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MORPHOLOGICAL POLYCENTRICITY IN SOUTHERN EUROPE: EVIDENCE AT THE NATIONAL LEVEL

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Abstract
Polycentricity constitutes a thoroughly discussed notion in the European spatial planning agenda. It is mostly seen as a tool for balanced regional development, European competitiveness and sustainable development, with main purpose to counterbalance the concentrated urban configurations of northwestern Europe. One of the lagging territories in terms of urban development –among others- is the European Continental South, which, in addition, was severely hit by the recent economic crisis. Therefore, the scope of this article is to monitor the change of national urban systems in terms of morphological polycentricity in the member-states of Greece, Italy, Portugal and Spain, for the period 2000-2014, in order to assess their urban development potential. Thus, the measures of urban primacy and rank-size coefficient are utilised to monitor the change in the degree of morphological polycentricity among the main Functional Urban Areas (FUAs) of the aforementioned countries, and the spatial distribution of FUAs over the national territory is estimated in order to identify the territorial balance aspect of polycentricity. The results indicate mixed outcomes for the examined countries. Despite the undeniably low levels of the derived polycentricity for Greece and Portugal, the polycentricity degree in Greece remains stable, while in Portugal there is a trend that favours polycentric development. As for traditionally more polycentric countries, the polycentricity rates of Spain and Italy show marginal change. In terms of territorial balance, Greece and Spain seem polycentric, while Portugal and particularly Italy are characterised as less polycentric in this respect.
Keywords: polycentricity, functional urban areas, urban primacy, rank-size distribution, territorial balance

1. INTRODUCTION

In general, the concept of polycentricity describes an urban system comprised of several agglomerations of the variable in question (population, employment, etc), and although it constitutes an important notion for the EU spatial planning agenda, it is not as clearly defined as one would expect. In the European Spatial Development Perspective (ESDP), polycentricity is defined simply as an opposite

to the notions of monocentricity, dispersal and sprawl (Nordregio et al. 2005). It can be claimed that this is for the main part due to the multiple dimensions, the different elements, and the several scales of application.

According to Davoudi (2003), the analytical dimension is used to interpret or analyse a polycentric system, while the normative one utilises polycentricity as a guiding principle to achieve specific policy goals. The endogenous characteristics of the centres, such as size and spatial distribution, that bring out the urban hierarchy make up the morphological elements of the notion; on the other hand, the connections (networks of flows and co-operation) between centres are referred to as functional elements (Green 2007). Furthermore, regarding the levels that polycentricity can be applied to, the ESPON 1.1.1. project identifies the continental (macro), the national and interregional (meso), and the intraregional level (micro) (Nordregio et al. 2005).

In fact, the first application of polycentrism as a development policy goes back to the 1960s when the French "métropoles d'équilibre" reinforced the development of a number of cities at the upper part of the urban hierarchy (Moseley 1974), with ultimate goal to counterweigh the dominant Paris. Polycentric was also the perspective of Dutch planners and politicians of the same era, that national cities should be characterised by equality in magnitude, since large dominating metropolises -like Paris and London- pose a threat to the moral values and to the development of rural areas (Van der Burg & Vink 2008).

However, polycentric development in its current form came to the fore in the 1990s, and it was firstly adopted as a policy concept in Germany in 1993 (Nordregio et al. 2005). At the European level, the European Spatial Development Perspective (1999) and the Territorial Agenda (2007), utilise polycentricity as a tool for balanced regional development, European competitiveness and sustainable development. With reference to the French case, the main concern of the European spatial framework is the counterbalance of the European urban system that is strongly influenced by the overconcentrated urban configurations of northwestern Europe.

The polycentricity discussion in the European Union, and the adoption of the polycentricity concept in the ESDP, caused a massive wave of relevant bibliography. Regarding the regional context, there has been implemented significant research work throughout Europe from the late 1990s and onwards (see Bailey & Turok 2001; Kloosterman & Lambregts 2001; Parr 2004; Hall & Pain 2006; Garcia-López & Muñiz 2010; Carmo 2013; Szabó et al. 2014; Bański and Czapiewski 2015; Zambon et al. 2017), although in the USA polycentricity had preceded the European discussion as a topic of academic interest (see Gordon et al. 1986; Gordon & Richardson 1996; Cervero & Wu 1997; McMillen & McDonald 1997). It was not until recently, though, that a growing interest for the polycentric phenomenon was noted in other global regions also, such as Latin America (see Romein et al. 2009;

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Suarez & Delgado 2009; Fernandez-Maldonado et al. 2014), and China (see Huang et al. 2016; Liu et al. 2016; Cheng & Shaw 2017; Murakami & Chang 2018).

However, even though the European Continental South is recognised as a lagging region in terms of economic growth (see European Commission 1999), which is quite relevant to the polycentric development degree of the respective national urban systems (see Brezzi & Veneri 2015), there hasn't been any focused analysis of its polycentric potential. Moreover, and in contrast to the central and northwestern Europe, the urban development and the relevant hierarchy of the southern European countries is very much affected by the more varied geographical nature of their territories, with population and economic activities being channeled through specific patterns over space. On top of that, the recent economic crisis hit –among others- the aforementioned countries (Parkinson & Meegan 2013), in the form of economic activity recession and the concomitant flows of internal and external migration. Therefore, the clarification of the national trajectories regarding polycentric development becomes a well-timed topic, firstly in order to assess the national polycentric development potential itself, and secondly because the efficient allocation of resources among the national urban areas is of great importance, particularly for countries that address a relevant shortage.

In this respect, regardless of the vast empirical bibliography on national polycentricity (see Nordregio et al. 2005; IGEAT 2007; Meijers et al. 2007; Meijers & Sandberg 2008; Brezzi & Veneri 2015), the study of polycentricity through time is a task that rarely has been implemented before, due to the slow transformation process of urban systems over time, not to mention the decreasing academic interest in national polycentricity in recent years.

Therefore, scope of this article is to monitor the change of national urban systems in terms of morphological polycentricity in the member-states of Greece, Italy, Portugal and Spain, for the period 2000-2014. In this framework, polycentricity is perceived as a notion describing a national system with urban areas of more similar size, and consequently more equal importance and influence.

Beyond this introductory part, the second section deals with the methodology for calculating and illustrating morphological polycentricity at the national level, as presented in previous papers, and as it is utilised in the present article. Next, the results of the analysis are presented and commented accordingly. Finally, the last (fourth) section, includes the summary of the analysis.

