XXXII CONFERENZA ITALIANA DI SCIENZE REGIONALI

POLYCENTRISM IN EUROPEAN REGIONS AND THE LISBON STRATEGY

Paola BERTOLINI[1], Enrico GIOVANNETTI[2], Francesco PAGLIACCI[3]

ABSTRACT

Polycentrism is a common feature of European urban systems. In recent years, the concept has assumed a more normative relevance and it has been often considered as a pre-requisite for a more sustainable and balanced development across Europe. However, the effects of polycentrism on other main European Strategies (such as the Lisbon Strategy, aimed at increasing European competitiveness and social cohesion) are not so clear. Therefore, the paper tries to highlight the relationships between a regional polycentric development and the achievement of the Lisbon Strategy's targets. Referring to a sample of 75 regions belonging to France, Germany, Italy and Spain, we have first measured the extent of polycentrism, by estimating through OLS the slope of the rank-size distribution of cities within each region. Then, we have performed a principal component analysis (PCA) in order to highlight the main features characterising the performance of each region according to Lisbon Strategy's targets. Looking at the correlations between the extent of polycentrism and the achievement of the Lisbon Strategy's targets, we have found that the former is significantly correlated both with the spread of manufacture and with low investments in human capital and innovation.

1 Department of 'Economia Politica', University of Modena and Reggio Emilia, Viale Berengario 51, 41121 Modena (MO). E-mail: paola.bertolini@unimore.it.
2 Department of 'Economia Politica', University of Modena and Reggio Emilia, Viale Berengario 51, 41121 Modena (MO). E-mail: enrico.giovannetti@unimore.it.
3 Ph.D Candidate in 'Economia e Statistica Agroalimentare', University of Bologna, Via Belle Arti 41, 40126, Bologna (BO). E-mail: francesco.pagliacci2@unibo.it

1 Introduction

Since the early days of the European Union (EU), several EU policies have been targeted to regional dimension. However, the regional perspective has gained more importance within the recent evolution of EU policies. In the last decade, several documents have been discussed and approved in order to strengthen the regional and territorial dimension of EU policies (CSD, 1999; European Union, 2007; Barca, 2009).

The EU's regional policy, that today holds second place as a share of EU total expenditures after the CAP, aims to reduce the economic disparities among EU regions, furthering social cohesion in the process of EU integration (Neal, 2007). In particular, regions are recognized as the most important territorial level of intervention, especially for policies which have to promote a greater coherence within the EU.

Within this policy framework, all EU territorial documents have stressed the relevance of polycentrism as a tool of territorial intervention. Since the middle '90s, the concept of polycentric development has not only been considered a simple theoretical tool in the analysis of the spatial organisation of metropolitan regions (as in Ostrom *et al.*, 1961). Instead, it has assumed a more normative relevance (Davoudi, 2003; Faludi, 2006): nowadays, polycentric development is acknowledged to be a main pre-requisite for a more sustainable and balanced development (CSD, 1999) and the concept has been transformed into a key policy goal. In particular, the economic integration of areas outside the so-called "Pentagon" (i.e. the area marked by its corners London–Paris–Milan–Munich–Hamburg) is crucial for assure greater competitiveness to EU (Faludi, 2006).

By the way, the strong attention to regional issues (and, in particular, to the polycentric development of EU territories) seems to be not fully acknowledged by another strategic policy of the EU, i.e. the Lisbon Strategy (now Europe 2020 Strategy). This policy should orient relevant EU interventions (e.g., the improvements in employment rates, in social inclusion and in economic competitiveness), promoting the growth of the EU Member States[4]. However, a persistent bias is observed: Lisbon Strategy mainly applies at EU and national level, thus totally ignoring the regional dimension (that is acknowledged to be more important in promoting territorial cohesion).

In particular, the paper focuses on regional performances according to the Lisbon Strategy, trying to highlight relationship between a regional polycentric development and the achievement of the targets of the Strategy. Therefore, we first measure the extent of polycentrism within EU regions, focusing our attention on four major EU countries: France, Germany, Italy and Spain. The analysis is performed on NUTS 2 regions, with the only exception of Germany, where NUTS 1 regions have been chosen. The extent of polycentrism is estimated by adopting a morphological perspective, i.e. by estimating through OLS the slope of the rank-size distribution of cities within each region. Then,

4. Lisbon Strategy was launched in 2000: its main aim was to make the EU "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" by 2010 (European Council, 2000). In 2010, Europe 2020 Strategy replaced Lisbon Strategy.

we perform a multivariate statistical analysis (principal component analysis or PCA) in order to detect the main features characterising regional performances according to the Lisbon Strategy's targets. Finally, we highlight main correlations between the extent of polycentrism and the achievement of these targets.

The work is organised as follows. Section 2 sums up the theoretical background about the development of the concept of polycentrism within main EU documents. Some insights on Lisbon Strategy and Europe 2020 Strategy are also provided. Section 3 is a methodological section: both rank-size distribution methodology and PCA are shown and explained. Section 4 provides main results about the extent of polycentrism at regional level and about regional performances according to the Lisbon Strategy's targets. Section 5 highlights main correlations between polycentrism and the achievement of these targets. Section 6 concludes the work.

2 Theoretical background

Since the middle of XX century, the concept of polycentricism has been adopted as a theoretical tool in order to analyze the contemporary spatial organisation of metropolitan regions (Ostrom *et al.*, 1961). In the '90s, the concept also assumed a more normative relevance (Davoudi, 2003; Faludi, 2006). Since the presentation of the "European Spatial Development Perspective" (ESDP) in 1999 (CSD, 1999) and the approval of the "Territorial Agenda of the European Union" (European Union, 2007), a set of normative tools has been applied in order to achieve crucial EU policy objectives. Recommendations are oriented to a more polycentric urban development, counterbalancing the central role of the so-called "Pentagon" (i.e. the area marked by its corners London–Paris–Milan–Munich–Hamburg) and involving explicit urban-rural partnerships (Guérois *et al.*, 2002). In particular, polycentric development is seen as a main pre-requisite for a more sustainable and balanced development (CSD, 1999) and also as a key policy goal. In 2009, the report "An Agenda for a Reformed Cohesion Policy" (Barca, 2009) acknowledged the role of networked polycentric regions as a way both to promote balanced territorial development and to overcome the disadvantages arising from big urban agglomerations. However, in comparison to the US, large urban agglomerations are not a typical feature of the European urban system (Le Galès, 2006; Vicari Haddock, 2004)[5]. Moreover, in Europe, agglomeration economies are often generated either by strong relationships between major cities and their hinterland or by "dense networks of big or middle sized cities" (Barca, 2009 – p. 18).

In spite of these key ideas, definitions about polycentrism are "vague" (Riguelle *et al.*, 2007 – p. 195). The concept is a typical multiscalar and multidimensional one (i.e., a region which is polycentric at a given spatial scale may be monocentric at a smaller one). By the way, there is a general consensus among scholars about main features of polycentrism. In polycentric regions, cities are located in close proximity to each other but they maintain their historical distinctions; they

5. In the US, urban agglomerations are bigger and cities are less connected to each other than in EU.

lack a leading city and they constitute independent political entities (Kloosterman *et al.*, 2001). At the same time, they are well-connected (Meijers, 2008) and interrelated through co-operation flows (Cowell, 2010). Therefore, when dealing with polycentrism, both morphological perspective and functional one have to be considered (Nordregio *et al.*, 2004; Veneri *et al.*, 2010): the former focuses on the distribution of cities and on their dimensions (Lambooy, 1998; Parr, 2004; Meijers, 2008); the latter focuses on the interactions among urban centres, by analyzing flows of people, goods or information (Van der Laan, 1998; Hall *et al.*, 2006; Limtanakool *et al.*, 2007).

It is important to point out that polycentrism has not only been used as a tool to describe specific ways of territorial organization. Indeed, according to the main EU territorial documents, polycentric development now represents a strategic tool which can promote economic competitiveness (Hague *et al.*, 2003), social cohesion (Meijers *et al.*, 2008) and environmental sustainability (CSD, 1999). However, several concerns about polycentric development arise. First, the positive effects of polycentrism often lack a theoretical rationale (Meijers, 2008; Veneri *et al.*, 2010). Moreover, these effects have not been sufficiently investigated through empirical analysis (Meijers, 2008). Then, a more theoretical issue is represented by the coherence of policies enhancing a polycentric development across EU with the other EU policies and in particular with the Lisbon Strategy. Although the EU Ministers responsible for spatial planning and development have declared their support to the Lisbon Strategy (European Union, 2007), the effects of a more polycentric development on the targets of this Strategy are not so straightforward.

In particular, the Lisbon Strategy rests on three pillars (European Council, 2000): i) an economic pillar, devoted to the preparation of the ground for the transition to a more competitive, dynamic and knowledge-based economy; ii) a social pillar with the aim of modernising the European social model through more investments in education and training and through the promotion of the employment; iii) an environmental pillar (which was added at the Göteborg European Council in June 2001), that draws greater attention to the impact of the economic growth on the use of natural resources[6].

In terms of possible links to polycentrism, the Lisbon Strategy seems to be affected by several biases. At present, the strategy does not take into account the deep differences existing amongst the 27 EU Member States. Nordic Countries, Mediterranean ones and Eastern ones sharply differ from each other. For example, according to the equity and the efficiency of their economy, Sapir (2006) has already highlighted the existence of four different European social models among EU countries[7]. Deep differences also exist within the EU Member Countries, especially within those of greater dimension. Nevertheless, Lisbon Strategy seems not to give importance to these regional patterns, ignoring the increasing attention paid to the regional dimension by EU territorial policies.

