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Urban spatial structure and economic growth in Spanish metropolitan areas

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URBAN SPATIAL STRUCTURE AND GROWTH IN SPANISH

METROPOLITAN AREAS: 1992–2008

Luisa Alamà* Marta R. Casanova[†] Anabel Forte[†] Emili Tortosa-Ausina[‡]

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Abstract

There is a large literature on the existence of agglomeration economies, as shown in the surveys by Moomaw (1983) or Gerking (1993). The benefits of these economies arise from multiple sources, but some negative externalities might also emerge. Within the hierarchical urban system, cities at different ranks (different size) take on different economic functions with variant “efficient sizes” (Capello and Camagni, 2000) and, indeed, the distributions of cities’ relative size have been stable in many countries (Black and Henderson, 1999; Eaton and Eckstein, 1997; Nitsch, 2005) and, in many cases they obey the Zipf’s law (Gabaix, 1999). If a city is able to adjust its spatial structure to offset the negative externalities due to its size, it will be able to keep growing. If that is not possible, it might be more convenient to transit from a monocentric to a polycentric structure, which is usually considered as a possible strategy to eliminate diseconomies in urban economics (Sasaki and Mun, 1996; Fujita et al., 1997). However, there is little empirical evidence on the links between urban spatial structure and growth—which are usually understood within the context of urban evolution. One notable exception is the study by Cervero (2001), where it is argued that more compact, centralized and accessible cities are usually associated with higher productivity levels. In this context, this paper explores the links between urban spatial structure and economic growth in metropolitan areas in Spain, where this type of analysis is virtually non-existent. The issue is analyzed in two stages, where the first one corresponds to the analysis of the evolution of the Central Business District over the 1992–2008, whereas the second stage deals explicitly with the implications for growth during the same period. This is a relevant policy issue due to a variety of reasons such as the increased urban sprawl and the different costs it brings about—especially when taking into account that the economy grew above the European average during that period. The analysis also enables to evaluate if there is any particular type of urban spatial structure which prevails on the grounds of its superior efficiency, together with evaluating if an efficient urban spatial structure hinges on the size and other attributes specific to each particular metropolitan area.

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1. Introduction

The migrations of population from the countryside to the cities have been traditionally associated with the development of nations, leading naturally to inquiry about how cities of different sizes grow during the process of development (Le Gallo and Chasco, 2008). Under these circumstances, the scenarios that may emerge as a result of the evolution of the size distribution of cities may be multiple, from urbanization taking the form of expansion of the largest cities to the detriment of smaller ones, or catching up of the latter with the former. A large literature has dealt with these and related issues, attempting to analyze whether the Zipf's law is verified (Gabaix, 1999).

A particular case deals with the evolution of the metropolitan spatial structures (Anas *et al.*, 1998). While many studies have dealt with the evolution of the size distribution of cities, the empirical evidence is comparatively smaller when dealing with the spatial changes and, particularly, their specifics—the form and nature of the spatial changes. These and related questions such as what the prominent features of emerging urban forms are, the primary forces driving spatial changes or, summing up, the transformation of metropolises from monocentric to polycentric structures have been explored in the US context (Lee, 2007). In the European case, the evidence is much less abundant, with few exceptions such as the analysis for the Italian metropolitan areas by Veneri (2010).

Our study focuses on the particular experience of Spain between 1992 and 2008, a relevant case not only because it is one of the largest European countries but also because of its unprecedented growth in most of the years of the sample period (1994–2008), and how the crisis is affecting the country. Some particular trends have accompanied these fifteen years of growth, but their distribution has been uneven among the Spanish territories—for instance, immigration rates were remarkably high, but they were not totally generalized.

In this particular scenario, this paper presents an empirical analysis of spatial trends in the Spanish metropolitan areas to address the question of whether they have become more polycentric or more dispersed, and how this might be related to

the aggregate growth for the country as a whole during the sample period. Although some recent papers such as Garcia-López and Muñiz (2010) have also dealt with the Spanish case, this is the first studies which focus in the entire country instead of a particular region, province or metropolitan area. Specifically, we we analyze the urban spatial trends of 51 Spanish Urban Areas¹ and their evolution over the 1992–2008 period.

