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CHAOS AND ORDER IN THE CONTEMPORARY CITY.

THE IMPACT OF URBAN SPATIAL STRUCTURE ON POPULATION DENSITY AND COMMUTING DISTANCE IN BARCELONA, 1986-2001.

Ivan Muñiz and Miquel- Àngel García-López

Abstract:

One of the criticisms leveled at the model of dispersed city found all over the world is its unarticulated, random, and undifferentiated nature. To check this idea in the Barcelona Metropolitan Region, we estimated the impact of the urban spatial structure (CBD, subcenters and transportation infrastructures) over the population density and commuting distance. The results are unfavorable to the hypothesis of the increasing destructuring of cities given that the explanatory capacity of both functions improves over time, both when other control variables are not included and when they are included.

1. Introduction

There is widespread consensus on the limitations of the model of Monocentric City Model when reflecting the complexity of the dispersed city (Krugman, 1996; Anas et al., 1998; White, 1999). However, the existence of employment subcenters, metropolitan corridors, or any other element on which urban sprawl settles unlike the typical continuous, dense urban grid has been interpreted from two different perspectives. The former upholds that the elements that make up the urban spatial structure do not actually order the space, so the settlement pattern, density conditions, or mobility patterns tend to be expressed in an increasingly random form (Pope, 1996; Dear and Flusty, 1998; Boeri, 2001; García, 2010). The latter, which can be found in the majority of polycentric models of the New Urban Economics (NUE), posits an alternative framework in which the employment subcenters replicate the functions of the traditional Central Business District (CBD), albeit on a smaller scale, thus contributing to organizing the urban peripheries (Sullivan, 1986; Wieand, 1987; White, 1999).

The discourse on the destructuring of the urban space has served to stimulate a new wave of studies in which the traditional idea of the tree structure common to hierarchical systems has been replaced by the fractal or rhizome structure (Nijkamp and Reggiani, 1998; Batty, 2005). To the contrary, no interest seems to have emerged among those working within the framework of the NUE to empirically check whether or not their models, based on the idea of structuring, tend to lose validity over time, which is strange given that the destructuring of the city approach entails a challenge to its postulates.

The empirical exercise performed consists of estimating a population density function and a home-work commute distance function using the distance to the employment centers (CBD and subcenters) and transportation infrastructures as regressors, along with some control variables, and then to later examine the changes experienced by the model's adjustment fit over time. The city studied is Barcelona and the period is 1986-2001. Put simply, should the hypothesis of the destructuring of the city be proven correct, we should notice a drop in the overall explanatory capacity, most likely accompanied by waning confidence levels in the regressors associated with urban spatial structure.

This exercise was planned as an attempt to provide empirical evidence related to the urban destructuring approach. Of course, it is just a partial examination which does not aim to validate or reject such a complex approach in terms of the variety of arguments present in the discourse and the subtlety with which they tend to be wielded; rather it is merely an attempt to check those implications which are liable to being analyzed as part of the polycentric models of the NUE for the case of Barcelona, specifically its capacity to predict the population density and commuting distance. Unfortunately, we have not managed to find any study with which to compare our results. There is, of course, extensive literature on the impact of centers and transportation infrastructures on both the population density (Baumont et al., 2004; Muñiz et al., 2008) and on commuting distance (Levinson and Kumar, 1997; Wang, 2000; Naess, 2007). However, most of them are static studies (for just one year) and/or partial studies (only one variable is examined, either density or commute).

The results indicate that far from losing their structuring capacity, the influence of transportation infrastructures and centralities has tended to rise in Barcelona, rendering it possible to better predict the population density and commuting distances in 2001 than in 1986. These results should be interpreted as coming from an urban region immersed in an intense process of metropolitan integration, where medium-sized cities that could be described as Christallerian subcenters have been absorbed into the radius of action of the main city, Barcelona.

2. Urban destructuring

Numerous voices, mainly from the field of urban planning, have stressed the increasingly amorphous and chaotic nature of urban space. The decentralization of both the population and jobs are generating a model of city in which the elements that were traditionally regarded as its basic skeleton – centralities and transportation infrastructures – are no longer exercising their structuring capacity. Morphologically, the urban space would resemble a labyrinth or a meaningless puzzle. To describe recent urban dynamics, Pope (1996) wields the concepts "entropy" and "disorganization", Boeri (2001) cites "undifferentiation", Batty (2011) claims a "lack of order", García (2010) notes "randomness" and Dear and Flusty (1998) describe "disarticulation" and Phelps (2004) "undifferentiation". All of these concepts revolve around the same idea, namely the rising destructuring of the city.[1]