6. The new Europe 2020 Strategy represents a much more effective reform programme, which is based on a smart, inclusive and sustainable growth (European Commission, 2010).

7. In Sapir (2006), just Western EU countries were considered. In a previous work, Bertolini and Pagliacci (2011) extended the analysis of Sapir also to EU Eastern Member Countries.

3 Methodology and data

As the aim of this work is twofold (i.e., trying to measure the extent of polycentrism within EU regions and to observe existing links with the achievement of Lisbon Strategy's targets), several statistical methodologies are applied in the paper. Before describing them (in section 3.2 and 3.3), we move from the description of the sample of considered regions.

3.1 The sample of regions

Our sample includes the regions of four major EU countries: i.e., France, Germany, Italy and Spain. According to the EU *Nomenclature of Territorial Units for Statistics* (NUTS), we have considered different NUTS level within the four selected countries. As suggested by the ESDP (CSD, 1999), we have considered NUTS 2 regions for France, Italy and Spain. Therefore, we have included in the sample 21 Italian *Regioni*, 22 French *Régions* and 16 Spanish *Comunidades Autónomas*[8]. Due to its peculiar administrative framework, we have selected German NUTS 1 regions (i.e., the 16 German *Länder*). Although corresponding to a different NUTS level, *Länder* are the most important administrative level in Germany and they are generally used in European comparative analysis.
A further *caveat* must be stated. When calculating the extent of polycentrism (see Section 4.1), the total sample is reduced from 75 to 72 regions. In Germany, 3 *Länder* are *Stadtstaaten* (i.e., city-states): Berlin, Hamburg and Bremen. Due to this reason, they are considered as belonging to the *Flächenländer* (i.e., area states) which contain them: Berlin is included in Brandenburg; Bremen in Niedersachsen; Hamburg in Schleswig-Holstein. When performing PCA (Section 4.2), the total sample of 75 regions is considered.

3.2 Measuring the extent of regional polycentrism: the rank-size distribution

A polycentric region is an area which is characterised by several cities which lack a clear hierarchy. In literature, several ways to measure the extent of polycentricy have been proposed. They focus both on the functional and on the morphological perspective (Nordregio *et al.*, 2004; Veneri et al., 2010). Due to a lack in statistical data, in the paper we mainly refer to the morphological (or geographical) extent of polycentricity at regional level. Following previous works on the topic (Nordregio *et al.*, 2004; Meijers, 2008; Veneri *et al.*, 2010), we choose the slope of the equation of the rank-size distribution of cities as the main indicator of the extent of polycentricity at the regional level. In particular, within each region, cities are ranked according to their population. For example, in Bayern, the first city is München; the second one is Nürnberg; the third is Augsburg and so on. Then, the following equation (1) is estimated:

8. Regions which are not located into the European continent have been excluded from the analysis. These regions are: i) the French Départements d'outre-mer (DOM) of Guadeloupe, Martinique, Guyane and Réunion; ii) Iles Canarias (Spain); iii) Ciudad Autónoma de Ceuta (Spain); iv) Ciudad Autónoma de Melilla (Spain).

$$\text{Ln (pop)} = \alpha + \beta \text{ Ln (rank)} \qquad (1)$$

This is the so-called rank-size equation, as expressed in the Lotka form (Parr, 1985). This is one of a variety of special applications of Zipf's Law, which was first formulated by a linguist (Zipf 1935; 1949)[9]. According to the Zipf's Law, when drawing log-rank against log-size, a straight line is obtained, with a slope which is very close to -1. Several studies have confirmed that the law holds within big countries (e.g., India, China, the US) or areas (the EU). However, since its original formulations, many explanations about this empirical law have been proposed, but all pose considerable difficulties. Gabaix (1999) suggest that Zipf's Law for cities follows the same analytical framework proposed by Gibrat's Law for firms' size distribution (cities grow randomly with the same expected growth rate and the same variance, i.e. the growth process of cities is independent of size). However, the rank-size rule is not a law (McCann, 2001) and, therefore, the theoretical problem about its economic explanation is still open.

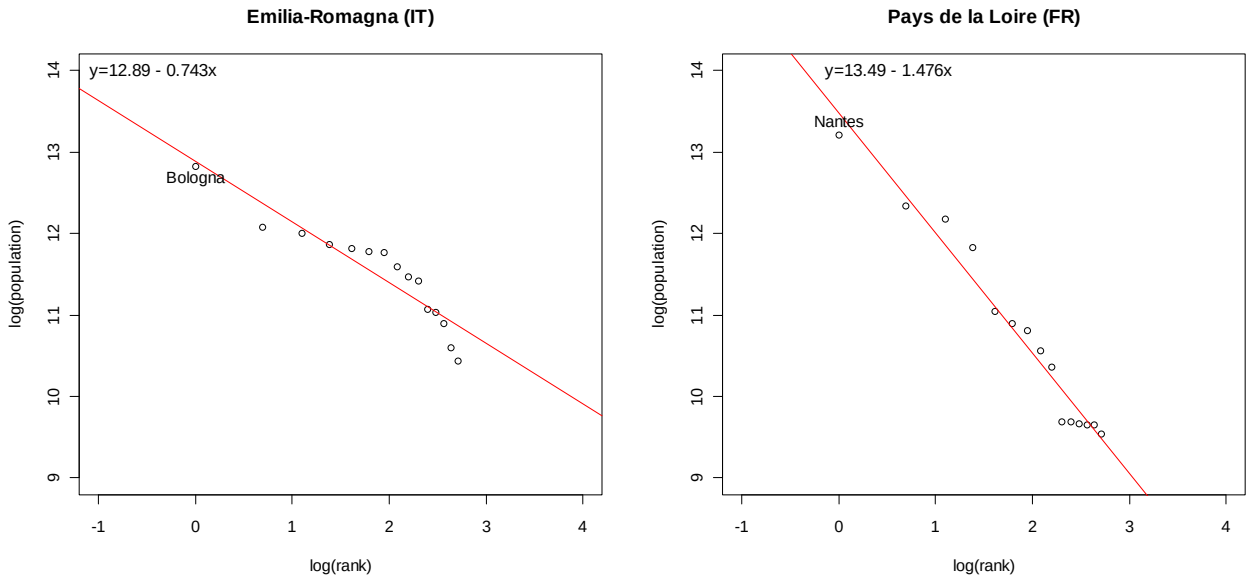
By the way, we use this empirical tool in order to establish the extent of polycentricity within each region. In doing so, we use the Lotka form as shown in (1), drawing on a consolidated tradition (Nordregio *et al*., 2004; Meijers, 2008; Veneri *et al*., 2010). In particular, we estimate the slope of equation (1) through OLS method. The estimations obtained for β describe the level of polycentricity within a given region: the higher the value, the more polycentric a region is. This result is straightforward. In a polycentric region, there is not a unique city which dominates over the others, thus the slope of the OLS regression line is generally greater than -1 (i.e., regression line is flatter). In contrast, monocentric regions show a slope of the OLS regression line which is smaller than -1 (i.e., the regression line is steeper). Two examples are provided in figure 1: Emilia-Romagna (Italy) is a more polycentric region than Pays de la Loire (France).

Although the adoption of this estimator as an indicator of polycentrism is straightforward, several issues have to be highlighted. A first concern is related to the definition of city to be used. Different definitions of cities are used across EU Countries. Therefore, we have chosen different units of analysis which allow a more homogeneous comparison of cities: we have taken Italian *comuni*, Spanish *municipios*, French *communes* or, more often, *communautés d'agglomeration*[10], German *gemeinden*. Data about population of Italian, Spanish and French cities refer to national Censuses (reference year is 2001 for both the Italian Census and the Spanish one; it is 1999 for French Census); whereas data about population of German cities refer to 2008. Urban systems are stable over time; due to this aspect, we can usually compare data referring to different years (Batty, 2001).

9. The original law simply states that the frequency of any word is inversely proportional to its rank in the frequency table: the most frequent word occur approximately twice as often as the second most frequent one, three times as often as the third most frequent one, and so on. The appearance of a Zipfian distribution in rankings of cities by population had been first noticed by Auerbach (1913).

10. France has a wider number of *communes* than Italy and Spain. As a consequence, larger French cities are generally divided into several *communes*. *Communautés d'agglomeration* are groups of *communes* which are in charge of managing greater urban areas. As a consequence, they are particularly suitable in order to identify urban areas.

Figure 1: rank-size distribution for a polycentric region (left) and a monocentric one (right)



Source: personal elaboration on Istat (2001) and Insee (1999)

A second issue concerns the fact that estimations may be affected by the number of cities which are included in the OLS regression analysis. In particular, the sample size can be identified by: i) a fixed number of towns; ii) a fixed size threshold of inhabitants; iii) a size above which the sample accounts for some given proportion of regional population. Following Meijers (2008), we choose option i), as we are dealing with heterogeneous regions belonging to different EU Countries[11].

The last question deals with the number of cities to be included within the OLS model. Meijers (2008) suggests selecting a few numbers of cities per region. According to this perspective, we measure the extent of polycentricism by estimating the slope of the regression line of the rank-size distribution based on the five, eight, ten, twelve and fifteen largest cities within each region. By the way, our main 'Policentricity Index' will be based on the estimations on the ten largest cities per region. Although this choice may seem arbitrary, it has been taken in order to counterbalance two opposite effects: the influence of national patterns on polycentrism which is observed when the number of cities included in the sample is greater than 12 and the influence of too local patterns, when such a number is reduced below 8).

