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INTRA-URBAN MOBILITY IN SPAIN AND ITS EFFECTS OVER DISPERSION PATTERNS OF NATIVES AND IMMIGRANTS: THE CASES OF MADRID AND BARCELONA

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ABSTRACT: The territorial distribution patterns of the foreign-born population in large cities are primarily determined by intra-urban mobility, which redistributes the foreign-born population among the city's neighbourhoods, significantly influencing their social and demographic composition. Using data from Madrid and Barcelona, this study analyses the intra-urban mobility patterns of immigrant groups in cities that have experienced significant growth in the foreign-born population over the last two decades, reaching 28.0% and 32.9% of the resident population respectively. The period considered is 2007-2021, divided into four phases according to economic cycles. Six groups of countries are identified and flows between origin and destination neighbourhoods are analysed using specific migration rates. The main objectives are 1) to characterise the evolution of intra-urban residential changes by origin; 2) to study the impact of different economic periods on these flows; 3) to determine the impact of internal mobility on the territorial distribution patterns of different origins; and 4) to compare Madrid and Barcelona. The study applies spatial econometric techniques, including Global Moran's I, Local Indicators of Spatial Association (LISA) and Spatial Focusing, to measure spatial dependence, clustering and the degree of concentration or dispersion in mobility patterns. The results confirm that intra-urban mobility follows structured spatial patterns influenced by economic and demographic factors. Economic downturns tend to facilitate

intra-urban mobility, resulting in increased spatial concentration, whereas during periods of economic growth, housing market pressures constrain mobility and promote a more dispersed pattern of internal flows.

Keywords: foreign-born, intra-urban mobility, segregation, concentration, Spain

INTRODUCTION

Most residential migration occurs within the same city's administrative boundaries, with individuals typically relocating to nearby areas with similar socio-demographic characteristics (Finney & Simpson, 2008). These movements are shaped by the real estate market, which can facilitate or constrain residential choices. In the case of the immigrant population, additional factors intervene, such as an initial lack of knowledge of the city's housing structure, constraints linked to recent arrival, and precarious labour market integration, all of which restricts residential mobility. These dynamics significantly affect their spatial distribution, fostering either concentration or dispersion and influencing residential segregation (Clark, 1992). These processes vary according to the urban context and the immigrant group of origin. In Spain, as in other southern European countries, the most dynamic cities have experienced a significant increase in international immigration during the 21st century, reaching percentages similar to those of other large European cities in just a few years (Parreño et al, 2021). This is the case of Madrid and Barcelona, where in 2024, 28% and 32.9% of the population, respectively, were foreign-born. At a smaller scale, areas like the historic district of Ciutat Vella in Barcelona (62.5% immigrants) and Centro in Madrid (40.7%) show high immigrant concentrations. In this context, neighbourhoods such as El Raval in Barcelona or Lavapiés in Madrid have acted as the main gateways for international immigration into the city. The dynamics of initial settlement and subsequent redistribution through intra-urban mobility determine the

presence of immigrants, generating both areas of high concentration and processes of gradual dispersion throughout the city (Musterd et al., 2017).

The aim of this article is to analyse the evolution of intra-urban movements of foreign-born immigrants in the two main Spanish cities, Barcelona and Madrid, and how these movements are affected by the different economic and migratory phases experienced by the country during the period 2007-2021. Intra-urban movements are defined as residential moves that take place within the administrative boundaries of the same city. Despite their limitations—especially considering that a significant portion of residential mobility occurs outside city limits at the metropolitan level (particularly in the case of Barcelona)—special attention is paid to this type of mobility due to its importance in the redistribution of the immigrant population.

For this purpose, we study the evolution of intra-urban mobility rates and the geographical dispersion associated with these movements, using different demographic and spatial indicators, such as the Spatial Focus (Plane & Mulligan, 1997; Rogers & Raymer, 1998), the Global Moran's I and the LISA values, derived from spatial econometric techniques (Anselin, 1995). The reflections and findings obtained on the spatial dynamics of immigrant and native populations within the urban space constitute the main contribution of this paper.

THEORETICAL FRAMEWORK

The contributions of the academic literature on intra-urban mobility are diverse, if not particularly abundant. Despite its early appearance in disciplines such as sociology, geography and demography, this line of research has not maintained a sustained continuity over time. Simmons (1968) already highlighted the explanatory role of intra-urban mobility in the redistribution of the population, its transformations and its

implications for spatial segregation, by influencing the social and demographic composition of the residents of a given area. During the 1970s, the first states of the question began to emerge (Quigley & Weinberg, 1977), although these initial analyses did not consolidate a systematic line of research, beyond some relevant individual contributions (Bonvalet et al., 1995; Frey, 1995).

In recent years, international interest in intra-urban mobility has resurged, although research remains scarce. This in mainly due to difficulties in accessing data on residential change. Only countries with population registers offers continuous information, restricting studies to specific regions, mainly in northern Europe and, to a lesser extent, in some southern countries, such as Spain or Italy. While some censuses include questions on recent dwelling changes, they often lack geographical references, limiting their analytical value.

New statistical sources have recently revived the study of intra-urban mobility, using data from bank transactions (Newberger et al., 2024) or medical records (Dragan et al., 2020). These sources have limitations in coverage. Certain groups, such as healthy young individuals or those with limited healthcare access, may be under-represented. Moreover, medical records reflect movements related to care, which may not align with residential changes. In banking, not everyone uses cards regularly, introducing bias, especially among those with limited financial access. In addition, shopping does not always reflect changes in residence as it may take place outside the usual area of residence. Finally, in certain instances, these data may be lacking in socio-demographic information.

But what factors influence the dynamics of intra-urban mobility? Changing residence within a city responds to a multiplicity of elements (Simmons, 1968; Brown & Moore, 1970). These include housing characteristics (tenure, size, age, number of rooms, price), the residential environment (prestige of the neighbourhood, perception of safety,

accessibility to jobs, quality of schools, presence of immigrants) and access to the city centre (availability of public transport). Physical factors of the neighbourhood (configuration of streets and squares, slopes, parks and green areas) and the availability of services (schools, shopping centres) also play a role. Housing change is also conditioned by the life cycle of individuals, the formation of new households and the desire to improve housing conditions (Rossi, 1955; Bonvalet & Fribourg, 1990). In addition, intra-urban mobility is closely linked to status and social mobility, influencing segregation levels (Nieuwnhuis et al., 2020). In this sense, residential mobility tends to be more frequent between neighbourhoods of the same social class (Bayona & Pujadas, 2010; Newberger et al., 2024).

If any population group has attracted attention in these studies, it is the immigrant population or those identified from an ethnic perspective. We begin with the observation that there is a relationship between international and internal migration for the foreign-born population, which moves significantly more in the early stages of arrival (Reher & Silvestre, 2009; Author-2, 2009, 2016). Additionally, specific patterns have been identified and described, taking into account the behaviour of both native and immigrant populations (Skifter, 2017). In the case of the native population, two main dynamics have been identified. On the one hand, there is the phenomenon of white flight (Frey & Liaw, 1998), in which natives migrate more intensively from neighbourhoods with a high concentration of immigrants. On the other hand, when natives avoid settling in the same neighbourhoods, we speak of white avoidance (Stillwell & Phillips, 2006; Brämä, 2006). Regarding the movements of the immigrant population, the preference to live in neighbourhoods with a strong presence of their own ethnic group has been identified as a key factor in the processes of residential segregation (Clark, 1992). When immigrants show a greater propensity to move to neighbourhoods with a high concentration of people

of the same origin, this is referred to as ethnic attraction, while lower emigration from these neighbourhoods, favouring immobility, is known as ethnic retention (Rathelot & Safi, 2014). This type of mobility has also been analysed in terms of territorial concentration and dispersion. In the case of London, Stillwell (2010) observes that intra-urban displacement favours the dispersion of ethnic groups, in parallel to upward social mobility. Similar processes have been documented in European cities such as Gothenburg (Brämä, 2008) and Rome (Crisci et al., 2025). However, in Tallinn, intra-urban mobility has resulted in increased spatial segregation of the Russian-speaking minority (Mägi et al., 2016). In other cases, the focus is on the interrelationship between internal migration and other types of mobility. According to Ellis and Wright (1998), suburbanisation processes create new residential opportunities, that allow immigrants to settle in certain areas of the city. For Simon (1998), some neighbourhoods act as gateways for international migrants, who subsequently disperse from these starting points.

Geographical analysis of intra-urban mobility has a long tradition. Simmons (1968) identified socio-economic differences in mobility, noting that longer distance commuting was more frequent in neighbourhoods with higher socio-economic status. However, the process that has attracted most interest in recent years is that of gentrification (Janssen et al., 2023). In these cases, the same space receives a population with a relatively high level of education and income, while residents with lower economic and educational capital migrate or are displaced. Initially, this displacement occurred to nearby areas with similar socio-economic characteristics, but there is now an increasing trend towards suburbanisation (Hochstenbach & Musterd, 2018). This is the case in Madrid, for example, where people with primary education are moving from the city centre to the suburbs (Ariza et al. 2024). In the past, the arrival of new residents in gentrifying areas was mostly from the city itself (Rérat, 2012). In recent years, however, the presence of

international migrants has grown, especially young people with high purchasing power (Hayes & Zaban, 2020), who often settle in areas under strong tourist pressure (Cócola-Gant & López-Gay, 2020).

Finally, a key factor in the development of intra-urban migration is the role of the housing market, both in terms of the characteristics and prices of the housing stock and the residential preferences of the population (Bolt et al. 2002; Bolt & Van Kempen, 2010).

