Regional Strategies for Dealing with Structural Change (provisional title)

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Abstract

In recent decades, the low economic performances of European countries have been mainly responsible for the emergence of an economic policy increasingly intended to strengthen the innovative and technology capacity of regions. In particular, the European periphery is lagging behind in the transition to a knowledge driven and eventually service-oriented economy. In a general context of de-industrialization and transition to service economy, and bearing in mind the policy debate at the EU level, the aim of this paper is to analyze the factors driving knowledge-intensive service specialization at the regional level in Italy. Our main research questions here can be summarized as follows: What determines the transition to Services and the specialization in Knowledge-Intensive Services (KIS) in Italy? What are the structural characteristics that may explain the regional variation of employment's share in high-knowledge services? Using data on Italian regions over the period 1995-2014 (and spatial panel models as a methodology), the analysis carried out in the paper suggests some considerations: the "mere" (but needed) transition to services activities can be positively associated with R&D Personnel, Tertiary Education, University Attractiveness, Tourism and efficient infrastructure (Railroad). But the transition to Knowledge Intensive Services, supposed to pay higher wages, may deserve a more appropriate and focused public intervention, in view of the fact that it seems to be mainly associated with Public R&D, Tertiary Education and University Attractiveness.

1 Introduction

In recent decades, the low economic performances of European countries have been mainly responsible for the emergence of an economic policy increasingly intended to strengthen the innovative and technology capacity of regions. The Lisbon Strategy aims to guide economic development and structural change towards a knowledge-based economy. The strategy has involved several important actions, among them better policies to enhance the level of investment in R&D. The Lisbon Strategy was relaunched in 2005, with its focus on the goals of growth and employment and its use as an instrument to put Europe back on the road to

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development and cohesion. A dual purpose was therefore assigned to the cohesion policy, whose prime objective had previously been reduction of the regional disparities and backwardness typical of marginal areas. In developing national strategic frameworks and operational programms for the period 2007-2013, Member States were invited to pay particular attention to supporting innovation, research and improving education and vocational training.

More recently, the Europe 2020 strategy further relaunched innovation as a key driver of regional development and structural change. In this respect, it is important to note that the European Commission has put a special emphasis on a set of technologies - labelled as 'Key Enabling Technologies' - that, because of their pervasiveness, may enable process, product and service innovation throughout the economy, thus favoring the structural transformation towards a 'knowledge-based' and 'low-carbon' economy. Technology-driven structural change and/or specialization is also a central ingredient of the 'Smart Specialization' strategy in the framework of the EU Cohesion Policy 2014-2020. In particular, the 'Research and Innovation Strategies for Smart Specialization' (RIS3) EU strategy encourages EU regions and cities to strengthen their distinctive technological bases, to concentrate the available resources on their actual or potential areas of comparative advantages, to diversify into technologies, products and services that are closely related to existing dominant technologies and the regional skills base (European Commission, 2011, 2014).

The European periphery is lagging behind in the transition to a knowledge driven and eventually service-oriented economy. The distribution of high-tech industries were more geographically clustered than traditional industries in Europe already in 1990 (Paci and Usai, 2000). The increasing polarization of the knowledge intensive industries during the 1990s (see Cutrini, 2010 for evidence) has favored Northern European countries and is usually associated with the wider availability of highly skilled labour. During the 1990s, structural changes in Northern Europe occurred towards greater specialization in high-technology manufacturing industries, while Southern regions lagged behind.

Italy has some characteristics that can explain a particular development path. In particular, specialization in traditional light industries dates back to the post-war period and the subsequent development of industrial districts (IDs) that derived their competitive advantages from the so-called Marshallian external economies. A substantial body of literature on Italian IDs in Italy has provided the underlying reasons for Italy's particular form of economic development. Other authors considered the result of an incomplete development path, both from a sectoral and territorial point of view.

In a general context of de-industrialization and transition to service economy, and bearing in mind the policy debate at the EU level, the aim of this paper is to analyze the factors driving knowledge-intensive service specialization at the regional level in Italy.

Our main research questions here can be summarized as follows: What determines the transition to Services and the specialization in Knowledge-Intensive Services (KIS) in Italy? What are the structural characteristics that may explain the regional variation of employment's share in high-knowledge services?

The paper is organized as follows: section two presents a brief review of the literature on the Italian structural change during recent years; section three illustrates methodology and data of the empirical analysis; section four presents the results; section five draws some conclusions and policy implications.

2 Literature review

We review two lines of research that are related to this paper. The empirical literature on the persistent manufacturing specialization in low-tech industries and the more recent literature on the transition from industry to the service sector, focusing on the Italian economy.