3.3 PCA for the analysis of regional performance according to the Lisbon Strategy

The second analysis performed on the sample of 75 NUTS 2 and NUTS 1 regions is the analysis of their performances according to the Lisbon Strategy's targets (economic competitiveness, social

11. In such a situation, the application of a fixed size threshold is inappropriate, as in large regions a town of 10,000 inhabitants is insignificant, whereas a similar town is of greater importance in smaller regions. Moreover, also the number of cities comprising a given proportion of the population may distort the analysis, due to the fact that this number is in itself a possible indicator of polycentrism.

cohesion, investments in education and human capital, environmental sustainability). In order to sum up this performance, a list of 25 demographic, economic, structural and environmental variables (periodically available at regional level) has been selected. Several statistical sources have been used: in particular, the Regional Statistics of Eurostat (Eurostat, 2011) and the Fifth Report on Economic Social and Territorial Cohesion Report (European Commission, 2010b). Just data referring to regional accessibility (provided at NUTS 3 level) are provided by the ESPON database (2006). Data generally refer to years between 2005 and 2009[12]; whereas regional accessibility data refer to year 2001. In Appendix A, the definition of the adopted variables, the statistical source and the reference year are provided in more detail.

Then, we apply the methodology of principal components analysis (PCA) to the 25 variables already identified. PCA belongs to multivariate statistics and it helps in reducing the number of variables of a system while preserving the most of the information (Hotelling, 1933; Pearson, 1901). In particular, PCA allows us not to make strong *a priori* assumptions on the model. With PCA, we transform a group of p indicators, obtained on a group of n statistical units, into a much smaller group of variables which can still explain a high level of variance of the original data, thus avoiding an important loss of information. Moreover, whereas the original variables are highly correlated, the obtained indicators (i.e., principal components) are a linear combination of the original variables and they are uncorrelated. In particular, we compute the PCA moving from the correlation matrix, in order to avoid, during the extraction, the distorting influence of variables showing a higher variance. Having obtained the values of each component moving from the correlation matrix, we can then calculate the scores of each statistical unit (in our case, of each region) for each component. The k principal component (where $k < p$) comes from the following linear combinations, expressed as a matrix:

$$Y = X\,A \qquad (2)$$

where Y is the nxk matrix, containing the scores of the n statistical units in the k components; A is the vector matrix pxk of the normalized coefficients; X is the nxp matrix of the standardized data.

In order to simplify the interpretation of factor loadings, principal components are orthogonally rotated (thus maintaining uncorrelation among the factors) with VARIMAX. After the rotation, the total variance explained by the components is reduced.

4 Main results

4.1 Applying rank-size distribution to the European regions

For the 72 regions composing the sample, the extent of polycentrism is calculated by estimating the coefficient β of the rank-size distribution in (1) through OLS method. In particular, we run several

12. More in general, the impact of the current economic international crisis has been voluntarily neglected.

OLS regressions respectively on the five, eight, ten, twelve and fifteen largest cities per region. Estimations for β change when moving from 5 to 15 cities. In particular, when just considering the five largest cities per region (i.e., when just considering the upper tail of the rank-size distribution), the 72 regions show an average estimation for β which is equal to -1.2288 and a standard deviation of 0.5167. When increasing the number of cities per region chosen, the average slope of the OLS regression line moves toward -1, according to the main results observed in literature. In particular, when estimating the regression line on the fifteen largest cities per region, the average slope is -1.0683 and the standard deviation strongly decreases (0.2562). Table 1 shows the main descriptive statistics for the estimated coefficients. In Appendix A, all the coefficients that have been estimated for the 72 regions are shown.

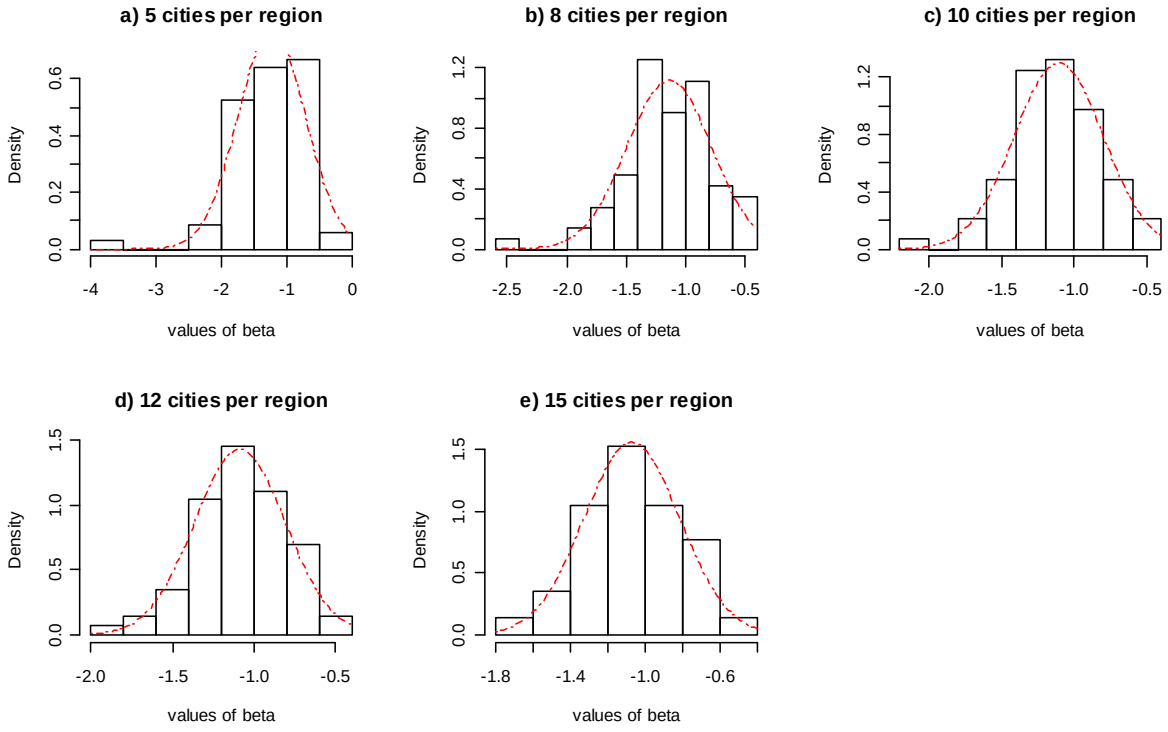
By the way, also the distribution of the estimated coefficients is a relevant feature. When estimating β on the basis of few cities per regions, scores are not normally distributed; when increasing the number of cities, scores of β appear more and more normally distributed (figure 2).

Table 1 – Main descriptive statistics for β coefficients of the rank-size equation (OLS estimations)

	5 Cities	8 Cities	10Ccities	12 Cities	15 Cities
Min	-3.510	-2.454	-2.096	-1.908	-1.726
Mean	-1.229	-1.136	-1.106	-1.086	-1.068
Max	-0.386	-0.495	-0.486	-0.505	-0.548
SD	0.5167	0.3578	0.3070	0.2786	0.2562
No. observations	72	72	72	72	72

Source: personal elaboration on Insee (1999), Istat (2001), Ine (2001), Destatis (2008)

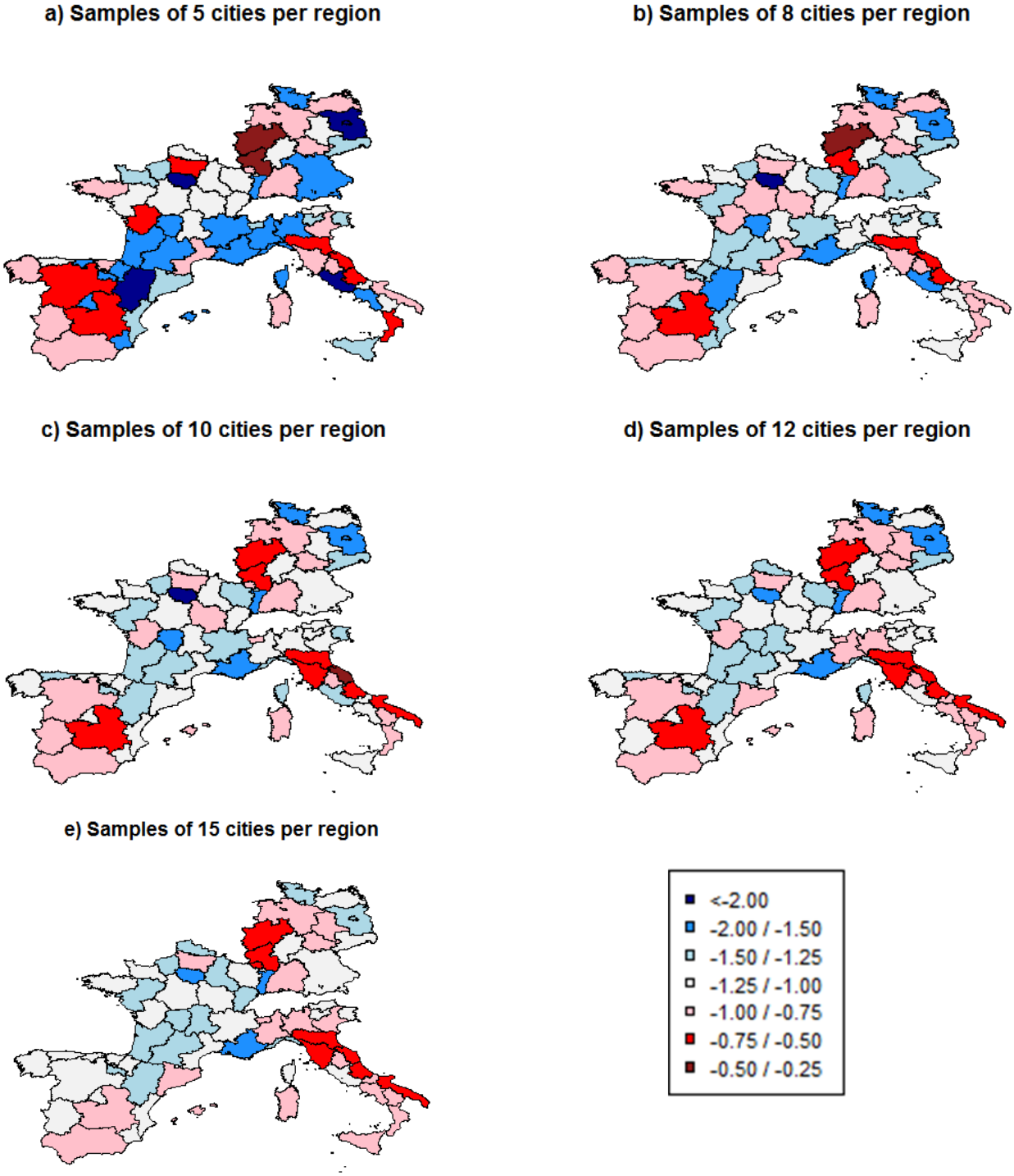
Figure 2 – Distribution of β coefficients of the rank-size equation estimated through OLS



