specialization in different knowledge intensive business services (KIBS) sectors, across the Italian provinces (NUTS3), using a panel from 2012 to 2017. More in detail, this study addresses issues which contribute to the literature on KIBS specialisation in two directions: first, enhancing the knowledge of the spatial effects at an underexplored level of aggregation and secondly disentangling the specific determinant of specialisation across KIBS subsectors. We deepen the analysis of the factors associated with the specialisation in KIBS exploring the role of agglomeration economies (measured by urbanisation economies and input-output linkages between KIBS and their manufacturing users), controlling for information and communication technologies, innovation, public expenditure in research and development, transport accessibility of the provinces. Spatial autoregressive models (SAR) are employed to get spatial spillover effects in explaining province specialization in different KIBS sectors allowing considering the presence of determinants in neighbouring provinces. Furthermore, with an IV spatial autoregressive model, we address the endogeneity problem related to our key agglomeration variables, i.e. population density and intermediate demand. We also check whether these relationships are affected by heterogeneity across KIBS subsectors. The results show evidence of significant spatial effects in explaining regional specialisation and that location in capital cities, input-output linkages, and KIBS specialisation in neighbours' regions, positively affect specialization in all KIBS subsectors across the provinces while the urbanisation economies and transport accessibility are determinants of specialisation only in some subsectors.

Keywords: Knowledge Intensive Business Services; Agglomeration Economies; Regional specialization; Technological Innovation; Spatial Models.

JEL Classifications: L84; R12; 03;

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1. Introduction

The theoretical and empirical analysis about Knowledge Intensive Business Services (KIBS) represents an innovative portion of the research activity of the last 15 years because previous attention was especially devoted to the manufacturing sectors. The demand of KIBS by most firms both in Italy and around the world has increased during the last years. KIBS have become strategic business partners because they provide knowledge-intensive intermediate inputs to private and public organizations and represent a guarantee of competitiveness in the knowledge-based economy.

Accordingly, they have recently obtained an increasing attention within the academic and economic-policy debate. A wide number of readings have emphasised the role of knowledge-intensive business services (KIBS) as intermediate providers of knowledge-intensive services in improving innovation and growth processes of regions acting as. KIBs local presence is frequently found to be important for the long-term competitiveness of regional industry (Andersson and Hellerstedt, 2009). Moreover, KIBS are characterized by specific production and innovation processes, require close interaction with their clients and have the potential to spur innovation in other economic sectors (Di Giacinto et al., 2020). The researchers have been interested in several dimensions and relationships. Some works investigated the impact of BS (business services) on growth rate of employment, valued added and productivity (Francois, 1990; Kox and Rubalcaba, 2007a, 2007b). Other studies have considered the innovation behaviour and the differences between KIBS and manufacturing, considering several innovation variables related to R&D (Teixeira and Santos, 2016; Boccia et al., 2020). Further studies support the evidence on the relationship between KIBs innovation and economic growth especially in the manufacturing sector focusing on the effect on productivity (Griliches, 1995, 1998; Loof and Heshmati, 2001; Crepon et al., 1998; Klomp and van Leeuwen, 1999; Evangelista, 1999; Krempet al., 2004). Cainelli et al. (2006) explore the two-way dynamic link between innovation and economic performance. The effect of an increase in urban population and in vertical disintegration on business services specialization of territories has been investigated recently with respect to the NUT2 EU regions (Meliciani and Savona, 2015; Gallego and Maroto, 2015). Two relevant contributions for Italy are related to the localization and productivity of KIBS firms in Local Labour systems (Di Giacinto et al. 2020), and in specific metropolitan areas (Antonietti and Cainelli, 2016). In line with this last strand of literature, this study accounts for the determinants of territorial specialization in knowledge-intensive business services, measured by the relative share of employment in KIBS across the Italian NUTS3 regions (provinces), using ISTAT data from 2012 to 2017.

We focus both on the role of spatial contiguity and urbanisation externalities, and on sectoral interdependencies between KIBS and manufacturing firms in which KIBS complement manufacturing activities by providing knowledge inputs. As emphasised in previous studies, knowledge flows more fluidly where both spatial and sectoral contiguity are relatively high (Raspe and van Oort, 2007; Frenken et al., 2007; Meliciani and Savona, 2015). The sectoral interdependencies that favour KIBS activities are also detected in a few studies (Corrocher & Cusmano, 2014; Gallego and Maroto, 2015: Meliciani & Savona, 2015; Sforzi & Boix, 2019; Consoli et al., 2020).

In our analysis, the impact of agglomeration economies is measured by urbanisation economies and Hirschman linkages between KIBS and their manufacturing users, in addition to controlling for innovation activities and regional accessibility. Each one of these determinants will be identified by variables like localization and urbanization economies, input-output linkages, information and communication technology, public expenditures in research and development, ICT and transport accessibility, which will be the main proxies adopted in our empirical analysis.[3]

The paper contribution to the literature on the agglomeration economies and KIBS localisation in Italy is twofold. First, we focus on exploring the province dimension and, secondly, we disentangle the subsector dimensions. To our knowledge, no papers have previously investigated the topic of heterogeneity of KIBS. There is a high diversity among KIBS, which include Technological Knowledge Intensive Business Services (T-KIBS), related to scientific and technological knowledge such as R&D services, engineering services, computer services, and Professional Knowledge Intensive Business Services (P-KIBS), who are more traditional professional services like legal accountancy, and many management consultancy and marketing services. Hence, it is crucial to consider sub sectors of KIBS services and capture their heterogeneous patterns.

More in detail, this analysis tries to answer the following questions. Is there a relationship between the urban spatial structure and the KIBS location? Considering eight KIBS sectors: is there a relationship between their activities and localization economies? What are the other determinants of specialization in KIBS? How these determinants affect each one of the eight KIBS sub-sectors of specialization?

We verify a clear spatial dependence pattern, as the coefficient of the lagged dependent variable is significant, this underlying the importance of clustering effects in KIBS specialisation in most subsectors. Hence, we rely on the application of spatial econometrics techniques, specifically designed to capture the spatial effects of specialisation in KIBS across the Italian province over the period 2012–2017. The econometric approach is based on two-stage least squares (2SLS) estimations with spatial lags of the endogenous variables as according to spatial autoregressive (SAR) models to consider the endogeneity problem related to our key variables, i.e. population density and Intermediate demand. The use of this methodology is justified from an empirical point of view considering all the tests required (e.g. diagnostics between OLS versus Spatial Error and SAR, the Sargan's test, the Pagan-Hall test).

The analysis contains detailed descriptive statistics such as maps showing the agglomeration in KIBS, but also the Moran's statistics and scatterplot, with results in favour of spatial agglomeration of all the variables of interest.

The results show evidence of significant spatial effects in explaining regional specialisation and that location in capital cities matters as large metropolitan areas allow KIBS to access both global and national dispersed markets (Shearmur and Doloreux, 2008). Besides, input-output linkages, and KIBs specialisation in neighbouring regions, positively affect specialization in all KIBS subsectors across the provinces. However, urbanisation economies and transport accessibility are not confirmed as general determinants of specialisation. They appear relevant only in three subsectors: those related to Scientific Research, which generally serve other high skilled and knowledge-intensive services, generally concentrated in urban areas, and those related to the services of advertising, marketing, legal activities and accounting, whose main users are also mainly located in urban areas.

Hence our results on the one hand emphasise the centripetal role of large metropolitan areas for KIBS location in line with the regional literature (Shearmur and Doloreux, 2008), on the other hand, confirm previous analyses (van Oort, 2007; Raspe and van Oort, 2007) which suggest that the local dimension of KIBS specialisation might go beyond the agglomeration in urban areas. As emphasised in this literature, spatial and sectoral contiguity are better captured within a larger spatial unit of analysis than the city. Another important result of this paper is the evidence of a strong spatial dependence. We confirm at NUTS3 level what other studies have found for NUTS2 regions: i.e. that KIBS tend to cluster

3 The role of the nodes of transport and communication networks is increasingly reinforced to be considered a key factor of agglomeration as it allows to catch the potential of opportunities for interaction between economic agents or to access to wider international markets as an important number of KIBS undertake their external relationships beyond the local context. Therefore, the study also introduces two proxy indicators of the transport and ICT accessibility. Long-distance face-to- face communication and knowledge exchange are considerably facilitated by international hub airports. Thus, also large urban areas would make long-distance access easier than local access.

(Meliciani and Savona, 2015; Gallego and Maroto, 2015). Besides, Hirschman forward linkages between KIBS and their manufacturing user sectors and innovation at province level are confirmed as important determinants of location of KIBS as already highlighted in previous analyses at a more aggregated level (Meliciani and Savona, 2015).

The paper is organized as follows: the next section presents the review of the literature on agglomeration, vertical disintegration, and productivity of KIBS. Section 3 describes the key variables employed in the analysis and section 4 shows the Descriptive analysis at spatial level. The estimation strategy and the results are discussed in Section 5. Concluding remarks reported in Section 6 end the paper.