1.1. Concentration vs. Dispersion

The main focus of this study is to analyze the spatial evolution of population in the period 1992-2008, considering the impact of the housing bubble, it is contrasted that in this period there were a change in the location household, density cities by municipalities near the city (defined as central and dispersed). It is important to analyze the factors that are determining the choice of household location, the economies and diseconomies of agglomeration in the urban structure. The literature (...) has focused their attention in the importance of agglomeration economies in cities, and in their influence in choosing the household.

There are arguments to explain the advantages of concentrating in big cities, economic, social, labor, etc., arguments as the followings: large cities have the most diverse labor force, the most highly trained experts, and the largest numbers of workers, creating a significant competitive advantage, Romer's (1986) endogenous growth model posits that more ideas beget even more ideas that cities are fertile ground for innovation and economic growth. Duranton and Puga (2001) characterize some cities as "nurseries" for growth, enhancing idea production due to their industrial diversity. Large cities also have the densest transport networks and generally best access to global transport networks. As highways followed the paths of earlier roadways, the communications infrastructure has in large part followed the transportation infrastructure. Moreover, since large cities have the greatest demand for communications services, suppliers take advantage of scale economies, offering more, better and cheaper service in the largest cities (Graham and Marvin, 1996). The proxim-

¹The concept 'Urban Area' from Spain corresponds to the term of 'metropolitan area'.

ity to market, the transports, business centers, employment centers, leisure centers, and cultural centers. On the other hand, the literature takes into account the diseconomies of agglomeration, cost of agglomeration, the arguments for not choosing a large city as household as pollution, housing prices, advantage for firm in locating outside large cities, quality of life in living in low density cities...

The standard urban model predicts (see Anas *et al.*, 1998; Fujita, 1989) a constantly decreasing population density with distance from the city center. Population density declines with distance, because unit housing costs decline as transport costs increase, and therefore households consume more housing. The model also predicts commuting patterns: the average commute trip distance is equal to the mean distance of total population to the center. If housing demand elasticity varies across households, those with stronger preferences for housing will locate further away from the center. And if these preferences are positively related to income, lower income households would locate closer to the center while higher income households would consume more housing and locate further away.

So, considering these factors we are interested in determining the spatial distribution of population and how the economic crisis has affected this distribution, we expect a translation from the Central Business District (CBD) to the other cities defined as central and dispersed municipalities.

In order to measure the spatial distribution of population, we focus on two dimensions of spatial structure, centralization and concentration. As Anas *et al.* (1998) suggest, spatial structure in a metropolitan area can be centralized versus decentralized and it can also be clustered versus dispersed. Centralization is the extent to which employment is concentrated with reference to the CBD, whereas concentration measures how disproportionately jobs are clustered in a few locations (Galster, 2001). The two spatial dimensions may be associated, but are distinctive as empirically revealed by a factor analysis in Cutsinger *et al.* (2005). Polycentric urban structure is a combined outcome of metro-wide decentralization and local level clustering (Anas *et al.*, 1998). If deconcentration concurs with decentralization, the metropolitan area would evolve in a more generally dispersed form without significant subcentering.

The table shows the two indicators used to capture the centralization and the concentration of population.

2. Data

Our descriptive and empirical analysis uses population and employment data at municipal level, for the years 1992-2008, from Caja España database², which also contains detailed information about the area of each municipality.

We will use the terms ‘municipality’, ‘city’ and ‘town’ as synonyms, because when we say ‘municipality’ we are referring to a single settlement and not to an administrative area that may contain multiple settlements. First, we need to define what we consider ‘Urban Area’, henceforth ‘UA’. This information is obtained from AUDES (Áreas Urbanas de España)³, which in addition to having information on the definition of UA, provides data on CBDs, subcenters and dispersed, called main and secondary municipalities in this database. We should not forget that, as said before, the term ‘UA’ corresponds to the better-known concept of ‘metropolitan area’.

Second, we need to identify the specific UAs we want to analyze. Therefore, we decide to analyse all the UAs which CBD is a provincial capital, that is to say 51. From here we deduce that the provincial capital is considered the CBD in each UA.

