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## Polycentric Development to Combat Regional Disparities? the Relation Between Polycentricity and Regional Disparities in European Countries

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# Polycentric development to combat regional disparities? The relation between polycentricity and regional disparities in European countries

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## Abstract

Trends in regional disparities have been a major issue in regional science for many decades and knowledge of ways to overcome such disparities has great importance for regional policy-making. Strong initial differences between regions affect the capacity of each region to grow and their ability to respond to challenges imposed externally, for instance globalisation and growing international competition and trade (Cuadrado-Roura, 2001). Initial differences can relate to a wide variety of factors, for instance the availability of human resources, the accessibility of a region and the presence of advanced production services. A factor that gets increasing attention is the city system. Flourishing regions can often count on a large, well-accessible and internationally known city or regional clusters of cities. Concentration of support to dynamic growth poles would be an engine for growth of the whole country (or regions) through regional spillovers (Perroux 1955 and Kaldor 1970)

Particularly also in regional and spatial policies addressing regional disparities attention is paid to the city system. It has been suggested that polycentric development can be instrumental to reducing regional disparities, see for instance in the European Spatial Development Perspective (CEC, 1999) and the Second Cohesion Report (CEC, 2001). In the Third Cohesion Report the main emphasis is territorial cohesion, which is placed on an equal footing as economic and social cohesion in the (unratified) Constitutional Treaty. Within the discussion on territorial cohesion polycentricity gets much emphasis (Faludi, 2005). Also many European countries pursue a polycentric development, often addressing the dominance of their prime city to diminish regional disparities. Apparently, policy makers assume a strong relationship between the urban system and the persistence of regional disparities. However, this assumption lacks empirical justification.

The aim of this paper is to test the hypothesis that a polycentric city system leads to less regional disparities. The paper presents measures of the extent of polycentricity of the national urban systems of 25 European countries. This data is linked with calculations of regional disparities within these 25 countries. Are countries with a relatively polycentric urban system characterised by less regional disparities than more monocentric countries? And, what are the consequences of our findings for regional development policies?

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## 1. The urban system and regional disparities

Trends in regional disparities have been a major issue in regional science for many decades and knowledge of ways to overcome such disparities has great importance for regional policy-making. Strong initial differences between regions affect the capacity of each region to grow and their ability to respond to challenges imposed externally, for instance globalisation and growing international competition and trade (Cuadrado-Roura, 2001). Initial differences can relate to a wide variety of factors, for instance the availability of human resources, the accessibility of a region and the presence of advanced production services. A factor that gets increasing attention is the shape of the city system as the fate of regions seems closely linked with the fate of cities in these regions. For instance, in the Second Cohesion Report (CEC, 2001) the European Commission emphasizes that cities are a key location for the pursuit of any strategy for cohesion. Evidence suggests that there is an important relationship indeed. Henderson (2000) reports a strong relationship between the level of urban concentration and economic growth for countries. Given that there are agglomeration economies and diseconomies, the urban agglomeration literature suggests that there is a best degree of urban concentration. Having established that there is a best degree of national urban primacy, which is related amongst others to per capita income and the population size of a country, Henderson finds that economic growth losses are large in the case of non-optimal urban concentration. 'Non-optimal' in most cases means excessive concentration (this includes European countries such as Austria, France, Greece, Ireland, and Portugal). There are also a few countries that show too little urban concentration, including the Netherlands and Belgium, which also negatively affects economic growth. Another finding is that urban concentration is more important for developing economies. In developed countries, de-concentration is increasingly efficient (Wheaton and Shishido, 1981; Hansen, 1990). In this contribution we aim to further explore the role of the shape of the urban system, in particular whether or not a polycentric urban system accounts for less regional disparities within countries.

Regional and spatial policies addressing regional disparities increasingly pay attention to the city system often under the label of 'polycentric development'. Central to the concept of polycentric development is that economic and/or economically relevant functions are distributed over the urban system in such a way that a multitude of urban centres rather than one or two gains significance (Meijers et al., 2005). Balanced urban or territorial development is a more or less synonymous term. It has been suggested that polycentric development can be instrumental to reducing regional disparities, see for instance the European Spatial Development Perspective (ESDP) (CEC, 1999) and the Second Cohesion Report (CEC, 2001). The preparation and publishing of the ESDP in particular has given a strong impetus to the spread of the idea of polycentric development among European countries. The main concern of this first EU policy document on territorial government, albeit informal and non-binding, is to combat existing regional disparities at the EU level. In order to arrive at a more balanced spatial structure its first main objective is the development of a balanced and polycentric urban system, as well as a new urban-rural relationship. It is argued that 'the economic potential of all regions of the EU can only be utilized through the further development of a more polycentric European settlement structure' (CEC, 1999, p.20). In the Third Cohesion Report the main emphasis is on territorial cohesion, which is placed on an equal footing as economic and social cohesion in the (unratified) Constitutional Treaty. Within the discussion on territorial cohesion the idea of polycentricity gets much emphasis (Faludi, 2005).

Next to the European scale, also many European countries pursue a polycentric development, often addressing the dominance of their prime city to diminish regional disparities. An example is France that has a long tradition of combating the dominance of Paris (see Guigou, 2000; Baudelle & Peyrony, 2005). Ireland tries to develop 'gateway cities' in lagging regions in order to overcome its overdependence on Dublin (DELG, 2002; Davoudi and Wishardt, 2005). Also Greece, with a

long tradition of polycentric development policies (Angelidis, 2005) identifies in the contemporary policy gateway cities, as well as cities in corridors and bi-polar urban networks in order to strengthen medium-sized cities (Ministry of Environment, Spatial Planning and Public Works, 2002). The Polish 'National Concept for Spatial Development' (2001) aims at balancing spatial development in the long run, while accepting that the presently increasing disparities and polarisation are inherent to being in a transition phase. The assumption is that because of Poland's stable and fairly polycentric urban system innovation and economic growth will 'diffuse from the west towards east Poland, trickledown from the main urban centres to the surrounding zones and smaller towns, and penetrate territory along the main traffic corridors, forming belt-like development zones' (Korcelli, 2005, p.139) and hence, will eventually lead to balanced spatial development. Obviously, polycentricity is not just a descriptive term, but also a policy stance prescribing a means to promote and equalise economic growth (Hague and Kirk, 2003).