2 Review of the Literature on Agglomeration, Vertical Disintegration and Productivity

The issue of agglomeration economies[4] has been crucial in the analysis of the localisation of KIBs. KIBS are sensitive to spatial agglomerations, which are crucial for their success and competitiveness (Audretsch, 1998; Scott, 1988). KIBS advantage from closeness to fonts of information (Porter, 1990) and to knowledge spillovers (Henderson, 2000; Krugman, 1991). They get access to a labour force with good competences and skills and major expertise (Coffey and Shearmur, 1997). Besides, they localize in high-density areas near customers, which favour firms' access to the market to undertake the necessary exchanges (Duranton and Puga, 2002, 2005; Krugman, 1991; Puga, 1998).

Large evidence has put forward that business services (BS) in general tend to cluster in dense urban areas, which exhibit a strong functional specialisation in knowledge-intensive and high killed activities. Hence, urbanization externalities favour regional specialisation in KIBs as these mainly serve other high skilled and knowledge-intensive activities, also concentrated in large urban areas. The Hirschman forward linkages between BS and their manufacturing user sectors and an innovation- prone regional environment are also important factors of location of BS. For example, Guerrieri and Meliciani (2005) discovered that several knowledge-intensive manufacturing activities like office and computing machinery, professional goods, electrical apparatus and radio, television and communication equipment, and chemicals and drugs businesses, are the main demanding economic agents of advanced services. Following this literature, we try to test if regional specialization in KIBS is expected to be positively and considerably supported by the regional urbanization state, KIBS immediacy to knowledge spill-overs, KIBS availability of a highly skilled labour force, KIBS closeness to key customers.

Antonietti and Cainelli (2008) have first underlined the importance of agglomeration externalities in affecting the choice to relocate knowledge-intensive activities as geographic proximity, knowledge spill-overs and closer interaction among agents make it easier for firms to manage complex interactions and to increase their competitiveness. Meliciani and Savona (2015) and Gallego and Maroto (2015) wrote seminal papers on the spatial analysis of clustering of KIBs in Nuts-2 regions. Employing a Spatial Durbin Model, Meliciani and Savona (2015) showed that urbanisation economies, the spatial structure of intermediate sectoral linkages and Information and Communication Technologies, are important factors in determining the specialisation in BS. Gallego and Maroto (2015), adopting spatial autoregressive models, also

[4] The industry component in agglomeration issues was first considered by Alfred Marshall (1890) theory of "localized industry". Further development of the theory of agglomeration economies, consider the advantages of the formation and development of agglomerations as a combination of three components: (1) localisation externalities (Combes, 2000; van Oort, 2007), (2) urbanization externalities (Glaeser et al., 1992, 1995; Henderson et al., 1995), (3) Jacobs' externalities deriving from the variety of activities within urban contexts (Jacobs, 1969; Duranton and Puga, 2000; Duranton and Puga, 2005).

analyse how agglomeration economies affect KIBS localization strategies. They find that KIBS also benefit from knowledge spillovers and availability of a highly skilled labour force.

Kekezi and Klaesson (2020) show that the distance decay of spillovers is fast. Only local concentrations of KIBS seem to be important. They reveal a possible spatial competition effect when obtain, over longer distance, negative results for trademarking. Zhang (2020) show that unlike manufacturing and traditional services, KIBS are characterized by relying heavily on highly skilled employment, intense interaction with clients, and professional knowledge. Hence, access to an appropriate la bour force, reducing the cost related to transport and transaction, and rising knowledge flows are the main characteristics through which agglomeration economies contribute to KIBS performance.

Di Giacinto, Micucci and Tosoni (2020) present evidence of a positive and significant urban productivity premium in KIBS sector, which is more recognizable compared with the generality of non- knowledge-intensive services activities and a bit larger compared with the average premium estimated for the remaining part of knowledge-intensive services.

Serrano (2019) also shows that (a) there is a relationship between urban spatial structure and KIBS location; (b) KIBS localise in a polycentric form in search of urbanization economies; (c) particular KIBS are very concentrated in just a few subcenters, looking for localization economies; (d) proximity to the core and agglomeration economies are a factor in the location of KIBS.

Largely investigated in the literature is also the structure of intermediate linkages. Among the determinants of regional specialization in KIBS, we have the sectoral structure of regional economies and the nature of intermediate demand and inter-sectoral linkages. The rise of services, particularly of KIBS, over the past 30 years, is mostly due to changes in the production processes in many sectors and to the ensuing increase in the demand for services as intermediate goods (Guerrieri and Meliciani, 2005).

In addition, the strong supplier-user interactions between KIBS and their users make the geographical proximity of customer industries particularly relevant (Muller and Zenker, 2001; Miles, 2005). Empirical support to the key role of intermediate demand rather than final consumption or trade in explaining the growth of Business services is also provided by Savona and Lorentz (2005) and by Montresor and Vittucci (2011). For the French business firms, Nefussi and Schwellnus (2010) show positive effects of the downstream demand by French manufacturing firms on location choice probabilities. Antonioli, Berardino and Onesti (2020) using the Word Input–Output Database on EMU19 countries concluded that disparities are growing in the composition of national productive structure, and they are even more pronounced when we consider intersectoral dynamics.

Endorsing the Krugman position on the growing specialisation among EMU countries, the core countries (central EMU) display a better level of KIBS pattern in manufacturing than bordering ones (southern and eastern EMU).

Another issue is the role of spatial contiguity, which such interdependencies and sectoral contiguities call for. The increasing adoption of ICT should make KIBS used and produced anywhere and traded on the global market more easily and the role of local factors in general and of the local innovation environment should be less important than in the past (Friedman, 2005). However, the importance of face-to-face contacts between KIBS suppliers and manufacturing clients varies across subsectors and in some services, spatial proximity is essential. Besides, the relevance of spatial contiguity also depends on the nature of technological innovation in KIBS. The adoption and diffusion of innovation in KIBS requires a substantial share of tacit knowledge embodied within firms in addition to codified and knowledge (produced and stored in universities and R&D laboratories). The role of tacit knowledge in the relationship between KIBS and their clients increases the importance of spatial proximity (den Hertog, 2000; Muller and Zenker, 2001; Raspe and Van Oort, 2007; Shearmur and Doloreux, 2008; Antonietti and Cainelli, 2008). The availability of highly skilled human capital and public R&D infrastructures, contribute to the creation of a local innovation environment able to favour KIBS localisation (Meliciani and Savona, 2015).

All in all, quite large evidence has emerged lately concerning the agglomeration, productivity and vertical integration of KIBs. However, the topic of agglomeration economies of KIBS sectors still needs further research. In this paper we fill two main research gaps.First, we investigate KIBS 2-digits subsectors, as analysing the localization patterns of KIBS one should draw attention to the technological base of the different KIBS categories. Secondly, we conduct the analysis for Italy at Province level, which gives a different perspective to the subject as usually the study has been conducted for Italy based on NUTS 2 regions (Meliciani and Savona, 2015), LLMA (Di Giacinto et al., 2020), or municipalities units (Antonietti, R. and Cainelli, G., 2016). The typical problem underlined in the literature is the choice of the most appropriate spatial level of analysis (known as the Modifiable Areal Unit Problem) described in some seminal studies (Burger et al., 2008; van Oort, 2007). According to these analyses, regional contiguity may have different meanings depending on the size of the regions and the location of the centroids from which distances are measured. This is of particular relevance in a spatial econometric framework given the different magnitude of the effects of agglomeration economies, which vary depending on the spatial unit of analysis considered. We deem that the province level of analysis allows us to select an appropriate spatial unit of analysis intermediate between the regional and LLMA territorial levels which risk to be respectively too large and too small.

3. Data

The data used in the analysis are obtained from ISTAT and cover information for 110 spatial units at NUTS-3 level (provinces) for the period 2012-2017. So, the total number of observations is 660. The classification of KIBS used throughout the analysis relates to the ATECO 2007 classification (see Table A.1 in Appendix for additional details). The aim is to cover the broad spectrum of KIBS, but also to dissect the sectoral heterogeneity by considering subsamples. The reader will identify hereinafter how this differentiation supports the analysis of the results. Table 1 and 2 show respectively the variables used in the analysis and the descriptive statistics. We carried out also a correlation matrix presented in Table A.2 in Appendix.

3.1 Dependent variable

We compute the regional specialization in KIBS for any of the Italian NUTS-3 regions (provinces) that are included in the analysis. We apply the location quotient (LQ). The ratio indicates whether a certain province economy has a greater share of KIBS activity when compared with a reference area. We compute the measure of employees in the KIBS sector using the ISTAT database that provides information on the number of persons employed in each KIBS sector and also on the total employment (TEMP) at both province and national levels be they either employees (working by agreement for another resident unit and receiving remuneration) or self-employed (owners of unincorporated enterprises).