3. Methodology

To analyze the data we consider two indices, one to measure the Centralization and another one to measure Concentration. The first one is the Modified Wheaton index (Wheaton, 2004). This index measures how fast the cumulative proportion of metropolitan employment increases along the way from the CBD toward the urban

²This database is downloadable from the following website:
<http://internotes.cajaespana.es/pubweb/decyle.nsf/datoseconomicos?OpenFrameSet>

³This dataset is downloadable from the following website:
<http://alarcos.inf-cr.uclm.es/per/fruiz/audes/index.htm>

edge using the distance from de CBD as a normalizing constant. This is:

$$MWI = \frac{\sum_{i=1}^n E_{i-1} DCBD_i - \sum_{i=1}^n E_i DCBD_{i-1}}{DCBD^*},$$

where n is the number of zones; E_i is the cumulative proportion of employment in zone i ; $DCBD_i$ is the distance of zone i from the CBD and $DCBD^*$ is the distance of the outermost zone from the CBD (Metropolitan Radius), For the computation of this index municipalities are sorted by the distance from the CBD. MWI ranges from -1 to 1 , with 1 indicating perfect centralization.

The other index is the Gini coefficient (Small and Song, 1994; Gordon *et al.*, 1986). This index measures the concentration of metropolitan employment and it is computed as:

$$GINI = \sum_{i=1}^n E_{i-1} A_{i-1} - \sum_{i=1}^n E_{i-1} A_i,$$

where n and E_i are defined as in the Modified Wheaton index and A_i is the cumulative proportion of land area in zone i . In the computation of this index all the municipalities should be sorted by employment density.

4. Results

Following the structure of the paper, first, we will carry out a descriptive analysis of the temporal evolution of the distribution of population in every UA. Afterwards, we will do the same with employment in order to compare whether there have been differences in the spatial distribution of both variables and, thus, in the urban spatial structure throughout the years.

Second, we will define the urban spatial structure by means of two concepts: centralization and concentration. Centralization is measured by the degree of concentration of the population (or employment) near the CBD, and concentration can be defined as the disproportioned distribution of the population (or employment) in a few locations. These two spatial dimensions will be calculated by means of the indicators from the methodology discussed above, the Wheaton index and the Gini

coefficient, and the results will be discussed.

4.1. Descriptive Analysis

In Table 1 and 2, we find descriptive and analytical information about the population shares in Spanish Urban Areas for 1992 and 2008. We can see the number of subcenters, or main municipalities, and the number of dispersed locations, or secondary municipalities, for every UA analysed. Moreover, we have the population of each UA and the population shares of the CBDs, subcenters and dispersed locations.

Comparing the three territorial levels defined in terms of population, it is shown that the CBDs of smaller UAs (less than 300,000 inhabitants) have a higher share of population on average, while the CBDs of larger UAs (more than 1,000,000 inhabitants) are those which have smaller shares of population. In contrast, the dispersed locations (secondary municipalities) of large UAs concentrate more population, on average, than those from medium and small UAs.

From the previous paragraph, we conclude that the shares of population in CBDs and dispersed locations vary when we consider different territorial levels. However, will these shares be modified throughout the years? To answer this question we need to take into account the evolution of seventeen years.

Figure 1 shows us that the distribution of population has been changing in the last seventeen years, by reducing the share of population belonging to the CBDs and increasing the shares of population in the main and secondary municipalities (subcenters and dispersed). This implies a change in the urban spatial structure.

4.2. Urban Spatial Structure: Centralization and Concentration

Figures 2 and 3 present a quick visual way to overview the patterns of the spatial distribution of population among the UAs, making reference to the concepts of concentration and centralization.

On the one hand, the upper right corner of these figures indicates highly centralized and concentrated spatial structure, i.e. a monocentric structure. Córdoba is the clearest example of this urban structure, both 1992 and in 2008. On the other hand,