Apparently, policy makers assume a strong relationship between the urban system and the persistence of regional disparities. A monocentric urban system, with a dominant city, often the capital, dominating over other cities would lead to divergence; while on the contrary, a more polycentric urban system would allegedly lead to convergence between regions. Not surprisingly, many European countries pursue polycentric development policies (Waterhout *et al.*, 2005). Concentration of support to dynamic growth poles would be an engine for growth for the whole country and its regions through regional spillovers (Perroux, 1955 and Kaldor, 1970).

However, this assumed relationship between a polycentric urban system and limited regional disparities lacks both a strong theoretical underpinning and empirical justification. The aim of this paper is to test the hypothesis that a polycentric city system leads to less regional disparities. The paper presents measures of the extent of polycentricity of the national urban systems of 27 European countries. This data is linked with calculations of regional disparities within these countries. Are countries with a relatively polycentric urban system characterised by less regional disparities than more monocentric countries? And, what are the consequences of our findings for regional development policies?

To answer these questions, we will first consider the theoretical rationale behind polycentric development. To do so, we discuss economic growth theories and their links with polycentric development in section 2. This is followed by an empirical analysis of the extent of mono- and polycentricity of European countries in section 3. Section 4 presents calculations of regional disparities within European countries. In section 5 we explore the link between the extent of mono- and polycentricity of a country's urban system and the persistence of regional disparities. Finally, in section 6, we will discuss the implications of our findings and assess whether polycentric development strategies provide a valuable and feasible contribution to the diminishing of regional disparities.

## **2. Regional economic growth and the urban system**

In this chapter, three dominating economic growth theories and their connection with polycentrism and regional disparities are presented. The natural choice is obviously the New Economic Geography (Krugman 1979, 1980 etc.) with components such as agglomerating and degglomerating factors, clustering, core-periphery, and specialisation, but the Neoclassical and Endogenous Growth theories should be considered for a general background to the discussion.

### *Neoclassical Conditional Convergence Theory*

According to the neoclassical growth theory, growth is determined by rates of expansion of factor supplies and technological change. Income convergence is predicted by the equalisation of factor productivities and occurs as the result of four separate, but mutually reinforcing processes. The lead region accumulates capital faster than the other regions and will sooner or later experience diminishing returns. Investment in laggard regions will then become more attractive

and productive for interregional labour migration, capital mobility, and transfer of technology. Since conditional convergence occurs with a range of steady states being attained, regional disparities can be expected to narrow over time although they will never be completely eliminated. The neoclassical growth theory is not explicit about the role of the city structure. Since there are no reinforcement factors from the city structure on growth in the neoclassical growth theory, the city structure is a result of labour and capital movements. Hence, we may conclude that the theory does not take account of the urban system or does not consider the urban system as a factor in the convergence process. At best, polycentricism would result as an effect of economic growth.

### *Endogenous Growth Theory*

In the neoclassical growth theory the technological progress, the driving force behind long run steady state growth, is exogenously determined. By arguing that technological progress is itself determined by the growth process, endogenous growth theory extends the neoclassical model. In the original approach of Romer (1986, 1990) technology is attached to the labour force variable within the neoclassical production function so that the workforce is adjusted for knowledge. It also means that the pace of technological change is determined by the size of the labour force devoted to the production of 'new ideas'. A region with a growing labour force experiences economic growth, exogenously as in the neoclassical way, and endogenously through the expansion in the labour force devoted to technological change and hence through improved technological innovation. The endogenous growth theory is more clearly connected with the city structure and may support polycentric development. It is also obvious that it favours a city structure with a high growth in cities with a high level of educated population. Obviously, this has provided a rationale for the establishment of many new universities in 'peripheral' cities so that technological innovation increases. This theory also explains 'traditional' regional development policies aiming towards a dispersal of population, and central government organizations etc. from the core towards the rest of the country. This then would lead to a more polycentric city system and a reduction of disparities.

### *The New Economic Geography*

Krugman's work (1979, 1980) on new trade theory and subsequent work by Fujita, Krugman and Venables (1999), Ottaviano and Puga (1997), and Krieger-Boden (2000) has provided alternatives to the traditional theories on growth where the New Economic Geography (NEG), in a common frame, collect and merge together different perspectives on regional performance and development. Through the general equilibrium models NEG describes the economic landscape as a decentralised market process that considers scale economies, heterogeneity of products, non-competitive markets, transport and transaction costs, factor mobility, and endogenous factor endowment.

The NEG theories may be divided into two cumulative causation models (i.e., divergence theories). Firstly, the footloose-labour version, Krugman (1991a,b), argue that once a region gets a head start of some sort on other regions, manufacturing companies will be drawn to it. The reason is the 'home-market' effect – a larger region is attractive for firms seeking to exploit economies of scale while producing an array of differentiated products. The new firms in turn draw in mobile labour, a process which expands the population and hence home-market effect advantages even more. A further influx of both firms and labour can therefore be expected, creating a 'virtuous circle' of growth. Secondly, intermediate goods producers drive the divergence process in the vertically-linked industries models (Krugman and Venables, 1996; Venables, 1996). A head-start region can gain further advantages in the form of cost savings from close-input-output linkages as intermediate goods producers flock to join firms already exploiting a strong 'home-market' effect. Thus, more or less mobile factors are assumed to be the engine of any agglomeration process, and the factor endowment in the destination region is improved by

the influx which increases its attraction as a location for other manufacturing activities which leads to ongoing in-migration of workers and companies driving a circular cumulative process. The factor endowments (centripetal and centrifugal forces) are therefore important for where the mobile factors are going to be located. Centripetal forces are technical increasing returns to scale, localisation economies, urbanisation economies, as well as home market and price index effects that – due to the saving of transport costs - increase factor incomes in agglomerations the more, the larger the agglomeration already is. Acting in the opposite direction are the centrifugal forces, such as scarcity of immobile factors, congestion costs, and the competition effect that – due to an increased supply of competing products - exerts the more pressure on factor incomes, the larger the agglomeration is. The relative strength of these two competing forces determines the location of production, Fujita et al. (1999).

