

Contrasting structures of metropolitan mobility in Spain

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Abstract

This paper draws upon results emanating from an INTERREG IIC European Union project, examining the territorial and functional characteristics of the Spanish metropolitan urban regions, in the context of the nature of the overall urban system of South-western Europe. Part of the study included research concerning the *structure of mobility and its territorial paradigm* in the Spanish metropolitan urban regions. The metropolitan urban regions under investigation were Barcelona, Madrid, Málaga, Seville, Valencia y Bilbao. Data of mobility for employment related purposes alone, between municipalities, was used, owing to the absence of homogenous mobility data sources for other purposes. The results indicate two clearly contrasting patterns of spatial organisation within the metropolitan urban regions. In the cases of Madrid, Valencia, Seville and Málaga, one can observe clearly *monocentric models* of development and mobility. Here the vast majority of the flows between place of residence and place of work gravitate to the centre of the metropolitan urban region and which are characterised by extensive radial distances. However in the metropolitan urban regions of Barcelona and to a lesser extent Bilbao, demonstrate more *decentralised models* of mobility, with the presence of sub-centres and a greater internal complexity, with shorter distances travelled and, as a consequence, areas which are potentially more sustainable.

1 Introduction

From a theoretical standpoint, a model of metropolitan decentralisation, seen as one organised through a grouping of primary areas, which contain a network of smaller sub-centres, or urban sub-systems, offers the possibility of achieving considerable savings of time and energy in questions of metropolitan mobility. What this research indicates is that of the Spanish metropolitan urban regions

forming part of this study, in practice the case of Barcelona is the one with the closest fit to this model of metropolitan decentralisation.

2 Methodology and theoretical background

The main objective of this analysis is in the context of a study of the territorial and functional characterisation of the Spanish metropolitan areas, and its integration within the south-west European urban system. Seven Spanish metropolitan areas (Barcelona, Madrid, Malaga, Seville, Valencia, Bilbao and Zaragoza) are considered, in order to seek to explain the nature of the urban mobility of each case.

Three kinds of clearly differentiated territorial spaces can be identified: economic agglomerations, morphologic agglomerations and finally spaces responding to the delimitation of functional urban regions. See for example the works of Hall and Hay[2] and Cheshire et al.[1].

However in light of the absence of an agreed methodology for the delimitation of metropolitan regions, this study has adapted the methodology used by the United States Census Bureau for the identification of the Spanish metropolitan areas, based upon travel to work journeys. The results differ considerably from other methodologies based upon morphological (NUREC [3]) and functional (GEMACA [4]) criteria.

The analysis of flows of journeys between place of residence and place of work enables the achievement of a clear understanding of the nature of the mobility patterns in the respective metropolitan regions.

3 Metropolitan delimitation

The methodology used to delimit these metropolitan areas involved an adaptation of the method used by the United States Bureau of Census (Office of Management and Budget [5]), based upon flows between place of residence and place of work at the municipality level of analysis. The delimiting process began by determining those municipalities from which at least 15% of the resident population's journeys to work were to the central city. This group of municipalities was treated as one area, to which outlying municipalities were added in a similar way as a second iteration, where the same 15% journey to work flow applied, repeating the process up to a fourth iteration.

The delimitation system adopted is that used in the states of New England because of its similarity with the Spanish (and Continental European) morphological structure and administrative institutions. In the study the agglomerations considered are Barcelona, Madrid, Malaga, Seville, Valencia, and Bilbao. Zaragoza was not considered owing to the non-availability of statistical information concerning mobility beyond the central municipality.

Following the North American system of metropolitan delimitation, some differentiated ambits have been identified: the Primary Metropolitan Areas (PMA) and the Consolidated Metropolitan Areas (CMA) linked between them to generate the CMA in the case of Barcelona.

The procedure to delimit the PMA consists in finding the CMA with the criteria described above and then in finding the PMA that exist therein, where these ambits have a minimum population of 75,000 inhabitants.

In the delimitation of the North American metropolitan areas there are two main elements that must be considered. The existence of an urban continuity clearly defined by the urbanised areas, and the functional and physical dependencies among the cities and towns originated by the daily commuting for job proposes determined historically.