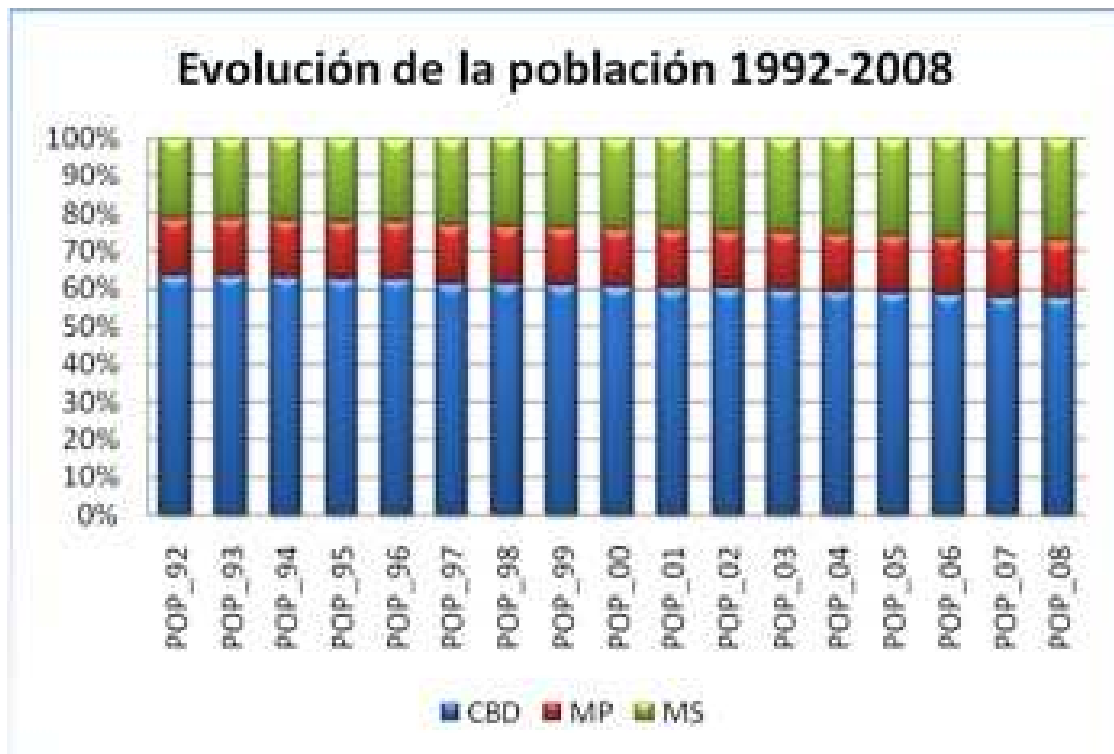


Figure 1: *Evolution of the Population, 1992-2008*

the lower left corner of these figures indicates a decentralized and dispersed spatial structure, as is the case of Eivissa. Finally, Valencia or Barcelona may reveal subcentering, because the population location is decentralized, but have a moderated level of concentration.