2.1 The Italian Way (1): manufacturing specialization in low-tech industries

Some authors have looked at the specialization patterns of Italy and their determinants from a national perspective (Epifani, 1999; Onida, 1999). On the basis of normalized shares of exports, Epifani (1999) showed that Italy was characterized by a weak performance in the so-called scale-intensive industries (transport equipment, chemicals, basic metals, etc..), in capital-intensive and large-scale industries, and in the so-called science-based industries (telecommunications, measuring and testing instruments, chemical and pharmaceutical products, etc), characterized by an intensive use of technical and scientific knowledge inputs. The Italian model of specialization, instead, is characterized by an outstanding performance in labour-intensive traditional industries, and in the so-called specialized suppliers (particularly, specialized machinery) characterized by intermediate intensity of physical capital.

Epifani (1999) argued that in the second post-war period Italy was a labour-abundant country relative to its trade partners, and particularly relative to other European countries. It therefore specialized in labour-abundant traditional industries.

On the basis of the idea that, in the presence of significant external economies, international specialization may be fully driven by the initial comparative advantages, Epifani (1999) argued that, despite the capital accumulation of the subsequent decades, the Italian model of specialization did not follow the change in its comparative advantages, as instead happened in rapidly catching-up countries like Japan and Spain. The persistence of the Italian specialization pattern may be thus explained by the advantages of the industrial districts that dominate the territorial organization of traditional industries in Italy. Italy was therefore locked-in in its specialization in traditional industries because of its important external economies in those industries.

Other authors contend that the reason for Italy's low specialization in high-technology industries is the manifestation of an 'incomplete' development path. From this perspective, the Italian anomaly is deeply rooted in the past century when - after 1960 - Italy drastically reduced, sometime to the point of discarding completely, its productive capacity in capital-, technology and knowledge-intensive industries such as chemicals, pharmaceuticals, informatics and consumer electronics, although it had long occupied a first-ranking position in these industries at the international level. The abandonment of these industries, which can be considered strategic for self-sustained and balanced economic development was, according to some authors, the result of complex political choices instead of the natural consequence of market-based competition (Gallino, 2003).

Differences in the sectoral composition of regional manufacturing activity underpin the persistence of a deep regional divide between the North and the South of the country. Some authors have considered the regional convergence-divergence process in the Italian development path and have confirmed that the persistence of the North-South divide has been driven by a growing technology divide in recent decades (Terrasi, 1999; Lanzafame, 2006).

2.2 The Italian Way (2): the transition from industry to services (and the current crisis?)

It is well known that Italy - as the other so-called advanced economies with high per-capita income - experienced during the past two decades a process of de-industrialization and shift towards tertiary sectors.

Italy entered this transition in the context of a general slowdown of the European economy and with a set of fragilities that Italy has in common with other economic systems of the European Periphery (namely Spain, Portugal and Greece): a low-tech oriented industrial structure, a high incidence of low-skilled workforce, and a significant educational gap with the other OECD countries[1].

To date, only few works focus on the structural change dynamics of the Italian economy including the period of the Great Recession.

Moreover, the literature on this topic suggests that there are important regional differences. For example, Quatraro (2009) investigated structural change in the Italian regions between 1980 and 2003, and found that, at least within late-industrialized regions -the so-called NEC regions (see Fu‡ and Zacchia (1983)- the manufacturing sector was still playing a crucial role. Within early industrialized macro regions (The North-West of the country), notwithstanding the diminishing importance of the manufacturing sector, knowledge based services did not reach a large scale either. Accetturo et al. (2015) focus on the structural change to a service economy in the North West macro region and confirm this tendency for the recent period. In particular, a too slow transition towards technology-intensive manufacturing sectors and to knowledge intensive services, is considered as one of the main factors explaining the the recent slow growth of the North West region.

Bellandi and Lombardi (2016) provided evidence of a de-industrialization which is evident by a strong employment decrease by the manufacturing industry in the decade 2001-2011 (-19.4% at the national level), with a huge heterogeneity across regions both in terms of employment and number of local units. Within the manufacturing industry, the incidence of sectors with higher technology content decreased during the period 2007-2013. Also in this case there are large regional differences.

Valentini et al., (2016) suggest two main tendencies of the recent structural change in the Italian economy: (1) a slow transition to services that mainly occurred towards low-payed jobs like services to persons (such as nursing, housecleaning and other very low skilled jobs) while it was negligible in “advanced” services, and (2) the persistence of specialization within the manufacturing industry in low-wage and low-tech manufacturing industries (like textiles, textile products, leather and footwear). The

[1] The persistence of this distinctive features over time caused a decrease of the overall labor productivity, according to some empirical studies (e.g. Da Silva and Teixeira (2012) for an analysis of Italy and Spain since 1995)

progressive contraction of the aggregated income, which has negatively affected aggregated demand may have been influenced to some extent, and among other factors, by these two types of structural tendencies.