Source: personal elaboration on Insee (1999), Istat (2001), Ine (2001), Destatis (2008)

Moreover, in figure 3, the extent of mono-/ polycentrism within the 72 regions when changing the number of largest cities included in the analysis is shown.

Figure 3 – Regions and their extent of mono-/ polycentrism, estimated for samples of five (a), eight (b), ten (c), twelve (d) and fifteen (e) largest cities per region



Source: personal elaboration on Insee (1999), Istat (2001), Ine (2001), Destatis (2008)

From figure 3 it is clear that, when changing the number of cities included in the OLS model, the extent of polycentrism within a given region deeply changes. In particular, when considering just

the five largest cities within each region, the extent of mono-/ polycentrism seems to be deeply affected by local characteristics, i.e. by the peculiar distribution of the biggest cities in a given region. As a consequence, extreme values in the estimated scores are quite common. On the opposite side, when considering a greater number of cities per region (e.g., the fifteen largest cities) different national patterns tend to emerge. In particular, these national patterns also affect regional estimations: as a consequence, most of Italian and German regions are quite polycentric, whereas French regions are generally monocentric.

As a consequence, in order to counterbalance these opposite effects (i.e., results too much affected by either local or national patterns), we refer to the estimations of the slope of the rank-size distribution considering the ten largest cities per region as the 'Policentricity Index'. Other estimations will be used in order to check for robustness.

Therefore, when considering the 10 largest cities per regions (recall figure 4.c), the following main features emerge. In France, the most monocentric region is Île de France (β = -2.096). Other monocentric regions are Alsace, Provence-Alpes-Côte d'Azur and Limousin. On the opposite side, only Poitou-Charente, Picardie and Bourgogne are considered polycentric regions, showing scores for β which are greater than -1.

German regions are generally much more polycentric than French ones: Nordrhein-Westfalen and Rheinland-Pfalz are the two most polycentric German regions (β = -0.520 and β = -0.649, respectively). This two *Länder* are located along the River Rhein including the Ruhr, i.e. one of the most polycentric areas across Europe (Romein, 2004). Brandenburg and Schleswig-Holstein, on the contrary, are monocentric *Länder*. These results are mainly due to the presence of the two biggest German cities, i.e. Berlin and Hamburg.

In Italy, the most polycentric region is Marche: showing a value for β which is equal to -0.486, Marche is the most polycentric region in the whole sample, when considering the 10 largest cities per region. However, also other regions belonging to the so-called *Third Italy* (Bagnasco, 1977; 1988) show typical polycentric features: this is the case of Emilia-Romagna, Toscana, Abruzzo. On the opposite side, Lazio, Liguria and Friuli Venezia Giulia are monocentric regions.

Referring to Spain, Castilla-La Mancha is the Spanish most polycentric region. More in general, the Southern and Western regions (such as Andalucia, Castilla-y-Leon and Extremadura) are more polycentric than the North-Eastern regions (e.g., Aragona, Asturias and La Rioja).

4.2 Applying PCA to the European regions

Working on a dataset of 25 economic, demographic and social variables (see Appendix A), we are able to identify the main features of the regional performance according to the targets of the Lisbon Strategy. The identification of the variables is a critical issue: according to available data, we have selected a list of indicators which is able both to catch the most relevant features of European regions and to show their performance according to the Strategy's main targets.

After having applied PCA to this dataset, KMO test is performed. The test is a measure of sampling adequacy, testing whether the partial correlations among variables are small. In our case, a value of 0.7633 is considered good. Then, different methods can be used to establish the right number of principal components (PCs) to be chosen: i) the Guttman-Kaiser criterion (i.e., taking the components able to explain at least the 70-80% of cumulative variance); ii) the choice of the principal components with eigenvalue over 1; iii) the empirical analysis of the *elbow* on the scree plot. Combining all these methods, we select 6 components, representing 81.9% of the original variance. Then principal components are orthogonally rotated with VARIMAX: after the rotation, the total variance explained by the components reduces to 76.5%. In table 2, all the factor loadings (with the only exception of those which are smaller than 0.2) are shown.

Table 2 – Factor loadings for the 6 PCs (after VARIMAX rotation)

	Factor1	**Factor2**	**Factor3**	**Factor4**	**Factor5**	**Factor6**
Resident Population	**0.716**					
GDP per capita	0.481	**-0.568**	0.247			
GVA of agriculture	**-0.636**			0.225		
GVA of manufacture	0.213		0.236		**0.909**	
Employment in agriculture	**-0.643**	0.246	-0.287	0.258		
Employment in manufacture		-0.325			**0.904**	
Total employment rate		-0.528	**0.765**			
Total employment rate (55-64 y)	0.381		**0.659**			
Female employment rate		-0.430	**0.759**	-0.346		0.240
Unemployment rate		**0.896**		0.266	-0.225	
Long-term unemployment rate		**0.892**		-0.283		
Unemployment rate (15-24 y)	-0.252	0.560	-0.520	0.397	-0.232	
Population with low education	-0.386		**-0.527**	**0.700**		
Population with tertiary education		-0.227				**0.920**
Early school leavers				**0.963**		
R&D expenditures	0.561			-0.271		**0.426**
Patents per million inhabitants	0.687		0.247	-0.297	0.209	
Household with broadband connection	0.496		0.501			**0.405**
Population at risk-of-poverty (after social transfers)		**0.794**	-0.300	0.284		
Concentration of PM_{10}	**0.666**		0.205		0.203	
Land for artificial uses (% on total)	**0.599**					
Passenger cars per 1000 inhabitants		-0.284	-0.211			-0.582
Railroad accessibility	**0.606**		0.248	-0.516		
Road accessibility	**0.562**		0.266	-0.519		
Air accessibility	**0.905**					

Source: elaboration on Eurostat (2011), © ESPON Database (2006), European Commission (2010b)

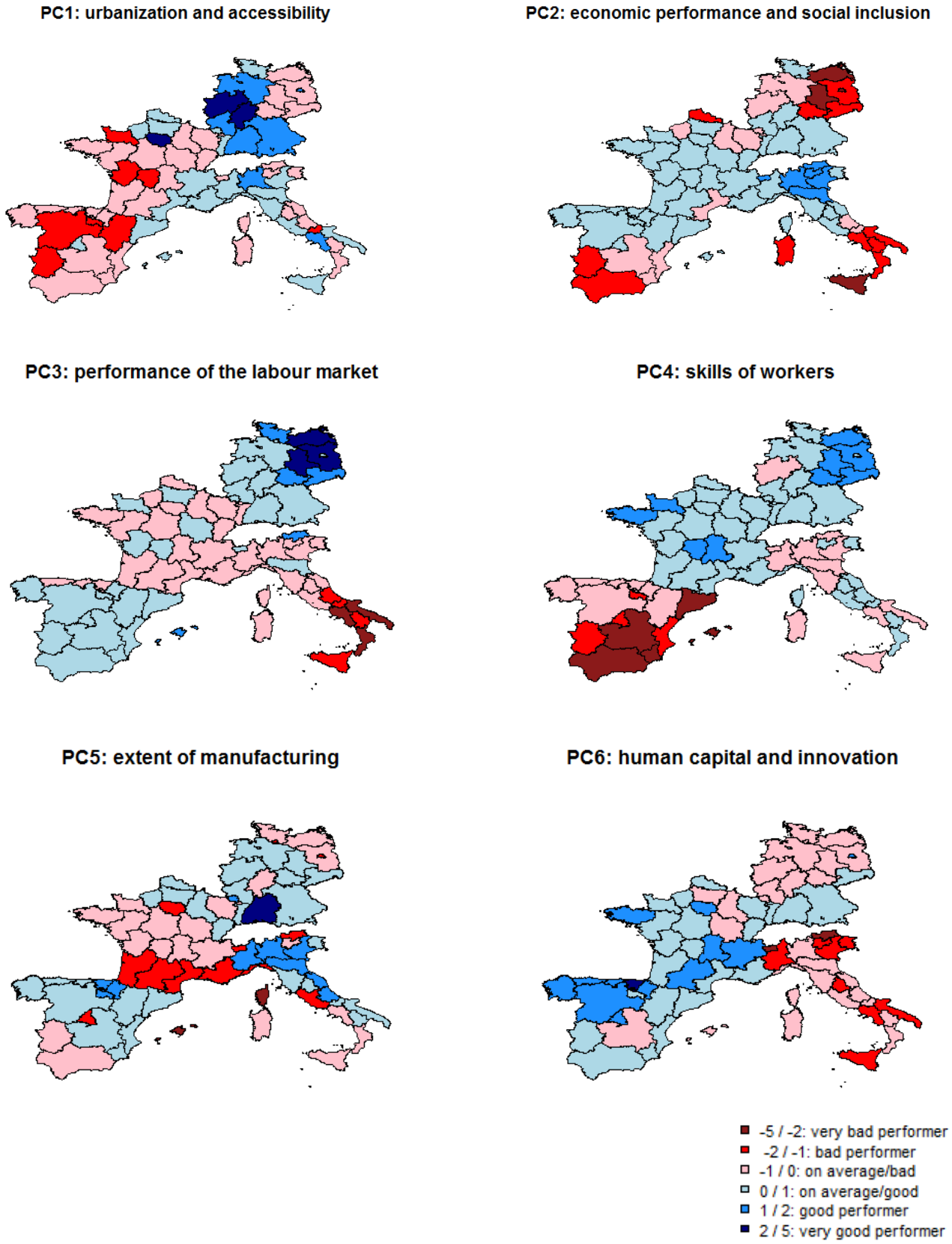
According to these factor loadings, the following explanation to the extracted principal components (PCs) is suggested. PC1, accounting for 21.9% of total variance, is positively linked to the resident population, to the share of land used for artificial purposes and to accessibility (mainly air accessibility but also rail and railroad accessibility). On the opposite side, negative factor loadings for PC1 are observed referring to agricultural GVA and employment (both expressed as % on the total). As a consequence, PC1 can be considered an indicator explaining the regional urbanization and its accessibility.

