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Commuting Times: Is There Any Penalty for Immigrants?

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Abstract

The assimilation of immigrants and their impact on the labour market of the host country have become a growing subject of study in recent literature. This is a topic of particular interest in countries like Spain, where immigration has become one of the main challenges of government policy in recent years. The Madrid region has experienced one of the highest increases in the number of foreign residents between 1996 and 2007. The intensity of this inflow in such a short period of time has led to restrictions on the ability of the residential and labour market to absorb all these newcomers, limiting their choice set of available dwellings and jobs. In this paper the spatial mismatch hypothesis for the Madrid region is tested by exploring the relationship between immigrants' residential location and employment accessibility as measured by commuting times. The findings reveal that immigrants from eastern Europe, Africa, Ecuador and Colombia are significantly more likely to experience higher commuting times when compared with natives. These differences in commuting times can be attributed to different preferences regarding dwelling and employment optimal decisions. However, they could also be seen as symptoms of residential segregation and the difficulties in employment accessibility experienced by immigrant groups.

1. Introduction

One characteristic of the late 20th century and the early 21st century is the increase in the movement of people across international borders. This expansion of international migration has rendered necessary the study of the assimilation of immigrants and their impact on the labour market of the host country. In

the past decade, immigration has become one of the main challenges faced by Spanish society. The number of foreign residents in Spain has increased from 280 000 at the beginning of the 1990s to 4 million people in the year 2007. This dramatic expansion of international migration, together with the increasing

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dispersion of metropolitan employment areas and the concentration of immigrants in certain branches of the economic activity (mainly domestic service, construction, hotels and restaurants), has led to significant differences in terms of commuting behaviour between natives and immigrants.

As in other host European countries, the settlement patterns of immigrants in Spain are largely characterised by spatial clustering. Different studies have convincingly demonstrated how immigrants tend to concentrate geographically in particular parts of the urban and regional system according to their ethnicity or country of origin. Immigrants also tend to be overrepresented in areas of socioeconomic disadvantage (Hohenberg, 2004; Goffette-Nagot, 2000; Borjas, 1993, 1998, 1999; Zavodny, 1999; Preston *et al.*, 1998).

This clustering trend among immigrants has also been related to the process of suburbanisation both in the US and in Europe (White, 1999; Crampton, 1999; Preston *et al.*, 1998; Preston and McLafferty, 1999; Giulano and Small, 1999). In fact, this relation develops in a different manner depending on the urban structures typically observed in the US and Europe. In relation to the US, some authors have suggested the idea of a 'White flight' (Goffette-Nagot, 2000) that links the process of suburbanisation with the characteristics of the centre—namely, a high percentage of African Americans in the urban population, high rates of poverty and high crime rates. Such factors generate disamenities and create an incentive for households to locate in suburban areas. In the case of Europe, some studies point out that population growth in most European urban areas still depends largely on migration (see Hohenberg, 2004). After 1960, the bulk of the new urban dwellers came from abroad rather than from the countryside. Some countries like Britain, France and Germany had a long tradition of foreign immigration, although not to the extent experienced nowadays; other countries

like Spain, Italy and Ireland, traditionally accustomed to send their own people abroad, are now experiencing a dramatic reversal of their migration flows. International migrants not only overwhelmingly choose an urban residence, but they also show a preference for large cities and industrial conurbations. In contrast to the US, however, the suburbanisation process observed in several European metropolitan areas and their more complex urban structures (with a mix of high/low-income areas and a more disperse employment location), leads to more heterogeneous patterns of spatial location for minorities, both in the central business district (CBD) and in the suburbs. Moreover, according to Hohenberg (2004), in many European countries the strong tendency for immigrants to cluster in certain enclaves can also be related to social problems derived from a clash of cultures and employment difficulties.

The creation of these ethnic enclaves or concentrations has clear implications in terms of labour market situation. In particular, the spatial mismatch hypothesis (Kain, 1968) suggests that residents of predominantly minority neighbourhoods, characterised by socioeconomic disadvantages, tend to experience higher unemployment rates, lower wages and longer commutes than those living in 'good' neighbourhoods.

Accordingly, commuting time can be considered a good indicator offering valuable insights to detect spatial mismatch between the labour supply and demand for different sectors and social groups (Crampton, 1999; Chung *et al.*, 2001; Sultana, 2005). This paper attempts to test the spatial mismatch hypothesis in the Madrid region by examining empirically the relationship between immigrants' residential location and employment accessibility as measured by commuting times. Special attention will be given to workers' nationality, since it could be an important variable in determining the choice of initial and subsequent residence locations. The reasons

to focus our analysis in the Madrid region are twofold: first, the significant increase in the migration phenomenon and, secondly, the intense process of suburbanisation experienced throughout the region in recent years.

For the purpose of our study, we have employed the data from the 2001 census elaborated by the National Statistics Institute of Spain (Censo 2001), adopting an econometric approach based on ordered logit models. To the best of our knowledge, this is the first analysis for the Madrid region that focuses on commuting time variation by nationalities using microeconomic techniques and individual data. By means of this new approach, we expect to shed some light on the situation of the main groups of immigrants within the region and to compare it with the results obtained in other countries.

A priori, based on the international literature on the topic, immigrant workers in the Madrid region could experience either lower or higher commuting times in relation to their native counterparts. On the one hand, newcomers tend to concentrate close to other immigrants of the same origin at an early stage in order to take advantage of existing social networks. As a result, their residential location is initially constrained by proximity criteria to co-nationals, until they reach higher levels of social and labour integration. This concentration of immigrants in some urban areas might lead to residential segregation—which increases the likelihood of distant employment for this particular group of workers. This residential segregation can be explained by the fact that

immigrants have often had to limit their dwelling options to precarious ones, for example, sharing house and renting in deteriorated neighbourhoods. In turn, these situations create new difficulties with neighbours, which tend to create a negative climate in public opinion and contribute to hinder their access to other housing options (Ministerio de Trabajo y Asuntos Sociales, 2004, p. 98; authors' translation).

In such a case, we would find that immigrants are more likely to be concentrated in neighbourhoods usually characterised by higher unemployment rates and lower wages. Thus, they might be willing to accept more distant job offers just to gain access to employment and increase their earnings (McCormick, 1986).

Furthermore, this residential concentration would be expected to be especially significant among those immigrant concentrations with greater cultural differences with respect to the native population (including limited proficiency in the host country language). In such case, we could expect immigrants from South and Central America to exhibit a higher degree of social and economic integration and, as a consequence, to show commuting patterns more similar to those of nationals than immigrants of other nationalities. Since most of the studies available in the literature consider English- and French-speaking countries, it would be interesting to test whether Latin-American immigrants might also face problems of integration in a host region with the same mother tongue.

On the other hand, it is important to point out the higher propensity among immigrants to rent or share flats with other immigrants, which could help them to locate near the employment centres. In contrast, the higher preferences and better access to housing market among nationals, implies that they sometimes tend to locate in the suburbs, far away from the employment offered in the central business district (CBD), induced by the greater availability of land and the cheaper prices. In such cases, immigrants could accordingly experience lower commuting times in comparison with nationals. This phenomenon has been widely described in the current literature about the relation between suburbanisation and commuting time (Hohenberg, 2004; White, 1999; Crampton, 1999; Giulano and Small, 1999).

Our study reveals the existence of significant differences in commuting times between

immigrants and natives, thus supporting the spatial mismatch hypothesis for the Madrid region. More particularly, we find that immigrants from eastern Europe and African countries are significantly more likely to experience higher commuting times when compared with natives. Regarding immigrants from South and Central America, the results do not exhibit significant differences in commuting times with respect to natives when considering all nationalities together. However, once we separate the two most representative nationalities (Ecuadorian and Colombian), we find these two groups exhibiting longer commuting times than nationals. The opposite result, however, is observed among immigrants from Asia and Oceania. This finding could be largely attributed both to the tendency of this group to cluster in the city centre and its specialisation in service activities, mostly concentrated in the CBD. In summary, our results suggest that the observed differences in commuting times can be largely attributed to different preferences regarding dwelling and employment optimal decisions. They could also be seen, however, as symptoms of the residential segregation and difficulties in employment accessibility experienced by most immigrants.