This evidence sound consistent with the theory of "extended crisis" proposed by Delli Gatti et al. (2012) for a symmetric interpretation of the crises of 1929 and 2008. Their main hypothesis is that, in the presence of barriers to labor mobility towards a "new" sector, the falling incomes in the manufacturing (agricolture in '29) industry reverberated in the rest of the economy, via a low demand for goods and services[2].

Actually, there is some evidence that the rise of unemployment during the Eurozone crisis is not just a cyclical phenomenon but it has some structural causes. Although structural unemployment was already very high in the euro area before the crisis, the euro area Beveridge curve, which summarizes unemployment developments at a given level of labour demand (or vacancies), suggests the emergence of a structural mismatch across euro area labour markets during the crisis. Moreover, the analysis of skill mismatch suggests a notable increase in the disparity between the skills of the labour force and the skills required by employers at regional, country and euro area level (Draghi, 2014).

The shift to a knowledge-oriented economy can be further slowed down by the lack of vertical integration between the so-called KIBS (Knowledge Intensive Business Services) and high-tech and low-tech industries, that characterized the Italian manufacturing system compared to France, Germany and United Kingdom (See Ciriaci and Palma, 2012, for an evidence)[3].

3 In search of determinants of services specialization

In view of the above arguments, the following analysis tries to contribute to understand what are the factors that could enhance an inter-sectoral

[2]Suppose that a long period of productivity growth hits the large distinctive sector - i.e manufacturing, and, in particular, low-tech and less-knowledge intensive industries in the 2008 crisis. Since traditional manufacturing industries are supposed to face inelastic, slower growing demand for goods, the growth of productivity implies a reduction of the labor, thus employment fall. In a frictionless world, this should not be a problem. Nonetheless, in the real world many difficulties prevent a fast migration of workers from one sector to another, even within the manufacturing industry (e.g. blu-collars considered as high-skilled workers in the textiles industry need to acquire different qualifications if they aim to be hired by firms operating in the biotech industry). Thus, since it is costly to move to knowledge-intensive industries or services, there will be a lower sectoral income for a large economic sector. Therefore, the effect will be a decrease of the global income in the economy, hence a reduction in the demand for other sectors' output, and lower prices in the manufacturing industry. In turn, this scenario may reduce the demand for services by the manufacturing firms.

[3]Knowledge intensive business services (KIBs) are considered a characteristic feature of a knowledge-driven economy. They are important sources of knowledge creation (Miles et al., 1995), and they includes activities in which modern technologies, specific abilities and professional knowledge are intensively used (Miozzo; Grimshaw, 2006). KIBs encompass different categories of services that are important fo improve the firms' capacity of innovation and internationalization: R&D services, technical/IT services for production and information/communication functions, economic services for management and administration functions, marketing/Advertising (Strambach et al. (2007)). They are usually provided in close interaction with the firm since they aim to meet the needs of clients by offering individualized solutions.

migration from the low productivity and low-wages sectors to high productivity and high-wages sectors, and contribute to define appropriate policies in order to foster long-run economic growth but also to overcome the demand-side crisis that hit the Italian and other countries mainly of the European Periphery.

Most of the empirical literature on technological specialization has been carried out at national level. Notable exceptions that consider regions as basic units of analysis are Peter and Frietsch (2009), Breschi (2000), Paci and Usai (2000), Montresor and Quatraro (2015). For a more recent period, and on the basis of patent data, Usai (2011) analyses inventive activities across regions of main OECD economies and Evangelista et al. (2016) investigate the effects of KETs on regional growth for NUTS2 regions taking into account the period 1996-2011.

The literature to date has not addressed the issue of what determines the regional specialization in Services and Knowledge Intensive Services at the regional level. With the aim of achieving deeper understanding of the determinants of regional specialization, this section present the result of a spatial panel analysis. The empirical analysis is carried out at a NUTS2 level using data for Italian regions over the period 1995-2014.

The results of the "classical" panel regression approaches might be biased, because they neglect any sort of spatial correlation. To take into account possible local spillover effects of regressors and possible spatial dependence in the patterns of specialization, it is recommended to follow the methodology proposed by (Belotti et al., 2013a)[4]. It consists of testing the presence of a spatially dependent scheme and to run different tests to determine the most appropriate model.