The ratio below is applied (1):

$$LQ_{pt} = (\text{number of employment in kibs}_{pt} / \text{total employment}) / \text{number of employment in kibs}_t / \text{total employment} \quad (1)$$

where p and t are the province and the time, respectively. LQ ratio of employment in KIBS and in each KIBS sub-sector are built.[5]

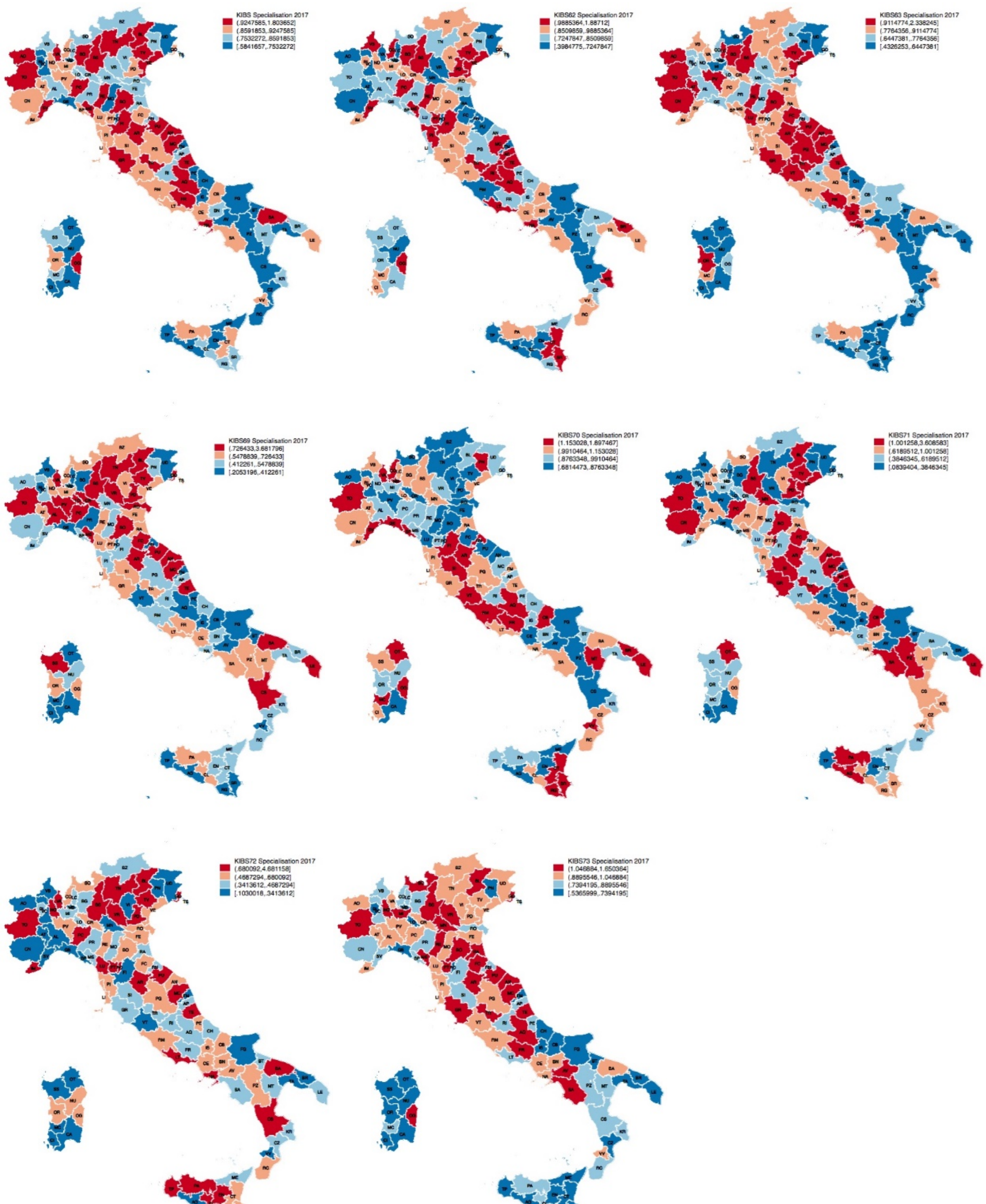

Figure 1. Specialization in KIBS in Italy by Provinces, localization quotient (LQ) levels, 2017: total KIBS and 62, 63, 69, 70, 71, 72, 73.
Source: ISTAT database.

[5] An LQ ratio equal to 1 means that the NUTS-3 region under consideration has the same percentage of employment in KIBS as the total Italian reference area. LQ ratios that are below or above 1 indicate that the regional employment in KIBS is, respectively, less or greater than expected in comparison with the reference area.

Since specialisation[6] in KIBS is the main variable of interest in the paper, the location quotient measuring specialisation in KIBS at the province level has been used to map the Italian provinces in terms of KIBS specialisation in 2007 (Figure 1). It shows KIBS specialization as the whole sector and by each Ateco 2007 2-digits subsectors (62, 63, 69, 70, 71, 72, 73).

The maps visually help bringing to light the presence of an agglomeration pattern in the province distribution of KIBS specialization. Most provinces in the analysis present lower specialization levels in KIBS than expected. Thus, in these provinces we assume that KIBS industry is not meeting the local demand. On the other hand, we assume that the regions, which take LQ values greater than 1, are selling their knowledge-intensive services beyond their region boundaries.

The most specialized provinces in KIBS are those including large urban areas in line with the urbanisation literature reviewed above (Glaeser et al., 1992). In particular, the most specialized ones include the "capoluoghi di provincia" (Figure. 1). Moreover, the evidence suggests the existence of a higher clustering in the northern and central Italian regions. In this respect, not only the "capoluogo di provincia" but also other smaller provinces (Rovigo, Treviso, Pisa, to mention some) are among the top specialized provinces and they are all clustered within the northern part of Italy. On the other hand, at the bottom of the ranking, there is a predominance of provinces from the Southern Italy. Looking at the subsectors the spread in agglomeration of KIBs between North and South is especially evident in the subsectors 62 (Software production, computer consulting and related activities) and 63 (Information activities and other information services).

It is noteworthy to see that in the South of Italy there are 2 subsectors that have higher specialization compared to other subsectors: 71 (Activities of architectural and engineering studies; tests and technical analysis) and 72 (Scientific research and development). The map of subsector 63 (informatics activities and other information services) is the closest to the spread of specialization of KIBS as whole sector. It can be explained by the fact that subsector 63 has the highest share in KIBS.

The highest value of LQ in subsector 62 is 1.89 in Potenza province that is located in the Southern Italian region of Basilicata, and the lowest values (0.4) is in Ogliastra in the eastern part of Sardinia. For subsector 63 it is 2.33 in Siena, in the Tuscany region in the central part of Italy, and the lowest in Vibo Valentia (0.43), and more in general in Calabria region in Southern Italy. In the province of Milan, in the Lombardy region in the Northern Italy, there is the highest specialization in subsector 69 (Legal activities) while the lowest LQ value is observed for this subsector in Agrigento province, in the Sicily region in Southern Italy (0.20). After analysing in the same way the rest of the provinces, it is worth to note that it confirms a strong North-South divide in KIBS specialization in Italy.

[6] There is not a standard definition of KIBS, and many studies, as in our case, keep on a practical approach which trusts on 'standard industrial classifications' to identify companies in the following principle sub-sectors: computer software, business and management consultancy (and related activities); research and development; legal services; accounting and related services (including book-keeping and auditing);architectural and engineering consultancy, advertising and market research and, less frequently, specialist design consulting. There are some KIBS such as merchant or investment banking that are, as in this paper, never included, and an empirical reason is that it is not easy to split investment banks from retail banks using SIC codes. Note also that while there seems to be a general consensus regarding the main KIBS sectors, some author supply their own, ad hoc classifications; among the activities included are university services, care-related services and services supporting resourced-based activities such as mining and gas extraction (see Muller and Doloreux, 2007).