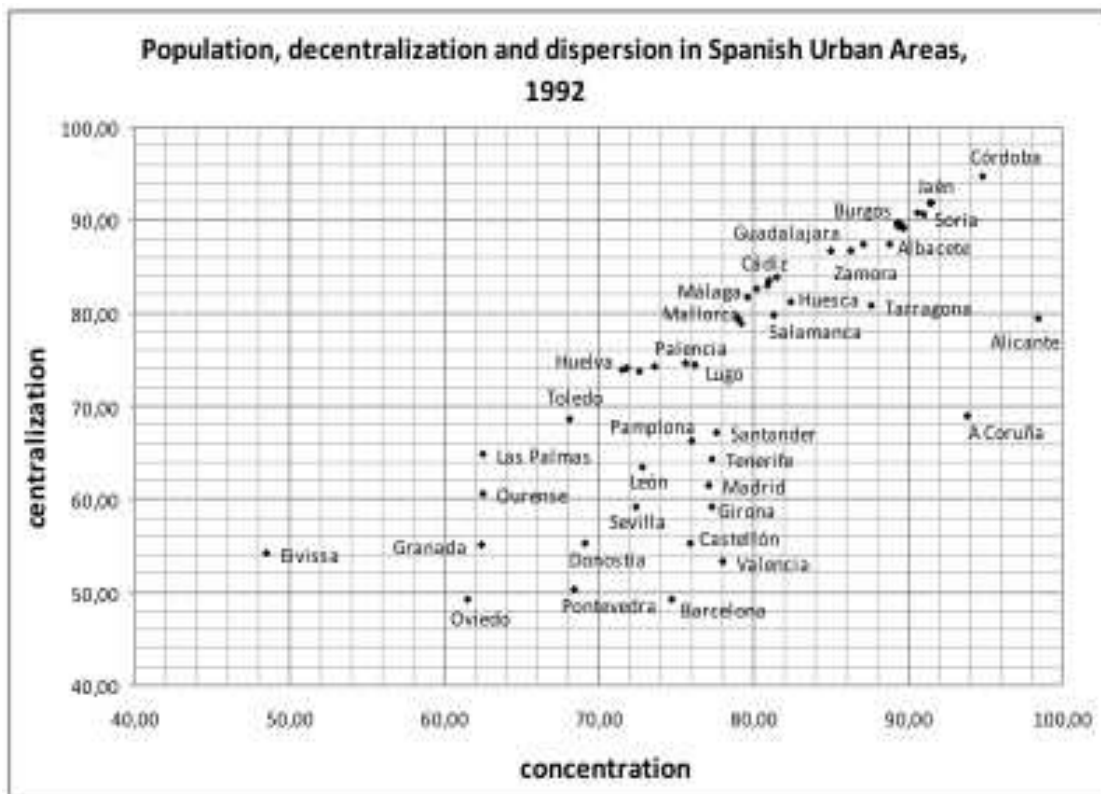


Figure 2: *Urban spatial structure of UAs, centralization and concentration, 1992*

Table 1: Population shares in Spanish Urban Areas, 1992

AU	SUBCENTER (MM)	DISPERSED(SM)	Population	SHARE OF POPULATION 92(%)				RANK_pop_92		
				CBD	SUBCENTERS	DISPERSED	SUB/(ALL.CENTERS)	Dispersed	decentralized	polycentric
				A	B		A/(A+B)			
Madrid	12	119	4892985	61.53	18.33	20.14	22.96	26	13	8
Barcelona	11	68	3339657	49.21	28.39	22.40	36.58	21	2	3
Valencia	14	50	1413267	53.27	25.73	20.99	32.57	24	5	5
Sevilla	8	33	1152649	59.26	14.23	26.51	19.37	10	11	11
Bilbao	8	51	1016239	36.39	38.41	25.19	51.35	19	1	1
>1.000.000 hab.	11	64	11814797	54.68	23.39	21.94	29.96			
Zaragoza	0	38	663092	89.64	0.00	0.00	0.00	51	46	46
Málaga	0	15	639163	81.69	0.00	18.31	0.00	29	33	33
Palmas de Gran Canaria (Las)	0	13	547864	64.77	0.00	35.23	0.00	5	16	24
Granada	5	51	462930	55.13	9.55	35.32	14.77	4	7	14
Murcia	0	5	413199	79.40	0.00	20.60	0.00	25	29	31
Oviedo	1	15	397645	49.30	11.07	39.62	18.34	2	3	12
Valladolid	0	38	396416	83.42	0.00	16.58	0.00	34	36	36
Palma de Mallorca	1	17	376081	78.91	3.08	18.01	3.76	30	27	20
Coruña (A)	1	9	357798	69.02	5.16	25.81	6.96	15	20	18
Alicante	4	3	334645	79.33	19.08	1.59	19.39	50	28	10
Córdoba	0	6	318874	94.76	0.00	5.24	0.00	49	51	51
Santa Cruz de Tenerife	1	10	311067	64.35	35.65	26.39	35.65	11	15	4
Donostia	1	10	310222	55.26	13.42	31.31	19.54	8	9	9
1.000.000<hab.<300.000	1	18	5528996	73.51	6.05	20.68	7.61			
Santander	2	18	284337	67.20	11.61	21.18	14.74	23	18	15
Pamplona	3	34	271942	66.33	14.34	19.33	17.78	27	17	13