The paper is organised as follows. A short review of the current literature on the topic will be provided in section 2. The localisation patterns of individuals and jobs in the Madrid region will be examined in sections 3 and 4, followed by a more detailed discussion of the main determinants of commuting time in section 5. The main conclusions of our study will be presented in section 6.

2. Previous Literature

Commuting is closely related to behavioural patterns in the labour and housing markets, since the commuting journey allows persons to link their workplace spatially to their residential location. Optimality, both in dwelling

and employment location choices, also implies an optimal commuting time.¹ It is for this reason that commuting time is considered a key variable extensively used in the current urban and labour economics literature.

According to the urban economics literature, the bid rent model (Alonso, 1964; Mills, 1967; Muth, 1969) describes the household optimal location by a decreasing and convex curve of bids for rents, where households choose between proximity to employment and housing cost, taking into account their preferences and income levels. This bid rent model has also been employed to explain the preferences of different groups (defined by income, race or family situation) in the presence of multiple CBDs, non-observable living conditions (congestion, pollution, etc.) and differences in the relative cost of commuting depending on income level (McCann, 2001).

According to the labour economics literature, the search models analyse labour and residence decisions simultaneously (van Ommeren *et al.*, 1997, 2000; Rouwendal, 1999). In these models, workers search for the combination of job and residence that maximises their intertemporal utility. Their commuting behaviour is the final product of a combination of labour and residential market features and of an individual decision-making process regarding the acceptance or rejection of a job offer. Commuting time can, accordingly, be affected by rigidities and imperfections in the housing and/or the labour market, acting in two different ways (see van Ommeren *et al.*, 1997, 2000). On the one hand, they impose higher costs on individuals when they decide to move to another residence or change their job. On the other, they reduce the arrival rate of new dwelling and/or job offers. As a result, the job and/or dwelling decisions and the actual commuting time can be far away from the optimal ones.²

These market imperfections, as suggested by the current literature, can be related to several factors such as individual and family

characteristics, institutional and regulatory frameworks, capital market imperfections and housing tenures. Regarding the influence of individual and family characteristics, McAuley and Nutty (1982) and van Ommeren *et al.* (1999) indicate that residential mobility strongly depends on the particular stage in the individual's life-cycle. In his review of stylised facts about mobility, Dohmen (2005) demonstrates that high-skilled workers migrate more than their low-skilled counterparts. Another further example is provided by van Ommeren *et al.* (1997) who point out that, when both members of a couple are employed, they tend to commute more because it becomes more difficult to adapt their residence to their respective job locations.

The institutional features of housing markets impose restrictions on the ability of individuals to switch freely their residence location and, therefore, affect directly their commuting times. There are a great variety of forms and examples of institutional restrictions that have been extensively collected by the current academic literature. An extreme case of institutional restriction, for instance, is the governmental refugee settlement policy pursued in Sweden during the 1980s that dictated to individuals their residential location (Aslund, 2005). Van Ommeren *et al.* (1999) point out that many properties in the Dutch housing market are owned by housing associations, which allocate them according to an existing waiting-list rather than to the highest bidder. In the case of Spain, municipal authorities used to subsidise housing through regulated prices for specific groups, the only legal requirement being a previous period of residence in the municipalities.

Among others, Pinto (2002) argues that the existence of imperfect capital markets acts as a barrier that prevents some people from changing their residence location because individuals do not only have to consider the cost and benefits from moving, but also the availability of housing finance. As a result, people who cannot

borrow will be constrained in terms of their capability of changing residence location and, therefore, are likely to be subjected to an excessive commuting.

The influence of housing tenure on the propensity to change residence and, indirectly, on the commuting time has also received a great deal of attention in the current literature. Green and Hendershott (2001) suggest that homeownership reduces mobility due to a variety of factors including the lump-sum costs associated with buying, financing and/or selling a house. Van Ommeren *et al.* (1999) point out that differences in moving costs are a decisive factor in explaining the differences between renters and owners in terms of residential mobility. Henley's (1998) work suggests that the high transaction cost for owner-occupiers may deter commuters from seeking a better match between dwelling and job.

When examining the residential and job location and, by extension, commuting times among immigrants, we must also consider other additional issues already addressed in the current academic literature. As indicated by Zavodny (1999) and Bartel (1989), the most important factor determining the location choices of newly arrived immigrants is the presence of other already established immigrants. This clustering behaviour may be indicative of the existence of informal ethnic networks for new immigrants that provide them with information about jobs and housing, or may serve as an indicator of the generosity of the local welfare system (see Borjas, 1999).³

According to the spatial mismatch hypothesis, the concentration of poverty and joblessness within predominantly non-national neighbourhoods can be partly explained by the geographical isolation of these neighbourhoods from job locations. If this hypothesis is combined with residential segregation (Massey, 1990) and transport mismatch (Boardman and Field, 2002; Taylor and Ong, 1995), we can accordingly expect to find higher commuting times

among immigrants. To the extent to which immigrants' nationality might determine the choice of initial and subsequent residence locations, this variable will be an individual characteristic of key importance in explaining commuting times.⁴

Limited proficiency in the host country language and lack of qualifications and skills can also create important barriers to labour market success for some immigrant minorities, reducing the arrival rate of job offers and limiting their ability to get a suitable combination of dwelling and job.

Economic factors, particularly income and occupation, are also important determinants in terms of commuting times. In theory, well-paid workers in high-status professional and managerial occupations are expected to commute longer distances than workers in secondary occupations that are less secure and poorly paid. If there are labour market imperfections, however, workers might not necessarily be fully compensated for increased commuting costs (van Ommeren *et al.*, 1997).

Finally, commuting time can also be influenced by access to transport. When individuals have limited access to faster transport modes,⁵ their commuting times would tend to be significantly higher (see Preston *et al.*, 1998; Preston and McLafferty, 1999).

In conclusion, based on the literature, we might expect that immigrants from specific origins may show higher commuting times than nationals due to a wide range of factors that affect their optimal location and employment decisions. The most important seem to be their tendency to cluster in space and concentrate in low-skilled jobs, the presence of housing restrictions and a lower access to private transport. Although some of these factors also affect national workers with low income levels, some others are specifically affecting the newcomers, at least during their first years in the host country.

3. Spatial Structure of the Madrid Region

The Madrid region concentrates more than 13.5 per cent of the national population and generates 17 per cent of Spain's output. According to the latest OECD territorial report (OECD, 2007), the Madrid region has experienced one of the highest rates of increase in population and economic growth within Europe and among OECD metropolitan areas. Between the years 2000 and 2005, the GDP of the Madrid region registered an average annual growth rate of 3.5 per cent, above the Spanish average (3.3 per cent) and twice the average of the European Union for the same period. This economic boom has made the Madrid region a focus of attraction for both national and international workers. From a sectoral point of view, the Madrid region is predominantly specialised in the service sector and in industrial activities with high value added. Despite its demographic and economic importance, the total surface area of the Madrid region is relatively small (7992 square km), resulting in a high level of spatial concentration of population, infrastructure and economic activity.

Leaving aside the remarkable importance of Inner Madrid during the past 50 years—coherent with an historical monocentric urban structure—the development of the Madrid metropolitan region has been built upon the interdependence between the central city and the outskirts, generating a series of metropolitan rings.⁶ The Madrid metropolitan area (Inner Madrid + rings) currently represents 92.2 per cent of total GDP of the region.⁷ As in other major metropolitan areas in the developed world (Hohenberg, 2004; Cavaillès *et al.*, 2004; Goffette-Nagot, 2000; White, 1999; Cervero and Wu, 1997, 1998), the process of suburbanisation has been driven by several forces like, for instance, the greater availability of land in the ring belt than in

the core, the deconcentration of economic activity, the cheaper housing in the periphery and the development of a modern network of infrastructure that facilitates commuting by public and private transport (OECD, 2007; Gutiérrez and García-Palomares, 2005; Gutiérrez and Gómez, 1999; Llano, 2006; Cuadrado, Roura and Sierra, 2000; Rubalcaba, 1998; Suarez-Villa and Rama, 1996).