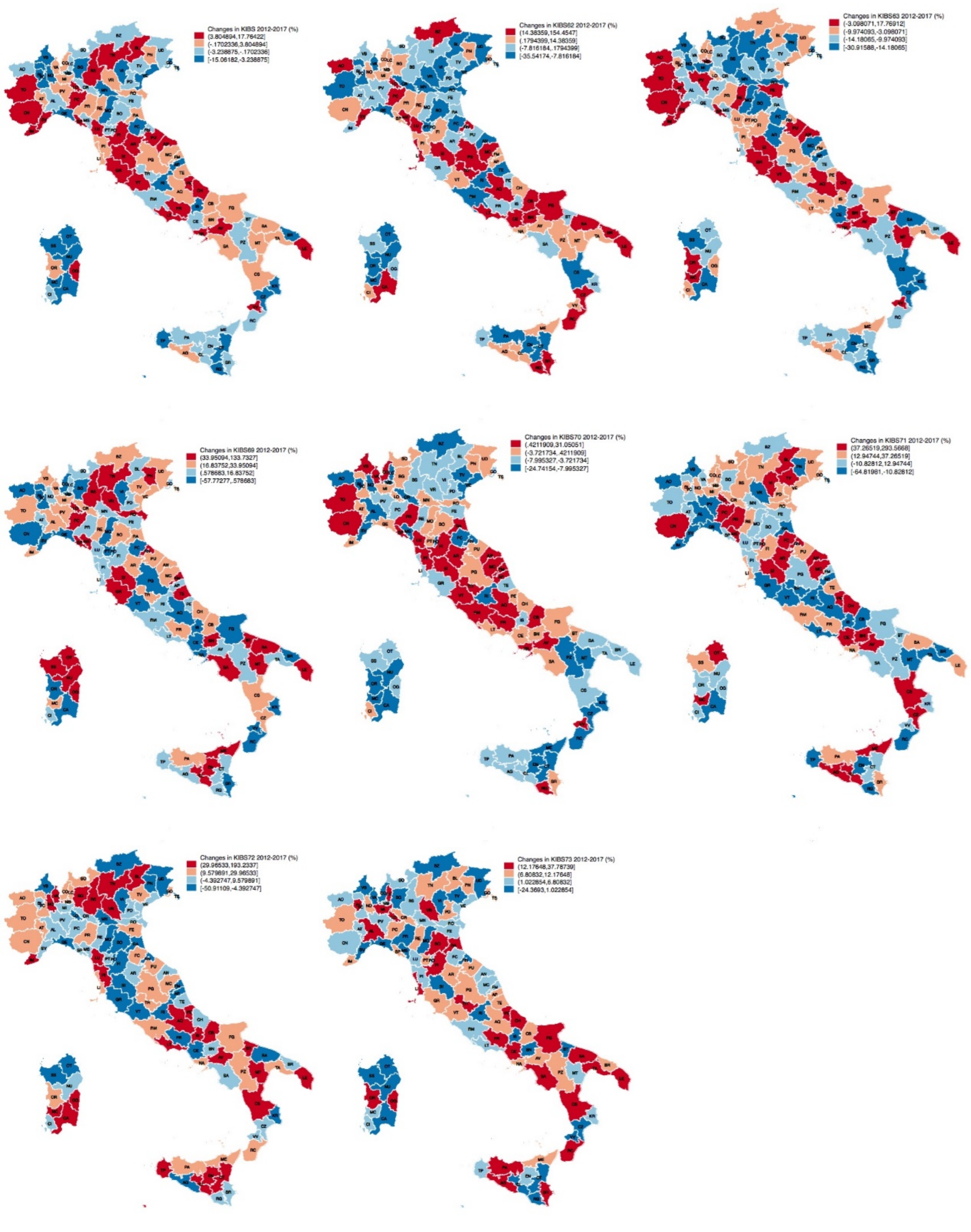

Figure 2. Changes in KIBS specialization in Italy by Province—localization quotient between 2012 and 2017.
total KIBS and 62, 63, 69, 70, 71, 72, 73.
Source: ISTAT database.

After introducing this classification, we wondered whether the specialization levels in KIBS of those regions ranked at the top of the list have increased the most since the year 2012 up to 2017. The respective growth rate values for the whole set of the province areas are shown in Fig. 2. Among the regions that have increased more importantly their relative specialization levels, we find many provinces in the South. This suggests a change in the productive structures of some provinces in the Southern of Italy. In particular, the provinces, which ranked poorly in Fig. 1, like Foggia, Cosenza, Potenza, Catanzaro, to quote some, have recorded growth rates higher than 100%.

Hence, for some provinces there is evidence of a catching-up process concerning their relative specialization levels in KIBS. However, the overall picture hides very dissimilar patterns with respect to specific economic sectors.

A clear clustering effect in the location quotient mapped in Figure 1 and 2 emerges, confirming that the factors explaining the sectoral composition of province employment in KIBS are likely to spread to neighbouring regions. We test this in a spatial econometric framework in section 4.

3.2 Independent variables

We introduce a set of determinants, which typically influence the regional specialization in KIBS. These determinants are identified as follows: urbanization, intermediate demand, R&D expenditure, ICT, accessibility, innovation, built as indicated in table 2 where the description, the sources and the time span of the variables are presented.

Table 1. Variables of Interest

Variables	**Description**	**Computation**	**Sources**	**Years**
LQKIBS (KIBS SHARE INDICATOR)	Province specialisation in KIBS	(Province Number of employees in KIBs/ province total number of employees)/(Italian Number of employees in KIBs/ Italian total number of employees) (Province level)	**ISTAT**	**2012-17**
PDENSITY	Population density. Proxy of agglomeration Economies	Population/ surface (in sq KM; Province level)	**ISTAT**	**2012-17**
CAP	"Capoluogo di provincia" Proxy of urbanisation economies.	Dummy indicator, which takes the value of 1 when the observation refers to a province which is "capoluogo di provincia"; and 0 otherwise		**2012-17**
IDEMAND	Intermediate demand. Proxy of demand spillovers from intersectoral forward linkages	Weighted share of employment in manufacturing industries that are high users of KIBS over total employment $\text{IDEMAND}_{i,s,t} = \Sigma_{s=1}^{M} W_j E_{ist} / \Sigma_{s=1}^{N} E_{ist}$ NOTE :i is province, s the sector, t the time, M the number of above average KIBS users manufacturing sectors, N the total number of sectors, E the employment, W the weight given by the average share of KIBS input in total industry output as computed from ISTAT symmetric Input Output tables in 2015	**ISTAT**	**2012-17**
R&DEXP	Proxy of knowledge spillovers	domestic in-house R&D expenditures in the NUTS-2 region current values (thousands of euro), over regional GDP. (Regional level)	**ISTAT**	**2012-17**
BROADBAND	Proxy for ICT: Enterprises with Broad Band.	Percentage of Enterprises with Broad Band (Regional Level)	**ISTAT**	**2012-17**
TRT	Proxy of Travel effort to reach a region	The index is obtained starting from the calculations made on travel times, expressed in minutes, from the centroid of each municipality to the three closest infrastructures for each of the four categories considered. The categories of infrastructures considered are: i) ports; ii) airports; iii) railway stations; iv) motorway toll booths. For the processing of travel times, a commercial road graph was used which takes into account the real road speeds (therefore also the morphology of the territory) in ideal conditions, i.e. in the absence of traffic (Provinces level)	**ISTAT**	**2013**
BRANDSHARE	Proxy for innovation: share of brands over population at province level	Brand/population (province level)	**Ufficio Italiano Brevetti e Marchi**	**2012-2017**
LATITUDE AND LONGITUDE	Distance-employed to compute the distance matrix.	Latitude: angular distance of a point from the equator Longitude: the angular distance of a point from an arbitrary reference meridian along the same parallel of the place.	**ISTAT**	**2012-2017**

Instruments				
RSE	a proxy for regional scale economies	the ratio between employment and number of firms –(Province level)	**ISTAT**	**2012-2017**
SURFACE	a proxy for regional scale economies	Total land area –(Province level)	**ISTAT**	**2012-2017**

Table 2: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
LQ_KIBS	660	.8559	.1994	0	1.809
LQ_KIBS62	660	.8850	.2874	0	2.173
LQ_KIBS63	660	.8578	.3087	0	2.911
LQ_KIBS69	660	.5813	.3721	0	3.681
LQ_KIBS70	660	1.029	.2628	0	2.137
LQ_KIBS71	660	.7746	.8430	0	12.690
LQ_KIBS72	660	.57527	.5392	0	5.022
LQ_KIBS73	660	.8677	.2355	0	1.653
LQ_KIBS74	660	1.052	.4092	0	2.259
PDENSITY	660	261.56	372.5	30.83	265.2
IDEMAND	660	.4916	.2721	0	1.4283
CAP	660	.18181	.3859	0	1
TRT	660	52.08	15.73564	25.481	120.5
BROADBAND	660	94.17	2.626	86.2	99.1
R&DEXP	660	.01206	.0043	0	.0220
BRANDSHARE	660	.0005	.00049	0	.0041

The urbanization factor is approached by accounting for a population density indicator, which specifies the share of population over the regional area (in square kilometres) (Ciccone, 2002). KIBS also tend to cluster in order to benefit from knowledge spillovers. The share of total R&D expenditure above the gross domestic product (GDP) of regions approach the knowledge spillovers factor.

The regional setting of ICT is another key attribute that influences KIBS agglomeration within a particular area. We use this determinant by considering the percentage of enterprises with a website at regional level. Moreover, transport accessibility are taken from the European Spatial Planning Observation Network (ESPON), whose indicator measures the minimum travel time (effort) to reach one region from any other European region. The potential accessibility of a particular region is calculated by summing up the population in all the other European regions, weighted by the travel time to go there. It is computed for rail, road and air transport types separately. In order to detect the overall effect of transport accessibility on the regional specialization in KIBS, the study uses a multimodal accessibility indicator which combines the three previously mentioned accessibility modes.

Furthermore, the closeness to their clients facilitates the localization of KIBS persuaded the closeness to their clients since it helps the transfer of tacit knowledge. Following Meliciani and Savona (2015) we considered the intermediate demand for KIBS (IDEMAND) proxied by the weighted share of employment in manufacturing enterprises that are intensive clients of KIBS over total employment. Intensive clients are identified using the Istat symmetric Input Output tables in 2015. In particular, in order to assess this indicator, we consider a vector, which identifies the use of services on output for manufacturing sectors, that are over average KIBS users and, for each Provinces and year, we multiply it by the total employment in each respective manufacturing sector. Then, we divide this number by the Province's i total employment in year t.

$$IDEMAND_{pst} = \Sigma_{s=1}{}^{M} W_j \, E_{pst} / \, \Sigma_{s=1}{}^{N} E_{pst} \quad (2)$$

In equation 2 above p is the province, s the sector, t the time, M the number of above average KIBS users manufacturing sectors, N the total number of sectors, E the employment, W the weight given by the average share of KIBS in total industry output as computed from ISTAT symmetric Input Output tables in 2015. A higher value of this indicator suggests a higher province employment in manufacturing sectors that are intensive users of KIBS with respect to total province employment for each year. In Table A.3 we report the coefficients that are used as weights to construct our indicator. These are obtained by regressing the share of KIBS in total output on industry dummies for all Italian provinces included in the analysis in the year 2012.