In Spain, internal migrations of foreign-born individuals have been extensively studied at the municipal level, where trends toward dispersion have been observed for most immigrant groups (Reher & Silvestre, 2009; author-1, 2016; author-2, 2016). However, only with the recent availability of data from the *Padrón Continuo*, provided by some municipal statistical services, has academic research on intra-urban migration dynamics expanded, with studies focusing on cities such as Barcelona (López-Gay, 2016), Madrid (Andújar-Llosa, 2017; Galiana-Martín, 2023), Valencia (Salom-Carrasco, 2021), or Zaragoza (Escolano et al., 2021). For Bayona & Pujadas (2010), three factors determine the direction and intensity of intra-urban flows in Barcelona: (a) residential proximity, (b) the income level of the neighbourhoods -particularly selective in high-income neighbourhoods- and (c) the presence of foreign residents in migratory flows. López-Gay (2016) points out that internal mobility perpetuates pre-existing urban inequalities and contributes to the socio-economic polarisation of the city.

Census data also allow us to analyse internal residential changes in Spain, albeit without geographical information to indicate their directionality (Palomares et al., 2017). In Barcelona, López-Gay & Recaño (2008) identify a residential filter that operates both for those moving within the city and for those migrating to the metropolitan region, favouring the retention of people with higher socioeconomic status. Thus, the characteristics of internal flows differ from those of metropolitan migration and are influenced by

contextual factors such as population growth, employment levels and the presence of immigrant populations (Duque-Cavalche et al., 2017).

In the Spanish case, the real estate market is key to understanding the recent evolution of intra-urban mobility. Three processes have contributed to its increase: (1) the increase in access to renting after the Great Recession of 2008 (Módenes & López-Colás, 2014), (2) the increase in housing instability associated with the growing practice of subletting rooms (Author-1, 2023), and (3) the touristification of urban centres in large cities, which has put upward pressure on housing prices (Cócola-Gant, 2016).

The analysis of intra-urban mobility has been approached from different theoretical perspectives, highlighting the influence of economic, migratory and spatial factors in the population redistribution. Based on these approaches, we have developed three hypotheses that allow us to examine three key dimensions: the temporal evolution of mobility, the differences between population groups and the spatial patterns of residential movements.

1) H1. Intra-urban mobility is influenced by the level of international immigration. During periods of high immigration, housing market competition makes it more difficult to move within a city, reducing mobility. In contrast, in periods of low immigration, housing market pressure is reduced, allowing greater flexibility in changing residence.
2) H2. Intra-urban mobility patterns differ between population groups. Immigrants from lower income countries are expected to have higher mobility rates due to their greater vulnerability in the housing market. In contrast, the native population and immigrants from developed countries have lower mobility rates, reflecting greater housing stability.

3) H3. Intra-urban mobility follows a structured and non-random spatial pattern. In particular, it is expected to occur predominantly between neighbourhoods with similar socio-economic characteristics, rather than being homogeneously distributed across the city.

DATA AND METHODS

The analysis of intra-urban mobility uses data from the Barcelona and Madrid Statistical Offices, covering movements within each city from 2007 and 2021. The dataset includes 73 neighbourhoods in Barcelona and 125 in Madrid[1], with variables such as sex, five-year age group, country of birth, nationality and neighbourhood of origin and destination. In total, 1.5 million internal movements are recorded in Barcelona and 3.3 million in Madrid, with 52% and 50% respectively involving foreign-born individuals.

Before introducing the indicators, it is important to define the population groups and periods analysed. Intra-urban mobility rates have been calculated for both immigrants and those born in Spain. Six main groups have been identified according to their origin. It was decided to classify the population according to place of birth, since in some groups, such as Latin Americans, a significant proportion of the population has become naturalised. The groups are: (1) EU-15 and other developed countries[2], (2) Other Europe, (3) Maghreb, (4) Sub-Saharan Africa, (5) Latin America and (6) Asia. In terms of chronology, four periods have been distinguished, reflecting the main recent economic and migration cycles: a) 2007-2008: end of the migration and housing boom; b) 2009-

[1] In both cities, the official delineation of neighbourhoods is employed, with average populations of 26,000 in Madrid and 22,000 in Barcelona respectively.

[2] The pre-enlargement EU-15 (member states between 1995 and 2004) has been retained as a separate category to distinguish them from later accession countries, whose migrant populations differ significantly in sociodemographic terms and account for a major share of migration to Spain, notably Romania.

2015: economic recession and declining immigration; c) 2016-2019: incipient recovery and rising inflows; and d) 2020-2021: COVID-19 and a sharp decline in migration.

For the neighbourhoods, periods and population groups described above, different types of mobility rates by sex have been estimated. Equation 1 describes the procedure for calculating the rates of movement within neighbourhoods, between neighbourhoods in the same district and between districts, where *m* and *M* are respectively the migration rates and the different migration events respectively, *g* is the population group and *i* is the neighbourhood of origin, $\overline{\bar{P}^{\,t}_{s,g,\iota}}$ is the average population of time interval *t*, by sex *s*, immigrant group *g* and neighbourhood of origin *i.*

$$m^{t}_{s,g,i} = \left(\frac{M^{t}_{s,g,i}}{\bar{P}^{\,t}_{s,g,i}}\right) x1000 \qquad (1)$$

A key aspect to consider is the concept of population at risk, which acts as a denominator in the measurement of migration rates and is not a neutral element. An immigration rate alone represents a proportion of the population in the destination area, but does not provide any information on the propensity to emigrate in the area of origin. In order to correct for this effect, we have opted for a strategy that converts the immigration rate of neighbourhood j into the emigration rate from the rest of the neighbourhoods to j. This approach maintains the numerator -the emigration with destination j-, but modifies the denominator: instead of considering the population of j, the total population likely to emigrate to j from the rest of the neighbourhoods is taken as a reference. Where: *t* and *g* have been defined in equation 1, *RN* represents the rest of the city's neighbourhoods, *I* are the immigrants arriving in *j*, and *j* is the destination neighbourhood.

$$m^{t}_{RN,g,j} = \left(\frac{I^{t}_{RN,g,j}}{\bar{P}^{\,t}_{RN,g,}}\right) x1000 \ (2)$$

To corroborate hypothesis 1, we applied the non-parametric Mann–Whitney U test to examine whether intra-urban migration rates differed significantly between consecutive

migratory periods. This method, suitable for non-normally distributed variables, compares two independent samples. We analysed three transitions: from high immigration (2007–2008) to low (2009–2015); low (2009–2015) to high (2016–2019); and high (2016–2019) to low (2020–2021). The test was conducted separately for Barcelona and Madrid and for each group. Significant differences in mean ranks indicate shifts in intra-urban mobility associated with immigration contexts, with results presented in Annex 1.

To corroborate hypothesis 2, we applied one-way Analysis of Variance (ANOVA) to evaluate whether intra-urban mobility patterns differed significantly by place of birth. The test was conducted separately for each migratory period and city. When the overall F-test indicated significant variation, Tukey's Honestly Significant Difference (HSD) post-hoc test was applied to identify pairwise differences. Tukey's HSD was chosen because it controls Type I error while maintaining statistical power. Groups within the same homogeneous subset do not differ significantly, whereas those in different subsets display significant differences ($p < 0.05$). Statistical results are presented in Appendix 2[3].

Two methods were used to address the spatial hypotheses (H3). First, we estimated the Spatial Focus, an indicator of inequality in the relative volumes of migration flows within an origin-destination matrix (Plane & Mulligan, 1997). Based on intra-urban migration matrices the method follows Rogers and Raymer (1998) and Rogers and Sweeney (1998), calculating the average of row- and column-weighted coefficients of variation. This indicator was computed both with all flows and excluding movements within the same neighbourhood. Spatial Focus captures the concentration of flows relative to a homogeneous distribution. Higher values indicate spatial concentration, while lower values reflect dispersion. Temporal changes reveal centralization or diversification,

[3] These two statistical procedures were obtained using the SPSS software

depending on whether Spatial Focus increases or decreases. An increase in the value of the Spatial Focus is generally associated with a higher concentration of flows, reflecting limited residential alternatives and resulting in relocations within already consolidated urban areas. A decrease in the value of the Spatial Focus indicates a greater dispersion of flows, reflecting wider residential opportunities and resulting in relocations across a broader range of neighbourhoods.

It is important to note that Spatial Focus is not directly comparable across cities with differing urban morphologies and numbers of neighbourhoods. Differences in spatial partitioning can affect the observed degree of concentration, reflecting the Modifiable Areal Unit Problem (MAUP). Therefore, interpretation should be limited to within-city comparisons across groups and periods, rather than direct cross-city contrasts.

The second spatial method used to evaluate Hypothesis 3 is based on spatial econometric indicators to determine whether the territorial distribution of intra-urban mobility rates in different time periods - in this case, the emigration rate from neighbourhoods to a given destination (equation 2) - follows a random pattern or responds to spatial autocorrelation patterns, i.e. whether it is grouped into spatial clusters. To this end, a spatial econometric analysis of intraurban migration rates was carried out based on two indicators: the Global Moran Index (I) and the Local Moran Index (Ii). The Global Moran Index (I), formulated by Moran (1948), allows us to assess the presence of spatial autocorrelation in the set of mobility rates. In this study, the hypothesis of spatial association was tested with a statistical significance level of p-value ≤ 0.001 (Table 3).