4 The Spanish metropolitan areas

The approach to delimit the Spanish metropolitan areas MAs (see Table 1), is similar to that used in New England, based principally upon 1990 Census data and the following criteria:

- 1) Centre identification: a municipality with at least 50,000 inhabitants. Where there are employees that live in other municipalities, but commute to this centre for work purposes (in a proportion greater than 15% of the active population of those bordering municipalities).
- 2) Ring delimitation (three rings as maximum): Delimited by municipalities that send the proportion of commuters described above to the precedent central municipality of ring.
- 3) The group of the municipalities that constitutes the metropolitan area, has to have as least 75,000 inhabitants. (In the study the MAs with more than 500.000 inhabitants.)

4.1 Primary and Consolidated Metropolitan Areas

The methodology used differentiates the ordinary metropolitan areas (formed around a main central nucleus) from the consolidated metropolitan areas (formed by the linkage among the primary metropolitan areas). The difference between the former and the latter is that the latter incorporates a group of Primary Metropolitan Areas.

Table 1: Principal characteristics of the Spanish metropolitan areas

Metropolitan Area	Number of municipalities	Population (1998)	Area (km ²)	Workplaces
Barcelona	217	4,348,272	4,592	1,560,393
Madrid	163	5,010,747	7,392	1,598,427
Málaga	26	715,252	1,654	167,385
Seville	56	1,346,413	6,672	322,852
Valencia	86	1,467,941	2,831	451,623
Bilbao	77	1,034,521	1,780	326,501
Zaragoza	25	625,593	2,548	

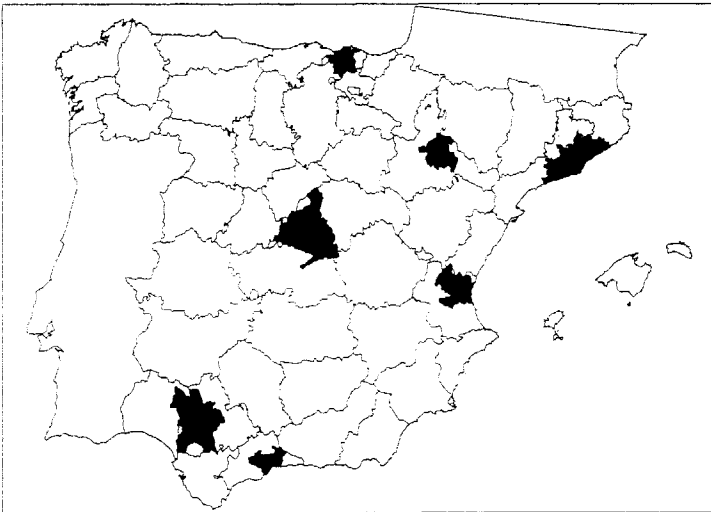


Figure 1: The Spanish metropolitan areas

A PMA is considered as an urban system that has an ordinary metropolitan area, but has an important link (>15%) with the remainder of the Consolidated Metropolitan Area (CMA). The condition to consider a PMA implies that its centre must be independent from the Consolidated Metropolitan Centre (>15%), and has to have a self-contention (>50%). An urban system is considered “consolidated” when there is an important complexity and de-centralisation, meaning reduced mobility dependent upon the main central municipality.

Of the 7 Spanish Metropolitan Areas, only Barcelona (see Figure 2) can be considered as a Consolidated Metropolitan Area (AMC) formed by six PMA (Sabadell, Terrassa, Granollers, Mataró, Vilanova, as well as Barcelona itself). The analysis shows Barcelona as the most de-centralised area.