From the outset, we should distinguish between the *Destructuring of the City Approach* and the *Dissolution of the City Approach*, which bear similarities to each other as well as major differences. According to the latter approach, improvements in the transportation and telecommunications would make physical distance less and less necessary, especially for jobs (Mitchell, 1995; Lang, 2003). This idea has been hotly debated and has merited in-depth research comparing the evolution of jobs inside and outside the centers (Gordon and Richardson, 1996; Pfister et al., 2000) and more closely examining employment figures with the purpose of discovering whether there are activities that are particularly resistant to the forces leading to de-concentration (Lee, 2007; Muñiz and García-López, 2010, García-López and Muñiz, 2010). In both

[1] The forerunners of this disorderly version of urban sprawl date back to the 1920's. We must first cite Patrick Geddes (1920), who claimed that cities had to stop growing like oil stains and instead follow an alternative growth model he described as botanical. Later, in the 1950's and 1960's, the comparison between sprawl and disorder remained alive. W.H. Whyte (1958) held that the problem of sprawl was the lack of order or a pattern, while Lewis Mumford (1961) believed that the American city was turning into an undifferentiated amalgam.

cases, the purpose is to weave a discourse on the future of the urban form based on recent trends. However, while the urban destructuring approach upholds the existence of rising morphological and functional disorder, the urban dissolution approach holds that the future will bring the total dispersion of both the population and jobs. In short, the destructuring of the city approach does not deny the future viability of employment centers; rather it underscores their rising inability to coherently organize the metropolitan system.

Albert Pope: Ladders

In his book *Ladders*, Albert Pope (1996) explains the model of urban growth that can be found in many cities in the United States as a peculiar mutation of the two other models of regional urban planning that emerged during the modern period, namely Arturo Soria's *linear city* and the *polycentrism* with which Howard accompanied his defense of the garden city (Gravagnuolo, 1998). According to Pope, the disperse growth of cities and their increasing disorder can be viewed as the failure of these models that attempted to articulate and impose a hierarchy on the city space.

In contrast with the traditional grid, which is regular yet also ready for unlimited growth in the expansions of 19th century European cities and in newly built American cities, transportation infrastructures and new subcentres became fundamental elements in urban expansion in the second half of the XXth century. Yet far from organizing the space on the metropolitan scale, all they managed to do was to affect their most immediate environment. As a result, the urban morphology that tended to emerge is described by Pope as a *weak metropolitan form*.[2]

According to Pope, Urban sprawl would be expressed today as a process that manages to lower the entropy in some parts of the urban space (business districts, housing developments, shopping centers, etc.) at the expense of maximizing the entropy of the rest of the territory. The disorder that accompanies urban sprawl reaches its maximal expression precisely in the intersticial spaces, areas without any apparent meaning, cut off from their surroundings, which in some cases have been painted as a

[2] Today, as an expression of their increasing in-ability to structure the space, they are regarded as yet another of the "strange attractors" of a city lacking differentiated, specialised organs (García, 2010).

representation of the failure of the disperse urban model and in others have earned a sincere interest in understanding their meaning and possibilities. The names that it has been bestowed are as varied as *post-architectural void* (Koolhaas et al., 1995), *smooth space* (Deleuze, 1989), *terrain vague* (Solà-Morales, 1995), *space of ellipsis* (Pope, 1996), *non-places* (Augé, 1994), and *banal spaces* (Phelps, 2004).

Urban spatial structure beyond the CBD: polycentricity and linear expansion in Regional Planning tradition and NUE models

Pope's vision of urban sprawl as a process characterized by its increasing lack of order and hierarchy, in which the bones of the urban skeleton are incapable of holding up a recognizable structure because they are broken, disconnected, scattered about without either order or meaning, generating something like many tiny tumors around it, is shared by the majority of applied studies on urban sprawl coming from the USA. For example, Galster et al. (2001) and Glaeser and Kahn (2004) include linear growth and polycentrism as two further dimensions of sprawl, along with low density, de-concentration, and discontinuity. In this kind of study, the assimilation of linear growth and polycentrism as elements common to urban sprawl contrasts with the experiments conducted in numerous cities – mainly in Europe – in which linear growth and polycentrism are the expression of a conscious struggle through urban planning against undifferentiated, amorphous sprawl lacking any hierarchy (Hall, 1996; Hall and Pain, 2006; Gravagnuolo, 1998).