The Moran Local Index (Ii), known as the Local Indicator of Spatial Association (LISA) and developed by Anselin (1995), provides a measure of the intensity and direction of spatial autocorrelation at the municipal level. The LISA values have been plotted on different maps (Figure 4), which facilitates the identification of spatial clusters, outliers

and areas without significant spatial association[4]. The clusters obtained are classified according to the following spatial autocorrelation criteria: a) A local positive spatial autocorrelation, i.e. Neighbourhoods with high intra-urban mobility rates surrounded by others with equally high values (high-high clusters or hotspots) or neighbourhoods with low mobility rates surrounded by others with equally low values (low-low clusters or coldspots). We can also find local negative spatial autocorrelation: high mobility neighbourhoods surrounded by low-mobility neighbours (high-low clusters) or low-mobility neighbourhoods surrounded by high-mobility neighbours (low-high clusters). These patterns often correspond to unique areas within the city. In the map, positive spatial autocorrelation is represented by red plots for high mobility scores and blue plots for low mobility scores, allowing the presence of clusters of similar scores to be identified. Areas with no significant spatial association are shown as non-significant on the maps.

Context. International migration in Barcelona and Madrid

The comparison of intra-urban mobility between Barcelona and Madrid is shaped by several factors arising from the difference between the two cities. Firstly, Madrid is larger, both in terms of population and surface area (604 km² and 3.42 million inhabitants in 2024), compared to Barcelona (101 km² and 1.69 million inhabitants in the same year). Secondly, the composition of the resident foreign-born population differs. In 2022, Latin Americans account for 66.7% of the immigrant population in Madrid, compared with 50.5% in Barcelona. In contrast, the weight of nationals from the EU-15 and other developed countries was 9.8 % in Madrid, compared to 17.9 % in Barcelona, while Asians accounted for 9.1 % in Madrid and 16.7 % in Barcelona. For the other groups, the proportions were similar, with the African population in both cases being low compared

[4] The spatial econometric indicators were calculated using the version of GeoDa 1.22.0.12 for 64-bit Windows in https://geodacenter.github.io/download-windows/

with the rest of the country (6.4% in Madrid and 6.6% in Barcelona, while the national average stands at 18%). These differences influence the mobility patterns of certain groups, especially in Madrid, where Asians have particular characteristics despite their lower relative weight. Thirdly, urban morphology and the demarcation of neighbourhoods also affect mobility. Barcelona has 73 neighbourhoods and is bounded to the east by the Mediterranean Sea, which determines the direction of flows. In Madrid, on the other hand, there is no such restriction and there are also more units of analysis (125), which may influence the results obtained. Finally, according to the 2021 census, 31% of dwellings in Barcelona are rented, compared to 24% in Madrid. Barcelona also has an older housing stock, with 24% of its dwellings constructed before 1940, versus 12% in Madrid. This may contribute to higher residential mobility in Barcelona, as rental housing is typically linked to shorter residence durations. Additionally, recent construction has been slower in Barcelona: while 33% of Madrid's housing was built after 1980, only 15% in Barcelona date from that period onwards.

RESULTS

The evolution of intra-urban migration

Despite receiving limited attention, internal mobility plays a key role in both cities. In fact, for many years it has been the main migratory movement in both Barcelona and Madrid, especially in the latter, and has only been surpassed by international immigration in the periods of greatest migratory intensity (Figure 1). In Barcelona, intra-urban migration was more numerous than international migration between 2009 and 2015, as well as in 2020-2021, coinciding with the economic crisis and reduced international immigration, and with the COVID-19 pandemic, when both flows decreased (Bayona & Domingo, 2024). In Madrid, intra-urban mobility has largely outpaced international immigration, except in the years 2017-2019, at the height of the second migration boom.

In general terms, the evolution of international migration and intra-urban migration shows an inverse relationship, reflecting different economic dynamics. While the arrival of international migrants increases in periods of economic growth, internal mobility tends to decrease, either because of competition in the residential market with international immigration or because of the increase in housing prices in these contexts (Unal et al. 2024). According to González and Ortega (2013), the arrival of migrants accounted for one quarter of the price increase in Spain between 2000 and 2008. Speculative forces linked to low bank interest rates and the expansion of foreign investment explained the remainder of the increase (Cochrane and Pot, 2021). Quantitatively, in Barcelona the number of movements ranged from a low of 38,000 in 2016 to a high of 66,000 in 2021, while in Madrid it ranged from 86,000 in 2016 to 142,000 in 2009. A significant part of this mobility corresponds to the immigrant population: between 2007 and 2021, it accounted for 51.9 % of movements in Barcelona and 52.9 % in Madrid, with peaks in 2008 in Madrid (58.8 %) and in 2021 in Barcelona (56.7 %).

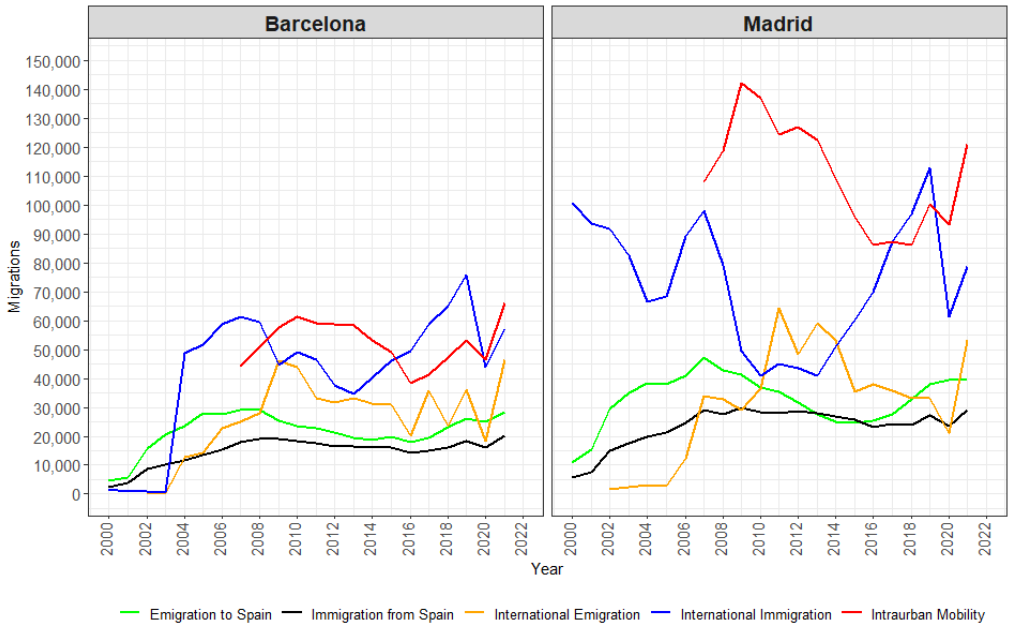

Figure 1: Migration dynamics in Barcelona and Madrid, 2000-2021

These results are consistent with the first hypothesis of this study: the close relationship between international migration cycles and the evolution of intra-urban mobility. Specifically, during periods of immigration growth, intra-urban mobility decreases due to difficulties in the housing market, in particular a shortage of vacant dwellings and rising prices (Módenes et al. 2024), particularly within the rental sector (Benéitez et al 2025). However, during phases of the migration cycle linked to economic crises -marked by falling inflows and rising outflows-, reduced pressure on rental and ownership markets facilitates residential mobility for those remaining in the city. However, this pattern also suggests a selection process among those who stay, probably associated with better labour market integration. This process takes place in a similar way and at the same time in both cities.

Intra-urban mobility intensity by population group and type of movement

The intensity of internal mobility supports hypothesis 1. Intra-urban mobility peaked during the economic crisis (2009-2015) for most groups, in a context of falling rental prices and reduced out-migration to other metropolitan municipalities. Mobility rates rose compared to the previous period, especially for North and Sub-Saharan Africans. However, the highest rates remained among Asians (over 250 per thousand in both cities) and, in Madrid, also among Latin Americans. During the recovery (2016-2019) mobility declined sharply, particularly among Africans, despite a renewed influx of foreign migrants reaching levels similar to the first migration boom. In the final phase, despite COVID-19 restrictions, mobility rates slightly recovered. An exception to this trend is presented by EU-15 Europeans, whose mobility showed continuous growth, especially in Madrid (Figure 2). Differences in mobility intensity between sexes are also evident in some groups, particularly among Asians in the first two stages. These differences reflect the gender composition of the immigrant population and their different roles within the

migration process, as noted in previous studies on the internal migration of foreigners in Spain (Recaño, 2016; Recaño & De Miguel-Luken, 2016). In any case, these results confirm hypothesis 2 with some nuances: the existence of a mobility hierarchy by country of birth. Native populations and immigrants from the EU-15 and other developed countries show the lowest rates, while Asians have the highest. This pattern prevails in both cities, with the exception of Latin Americans in Madrid, especially women, whose high mobility is linked to changes in the geographical and social composition of the arrivals of this group (Thiers-Quintana & Gil-Alonso, 2020).