2. RESEARCH METHODOLOGY AND DATA

Although the the addition of the variables of distribution and connectivity to the population size of urban centres plays a significant role in the consistent measuring of urban polycentricity (Wegener 2013), the inclusion of these functional elements in the analysis leads to dealing with more complex measures and

more sophisticated data. Partly for this reason the bulk of the bibliography on capturing and illustrating national polycentricity utilises mostly morphological methods, namely the urban primacy index and the rank-size distribution (see Nordregio et al. 2005; Meijers et al. 2007; Meijers 2008; Meijers & Sandberg 2008; Bačić & Šišinački 2014; Brezzi & Veneri 2015).

In the following analysis are utilised these very measures of urban primacy and rank-size coefficient in the countries of Southern Continental Europe to estimate the change in the degree of morphological polycentricity among their main Functional Urban Areas (FUAs) for the period 2000-2014. Moreover, the spatial distribution of FUAs is estimated in order to identify the territorial balance at the national level.

The first method used is the primacy degree (Veneri & Burgalassi 2012). The primacy degree measures urban primacy in a country and it is calculated as the ratio of people living in the primate city over the total urban population of the country (primacy), as shown in equation (1), where n=1 indicates the primate city and *N* indicates the number of urban centres taken into consideration. In this way, the dominance of the primate city is attributed in comparison to the national urban system: the higher the primacy, the more monocentric the country, and vice versa.

$$primacy = \frac{pop(1)}{\sum_{n=1}^{N} pop(n)} \qquad (1)$$

The second method utilised in the analysis takes into account the size distribution of the national cities, and it can be claimed that records polycentricity more effectively, since it examines the relevant size of the most significant national urban centres, instead. Meijers (2008), measures polycentricity through the beta coefficient of the following equation:

$$\ln(size) = a + bln(rank) \qquad (2),$$

where *size* is the population of each FUA within a country, and *rank* is the size ranking of each FUA, computed at the national level. The slope of the regression line, given by the estimated beta, indicates the level of hierarchy among FUAs, and thus the level of polycentricity for each country. The slope is a negative one, because, as the city size diminishes, the city ranking increases. The population is placed on axis *y* and the rank on axis *x*. The country becomes more polycentric when the slope decreases in absolute value (flattens), and vice versa (see Nordregio et al. 2005; Meijers et al. 2007; Meijers 2008).[1]

Finally, a third method is employed, regarding the relevant spread of the largest FUAs over the national space, as a morphologically polycentric country has not necessarily territorially balanced large urban centres. Following Meijers & Sandberg (2008), it is tested to what extent the largest national FUAs are

[1] In bibliography can be found examples of placing population on axis *x* and the rank on axis *y*, where the slope is also negative. What differs is the interpretation of the slope change. In this case the country becomes more polycentric when the slope increases in absolute value, and vice versa (see Brezzi & Veneri 2015).

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evenly located across the NUTS2 regions. A country that has a large FUA in every NUTS2 region of its territory shows the greatest degree of territorial balance. In this regard, the spread of FUAs across the national territory is considered to make the urban system more polycentric while, on the other hand, the clustering of FUAs in a few regions indicates a system that favours polycentricity less. These centres are perceived as "growth poles", which could reinforce the economic development of the region (Meijers & Sandberg 2008), or as "market areas" that supply their hinterland with goods and services (Nordregio et al. 2005). The standardised z-scores of the results and the rank-size beta z-scores of each country for 2000 and 2014 are then illustrated on the same graph.

The number of –larger national- FUAs used for this application is equivalent to the number of NUTS2 regions that each country is partitioned into. The aforementioned standard cannot be applied to Greece, since there are only available official data for 9 Greek FUAs, where at least 13 FUAs would be necessary for this type of analysis. Therefore, this paper abusively considers as optimal the distribution of the 9 Greek FUAs to 9 different NUTS2 regions, while it is acknowledged that it fails to fully test the territorial balance in the country, due to data unavailability. Moreover, even though Meijers & Sandberg (2008) suggest that it is not appropriate to assign an absolute designation to an urban system as to whether it is polycentric or not, a moderate nomenclature for the purposes of the current analysis is presented.

Regarding the data of the analysis, as an urban unit the Functional Urban Area (FUA) is utilised -which consists of a city and its commuting zone- for reasons of data availability and comparability between different countries,[2] as is the case in several previous similar analyses (see Nordregio et al. 2005; Meijers et al. 2007; Meijers & Sandberg 2008; Brezzi & Veneri 2015).

The analysis is carried out through the examination of the FUA population data that come from the OECD database for the years 2000 and 2014 (OECD 2016), which are the only available and complete data for this set of countries.According to OECD (2013), four types of urban agglomeration FUAs are distinguished:

- Small urban areas (50,000 - 200,000 inhabitants)
- Medium-sized urban areas (200,000 - 500,000 inhabitants)
- Metropolitan areas (500,000 - 1.5 million inhabitants), and
- Large metropolitan areas (above 1.5 million inhabitants).

[2] Even though the techniques and reasoning for designating a Functional Urban Area may vary among different countries.

In addition -and regarding the criteria for selecting the number of FUAs for the analysis- there are some alternatives discussed in the bibliography. Nordregio et al. (2005) utilised large number of FUAs per country, as well as different selection criteria for the FUAs used, and omitted from their analysis the most populated national FUA. Instead, Meijers et al. (2007) propose a fixed and limited number of FUAs for international comparisons, which includes urban areas of analogical size for each country. In the same way, Brezzi & Veneri (2015) utilise the four largest FUAs for the comparison of national urban systems (as well as regional ones).

Pavleas and Petrakos (2006) in order to examine the small -in general terms- urban systems in southeastern Europe, employ a 10,000 population city threshold. However, Meijers et al. (2007) reject the adoption of a specific low population threshold, because of the influence that small provincial cities would have on the results. The present analysis is based on the examination of 9 FUAs for each country, since this was the lower number of FUAs of a country under analysis in 2011 (Greece). The FUAs in Azores, Madeira and the Canary Islands are not considered, as in previous analyses (see Nordregio et al. 2005).

3. APPLICATIONS AND RESULTS

Since the polycentricity level depends on the relevant size of national urban areas, the existing urban structure of the countries under analysis is a rather significant element for the morphological assessment of the concept. In this respect, some countries have a few large metropolises which tend to dominate the national urban system (less polycentric), while others are characterised by a larger number of similar sized urban areas (more polycentric).