PC2 (15.3% of total variance explained) is positively linked to unemployment rates and to long-term unemployment rates. A positive relation is also observed referring to the share of population at

risk of poverty after social transfers. On the contrary, PC2 is negatively related to per capita GDP. Due to these reasons, PC2 identifies a weak economic performance and social exclusion.
PC3 explains 12.2% of total variance. Positive values are associated with employment rates (total, female and elder people employment rates). A negative relation is observed between PC3 and the share of less educated people. Therefore, PC3 identifies regions with well-performing labour markets.
PC4 (11.6% of total variance explained) is positively associated to high level of early school leavers and to a great share of less-educated people on the total. Therefore, PC4 identifies labour markets characterised by a large presence of low-skilled workers.
PC5 explains 8.2% of the total variance. It is positively related just to two variables: GVA and employment in industrial sectors. Therefore, the component highlights the extent of manufacture.
The last principal component (PC6, which explains 7.3% of the total variance) is positively linked to tertiary education, to R&D expenditures and to the percentage of households with broadband connection. Therefore, PC6 is a proxy of innovation and investments in human capital.
According to these results, we can measure regional performances according to the Lisbon Strategy's key dimensions, by assigning to each region a standardized score on each extracted PC[13].
In figure 4, the results obtained by each region on the 6 PCs are shown: bad performer regions (in red colours) are regions which show a value below the average on a given PC; whereas, good performer regions (in blue colours) are regions showing values for each PC above the average.
Referring to PC1 (regional urbanization and accessibility), the highest values are shown by German *Länder* along the river Rhein and by Île de France. In Italy, also Lombardia and Campania show high value for this PC. On the opposite, Western French and Spanish regions generally show low values for PC1: these results are mainly due to the low accessibility of these regions and to their agricultural features.
Weak economic performance and social exclusion (PC2) particularly affect four groups of regions: i) Italian Southern regions; ii) the *Länder* of the former German Democratic Republic; iii) the Southern part of Spain (Andalucia and Extremadura); iv) Nord-Pas-de-Calais, in Northern France, which is affected by deindustrialization. The best performer regions according to PC2 are located in Northern Italy.
Moving to the labour market (PC3), *Länder* in Eastern Germany perform very well, showing the highest employment rates within the four countries. Positive values for PC3 are also registered in Spanish regions. Instead, in Southern Italy regions are affected by very low employment rates.
Scores referring to PC4 show the presence of low-skilled workers within the regional labour market. Referring to this indicator, Spanish regions (and especially Southern ones) perform very poorly if compared to both French and German regions (whose labour markets generally employ high-skilled workers). Scores for Italian regions are generally on average.

13. In doing so, we use the regression method of Thomson (1951).

Figure 4 – Scores for the six PCs for the 75 regions



Source: elaboration on Eurostat (2011), © ESPON Database (2006), European Commission (2010b)

PC5 is associated to the presence of manufacture: the most manufacturing regions are Baden-Württemberg and Saarland in Germany; País Vasco and Navarra in Spain; Northern and Central regions in Italy. Instead, regions hosting capital cities are among the least industrialised regions, due to the strongest relevance of services in their economy. More in general, other Mediterranean (and Southern) regions of Italy, France and Spain are less industrialized regions.

Lastly, PC6 is associated to the regional investments in human capital and innovation. Italian regions (both in the Northern and in the Southern part of the country) perform poorly if compared to Spanish and French regions. Also Northern German regions (with the only exceptions of Berlin and Bremen) perform below the average. We can conclude that, according to human capital and innovation, a sharp distinction between Northern regions and Southern ones does not emerge.

Deepening the analysis according to the Lisbon Strategy, EU regions show different patterns in relation to the different pillars of the Strategy itself: for instance, a good performing labour market, high investments in human capital and skills are not always positively linked to the general economic performance. This suggests that there is not a unique relationship among the three different pillars of the Lisbon Strategy. Some more detailed examples may clarify this issue. Eastern German *Länder*, in spite of their high employment rates and their high-skilled workers, are characterised by low levels of per capita GDP and by high unemployment rates. Rural French regions perform generally well according to the Lisbon Strategy, having invested in human capital, R&D, broadband connections and so on. However, in spite of the presence of high-skills workers, these investments (following Lisbon Strategy's key targets) have not led employment rates above the average.

Moving to the Mediterranean regions, they perform worst than Continental ones, according to the Lisbon Strategy's targets, thus confirming the findings highlighted by Sapir (2006). However the performance of Spanish regions differs from that of Italian ones. Spain has deeply invested in innovation and human capital, thus increasing the employment rates (note that we are not considering the effects of the current economic crisis). By the way, Southern Spain regions are affected both by a weak economic performance (with high unemployment rates) and by a strong presence of low-skilled workers. On the other side, Italian regions can be considered amongst the worst performing regions according to Lisbon Strategy's targets. The performance of the labour market is particularly poor only in Southern regions, whereas investments in R&D and skills of workers are generally low also in Northern richer regions.

Therefore, if different patterns according to the Lisbon Strategy performance emerge, other structural features of the regions may be relevant in order to explain such patterns. In particular, two related key-aspects may help in defining them. The first issue is a strong core-periphery model still lasting within Europe, in spite of the improvements of territorial EU policies: the historical core of Europe (known as Blue-Banana) still shows a better social and economic performance than more peripheral regions. A second issue is related to the distribution of manufacturing activities within and amongst regions. Although findings are not unique, manufacturing regions tend to employ low-skilled workers, investing less on human capital and innovation. This relationship is particularly

strong within Italian manufacturing regions, even if the economic performance of these regions is amongst the best in Europe. If the first issue underlines a clear geographical pattern, the second one creates a more complex scheme, according to the distribution of manufacture.

5 How polycentrism affects the achievement of the Lisbon Strategy's main targets

We have just highlighted the different performances which characterise EU regions according to the Lisbon Strategy's main goals. This section sheds light on the existing relationships between the achievement of Lisbon Strategy's targets and the extent of polycentrism, which could derive by territorial policies oriented to a more equilibrated distribution of the economic activities amongst regions. In particular, following the literature suggesting the positive effects of polycentrism on economic competitiveness and social cohesion (CSD, 1999; Hague *et al.*, 2003; Meijers *et al.*, 2008), we investigate if the sharp differences emerging by the PCA can be better explained through different extents of polycentrism at regional level. By the way, empirical results do not support this hypothesis. Indeed, Polycentricity Index estimated on the 10 largest cities per region is not significantly correlated to key economic and social variables, such as per capita GDP (r = -0.191), unemployment rate (r = -0.021) or total employment rate (r = -0.159). Nor environmental indicators (such as the PM_{10} concentrations and the share of land used for artificial purposes) seem to be correlated to the Polycentricity Index[14].

As we have extracted six PCs from the original set of variables, a more complete analysis can be developed by observing the correlations amongst each PC and the Polycentricity Index. Table 3 shows these correlations: all the policentricity indexes estimated (i.e., based on 5, 8, 10, 12 and 15 largest cities per region) are reported.

Referring to PC1, no correlation is observed between polycentrism and regional urbanization and accessibility: urban and central regions may be polycentric as well as rural and peripheral ones. Furthermore, polycentric regions are not more inclusive than monocentric ones: on the contrary, the correlation between PC2 (i.e., "weak economic performance and social exclusion") and Policentricity Index is positive, even though it is not significant. Referring to PC3 ("performance of the labour market"), no evidence emerges about a better performance of the labour market within polycentric regions. On the opposite side, polycentric regions are more oriented to employ low-skilled workers: those regions are characterised by higher shares of early school leavers and population with a lower education qualification. In particular, correlation between PC4 and 15-cities policentricity index is positive and significant. However, it is important to underline that the index based on 15 cities per region is more affected by national patterns and in particular by the Italian one.