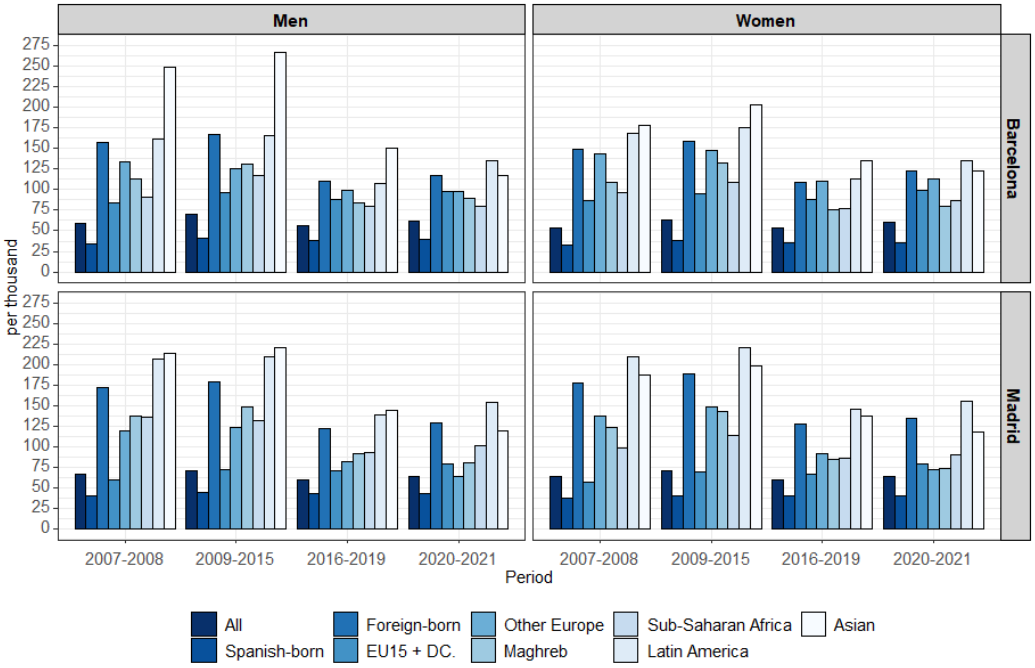

Figure 2. Intra-urban mobility rates, by sex, Barcelona and Madrid, 2007-2021

Intra-urban mobility analysis considers three types of mobility, distinguishing between movements within the same neighbourhood, between neighbourhoods within the same district, and between different districts (Table 1). In general terms, these mobility patterns reflect the trends observed for intra-urban mobility as a whole, albeit with some nuances. The most pronounced differences are observed between the periods 2009–2015 and 2016–2019, during which there is a marked decline in intra-neighbourhood mobility rates, particularly among the immigrant population. This trend coincides with changes in the

economic context and the progressive increase in housing rental prices, which have had a significant impact on central urban areas and on the most vulnerable groups, as noted by Ardura et al. (2021) in the case of Madrid.

The greatest differences between natives and foreigners occur in inter-district mobility, which is the most intense for all groups. At the same time, intra-neighbourhood mobility is more intense than inter-neighbourhood mobility within the same district, so that the change either takes place in the immediate geographical environment or is directed to other areas of the city, usually with the same social characteristics (Bayona & Pujadas, 2010). In Madrid, the values for these types of mobility are generally higher than in Barcelona for the population as a whole, a gap that generally increases for those groups that are more over-represented in Madrid, such as Latin Americans.

Rates are also higher between districts in Madrid, partly due to the cities' differing morphology, especially evident in 2007-2008. In Barcelona, all Europeans show higher inter-districts rates, which we can attribute to a greater socio-demographic diversity, linked to what some authors have called transnational gentrification (Cócola & López-Gay, 2020), and to the emergence of new high-income areas along the coast. Also noteworthy for Barcelona is the high value of intra-neighbourhood rates for Asians, possibly related to the presence of Pakistani, Chinese, and Indian groups concentrated in the city centre (Galeano & Bayona, 2018) whose small ethnic businesses may encourage mobility within nearby areas.

The Mann–Whitney tests reveal significant temporal shifts in intra-urban mobility linked to immigration contexts. In Barcelona, mobility rose between 2007–2008 and 2009–2015 for both natives and immigrants ($p < 0.05$), consistent with reduced immigration pressure. Most foreign groups then experienced sharp declines in 2016–2019 ($p < 0.001$), reflecting renewed competition, while 2020–2021 showed mixed results: stability among natives

but increases for Latin American and Asian migrants ($p < 0.01$). Overall, these findings confirm Hypothesis 1: mobility rises in low-immigration contexts and falls under high immigration (Annex 1).

Table 1. Mobility rates by period, typology and origin. Madrid and Barcelona (2007-2021)

Barcelona

Place of birth	Period	All	Spanish-born	EU15 + DC.	Other Europe	Maghreb	Sub-Saharan Africa	Latin America	Asian
Intra-neighbourhood	2007-2008	**15.6**	10.0	15.1	24.2	35.9	25.2	37.5	86.0
	2009-2015	**20.8**	12.7	21.5	30.9	43.1	31.9	48.2	104.7
	2016-2019	**15.2**	11.3	18.0	20.9	19.4	16.8	23.5	51.0
	2020-2021	**16.0**	11.7	20.5	20.4	16.0	13.4	27.6	39.6
Between neighbourhoods of the same district	2007-2008	**10.6**	6.9	15.9	25.3	16.8	19.2	30.6	29.3
	2009-2015	**13.3**	8.6	19.1	28.3	23.6	22.3	35.3	33.0
	2016-2019	**12.0**	8.5	18.0	21.8	16.5	15.5	24.2	26.1
	2020-2021	**13.5**	8.8	20.1	22.7	18.5	18.0	29.2	23.7
Inter-district	2007-2008	**30.2**	16.3	54.6	89.7	59.4	49.2	97.9	110.5
	2009-2015	**32.4**	18.8	55.2	78.8	64.7	60.8	87.5	105.7
	2016-2019	**27.7**	16.7	51.6	63.4	44.7	46.2	62.8	67.3
	2020-2021	**31.5**	16.9	58.1	63.5	50.7	50.8	78.9	56.4

Madrid

Place of birth	Period	All	Spanish-born	EU15 + DC.	Other Europe	Maghreb	Sub-Saharan Africa	Latin America	Asian
Intra-neighbourhood	2007-2008	**16.7**	9.5	13.1	36.4	34.9	29.6	54.9	55.2
	2009-2015	**22.5**	12.7	18.9	48.9	51.7	40.9	71.8	68.8
	2016-2019	**17.5**	13.2	16.9	27.7	27.4	21.6	36.5	38.3
	2020-2021	**17.5**	12.8	19.5	20.4	20.8	20.4	36.9	30.8
Between neighbourhoods of the same district	2007-2008	**12.9**	7.9	11.1	24.3	21.2	22.6	40.7	33.8
	2009-2015	**15.1**	8.7	14.1	29.3	29.3	25.3	48.2	41.5
	2016-2019	**12.7**	8.7	14.4	17.8	17.3	16.8	31.2	29.2
	2020-2021	**13.3**	8.7	17.3	13.8	15.4	19.2	32.5	25.2
Inter-district	2007-2008	**37.3**	22.2	36.7	68.9	76.2	72.4	117.2	117.2
	2009-2015	**34.7**	21.6	41.0	59.9	65.6	61.1	99.8	103.4
	2016-2019	**31.0**	20.8	40.8	42.4	43.9	53.1	77.2	76.1
	2020-2021	**33.9**	21.1	46.5	34.5	42.0	58.5	88.1	64.3

In Madrid, early changes (2007–2008 to 2009–2015) were modest, with increases among natives and EU15 + DC migrants ($p < 0.01$), while Latin American and Sub-Saharan groups showed no significant shifts. The strongest evidence appeared between 2009–2015 and 2016–2019, when all foreign-born groups recorded significant declines ($p < 0.001$). In 2020–2021, mobility stabilised for natives but rose significantly among several immigrant groups, consistent with reduced housing market pressure.

Across both cities, the Mann–Whitney results provide strong support for Hypothesis 1. Periods of high immigration were associated with lower intra-urban mobility rates, particularly among foreign-born groups, while periods of lower immigration corresponded to greater mobility. Although the magnitude of change differed between Barcelona and Madrid, the overall temporal pattern confirms that intra-urban mobility is shaped by immigration dynamics and the level of pressure in the housing market.

These findings also suggest, hypothetically, that housing market dynamics may underpin the observed shifts. During phases of intense immigration, increased competition for accommodation likely restricted residential moves, particularly for more vulnerable groups. By contrast, in periods of lower immigration and intensified return migration, some dwellings may have become vacant, reducing competition and creating greater flexibility for intra-urban relocation. This potential availability of housing in less pressured contexts may have contributed to the mobility increases detected in the Mann–Whitney tests.

ANOVA results with Tukey's HSD post-hoc comparisons reveal a consistent stratification of intra-urban mobility by place of birth in both Barcelona and Madrid. Across all periods, Spanish-born residents exhibited the lowest mobility rates, while Latin American and Asian migrants consistently recorded the highest. EU-15 and other developed countries clustered near the native-born, whereas migrants from the Maghreb,

Sub-Saharan Africa and Other Europe generally occupied intermediate positions. Notably, Sub-Saharan Africa often bridged lower and higher clusters, indicating a transitional position in the hierarchy (Annex 2).

In Barcelona, differentiation was already visible in 2007–2008, sharpened during 2009–2015 with clear separation between lower, intermediate, and higher mobility groups, and stabilised afterwards. Madrid displayed a similar pattern, with Spanish-born and EU migrants at the bottom, Maghreb, Sub-Saharan Africa and Other Europe in the middle, and Latin America and Asia at the top. The differences persisted across all four periods, though the gaps between intermediate and higher groups narrowed slightly in the most recent period (2020–2021).