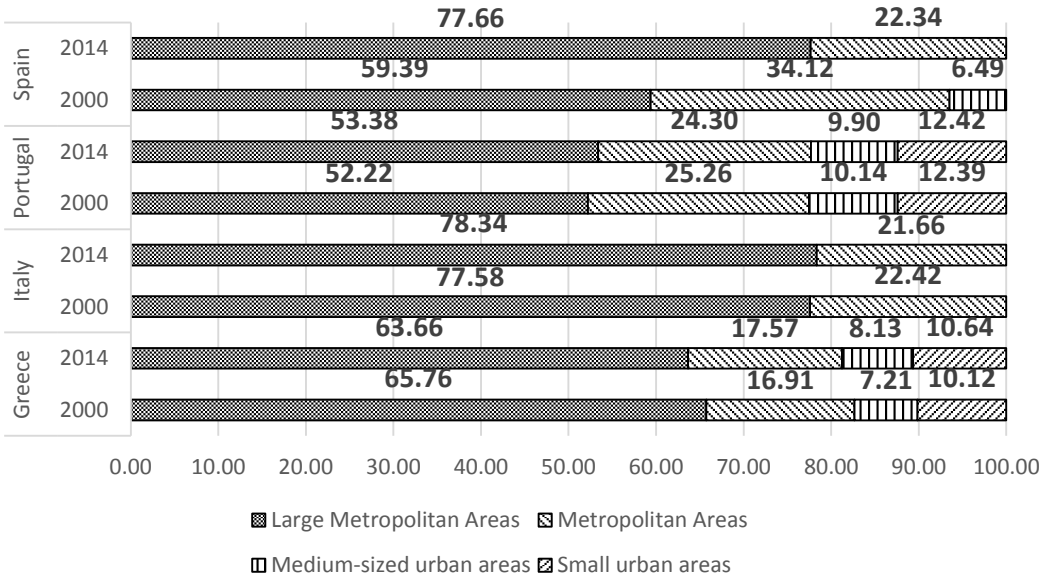

FIGURE 1 - THE NATIONAL URBAN DISTRIBUTION OF THE EXAMINED COUNTRIES (%, 2000 & 2014)
Source: Authors' elaboration on data from OECD

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In this respect, by employing a fixed number of FUAs, countries are represented in the analysis by different mixtures of urban area types, revealing at a great extent the national characteristics in terms of polycentricity. In Figure 1, the distribution of the examined urban systems is illustrated in respect of the typology of their urban areas under analysis. In particular, the Metropolitan areas, Medium-sized urban areas and Small urban areas of Greece account for almost 35% of the examined urban system, although they represent 8 of the 9 FUAs under analysis. In Italy, the four Larger urban areas constitute the 77.58% (78.34%), and the five rest FUAs are characterized as Metropolitan areas. In Portugal's only Larger urban area resides almost the half of the urban system population, while the rest FUAs of the analysis belong to the types of Metropolitan areas, Medium-sized urban areas and Small urban areas. Finally, in 2000 the Larger urban areas of Spain account for almost 60% of the examined urban population, while in 2014 the percentage has risen up to almost 80% and the rest FUAs are all Metropolises.

Furthermore, considering the primacy rates (Table 1), Greek FUAs exhibit the highest values since Athens contains a significantly large portion of the Greek population in comparison to the rest of the FUAs. On the contrary, among the Spanish and particularly the Italian FUAs, one can notice a dispersion of population rather than a concentration in the capital city. Finally, Portugal presents quite considerable rates of urban primacy, but lower than these of Greece. On average, urban primacy is stable during the examined period, while its deviation among the examined urban systems remains considerably high. During the examined period the primacy rates show only a marginal decrease. Concluding, countries with a greater tradition of industrialization and urban history still tend to be characterised by lower primacy degrees (see Berry 1961).

TABLE 1 - PRIMACY RATES FOR 2000 & 2014

2000			2014		
Rank	**Country (Primate city)**	**Primacy rate**	**Rank**	**Country (Primate city)**	**Primacy rate**
1	Greece (Athens)	0.658	1	Greece (Athens)	0.637
2	Portugal (Lisbon)	0.522	2	Portugal (Lisbon)	0.534
3	Spain (Madrid)	0.370	3	Spain (Madrid)	0.390
4	Italy (Milan)	0.242	4	Italy (Milan)	0.239
Average		0.448	Average		0.450
CV (%)		34.96	CV (%)		33.36

Source: Authors' elaboration on data from OECD

The Greek FUAs included in the analysis are: the Large metropolitan area of Athens, the Metropolitan area of Thessalonica, the Medium-sized urban area of Patra, and the Small urban areas of Irakleio, Larisa, Volos, Ioannina, Kavala, and Kalamata (Table 2). According to Angelidis (2005), the growth of the Greek urban system used to be rather concentrated in the two larger metropolises and the corridor of Patra – Athens – Thessalonica – Kavala, however, in the recent decades the pattern has become quite more complex, with the rest urban centres growing also, depending on morphological, locational,

economic and functional characteristics. Compliant with these findings, although a significant part of the national population is concentrated in Athens, it is recorded a decrease of its population during the examined period, as well as a minor increase of Thessalonica and Patra.

However, the population of these urban centres in recent decades tends to shift away from the core city (Salvati and De Rosa 2014; Salvati et al. 2016), which might be decisive for the recorded changes. Moreover, a remarkable population increase is recorded in the middle and lower part of the distribution, namely the FUAs of Irakleio and Larisa, as well as Ioannina, while Kavala and Kalamata in the lower ranks show negative change. Moreover, Athens and Thessalonica, which constitute the basic poles of the country (Christofakis and Papadaskalopoulos 2011), and the next tier of cities show a considerable gap, the address of which, although has been a national policy objective (see Meijers et al. 2007), has still to be dealt with effectively.

The population of the selected Greek FUAs shows on average a minor decrease, not to mention the enormous variation of the distribution for both 2000 and 2014.

TABLE 2 - POPULATION AND PERCENTAGE CHANGE FOR THE GREEK FUAS (2000 & 2014)

2000			2014			Change
Rank	FUA	Population	Rank	FUA	Population	(%)
1	Athens	3,687,167	1	Athens	3,535,055	-4.13
2	Thessalonica	948,254	2	Thessalonica	975,439	2.87
3	Patra	214,113	4	Patra	219,009	2.29
4	Irakleio	190,019	3	Irakleio	232,191	22.19
5	Larisa	176,906	5	Larisa	195,285	10.39
6	Volos	123,787	7	Volos	123,699	-0.07
7	Ioannina	122,363	6	Ioannina	133,734	9.29
8	Kavala	74,558	8	Kavala	69,516	-6.76
9	Kalamata	70,099	9	Kalamata	68,815	-1.83
Average		623,030	Average		616,971	-0.97
CV (%)		178.69	CV (%)		172.59	

Source: Authors' elaboration on data from OECD

For both 2000 and 2014, polycentricity remains unchanged (b2000 = b2014 = -1.744), and therefore Greece is characterised by the less polycentric urban system in Southern Continental Europe (Figure 2). In general, the size distribution seems rather linear, with most notable exception the FUA of Patra, which shows lower population than expected for both the years of the analysis.