So, factor endowments are important for growth and location decisions and the magnitude of the factor endowments is in turn determined by the magnitude of the agglomerations. But since these factor endowments operate in opposite directions makes it hard to make any definite conclusions about the importance of the city structure on the reduction of disparities. It all depends on which factor endowment that dominates. If the agglomerating factors are dominating then a monocentric urban system would result that would reinforce this process. Seen from the perspective of regions, interaction evolves a core-periphery system where the economic centre (core) gets specialised in the sector with increasing returns, monopolistic competition, and a high income potential. By contrast, the periphery will get specialised in what is left, a sector with constant returns, perfect competition, and a low income potential, which is not subject to concentration. The hypothesis is then a monocentric city structure. On the other hand, in the case that degglomerating factors dominate, a reduction of city sizes possibly leading to a more polycentric city structure may be the case. Trade integration may also lead to spill-over in knowledge and thus bring about less specialisation through learning and imitation from the regional “capital” city to the surrounding periphery area, thus creating a larger area/population included in the region. Thus, concentration of support to dynamic growth poles would be an engine for growth of the whole country (or regions) through regional spillovers (Perroux, 1955 and Kaldor, 1970) and thus as a way to reduce disparities.

A feature of NEG growth models, which is important to remember about the interpretation of regional disparities in the EU, is that industrial clustering and divergence is not an inevitable outcome of these models. Krugman and Elizondo (1996), for example, develop a model in which gradually falling transport costs over time triggers first a process of cumulative growth (and hence divergence in disparities), followed by industrial dispersal to peripheral regions (convergence).

The final conclusion from the review of economic growth models is that they are not very specific, if mentioned at all, about the development of the city structure and the role that this structure may have in reducing disparities. Therefore, the connections between regional economic growth, polycentricity and regional disparities as assumed by many governmental actors are rather poorly theoretically underpinned.

Having established this, the next sections will explore the empirical underpinning of these connections. Does a polycentric urban structure actually have an impact on the persistence of regional disparities?

### **3. Analysis of the extent of mono- or polycentricity of national urban systems**

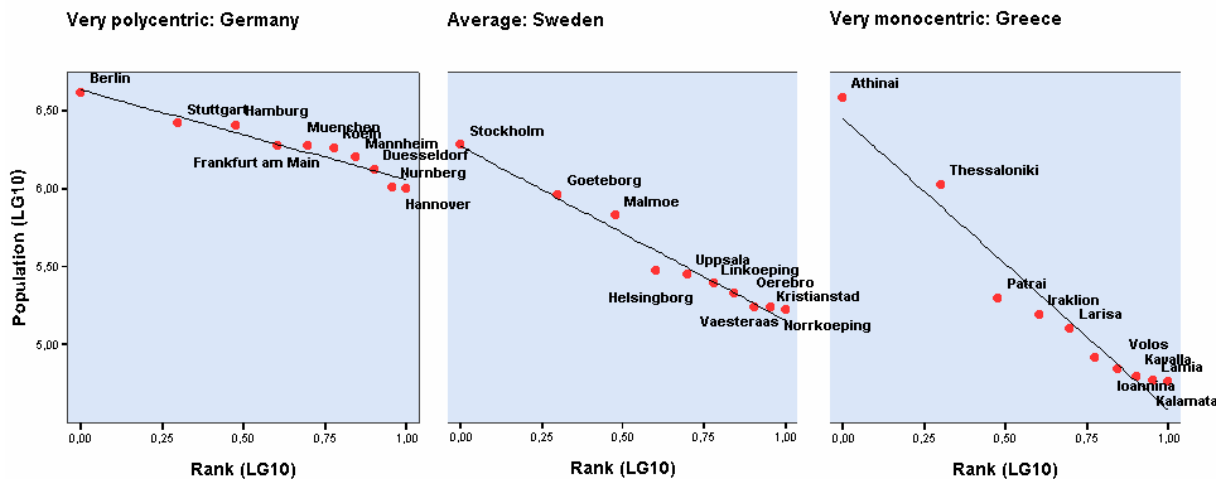
Essentially, polycentricity is a scale-less phenomenon. The term has been applied to a wide variety of spatial scales ranging from Europe, to many of its countries, to regions and to cities. Basically, polycentricity refers to the plurality of centres in a given area. In a synthesis of the defining conditions of a polycentric urban region, Parr (2004) points, amongst others, at the separation of cities and the size distribution of cities. Indeed, morphological characteristics as the size and spacing of cities are determining factors in establishing whether or not any given area is

polycentric or the opposite, monocentric. A dichotomous approach to the question, however, must be avoided. Rather than considering a given area polycentric or monocentric, it is more appropriate to score an area on a scale ranging from (very) polycentric to (very) monocentric. Here we will present two measures of mono/polycentricity for national urban systems. The first is based on the rank-size order of cities. The second measures the distribution of cities over the territory. In doing so we partly draw on the work carried out within the framework of the ESPON 1.1.1 project on polycentricity (Nordregio et al., 2004)<sup>3</sup>, in particular using the ESPON 1.1.1 data on functional urban areas in each country. Both measures will be combined in an overall index of monocentricity and polycentricity.

#### *Polycentricity and the rank-size distribution*

Characteristic for a polycentric national urban system is that no city dominates over other cities in economic, cultural and other respects. In other words, a polycentric urban system lacks strong hierarchy. Rather, characteristic for polycentric urban systems is that cities often tend to be relatively similar-sized. The rank-size distribution of the national urban system provides information on this hierarchy and is therefore an excellent indication of the extent of mono- or polycentricity. Figure 1 presents the rank-size distributions of three countries that are among the most polycentric (Germany), not polycentric nor monocentric (Sweden) and among the most monocentric (Greece). The data on population presented in the figure is for functional urban areas (FUA), not necessarily municipalities. They are delimited following national definitions (see Nordregio *et al.*, 2004). To be included in the database, FUAs should have at least 20.000 inhabitants. Hence, when reference is made to cities, then the FUA is meant. Data was collected for either 2000 or 2001, depending on the availability in each country. Given the strong inertia of urban systems over time, data for one year presents a robust picture.