Overall, the findings strongly support Hypothesis 2, which posited that intra-urban mobility patterns differ between population groups. Migrants from Latin America and Asia, and in some periods also from Sub-Saharan Africa, consistently showed higher mobility rates, reflecting their more unstable position in the housing market. By contrast, the native-born population and immigrants from developed countries maintained comparatively low levels of mobility. The results therefore corroborate that intra-urban mobility differs systematically by place of birth.

Territorial distribution

The analysis of intra-urban mobility in Barcelona and Madrid requires a spatial approach to identify patterns and dynamics of residential relocation. The concept of Spatial Focus is central to understanding how population groups concentrate or disperse within the urban territory, and how structural factors such as urban morphology, housing supply and property market dynamics influence these movements. From this perspective, it is

possible to assess whether internal mobility reproduces pre-existing spatial inequalities or, on the contrary, contributes to their transformation.

An increase in the Spatial Focus score indicates a greater concentration of intra-urban migration flows in specific areas of the city. Conversely, a decrease reflects a more homogeneous and dispersed pattern of residential change across neighbourhoods, with a smaller coefficient of variation in mobility rates. This variability in dispersion manifests itself differently in Barcelona and Madrid between 2007 and 2021, influenced by economic and migratory fluctuations, although the time sequence follows similar patterns (Figure 3)[5].

[5] Spatial Focus should be understood as a relative indicator within the urban system under analysis, rather than as an absolute measure suitable for direct comparison across cities. Because Barcelona and Madrid differ substantially in size, urban morphology and number of neighbourhoods, an identical numerical value does not necessarily represent the same substantive meaning in both cases. Spatial Focus primarily captures the degree of concentration or dispersion of intra-urban migration flows within each city; its interpretation should therefore emphasise temporal change and variation between population groups within a given urban context. Within this framework, a difference between values of approximately 2 and 6 is substantively significant when observed within a single city, as it denotes a marked change in the spatial inequality of residential mobility destinations. Values near 2 indicate a relatively dispersed pattern of flows across neighbourhoods, whereas values approaching 6 denote a strong concentration of movements in a limited number of areas, signalling heightened spatial selectivity and a contraction in the range of available residential alternatives. These differences, however, should not be read symmetrically between Barcelona and Madrid, as each city constitutes a distinct mobility system. The key analytical insight offered by Figure 3 lies in demonstrating that, despite operating on different city-specific scales, both cities display a remarkably similar temporal evolution of the Spatial Focus indicator. This parallelism suggests that the temporal dynamics of intra-urban mobility are driven by common structural forces—most notably economic cycles and housing market conditions—rather than by the absolute scale or internal partitioning of each urban system.

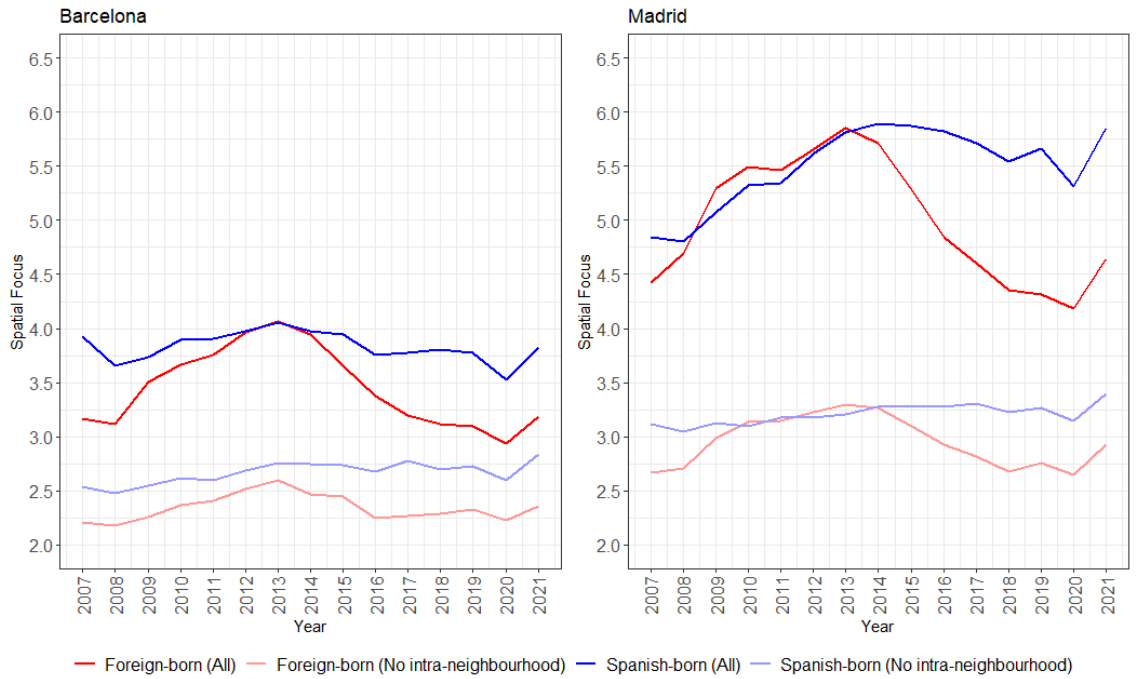

Figure 3: Spatial Focus evolution by origin, Barcelona and Madrid, 2007-2021

During the economic crisis (2009-2015), the indicator reached its highest levels in both cities and for all population groups. This suggests that, in a context of reduced housing pressure and declining immigration, internal residential moves became concentrated in geographical areas with vacant dwellings left behind by returning migrants. This dynamic reinforced urban spaces already occupied by certain immigrant groups. However, an expanded housing supply within the city does not guarantee equal access for all groups, as opportunities remain shaped by both housing prices and the sociodemographic characteristics of destination neighbourhoods.

From 2016 onwards, as the number of migrants started to increase again and the economy started to recover, spatial concentration gradually decreased. The economic recovery and the increase in immigration appear to have reinforced certain spatial dynamics, leading to a less dispersed pattern of residential moves, as certain neighbourhoods consolidate as poles of attraction for certain groups. These results reveal a complex relationship between variations in the value of Spatial Focus and the evolution of the economic, migratory, and housing market context.

The housing market plays a fundamental role in understanding this development. During the economic crisis, the decline in house prices and the reduced pressure on housing supply allowed for greater residential mobility. Despite this rise in mobility, a trend towards concentration can be observed. The economic downturn disproportionately affected the immigrant population who experienced high unemployment rates. This appears to have constrained their residential choices, leading to relocation towards neighbourhoods with higher concentration of immigrants. These areas offer more accessible housing options, but this pattern also reflect a form of ethnic attraction at a time when access to housing is comparatively easier.

Table 2. Spatial Focus of intraurban mobility. Madrid and Barcelona (2007-2021)

Place of birth	Period	Barcelona		Madrid	
		Total	No structural zeros and movements within the neighborhood	Total	No structural zeros and movements within the neighborhood
Total	2007-2008	5.08	2.69	6.23	3.36
	2009-2015	5.66	3.02	7.54	3.92
	2016-2019	5.13	2.97	7.03	3.75
	2020-2021	4.92	2.87	6.72	3.59
Spanish-born	2007-2008	5.49	2.78	6.20	3.52
	2009-2015	5.72	3.09	7.17	3.77
	2016-2019	5.68	3.17	7.54	3.87
	2020-2021	5.75	3.09	7.44	3.72
Foreign-born	2007-2008	4.84	2.61	6.41	3.22
	2009-2015	5.66	3.01	7.94	4.14
	2016-2019	4.68	2.80	6.51	3.59
	2020-2021	4.36	2.67	6.10	3.32
Ancient EU15+DC.+Other european countries	2007-2008	3.85	2.14	6.93	2.58
	2009-2015	4.36	2.61	8.04	3.67
	2016-2019	4.12	2.46	7.07	2.86
	2020-2021	4.19	2.34	6.82	2.43
Maghreb and Subharian Africa	2007-2008	6.20	1.90	7.12	2.19
	2009-2015	5.92	2.46	8.51	3.29
	2016-2019	4.89	2.09	7.59	3.72
	2020-2021	4.70	1.96	-	-
Latinamerica	2007-2008	4.33	2.32	6.40	3.21
	2009-2015	5.15	2.75	7.95	4.20
	2016-2019	4.13	2.48	6.41	3.58
	2020-2021	4.01	2.43	6.03	3.27
Asian	2007-2008	7.54	3.65	-	-
	2009-2015	8.02	4.28	-	-
	2016-2019	6.98	3.86	-	-
	2020-2021	6.73	3.49	-	-

However, with the economic recovery, the rise in housing prices and increased competition for accommodation limited the possibilities for relocation. Indeed, in Spain, it is possible to speak of a housing affordability crisis, particularly in major cities, which disproportionately affects young people and the most vulnerable groups, such as immigrants (Martínez del Olmo, 2024). This is reflected in the previously mentioned decline in intra-urban mobility and a trend towards greater spatial dispersion. This phenomenon can be interpreted in two ways. On the one hand, it may indicate that, during periods of heightened pressure on the housing market, the immigrant population is unable to access their preferred residential options and is consequently pushed towards dispersion. This pattern is particularly evident in Madrid, where rising housing costs have exacerbated the polarisation in the distribution of residential moves. On the other hand, the trend towards greater dispersion may also be associated with improved economic conditions and a more stable settlement process.

In summary, the analysis of the spatial dynamics of residential mobility in Barcelona and Madrid reveals differentiated patterns over time and across groups. During periods of economic crisis, there is an increase in concentration, whereas in times of recovery and migration growth, mobility tends to become less concentrated. Temporal variations in Spatial Focus and the dynamics of the economy, migration, and the housing market is complex and warrants further investigation.