In Italy, a social and economic division at the spatial level is rather obvious, with the northern cities already being industrialised since the formation of the Italian unitary state in the 19th century. As a result, the Italian spatial policies face over time the complex issue of the disparities between the cities in the North and the cities in the South (Meijers et al. 2007). In the present analysis, Italy is represented by the FUAs of: the Large metropolitan areas of Milan, Rome, Naples, and Turin, as well as the five Metropolitan areas of Palermo, Genova, Bologna, Florence, and Catania (Table 3).

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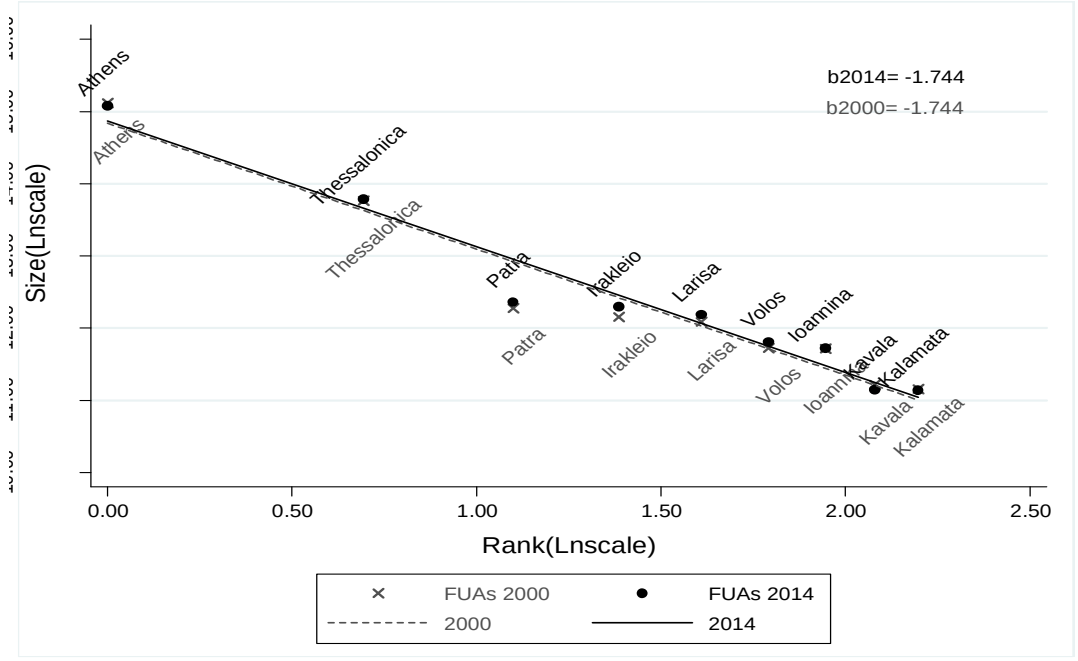

FIGURE 2 - DEGREE OF POLYCENTRICITY (RANK-SIZE COEFFICIENT) IN GREECE FOR 2000 & 2014
Source: Authors' elaboration on data from OECD

All of the examined FUAs grow in terms of population, apart from Genova, whose population decreases. Large metropolises such as Milan, Rome and Turin experience a significant increase, however, Rome seems to monopolise the urban growth among the southern urban centres. Concerning the large metropolises, according to Veneri (2013), the growth of Milan and Rome is a result of the territorial integration of previously neighboring urban nodes, in the way that Champion (2001) describes the incorporation evolving mode. Finally, the population of the metropolises in the lower ranks of the distribution also increases notably (Bologna, Florence and Catania). On average, the examined urban population increases almost by 6%, while its distribution, even though it varies considerably, it shows the lower value among the examined countries.

TABLE 3 - POPULATION AND PERCENTAGE CHANGE FOR THE ITALIAN FUAS (2000 & 2014)

2000			2014			Change
Rank	FUA	Population	Rank	FUA	Population	(%)
1	Milan	3,847,991	1	Milan	4,159,854	8.10
2	Rome	3,702,216	2	Rome	4,149,364	12.08
3	Naples	3,519,828	3	Naples	3,572,928	1.51
4	Turin	1,687,005	4	Turin	1,774,507	5.19
5	Palermo	931,194	5	Palermo	940,259	0.97
6	Genova	739,138	8	Genova	707,321	-4.30
7	Bologna	703,630	6	Bologna	763,811	8.55
8	Florence	700,959	7	Florence	732,746	4.53
9	Catania	611,090	9	Catania	630,814	3.23
Average		1,827,006	Average		1,936,845	6.01
CV (%)		74.07	CV (%)		76.15	

Source: Authors' elaboration on data from OECD

During the examined period, the Italian urban system presents a marginal decrease of polycentricity (b2000 = -1.021, b2014 = -1.053), which is depicted on the graph as a confined eccentric clockwise relocation of the regression line, caused mainly by the relatively more intense increase of population in the larger cities (Figure 3). Although the rank-size beta marginally decreased, Italy remains the most polycentric of the examined countries. Regarding the convexity of the distribution, it can be claimed that the observed concavity in the middle of the size distribution relates to a disproportionately high concentration of population in the metropolis of Naples for both the years of the analysis whereas, on the contrary, the metropolis of Milan shows disproportionately low levels of concentration.