Focussing on the manufacturing sectors, Table A.3 shows that those that make considerable use of KIBS are all (with the exception of Tobacco products) knowledge-intensive industries (printed matter and recorded media; chemicals and chemical products; office machinery and computers, radio, television and communication equipment and apparatus; medical, precision and optical instruments, watches and clocks).On the contrary, labour- and scale-intensive industries appear, on average, to be low or medium users of KIBS. Tab A.3 also shows a high use of KIBS by other KIBS. Despite this evidence on the importance of the use of KIBS by other services, we focus on Hirschman linkages between KIBS and manufacturing sectors. In this way, we focus on the path of specialisation in KIBS occurring in traditional manufacturing-based regions. Furthermore, many inter-sectoral linkages between KIBS and other service sectors occur in large urban areas and are captured by the proxy of urbanisation economies.

Finally, a control variable (CAP) is also constructed, by means of a dummy indicator, which takes the value of 1 when the observation refers to a province which is "Capoluogo di provincia"; and 0 otherwise. This variable is likely to be positively correlated to the dependent variable.

Descriptive statistics on the maximum, minimum, means, standard deviations of the dependent and independent variables, and partial correlations between these variables are presented in Table 2 and in Table A.2 in Appendix respectively. Data refer to the years 2012-2017. On average, the LQ index value is less than 1. Most provinces in the analysis present lower specialization levels in KIBS than expected. Thus, in these regions it is supposed that the local demand does not meet KIBS. On the other hand, 15% 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.

4. Descriptive analysis at spatial level

The following section is devoted to the descriptive analysis at spatial level, considering both the construction of the spatial matrix and the Moran's correlation coefficients and graphs.

4.1 Spatial Correlation

In order to capture the spatial correlation between KIBS specialization proxy LQKIBS and the variables affecting it we have to specify the pattern of spatial interactions among provinces as captured by the spatial weight matrix. The use of the spatial weight matrix finds its reason in the fact that it defines the limits of spatial interactions and the level of these interactions. Two are the "methods" used in the literature to evaluate the geographical connections: a contiguity or a distance indicator~~,~~ we adopt a distance-based matrix. When the distance is selected as measure this signifies that we attribute to the distance between the provinces the intensity of the interactions. In defining a distance matrix various indicator can be used depending on the definition of the distance (great circle distance, distance by roads, etc.) and on the functional form (the reverse of the distance, the reverse of the squared distance, etc.). In order to choose the functional form and the cut-off distance we rely on comparisons between different spatial matrices and evaluate the solution that maximise the overall explanatory power of the model (as given by the R-squared and log likelihood) assessed with distinctive spatial matrices as proposed by Lee (2009). Given the NUTS3 units (Provinces) we employ the great circle distance between provinces centroids, the inverse of the distance and we choose the minimum bandwidth allowing each province to have at least one neighbour[7]. More in detail, each element of the spatial weight matrix is defined as follows:

$$w_{ij}=0 \text{ if } i=j \text{ ;}$$

$$w_{ij}=1/d_{ij}^{K} \quad \text{ if } i\neq j \text{ ;}$$

Where:

- w_{ij} is part of the row standardized weight matrix W (with row standardization spatially weighted variables indicating an average across neighbouring provinces);
- d_{ij} is the great circle distance between centroids of provinces i and j; k is the functional form.

[7] We also tested our results for different distances of 100; 200; 300; 400 km. Our results are robust.

4.2 Moran's Correlation

We assess the spatial correlation regarding the province localization of KIBS using means of the Moran's I-statistic, a measure of global spatial correlation that allows the researcher to know 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. Values of I larger (smaller) than the expected value E(I)=–1/(n-1) indicate positive (negative) spatial autocorrelation.

We also use the Moran function, which illustrates the strength of spatial autocorrelation employing 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, 1996).

This indicator aids to evaluate whether there are local spatial bands of high or low values. A positive coefficient indicates spatial clustering of similar values (high or low) while a negative value indicates spatial clustering of dissimilar values between a province and its neighbours.

Table 3 and the Figures 3 below show respectively the global Moran's coefficient based on the distance matrix here defined for the dependent variables object of analysis and the Moran' s scatterplot. The statistics are computed in the 2012- 2017, the years of analysis.

The results reported highlight that as to the total KIBS and the subsectors, the spill-over effects are, in fact, positive and significant, confirming the spatial clustering of the specialization patterns underlined in the preliminary descriptive analysis in the previous section. The degree of spatial correlation in the localization of KIBS is positive and significant at high level, the global Moran coefficient is 0.072 (significant at 1%).

Table 3: Moran coefficient for KIBS specialization in Italy by Province—localization quotient between 2012 and 2017. (total KIBS and 62, 63, 69, 70, 71, 72, 73, 74)

VARIABLE	MORAN' S TEST	PVALUE
DEPENDENT VARIABLES		
LQKIBS	0.072	0.000
LQKIBS62	0.016	0.000
LQKIBS63	0.077	0.000
LQKIBS69	0.060	0.000
LQKIBS70	0.015	0.000
LQKIBS71	-0.011	0.000
LQKIBS72	0.004	0.025
LQKIBS73	0.191	0.000

Source: ISTAT data.

Considering Figure 2, Panel a, related to total KIBS, there appears to be important clustering effects with most provinces located in the upper-right or bottom-left quadrants (indicating positive spatial correlation respectively of high and low values). Only a few provinces are located in the upper left or bottom right quadrants (indicating negative spatial correlation of respectively low (high) LQKIBS provinces surrounded by high (low) LQKIBS provinces). This is also true for specialization in 62, 63, 69, 70, and 73. As to specialization in 71 (architectural services) and 72 (R&D) we have a negative and a low correlation, also evidenced in Figure 3.

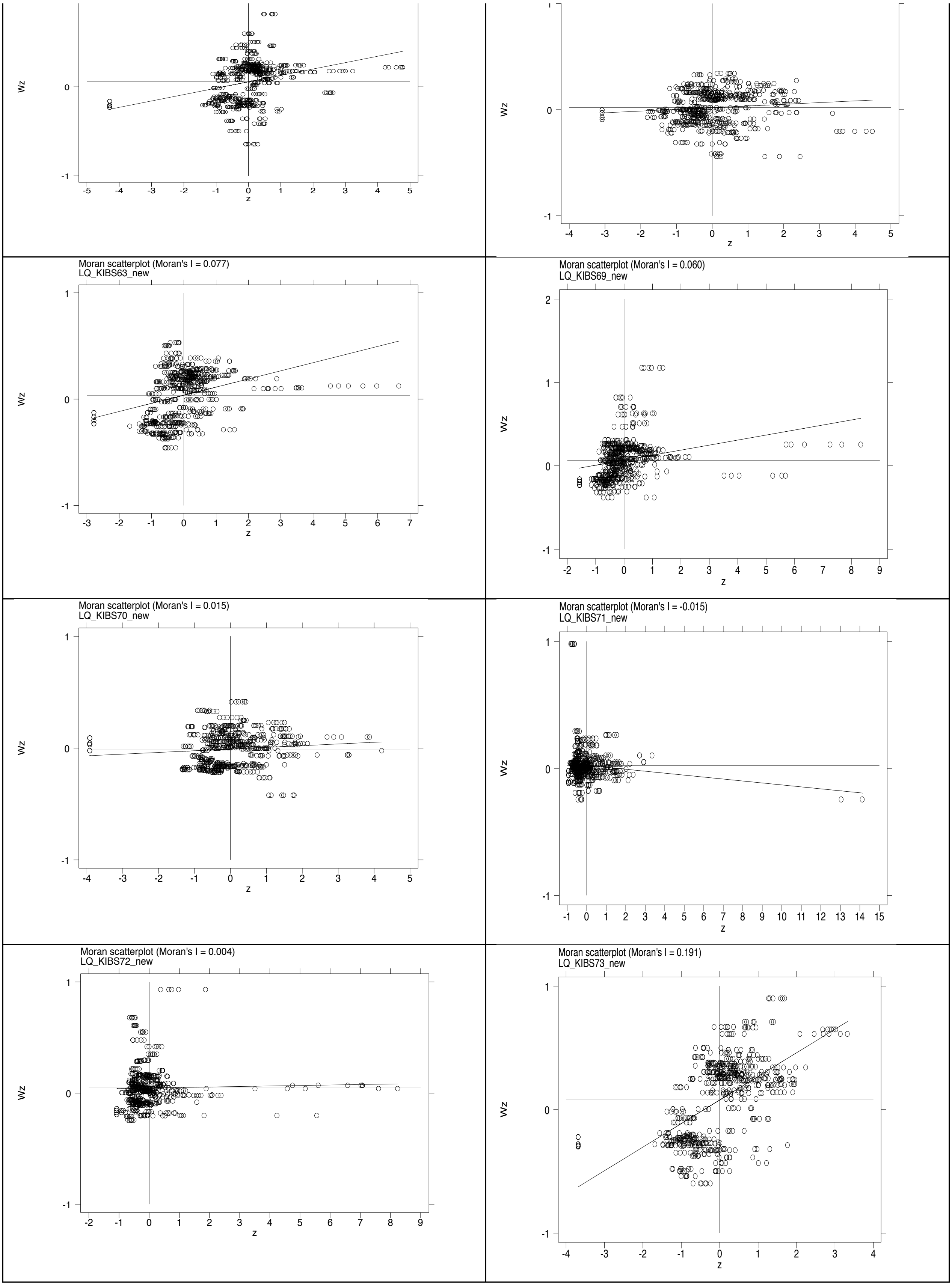

Figure 3. Moran scatterplot for KIBS specialization in Italy by Province —location quotient between 2012 and 2017.total KIBS and 62, 63, 69, 70, 71, 72, 73. Moran scatter plot of dependent variables. z=vector of each the variable in deviation from the regional mean; W=vector of spatial lags. Source: ISTAT database.