Population groups' behaviour in the territory

The Global Moran indicator detects spatial patterns in intra-urban mobility, showing whether residential changes are structured or randomly distributed. Its evolution over time reveals dynamics of concentration or dispersion, identifying emerging trends or spatial stability in migratory flows. Its analysis in Barcelona and Madrid between 2007 and 2021

allows us to assess the spatial distribution of those immigration rates originated in the rest of the city. This indicator measures spatial autocorrelation of the values, in other words, whether intra-urban mobility follows a structured pattern or whether it is randomly distributed. The incorporation of the Global Moran statistical significance levels allows us to confirm the robustness of the results, since values below 0.05 indicate that the spatial distribution is not random and that there are patterns of spatial dependence.

Throughout the analysed period, the Global Moran shows positive and significant values in most cases for both cities, suggesting that intra-urban residential mobility is structured and that neighbourhoods with high arrivals rates tend to cluster with similar ones. Generally, Barcelona records the highest values, with a more consistent spatial distribution and significant autocorrelation across all four periods. In Madrid, the Global Moran also shows positive values, though significance levels are higher, indicating less stable spatial autocorrelation. This suggests that spatial trends in intra-urban mobility may have changed over time. In periods where statistical significance is lower, it is observed that intra-urban mobility may have followed more dispersed patterns, without such a defined spatial structure as in Barcelona.

Table 3. Spatial autocorrelation of intra-urban mobility rates to a given neighbourhood. Global Moran I

	2007-2008		2009-2015		2016-2019		2020-2021	
Barcelona	Global Moran	Sig.	Global Moran	Sig.	Global Moran	Sig.	Global Moran	Sig.
Spanish-born	0.389	0.001 ***	0.428	0.001 ***	0.401	0.001 ***	0.439	0.001 ***
Foreign-born	0.301	0.001 ***	0.362	0.001 ***	0.389	0.001 ***	0.458	0.001 ***
EU-15+Dev. Countries	0.608	0.001 ***	0.620	0.001 ***	0.591	0.001 ***	0.616	0.001 ***
Other Europe	0.173	0.007 **	0.325	0.001 ***	0.327	0.001 ***	0.397	0.001 ***
Maghreb	0.207	0.007 **	0.158	0.014 *	0.220	0.004 **	0.343	0.001 ***
Subsaharian Africa	-0.060	0.236	0.083	0.091	0.060	0.162	0.130	0.029 *
Latinamerica	0.304	0.001 ***	0.363	0.001 ***	0.318	0.001 ***	0.391	0.001 ***
Asia	0.212	0.001 ***	0.265	0.004 **	0.338	0.001 ***	0.369	0.001 ***
Madrid								
Spanish-born	0.009	0.293	0.018	0.266	-0.013	0.488	0.013	0.314
Foreign-born	0.277	0.001 ***	0.298	0.001 ***	0.297	0.001 ***	0.241	0.001 ***
EU-15+Dev. Countries	0.165	0.003 **	0.337	0.001 ***	0.290	0.001 ***	0.330	0.001 ***
Other Europe	0.375	0.001 ***	0.403	0.001 ***	0.441	0.001 ***	0.306	0.001 ***
Maghreb	0.185	0.002 **	0.315	0.001 ***	0.356	0.001 ***	0.281	0.001 ***
Subsaharian Africa	0.391	0.001 ***	0.388	0.001 ***	0.365	0.001 ***	0.293	0.001 ***
Latinamerica	0.297	0.001 ***	0.323	0.001 ***	0.332	0.001 ***	0.286	0.001 ***
Asia	0.227	0.001 ***	0.274	0.001 ***	0.284	0.001 ***	0.259	0.001 ***

By population group, the Global Moran values vary markedly. In general, immigrants from the EU-15 and developed countries show the highest values of spatial autocorrelation, indicating that their intra-urban mobility patterns tend to be more concentrated in certain specific neighbourhoods and surrounded by similar areas. In contrast, immigrants from the Maghreb and Latin America show more variable Global Moran values, reflecting greater heterogeneity in their mobility patterns and the possibility that they relocate to different parts of the city without generating strong spatial concentration. The incorporation of statistical significance levels confirms the relevance of these findings by showing that the spatial patterns of intra-urban mobility are statistically significant in most cases.

LISA values and cluster maps offer a more detailed approach by showing the specific location of areas with high or low mobility. These indicators allow to detect neighbourhoods where mobility is significant and to understand how residential dynamics are spatially clustered. The maps representing the LISA values for Barcelona and Madrid during the period 2009-2015 – the phase of greater mobility–, allow us to identify the

spatial distribution of intra-urban mobility at the neighbourhood level, showing clusters of high and low intensity of population inflows from other neighbourhoods of the city (Figure 4). In Barcelona, neighbourhoods with high levels of intra-urban immigration for the native population are located mainly in the centre, in some affluent neighbourhoods and in areas undergoing urban transformation with gentrification processes, but avoiding the historic centre of the city. On the other hand, the affluent neighbourhoods in the north-west of the city areas show low levels of residential mobility for all groups, with the exception of EU-15 migrants. On the other hand, the historic centre, with more precarious and rented dwellings, is present for all groups, except for Latin Americans, who show patterns more similar to those of the natives.

In contrast to Barcelona, Madrid exhibits a different spatial pattern in the arrival of new residents through intra-urban mobility. Neighbourhoods with high residential attractiveness are located in the south and some peripheral areas, reproducing the traditional class divisions, with low-income residents located in the south of the municipality (Sorando et al. 2021). The native population is highly dispersed, with reception areas in the south-east of the city, where new housing development is concentrated. Only migrants from the former EU15 move to the so-called Central Almond, high-income districts in the city centre. Other origins are located in the south, with more dispersed patterns for Africans and the rest of Europe, and higher concentrations of Asians.

BARCELONA

Spain ***Foreign-born*** ***EU-15 + DC.*** ***Other Europe***

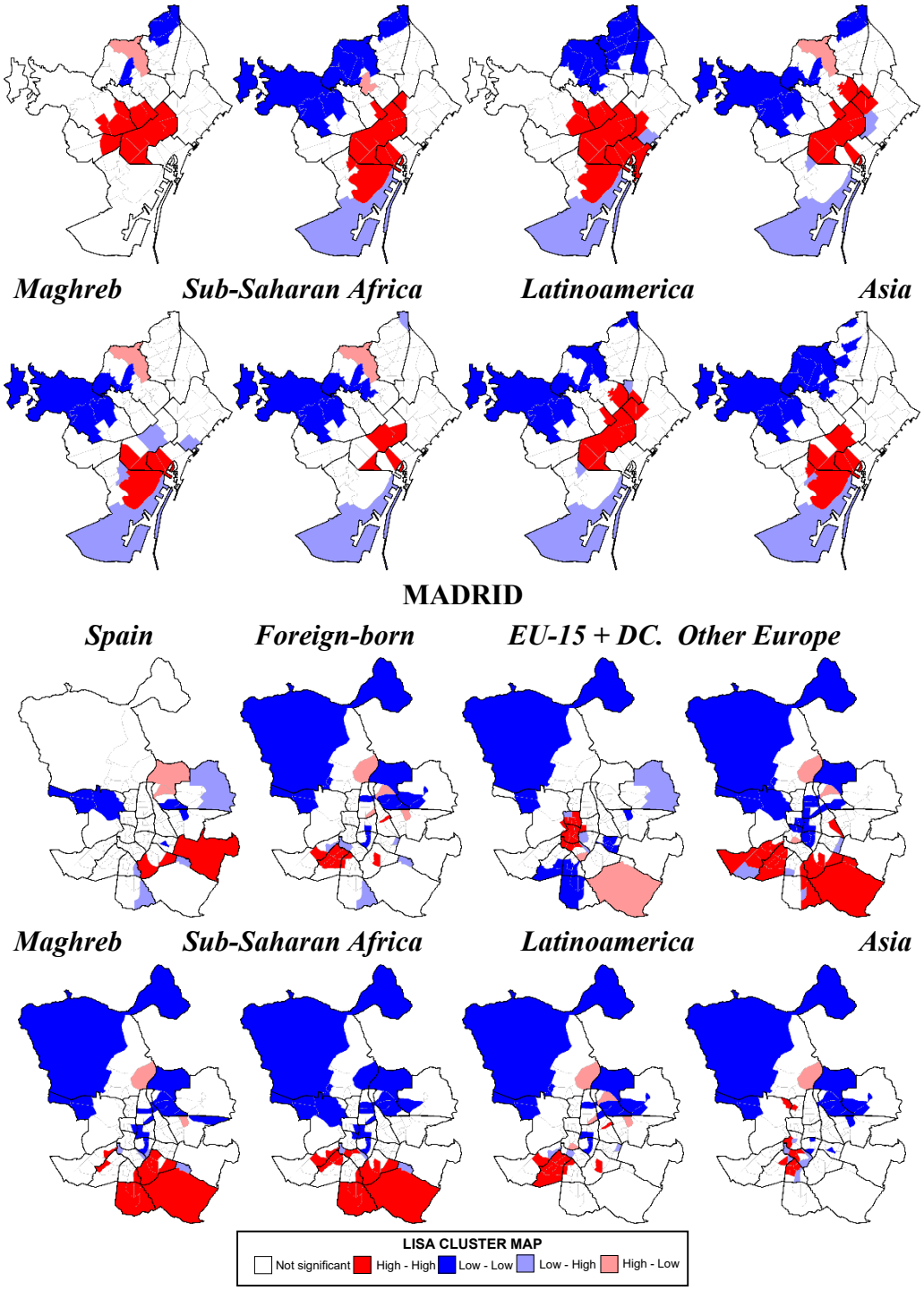

Figure 4. Local indicators of Spatial association, by origin, Barcelona and Madrid, 2009-2015

In Barcelona, both Spanish-born and foreign-born populations display significant positive spatial autocorrelation in intra-urban mobility, confirming the presence of neighbourhood clustering. For natives, Moran's I remains moderate and stable (0.389–0.439, $p < 0.001$), while for the foreign-born it increases over time (0.301 in 2007–2008 to 0.458 in 2020–

2021), indicating stronger spatial structuring. Among migrant groups, EU15 + DC. show the highest clustering (Moran's I > 0.59), with Latin Americans and Asians also presenting strong patterns, particularly in later periods. Maghreb and Other Europe record lower but significant values, whereas Sub-Saharan Africa exhibits weak and inconsistent clustering, only significant in 2020–2021.