Nor does Pope's approach match what could be expected of a process of polycentric decentralization of employment according to the majority of models of the New Urban Economics (NUE). In the polycentric theoretical models of the NUE, just like in the standard monocentric model, the city is arranged in an orderly fashion around the CBD and the subcenters, even though this is a spontaneous order that emerged from the individual economic rationality of the agents instead of from urban planning. In this kind of models, the proximity to subcenters is viewed positively by companies and workers, the former to access part of the agglomeration economies generated there at a low cost, and the latter to minimize commuting distance. On the other hand, the emergence of subcenters can be explained as the outcome of a precarious balance between agglomeration economies and diseconomies (Sullivan, 1986; Wieand, 1987; White, 1999).

In this kind of models, the ideas on structuring and order take on a very specific meaning. The centralities, CBD and subcenters, are the spatial references for the rest of the territory. All the relations and valuations established give rise to a space where, were there no geography, nor history, nor market regulation, it would be perfectly possible to predict some basic parameters such as population and employment density, land value, or commuting distance for any zone in the city according to its proximity to the CBD and employment subcenters. This approach to polycentrism – which can be extended to other theoretical models of linear urban expansion (Anas and Moses, 1979, Baum-Snow, 2007b) assume the existence of a structure or a skeleton which is capable of sustaining, orienting, organizing, and hierarchizing the decentralization of the population and employment.

The empirical evidence of the impact of centralities (CBD and subcenters) and of transportation axes on the population density confirms their structuring capacity in the majority of cases. There are numerous studies where the distance to subcenters and transportation axes exert a significant negative effect on the population density (Song, 1992; McDonald and Prather, 1994; Small and Song, 1994; Baumont et al., 2004; Muñiz et al., 2008; Steen, 1986; Baum-Snow, 2007a; and García-López, 2010, 2012).[3] In the case of the impact of employment centers and transportation axes on commuting distance, the empirical evidence offers contradictory results. Even though in studies like Tkock and Kristensen (1994), Levinson and Kumar (1997), Wang (2000), and Naess (2007), the commuting distance is affected by the place of residence's proximity to the main employment centers and the transportation infrastructure, Giuliano (1995), Handy (1996), Weber and Kwan (2002), and Weber (2007) assert that the urban spatial structure tends to be less and less important, since when social and economic variables are included in the model, the structure coefficients tend to lose their significance. The problem with this kind of studies is that most of them analyze a single year and consider only one of the variables – either mobility or density – so they are

[3] Few studies question the structuring role of the subcenters due to their scant statistical significance (McMillen and Lester, 2003; and Dowall and Treffeisen, 1991).

actually incapable of determining whether the urban spatial structure tends to become more or less important over time.

Towards a dynamic approach to the impact of urban spatial structure on population density and commuting distance

As noted above, both the studies evaluating the impact of polycentrism on commuting distance and those evaluating its impact on the population density have striven more or less explicitly to prove the validity of the theoretical models, either monocentric or polycentric. This spirit can particularly be found in Song's study (1994), which evaluates the impact of polycentrism on the population density and commuting distance simultaneously. Song's results confirm the connection between morphological and functional polycentrism in Los Angeles, although it is quite interesting to consider the possibility that this were not so, since it would require us to more subtly examine the validity of the theoretical model. What might be the explanation of the fact that the urban spatial structure would remain for density but not for commuting distance, or vice-versa?[4].

Unfortunately, the studies on the impact of the urban spatial structure on density or mobility have generally not used a dynamic approach. As a result, the debate has stagnated on whether the model that better captures actual urban form is monocentrism, polycentrism, or neither of them. Perhaps for this very reason, this kind of study has not managed to have a significant effect on the debate regarding whether cities of the future should retain a given structure or whether they will irremediably tend to chaos. In this debate, considering the impact of the urban spatial structure on density and mobility in dynamic terms would enable us to test whether indeed turban spatial structure tends to be decreasingly important.

[4] Different studies analyze whether functional (mobility) and morphological (density) polycentricity are actually connected (Burger and Meijers, 2010; Veneri and Burgalassi, 2010; Hall and Pain, 2006) in the case of city-regions. City-regions like Randstad or the Flemish diamond are normally delimitated by administrative boundaries and are much larger than metropolitan regions. Therefore, it is not surprising that functional polycentricity measured by commuting patterns shows very poor results.