5. Econometric strategy and results

Given the existence of spatial correlation in the dependent variable, in order to perform our analysis, we employ spatial lag or spatial autoregressive (SAR) model (Anselin, 1988) and an IV spatial estimation. The choice of the SAR model is based on the test performed in Tab. A.3 where Lagrange Multiplier tests and their robust versions are used to test the OLS versus the SAR and SEM.

This model includes amongst the regressors also the spatial lagged dependent variable[8]. In this context, the models can be represented as variants of the following equation:

$$LQKIBS_{pt}^{SP} = a_p + \rho WLQKIBS_{ptSP} + B_1 IDEMAND_{pt} + B_2\, PDENSITY_{pt} + B_3\, TRT_{pt} + B_4 R\&DEXP_{rt} + B_5\, CAP_{pt} + B_7\, BROADBAND_{rt} + BRANDSHARE_{pt} + e_t \qquad (3)$$

Where W is a N*N non-negative spatial weights matrix with zeros on the diagonal that formalizes the provinces network structure: ρWLQKIBS is the spatial lagged LQ ratio of KIBS (total and for each sector separately); ρ is the SLM parameter.

The variables for province *p* and region *r* are taken as follows:

- LQKIBS denotes a N*1 vector consisting of one observation for every spatial unit of the dependent variable in the t-th time period, where the dependent variable indicates the specialization in KIBS measured by the regional share of employment in them, above discussed. We want to point on the use of all the KIBS subsector (62; 63; 69; 70; 71; 72; 73) and specialization discussed in the above section.
- PDENSITY, is the share of population over the province area, a proxy of urbanisation economies;
- CAPITAL is a dummy for regions where main cities in the region (Capoluoghi di provincia) are located;
- IDEMAND - represents the weighted share of employment in manufacturing industries that are intensive users of KIBS over total employment;
- R&DEXP is the public R&D expenditure over the GDP;
- BROADBAND is a proxy of Information Technology and it is given by the percentage of firms that have the broadband;
- BRANDSHARE represents the share of brands over population;
- TRT represents the accessibility index[9];
- e_{it} represent an N*1 vector of residuals for every spatial unit assumed to be independently and identically distributed with a mean of zero and a variance of ∂^2.

All variables are in logarithms and the model is estimated for a panel of 110 NUTS3 Italian regions drawn from the ISTAT data pooled over the period 2012-2017.

Moreover, the potential endogeneity of some variables (e.g. IDEMAND and PDENSITY)[10] highlights the risk that OLS estimates are upward biased. In order to test the existence of endogeneity in the model, the Hausman (1978) specification test is used that allows one to choose between the OLS estimation and a substitute two-stage least-squares (2SLS)

[8] Robust Lagrange multiplier tests clearly discriminate where the spatial process is allocated as a spatial lag of the endogenous variation (See Table A2 in Appendix for additional details).

[9] Data on accessibility are not available for all the years in the time period under analysis, but only for 2013.

[10] The Population density is strongly influenced by the geophysical characteristics of the reference area, which may or may not include non-habitable areas (high mountain areas, water surfaces) and by the different settlement contexts of urban and rural areas. The Intermediate demand might be affected by the problem of reverse causality.

approach employing an IV strategy.[11]

In addition to spatial Lag Model, in order to implement the instrumental variables estimation, an IV spatial Lag is employed. We consider two instruments: the proxy for regional scale economies (the ratio between employment and number of firms) (Paluziè et al., 2001; Galego and Maroto, 2015), and the total land area of the region (Artis et al., 2009; Brulhart and Mathys, 2008; Ciccone, 2002; Galego and Maroto, 2015).

The analysis uses these two instruments to enable the performing of over-identification tests as well, which indicate that endogeneity is a problem. This paper therefore deals with this issue by performing 2SLS estimations (F-statistic of first-stage estimation is higher than 10, which suggests that the instruments used in 2SLS are commonly valid).

The results, presented in table 4 and 5, are broadly consistent along the two models (SAR and 2SLS) considered but do not coincide. We focus on the Spatial Lag IV Model in commenting our results as these address endogeneity issues[12].

Sargan statistics for mutual consistency of the available instruments are performed, and the test rejects the null hypothesis of correlation between the instruments and the error. In order to test that the instruments (for a detailed review of this topic in use are not weak, some traditional tests have been carried out, following other similar models in papers such as Alcala and Ciccone (2004) (see Stock et al., 2002). Pagan–Hall tests are also provided, and the null hypothesis of homoskedasticity in the IV estimations cannot be rejected, in the most of cases, so we don't apply a GMM estimator.

A Moran's I-test for SAR and 2SLS residuals proposed by Anselin and Kelejian (1997) is realized. The test does no reject the null hypothesis of no spatial error autocorrelation. Hence, we follow a SAR instead of a SEM model (Table 3 and 4).

Considering the results, the positive number of the spatial lag confirms the picture provided by the Moran scatter plot and establishes the spatial dependence in KIBS specialisation, in fact as before advised in the descriptive analysis, spatial relationships also play an important role in combining the accessibility and localization of KIBS in Italian Provinces. Nearby externalities and positive spillovers may support lagged provinces to increase their KIBS activity, so we can conclude that the statistically significant coefficient of the lag of the dependent variable suggests that changes in the localization of KIBS in Italy positively depend on the localization patterns observed in neighbouring provinces.

In the framework of this paper, the spatial lag model takes through the spatial global multiplier[13] both the direct (marginal)[14] and indirect (spillover) effects of neighbourhood's externalities on KIBS localization. Variations in explanatory variables are handled simultaneously not only within the analysed region, but also by other neighbourhood regions with a ripple effect. The boundary that explains the size of the ripple effect is the spatial lag, which mixes spillovers through the spatial multiplier. So, the estimated quantities are steady estimates of the marginal effect, where the full effect is a multiple of the marginal effect.

For example, in KIBS specialization table 4 observing the overall KIBS and the KIBS related to architecture and engineering activities the coefficient of Global multiplier is respectively of 3.17 and 8.77. Thus, almost 17 % and 77 % of the previously analysed impact is reflected in neighbourhood specialization through indirect reaction effects. As to the other coefficients (Table 4 and 5), the global spatial multiplier is negative for most of KIBS sectors thus, signifying that the previously analysed impact is reflected in neighbourhood specialization through indirect negative reaction effects.

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[11] The Hausman test is based on the difference equal to zero between the covariance of an efficient estimator with respect to an inefficient estimator.

In this context, the null hypothesis is accepted. The statistic, under the null hypothesis of endogeneity of the regressors, is asymptotically distributed as a χ^2 with as many degrees of freedom as non-exogenous regressors are present in the specification.

[12] Sargan statistics for mutual consistency of the available instruments are made on, and the test rejects the null hypothesis of correlation between the instruments and the error.

[13] Anselin (2003) describes the global spatial multiplier $(1/1 - \rho)$ as the average extent to which the direct effect of a factor on the dependent variables is magnified by the spillovers in the system.

[14] Our analysis allows for better results in direct effects (in line with Meliciani and Savona, 2015), whereas the indirect effects indicate positive externalities only in overall KIBS and in one subsector.

These results are in line with Gallego and Maroto (2015) as the overall KIBS, but differ when we consider the subsectors. Looking at the agglomeration variables, the POPULATION DENSITY shows positive results only in some subsector (Advertisings and Marketing; Scientific research and development; Legal and accounting); while the coefficients are not significant in all the other sectors, and even negative in Business management and advisory management activities. These results are not surprising and seems to be in line with the pattern of the last years according to which the higher is the population density the less the level of specialization in KIBS which, due to congestion effects, are more likely to be in places where the agglomeration economies are decreasing (Gallego and Maroto, 2015). Hence, urbanisation externalities do not appear as key determinants of province specialisation in KIBS. This is an important result because it implies that urbanisation externalities have been counter-balanced by the effect of centrifugal forces leading KIBS to locate outside urban areas; on the other hand, the relevance of the spatial autocorrelation in KIBS location shows that the location of KIBS also depends on previous regional sectoral specialisation. Lack of significance of a high population density as well as the specific role of urban economies can also be interpreted as a less relevant role of (final) demand determinant of KIBS specialisation. Our results are in line with Gallego (2015) but differ from those by Shearmur and Doloreux (2008), who observe that in Canada KIBS serving a manufacturing may not automatically leave urban areas.

However, as to the dummy for provinces with CAPITAL cities this is highly correlated with the total KIBS specialization, and also in most of the subsectors (with the exception of Advertising and marketing) confirming the tendency to agglomerate towards the top of the urban hierarchy, i.e. in large metropolitan areas. In addition, this highlights a specific role played by large urban centres as attractors of these services. Top-tier urban agglomerations suggest positive economic externalities and favour positive connections of expertise, which are essential in KIBS activity. In this respect, the results indicate how easy access to a skilled labour force and KIBS proximity to key causes of information and knowledge impact their localization decision-making.