**Figure 1. Rank-size distributions of Germany, Sweden and Greece.**



Germany: Population (LG10) = 6,63 + -0,571\*Rank (LG10) (R<sup>2</sup> = 0,93), Sweden: Population (LG10) = 6,27 + -1,118\*Rank (LG10) (R<sup>2</sup> = 0,97), Greece: Population (LG10) = 6,45 + -1,894\*Rank (LG10) (R<sup>2</sup> = 0,95)

Figure 1 clearly demonstrates that the main cities of Germany differ much less in significance than do those in Sweden or Greece. The gaps between cities in Greece are much larger, and Athens towers above the other ones. Also the primacy of Stockholm is larger compared to Berlin. The flatter the regression line in Figure 1, the more polycentric the urban system is. Conversely, the steeper this regression line is, the more monocentric a country's urban system is. Therefore, the slope of the regression line is an excellent indicator of the extent of mono- or polycentricity. With a slope of the regression line of -0,571, the German urban system is relatively polycentric. Contrarily, the slope for Greece is -1,894 and hence its urban system is rather monocentric. The

<sup>3</sup> One of the authors participated in the ESPON 1.1.1 project, see [www.espon.lu](http://www.espon.lu).

slope for Sweden is average, and consequently its urban system is not polycentric nor monocentric for European standards.

Obviously, the outcome of these calculations is influenced by the number of cities included in the regression analysis. In general, sample size can be a fixed number of cities, a fixed size threshold, or a size above which the sample accounts for some given proportion of a country's population (see also Cheshire, 1999). The latter has disadvantages for this research, as it will turn out that the number of cities included in the analysis is large for polycentric countries and small for monocentric countries. Hence, the number of cities including some given proportion of the population is in itself an indicator of mono- or polycentricity and applying such a measure twice would distort the picture. A fixed size threshold is equally less appropriate as in large and more densely populated countries a city of say 50.000 inhabitants may be insignificant, while it could be of great importance in small or less populated countries. It could be argued that a city ranked for instance 10<sup>th</sup> in a country is of importance in that country, despite its possible small size. Therefore, when measuring polycentricity on the basis of the rank-size distribution, the sample size could best be based on a fixed number of cities. The question then is what this number should be. The answer seems arbitrary by definition. Given that we will link the measures of mono/polycentricity with regional disparities, we could take the average number of regions in a country as a proxy, assuming that when each region would benefit from the presence of a significant city regional disparities could be less. The average number of regions (nuts 2) in a country is about 10. Therefore, we will base our calculations of mono- and polycentricity on the ten most populous cities in each country. The outcomes also correspond well with our tentative impression of the extent of polycentricity of a country, which is often based on a mere handful of cities. Moreover, calculations show that results for  $n=10$  correlate strongly with sample sizes of  $n=5$  or  $n=20$ . If a country did not have at least 10 cities, then all cities were included. However, countries with three or less FUAs (Luxemburg, Malta) were excluded. Data for Switzerland and Cyprus is included, although no data on regional disparities were available in time (CH), or not meaningful (CY). Therefore, our further analysis of the link with regional disparities concentrates on 25 countries. Table 1 presents the results of our calculations of mono- or polycentricity for the 27 countries included in this part of the analysis.



**Table 1. Extent of mono/polycentricity of European countries based on the rank-size distribution.**

<i>Country</i>	<i>N cities (FUA)</i>	<i>Mono/Polycentricity score</i>	<i>Ranking</i>	
Germany	10	-0,571	1	Most polycentric
Slovak Republic	10	-0,589	2	
Belgium	10	-0,591	3	
Romania	10	-0,722	4	
The Netherlands	10	-0,759	5	
Poland	10	-0,773	6	
Italy	10	-0,820	7	
Hungary	10	-0,894	8	
Norway	10	-0,991	9	
Switzerland	10	-1,002	10	
Bulgaria	10	-1,042	11	
Czech Republic	10	-1,045	12	
Finland	10	-1,088	13	
Denmark	10	-1,116	14	
Spain	10	-1,116	15	
Sweden	10	-1,118	16	
France	10	-1,119	17	
United Kingdom	10	-1,203	18	
Cyprus	4	-1,210	19	
Estonia	10	-1,312	20	
Lithuania	8	-1,316	21	
Slovenia	6	-1,351	22	
Austria	10	-1,440	23	
Latvia	8	-1,576	24	
Portugal	10	-1,599	25	
Ireland	7	-1,887	26	
Greece	10	-1,894	27	Most monocentric

According to their rank-size distributions, we find polycentric countries all over Europe, most notably northwest European countries such as Germany, Belgium and the Netherlands, but also Eastern European countries such as the Slovak republic, Romania and Poland. Italy is a clear example from southern Europe. The most monocentric countries such as Greece, Ireland, Portugal and Latvia, are found in the relative periphery of Europe. Ironically, it seems that some countries that have a rather polycentric urban system, for instance Belgium and the Netherlands, fear the lack of critical mass of their main cities and have developed strategies to promote clusters of proximally-located cities, so-called polycentric urban regions, e.g. the Randstad region (see for instance Van der Burg and Dieleman, 2004) and the Flemish Diamond (Albrechts, 1998). They try to present a more monocentric image internationally, with the Randstad and Flemish Diamond being the main cores in each country.