14. Although, referring to these environmental variables, several outliers may affect our estimations.

Table 3 – Correlations amongst extracted PCs and policentricity indexes

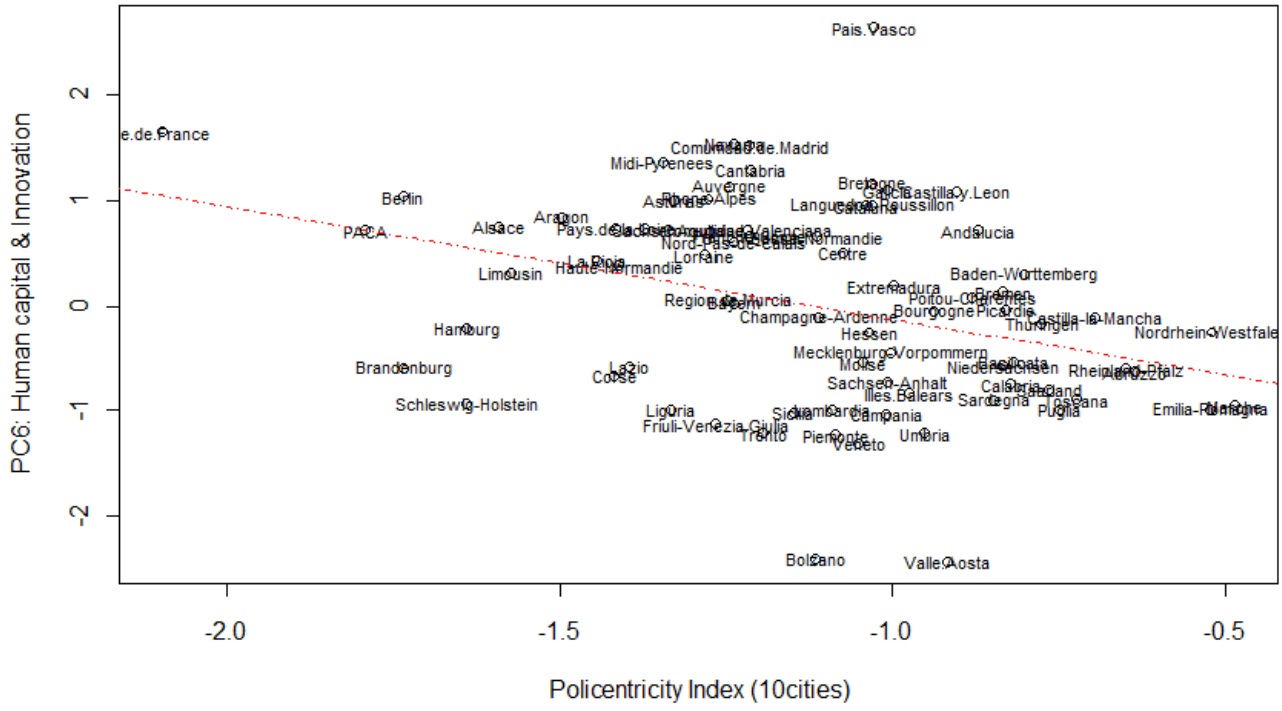
	Policentricity Index – 5 cities	Policentricity Index - 8 cities	Policentricity Index - 10 cities	Policentricity Index - 12 Cities	Policentricity Index – 15 cities
PC1: urbanization and accessibility	-0.215	-0.160	-0.101	-0.049	0.020
	(0.064)	(0.1695)	(0.3893)	(0.6745)	(0.8664)
PC2: weak economic performance and social exclusion	0.101	0.086	0.091	0.116	0.142
	(0.3897)	(0.4613)	(0.4361)	(0.3232)	(0.2256)
PC3: performance of labour market	-0.128	-0.109	-0.118	-0.112	-0.090
	(0.2729)	(0.3515)	(0.3114)	(0.3379)	(0.4447)
PC4: low-skilled workers	0.007	0.091	0.159	0.216	**0.265**
	(0.9526)	(0.4393)	(0.1726)	(0.06219)	**(0.02151)**
PC5: extent of manufacture	**0.409**	**0.428**	**0.430**	**0.436**	**0.430**
	(0.0002743)	**(0.000128)**	**(0.0001197)**	**(0.00009)**	**(0.0001184)**
PC6: human capital and innovation	-0.187	**-0.288**	**-0.351**	**-0.417**	**-0.484**
	(0.1072)	**(0.01219)**	**(0.00199)**	**(0.0001955)**	**(0.00001)**

p-values in parentheses

Source: elaboration on Insee (1999), Istat (2001), Ine (2001), Destatis (2008) and on Eurostat (2011), © ESPON Database (2006), European Commission (2010b)

Similar results emerge by analysing the correlation between PC6 ("human capital and innovation") and 10-cities Policentricity Index: here, correlation is significant and negative. This implies that the more polycentric a region is, the less the region invests in human capital and innovation. The relation is shown in Figure 5.

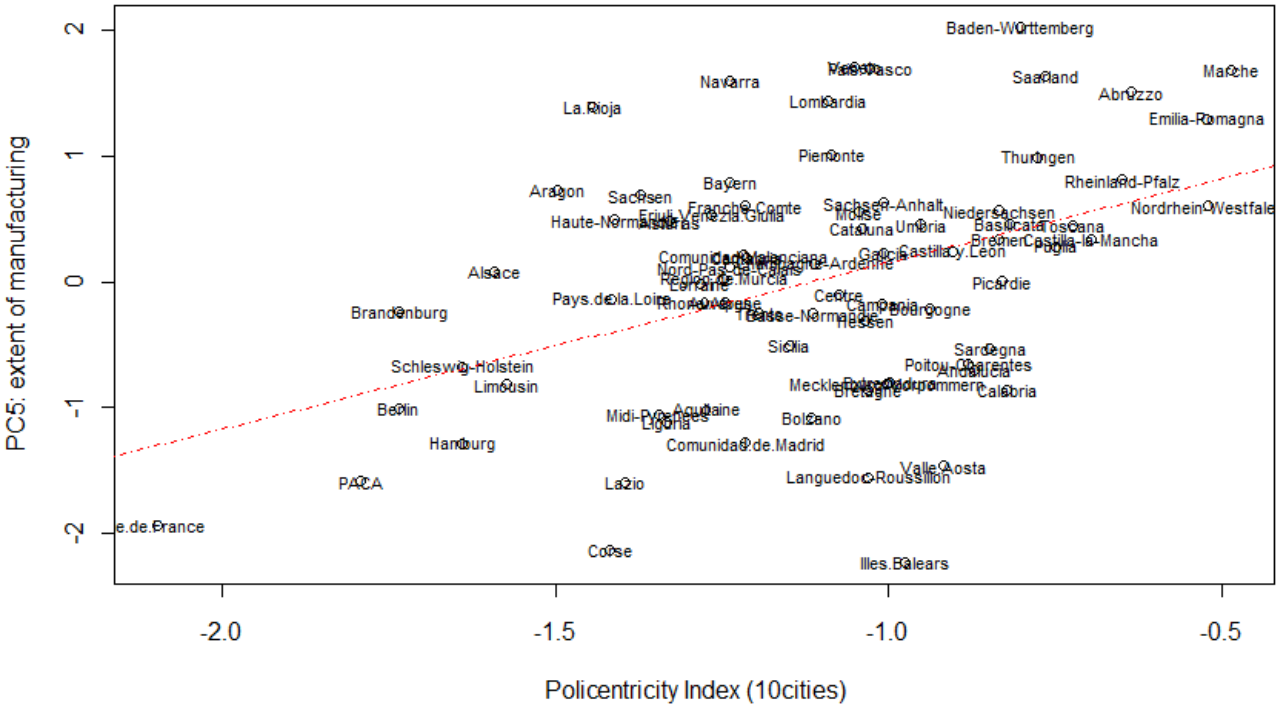
Figure 5 – Correlation between PC6 and Policentricity Index (10 cities)



Source: elaboration on Insee (1999), Istat (2001), Ine (2001), Destatis (2008) and on Eurostat (2011), © ESPON Database (2006), European Commission (2010b)

However, an even more significant correlation is that between PC5 ("extent of manufacture") and policentricity index. Polycentric regions show a higher presence of manufacturing activities than monocentric ones. The correlation is very significant: it holds whatever estimating policentricity index. Therefore, the manufacturing structure of the economy seems to be the most relevant feature of polycentric regions (figure 6).

Figure 6 – Correlation between PC5: Manufacturing and Policentricity Index (10 cities)



Source: elaboration on Insee (1999), Istat (2001), Ine (2001), Destatis (2008) and on Eurostat (2011), © ESPON Database (2006), European Commission (2010b)

Therefore, a strong relationship between manufacturing and polycentrism emerges. In other words, the spread of industrial activities can be still considered one of the most important drivers of a polycentric regional development. The opposite is also true: monocentric regions, which are characterised by largest metropolitan areas (e.g., Île de France, Lazio or Provence-Alpes-Côte d'Azur), are more focused on tertiary activities. Therefore, this link between polycentrism and manufacturing activities may affect policies' effectiveness, representing an obstacle to the full achievement of Lisbon Strategy's main targets. In particular, manufacturing activities still affect the investments in human capital, especially in some countries, such as Italy. On the other side, less industrialized regions (such as the most part of French regions) show better performance in terms of investment in R&D and human capital.