3 METHODOLOGY

To evaluate the influence of urban spatial structure on population density and commuting distance, we estimate two a density function[5] (*morphological approach*, equation (1)), and a commuting distance function (*functional approach*, equation (2)). It is important to note that both functions include the same explanatory variables, with the exception of control variables:

$$\ln D = \alpha_0 + \alpha_1 d_{CBD} + \alpha_2 d_{SUB}^{-1} + \alpha_3 d_{INF} + A_4 X_D + \varepsilon \quad (1)$$

$$\ln AD = \beta_0 + \beta_1 d_{CBD} + \beta_2 d_{SUB}^{-1} + \beta_3 d_{INF} + B_4 X_{AD} + \mu \quad (2)$$

where $\ln D$ and $\ln AD$ are the natural logarithms of net population density and average commuting distance, respectively. d_{CBD} is distance to the CBD, d_{SUB}^{-1} is the inverted distance to the nearest subcenter, and d_{INF} is distance to the nearest main road. Finally, X_D and X_{AD} denote a vector of observed location characteristics. ε and μ are the error terms.

The sign and significance of the estimated coefficients provide us with the required information to discuss the influence of urban spatial structure. For the density function (equation (1)), a significant and negative value of the CBD gradient ($\alpha_1 < 0$) and a positive value of the subcenter gradient[6] ($\alpha_2 > 0$) would verify the influence of employment centers on residential location and land consumption patterns, that is, a decreasing net population density as the inhabitants move further from the CBD and the nearest subcenter. A negative and significant infrastructure gradient ($\alpha_3 < 0$) would confirm the influence of main roads.

Similarly, positive and significant coefficients for distances to the CBD and the nearest main road ($\beta_1 > 0$ and $\beta_3 > 0$) and a negative and significant coefficient for the distance to the nearest employment subcenter($\beta_2 < 0$)would confirm the influence of the urban spatial structure on commuting patterns (equation (2), Figure (1)).

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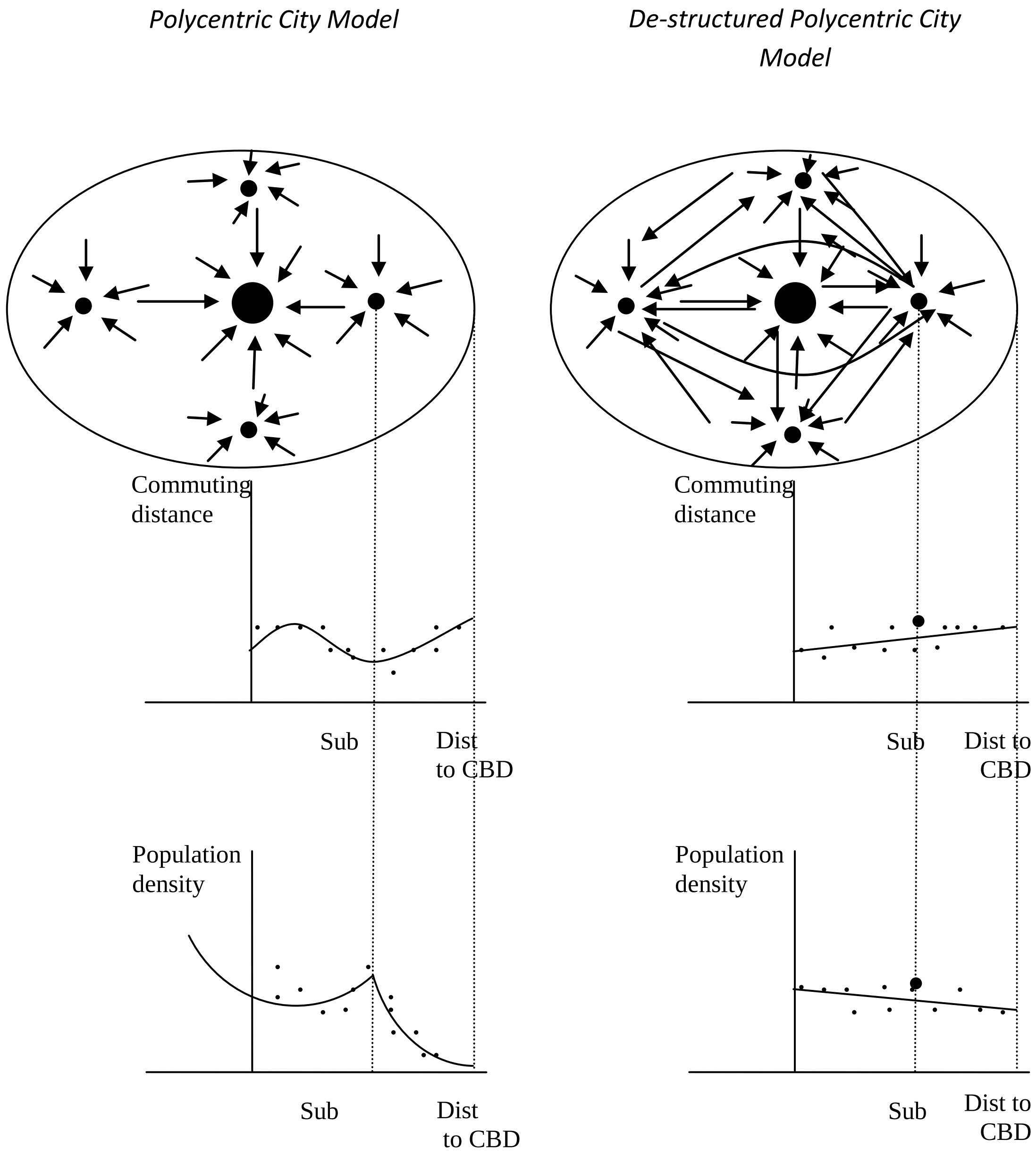
[5] This functional form is the linearized version of a negative exponential function derived from a quasilinear utility.