For the past few years, the Madrid region has become one of the largest recipients of immigrants, accounting for 19 per cent of all immigrants arriving in Spain. Between 1998 and 2007, the foreign population living in the Madrid region increased by 653 per cent. As reported in Table 1, based on the 2001 census, the main origins of immigrants living in Madrid are South America (47.53 per

cent), Africa (16.27 per cent) and European countries not in the EU15 (11.78 per cent). In numerical terms, the largest number of immigrants is found in the Madrid municipality (63.9 per cent), representing 13 per cent of the total population.

As can be observed, the location patterns of nationals and immigrants are, in general, relatively similar. The only remarkable difference is the slight preference among foreigners for Inner Madrid (63.9 per cent compared with 54.4 per cent for Spanish). More significant differences, however, are revealed when the data are analysed in terms of immigrants' area of origin. Thus, immigrants from South and Central America and Asia show a clear preference for Inner Madrid, with 76.4 per cent, 69.3 per cent and 75.4 per cent of these groups

Table 1. Spatial distribution of population in the Madrid region, by groups of origin (percentages)

	<i>Total</i>	<i>Natives</i>	<i>Non-nationals</i>						
			<i>Other European countries</i>	<i>Africa</i>	<i>Central America</i>	<i>South America</i>			<i>Asia</i>
						<i>Total</i>	<i>Colombia</i>	<i>Ecuador</i>	
Inner Madrid	55.0	54.4	40.7	41.8	69.3	76.4	66.2	86.3	75.4
Nord metropolitan crown	4.2	4.2	2.0	3.2	4.5	3.3	3.1	3.1	3.3
East metropolitan crown	8.3	8.4	25.5	7.3	5.9	3.4	5.9	1.4	4.0
Sud metropolitan crown	17.8	18.2	14.8	25.5	9.0	7.1	10.9	3.7	8.9
West metropolitan crown	4.5	4.5	2.4	4.8	5.8	4.0	5.7	1.8	4.4
Non-metropolitan area	10.2	10.3	14.6	17.4	5.5	5.8	8.1	3.8	4.1
Number of inhabitants	5 372 433	5 007 298	43 035	59 289	24 344	173 452	43 920	85 103	21 843

Source: Census 2001.

settling in this area respectively. In contrast, immigrants from eastern Europe (non-EU15) and Africa show a slight preference for the metropolitan Crown and non-metropolitan municipalities. There are very significant concentrations of eastern Europeans (non-EU15) in the East Crown (25.5 per cent of total) and of Africans in the South Crown (25.5 per cent of total).

Making use of location coefficients and global and local spatial autocorrelation analysis, we investigate the highest levels of spatial concentration of immigrants by areas of origin. We follow Pacheco and Tyrrell (2002) and Guillain *et al.* (2006), among others, to corroborate the existence of spatial agglomeration patterns for immigrant groups. We first measure global spatial autocorrelation by means of the Moran's I statistic. This test is applied to the number of immigrants from each group living in a particular municipality, using the following expression

$$I = \frac{n}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (y_i - \mu)(y_j - \mu)}{\sum_j (y_j - \mu)^2} \quad (1)$$

where, w_{ij} are the elements of the spatial weights matrix, W ; μ is the average of the observations of the variable y , which is observed in N geographical areas ($i, j = 1, 2, \dots, N$; being $N = 179$ municipalities).

A positive and significant value of statistical Moran's I (positive spatial autocorrelation) indicates that municipalities with a high (low) number of immigrants of a particular group are surrounded by municipalities with high (low) number of immigrants of the same group. The spatial weights matrix is defined by Queen's contiguity and the inverse distance matrix.

The results of the test Moran I are reported in Table 2, which shows a significant positive spatial correlation for all groups, being particularly high in the case of eastern Europeans (non-EU15) and Africans. Only for these two groups is the spatial concentration above the average level in the region. Moreover, the results obtained for immigrants coming from eastern Europe and Africa are consistent with their higher propensity to cluster in certain ethnic enclaves, largely due to their greater cultural and linguistic differences with respect to Spanish people.

For a more in-depth study of these behavioural patterns, we analyse the local spatial autocorrelation for groups of immigrants coming from eastern Europe (non-EU15) and Africa. Through this analysis, we will be able to identify a number of municipalities with different types of association regarding their level of concentration of these two groups of immigrants: HH refers to municipalities with high values surrounded by municipalities with high values;⁸ HL, to municipalities with high values surrounded by municipalities with low values; LH, to municipalities with low

Table 2. Spatial correlation statistic: Moran's I

	Queen's contiguity	P-value	Inverse distance	P-value
Eastern Europe (non-EU15)	0.1343	(0.002)	0.0588	(0.002)
Africa	0.0947	(0.005)	0.0283	(0.012)
Central America	0.0350	(0.002)	0.0242	(0.001)
South America	0.0183	(0.001)	0.0095	(0.002)
Colombia	0.0418	(0.001)	0.0125	(0.005)
Ecuador	0.0002	(0.041)	0.0063	(0.003)
Asia	0.0245	(0.003)	0.0150	(0.001)
Madrid region, total population	0.0748	(0.001)	0.0272	(0.003)

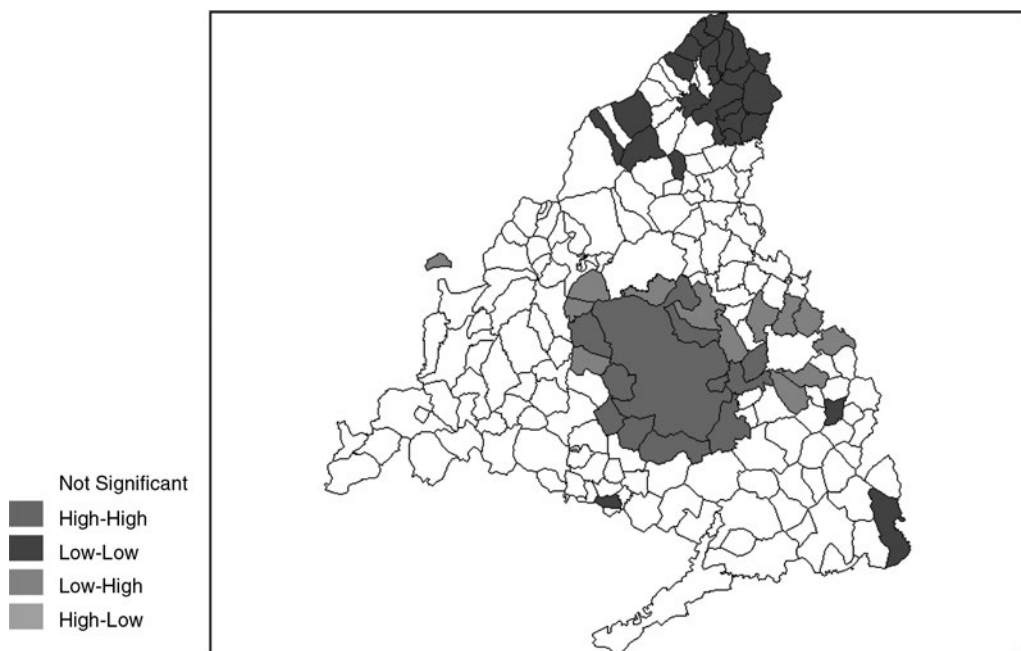


Figure 1. Local spatial autocorrelation: immigrants from eastern Europe (non-EU15).