6 Conclusions

Polycentric development plays a key role both on academic debate on regional topics and on EU planning policies. Since the presentation of the ESDP, a polycentric regional development has been acknowledged as the main tool to foster inclusion, economic competitiveness and environmental sustainability withine European regions (CSD, 1999; Hague *et al.*, 2003; Meijers *et al.*, 2008). Most of these targets are now included in the Lisbon Strategy (as well as in Europe 2020 Strategy), even if the Strategies do not mainly refer to the regional level.

In the present paper, we have studied the achievement of the targets related to the Lisbon Strategy and we have observed significantly different performances at regional level.

First of all, a clear core-periphery pattern at EU level still lasts, in spite of the important efforts of the EU in improving territorial cohesion (CSD, 1999). Indeed, more 'central' regions according to population, accessibility and wealth still perform better than peripheral regions when considering economic competitiveness and investments in human capital. These findings confirm the differences still existing between the Continental social model and Mediterranean one (Sapir, 2006)

Second, within this EU pattern, differences within each Country are observed when analysing the regional performance according to the Lisbon Strategy. These differences are more significant in Italy and in Germany, where the contrast between central regions and lagging behind ones has stronger historical roots. At the opposite, France seems to be characterised by a more homogeneous development pattern amongst its regions.

Third, when considering regional patterns, manufacture still plays a strategic role in creating new emerging differences amongst regions, especially referring to the economic performance: the most manufacturing regions are still amongst the richest ones within the continent. However, nowadays we observe that in manufacturing regions investment in human capital are not developed with the same intensity of past decades. This issue, in perspective, could play a negative role in fostering regional growth of these areas.

Within this framework, the current analysis has also highlighted that polycentricity is positively related to manufacturing activity. Moreover, a negative relation between polycentrism and lack of investments in human capital is found. Therefore, even though the promotion of a more distributed pattern of activities within EU regions fosters the economic growth, two main drawbacks can be highlighted within this framework: i) the core-periphery pattern at the EU scale has not yet been removed; ii) the polycentric development mainly based on manufacture does not remove new emerging divides between innovation poles and manufacturing areas. As a consequence, from this analysis we cannot support the hypothesis that a more polycentric development brings more social cohesion and long-term economic competitiveness to EU regions.

7 Appendix A

In table A.1, the 25 social, economic and demographic variables which are used for PCA in section 4.1 are shown. Statistical sources and reference year are also reported.

Table A.1 – Description of variables used for PCA

Variable	**Source**	**Refer. Year**
Resident Population	Eurostat	2009
GDP per capita (EU-27 = 100)	Eurostat	2008
GVA agriculture (% on the total)	Eurostat	2007
GVA industrial sect. (% on the total)	Eurostat	2007
Employment in agriculture (% on the total)	Eurostat	2007
Employment in industrial sect. (% on the total)	Eurostat	2007
Total employment rate	Eurostat	2008
Employment rate (55-64 years)	Eurostat	2008
Female employment rate	Eurostat	2008
Unemployment rate	Eurostat	2008
Long-term unemployment rate	Eurostat	2008
Unemployment rate (15-24 years)	Fifth report on cohesion	2008
Population at risk of poverty after social transfers (% of total population)	Fifth report on cohesion	2008
Early school leavers aged 18-24 (in % on the total of the same years)	Fifth report on cohesion	2007-2009
Population aged 25-64 with low education (% on the total)	Fifth report on cohesion	2008
Population aged 30-34 with tertiary education (% on the total)	Fifth report on cohesion	2008
Expenditure on R&D (% of GDP)	Eurostat	2008
Patent application to EPO per million inhabitants	Fifth report on cohesion	2006-2007
Households with broadband connection (% of all households)	Fifth report on cohesion	2009
Land for artificial uses (% on total)	Eurostat	2009
Railroad accessibility (average value of Nuts 3)	Espon	2001
Road accessibility (average value of Nuts 3)	Espon	2001
Air accessibility (Nuts 3 with max accessib.)	Espon	2001
Passenger cars per 1000 inhabitants	Eurostat	2008
Yearly average concentration of PM_{10} ($\mu g/m^3$) (average value of Nuts-3)	Fifth report on cohesion	2009

Source: elaboration on Eurostat (2011), © ESPON Database (2006), European Commission (2010b)

In table A.2, β coefficients estimated from equation (1) for the 72 regions are shown. The table shows the estimations through OLS method considering the largest 5, 8, 10, 12 and 15 cities within each region. By the way, the 'Policentriciy Index' most used within the paper is the index that is estimated according to the 10 largest cities.

Table A.2 – β coefficients estimated from equation (1) for the 72 regions

NUTS NAME	5 cities	8 cities	10 cities	12 cities	15 cities	NUTS NAME	5 cities	8 cities	10 cities	12 cities	15 cities
Galicia	-0.822	-0.891	-1.006	-1.036	-1.029	Baden-Württemberg	-0.794	-0.817	-0.803	-0.796	-0.784
Asturias	-1.205	-1.284	-1.330	-1.311	-1.242	Bayern	-1.519	-1.256	-1.238	-1.192	-1.127
Cantabria	-1.574	-1.338	-1.212	-1.162	-1.116	Brandenburg (incl. Berlin)	-2.447	-1.955	-1.734	-1.569	-1.393
País Vasco	-0.912	-1.036	-1.027	-1.048	-1.040	Hessen	-1.068	-1.053	-1.035	-1.021	-1.012
Navarra	-1.590	-1.317	-1.238	-1.165	-1.096	Mecklenburg-Vorpommern	-0.836	-0.946	-1.001	-1.047	-1.071
La Rioja	-1.679	-1.488	-1.444	-1.388	-1.328	Niedersachsen (incl. Bremen)	-0.878	-0.874	-0.834	-0.847	-0.847
Aragón	-2.245	-1.691	-1.498	-1.360	-1.266	Nordrhein-Westfalen	-0.386	-0.495	-0.520	-0.537	-0.548
Comunidad de Madrid	-1.688	-1.275	-1.215	-1.169	-1.135	Rheinland-Pfalz	-0.477	-0.595	-0.649	-0.670	-0.706
Castilla y León	-0.747	-0.853	-0.902	-0.946	-1.041	Saarland	-0.927	-0.758	-0.766	-0.754	-0.721
Castilla-La Mancha	-0.509	-0.614	-0.696	-0.722	-0.757	Sachsen	-1.338	-1.445	-1.374	-1.292	-1.222
Extremadura	-0.932	-0.981	-0.997	-1.011	-1.023	Sachsen-Anhalt	-1.175	-1.096	-1.007	-0.938	-0.853
Cataluña	-1.302	-1.124	-1.038	-0.999	-0.966	Schleswig-Holstein (incl. Hamburg)	-1.917	-1.693	-1.641	-1.558	-1.447
Comunidad Valenciana	-1.366	-1.318	-1.216	-1.120	-1.040	Thüringen	-0.854	-0.809	-0.775	-0.799	-0.796
Illes Balears	-1.519	-1.117	-0.975	-0.950	-0.910	Île de France	-3.510	-2.454	-2.096	-1.908	-1.726
Andalucía	-0.836	-0.853	-0.872	-0.854	-0.881	Champagne-Ardenne	-1.059	-1.063	-1.111	-1.227	-1.329
Región de Murcia	-1.532	-1.337	-1.245	-1.165	-1.092	Picardie	-0.619	-0.775	-0.830	-0.857	-0.895
Piemonte	-1.638	-1.248	-1.086	-0.967	-0.891	Haute-Normandie	-1.463	-1.404	-1.412	-1.421	-1.431
Valle d'Aosta	-1.288	-1.028	-0.918	-0.830	-0.754	Centre	-1.014	-0.968	-1.073	-1.174	-1.229
Liguria	-1.658	-1.432	-1.334	-1.298	-1.256	Basse-Normandie	-1.356	-1.204	-1.113	-1.164	-1.159
Lombardia	-1.642	-1.246	-1.090	-0.996	-0.938	Bourgogne	-1.053	-0.828	-0.937	-1.073	-1.173
Provincia Auton. Bolzano	-1.246	-1.141	-1.116	-1.085	-1.027	Nord - Pas-de-Calais	-1.009	-1.206	-1.237	-1.264	-1.435
Provincia Auton. Trento	-1.291	-1.256	-1.194	-1.121	-1.090	Lorraine	-1.088	-1.290	-1.282	-1.256	-1.213
Veneto	-0.751	-1.022	-1.051	-1.023	-0.976	Alsace	-1.608	-1.572	-1.591	-1.615	-1.599
Friuli-Venezia Giulia	-1.308	-1.326	-1.265	-1.184	-1.082	Franche-Comté	-1.032	-1.144	-1.214	-1.228	-1.258
Emilia-Romagna	-0.614	-0.508	-0.524	-0.604	-0.743	Pays de la Loire	-1.186	-1.292	-1.416	-1.489	-1.476
Toscana	-0.870	-0.758	-0.723	-0.710	-0.716	Bretagne	-0.846	-0.898	-1.029	-1.055	-1.083
Umbria	-0.953	-0.958	-0.952	-0.941	-0.906	Poitou-Charentes	-0.648	-0.819	-0.881	-0.932	-1.134
Marche	-0.535	-0.508	-0.486	-0.505	-0.559	Aquitaine	-1.524	-1.333	-1.273	-1.275	-1.394
Lazio	-2.338	-1.654	-1.396	-1.235	-1.105	Midi-Pyrénées	-1.604	-1.440	-1.346	-1.306	-1.276
Abruzzo	-0.625	-0.571	-0.636	-0.649	-0.693	Limousin	-1.824	-1.643	-1.573	-1.484	-1.381
Molise	-1.123	-1.105	-1.044	-0.991	-0.932	Rhône-Alpes	-1.535	-1.322	-1.277	-1.237	-1.176
Campania	-1.529	-1.129	-1.008	-0.918	-0.827	Auvergne	-1.121	-1.124	-1.243	-1.343	-1.360
Puglia	-0.805	-0.751	-0.749	-0.725	-0.686	Languedoc-Roussillon	-0.847	-0.918	-1.030	-1.098	-1.181
Basilicata	-1.089	-0.898	-0.817	-0.765	-0.770	Provence-Alpes-Côte d'Azur	-1.583	-1.821	-1.792	-1.711	-1.621
Calabria	-0.668	-0.790	-0.823	-0.869	-0.892	Corse	-1.657	-1.516	-1.418	-1.340	-1.228
Sicilia	-1.293	-1.216	-1.147	-1.081	-0.993						
Sardegna	-0.955	-0.894	-0.848	-0.838	-0.838						

Source: personal elaboration on data from: Istat (2001) for Italian comuni*; Insee (1999) for French* communes *or* communautés d'agglomération*; Ine (2001) for Spanish* municipios*; Destatis (2008) for German* gemeinden.