[6] An inverted distance allow us to avoid multicolinearity problems with the variable CBD distance (McDonald and Prather, 1994; Muñiz et al., 2008)

Figure 1. Polycentric city model versus polycentric destructured city model



The evolution in the explanatory capacity of the models for population density and commuting distance stand out four alternative scenarios:

1) The model's explanatory capacity improves in the cases of both density and commuting distance. In this case, it would be capturing a properly structured process of polycentric decentralization, as upheld by the majority of NUE polycentric models.
2) The model's explanatory capacity worsens in both cases. If so, it would be capturing a process of dispersed decentralization in which the urban spatial structure matters less and less. This would mean extending Giuliano's (1995) criticism on the weakening of the connection between urban spatial structure and mobility to the case of density.
3) The model's explanatory capacity improves for density but worsens for mobility. This scenario would mean an asymmetry that has not been posited by polycentric models in which mobility would remain somewhat on the sidelines of structure, but the density behavior would be as expected. Something similar has been argued to explain the concept of network city (Batten, 1995), in which a preindustrial urban spatial structure is compatible with the emergence of an apparently random mobility pattern.
4) The model's explanatory capacity improves for mobility but not for density. In this case, the process of decentralization, though prioritizing certain areas where there might be a concentration of jobs and therefore a net arrival of commuters, does not actually affect land values and therefore densities. In our opinion, when Lang (2003) described the so-called edgeless cities, he was drawing a very similar picture.

4. THE URBAN SPATIAL STRUCTURE OF THE BARCELONA METROPOLITAN REGION

The Barcelona Metropolitan Region (BMR) was delimited in 1966 by the Pla Director de l'Àrea Metropolitana, which was legally defined in 1987 by the Lleis d'Ordenació Territorial. It is currently used by the Pla Territorial General de Catalunya as a functional region for planning purposes. Made up of 164 municipalities, the BMR covers an area of 324,000 ha in a radius of approximately 55 km. Because of its steep topography, only 67,999 ha were urbanized in 2002 (Garcia-López, 2010).

Despite the fact that it is one of the densest urban agglomerations in Europe (Serra et al., 2002), the BMR is affected by urban sprawl, particularly between 1960 and 1988 (Font et al., 1999, 2005; Rueda, 2002). However, very few studies are devoted to studying the polycentric nature of the area and its influence on location and mobility patterns. Worth noting is the study by Muñiz et al. (2008) which demonstrates the impact of employment subcenters on population density patterns, as well as the study by Roca Cladera et al. (2009) which analyses the impact of subcenters on mobility and claims the need to include commuting patterns as a criterion for identifying subcenters.