*Polycentricity and the spatial distribution of cities*

Next to the rank-size order distribution, also the spacing of cities is important. When all major cities would be clustered together in one part of the country, this could not be considered very polycentric, even when these cities would be of comparable size. Therefore, the spacing of cities is important. The more even spread over the territory, the more polycentric a country is. Note the difference with polycentricity on the regional scale, as exactly the opposite, clustering of cities together, is a characteristic of polycentric urban regions. The presence of such regions in countries may cause that the national urban system is less polycentric. For instance, the four main

cities in the Netherlands are clustered in the Randstad region in the west of the country. A more even distribution would result in a more polycentric urban system on the national scale. Our interest in this paper is the link between polycentricity and regional disparities. The idea is that when each region disposes of a ‘dynamic growth pole’, every region will benefit from regional spillovers. Regions without a major city are less able to compete (inter)nationally. Therefore, we focused our analysis on the question whether subnational regions do have such a trump within their borders. For each country we took the number of nuts 2 regions. Then we examined in which regions the major cities of that country were located. The number of cities considered in a country was similar to the number of nuts 2 regions in that country. So, a country should be considered very polycentric when each region would have a major city within its borders. On the contrary, a country should be considered monocentric when a relative large number of regions would not have such a city within its borders. This implies that the major cities are concentrated in a limited number of regions. If a country was divided in less than 5 nuts 2 regions, then we included the nuts 3 division, hence also basing our set of major cities on this number of nuts 3 regions. So, for example, Belgium is divided in 11 nuts 2 regions, so we examined the spread of the 11 most populous cities (FUAs) over these regions. These were located in 9 regions, so 2 such regions had to do without a (top 11) major city. Therefore, Belgium scored  $9/11 = 0,818$  on our measure. The results for all countries are presented in Table 2. No meaningful data could be calculated for Cyprus, Luxembourg and Malta.

**Table 2. Extent of mono/polycentricity of European countries based on the spatial distribution of cities.**

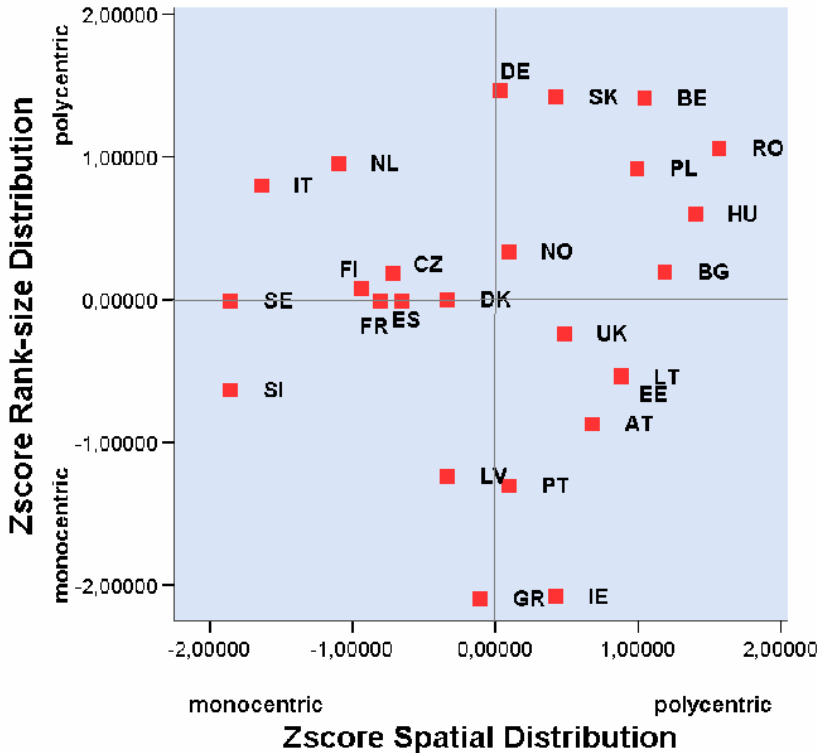
<i>Country</i>	<i>N nuts2 regions</i>	<i>Mono/Polycentricity score</i>	<i>Ranking</i>		
Romania	8	0,875	1	most polycentric	
Hungary	7	0,857	2		
Switzerland	7	0,857	3		
Bulgaria	6	0,833	4		
Belgium	11	0,818	5		
Poland	16	0,813	6		
Estonia	5*	0,8	7		
Lithuania	10*	0,8	8		
Austria	9	0,778	9		
United Kingdom	37	0,757	10		
Slovak Republic	8*	0,75	11		
Ireland**	8*	0,75	12		
Norway	7	0,714	13		
Portugal	7	0,714	14		
Germany	41	0,707	15		
Denmark	15*	0,707	16		
Greece	13	0,692	17		
Latvia	6*	0,667	18		
Spain	19	0,632	19		
Czech Republic	8	0,625	20		
France	26	0,615	21		
Finland	5	0,6	22		
The Netherlands	12	0,583	23		
Italy	21	0,524	24		
Sweden	8	0,5	25		
Slovenia**	12*	0,5	26		most monocentric

\* Number of nuts 3 regions.

\*\* The number of FUAs with at least 20.000 inhabitants is less than the number of regions.

There is no European country in which major urban regions are fully evenly spread across the regions. Some countries come close, however. This holds for instance for Romania, Hungary, Switzerland, Bulgaria and Belgium. The opposite is true for Finland, the Netherlands, Italy, Sweden and Slovenia, although the latter country provides perhaps not a good picture, given the fact that it has far less FUAs (6) than regions (12). There is hardly a correlation with the measure of polycentricity based on the rank-size order ( $r=0,101$ ). Figure 2 presents the scores on both our measures of polycentricity. For instance, The Netherlands and Italy score quite polycentric on the basis of their rank-size distribution, while they are relatively monocentric given the spread of cities over the country. Some countries come out polycentric on both measures. This includes Belgium, Romania and Poland for example. Latvia, Slovenia and Greece are monocentric by both measures.

**Figure 2.** The relationship between polycentricity-indicators based on the rank-size distribution and the spatial distribution of cities across the national territory.



*An index of polycentricity*

We used the standardized z-scores on both indicators of polycentricity to construct an overall-indicator for how monocentric or polycentric European countries are. A z-score of 0 was given a value of 100, and 1 standard deviation was given a value of 20. So, a z-score of -1 results in a value of 100-20=80. We calculated such values for both indicators for each country, and the mono/polycentricity index score presents their average value, see Table 4.