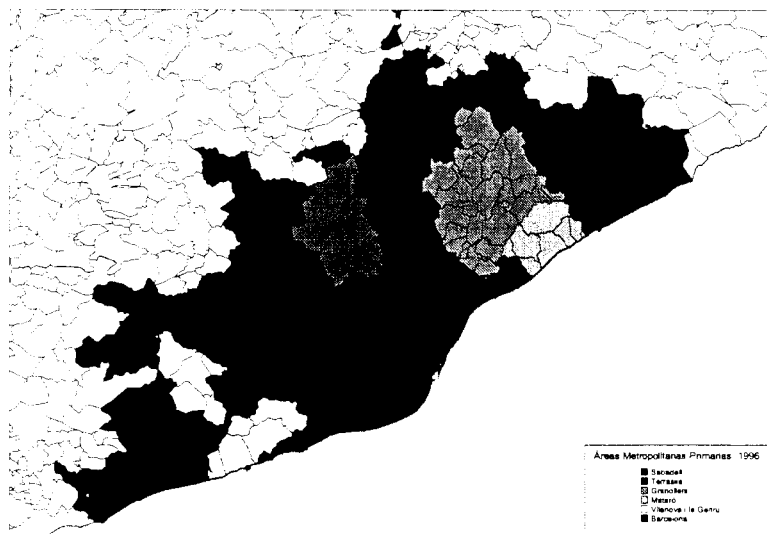


Figure 2: Consolidated Metropolitan Area of Barcelona

4.2 Outcommuting from the metropolitan municipalities

The dynamic of the inter municipal commuting shows a significant image of the labour market's outcommuting, in other words the employees that are *obliged* to commute to another municipality for job purposes.

The main results of the analysis of the labour market are described below (see Table 2):

a) Among all the metropolitan areas, Madrid shows the greatest degree of outcommuting (65%), followed by Barcelona (61%), Bilbao (58%), Seville (56%), Valencia and Malaga (50%).

b) Considering the number of employees that work in a municipality different to that of their residence, it is found that Barcelona (44%) and Bilbao (43%) have the highest values, followed by Madrid (39%), Valencia (32%), Seville (21%) and Malaga (9%).

c) With regard to the outcommuting from the metropolitan cores, Bilbao shows a figure of 25% and Barcelona 21% (the highest), followed by Valencia 18% and Madrid 15% (in the medium range), and Seville and Malaga 12% (with lowest outcommuting).

The maps of the Metropolitan Area (see Figure 3) shows, except for Barcelona, a clear concentration of the most open municipalities around the centres, as well as, a tendency of open reduction as the municipalities apart from the centres.

Table 2:

Metropolitan Area (MA)	Average outcommuting for the MA	Total outflow	Total outcommuting for the MA	Outcommuting from core municipality
Barcelona	0.61	674,757	0.44	0.21
Madrid	0.65	621,012	0.39	0.15
Málaga	0.5	13,852	0.09	0.12
Seville	0.56	66,125	0.21	0.12
Valencia	0.5	139,475	0.32	0.18
Bilbao	0.58	137,130	0.43	0.25