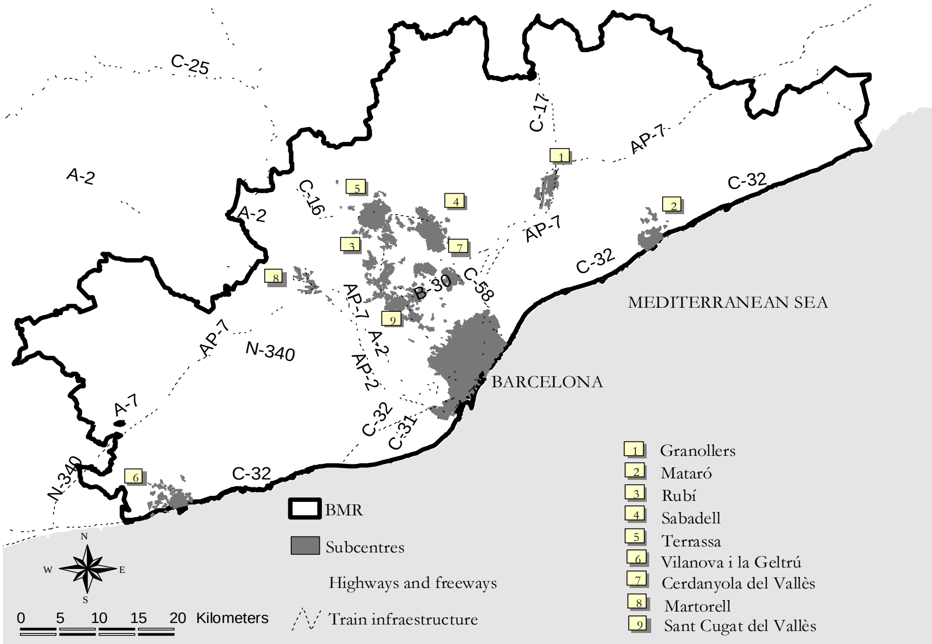
The BMR is an excellent case study for our purposes because of two of its characteristics. Firstly, it is undergoing an employment decentralization process affecting the population location and land consumption patterns, as well as commuting patterns. Secondly, its urban spatial structure[7] is clearly polycentric (Muñiz et al. 2008; Roca-Cladera et al., 2009).

Defining the Barcelona municipality as the main center (CBD), Muñiz et al. (2008) identify 9 main subcenters in 2001 using a statistical threshold method (Figure 2 and 4). These subcenters are municipalities with an employment density greater than the BMR average density and amount of employment greater than one per cent of BMR total employment. This method adapts the numerical threshold method first proposed

[7] See Muñiz et al. (2008), Garcia-López and Muñiz (2010) or Garcia-López (2012), among others, for further details on BMR characteristics and its urban spatial structure.

by Giuliano and Small (1991). A statistical threshold[8] is preferred over a numerical one when the period studied includes important cyclical variability in employment.

Figure 2: BMR employment centers



The BMR main road network is based on several highways and freeways (A-2, AP-2, AP-7, C-16, C-17, C-32, C-33, and C-58) and other main roads (C-15, C-31, C-35, N-340, and N-II, among others). The former are fast high-capacity roads with access limited to ramps, while the latter are main roads that cross municipalities and can be accessed from any point along the roadway. Nowadays, there are 516 km of highways-freeways and 670 km of other main roads (Figures 3 and 4).

[8] Other methods are based on commuting flows (Gordon and Richardson, 1996), density or job-ratio maxima (Gordon et al., 1986; McDonald, 1987; Muñiz et al., 2003; Redfearn, 2007), significant positive residuals (McMillen, 2001; Lee, 2007; Garcia-López, 2010), and local indicators of spatial associations (LISA) (Baumont et al., 2004; Guillain et al., 2006).