**Table 4. Extent of mono/polycentricity of European countries.**

<i>Country</i>	<i>Standardised score slope regression line rank-size distribution</i>	<i>Standardised score spatial distribution across territory</i>	<i>Index mono/polycentricity</i>	
Romania	121,33	131,39	126,36	most polycentric
Belgium	128,34	121,03	124,69	
Hungary	112,02	128,14	120,08	
Poland	118,57	120	119,28	
Slovak Republic	128,45	108,6	118,52	
Germany	129,44	100,81	115,13	
Bulgaria	104,06	123,8	113,93	
Norway	106,79	102,09	104,44	
Estonia	89,5	117,72	103,61	
Lithuania	89,31	117,72	103,51	
United Kingdom	95,4	109,83	102,61	
The Netherlands	119,29	78,2	98,75	
Austria	82,61	113,66	98,14	
Denmark	100,06	93,4	96,73	
Czech Republic	103,92	85,8	94,86	
Spain	100,05	87	93,53	
France	99,93	84,05	91,99	
Italy	116,04	67,35	91,69	
Finland	101,59	81,24	91,41	
Portugal	74,01	102,09	88,05	
Latvia	75,3	93,4	84,35	
Ireland	58,5	108,6	83,55	
Sweden	99,95	63,01	81,48	
Greece	58,15	98,08	78,11	
Slovenia	87,39	63,01	75,2	most monocentric

The next section presents findings on regional disparities for the countries listed in Table 4. In section 5 we will examine the relationship between these polycentricity scores and regional disparities.

#### 4. Regional Disparities

In a recent overview of the discussion on regional convergence in the European Union, Cuadrado-Roura (2001) shows that empirical analyses of convergence trends often contradict each other. On the one hand, results of neo-classical analyses tend to underline a trend towards convergence (see for instance Sala-I-Martin, 1996) whereas on the other hand analyses lead to the conclusion that divergence, or increasing polarisation is the case (see for instance Magrini, 1999). The period under study provides part of the explanation of the different results. In general, from 1960 to the mid-1970s regional disparities within the EU tended to decrease. Between the mid-1970s and mid-1980s, this process comes to a halt, while in some countries (for instance France, Italy, Spain and the UK) disparities increase. In the decade following the mid-1980's trends seem more or less stable as regional disparities within the then EU15 hardly improved. All in all, 'from the end of the seventies, disparities have very slightly increased or decreased in the EU, so that the global trend is practically equal to zero' (Cuadrado-Roura, 2001: 342).

In this section, we will present data on regional disparities for the most recent years possible. Given the apparent stability of regional disparities, it seems that taking just one or some recent

years into account still provides an accurate picture. A wide number of measures of regional disparities circulate in the literature (see for instance Portnov and Felsenstein, 2005). Here we restrict ourselves to some of the most common measures: the Coefficient of Variation (CV) and the Theil index.

The Coefficient of Variation (CV) is a measure of dispersion of a probability distribution and often used when discussing the normal distribution for positive mean values with the standard deviation significantly less than the mean. It is defined as the ratio of the standard deviation to the mean.

$$CV = \frac{\sigma}{\mu} \cdot 100$$

CV is a dimensionless number that allows comparison of the variation of populations with significantly different mean values. Normally it is reported on a scale from 0 to 100% after multiplying the ratio by 100. A high CV indicates large disparities between the regions.

The Theil-index is calculated as

$$T = \sum_{i=1}^N \left( \frac{x_i}{\sum_{j=1}^N x_j} \cdot \ln \frac{x_i}{\bar{x}} \right)$$

where  $x_i$  is the GDP of the  $i$ th region,  $\bar{x}$  is the mean GDP, and  $N$  is the number of regions. The first term inside the sum can be considered the region's share of aggregate GDP, and the second term is that region's GDP relative to the mean. If every region has the same (i.e., mean) GDP, then the index = 0. If one region has all the GDP, then the index =  $\ln N$ .

Eurostat provided data on GDP per capita and unemployment rates at the nuts3 level, for the years 2000-2001-2002. Data was available for all member states of the EU, as well as for Bulgaria and Romania. No meaningful data on regional disparities could be calculated for the smallest countries (Luxembourg, Cyprus, and Malta). Norway does not have explicit NUTS regions so we instead used information on its 19 counties a level that approximately correspond to the NUTS3 level. The actual data on GDP per capita in 2000 expressed as PPP is gathered from the study by Östbye and Westerlund (2004). Using this data we calculated the extent to which regional disparities are present *within* each country (that is, no reference is made to a European average). The results are presented in Table 5. Since both the CV and Theil-index measures yield similar results we therefore only illustrate the CV results in Figure 3 (CV GDP/capita) and Figure 4 (CV unemployment rates) for the year 2001. The CV for GDP per capita show that large disparities exists in Slovak Republic, Latvia, Germany, UK, Poland, Estonia and the Czech Republic while Italy, Spain, the Netherlands, Slovenia, and the Northern countries have a low degree of GDP per capita disparities. A slightly different picture is presented for the unemployment rates, where large disparities appear foremost in Germany and Italy and to a slightly lesser degree in Belgium, France, Spain, and the Czech Republic. Small unemployment rate disparities are found among Greece, Lithuania, and the Nordic countries.

**Table 5. Regional disparities in European countries in 2001.**

<i>Country</i>	<i>CV GDP/capita 2001</i>	<i>Theil-index GDP/capita 2001</i>	<i>CV Unemployment 2001</i>
Austria	26,9	0,03	39,3
Belgium	33,7	0,05	57,1
Bulgaria	31,3	0,03	28,4
Czech Republic	41,3	0,06	44,5
Denmark	26,1	0,03	21,9
Estonia	45,1	0,07	33,1
Finland	22,2	0,02	35,4
France	35,6	0,04	44,3
Germany	42,8	0,08	66,2
Greece	31,9	0,04	16,5
Hungary	37,5	0,05	34,2
Ireland	26,5	0,02	22,7
Italy	24,8	0,03	82,4
Latvia	53,5	0,10	24,4
Lithuania	25,0	0,03	10,4
The Netherlands	21,6	0,02	30,8
Norway <sup>1</sup>	10,6	0,01	21,9
Poland	40,5	0,06	35,6
Portugal <sup>1</sup>	28,3	0,04	29,3
Romania	32,1	0,04	35,2
Slovakia	50,5	0,09	27,8
Slovenia	20,4	0,02	33,8
Spain	21,3	0,02	43,1
Sweden	13,3	0,01	26,9
United Kingdom	45,0	0,07	39,5

<sup>1</sup> Data on GDP/capita is for 2000

Source: Norway: Statistics Norway; other countries: Eurostat.