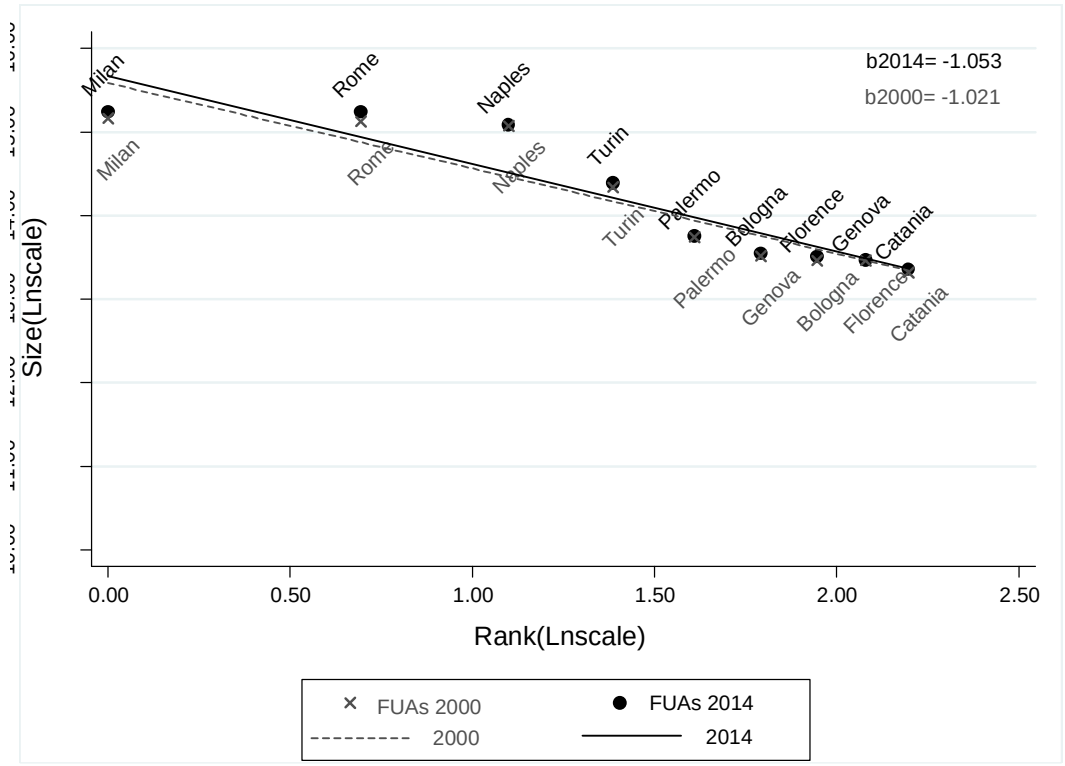

FIGURE 3 - DEGREE OF POLYCENTRICITY (RANK-SIZE COEFFICIENT) IN ITALY FOR 2000 & 2014
Source: Authors' elaboration on data from OECD

Alves et al. (2016) identify as the three main axes of the Portuguese urban system during the 20th century, the polarization around the cities –and eventual metropolises- of Lisbon and Porto, the small set of medium-sized cities, and the dense complementary network of small urban centres, particularly in the centre and north of the country, while Delgado & Codinho (2005) claim that the system is characterised by the proliferation of small cities and the dominant cities of Lisbon and Porto. Given the aforementioned remarks, the disparities addressed by the spatial policies are these among the largest metropolises and the next group of –medium-sized- cities (Meijers et al. 2007). Moreover, in terms of population density, Portugal shows a North-South pattern too, as well as a contrast between the coastal

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areas -which include the total of the examined FUAs- and inland regions along the border with Spain (Nordregio et al. 2003).

The FUAs under analysis are: the Large metropolitan area of Lisbon, the metropolitan area of Porto, the two Medium-sized urban areas of Coimbra, Braga, as well as the Small urban areas of Guimarães, Aveiro, Setúbal, Faro and Viseu (Table 4). The population of all the examined FUAs grows, with the exception of Coimbra, whereas Lisbon and Porto continue to dominate the urban system. However, the most remarkable increase present the urban centres of Braga and Faro. The average population increases over the examined period at a rate of almost 7%, while the distribution shows a high degree of variation, being the second highest among the examined urban systems.

TABLE 4 - POPULATION AND PERCENTAGE CHANGE FOR THE PORTUGUESE FUAS (2000 & 2014)

2000			2014			Change (%)
Rank	FUA	Population	Rank	FUA	Population	
1	Lisbon	2,638,111	1	Lisbon	2,886,662	9.42
2	Porto	1,276,205	2	Porto	1,313,829	2.95
3	Coimbra	284,196	3	Coimbra	279,204	-1.76
4	Braga	227,929	4	Braga	256,427	12.50
5	Guimarães	182,384	5	Guimarães	182,433	0.03
6	Aveiro	134,533	6	Aveiro	144,673	7.54
7	Setúbal	107,992	7	Faro	124,779	15.67
8	Faro	107,878	8	Setúbal	118,340	9.58
9	Viseu	93,030	9	Viseu	101,418	9.02
Average		561,362	Average		600,863	7.04
CV (%)		145.06	CV (%)		147.27	

Source: Authors' elaboration on data from OECD

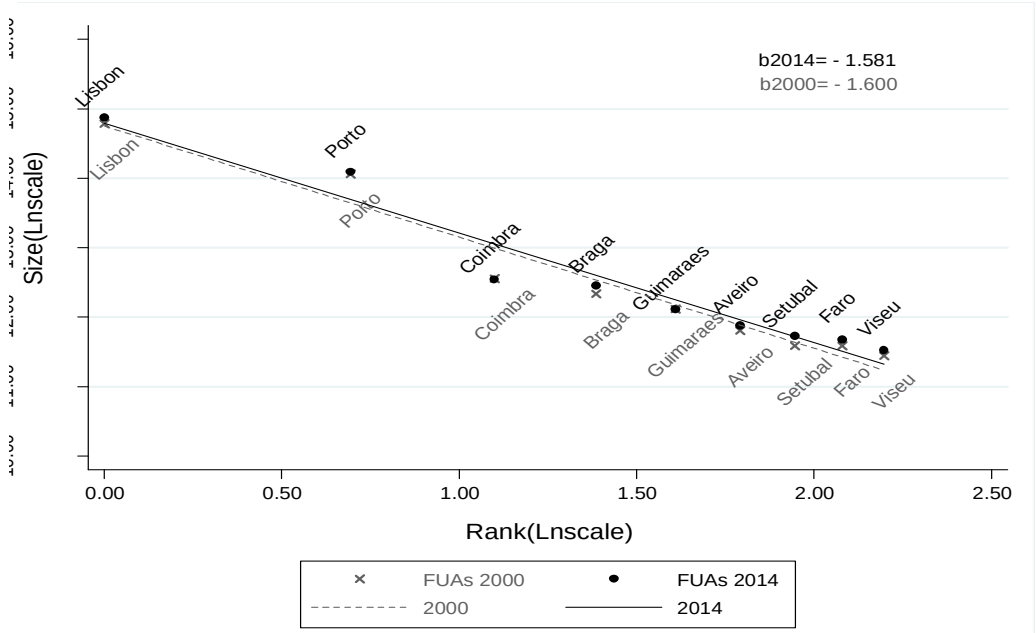

FIGURE 4 - DEGREE OF POLYCENTRICITY (RANK-SIZE COEFFICIENT) IN PORTUGAL FOR 2000 & 2014
Source: Authors' elaboration on data from OECD

The Portuguese urban system is characterised as relatively monocentric since it presents, along with the Greek urban system, the second highest –in absolute value- beta coefficients for both the years of the analysis (b_{2000} = -1.600, b_{2014} = -1.581, Figure 4). The increase of population of the middle and lower tier FUAs between 2000 and 2014 decreased marginally the beta coefficient, with the urban system becoming consequently slightly more polycentric, which is depicted as a confined anticlockwise relocation of the regression line (an opposite one to the aforementioned Italian trend). Regarding convexity, the second largest FUA of Porto shows larger population than expected. Apart from that, the convex middle part of the distribution shows dispersed concentration of population for Coimbra.