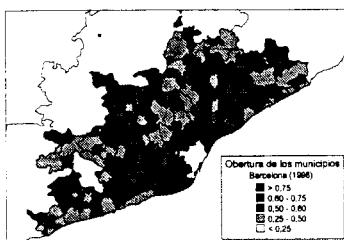


Figure 3a: Barcelona

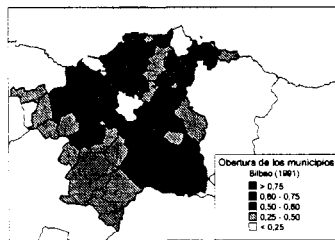


Figure 3b: Bilbao

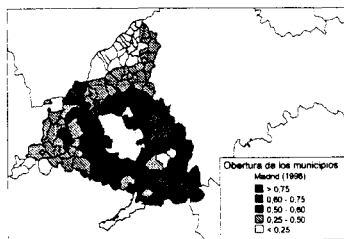


Figure 3c: Madrid

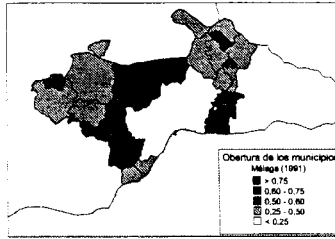


Figure 3d: Málaga

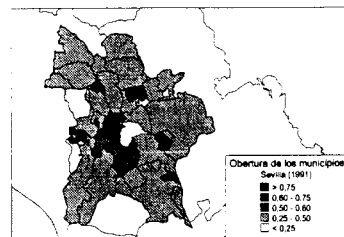


Figure 3e: Seville

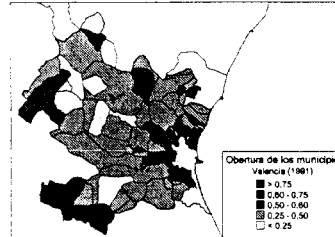


Figure 3f: Valencia

Figures 3a - 3f: Outcommuting within the Spanish metropolitan areas

The metropolitan areas like Barcelona and Bilbao with high outcommuting have a complex metropolitan structure, meanwhile the other metropolitan areas have a much less complex organisational structure, besides administrative facts such as the size of the core capital.

- a) The metropolitan areas with high outcommuting are characterised by having cores with the smallest relative weight. For example the core municipality of Barcelona accounts for only 35% of the total population of its metropolitan area and Bilbao represents only 24%. On the other hand the core municipalities of Valencia, Seville, Madrid and Malaga have 50%, 52%, 58% and 74% of the respective metropolitan population.
- b) The administrative size of the municipality also affects the degree of outcommuting. Barcelona with 98km² is smaller than Madrid with 605km², and Bilbao with 41 km² is smaller than Malaga with 394 km², Seville with 141 km² and Valencia with 134 km². So the spatial extent of the core municipality clearly affects the labour market's outcommuting.

4.3 The Sub Centres of the Metropolitan Areas

Beyond the distinctions between MA and CMA, and the degree of outcommuting, the structure of the metropolitan sub-centres shows the differences of the mobility for job purposes.

Here sub-centres are understood as those municipalities, other than the metropolitan core, with over 10.000 inhabitants that attract as least 15% of the workers from other municipalities.

Barcelona stands out from the other areas with 13 sub centres, followed by Madrid with 11, Bilbao with 4, Valencia and Malaga with 1, and Seville where the metropolitan core is at the same time the sub-centre.

The de-centralised structure of Barcelona compared with the rest of the metropolitan areas, stands out not only for the number of sub-centres, but by the level of autonomy of the sub-centres relative to the metropolitan core. Of the 13 sub-centres found in that metropolitan area only two (Mollet and Badalona) have flows >15% to the metropolitan core. On the other hand, in the case of Madrid the 11 sub-centres depend upon the core. In the rest of the metropolitan areas only Bilbao (with Mungia and Llodio) and Valencia (with Liria) show a degree of de-centralisation in their metropolitan area structure.

4.4 The radial distance from the core

The average radial distance of all the municipalities of the metropolitan areas measured from their core reveals the geometry of each area.

Despite the difference in the size and population between Madrid and Barcelona's MAs, the radial distance of the latter (34.1 km), due the existence of the coast and the coastal hill ranges, exceeds that of the Spanish capital (30.3 km).

Following these two principal metropolitan areas, one finds Seville with 25.5km, Valencia with 23.9km, Malaga with 20.7 and Bilbao with 14.9 km.

If the distance to the core is weighted by number of flows (excluding the internal journeys to each core municipality) the perception varies significantly: The functional space, considering the central distance, is quite different from the geometric space.

The longest average distance is that registered in the metropolitan area of Madrid (20.5) followed by Malaga (18.9 km) Seville (17.1 km), Barcelona (13.8 km) Valencia (12.6 km) and Bilbao (9.8 km).

This means a reduction of the distance to the centre in a proportion of 60% for Barcelona, 47% for Valencia, 34% for Bilbao, 33% for Seville, 32% for Madrid and only 9% for Malaga.