The following one is a general specification for Spatial Panel models (Belotti et al., 2013a):

$$y_{i,t} = \alpha + \tau y_{i,t-1} + \rho \sum_{j=1}^{n} w_{ij} y_{j,t} + \sum_{k=1}^{K} x_{i,t,k}\beta_k + \sum_{k=1}^{K}\sum_{j=1}^{n} w_{ij} x_{j,t,k}\theta_k + \mu_i + \gamma_t + \nu_{i,t}$$

$$\nu_{i,t} = \lambda \sum_{j=1}^{n} m_{ij}\nu_{i,t} + \epsilon_{i,t} \quad i = 1, ..., n \quad t = 1, ..., T \tag{1}$$

where i and j identifies the regions; $u_{i,t}$ is a normally distributed error term; w_{ij} are the elements the spatial matrix W, used for the autoregressive component and for the spatially lagged independent variables[5]; m_{ij} are the elements of the spatial matrix for the idiosyncratic error component; μ_i is the individual fixed or random effect and γ_t is the potential time fixed effect[6].

The ratio of Service, or Knowledge Intensive Services, employment to total employment will be used as dependent variable (y_i), alternatively[7].

[4]Belotti et al. (2013a) base their work on Lee and Yu (2010), Elhorst (2010) and Cameron et al. (2011).

[5]We use an inverse distance matrix based on the geographical distance between the regions' centroids in which $w_{ij} = \frac{1}{d_{ij}}$. Data on regional administrative boundaries are drawn from ISTAT (http://www.istat.it/it/archivio/124086).

[6]Given the not very high number of observations and the high number of parameters to estimate, in particular with regional fixed effects, time fixed effects will be excluded.

[7]Sources, Eurostat Datasets: "Employment in technology and knowledge-intensive sectors by NUTS 2 regions and sex (1994-2008, NACE Rev. 1.1)" [htec_emp_reg] and "Employment in technology and knowledge-intensive sectors by NUTS 2 regions and sex (from 2008 onwards, NACE Rev. 2)" [htec_emp_reg2].

The independent variables (x_i) will be considered one at time in each estimation, because of the not very high number of observations in our dataset and the high number of parameters needed to be estimate. The independent variables are:

- **Research and Development Personnel** (full time equivalent per 1000 inhabitant);
  R&D functions may be located in urban areas and metropolitan regions characterized by higher degree of services orientation. The functional specialization of urban regions with headquarters and business services clustered in larger cities (see Duranton and Puga, 2005) may attract larger firms endowed with R&D labs. Bade et al. (2015) provide evidence of increasing co-localization of R&D and headquarters for some manufacturing industries in Germany. Hence, R&D personnel density can be positively associated with the regional specialization in services activities.
- **Public Expenditure for R&D** (% gdp);
  We aim to consider the role played by the public provision of material infrastructure and the quality of immaterial infrastructures. In particular, for the latter, we consider the share of public expenditure in R&D over gdp. Moreover, it can be a good way to face the current crisis in view of the arguments of Delli Gatti et al. (2012): Public Expenditure for R&D can sustain the aggregate demand in the short run (in front of the fall of the employment in manufacturing), and facilitate the transition to (knowledge based) services in the long run.
- **Tertiary Education** (university, doctoral and specialization courses), % of 15-64 population;
  To foster the inter-sectoral migration toward higher-wages jobs, it is necessary to improve the matching of labour supply and demand in terms of skill requirements. In this view, the share of active population with a tertiary education aims to capture the need of a specific human capital to favor the transition of regional economic system towards services, and, in particular, towards knowledge-intensive activities.
- **Index of Attractiveness of Universities** (ratio between the net migration of students and the total number of enrolled students, %);
  The attractiveness of the regional university system intends to measure the quality of the university system could be related to a more developed service sector (again, usually metropolitan regions are endowed with both a better educational systems and a more service-oriented economic structure).
- **Rail Network** on regional surface (km per hundred square km);
  A well developed railway infrastructure may be associated either to a balanced regional urban system so as to connect the whole regional territory, or to the presence of a metropolitan area. Both kind of urban system should be associated to the development of services but not necessary to knowledge-intensive services which do not need material infrastructure for its development[8].

[8] For KISs, it is probably more important the quality of immaterial infrastructure, as our results confirm.

Source for "Tertiary education (university, doctoral and specialization courses), % of 15-64 population": ISTAT online database "I.Stat". Source for all the remaining variables: ISTAT, "Banca dati indicatori territoriali per le politiche di sviluppo" (http://www.istat.it/it/archivio/16777). Data range from 1995 to 2014. For all the y_i and x_i, we use the logarithmic transformations of the data taken form the dataset listed in the respective footnotes.