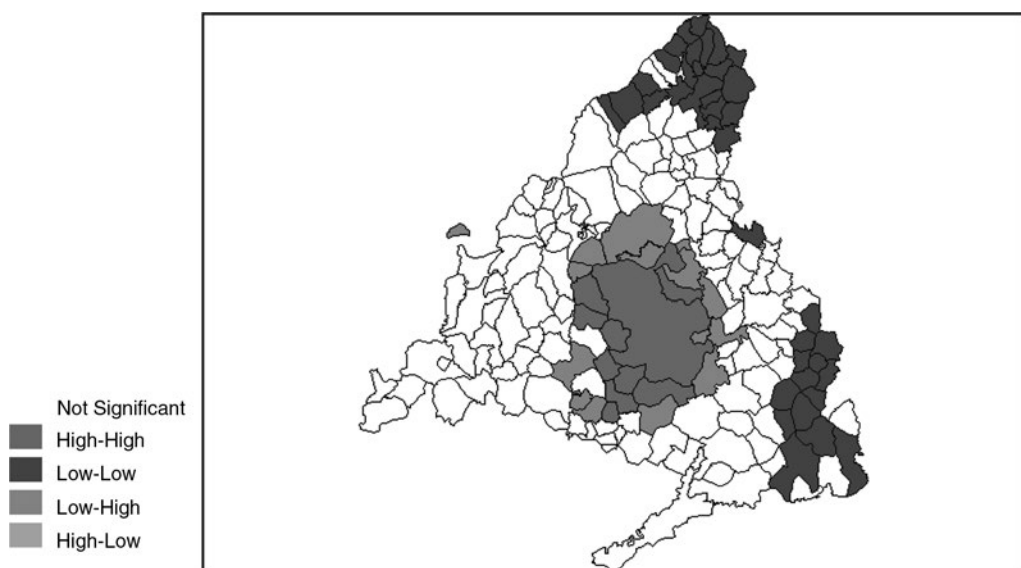


Figure 2. Local spatial autocorrelation: immigrants from Africa.

values surrounded by municipalities with high values; and LL, to municipalities with low values surrounded by municipalities with low values. The results of this analysis are shown in Figures 1–4. Apart from the

general pattern of concentration in the metropolitan area, similar to that exhibited by the whole population, there are specific results worth mentioning. Immigrants from eastern Europe (Figure 1), once

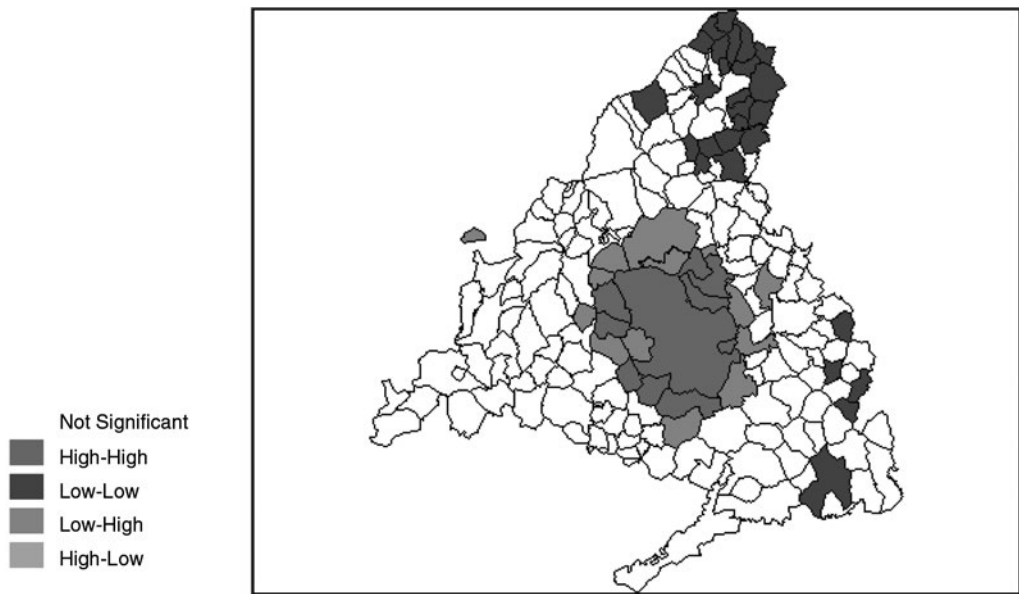


Figure 3. Local spatial autocorrelation: immigrants from Colombia.

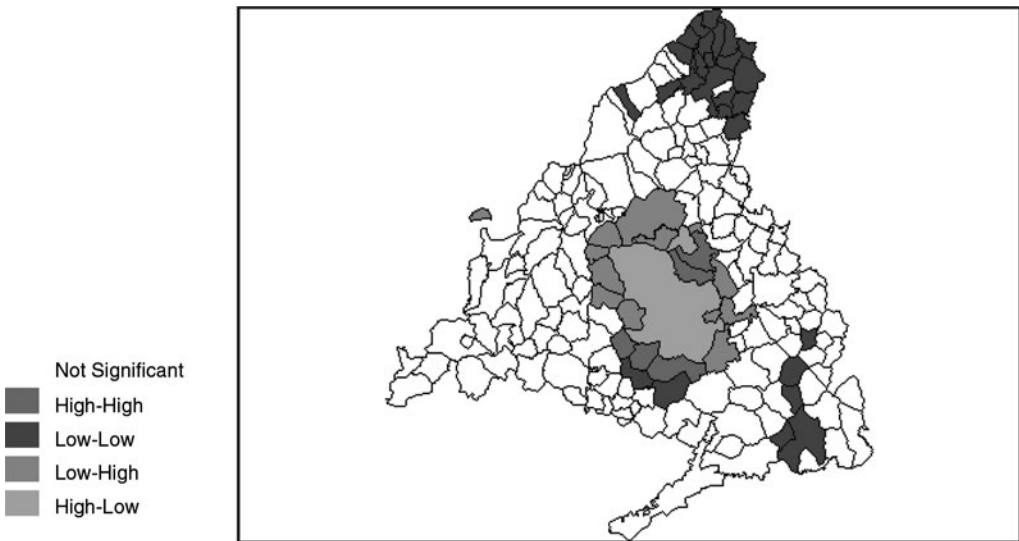


Figure 4. Local spatial autocorrelation: immigrants from Ecuador.

again, appear to cluster predominantly in the municipalities of the East Crown. In this area there are several types HH and LH municipalities. In contrast, immigrants from Africa and Colombia (Figures 2 and 3) tend to concentrate in the South Crown with

municipalities associated with a HH pattern. In the case of immigrants from Ecuador (Figure 4), it can be observed that there is a higher preference for the metropolitan area, with more than 86 per cent of these immigrants concentrated there.

4. Distribution of Employment in the Madrid Region

Apart from differences in residential location between nationals and immigrants, it is also important to examine the spatial distribution of employment and, more particularly, the type of jobs occupied by the different groups of immigrants.

Figure 5 shows the location patterns of employment in the Madrid region by sector of activity. In particular, we distinguish between industry, construction and the following four categories within the service sector: Serv1—wholesale and retail trade, repair of motor vehicles, motorcycles and personal household goods; Serv2—hotels and restaurants; Serv3—transport, storage and communications; financial intermediation; real estate, renting and business activities; public administration and defence, compulsory social security; education; health and social work; Serv4—other community,

social and personal service activities, private households with employed persons, extra-territorial organisations and bodies. As can be observed, the majority of employment is concentrated in Inner Madrid, although there are some differences by sector worth noting. The industry sector, for instance, has the highest dispersion of employment across the Madrid region, with less than 50 per cent of the total employment in this sector concentrated in Inner Madrid. In contrast, employment within the Serv3 category is highly concentrated in Inner Madrid (more than 70 per cent).

Regarding the sectoral distribution of national and immigrant employees, Figure 6 shows a remarkable concentration of immigrants in three sectors: construction; hotels and restaurants; and other community, social and personal service activities, private households with employed persons, extra-territorial organisations and bodies (see also Table 3).