Castellón de la Plana	2	11	243235	55.18	0.00	22.92	0.00	20	8	22
León	1	30	227167	63.40	9.03	27.58	12.46	9	14	16
Vitoria	0	24	227119	90.75	0.00	9.25	0.00	46	48	48
Salamanca	1	39	204199	79.77	3.34	16.89	4.02	33	30	19
Huelva	0	7	192947	73.88	0.00	26.12	0.00	13	22	26
Cádiz	0	1	183985	83.89	0.00	16.11	0.00	35	37	37
Burgos	0	27	179225	89.43	0.00	10.57	0.00	43	44	44
Almería	0	12	177664	87.31	0.00	12.69	0.00	38	40	40
Ourense	0	23	169555	60.60	0.00	39.40	0.00	3	12	23
Lleida	0	24	150956	74.26	0.00	25.74	0.00	16	24	28
Albacete	0	12	148672	87.46	0.00	12.54	0.00	39	41	41
Logroño	0	16	147486	82.89	0.00	17.11	0.00	32	35	35
Pontevedra	1	8	142288	50.24	16.90	32.86	25.17	6	4	6
Badajoz	0	6	136482	89.55	0.00	10.45	0.00	44	45	45
Tarragona	1	9	136177	80.89	8.47	10.64	9.47	42	31	17
Girona	1	19	116133	59.12	18.78	22.10	24.11	22	10	7
Jaén	0	4	112402	91.87	0.00	8.13	0.00	48	50	50
Lugo	0	7	111720	74.51	0.00	25.49	0.00	17	25	29
Palencia	0	16	104249	74.69	0.00	25.31	0.00	18	26	30
Cáceres	0	12	100671	74.09	0.00	25.91	0.00	14	23	27
Toledo	0	12	87313	68.49	0.00	31.51	0.00	7	19	25
Ciudad Real	0	9	77412	73.67	68.82	26.33	48.30	12	21	2
Zamora	0	11	74419	86.64	0.00	13.36	0.00	36	38	38
Guadalajara	0	9	73446	86.66	0.00	13.34	0.00	37	39	39
Segovia	0	11	65836	82.59	0.00	17.41	0.00	31	34	34
Eivissa	0	2	55196	54.23	0.00	45.77	0.00	1	6	21
Huesca	0	10	54360	81.25	0.00	18.75	0.00	28	32	32
Ávila	0	8	51603	89.10	0.00	10.90	0.00	40	42	42
Cuenca	0	7	46664	91.76	0.00	8.24	0.00	47	49	49
Soria	0	6	35719	90.60	0.00	9.40	0.00	45	47	47
Teruel	0	2	31934	89.21	0.00	10.79	0.00	41	43	43
<300.000 hab.	0	14	4422513	75.36	4.75	19.89	5.93			