Figure 3: BMR transportation infrastructure

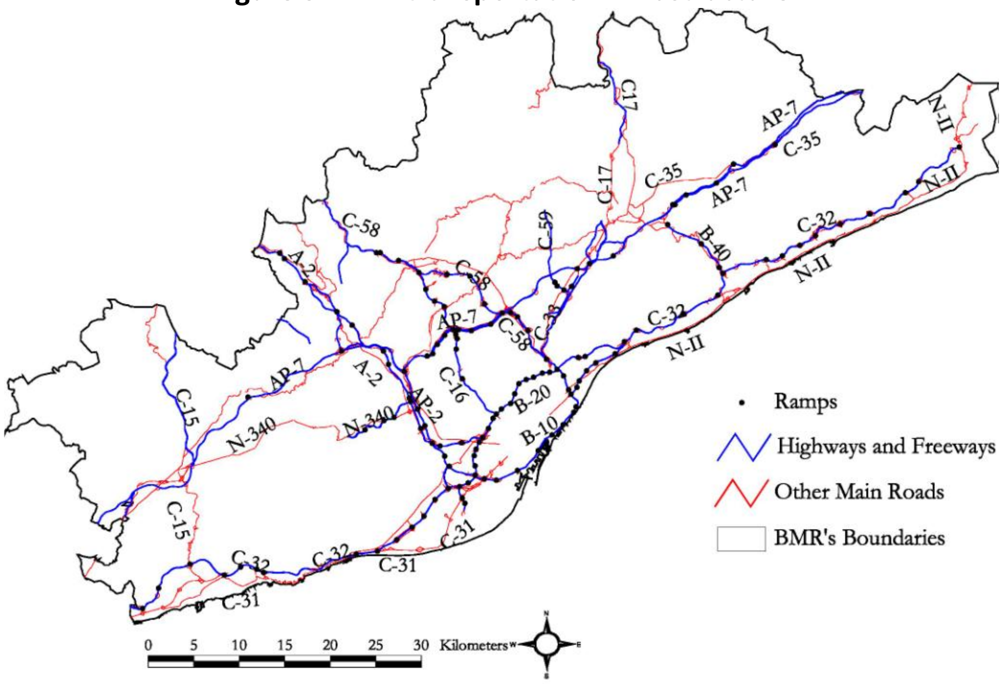
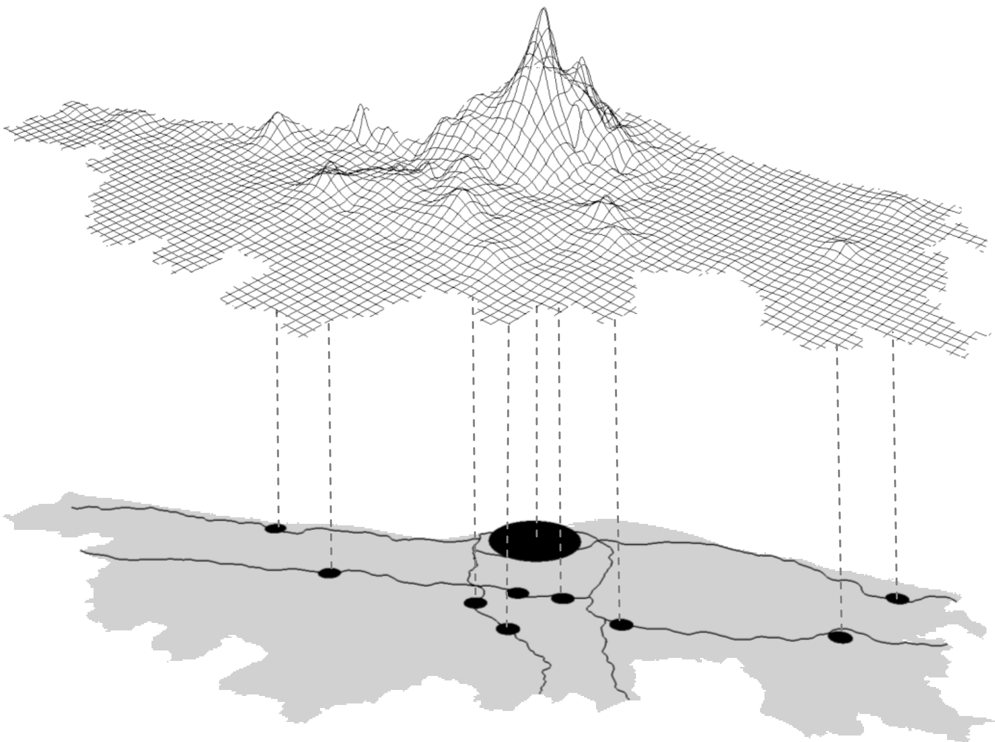


Figure 4: BMR 3-D population density and urban spatial structure



Data

Net population densities for each municipality is computed dividing its inhabitants by its residential land (ha). The average commuting distance is computed as the sum of distances (km) from one municipality to the others weighted by the proportion of commuters.

BMR population and commuting data come from the 1986 and 2001 population censuses (Instituto Nacional de Estadística). Even though some information is collected at the census tract level (population), most data are related to the municipal level, a larger spatial scale (e.g., workplace and, hence, commuting patterns). As a result, we use municipal data.

Residential land data come from Mapes d'Usos del Sòl de Catalunya (Land Use Maps of Catalonia) from 1987 and 2002, drawn up by the Institut Cartogràfic de Catalunya using multispectral data taken from the Thematic Mapper sensor of the LANDSAT-TM satellite at a scale of 1:25,000. These maps show a classification of 21 uses, including four urban types. Residential land is obtained by adding together the "urban nucleuses" and "condominium of single and semi-detached houses" land categories.

Transportation infrastructure graphs related to the main road network were provided by the Departament de Política Territorial i Obres Públiques. These are vector digital maps with polylines (highway-freeway and other main road segments) and points (highway-freeway ramps).

We use GIS software to obtain municipal centroid coordinates and calculate distances in straight line (km) from each centroid to the others (to compute the average commuting distance), to the CBD centroid, to the nearest subcenter centroid, and to the nearest main road segment.

Some control variables are also included in an additional specification; for the case of density function, control variables are municipal average income and the percentage of forest land, and for the case of commuting distance, control variables are municipal average income and the municipal job-ratio.[9].