Moreover, our findings related to IDEMAND from manufacturing industries also represents a major determinant of KIBS specialisation across regions with the only exception of Business management and Advisory management activities. This result has important implications: on the one hand it suggests that urbanisation externalities are counter-balanced by the effect of centrifugal forces leading KIBS to locate outside urban areas; on the other hand it shows that the location of KIBS also depends on prior regional sectoral specialisation.

Overall, co-localization remains important for KIBS, where face-to-face interactions play an important role in the coordination of activities, in fact considering the TRT, the coefficient is positive and significant overall and for some subsectors, suggesting that the lower is the accessibility the greater is KIBS' need for co-localization.

Differently by the literature on innovation in services (Antonietti and Cainelli, 2008; Meliciani and Savona, 2009, Gallego and Maroto, 2015) ICT tools, here proxied by the Broadband diffusion across firms, does not show interesting results.

Alike in Meliciani and Savona (2015), that found a relationship between patents over population across regions and business services specialisation, here the level of BRANDSHARE is a key determinant and has a large impact on KIBS specialisation in all subsectors except for the Business management and advertising. In addition, the innovation environment and knowledge infrastructure of the region, proxied by PUBLIC R&D expenditure, has a positive impact on overall KIBS specialisation (Table 2), but the coefficient is only significant for Information activities and services.

From our results, it seems to be emerging that the localization patterns of KIBS do not seem to influence the localization strategies of the different KIBS subsectors alike. Market KIBS, for instance, are found to be more likely to co-localise but much less rely on R&D spillovers than their high-technology counterparts.

Table 4: Spatial Lag Model

VARIABLES	LQ_KIBS	LQ_KIBS62	LQ_KIBS63	LQ_KIBS69	LQ_KIBS70	LQ_KIBS71	LQ_KIBS72	LQ_KIBS73
	All KIBS	Software production, computer consulting and related activities	Information activities and other information services	Legal activities and accounting	Business management and advisory management activities	Activities of architectural and engineering studies; tests and technical analysis	Scientific research and development	Advertising and market research
LQKIBS NEIGHBOUR PROV.	0.685***	1.380***	1.456***	1.188***	1.517***	0.886***	1.022***	1.431***
	(0.229)	(0.264)	(0.133)	(0.160)	(0.283)	(0.205)	(0.196)	(0.131)
PDENSITY	0.0122	0.00346	0.0205	0.182***	-0.112***	0.0806	0.319***	0.0521**
	(0.0184)	(0.0351)	(0.0331)	(0.0398)	(0.0238)	(0.0887)	(0.0623)	(0.0229)
IDEMAND	0.184***	0.149***	0.344***	0.449***	-0.0634***	0.570***	0.624***	0.219***
	(0.0103)	(0.0242)	(0.0150)	(0.0335)	(0.0112)	(0.0653)	(0.0447)	(0.0144)
CAP	0.159***	0.150**	0.185***	0.273***	0.119***	0.485***	0.194*	0.0658
	(0.0324)	(0.0623)	(0.0584)	(0.0713)	(0.0422)	(0.158)	(0.111)	(0.0405)
TRT	0.158***	0.0894	0.252***	0.263**	-0.0410	0.201	0.405**	0.125*
	(0.0535)	(0.102)	(0.0962)	(0.116)	(0.0693)	(0.258)	(0.181)	(0.0665)
BROADBAND	-0.000117	-1.45e-05	0.000180	-0.00213	-0.000882	-0.00189	0.00351	-0.000553
	(0.000824)	(0.00208)	(0.00116)	(0.00317)	(0.000892)	(0.00575)	(0.00390)	(0.00121)
R&D	2.832**	-1.611	1.680	3.985	1.428	4.823	-4.835	3.530*
	-1.362	-3.194	-1.968	(4.461)	-1.489	-8.680	-5.908	-1.961
BRANDSHARE	72.50***	106.4***	71.55***	278.7***	-6.226	244.3**	260.4***	74.84***
Constant	-0.722**	-0.353	-0.969*	-1.898***	0.746**	-1.109	-3.502***	-0.678*
	(0.287)	(0.555)	(0.503)	(0.667)	(0.364)	-1.422	-1.002	(0.360)
Observations	660	660	660	660	660	660	660	660
Method	SPA_LAG	SPA_LAG	SPA_LAG	SPA_LAG	SPA_LAG	SPA_LAG	SPA_LAG	SPA_LAG
Wald Test	441.7505***	88.4496***	776.2421***	398.0521***	113.7971 ***	134.7342***	316.1236***	494.5538***
R squared	0.1448	0.0971	0.1508	0.4157	0.3074	0.0145	0.0768	0.4332
Log Lik	290.3485	56.5225	-96.2202	-219.0167	251.6485	-702.5232	-525.0738	228.3280
Global Multiplier	3.17	-2.63	-2.19	-5.13	-1.93	8.77	-45.5	-2.32
Moran I	0.0177 (0.1777)	0.0046 (0.7535)	0.0152 (0.0845)	0.0276 0.2888	0.0006 0.9209	0.0165 0.5299	0.0117 0.2812	0.0081 0.3223

Standard errors are in parenthesis. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level; Standard errors in bracket

Table 5: Spatial Lag IV Model

VARIABLES	LQ_KIBS	LQ_KIBS62	LQ_KIBS63	LQ_KIBS69	LQ_KIBS70	LQ_KIBS71	LQ_KIBS72	LQ_KIBS73
	All KIBS	Software production, computer consulting and related activities	Information activities and other information services	Legal activities and accounting	Business management and advisory management activities	Activities of architectural and engineering studies; tests and technical analysis	Scientific research and development	Advertising and market research
LQKIBS NEIGH	1.429***	1.840**	1.869***	0.664***	1.849***	1.218***	1.099***	1.399***
	(0.453)	(0.890)	(0.304)	(0.254)	(0.487)	(0.383)	(0.364)	(0.183)
PDENSITY	0.0652*	0.0563	0.0437	0.163**	-0.0410	-0.0467	0.126	0.110***
	(0.0356)	(0.0701)	(0.0520)	(0.0667)	(0.0536)	(0.155)	(0.138)	(0.0402)
IDEMAND	0.192***	0.138	0.150*	0.601***	0.0486	0.516**	0.501**	0.244***
	(0.0570)	(0.107)	(0.0795)	(0.0984)	(0.0831)	(0.236)	(0.222)	(0.0626)
CAP	0.149***	0.135**	0.116**	0.317***	0.135**	0.481***	0.195	0.0607
	(0.0365)	(0.0682)	(0.0521)	(0.0644)	(0.0555)	(0.151)	(0.132)	(0.0410)
TRT	0.233***	0.158	0.235**	0.333**	0.119	-0.0578	0.0462	0.228***
	(0.0736)	(0.142)	(0.107)	(0.135)	(0.110)	(0.315)	(0.278)	(0.0838)
BROADBAND	-0.000169	-0.000279	-0.000463	-0.00173	-0.000182	-0.00235	0.00319	-0.000449
	(0.000880)	(0.00215)	(0.00147)	(0.00353)	(0.00104)	(0.00600)	(0.00396)	(0.00128)
R&D	1.672	-2.337	4.972**	1.883	0.937	3.340	-2.349	3.252
	-1.572	-3.652	-2.393	(4.888)	-1.715	-9.558	-6.841	-2.131
BRANDSHARE	69.12***	100.3**	155.0***	261.5***	-35.78	283.2**	318.5***	64.42**
	(21.68)	(46.67)	(34.32)	(51.12)	(31.13)	(113.2)	(91.58)	(27.31)
Constant	-1.205***	-0.827	-1.160*	-2.130**	-0.201	0.641	-1.209	-1.358***
	(0.441)	(0.838)	(0.640)	(0.829)	(0.657)	-1.900	-1.627	(0.504)
Observations	660	660	660	660	660	660	660	660
Method	SPA_IV	SPA_IV	SPA_IV	SPA_IV	SPA_IV	SPA_IV	SPA_IV	SPA_IV
R Squared	0.0479	0.0925	0.2858	0.3261	0.1817	0.0251	0.1276	0.3763
Log Lik	254.9527	-58.2171	-15.9491	-266.0851	196.6103	-698.9760	-506.3926	196.7448
Wald Test	116.5111***	30.9689 ***	101.4630 ***	237.8969***	40.9059 ***	60.6949 ***	78.7369 ***	218.9185 ***
Sargan Test	2.1188	0.00051	8.71777	73.8841	13.25920	2.54624	15, 53101	3.27547
P value Sargan	0.7139	1.0000	0.0686	0. 305	0. 1018	0.6364	0. 3303	0.5128
Pagan Hall Test	15.147 0.989	1.151 0.2832	0.0036 0.9519	3. 8834 0. 4488	0. 0059 0. 9389	12. 4242 0. 6684	2. 7121 0. 0996	8. 0739 0. 0045
Global Multiplier	-2.33	-1.19	-1.15	−2. 97	−1. 17	−4. 58	−1. 01	−2. 50
Moran's I Stat	0.0262 (0.1779)	0. 0130 (0. 1369)	0.0217 (0.0166)	0. 0596 0. 8988	0. 0037 0. 8294	0. 0524 0. 7899	0. 0082 0. 4825	0. 0077 0. 5246

Standard errors are in parenthesis. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level; Standard errors in brackets.