8 References

Auerbach F. (1913), Das Gesetz der Bevölkerungskonzentration, *Petermann's Geographische Mitteilungen,* 59, 74–76

Bagnasco A. (1977), *Tre Italie: la problematica territoriale dello sviluppo economico italiano*. Bologna: Il Mulino.

Bagnasco A. (1988), *La costruzione sociale del mercato.* Bologna: Il Mulino.

Barca F. (2009), *An Agenda for a Reformed Cohesion Policy. A place-based Approach to Meeting European Union Challenges and Expectations*. Independent Report prepared at the request of Danuta Hubner, Commisioner for Regional Policy.

Batty M. (2001), Polynucleated urban landscapes, *Urban Studies*, 38, 4: 635–655.

Bertolini P., Pagliacci F. (2011), Lisbon strategy and EU countries' performance: social inclusion and sustainability, *Working Papers of the Department of Economics (Dipartimento di Economia Politica)*, University of Modena and Reggio Emilia, n. 648.

Cowell M. (2010), Polycentric Regions: Comparing Complementarity and Institutional Governance in the San Francisco Bay Area, the Randstad and Emilia-Romagna, *Urban Studies*, 47, 5: 945-965.

CSD (Committee on Spatial Development) (1999), *European Spatial Development Perspective. Towards Balanced and Sustainable Development of the Territory of the EU*. Postdam: Presented at the Informal Meeting of Ministers Responsible for Spatial Planning of the Member States of the European Union.

Davoudi S. (2003), Polycentricity in the European Spatial Planning: from an analytical tool to a normative agenda, *European Planning Studies*, 11, 8: 979-999.

Destatis (2008), *List of German Gemeinden with more than 5,000 inhabitants, December 31st, 2008* http://www.destatis.de *(accessed April 30, 2011)*

ESPON Database (2006). http://www.espon.eu *(accessed April 15, 2011)*

European Commission (2010a), *Europe 2020: a strategy for smart, sustainable and inclusive growth.* Bruxelles.

European Commission (2010b), *Investing in Europe Future. Fifth Report on Economic Social and Territorial Cohesion Report*. Luxembourg: Publications Office of the European Union, 2010 http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion5/pdf/5cr_en.pdf

European Council (2000), *Presidency Conclusion, Lisbon European Council*, Lisbon.

European Union (2007), *Territorial Agenda of the European Union. Towards a More Competitive Europe of Diverse Regions*. Leipzig: Presented at the Informal Ministerial Meeting on Urban Development and Territorial Cohesion.

Eurostat (2011), Regional Statistics. http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/data/database *(accessed April 15, 2011)*

Faludi A. (2006), From European Spatial Development to Territorial Cohesion Policy, *Regional Studies*, 40, 6: 667-678.

Gabaix X. (1999), Zipf's Law and the growth of cities, *The American Economic Review,* 89, 2: 129-132

Guérois M., Pumain D. (2002), *Urban Sprawl in France (1950-2000)*, Milano: FrancoAngeli.

Hague C. and Kirk K. (2003), *Polycentricity scoping study*. London: Office of the Deputy Prime Minister.

Hall, P. and Pain, K. (Eds.) (2006), *The Polycentric Metropolis: Learning from Mega-city Regions in Europe*. London: Earthscan.

Hotelling H. (1933), Analysis of a complex of statistical variables into principal components, *Journal of Educational Psychology*, 24, 7: 498-520.

Ine (2001), *Census of Spanish Resident Population, year 2001.* http://www.ine.es *(accessed April 15, 2011)*

Insee (1999), *Census of French Resident Population, year 1999.* http://www.insee.fr *(accessed April 15, 2011)*

Istat (2001), *Census of Italian Resident Population, year 2001.* http://www.istat.it *(accessed April 15, 2011)*

Kloosterman R.C., Musterd S. (2001), The Polycentric Urban Region: toward a Research Agenda, *Urban Studies*, 38, 4: 623-633.

Lambooy, J.G. (1998), Polynucleation and economic development: the Randstad, *European Planning Studies*, 6, 4: 457-466.

Le Galès P. (2006), *Le città europee. Società urbane, globalizzazione, governo locale*. Bologna: Il Mulino.

Limtanakool N., Dijst M. and Schwanen T. (2007), A theoretical framework and methodology for characterizing National urban systems on the basis of flows of people: empirical evidence for France and Germany, *Urban Studies*, 44, 11: 2123-2145.

McCann P. (2001), *Urban and regional economics*. Oxford: Oxford University Press.

Meijers E. (2008), Summing Small Cities Does Not Make a Large City: Polycentric Urban Regions and the Provision of Cultural, Leisure and Sport Amenities, *Urban Studies*, 45, 11: 2323-2342.

Meijers E., Sandberg K. (2008), Reducing regional disparities by means of polycentric development: panacea or placebo?, *Scienze Regionali – Italian Journal of Regional Science*, 7, 2 (Special Issue): 71-96.

Neal L. (2007), *The Economics of Europe and the European Union.* Cambridge: Cambridge University Press.

Nordregio et al. (2004), *ESPON Final Report 1.1.1 Potentials for polycentric development in Europe* Luxembourg: Nordregio/ESPON Monitoring Committee (http://www.espon.eu).

Ostrom V., Tiebout C.M., Warren R. (1961), The organization of Government in Metropolitan Areas: A theoretical inquiry, *American Political Science Review*, 55: 831-842.

Parr J.B. (1985), A note on the size distribution of cities over time, *Journal of Urban Economics*, 18, 2: 199-212.

Parr J.B. (2004), The Polycentric Urban Region: A Closer Inspection, *Regional Studies*, 38, 3: 231-240.

Pearson K. (1901), On lines and planes of closest fit to systems of points in space, *Philosophical Magazine*, 2, 6: 559-572.

Riguelle F., Thomas I., Verhetsel A. (2007), Measuring Urban Polycentrism: a European Case Study and its Implications, *Journal of Economic Geography*, 7, 2: 193-215.

Romein, A. (2004), *Spatial Planning in Competitive Polycentric Urban Regions: Some Practical Lessons from Northwest Europe*. Chicago: paper submitted to City Futures Conference.

Sapir A. (2006) *Globalization and the reform of the European Social models,* 44, 2: 369-90

Thomson G. H. (1951) *The Factorial Analysis of Human Ability.* London: University Press.

Van der Laan L. (1998), Changing urban systems: an empirical analysis at two spatial levels, *Regional Studies*, 32, 3: 235-247.

Veneri P., Burgalassi D. (2010), *Questioning the effects of polycentric development. Issues of definition and measurement for the Italian NUTS-2 regions*. Aosta: Paper presented at XXXI Conferenza Italiana di Scienze Regionali.

Vicari Haddock S. (2004), *La città contemporanea*. Bologna: Il Mulino.

Zipf G. K. (1935), *The Psycho-Biology of Language, An Introduction to Dynamic Philology*, Cambrige (MA): The Riverside Press.

Zipf G. K. (1949), *Human Behavior and the Principle of Least Effort*. Cambridge (MA): Addison-Wesley.

SOMMARIO

Il policentrismo è un tratto comune dei sistemi urbani Europei. Recentemente, il concetto ha assunto una rilevanza normativa, essendo considerato come un pre-requisito fondamentale per uno sviluppo più sostenibile e bilanciato all'interno e tra le regioni Europee. Tuttavia, gli effetti del policentrismo rispetto ad altre importanti Strategie Europee (come ad esempio la Strategia di Lisbona, indirizzata all'incremento della competitività e della coesione sociale in Europa) non sono chiari. Il paper mette in evidenza le possibili relazioni tra uno sviluppo policentrico a livello regionale ed il raggiungimento degli obiettivi previsti dalla Strategia di Lisbona. Utilizzando un gruppo di 75 regioni appartenenti a Francia, Germania, Italia e Spagna, abbiamo inizialmente misurato il grado di policentrismo di queste regioni, stimando (attraverso la tecnica dei minimi quadrati) la pendenza della distribuzione rank-size delle città all'interno di ciascuna regione. In seguito, è stata applicata un'analisi in componenti principali, al fine di evidenziare le principali caratteristiche della performance di ciascuna regione rispetto agli obiettivi della Strategia di Lisbona. Infine, analizzando le correlazioni tra grado di policentrismo e il raggiungimento di tali obiettivi, si è osservato come il policentrismo sia significativamente correlato sia alla diffusione dell'attività manifatturiera sia a bassi investimenti in innovazione e in capitale umano.