Turning back to equation (1), different models specifications derive from different values of some key parameters:

- Static Models ($\tau = 0$) and Dynamic Models ($\tau \neq 0$);
- if $\theta = 0$: Spatial Autoregressive Model with Auto Regressive disturbances (SAC);
- if $\lambda = 0$: Spatial Durbin Model (SDM);
- if $\lambda = 0$ and $\theta = 0$: Spatial Autoregressive Model (SAR);
- $\rho = 0$ and $\theta = 0$: Spatial Error Model (SEM)

The possibile alternative spatial models have been tested by the tools proposed by Belotti et al. (2013a). The only spatial model which can be excluded with some confidence, in all the specifications, is the SAR one[9].

4 Results

Tables 1-7 present the results of the other models (SDM, SAC and SEM). In all the models, a cluster-correlated robust estimate of variance is used[10]. At this stage, we comment the results only as mere correlations (causal analysis to be performed).

The results can be briefly summed up: the "mere" (but needed) transition to services activities can be positively associated with R&D Personnel, Tertiary Education, University Attractiveness, Tourism and an efficient Railroad. But the transition to Knowledge Intensive Services, supposed to pay higher wages, may deserve a more appropriate and focused public intervention, in view of the fact that it seems to be mainly associated with Public R&D, Tertiary Education and University Attractiveness.

In the context of the Smart Specialization strategy, some other considerations are worth to be done. It goes without saying that not all regions can be specialized in the same activities. Although, knowledge-intensive services can facilitate the production of different goods with very different technological and innovation content. Hence, they are important to facilitate the modernization of production processes and firm organization even in traditional sectors (particularly KIBs). What takes place at the microeconomic level has also an impact at the regional level, hence the path-dependence in manufacturing specialization pattern or diversification of the regional industrial base are not good or bad by themselves, but should be considered in the light of the capacity of the existing industrial system to connect with high-skilled sectors (both within the industrial sector or in the service sector).

[9]We tested the hypothesis of $\lambda = 0$ and $\theta = 0$ in our models, by comparing Log-pseudolikelihood, BIC and AIC of SDM and SAR models, as suggested by Belotti et al. (2013b)

[10]Rogers (1993), Williams (2000), Wooldridge (2002), Froot (1989).

Therefore, the effort to acquire competencies in knowledge-intensive services is not inconsistent with a strategy aiming at consolidating the long-term comparative advantages of regions, even if it is on traditional industries. Conversely, it is worth noting that our result suggest that enhancing tourism can not be enough to drive the transition from a manufacturing based economic system towards a knowledge-driven or services based one.

5 Comments

There is a generalized consensus that Italy needs a new economic policy aimed at restarting growth but consensus is lacking on what its pillars should be.

This paper aims to provide a contribution to the ongoing debate and for the formulation of an appropriate economic policy for Italy by examining some drivers, at the regional level, of services and KIS specialization.

Our results suggest that economic activities linked to tourism inevitably constitute an important driver of the transition towards services, because an evident and historical comparative advantage. But public authorities can play a major role in directing the transition also towards KIServices, by investing in public R&D and in the university and educational system.

Sustaining the development of knowledge-intensive services is desirable not only to overcome the crisis of aggregate demand, but also to improve the capacity of Italian firms to foster their innovation, their international activities and compete in global markets, even if the Italian industry will continue to be based on traditional manufacturing sectors. In this view, the challenge is to strengthen the link between the material production know as Made in Italy and other activities with high innovation potential, mainly Knowledge Intensive Business Services. The effort to acquire competencies in these activities is not inconsistent with a strategy aiming at consolidating the long-term comparative advantages of regions.

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Table 1: Research and Development Personnel (full time equivalent per 1000 inhabitant)

Dep. Var: **Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
Services (t-1)	0.444***				
R&D personnel	0.025**	0.032**	0.025**	0.043***	0.040***
cons					4.158***
R&D personnel (Wx)	-0.009	0.018			
ρ	0.447***	0.665***	0.843***		
λ			-1.022**	0.800***	
N	187	204	204	204	204
n	17	17	17	17	17
Log-pseudolikelihood	539.506	558.206	561.872	550.632	491.740
AIC	-1069.012	-1108.413	-1115.745	-1095.263	-973.479
BIC	-1052.856	-1095.140	-1102.472	-1085.309	-956.889
R-sq within	0.744	0.606	0.606	0.479	0.479
R-sq overall	0.867	0.010	0.022	0.001	0.001
R-sq between	0.952	0.045	0.038	0.021	0.021
Prob>=chi2 (hausmann)	0.000	0.000		0.605	