Table 2: Population shares in Spanish Urban Areas, 2008

AU	SUBCENTER (MM)	DISPERSED(SM)	Population	SHARE OF POPULATION_08(%)				RANK_pop_08		
				CBD	SUBCENTERS	DISPERSED	SUB/(ALL.CENTERS)	Dispersed	decentralized	polycentric
				A	B		A/(A+B)			
Madrid	12	119	6240982	51	19.49	29.02	27.46	17	8	7
Barcelona	11	68	3650161	44	25.42	30.31	36.48	13	3	3
Valencia	14	50	1704066	47	26.88	25.75	36.20	24	5	4
Sevilla	8	33	1357786	52	16.47	31.99	24.22	8	9	11
Bilbao	8	51	1023432	35	36.11	29.36	51.12	15	1	1
>1.000.000 hab.	53	321	13976427	48	22.86	29.27	32.33			
Málaga	0	15	812749	70	0.00	30.30	0.00	14	24	27
Zaragoza	0	38	777354	86	0.00	14.31	0.00	39	41	41
Palmas de Gran Canaria (Las)	0	13	622198	61	0.00	38.75	0.00	3	18	22
Murcia	0	5	560346	77	0.00	23.16	0.00	31	34	34
Granada	5	51	559753	42	14.75	42.91	25.84	2	2	9
Palma de Mallorca	1	17	558422	71	5.80	23.19	7.55	30	26	20
Santa Cruz de Tenerife	1	10	498524	45	29.76	25.71	40.06	25	4	2
Alicante	4	3	461343	72	26.17	1.93	26.68	51	28	8
Valladolid	0	38	437028	73	0.00	27.13	0.00	21	30	31
Coruña (A)	1	9	413890	59	32.94	7.82	35.74	49	17	5
Oviedo	1	15	413022	53	12.16	34.42	18.54	6	11	15
Pamplona	3	34	349660	56	14.63	28.95	20.59	18	12	14
Castellón de la Plana	2	11	345865	51	21.55	27.01	29.52	22	7	6
Córdoba	0	6	343872	95	0.00	5.36	0.00	50	51	51
Donostia	1	10	322723	57	11.93	30.98	17.28	11	14	17
Santander	2	18	313872	58	15.34	26.58	20.89	23	15	13
1.000.000>hab.>300.000	21	293	7790621	65	10.05	24.70	13.35			
Vitoria	0	24	263210	88	0.00	11.68	0.00	41	43	43
León	1	30	238322	57	12.68	30.62	18.28	12	13	16
Almería	0	12	226179	83	0.00	17.09	0.00	35	38	38
Salamanca	1	39	226153	69	6.33	24.81	8.42	26	22	19
Huelva	0	7	220415	67	0.00	32.84	0.00	7	21	25
Burgos	0	27	201698	88	0.00	11.81	0.00	40	42	42
Logroño	0	16	189361	79	0.00	20.75	0.00	33	36	36
Albacete	0	12	188283	89	0.00	11.35	0.00	42	44	44
Lleida	0	24	186092	71	0.00	29.21	0.00	16	25	28
Tarragona	1	9	185624	74	10.80	15.11	12.72	37	31	18
Ourense	0	23	173899	62	0.00	38.44	0.00	4	19	23
Cádiz	0	1	166848	76	0.00	23.76	0.00	29	33	33
Badajoz	0	6	163472	90	0.00	10.18	0.00	44	46	46
Girona	1	19	162174	58	17.74	24.00	23.34	28	16	12
Pontevedra	1	8	154553	52	16.74	31.01	24.26	10	10	10
Jaén	0	4	128812	90	0.00	9.62	0.00	45	47	47
Toledo	0	12	126389	64	0.00	36.06	0.00	5	20	24
Lugo	0	7	120331	79	0.00	20.71	0.00	34	37	37
Guadalajara	0	9	117766	69	0.00	31.03	0.00	9	23	26
Cáceres	0	12	117694	78	0.00	21.67	0.00	32	35	35
Palencia	0	16	109805	75	0.00	24.75	0.00	27	32	32
Ciudad Real	0	9	100914	72	0.00	28.45	0.00	19	27	29
Eivissa	0	2	98503	48	0.00	52.45	0.00	1	6	21
Segovia	0	11	78845	72	0.00	27.89	0.00	20	29	30
Zamora	0	11	78370	85	0.00	14.93	0.00	38	40	40
Ávila	0	8	61866	91	0.00	9.25	0.00	46	48	48
Huesca	0	10	61616	83	0.00	17.04	0.00	36	39	39
Cuenca	0	7	59824	91	0.00	8.73	0.00	48	50	50
Soria	0	6	43704	89	0.00	10.58	0.00	43	45	45
Teruel	0	2	38518	91	0.00	9.04	0.00	47	49	49
<300.000 hab.	5	383	4289240	75	2.78	22.46	3.58			