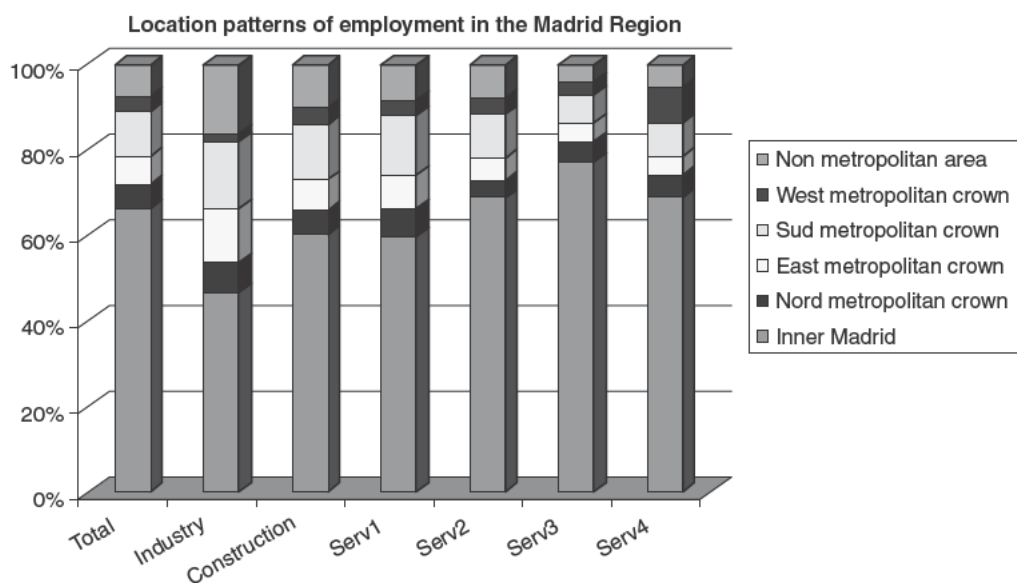


Figure 5. Spatial distribution of employment by sectors in the Madrid region.

Source: Directorio de Unidades de Actividad Económica de la Comunidad de Madrid, 2001.

Table 3. Sectorial Distribution of workers by nationality (percentages)

	Other			South and		Asia and	
	Natives	EU15	European Countries	Africa	USA and Canada	Central America	Rest
Agriculture	0.43	0.83	1.32	2.70	0.00	0.73	0.32
Mining	0.03	0.33	0.00	0.00	0.00	0.02	0.08
Industry	15.29	13.27	8.91	8.34	10.00	6.16	6.35
Construction	7.54	4.48	31.98	33.84	2.86	17.10	14.30
Serv1	10.64	8.96	10.02	9.87	4.29	8.88	8.51
Serv2	4.27	8.96	5.77	12.46	7.14	14.12	13.01
Serv3	58.65	58.21	21.05	18.92	72.86	24.40	30.84
Serv4	3.15	4.98	20.95	13.87	2.86	28.58	26.59

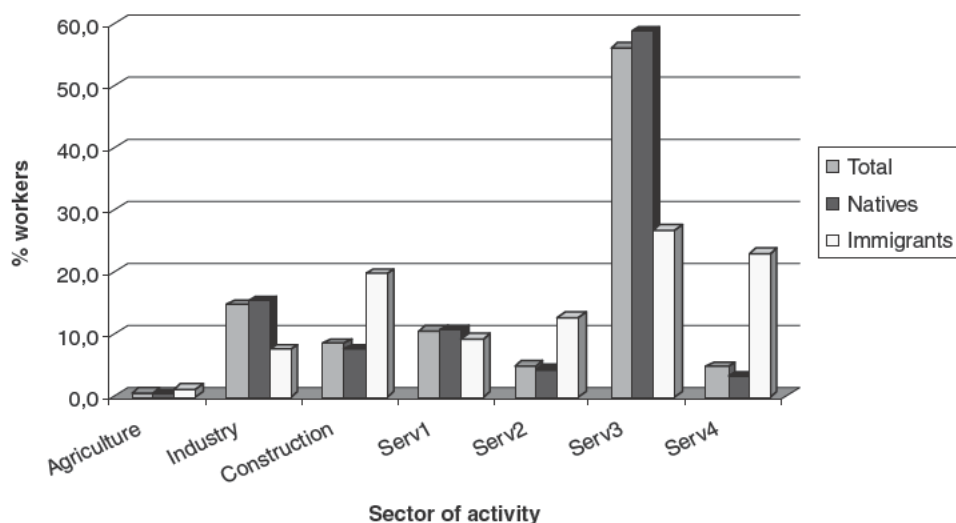


Figure 6. Sectoral distribution of national and immigrant employees in the Madrid metropolitan area.

Source: Census, 2001, microdata sample.

5. Determinants of Commuting Times in the Madrid Region

In this section, we aim to offer a more in-depth analysis of the main factors determining commuting times in the Madrid region, paying particular attention to the effects of nationality. More specifically, we will try to address the question of whether immigrant workers experience higher commuting times than their national counterparts. For this purpose, we use the data available from the 2001 census.

5.1 Data Description: 2001 Census

The census is conducted every 10 years by the National Statistics Institute of Spain (INE). The questionnaire collects both household and personal information that allows us to distinguish between nationals and non-nationals. In relation to non-nationals, the Census also offers information about their nationality. For the purpose of this paper, we have selected a sample of wage and salary workers aged between 16 and 64 years old and living in municipalities with more than 20 000 inhabitants within the Madrid region.⁹

Table 4 describes the main characteristics of the selected sample. The chosen variables, which are later used as explanatory variables to study the determinants of the commuting time, primarily relate to personal, household and job characteristics such as nationality, gender, age, marital status, household type, education, type of contract, housing tenure, transport mode and a set of activity dummies.¹⁰

As can be observed in Figure 7, the majority (almost 60 per cent) of immigrants living in the Madrid region come from Latin American countries. The second most common nationality corresponds to people coming from other European countries (non-EU15) and Africa. The descriptive statistics also reveal important differences between nationals and immigrants in relation to other different aspects.

As shown in Figure 8, renting is significantly more extensive amongst immigrants compared with nationals. More than 70 per cent of immigrants are renters, while the corresponding percentage amongst nationals is less than 10 per cent. This phenomenon can be easily explained by differences both

Table 4. Descriptive statistics (means)

	<i>Total sample</i> (<i>N</i> = 86 120)	<i>Natives</i> (<i>n</i> = 79 038)	<i>Immigrants</i> (<i>n</i> = 7082)
<i>Commuting time (minutes)</i>			
< 10	0.100	0.100	0.098
10–20	0.207	0.211	0.162
20–30	0.218	0.220	0.203
30–45	0.211	0.210	0.212
45–60	0.159	0.156	0.192
60–90	0.091	0.089	0.109
> 90	0.015	0.014	0.023
<i>Nationality</i>			
EU(15)	0.007		0.085
Other European countries	0.011		0.140
Africa	0.010		0.120
USA and Canada	0.001		0.010
South and Central America	0.049		0.598
Asia and Oceania	0.004		0.047
Male	0.638	0.644	0.567
Reference person	0.482	0.492	0.364
<i>Age (years)</i>			
16–24	0.020	0.014	0.091
25–39	0.338	0.315	0.603
40–54	0.446	0.464	0.241
55–64	0.169	0.181	0.029
Married	0.756	0.773	0.568
<i>Household type</i>			
Single without children	0.405	0.395	0.519
Couple without children	0.142	0.136	0.211
Single with children	0.047	0.046	0.063
Couple with children	0.406	0.423	0.207
<i>Education</i>			
Primary or less	0.164	0.160	0.205
Secondary	0.512	0.506	0.582
Tertiary	0.324	0.334	0.213
Temporary contract	0.167	0.140	0.464
<i>Housing tenure</i>			
Owner without mortgage	0.453	0.486	0.082
Owner with mortgage	0.360	0.379	0.149
Renter	0.150	0.096	0.745
Free housing	0.018	0.019	0.013
Other type	0.019	0.020	0.011
<i>Type of transport</i>			
Public	0.454	0.435	0.671
Private	0.432	0.453	0.197
None	0.113	0.111	0.129
Other	0.001	0.001	0.002

Note: activity dummies included in the estimation.