The FUAs of Spain included in the analysis are the Large metropolitan areas of Madrid and Barcelona, the Metropolitan areas of Valencia, Seville, Bilbao, Zaragoza, Málaga, and Las Palmas, as well as the Medium-sized urban area of Palma de Mallorca, and Granada in 2000, which is substituted by Murcia in 2014 (Table 5). The Spanish urban system is an hierarchical one, although, Madrid and Barcelona seem to share the status and functions of primacy (Costa et al. 1991). Gil-Alonso (2013), distinguishes the main trends of its recent history into the suburbanization phase during the mid 1990s, the redirection of population to the urban centres after 2000, and the restraint of the metropolitan area growth and the suburbanisation dynamics as a result of the 2008 economic and real estate crisis. However, the total of the examined FUAs show growth of their population in the period 2000-2014, where significant changes take place, with the exception of Bilbao, which shows a less intense increase. The average population of Spain in the examined period records the highest growth among the countries of the analysis (23.72%). Regarding the deviation of the distribution, there is a considerable increase between the years of the analysis.

TABLE 5 - POPULATION AND PERCENTAGE CHANGE FOR THE SPANISH FUAS (2000 & 2014)

2000			2014			Change
Rank	FUA	Population	Rank	FUA	Population	(%)
1	Madrid	5,444,389	1	Madrid	7,079,173	30.03
2	Barcelona	3,299,771	2	Barcelona	3,846,697	16.57
3	Valencia	1,364,782	3	Valencia	1,668,153	22.23
4	Seville	1,259,522	4	Seville	1,500,644	19.14
5	Bilbao	964,608	5	Bilbao	1,013,805	5.10
6	Zaragoza	726,177	6	Málaga	898,253	21.15
7	Málaga	708,797	7	Zaragoza	879,797	26.73
8	Granada	482,701	8	Palma de Mallorca	655,702	38.61
9	Palma de Mallorca	473,052	9	Murcia	606,950	-
Average		1,635,978	Average		2,023,975	23.72
CV (%)		96.23	CV (%)		125.02	

Source: Authors' elaboration on data from OECD

The examination of the rank-size distribution for the Spanish FUAs indicates significant polycentricity in comparison to the other urban systems for both the years of the analysis (b_{2000} = -1.148, b_{2014} = -1.139, Figure 5). The beta coefficients in the examined period render Spain the second most polycentric

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country in the European Continental South, while there is a marginal increase of polycentricity. The almost parallel relocation of the regression line shows that the growth of population in the whole spectrum of the distribution is of equal value (Figure 5). The distribution of the Spanish urban system seems rather consistent in terms of linearity, with most significant exceptions these of Barcelona (greater concentration that expected in 2000) and Valencia (lower concentration than predicted by the regression line in 2014).

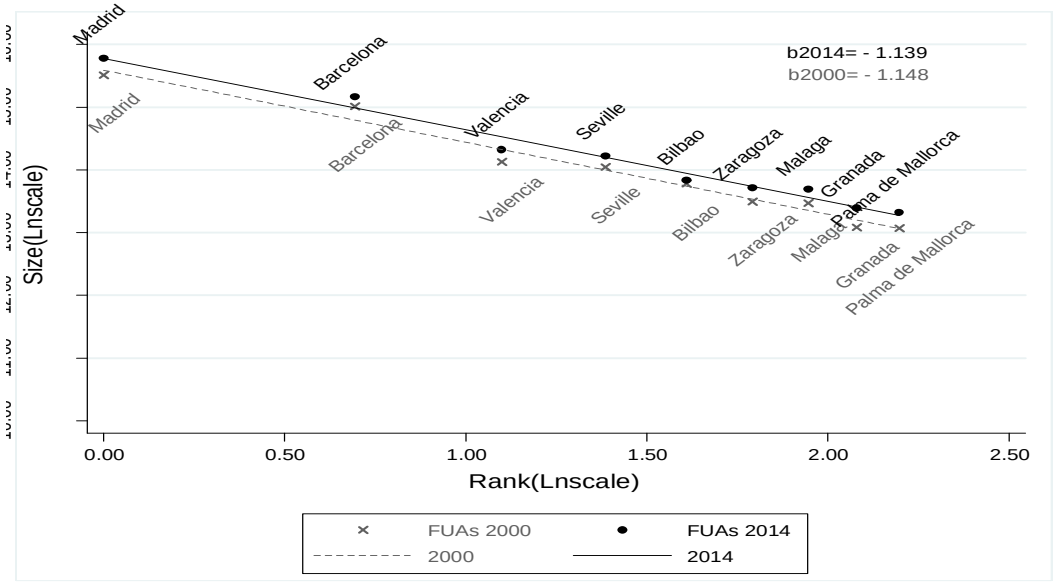

FIGURE 5 - DEGREE OF POLYCENTRICITY (RANK-SIZE COEFFICIENT) IN SPAIN FOR 2000 & 2014
Source: Authors' elaboration on data from OECD

On a comparative examination of the rank-size betas, the Greek and the Portuguese urban systems appear to be the most monocentric, while the Spanish and the Italian the most polycentric ones, for both the years of the analysis. The findings match the previous analysis on urban primacy, showing a high degree of correlation between the two utilised methods, although rank-size coefficient quantifies more precisely the urban system. On average polycentricity stays essentially unchanged (Table 6), while the distribution seems to variate considerably for both 2000 and 2014, bringing out significant incoherence in terms of urban polycentricity in Southern Europe.

TABLE 6 - RANK-SIZE BETAS OF THE EXAMINED COUNTRIES FOR 2000 & 2014

More Monocentric	2000			2014			Change of Polycentricity
	Rank	Country	Rank-size beta	Rank	Country	Rank-size beta	
⇕	1	Greece	-1.744	1	Greece	-1.744	-
	2	Portugal	-1.600	2	Portugal	-1.581	↑
	3	Spain	-1.148	3	Spain	-1.139	↑
	4	Italy	-1.021	4	Italy	-1.053	↓
More Polycentric	Average		-1.378	Average		-1.379	↓
	CV (%)		21.87	CV (%)		21.07	

Source: Authors' elaboration on data from OECD

In terms of territorial balance, Italy and Portugal have the less balanced urban systems, while the Spanish and the Greek ones seem to have a more even spread of their large urban areas (Table 7).[3] Moreover, between the years of the analysis the national percentages are unchanged, which is an expected outcome considering the methodology and the period employed. The standardized z-scores of Table 6 and Table 7 results are illustrated in Figure 6. Starting from the upper right quadrant and continuing clockwise, the urban system of a country may be respectively characterised as: a) Sufficiently Polycentric (polycentric and territorially balanced), b) Potentially Polycentric (not polycentric and territorially balanced), c) Monocentric (or Oligocentric) (not polycentric and not territorially balanced), and d) Insufficiently Polycentric (polycentric and not territorially balanced), always considering solely the morphological polycentricity.