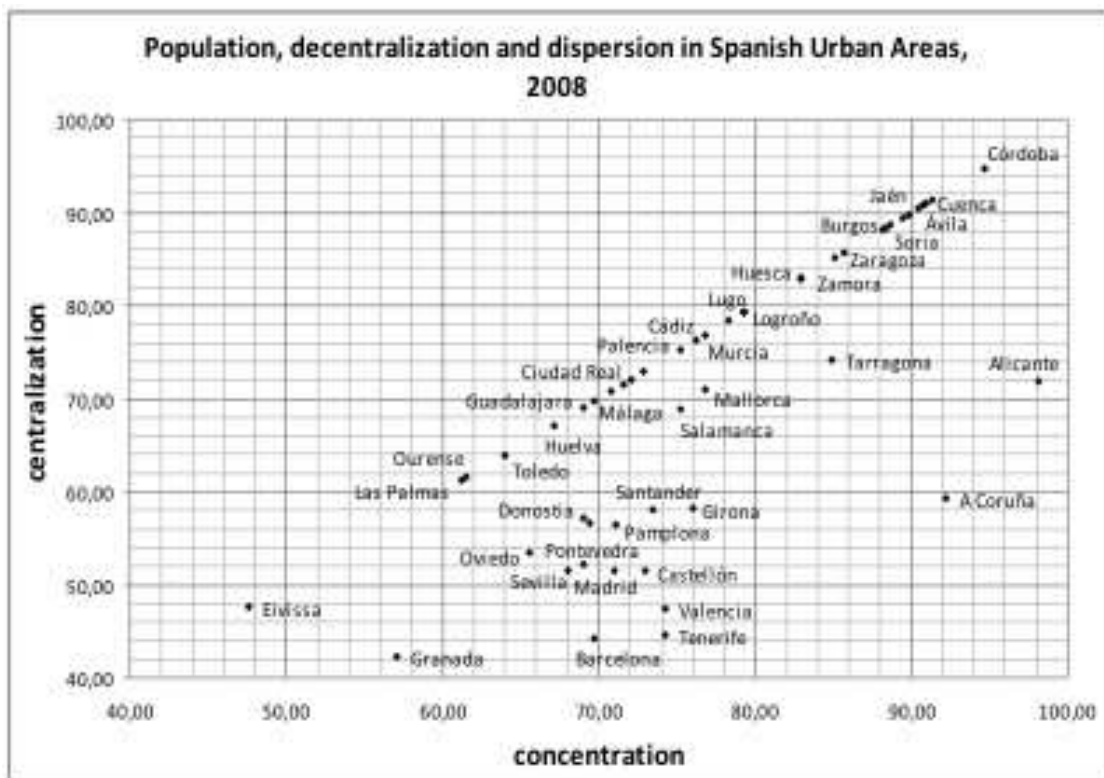


Figure 3: *Urban spatial structure of UAs, centralization and concentration, 2008*

References

- Anas, A., Arnott, R., and Small, K. (1998). Urban spatial structure. *Journal of Economic Literature*, 36(3):1426–1464.
- Black, D. and Henderson, V. (1999). Spatial evolution of population and industry in the United States. *American Economic Review*, 89(2):321–327.
- Capello, R. and Camagni, R. (2000). Beyond optimal city size: an evaluation of alternative urban growth patterns. *Urban Studies*, 37(9):1479.
- Cervero, R. (2001). Efficient urbanisation: Economic performance and the shape of the metropolis. *Urban Studies*, 38(10):1651.
- Cutsinger, J., Galster, G., Wolman, H., Hanson, R., and Towns, D. (2005). Verifying the multi-dimensional nature of metropolitan land use: Advancing the understanding and measurement of sprawl. *Journal of Urban Affairs*, 27(3):235–259.
- Duranton, G. and Puga, D. (2001). Nursery cities: urban diversity, process innovation, and the life cycle of products. *The American Economic Review*, 91(5):1454–1477.
- Eaton, J. and Eckstein, Z. (1997). Cities and growth: Theory and evidence from France and Japan. *Regional Science and Urban Economics*, 27(4-5):443–474.
- Fujita, M. (1989). *Urban Economic Theory: Land Use and City Size*. Cambridge University Press, Cambridge.
- Fujita, M., Thisse, J.-F., and Zenou, Y. (1997). On the endogenous formation of secondary employment centers in a city. *Journal of Urban Economics*, 41(3):337–357.
- Gabaix, X. (1999). Zipf's Law For Cities: An Explanation. *Quarterly Journal of Economics*, 114(3):739–767.
- Galster, G. (2001). On the nature of neighbourhood. *Urban studies*, 38(12):2111–2124.
- Garcia-López, M. À. and Muñiz, I. (2010). Employment decentralisation: Polycentricity or scatteration? the case of Barcelona. *Urban Studies*, 47(14):3035.

- Gerking, S. (1993). Measuring productivity growth in US regions: a survey. *International Regional Science Review*, 16(1-2):155.
- Gordon, P., Richardson, H., and Wong, H. (1986). The distribution of population and employment in a polycentric city: the case of Los Angeles. *Environment and Planning A*, 18(2):161–173.
- Graham, S. and Marvin, S. (1996). *Telecommunications and the City: Electronic Spaces, Urban Places*. Routledge, London.
- Le Gallo, J. and Chasco, C. (2008). Spatial analysis of urban growth in Spain, 1900–2001. *Empirical Economics*, 34(1):59–80.
- Lee, B. (2007). “Edge” or “edgeless” cities? Urban spatial structure in US metropolitan areas, 1980 to 2000. *Journal of Regional Science*, 47(3):479–515.
- Moomaw, R. L. (1983). Spatial productivity variations in manufacturing: a critical survey of cross-sectional analyses. *International Regional Science Review*, 8(1):1.
- Nitsch, V. (2005). Zipf zipped. *Journal of Urban Economics*, 57(1):86–100.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5):1002.
- Sasaki, K. and Mun, S.-I. (1996). A dynamic analysis of multiple-center formation in a city. *Journal of Urban Economics*, 40(3):257–278.
- Small, K. A. and Song, S. (1994). Population and employment densities: structure and change. *Journal of Urban Economics*, 36(3):292–313.
- Veneri, P. (2010). Urban polycentricity and the costs of commuting: evidence from Italian metropolitan areas. *Growth and Change*, 41(3):403–429.
- Wheaton, W. C. (2004). Commuting, congestion, and employment dispersal in cities with mixed land use. *Journal of Urban Economics*, 55(3):417–438.