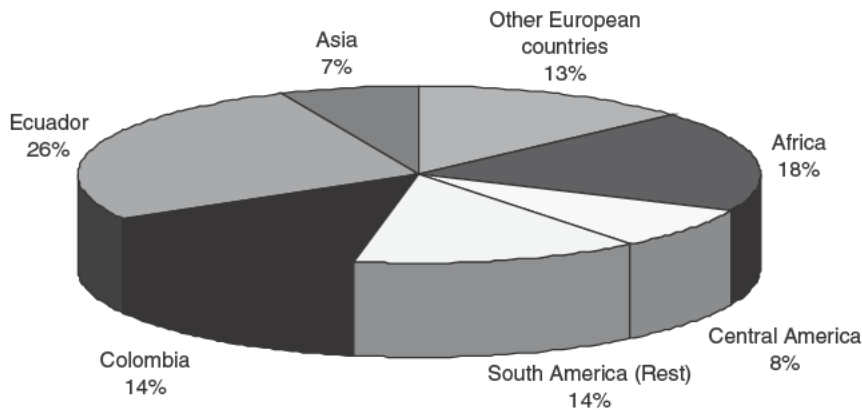


Figure 7. Immigrants in the Madrid metropolitan area by country of origin.
Source: Census, 2001, microdata sample.

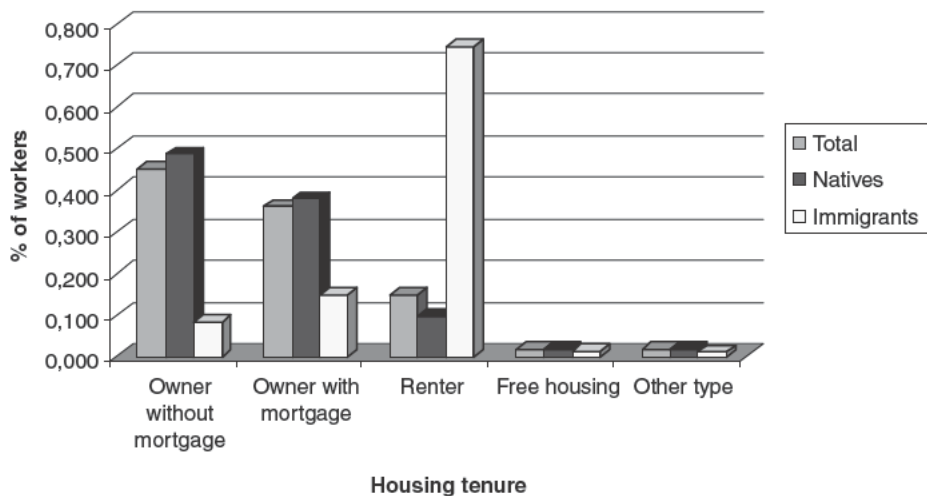


Figure 8. Housing tenure for nationals and immigrants in the Madrid metropolitan area.
Source: Census, 2001, microdata sample.

in terms of personal preferences and access to the housing market. On the one hand, the higher propensity for housing tenure among Spanish households is already well documented when compared with their European counterparts (Barceló, 2001; Antolín and Boyer, 1997). This tendency has been fostered in recent years by several macroeconomic factors such as a high employment rate and advantageous financial conditions. On the other hand, the higher propensity for renting among immigrants has been rein-

forced due to the coincidence of their arrival with one of the largest house-price booms in Europe (IMF, 2006; *The Economist*, 2005).¹¹ Taking into account this increasing trend in housing prices in Spain, and given that the majority of immigrants tend to be occupied in less-skilled jobs with lower wages, it is not surprising to find that renting has become the most common form of housing tenure among immigrants.

Significant differences can also be appreciated in terms of transport mode. As can

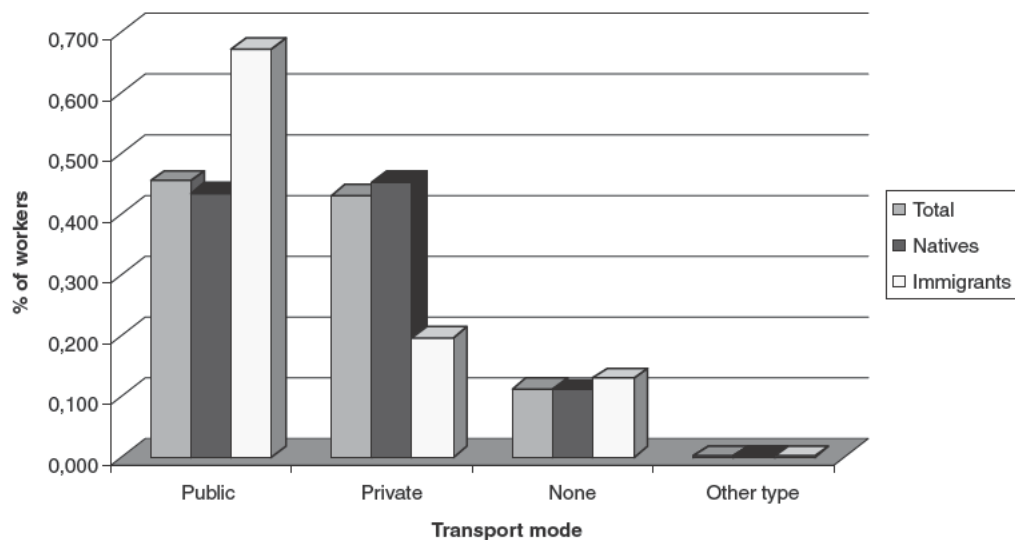


Figure 9. Commuting mode of immigrants and nationals in the Madrid metropolitan area.
Source: Census, 2001, microdata sample.

Table 5. Census 2001: commuting time categories

Categories	Commuting times (minutes)
$j = 1$	<10
$j = 2$	10–20
$j = 3$	21–30
$j = 4$	31–45
$j = 5$	46–60
$j = 6$	61–90
$j = 7$	>90

be observed in Figure 9, most immigrants use public transport to commute to their workplace (almost 70 per cent), whereas no significant differences can be observed in the use of private and public transport amongst nationals. This result can be partly attributed to the fact that immigrant people, in general, do not have access to a private vehicle, for legal (a driving licence provided by the Spanish authorities is compulsory) or economic reasons.

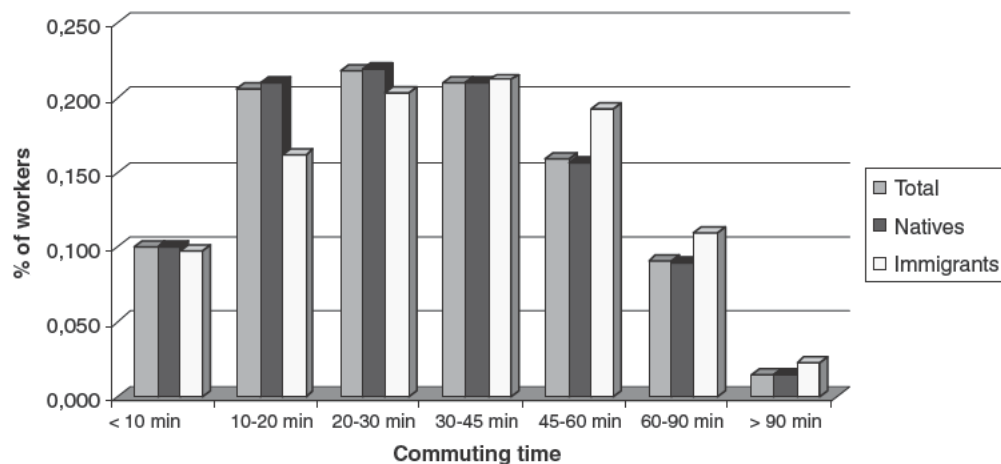


Figure 10. Commuting time of national and immigrant employees in the Madrid metropolitan area.
Source: Census, 2001, microdata sample.

As mentioned in the previous section, the descriptive statistics provided by the 2001 census also reveal the higher tendency among immigrants to concentrate in certain economic activities like, for example, construction, hotels and restaurants, and other community, social and personal service activities, private households with employed persons, extra-territorial organisations and bodies (Figure 6).

Finally, we provide some descriptive evidence on the differences in commuting times between nationals and immigrants in the Madrid region. In our data, information on commuting times is provided by the original data of Census 2001 as an ordered discrete variable with $j = \{1, \dots, 7\}$ categories (as shown in Table 5).