TABLE 7 – TERRITORIAL BALANCE OF THE EXAMINED COUNTRIES FOR 2000 & 2014

Less Territorially Balanced	2000			2014			Change of Territorial Balance
	Rank	Country	Territorial balance degree	Rank	Country	Territorial balance degree	
⇕	1	Italy	0.524	1	Italy	0.524	-
	2	Portugal	0.600	2	Portugal	0.600	-
	3	Spain	0.688	3	Spain	0.688	-
	4	Greece	0.889	4	Greece	0.889	-
More Territorially Balanced	Average		0.675	Average		0.675	-
	CV (%)		20.20	CV (%)		20.20	

Source: Authors' elaboration on data from OECD

Drawing from the above, the rank-size betas of Greece suggest weak polycentricity, while its territorial distribution seems rather polycentric (balanced), since the 9 examined FUAs of the Greek urban system are located in 8 NUTS2 regions, with only two FUAs (Larisa and Volos) lying in the same region (Thessaly). The Greek urban system can be characterised as potentially polycentric, as a greater urban cohesion (polycentricity) can be achieved by reinforcing the role of smaller peripheral urban centres. As stated above, there is significant growth in particular centres in the middle of the distribution, such as Irakleio, Larisa and Ioannina, thus it could constitute a development priority to reinforce the function of other centres on continental or even insular lagging regions (Western Macedonia, Ionian Islands, North Aegean and South Aegean).

Portugal cannot be designated as polycentric at all, neither in terms of the rank-size distribution nor in terms of the spatial distribution of its urban centres, showing an oligocentric physiognomy (Lisbon – Porto bipolar). The FUAs utilised in the spatial distribution analysis spread over only 3 of the 5 considered NUTS2 regions, with Algarve and Alentejo, the southern territories of the country, lagging in

[3] Although the validity of the results for Greece is questioned, due to the limitations already discussed in the methodology section.

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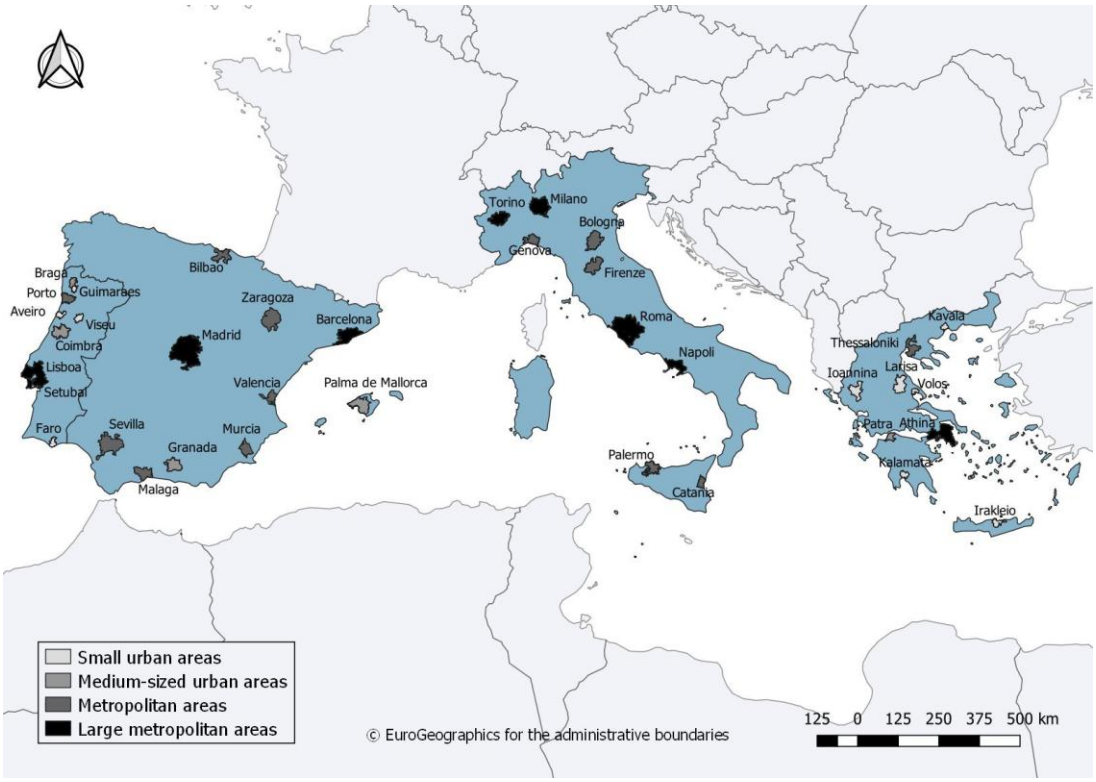
terms of urban growth.[4] Moreover, as it is extracted from Map 1 none of the large FUAs of the country is located at the eastern -neighboring to Spain- territories.



MAP 1 – LARGE FUNCTIONAL URBAN AREAS IN SOUTHERN EUROPE (2000 & 2014)
Source: Authors' elaboration on data from Eurostat/GISCO

On the other hand, Italy is rather polycentric depending on its rank-size betas but monocentric considering the spatial distribution of its urban centres, while Map 1 shows that the large FUAs of the country do not face the Adriatic sea and mostly concentrate at the Northern regions. The Italian fits the characteristics of an insufficiently polycentric urban system, since, although there are already multiple centres, new centres have to emerge in the regions that do not show significant urban development in order for the system to get territorially balanced. More specifically, the examined FUAs spread over 11 of the total 21 NUTS2 regions, thus the development of the territorial balance should focus on the 10 lagging NUTS2 regions, namely Valle d'Aosta, Abruzzo, Molise, Basilicata, Calabria, Autonomous Province of Bolzano, Autonomous Province of Trento, Friuli-Venezia Giulia, Umbria, and Marche.

Finally, Spain shows a sufficiently polycentric urban system, since it is polycentric in terms of both the rank-size and spatial distribution of its urban centres. This finding may justify why Spain does not pursue any polycentric policy at the national level (Nordregio et al. 2005), however Map 1 shows that

[4] The regions of Azores and Madeira are not considered in the analysis, as already mentioned. Moreover, because of the small number of the Portuguese NUTS2 regions, in the spatial distribution analysis are employed less FUAs (5), than in the previous analysis (9).