In Madrid, Spanish-born residents show no significant spatial autocorrelation, suggesting random intra-urban mobility. By contrast, all foreign-born groups display significant clustering, with Sub-Saharan Africa presenting the strongest values (0.293–0.391), followed by Other Europe, Maghreb, and Latin America. EU15 + DC and Asia also reveal positive but lower levels of spatial structuring.

The spatial econometric indicators strongly corroborate Hypothesis 3. In both Barcelona and Madrid, the propensity to migrate to particular neighbourhoods from elsewhere in the city shows significant spatial autocorrelation among foreign-born groups, confirming that intra-urban mobility follows a structured rather than random spatial pattern, as suggested by Newberger et al (2024). In Barcelona, this structuring is evident for both native and foreign-born populations, whereas in Madrid it is largely confined to foreign-born groups.

CONCLUSIONS

Analysing intra-urban mobility has revealed spatial and temporal patterns that explain how the population is redistributed within the city and its relationship with structural factors such as the economy, international migration and the housing market. On the basis of the results obtained, some of the initial hypotheses have been confirmed, while others have been qualified or partially refuted.

First, the hypothesis of an inverse relationship between intra-urban mobility and the volume of international migration has been largely confirmed. In periods of high

immigration, pressure on the housing market limits the possibility of intra-urban relocation, thereby reducing internal mobility. In contrast, during economic downturns, when international migration declines and housing pressure is reduced, an increase in internal mobility has been observed. This suggests that housing availability and affordability play a key role in shaping residential dynamics. This contrasts with the trend towards suburbanisation observed in central cities and their metropolitan peripheries, which slowed during the crisis and accelerated during periods of economic expansion (Otero et al. 2019). Consequently, the inability of the central cities to accommodate residential demand redirects growth to their peripheries, establishing a clear link between international immigration, intra-urban mobility and suburbanisation.

However, this effect is not uniform across all population groups. While some groups have taken advantage of the greater flexibility of the housing market in times of crisis, others have remained in their neighbourhoods due to economic insecurity or lack of resources to move. This suggests that the relationship between the economic crisis and internal mobility is complex and mediated by individual socio-economic factors, particularly among immigrant populations, which tend to be more vulnerable during economic downturns.

Secondly, the results have confirmed that intra-urban mobility is not uniform across different population groups. Immigrants from lower income countries have shown higher mobility rates, confirming the greater vulnerability of these groups in the housing market, particularly during the initial stages of their settlement in the city. In contrast, the native population and immigrants from developed countries have shown lower mobility, reflecting greater residential stability and more consolidated access to housing.

Finally, the hypothesis that intra-urban mobility follows a spatially structured and non-random pattern has been fully validated. Analyses of Global Moran and LISA scores have

shown that changes of residence tend to occur between neighbourhoods with similar socio-economic characteristics, rather than being homogeneously distributed across the city. Furthermore, the identification of high and low mobility clusters confirms that intra-urban mobility is influenced by the configuration of urban space and residential segregation processes, which in both cities are characterised by a decline in centralisation (Martori and Madariaga, 2023).

Nevertheless, the study has some limitations. Due to the nature of the statistical data, movements to other municipalities within the metropolitan area were not considered, meaning that only a portion of the total residential mobility was examined. Similarly, the migrants' socioeconomic characteristics (education, occupation, year of arrival) and the housing in which they reside (tenure, habitability) were not taken into account when working with basic data. Finally, the heterogeneity of the different origins represented here may mask differential behaviours. In any case, these are challenges for future approaches.

In conclusion, the study confirms that intra-urban mobility is not a random phenomenon, as also observed in Italian cities (Rimoldi et al. 2024), but is determined by a set of structural and socio-demographic factors. The interaction between the real estate market, economic cycles and the composition of the migrant population shapes patterns of residential redistribution within the city. The results obtained provide a solid basis for future research to deepen the analysis of residential dynamics in urban contexts and the formulation of public policies aimed at managing mobility and social inclusion.

REFERENCES

Andújar-Llosa A (2017) Movilidad residencial y (re)composición social del espacio urbano en el municipio de Madrid. *Papers* 102(4): 761–792.

Ardura A, Lorente I, Sorando D (2021) Vivir en la incertidumbre: burbuja de alquiler y olas de gentrificación entre crisis en Madrid. *INVI* 36(101) 56-82. https://dx.doi.org/10.4067/S0718-83582021000100056

Ariza J, Sorando D, Barañano M (2024) La precarización de la periferia. Movilidad y desigualdad residencial en Madrid (2013-2019). *Eure*, 50(151): 1-23.

Bayona J, Domingo A (2024) Migratory flows and pandemics. An analysis of the impacts on immigrants of foreign origin in Spain. *International Migration* 62 (1): 94-111. DOI: 10.1111/imig.13197.

Bayona J, Pujadas I (2010) Cambios residenciales internos en la ciudad de Barcelona: evolución y características territoriales. *Investigaciones Geográficas* 52: 9-36.

Benéitez I, Martínez R, Cabezas A (2025) Access to housing in Spain: main barriers. *Journal of Housing and the Built Environment,* https://doi.org/10.1007/s10901-025-10257-3

Bonvalet C, Fribourg AM (1990) *Stratégies résidentielles*. Paris: Ined, Col. Congrès et Colloques, v. 2.

Bonvalet C, Carpenter J., White P (1995) The residential mobility of ethnic minorities: a longitudinal analysis. *Urban Studies* 32(1): 87-103.

Bolt G, Van Kempen R (2010) Ethnic segregation and residential mobility: relocations of minority ethnic groups in the Netherlands. *Journal of Ethnic and Migration Studies* 36(2): 333–354.

Bolt G, Hooimeijer P, Van Kempen R (2002) Ethnic Segregation in the Netherlands: New Patterns, New Policies? *Tijdschrift voor economische en sociale geografie* 93: 214-220. https://doi-org.sire.ub.edu/10.1111/1467-9663.00196

Bråmå Å (2008) Dynamics of Ethnic Residential Segregation in Göteborg, Sweden, 1995-2000. *Population, Space and Place* 14: 101-117.

Bråmå Å (2006) "White Flight"? The Production and Reproduction of Immigrant Concentration Areas in Swedish Cities, 1990-2000. *Urban Studies* 43(7): 1127-1146. https://doi.org/10.1080/00420980500406736

Brown LA, Moore EG (1970). The Intra-Urban Migration Process: a Perspective. *Geografiska Annaler: Series B, Human Geography.* 52(1): 1–13. https://doi.org/10.1080/04353684.1970.11879340

Clark WA (1992) Residential Preferences and Residential Choices in a Multiethnic Context. *Demography* 29(3): 451-466.

Cochrane W, Poot J (2021) Effects of Immigration on Local Housing Markets. In: Kourtit K, Newbold B, Nijkamp P, Partridge M (eds) *The Economic Geography of Cross-Border Migration. Footprints of Regional Science*. Springer, Cham. https://doi-org.sire.ub.edu/10.1007/978-3-030-48291-6_12

Cócola-Gant A (2016) Holiday Rentals: The New Gentrification Battlefront. *Sociological Research Online*, 21(3)

Cócola-Gant A, Lopez-Gay A (2020) Transnational gentrification, tourism and the formation of 'foreign only' enclaves in Barcelona. *Urban Studies* 57(15): 3025-3043. https://doi.org/10.1177/0042098020916111

Crisci M, degli Uberti S, Pelliccia A, Santurro M (2025) Patterns and Motivations of Intra-Urban Residential Mobility in a Southern European Metropolis. The Case of Filipino Migrants in Rome. *Population, Space and Place*, 31 (1): e2875. https://doi.org/10.1002/psp.2875

Dragan K, Gould IE, Glied S (2020) Does gentrification displace poor children and their families? New evidence from medicaid data in New York City. *Regional Science and Urban Economics* 83:103481, https://doi.org/10.1016/j.regsciurbeco.2019.103481

Duque-Calvache R, Torrado JM, Fuster N (2017) La importancia de los factores espaciales y contextuales en la movilidad residencial. *Papers* 104(4): 607-635.

Ellis M, Wright R (1998) The Balkanization Metaphor in the Analysis of U.S. Immigration. *The Annals of the Association of American Geographers* 88(4): 686-698.