Figure 3. Coefficient of Variation for GDP/capita at NUTS 3, 2001.

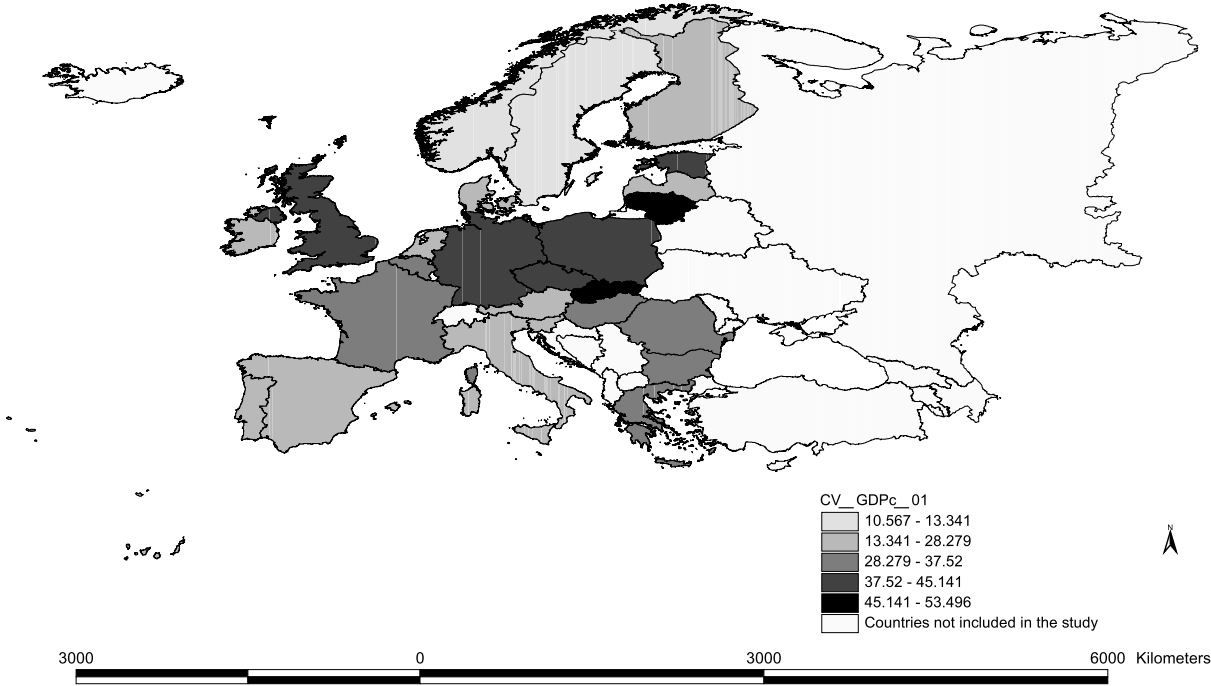
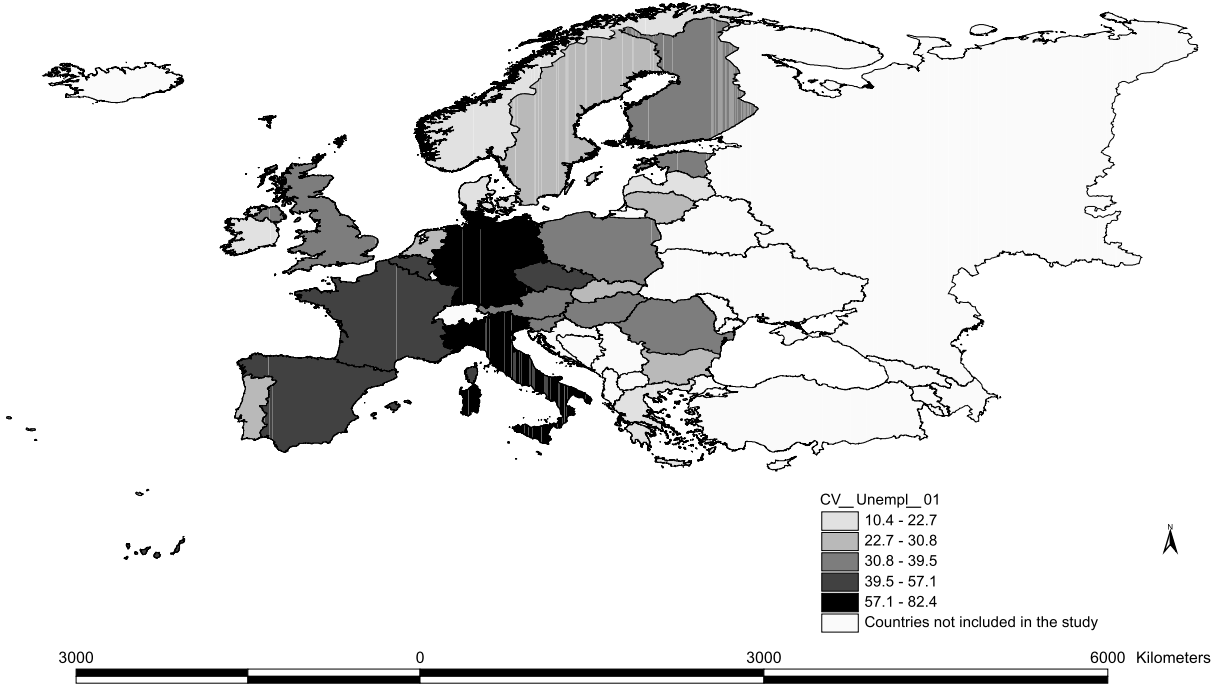


Figure 4. Coefficient of Variation for Unemployment rates at NUTS 3, 2001.