Northwestern Spain lacks any large functional urban area. The employed FUAs for the spatial distribution analysis spread over 11 of the 16 considered national NUTS2 regions.[5] The 5 NUTS2 regions with no located large FUAs are these of Principality of Asturias, Cantabria, La Rioja, Castilla-La Mancha, and Extremadura.

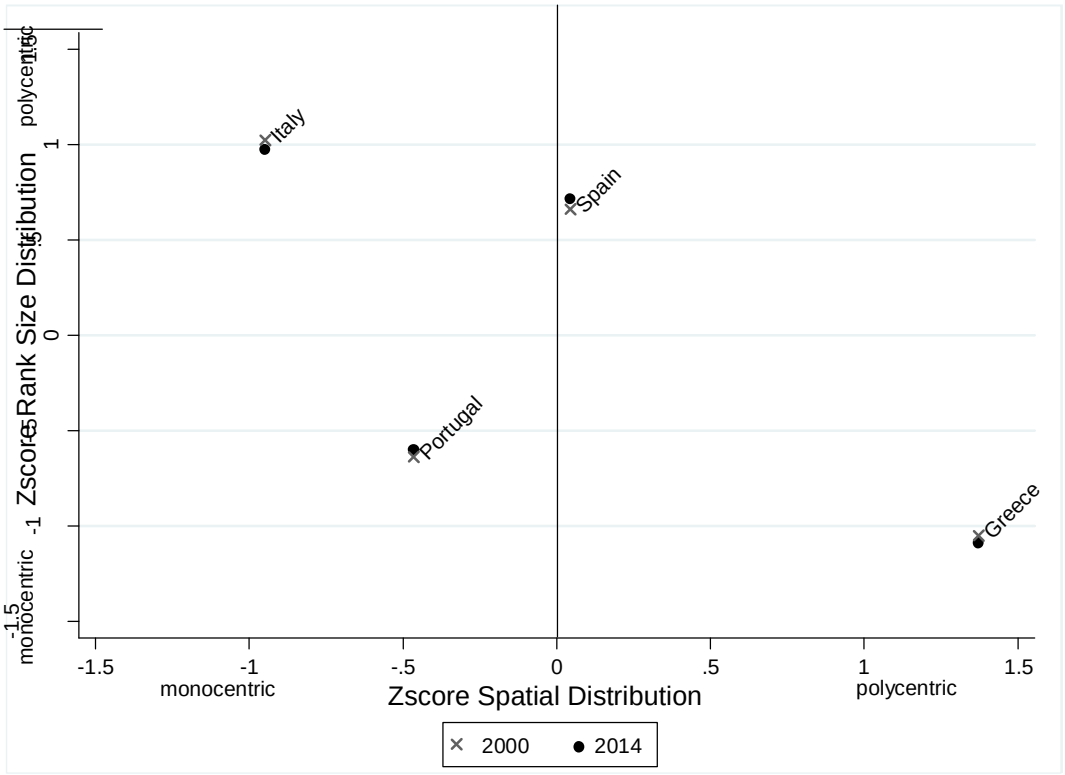


FIGURE 6 - POLYCENTRICITY IN TERMS OF RANK-SIZE AND SPATIAL DISTRIBUTION OF FUAS ACROSS THE NATIONAL TERRITORY (2000 & 2014)
Source: Authors' elaboration on data from OECD

Drawing from Table 7, during the period 2000-2014 none of the examined national urban systems changes in terms of spatial distribution, which is a rather expected result, since the transformation of an urban system is a quiet time-consuming process. The findings render the territorial balance of large urban centres a more complex issue, as it doesn't come out that it relates clearly with the national urban tradition, the size of the country or the number of regions in which it is partitioned. Moreover, even though the analysis above draws a quite accurate picture of the territorial balance for the urban systems, it cannot be overlooked that the method employed cannot result in a thorough distribution of the largest cities across the national space. For instance, the fact that the largest FUAs spread across the half of national NUTS2 regions may suggest either a rather monocentric or a rather polycentric national reality, depending on the exact location of the aforementioned centres across the national territory as a whole.

[5] The NUTS2 of Canary Islands, and the Autonomous Cities of Ceuta and Melilla are considered in the analysis.

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4. CONCLUSIONS

The article presents morphological polycentricity in the national urban systems of the European Continental South in 2000 and 2014. By examining the urban primacy and the rank-size distribution of the urban systems, as well as the distribution of FUAs over national space, it is extracted whether they constitute a relatively polycentric or monocentric system, in order to assess the national polycentric development potential and consequently the efficient allocation of resources among the national urban areas.

More specifically, according to primacy degree, the primate cities of Athens and Milan become slightly less significant in the urban development of their countries while, on the contrary, the role of Lisbon and Madrid have become more significant than the rest of cities in Portugal and Spain. In addition, and drawing from the rank-size distribution analysis, during the examined period polycentricity shows a marginal increase in Portugal, while one can notice a marginal decrease in Spain and particularly in Italy. The polycentricity factor of Greece doesn't change during the examined period.

Moreover, taking into account the spatial distribution of FUAs over the national territory, Spain is characterised as sufficiently polycentric, since its rank-size betas are considerably high and its urban centres are distributed more evenly over space. Italy is designated as insufficiently polycentric, because no matter it is polycentric in terms of its rank-size distribution, it seems less polycentric in terms of territorial balance, as its centres of considerable size spread over only a few of its regions. Subsequently, Portugal can be defined as oligocentric, as it is less polycentric considering both the rank-size distribution and territorial balance, denoting the roles of its capital, and second-tier city in the urban development and the spread of its FUAs in a rather small number of regions. Last but not least, Greece, although not polycentric, proves to be potentially polycentric, as the Greek urban system seems to be relatively territorially balanced, although reservations have already been discussed regarding the credibility of these particular findings.

To sum up, by employing population data, this paper provides some significant notes on the assessment of morphological polycentricity in a national perspective for Southern Europe. However, despite the fact that this region is considered a coherent geographical territory, the findings of the present analysis show considerable variation in terms of urban polycentricity potential among the four countries, thus rendering the examination of the subject quiet complex. Therefore, further analysis is deemed necessary for a more thorough perspective on the matter, since urban development and planning do not depend solely on the size of a city, but on a combination of additional economic, administrative and cultural functions (Costa et al. 1991). Besides, polycentric development has already

been identified as a fuzzy and multi-dimensional issue that involves several spatial scales and methodological approaches (see Veneri and Burgalassi 2012).

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