Dep. Var: **Knowledge Intensive Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
KIServices (t-1)	0.452***				
R&D personnel	0.026	0.026	0.079**	0.055	0.046
cons					3.393***
R&D personnel (Wx)	-0.039	0.114			
ρ	0.571***	0.765***	0.848***		
λ			-0.189	0.879***	0.877***
N	187	204	204	204	204
n	17	17	17	17	17
Log-pseudolikelihood	344.256	319.489	316.997	310.216	269.856
AIC	-678.512	-630.977	-625.994	-614.431	-529.713
BIC	-662.357	-617.705	-612.721	-604.477	-513.122
R-sq within	0.731	0.635	0.630	0.404	0.404
R-sq overall	0.730	0.287	0.270	0.050	0.050
R-sq between	0.931	0.025	0.000	0.003	0.003
Prob>=chi2 (hausmann)	0.000	0.000		0.641	

Significance: $\star$: 10%, $\star\star$: 5%, $\star\star\star$: 1%
Robust Standard Errors

APPENDIX A

Table 2: Public Expenditure for R&D (% gdp)

Dep. Var: **Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
Services (t-1)	0.464***				
Public R&D	0.004	0.002	-0.001	-0.002	0.000
cons					4.199***
Public R&D (Wx)	0.037*	0.071**			
ρ	0.443***	0.772***	-0.810**		
λ			0.914***	0.827***	0.825***
N	170	187	187	187	187
n	17	17	17	17	17
Log-pseudolikelihood	487.284	504.562	502.187	500.246	443.032
AIC	-964.567	-1001.124	-996.374	-994.493	-876.065
BIC	-948.888	-988.199	-983.449	-984.799	-859.909
R-sq within	0.691	0.287	0.012	0.040	0.040
R-sq overall	0.905	0.035	0.067	0.073	0.073
R-sq between	0.965	0.012	0.073	0.076	0.076
Prob>=chi2 (hausmann)	0.000	0.000		0.334	

Dep. Var: **Knowledge Intensive Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
KIServices (t-1)	0.412***				
Public R&D	0.042**	0.114**	0.118***	0.107**	0.093***
cons					3.506***
Public R&D (Wx)	-0.046	0.009			
ρ	0.585***	0.876***	0.837***		
λ			0.255	0.889***	0.885***
N	170	187	187	187	187
n	17	17	17	17	17
Log-pseudolikelihood	309.710	294.671	294.934	293.409	252.866
AIC	-609.421	-581.342	-581.868	-580.818	-495.732
BIC	-593.742	-568.417	-568.943	-571.125	-479.577
R-sq within	0.708	0.260	0.253	0.087	0.087
R-sq overall	0.676	0.098	0.081 0.045	0.045	
R-sq between	0.817	0.031	0.034	0.053	0.053
Prob>=chi2 (hausmann)	0.000	0.000		0.054	

Significance: ⋆: 10%, ⋆⋆: 5%, ⋆ ⋆ ⋆: 1%
Robust Standard Errors

Table 3: Tertiary education (university, doctoral and specialization courses), % of 15-64 population

Dep. Var: **Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
Services (t-1)	0.361***				
Tertiary Education	0.056*	0.110**	0.099**	0.181***	0.180***
cons					3.734***
Tertiary Education (Wx)	0.087**	0.058			
ρ	0.029	0.138	0.498**		
λ			-0.634	0.158	0.164
N	200	220	220	220	220
n	20	20	20	20	20
Log-pseudolikelihood	626.986	632.490	633.357	626.419	556.651
AIC	-1243.972	-1256.980	-1258.714	-1246.838	-1103.303
BIC	-1227.481	-1243.405	-1245.139	-1236.657	-1086.335
R-sq within	0.807	0.724	0.723	0.708	0.708
R-sq overall	0.809	0.049	0.053	0.043	0.043
R-sq between	0.911	0.001	0.001	0.004	0.004
Prob>=chi2 (hausmann)		0.094		0.708	

Dep. Var: **Knowledge Intensive Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
KIServices (t-1)	0.409***				
Tertiary Education	0.171**	0.264**	0.273**	0.361**	0.313**
cons					2.653***
Tertiary Education (Wx)	-0.184*	-0.097			
ρ	0.625***	0.728***	0.550**		
λ			0.375	0.778***	0.793***
N	200	220	220	220	220
n	20	20	20	20	20
Log-pseudolikelihood	405.728	377.394	377.929	373.168	322.111
AIC	-801.455	-746.788	-747.859	-740.337	-634.222
BIC	-784.964	-733.214	-734.284	-730.156	-617.254
R-sq within	0.729	0.600	0.599	0.577	0.577
R-sq overall	0.643	0.189	0.179	0.111	0.111
R-sq between	0.730	0.000	0.000	0.001	0.001
Prob>=chi2 (hausmann)		0.000		0.332	