6. Conclusions

Our results suggest that agglomeration economies do not affect KIBS localization strategies as expected. Actually, in most cases we found that the higher the growth of the regional population density, the less the level of regional specialization in KIBS. This fact suggests that KIBS are getting more incline to localize in areas where decreasing agglomeration economies are taking place. However, localisation economies remain important for KIBS where face-to-face interactions play an important role in the coordination of activities such as in advertising and marketing (PKIBS).

However, KIBS' tendency to agglomerate in the biggest urban centres remains. Hence, our results do emphasise the centripetal role of large metropolitan areas for KIBS location.

Moreover, closeness to knowledge spill overs and to their customers do benefit KIBS as suggested by the fundamental role played by regional R&D spillovers and domestic intermediate demand in raising the regional specialization patterns in most KIBS sectors both related to P-KIBS and T-KIBS. Transport and communication networks are also crucial for KIBS localization but only in some sectors especially related to P-KIBS.

Some relevant lessons derive from our analysis in terms of the role of geographical proximity. The diffusion of ICT has created new ways of service provision over distance, and a path of externalization and outsourcing of specialized knowledge functions to different intra and inter-national markets. This might be the reason that relaxes in some sectors (Software production and Business management services) the requirement of face-to-face communication between KIBS and their clients, favouring KIBS tradability. However, these aspects deserve further investigation, given the lack of an ICT accessibility measure at province level covering a long span of time.

In addition to this, the improvements in transport accessibility of regions are reducing the protection that distance offered to more hinterland areas 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, although this also deserves future analysis.

Besides, our results also suggest that the local dimension of KIBS specialisation goes beyond the agglomeration in large urban areas.

Following van Oort, (2007) and Raspe and van Oort, (2007) spatial and sectoral contiguity, which need to be captured within a larger spatial unit of analysis than the city, explain much of the KIBS specialisation across Italian provinces regions.

The issue of agglomeration is not losing reason for being discussed. It has rather become relevant to analyse how the foundations of the agglomeration process are evolving and how regional transport and digital infrastructures are a channel for the generation of new agglomeration clusters in which there are interactions with actors localised in distant areas.

In terms of policy there are important issues deriving from the analysis given that KIBS are increasingly considered to be fundamental to the development of regional innovation systems and to the boosting of regional economic growth of advanced economies as channels of transmission of transformation and knowledge to the rest of economic actors.

A first important indication from our findings is to inform the regional policy of the risks deriving from the spatial concentration of KIBS, which can create a strong regional polarisation of activities and reinforce the gap between core and peripheral areas. The location of knowledge-intensive activities in large metropolitan areas may foster regional development, but it could also cause negative externalities in surrounding areas especially in peripheral rural and 'old manufacturing' areas.

Our results are also in line with Wernerheim and Sharpe (2003) in rejecting the hypothesis of footloose service location according to which, due to the diffusion of ICT, business and knowledge intensive services would locate independently from proximity to other manufacturing industries. Our findings have shown that KIBs tend to concentrate not only in large metropolitan areas, but also in regions where KIBS users are located. This would make not efficient policies of incentive to location in regions not specialised in KIBs users sectors.

What seems to matter is also the ability to build on regions' existing specialisation, ensure technological upgrading of traditional sectors in manufacturing and expand into knowledge-related sectors, which reinforce the innovation ecosystem. This makes essential to support KIBS with public investment as service-based prompters of innovation instead of adopting a strategy only focused on production and technology as the basis for the economic catching up of regions.

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Appendix: Additional Tables and Figures

Table A.1. KIBS by ATECO 2007 classification

J62	Software production, computer consulting and related activities
J63	Information activities and other information services
M69	Legal activities and accounting
M70	Business management and advisory management activities
M71	Activities of architectural and engineering studies; tests and technical analysis
M72	Scientific research and development
M73	Advertising and market research
M74	Other professional, scientific and technical activities

Table A.2 Correlation Matrix

	LQKIBS	LQ62	LQ63	LQ69	LQ70	LQ71	LQ72	LQ73	LQ74	PDEN		CAP	TRT	BBAND	R&D	BRANDS
LQ_KIBS	1.000															
LQ_KIBS62	0.6216	1.0000														
LQ_KIBS63	0.8001	0.3800	1.0000													
LQ_KIBS69	0.7042	0.3884	0.4336	1.0000												
LQ_KIBS70	0.4381	0.3149	0.0840	0.0337	1.0000											
LQ_KIBS71	0.3330	0.1011	0.1782	0.2128	0.1030	1.0000										
LQ_KIBS72	0.5164	0.2366	0.3051	0.6511	-0.0822	0.1518	1.0000									
LQ_KIBS73	0.7260	0.3683	0.5091	0.5522	0.1532	0.2426	0.3540	1.000								
LQ_KIBS74	0.3398	0.2241	0.2866	0.0306	0.2184	0.0596	0.0498	0.3332	1.0000							
PDENSITY	0.2829	0.1595	0.1669	0.5231	-0.2510	0.1421	0.4244	0.4106	-0.1567	1.0000						
IDEMAND	0.2084	0.1111	0.1892	0.1930	-0.1221	-0.0065	0.0706	0.4730	0.1093	0.2122	1.0000					
CAP	0.3272	0.2697	0.1741	0.3766	0.1610	0.1842	0.2196	0.1524	-0.0906	0.2029	-0.0897	1.0000				
TRT	-0.2137	-0.1104	-0.1152	-0.2883	0.0784	-0.1417	-0.2225	-0.3164	-0.0779	-0.5590	-0.3461	-0.1362	1.0000			
BROADBAND	0.1384	0.1078	0.1408	0.1361	-0.1116	0.0281	0.0979	0.2260	0.1651	0.0406	0.2380	-0.0134	-0.0141	1.0000		
R&D	0.2706	0.0373	0.3510	0.2599	-0.2175	0.1019	0.1174	0.4285	0.3262	0.2478	0.3825	-0.1297	-0.3217	0.2070	10.000	
BRANDSHARE	0.5959	0.3653	0.4511	0.7318	-0.0691	0.2317	0.5644	0.4953	0.0438	0.3985	0.2264	0.3511	-0.3018	0.1424	0.2771	1.0000

Table A.3 Diagnostics

Test	Statistic	p-value
Spatial error:		
Moran's I	2.990	0.003
Lagrange multiplier	2.499	0.114
Robust Lagrange multiplier	10.542	0.001
Spatial lag:		
Lagrange multiplier	34.496	0.000
Robust Lagrange multiplier	42.538	0.000

Table A.4. Share of KIBS in total industry output, Italy

Above-average manufacturing industries	Share	Above-average service industries	Share
18: printing and reproduction of recorded media	11,16%	60: programming and broadcasting activities	27,58%
		59: motion picture, video and television programme production, sound recording and music publishing activities	27,58%
17: manufacture of paper and paper products	7,00%	62: computer programming, consultancy and related activities	25,08%
30: manufacture of other transport equipment	4,91%	63: information service activities	25,08%
27: manufacture of electrical equipment and of non-electric domestic appliances	4,76%	74: other professional, scientific and technical activities	24,42%
33: repair and installation of machinery and equipment	4,55%	75: veterinary activities	24,42%
29: manufacture of motor vehicles, trailers and semi-trailers	4,26%	71: architectural and engineering activities, technical testing and analysis	23,21%
28: manufacture of machinery and equipment n.e.c.	3,78%	69: legal and accounting activities	20,28%
22: manufacture of rubber and plastic products	3,65%	70: activities of head offices, management consultancy activities	20,28%
21: manufacture of basic pharmaceutical products and pharmaceutical preparations	3,39%	85: education	14,26%
31: manufacture of furniture	3,09%	72: scientific research and development	13,31%
32: other manufacturing	3,09%	58: publishing activities	13,21%
		95: repair of computers and personal and household goods	10,88%
		78: employment activities	10,53%
		77: rental and leasing activities	10,13%

Below-average manufacturing industries	Share	Below-average service industries	Share
09: mining support service activities	0,82%	56: food service activities	5,89%
10: manufacture of food products	0,40%	47: retail trade, except of motor vehicles and motorcycles	5,11%
11: manufacture of beverages	0,40%	64: financial service activities, except insurance and pension funding	4,92%

12: manufacture of tobacco products	0,40%	93: sports activities and amusement and recreation activities	4,90%
19: manufacture of coke and refined petroleum products	0,38%	79: travel agency, tour operator and other reservation service and related activities	4,29%
		41: construction of buildings	4,06%
		42: civil engineering	4,06%
		43: specialised construction activities	4,06%
		53: postal and courier activities	3,99%
		51: air transport	2,78%
		90: creative, arts and entertainment activities	2,70%
		91: libraries, archives, museums and other cultural activities	2,70%
		92: gambling and betting activities	2,70%
		50: water transport	2,18%
		49: land transport and transport via pipelines	1,95%
		35: electricity, gas, steam and air conditioning supply	1,66%
		52: warehousing and support activities for transportation	1,62%
		86: human health activities	1,49%
		36: water collection, treatment and supply	1,33%
		96: other personal service activities	0,97%
		37: sewerage	0,87%
		38: waste collection, treatment and disposal activities, materials recovery	0,87%
		39: remediation activities and other waste management services	0,87%
		87: residential care activities	0,26%
		88: social work activities without accommodation	0,26%

Source: ISTAT database.

Notes: Industries are defined as above (below) average when the share is higher (lower) than the average plus (minus) (1/2) standa deviation.