5. MAIN RESULTS

Tables 1 and 2 present OLS results for our main explanatory variables. In both tables, Columns 1 and 3 show unconditional results, that is, without any control variable. Columns 2 and 4 include control variables.

Table 1. Net density functions: morphological approach

	1986		2001	
	(1)	(2)	(3)	(4)
Distance to CBD	-0.035***	-0.038***	-0.029***	-0.031***
	(-4.76)	(-5.55)	(-4.86)	(-5.90)
Inv. distance to the nearest subcenter	0.605**	0.402*	0.743***	0.543***
	(2.16)	(1.81)	(3.86)	(3.06)
Distance to the nearest main road	-0.160***	-0.059	-0.223***	-0.140***
	(-2.83)	(-1.08)	(-5.29)	(-3.23)
Control variables	N	Y	N	Y
R-squared	0.2795	0.4159	0.4149	0.5385

Notes: All regressions include a constant term. Control variables are municipal income per capita and percentage of forest land. Statistic t-student in parentheses. ***, **, and *: significant at the 1, 5 and 10 percent level, respectively.

Main results for the density estimates (Table 1) are as follows:

a) All the parameters show the expected signs, and all are statistically significant, which allow us to state that, in order to capture the complexity of the BMR urban spatial structure, it is necessary to consider not only the CBD but also main roads and subcenters.

b) As expected in a decentralization context, the estimated coefficient for distance to the CBD (its density gradient) decreases.

c) When comparing the estimated coefficients for distance to the nearest subcenter and distance to the nearest main road at the beginning and end of the period, they clearly rose in value, which seems to capture a recent peripheral reorganization of employment in which subcenters and main roads are attracting activity and population.

[9] The job ratio is the ratio between the number of jobs and the active population. It gives us an idea of the potential for self-containment of the municipal job market if the municipality's entire population worked in the same municipality where they live.

d) Most importantly, the individual explanatory capacity ("t" values) and the overall explanatory capacity tend to increase. As stated before, this is the most important evidence to support the idea that urban spatial structure increasingly determines employment relocation and land use intensity in a decentralization context.

Table 2. Average commuting distance functions: functional approach

	1986		2001	
	(1)	(2)	(3)	(4)
Distance to CBD	-0.003 (-1.49)	0.001 (0.33)	0.010*** (5.44)	0.013*** (7.99)
Inv. distance to the nearest subcenter	-0.147 (-1.51)	-0.123 (-1.50)	-0.168** (-2.09)	-0.129** (-2.09)
Distance to the nearest main road	0.033* (1.78)	0.030* (1.96)	0.028** (2.13)	0.015 (1.34)
Control variables	N	Y	N	Y
R-squared	0.0468	0.3827	0.3181	0.5635

Notes: All regressions include a constant term. Control variables are municipal income per capita and municipal job ratio. Statistic t-student in parentheses. ***, **, and *: significant at the 1, 5 and 10 percent level, respectively.

Main results for the commuting distance estimates (Table 2) are as follows:

a) Between 1986 and 2001, the statistical significance of the parameters improves, as does the overall explanatory capacity, replicating a behavior similar to population density. Therefore, urban spatial structure increasingly helps to explain commuting distances, offering results consistent with the Polycentric City Approach.

b) The results for 1986 spectacularly depart from expectations. The overall explanatory capacity is very low, the coefficients are not significant, and the sign of coefficient for distance to the CBD is contrary to expectations. These results most likely capture the very beginning of an integration process that perhaps is not yet over. In 1986, the Barcelona Metropolitan Region was working not so much as an integrated metropolis but as a sum of segmented local markets.

By incorporating control variables, the overall explanatory capacity of models for both, population density and commuting distance, improves. Estimated coefficients for control variables show expected signs. Urban spatial structure coefficients and their statistical significance and evolution are not significantly affected. As a result, the previous conclusions still hold.

6 CONCLUSIONS

The results obtained confirm the impact of main roads and subcenters on density patterns and commuting distance. They should therefore join the CBD as key elements in accurately describing the BMR urban spatial structure. Their importance lies not only in their physical presence but also in their ability to organize the territory, order mobility flows, and determine the land value, as well as its intensity of use.

From a temporal point of view, there is a process of adjustment in which the BMR urban spatial structure better explains population density and commuting patterns. These results are clearly contrary to the predictions of the destructured city approach, which claim that as physical distance becomes less important, cities tend toward total dispersion following a random location pattern.

At both a functional and morphological level, the results confirm the validity of the polycentric city approach in the case of the Barcelona Metropolitan Region and at the same time can be interpreted as empirical evidence favorable to the positive correlation between functional and morphological polycentricity.

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