Significance: $\star$: 10%, $\star\star$: 5%, $\star\star\star$: 1%
Robust Standard Errors

Table 4: Index of attractiveness of universities (Ratio between the net migration of students and the total number of enrolled students, %)

Dep. Var: **Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
Services (t-1)	0.631***				
University Attract.	0.017***	0.030***	0.024***		0.030***
cons					4.021***
University Attract. (Wx)	-0.018	-0.019			
ρ	0.353***	0.845***	-1.253***		
λ			0.944***	0.831***	0.847***
N	285	304	304	380	304
n	19	19	19	19	19
Log-pseudolikelihood	795.053	736.631	744.902	859.869	674.276
AIC	-1580.106	-1465.262	-1481.805	-1713.737	-1338.553
BIC	-1561.843	-1450.394	-1466.936	-1701.917	-1319.968
R-sq within	0.831	0.077	0.022	0.039	0.039
R-sq overall	0.939	0.023	0.038	0.023	
R-sq between	0.992	0.015	0.043	0.021	0.021
Prob>=chi2 (hausmann)		0.000		0.262	

Dep. Var: **Knowledge Intensive Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
KIServices (t-1)	0.374***				
University Attract.	0.016**	0.055***	0.053***	0.054***	0.052***
cons					3.120***
University Attract. (Wx)	0.019	-0.032			
ρ	0.531***	0.906***	-0.082		
λ			0.915***	0.907***	0.905***
N	285	304	304	380	304
n	19	19	19	19	19
Log-pseudolikelihood	513.075	462.232	462.199	462.155	415.355
AIC	-1016.151	-916.464	-916.397	-918.310	-820.710
BIC	-997.889	-901.596	-901.529	-907.159	-802.125
R-sq within	0.833	0.104	0.021	0.023	0.023
R-sq overall	0.781	0.031	0.009	0.009	0.009
R-sq between	0.960	0.001	0.005	0.004	0.004
Prob>=chi2 (hausmann)		0.000		0.606	

Significance: $\star$: 10%, $\star\star$: 5%, $\star\star\star$: 1%
Robust Standard Errors

Table 5: Tourism: Nights spent in accommodation establishments (per inhabitant)

Dep. Var: **Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
Services (t-1)	0.686***				
Tourism	0.019*	0.069**	0.025**	0.072**	0.066**
cons					4.068***
Tourism (Wx)	-0.028*	-0.011			
ρ	0.289***	0.786***	0.932***		
λ			-1.741***	0.831***	0.832***
N	361	380	380	380	380
n	19	19	19	19	19
Log-pseudolikelihood	973.622	863.885	882.165	859.869	795.891
AIC	-1937.244	-1719.770	-1756.330	-1713.737	-1581.782
BIC	-1917.799	-1704.009	-1740.570	-1701.917	-1562.081
R-sq within	0.866	0.474	0.471	0.308	0.308
R-sq overall	0.936	0.029	0.072	0.021	0.021
R-sq between	0.972	0.001	0.000	0.011	0.011
Prob>=chi2 (hausmann)		0.016		0.262	

Dep. Var: **Knowledge Intensive Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
KIServices (t-1)	0.540***				
Tourism	0.001	0.021	0.023	0.021	0.012
cons					3.353***
Tourism (Wx)	0.010	0.117**			
ρ	0.469***	0.873***	-0.514		
λ			0.946***	0.912***	0.911***
N	361	380	380	380	380
n	19	19	19	19	19
Log-pseudolikelihood	629.922	560.268	553.846	551.751	503.191
AIC	-1249.843	-1112.537	-1099.693	-1097.502	-996.382
BIC	-1230.399	-1096.776	-1083.932	-1085.681	-976.682
R-sq within	0.876	0.452	0.135	0.226	0.226
R-sq overall	0.844	0.219	0.002	0.003	0.003
R-sq between	0.996	0.034	0.000	0.002	0.002
Prob>=chi2 (hausmann)		0.016		0.648	

Significance: $\star$: 10%, $\star\star$: 5%, $\star\star\star$: 1%
Robust Standard Errors

Table 6: Railroad: Rail network on regional surface (km per hundred square km)