As can be observed in Figure 10, immigrants appear to be more likely to fall into those categories representing longer commuting times.¹² However, these differences in commuting times can be attributed to differences in educational attainments or skill qualifications (Borjas, 1993) that restrict immigrants to certain types of job. Alternatively, it might well be the case that certain types of disadvantage in the housing and labour market commonly encountered by immigrants just translate into longer commuting times (Arnott *et al.*, 1991; Reitz and Breton, 1995).

5.2 Econometric Analysis

In order to account for the main determinants of commuting times, we estimate an ordered logit model. We rely on ordered regressions since the dependent variable, commuting time, is an ordered discrete variable. In particular, we consider the following dependent variable

$$y_{ij} = \begin{cases} 1 & \text{if individual } i \text{ belongs} \\ & \text{to category } j \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

where, $i = 1, \dots, N$; $j = 1, \dots, m$; and where j can be thought a commuting time profile, with the $m = 7$ categories described earlier.

Let y^* be a latent variable which can be modelled as

$$y_i^* = \beta'x_i + \varepsilon_i; \varepsilon_i \sim \text{Logistic}(\theta = 1) \quad (3)$$

that is, y^* can be explained by k explanatory variables contained in x .

Nationality is included as one of these explanatory variables. In particular, we distinguish the six following non-national categories: EU (15); other European countries; Africa; US and Canada; South and Central America; Asia and Oceania. Native-born workers are taken as the reference group. Furthermore, the vector of covariates also contains personal and household characteristics (gender, age, marital status, education, housing tenure), job characteristics (type of contract and sector of activity) and the transport mode.¹³

The logistic distribution with mean 0 has the following probability density function

$$f(x) = \frac{1}{\theta} \frac{\exp(x/\theta)}{(1 + \exp(x/\theta))^2} \quad (4)$$

The individuals are classified into the $m = 7$ commuting intervals by the following rule

$$\begin{aligned} y_{i,1} &= 1 \text{ if } y_i^* \leq \alpha_1 \\ y_{i,j} &= 1 \text{ if } \alpha_{j-1} < y_i^* \leq \alpha_j \text{ for } j = 2, \dots, m-1 \\ y_{i,m} &= 1 \text{ if } \alpha_{m-1} < y_i^* \end{aligned} \quad (5)$$

Combining (2), (3) and (4), we obtain that

$$\begin{aligned} &P(\text{individual } i \text{ belongs to category } j) \\ &= P(y_{ij} = 1) \\ &= P(\alpha_{j-1} < y_i^* \leq \alpha_j) \\ &= P(\alpha_{j-1} < \beta'x_i + \varepsilon_i \leq \alpha_j) \\ &= P(\alpha_{j-1} - \beta'x_i < \varepsilon_i \leq \alpha_j - \beta'x_i) \\ &= F(\alpha_j - \beta'x_i) - F(\alpha_{j-1} - \beta'x_i) \end{aligned} \quad (6)$$

Table 6. Ordered logit for commuting times ($N = 86\,120$)

	<i>Odds ratio</i>	<i>T-value</i>	<i>Odds ratio</i>	<i>T-value</i>
<i>Nationality</i>				
EU(15)	0.941	−0.82	0.942	−0.81
Other European countries	1.671	8.33	1.676	8.38
Africa	1.175	2.43	1.178	2.48
USA and Canada	1.043	0.2	1.043	0.20
<i>South and Central America</i>				
Ecuador (48.77 per cent)	1.060	1.73	1.119	2.53
Colombia (21.82 per cent)			1.127	1.93
Rest (29.41 per cent)			0.935	−1.25
Asia and Oceania	0.809	−2.12	0.811	−2.09
Male	1.028	1.93	1.028	1.92
Reference person	1.093	6.22	1.094	6.28
<i>Age (years)</i>				
16–24				
25–39	1.080	2.51	1.082	2.57
40–54	1.088	2.73	1.091	2.83
55–64	1.188	5.09	1.192	5.19
Married	1.016	0.88	1.014	0.80
<i>Household type</i>				
Single without children				
Couple without children	1.112	5.07	1.113	5.12
Single with children	0.980	−0.63	0.980	−0.64
Couple with children	1.003	0.17	1.003	0.18
<i>Education</i>				
Primary or less				
Secondary	0.985	−0.82	0.985	−0.79
Tertiary	1.052	2.32	1.053	2.38
Temporary contract	1.115	6.06	1.114	6.00
<i>Housing tenure</i>				
Owner without mortgage				
Owner with mortgage	1.006	0.4	1.007	0.44
Renter	0.906	−4.5	0.904	−4.60
Free housing	0.785	−5.14	0.785	−5.13
Other	0.932	−1.54	0.933	−1.53
<i>Type of transport</i>				
Public				
Private	0.240	−98.5	0.240	−98.49
None	0.020	−155.9	0.020	−155.88
Other type	0.122	−12.46	0.122	−12.46
Log likelihood	−137 104		−137 099	

Note: a set of activity and municipal dummy variables has been included in the estimation.

where, F denotes the cumulative density function of the logistic distribution.

The parameters of the model can be estimated using maximum likelihood technique. The likelihood function has the following expression:

$$\begin{aligned} L(\alpha, \beta) &= \prod_{i,j} P(y_{ij} = 1) \\ &= \prod_{i=1}^n \prod_{j=1}^m P(y_{ij} = 1)^{y_{ij}} \\ &= \prod_{i=1}^n \prod_{j=1}^m [F(\alpha_j - \beta' x_i) \\ &\quad - F(\alpha_{j-1} - \beta' x_i)]^{y_{ij}} \end{aligned} \quad (7)$$

so that, the log-likelihood function is given by

$$\begin{aligned} \ln L &= \sum_i \sum_j y_{ij} \ln [F(\alpha_j - \beta' x_i) \\ &\quad - F(\alpha_{j-1} - \beta' x_i)] \end{aligned} \quad (8)$$

Table 6 presents the estimation results of the ordered logit model. For a better understanding of the results, we present them in terms of odd ratios instead of coefficients. Our main interest here is on the nationality dummies. The first two columns refer to the case in which all immigrants from South and Central America are considered together, while the last two correspond to the case in which people from Ecuador and Colombia are separated from the rest. As can be observed, immigrants coming from European countries other than the EU15 and from Africa are significantly more likely to experience higher commuting times compared with nationals. In particular, we find that an individual who only differs from the reference group in that he/she is an immigrant from a European country other than the EU15 has a 1.67 times greater probability of having a higher commuting time. For the case of immigrants coming from Latin American countries, our results reveal no significant differences, with respect to nationals, when including all

of them within the same category. However, the results appear to be different when considering the two most representative groups (Ecuadorians and Colombians) separately. In this case, we again find evidence of spatial mismatch. In particular, the estimation results show that an individual who only differs from the reference group in that he/she is an immigrant from Ecuador (Colombia) has a 1.19 (1.27) times greater probability of having a higher commuting time. Thus, the fact that these two immigrant groups share cultural and linguistic similarities with native workers does not seem to avoid the presence of spatial mismatch among them.

The case of immigrants from Asia and Oceania is of particular interest. Surprisingly, our results show that an individual who only differs from the reference group in that he/she is a non-national coming from Asia or Oceania has a 1.123 (= 1/0809) times lower probability than a national counterpart of a higher commuting time. This apparently misleading result can be largely attributed to the fact that these groups are clustered in the city centre and that they are highly specialised in retailing activities mostly located in this part of the Madrid region.

In sum, the longer commuting times experienced by a high proportion of immigrants (European countries other than EU15, Africa, Ecuador and Colombia) would suggest the presence of spatial mismatch in the Madrid region. This result is especially evident among the first group which, as we mentioned in section 3, is particularly present in the East metropolitan crown, where housing prices are relatively low. However, this metropolitan area offers very few employment opportunities for immigrants, since the concentration of employment in construction, Serv2 and Serv4, the sectors with a relatively higher presence of immigrants, is only of 7.12 per cent, 5.04 per cent and 4.46 per cent respectively.