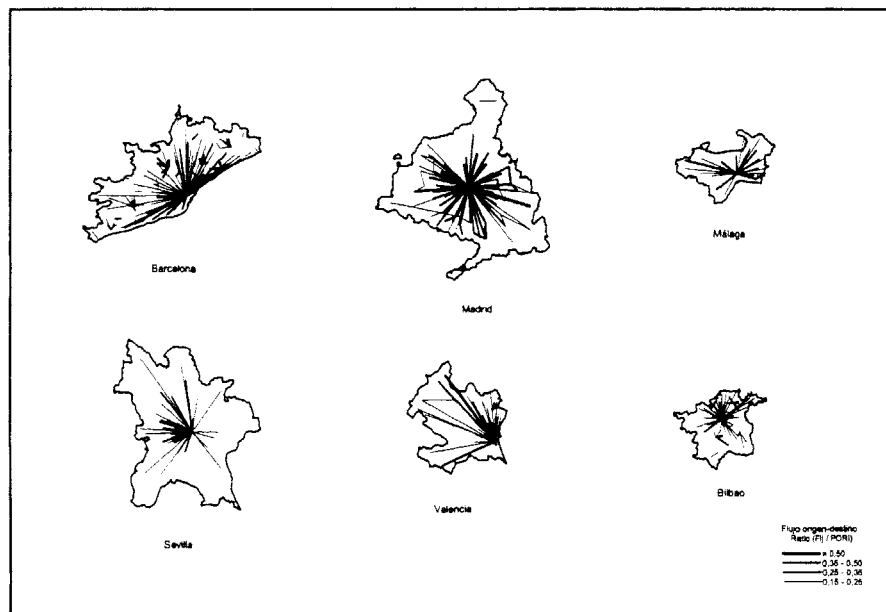


Figure 4: Metropolitan mobility

4.5 Distance to the main destination and total average distance

This reduction of the distance in Barcelona with regard to the rest of metropolitan areas is still shorter if one considers the average distance (considering the number of flows) to the main destination (not necessarily to the centre).

The average distance of Barcelona's Metropolitan Area (11.5 km) is the smallest after Bilbao (9.23 km). Valencia (12.7 km) represents the third metropolitan area with the shortest distance to the main destination.

In contrast, Madrid (19.8 km), Málaga (17.4 km), and Seville (17.0 km) show much higher journey distances to the principal destination.

If the total average distance is considered, i.e. the result of all the employment related journeys, including those within each municipality, the results are as follows:

Madrid is the MA with the greatest journeys (10.6 km) followed by Barcelona (6.7 km), Seville (5), Valencia (4.7), Bilbao (4.4), and Malaga (3.3).

Despite the clearly inferior territorial extension of the urban continuity of Barcelona, relative to Madrid, the Catalan capital shows a pattern of employment related mobility clearly more sustainable than that of Madrid. The same observation can be applied, with certain qualifications, to Bilbao relative to the comparable metropolitan areas of Seville and Valencia.

Table 3: principal indicators of the distance travelled in the work related journeys

Metropolitan areas	Average distance from the core (km)	Average distance weighted by flows (km)		
		to the core	To the principal destination	Total
Barcelona	34.1	13.8	11.5	6.7
Madrid	33	20.5	19.8	10.6
Málaga	20.7	18.9	17.4	3.3
Seville	25.5	17.1	17	5
Valencia	23.9	12.6	12.7	4.7
Bilbao	14.9	9.8	9.2	4.4

5 Conclusions

The Spanish Metropolitan Areas shows two clearly differentiated patterns of spatial organisation:

On the one hand one can identify the monocentric model, strongly hierarchical that is found in the metropolitan areas of Madrid, Valencia, Seville and Malaga. In these areas practically all the flows for job related purposes gravitate towards the centre, determining as general rule, long radial journeys.

On the other hand the more decentralised model: that can be found in Barcelona and to a lesser extent in Bilbao. In this model, the presence of sub-centres implies a strong complexity with shorter travel distances, meaning a potentially more sustainable system.

Barcelona is an exceptional example of metropolitan de-centralisation. Its metropolitan area is the only one of the Spanish cases organised by 'primary areas' PMA: i.e. Sabadell, Terrassa, Mataro, Granollers, Vilanova and Barcelona. Furthermore it is the only one that has a network of minor sub-centres (Sant Celoni, Malgrat, Martorell, Pineda, Vilafranca, and El Vendrel, as well as Badalona and Mollet) that act like cores of their own respective urban subsystems. This structure implies an important saving in metropolitan movement, despite its clearly complex geography.

References

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