Dep. Var: **Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
Services (t-1)	0.447***				
Railroad	0.055***	0.118***	0.117***	0.094***	0.081**
cons					4.061***
Railroad (Wx)	0.035	0.224			
ρ	0.478***	0.797***	0.940***		
λ			-1.582***	0.837***	0.837***
N	220	240	240	240	240
n	20	20	20	20	20
Log-pseudolikelihood	647.564	636.234	646.369	631.780	564.867
AIC	-1285.129	-1264.468	-1284.739	-1257.560	-1119.735
BIC	-1268.161	-1250.545	-1270.816	-1247.118	-1102.332
R-sq within	0.752	0.281	0.276	0.062	0.062
R-sq overall	0.790	0.045	0.024	0.004	0.004
R-sq between	0.826	0.027	0.009	0.003	0.003
Prob>=chi2 (hausmann)		0.102		0.648	

Dep. Var: **Knowledge Intensive Services** employment/total employment

	sdm (fe)	sdm (fe)	sac (fe)	sem (fe)	sem (re)
KIServices (t-1)	0.434***				
Railroad	-0.071	-0.030	-0.053	-0.052	-0.016
cons					3.494***
Railroad (Wx)	-0.715**	0.309			
ρ	0.557***	0.885***	-0.123		
λ			0.906***	0.892***	0.888***
N	220	240	240	240	240
n	20	20	20	20	20
Log-pseudolikelihood	411.357	378.256	377.869	377.794	329.971
AIC	-812.713	-748.511	-747.737	-749.588	-649.942
BIC	-795.745	-734.589	-733.815	-739.146	-632.539
R-sq within	0.701	0.201	0.003	0.004	0.004
R-sq overall	0.540	0.073	0.001	0.001	0.001
R-sq between	0.496	0.010	0.002	0.002	0.002
Prob>=chi2 (hausmann)		0.000		0.491	

Significance: $\star$: 10%, $\star\star$: 5%, $\star\star\star$: 1%
Robust Standard Errors

Resident population by degree of urbanization	Low	Medium	High
Abruzzo	41.2	49.8	9.1
Basilicata	72.6	5.3	22.1
Calabria	42.9	39.7	17.4
Campania	13.3	27.1	59.7
Emilia-Romagna	30.2	34.0	35.7
Friuli-Venezia G	28.2	42.9	29.0
Lazio	19.7	29.4	50.9
Liguria	11.5	37.7	50.8
Lombardia	11.9	47.8	40.3
Marche	32.5	54.8	12.6
Molise	60.4	23.9	15.7
Piemonte	28.8	45.8	25.4
Puglia	27.0	51.8	21.2
Sardegna	46.4	36.7	16.9
Sicilia	23.2	49.1	27.7
Toscana	25.3	47.7	27.1
Trentino-Alto Adige	47.3	31.5	21.2
Umbria	48.3	20.7	31.0
Valle d'Aosta	50.5	49.5	0
Veneto	19.9	61.2	18.9
Total	24.3	42.4	33.3

Source: Istat

APPENDIX B: Summary if the dataset

Region	Services	KIS employment	Research and Development Personnel	Public Expenditure for R&D	Tertiary education	Universities attractiveness	Tourism	Railroad
	% employment	% employment	full time equivalent per 1000 inhabitant	% gdp	% of 15-64 population	Ratio between the net migration of students and the total number of enrolled students	Nights spent in accommodation establishments (per inhabitant)	km per hundred square km
Abruzzo	63	27	2.5	.53	16	12	5.2	5.7
Basilicata	60	28		.42	13	-207	2.8	5.4
Calabria	70	32		.4	13	-62	3.6	7.1
Campania	70	31	2.3	.66	12	-12	3.3	10
Emilia-Romagna	60	27	5.1	.49	16	34	8.8	6.9
Friuli-Venezia G	63	29	4.4	.63	14	10	7.1	6.1
Lazio	79	37	5.9	1.1	19	19	5.2	7.9
Liguria	75	33	3.9	.52	17	-13	9.2	9.7
Lombardia	60	29	4.2	.29	15	11	2.9	8.5
Marche	57	25	2.6	.36	16	3.5	7.9	4
Molise	62	28		.35	15	-44	1.9	6.1
Piemonte	60	28	5.1	.36	14	-5	2.3	7.8
Puglia	64	28	1.6	.51	11	-40	2.6	7.5
Sardegna	70	30	1.9	.61	12	-21	6.2	4.3
Sicilia	72	33	1.7	.59	12	-14	2.6	5.8
Toscana	65	28	3.8	.68	15	18	11	6.8
Trentino-Alto Adige	68	32	3.9	.46	14	-12		3.1
Umbria	64	28	3	.63	17	19	6.4	6.1
Valle d'Aosta	72	32	2.1	.10	12		26	2.5
Veneto	57	25	3.5	.34	13	-8.7	12	6.7
Total	66	30	3.1	.5	14	-29	8.4	6.4

Source: Eurostat/Istat