In relation to the effects of other variables, there are several points worth mentioning in

some detail. Males, older workers and workers who are the reference person in the household usually tend to experience higher commuting times. The household type seems to affect commuting times too. More particularly, if we take single individuals without children as the reference group, we find that those living as a couple and with children experience higher commuting times. The type of contract is also found to be another important factor in determining the commuting time. The results reveal that workers holding a temporary contract are 1.115 times more likely to experience higher commuting times than those with a permanent contract.

Housing tenure is another relevant factor in explaining commuting times. If we take owners without a mortgage as the reference category, we find that renters and those workers living in free housing experience lower commuting. As has been pointed out by some other studies (for example, van Ommeren *et al.*, 1999), the differences in moving costs between owners and renters are a key factor in explaining differences in residential mobility. These differences in residential mobility serve to explain, at the same time, the existing differences in commuting times.

Finally, commuting times are also found to be influenced by the transport mode. In particular, the estimation results reveal that using public instead of private transport increases commuting times. This result is, again, in agreement with other studies in the current literature (for example, Preston *et al.*, 1998) showing that individuals who only have a limited access to faster transport modes experience significantly higher commuting times.

6. Concluding Remarks

This paper aimed to test the well known spatial mismatch hypothesis in the context of the Madrid region, which has experienced one of the largest inflows of immigrants within the

OECD countries in the past decade (OECD, 2007). Since commuting time has been considered as a good indicator in order to detect spatial mismatch, we focus the analysis on this variable. In particular, we explore the connection between commuting flows, residential location, employment accessibility and worker nationality. This latter variable may be expected to be important in determining the commuting times, since it affects the choice of initial and subsequent residence locations.

By means of location coefficients and global and local spatial autocorrelation analysis, we have first investigated the high levels of spatial concentration of immigrants by area of origin. The analysis reveals that immigrants from eastern Europe (non-EU15) and Africa exhibit a slight preference for the Metropolitan Crown and non-metropolitan municipalities, while the other nationalities do not show any significant concentration patterns that could affect their commuting time and their access to employment. Similarly, the spatial autocorrelation analysis shows how immigrants from Colombia tend to concentrate in the South Crown whereas the Ecuadorians exhibit a higher concentration in Inner Madrid. This analysis was then extended using an ordered logit model to elucidate the main determinants affecting the commuting time. After controlling for residence location, housing tenure, educational level and demographic variables, our findings reveal that immigrants coming from European countries other than the EU15, Africa, Ecuador and Colombia are significantly more likely to experience longer commuting times compared with nationals. In this respect, our results appear to suggest the existence of certain kinds of trade-off between the degree of spatial clustering and the accessibility to employment (spatial mismatch).

In conclusion, the commuting time penalty found in the Madrid region for certain nationalities can, to some extent, be attributed to different preferences regarding their dwelling and employment optimal decisions. They

could also be seen as symptoms of residential segregation and difficulties in employment accessibility. Further research is needed to verify whether the existing differences between these immigrant groups remain stable over time or tend to disappear as the newcomers become gradually integrated in the host country.

Notes

1. Optimal commuting time does not necessarily mean minimum commuting time among the existing alternatives.
2. Following Hamilton (1982) and Small and Song (1992), such sub-optimality is reflected in terms of wasteful or excess commuting.
3. Other alternative and complementary explanations for this behaviour are the ethnic goods theory proposed by Chiswick and Miller (2001) and the herd effect theory by Epstein (2002).
4. This assertion may be mediated by several variables, such as level of education, country of origin, language and occupation or legal restrictions (Aslund, 2005).
5. As suggested in Taylor and Ong (1995), despite increasing commuting distances over time, the average commuting time remains unchanged between 1977 and 1985. They argued that this fact can be explained by the increasing use of private vehicles.
6. The Madrid region is composed of 179 municipalities, with a clear central business district located in the city of Madrid (Inner Madrid). Although Inner Madrid covers only 8 per cent of the region's territory, it contains more than 52 per cent of the regional population.
7. See Figure A1 in the Appendix constructed using data extracted from the Statistical Institute of the Madrid Region (IECM).
8. We refer to values of the variable that captures the concentration of these two groups in a particular municipality.
9. Census 2001 does not provide disaggregated information on municipalities with less than 20 000 inhabitants.
10. Since the 2001 census does not include income as an specific variable, the economic

level of individuals has to be captured by different variables, including education, type of contract and housing tenure.

11. As a result of the house price bubble, problems of segregation and polarisation in access and quality of housing have emerged (Ministerio de Trabajo y Asuntos Sociales, 2004). In the period 1997–2004, the average price of new buildings has increased by 79.4 per cent.
12. Figure 10 represents a probability density function, $P(t)$, for the discrete random variable 'commuting time' with seven categories. Such a function returns the probability of a particular individual falling into one of those categories.
13. We also include in the estimation municipal dummies.

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Appendix

Figure A1 shows the organisation of the Madrid region. The Nord area comprises Alcobendas, Colmenar Viejo, San Sebastián

de los Reyes and Tres Cantos. The East comprises Alcalá de Henares, Coslada, Mejorada del Campo, Paracuellos de Jarama, Rivas-Vaciamadrid, San Fernando de Henares, Torrejón de Ardoz and Velilla de San Antonio. The Sud is made up of Alcorcón, Fuenlabrada, Getafe, Leganés, Móstoles, Parla and Pinto. The West comprises Boadilla del Monte, Majadahonda, Pozuelo de Alarcón, Las Rozas de Madrid, Villanueva de la Cañada, Villanueva del Pardillo and Villaviciosa de Odón.

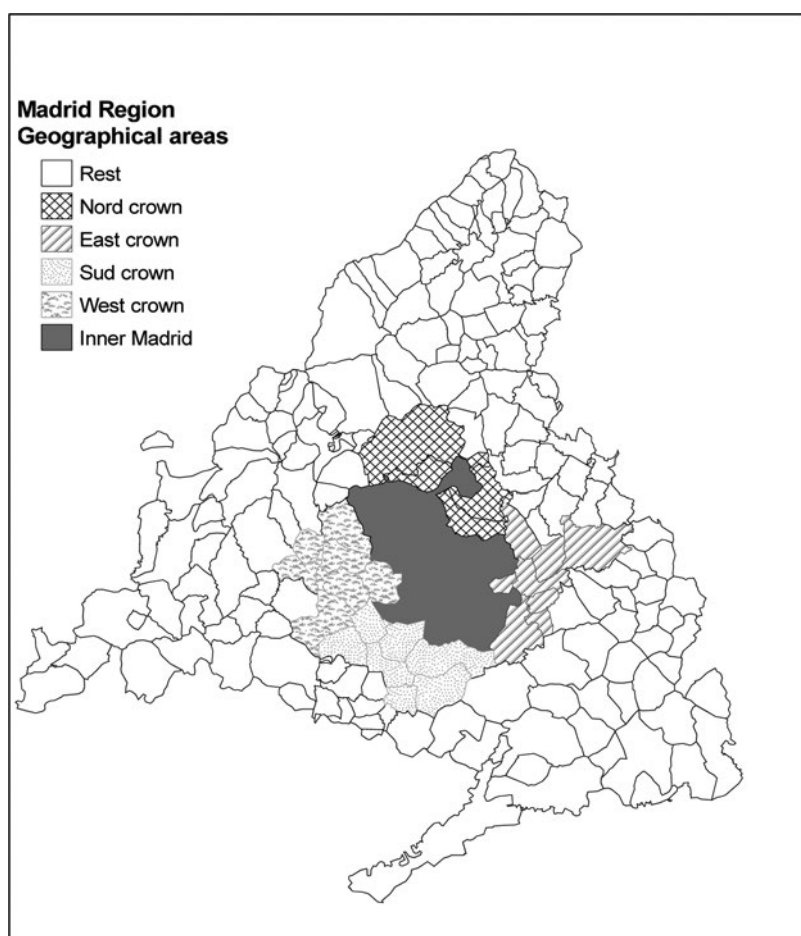


Figure A1. The administrative areas of the Madrid region.