5. Analysis

In order to see whether or not a polycentric urban system goes hand in hand with less regional disparities we calculated Pearson correlation coefficients for our measures of polycentricity and regional disparities. We used the two measures of polycentricity presented in section 3 and their aggregate, the total index score of mono/polycentricity. For regional disparities we included the

CV GDP/capita, the Theil-index GDP/capita, and the CV Unemployment rates, each for the three years, 2000, 2001 and 2002.

We ran analyses with three sets of countries. In the first place, we took all 25 countries for which we have data available together. Second, we calculated correlation coefficients for just the former EU 15 countries. In the third place, we did the similar analysis also for the group of transition countries that recently accessed the EU (2004) or are scheduled to do so in 2007. In general, because of being in a transition phase, regional disparities tend to be higher in these countries. The results are presented in Table 6.



**Table 6. Pearson Correlations between polycentricity indicators and disparity measures for GDP/capita and Unemployment rates at NUTS3 level. \* indicate significance at 0.05 level, \*\* at 0.01 level.**

<i>Disparity measure</i>	<i>year</i>	<i>All countries (N=25)</i>			<i>Former EU15 excl. Luxembourg (N=14)</i>			<i>Recently accessed EU countries<sup>1</sup> + Bulgaria, Romania (N=10)</i>		
		Index mono/polycentricity	Rank-size distribution	Spatial distribution	Index mono/polycentricity	Rank-size distribution	Spatial distribution	Index mono/polycentricity	Rank-size distribution	Spatial distribution
CV	2002	,340	,054	,451*	,011	,655*	,464	,107	,035	,139
GDP/capita	2001	,352	,110	,413*	,105	,611*	,518	,120	,100	,106
	2000	,360	,095	,440*	,081	,626*	,506	,158	,091	,173
Theil-index	2002	,325	,114	,368	,209	,592*	,599*	,013	-,030	,044
GDP/capita	2001	,359	,179	,353	,277	,539*	,623*	,056	,055	,043
	2000	,360	,156	,379	,257	,555*	,616*	,084	,029	,108
CV	2002	,222	,476*	-,147	,611*	-,060	,510	,078	,346	-,154
Unemployment rates	2001	,207	,517**	-,210	,691**	-,094	,558*	,061	,356	-,188
	2000	,230	,507*	-,149	,647*	-,210	,436	,275	,439	,077

<sup>1</sup> Excluding Cyprus and Malta

The results of the correlation analysis lead to some interesting conclusions. In the first place, our index of mono- and polycentricity does not correlate significantly with the existence of regional disparities when we look at all countries or at the accession countries. However, there is a significant relationship between the former EU15 countries and regional disparities in terms of unemployment rates. This relationship is positive, thus the more polycentric a country is, the more regional disparities exist. Also the other significant relationships between one of the two measures of polycentricity (either based on the rank-size order distribution or the spatial distribution across the territory) indicates that a polycentric urban system does correspond with higher regional disparities than does a monocentric urban system. Such significant relationships were found between our polycentricity measure based on the rank-size distribution and the CV and Theil-index on GDP/capita, but just for the EU15 subset of countries. The uneven spatial spread of cities across a country's territory correlates significantly with the GDP/capita for all countries, but, however, not for our two subsets of countries. Former EU15 countries with an uneven spatial distribution of cities as well as a relatively flat city hierarchy tend to have more regional disparities in GDP/capita according to the Theil-index. In general, relationships between the shape of the urban system and regional disparities are more common for the EU15 subset of countries than for the new member states and Bulgaria and Romania, where no significant relationships were found. We also ran an analysis of the former EU15 countries while excluding Germany, as we thought that this country may perhaps provide for a strange case given the reunion between East and West Germany in 1990. However, this only leads to slight adjustments of the values in Table 6.

Once again, we would like to stress that as far as there are significant relationships between the shape of the urban system and regional disparities, these should all be interpreted as favouring monocentric city systems. Generally, the more monocentric a country's urban system is the less regional disparities within that country.

## 6. Conclusions

Polycentric development rapidly has become a widely spread paradigm in regional development policies on a variety of spatial scales. Rather than the traditional redistributive policies of the 1960s and 1970s, polycentric development policies emphasise the building on endogenous potential, developing regional organizing capacity, equal treatment rather than equality and a nodal approach rather than a zonal approach. It is generally considered a positive-sum game, and it tries to combine competitiveness and cohesion issues. Not surprisingly given these characteristics ascribed to polycentric development, it has been well received by policy-makers, in particular also on the European and national scale. As is the general case with new concepts, after the initial policy enthusiasm, the concept of polycentric development needs to be tested on its usefulness and validity if it is to sustain.

This paper presented an empirical test of one of its main assumed promises, namely that of bringing about more cohesion. In practice, cohesion is generally equated with a lack of regional disparities. This paper explored whether a polycentric national urban system results in only limited regional disparities, or, the other way around, whether a monocentric urban system leads to large regional disparities. In doing so, the paper presents one of the first attempts to quantify the extent of polycentricity and monocentricity of national urban systems, thereby focusing on the distribution of city-sizes and the spread of cities across the national territory. These outcomes are linked with calculations of regional disparities within European countries.

The outcomes of these correlations force us to temper the policy enthusiasm over the concept's promise of bringing about cohesion. Between most of our measures of polycentricity (the rank-size distribution; the spatial distribution over the territory; the overall index) and our measures of regional disparities there is no significant relationship. However, between some of our measures of polycentricity and some regional disparity measures we find significant relationships, either for

all countries together or one of our subsets (former EU15; new member states + some accession countries). However, when there are some significant correlations, the direction of these relationships is completely opposite to what is generally expected. The more polycentric a national urban system is, the more regional disparities exist. Or, more monocentric urban systems are characterised by less regional disparities. This holds particularly for the former EU15 countries. These findings are perhaps not surprising given our observation that theories on regional economic growth do not underpin the assumed relationships between a polycentric city structure and regional disparities either.

There may perhaps be good other reasons for pursuing a polycentric development at the national or European scale. However, our results call for a critical reflection on the assumed link between polycentric development and its contribution to diminishing regional disparities. Why would one pursue a polycentric development for the sake of bringing about more cohesion when countries that are already characterised by a polycentric urban system do not have less regional disparities, or even, more such disparities?

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