Escolano S, López C, Pueyo Á (2021) Movilidad residencial intraurbana de los españoles y extranjeros en Zaragoza (España): diferentes espacios, distintos procesos. *Investigaciones Geográficas*, (76): 75–95. https://doi.org/10.14198/INGEO.18397

Frey WH (1995) Immigration and internal migration "flight" from US metropolitan areas: toward a new demographic balkanization. *Urban Studies* 32(4): 733-757.

Finney N, Simpson L (2008) Internal migration and ethnic groups:Evidence for Britain from the 2001 Census. *Population, Space and Place*, 14(2), 63‑83. https://doi.org/10.1002/psp.481

Frey WH, Liaw KL (1998) Immigrant Concentration and Domestic Migrant Dispersal: Is Movement to Nonmetropolitan Areas "White flight"?. *The Professional Geographer*, 50(2): 215-232.

Galeano J, Bayona J (2018) Residential Segregation and clustering dynamics of migrants in the metropolitan area of Barcelona: A demo-spatial analysis at the census tract level. *Revue Quetelet*, 6(1): 99-127. https://doi.org/10.14428/rqj2018.06.01.05

Galiana-Martín L (2023) Mejora ambiental, movilidad social y desplazamiento residencial en el entorno de Madrid Río. *Scripta Nova* 27(4): 183-219.

Gonzalez L, Ortega F (2013) Immigration and Housing Booms: Evidence from Spain. *Journal of Regional Science*, 53: 37-59. https://doi.org/10.1111/jors.12010

Hayes M, Zaban H (2020) Transnational gentrification: The crossroads of transnational mobility and urban research. *Urban Studies*, 57(15): 3009-3024. https://doi.org/10.1177/0042098020945247

Hochstenbach C, Musterd S. (2018) Gentrification and the Suburbanization of Poverty: Changing Urban Geographies Through Boom and Bust Periods. *Urban Geography* 39: 26–53. https://doi.org/10.1080/02723638.2016.1276718

Janssen KMJ, Cottineau C, Kleinhans R, van Bueren E (2023) Gentrification and the Origin and Destination of Movers: A Systematic Review. *Journal of Economic and Human Geography*. 114: 300-318. https://doi.org/10.1111/tesg.12581

López-Gay A (2016) Barcelona's got talent: migration, residential change and socioeconomic polarisation. *Perspectives Demogràfiques*, 1-4.

López-Gay A, Recaño J (2008) La renovación sociodemográfica de un centro urbano maduro: perfiles migratorios y filtros residenciales en la ciudad de Barcelona. *Scripta Nova* 12(126).

López-Gay A, Andújar-Llosa A, Salvati L (2020) Residential Mobility, Gentrification and Neighborhood Change in Spanish Cities: A Post-Crisis Perspective. *Spatial Demography* 8, 351–378. https://doi-org.sire.ub.edu/10.1007/s40980-020-00069-0

Mägi K, Leetmaa K, Tammaru T, van Ham M (2016) Types of spatial mobility and change in people's ethnic residential contexts. *Demographic Research* 34(41): 1161-1192. 10.4054/DemRes.2016.34.41

Martínez del Olmo A (2024) Less Access and More Inequality: Evidence of and Responses to the Housing Affordability Crisis Faced by Young People in Spain's Larger Cities. *Critical Housing Analysis* 11 (2): 229-241.
https://doi.org/10.13060/23362839.2024.11.2.580

Martori JC, Madariaga R (2023) Residential segregation by nationalities: A global and multilevel approach to Barcelona and Madrid (2008–2018). *Population, Space and Place* 29 e2655. https://doi.org/10.1002/psp.2655

Módenes JA, Marcos M, García-García DM (2024) Nueva demanda demográfica y escasez de vivienda en España: políticas de vivienda en una población postransicional. *Estudios Geográficos*, 85(297), 1163. https://doi.org/10.3989/estgeogr.2024.1163

Módenes JA, López-Colás J (2014) Recent Demographic Change and housing in Spain: Towards a New Housing System? *Revista Española de Investigaciones Sociológicas* 148: 103-134.

Musterd S, Marcińczak S, Van Ham M, Tammaru T (2017) Socioeconomic segregation in European capital cities. Increasing separation between poor and rich. *Urban Geography*, 38(7), 1062‑1083. https://doi.org/10.1080/02723638.2016.1228371

Newberger R, O'Dell M, George T (2024) Residential mobility and neighborhood characteristics in Chicago. *ChicagoFedLetter*, 495. https://doi.org/10.21033/cfi-2024-495.

Nieuwenhuis J, Tammaru T, Van Ham M, Hedman L, Manley D (2020) Does segregation reduce socio-spatial mobility? Evidence from four European countries with different inequality and segregation contexts. *Urban Studies*, 57(1): 176-197. https://doi.org/10.1177/0042098018807628

Orozco C, Bayona J, Gil F (2023) El papel del subarriendo en las trayectorias residenciales de la población inmigrante: el caso del Área Metropolitana de Barcelona. *EURE*, 49(147). doi: https://doi.org/10.7764/4372.

Otero R, García-Abad J, Domínguez-Mujica J, Pérez-Caramés A (2019) Inmigración y dinámicas territoriales en España: crisis y recuperación (2008-2017). *Anuario CIDOB de la Inmigración 2019* 190-217. https://doi.org/10.24241/AnuarioCIDOBInmi.2019.190

Palomares I, Feria JM, Susino J (2017) Mesura i evolució de la mobilitat residencial en les àrees metropolitanes espanyoles. *Papers: revista de sociologia* 102(4): 545-574.

Parreño, JM., Moreno C, Domínguez-Mujica J, Santana C (2021) Mapping foreign immigration in Spain (1998–2018). Trends and spatial patterns. *Journal of Maps* 17(1), 79-84.

Plane DA, Mulligan GF (1997) Measuring Spatial Focusing in a Migration System. *Demography* 34(2): 251-262.

Quigley JM, Weinberg DH (1977) Intra-urban residential mobility: a review and synthesis. *International Regional Science Review 2*(1): 41-66.

Rathelot R, Safi M (2014) Local Ethnic Composition and Natives' and Immigrants' Geographic Mobility in France, 1982-1999. *American Sociological Review* 79(1): 43-64.

Recaño J, de Miguel-Luken V (2016) The internal migration of foreign-born population in Southern Europe: Demographic patterns and individual determinants. In: *Minority internal migration in Europe*. Routledge, 239-262.

Recaño J (2016) La consolidación de las migraciones internas de inmigrantes como factor estructural de la movilidad geográfica de España. *Panorama social* 24(2): 49-71.

Rérat P (2012) Gentrifiers and their Choice of Housing: Characteristics of the Households Living in New Developments in Swiss Cities. *Environment and Planning A* 44: 221–236.

Reher D, Silvestre J. (2009) Internal Migration Patterns of Foreign-Born Immigrants in a Country of Recent Mass Immigration: Evidence from New Micro Data for Spain. *International Migration Review*, 43 (4), 815–849. https://doi.org/10.1111/j.1747-7379.2009.00785.x

Rimoldi SML, Crisci M, Benassi F, Raymer J (2024) Intra-urban residential mobility and segregation of foreigners in Rome. *Population, Space and Place*, 30, e2777. https://doi.org/10.1002/psp.2777

Rogers A, Raymer J (1998) The spatial focus of US interstate migration flows. *International Journal of Population Geography*, 4(1): 63-80.

Rogers A, Sweeney S (1998) Measuring the Spatial Focus of Migration Patterns. *Professional Geographer* 50(2): 232-242.

Rossi PH (1955) *Why families move: a study of the social psychology of urban residential mobility*. Glencoe, Illinois: The Free Press.

Salom-Carrasco J (2021) Cambios residenciales y migratorios de la población extranjera en la ciudad de Valencia (2014-2017). *Estudios Geográficos* 82(291) e085. https://doi.org/10.3989/estgeogr.202196.096

Simmons JW (1968) Changing Residence in the City: A Review of Intraurban Mobility. *Geographical Review* 58(4): 622-651.

Simon P (1998) Mobilité residentielle et milieu de vie des immigrés. In: Grafmeyer Y, Dansereau F (eds) *Trajectoires familiales et espaces de vie en milieu urbain.* Lyon, Presses Universitaires de Lyon, 417-445.

Skifter H (2017) Selective moving behaviour in ethnic neighbourhoods: White flight, White avoidance, Ethnic attraction or Ethnic retention?. *Housing Studies*, 32(3): 296-318.

Sorando D, Uceda P, Domínguez M (2021) Inequality on the Increase: Trajectories of Privilege and Inequality in Madrid. *Social Inclusion 9*(2) 104-116. https://doi.org/10.17645/si.v9i2.3845

Stillwell J (2010) Ethnic population concentration and net migration in London. *Environment and Planning A*. 42: 1439-1456.

Stillwell J, Phillips D (2006) Diversity and change: Understanding the Ethnic Geographies of Leeds. *Journal of Ethnic and Migration Studies* 32(7): 1131-1152.

Thiers-Quintana J, Gil-Alonso F (2020) Dinámicas residenciales de la inmigración latinoamericana en las metrópolis de Barcelona y Madrid: cambios de tendencias durante la expansión, la crisis y la poscrisis. *Documents d'Anàlisi Geogràfica*, 66(1): 57-82.

Unal U, Hayo B, Erol I (2024) The Effect of Immigration on Housing Prices: Evidence from 382 German Districts. The Journal of real Real Estate Finance and Economics. https://doi.org/10.1007/s11146-024-09988-x

ANNEX

Annex I. Mann-Whithey Test for Differences in Intra-Urban Migration Rates Between Periods by Place of Birth. Barcelona and Madrid.

Barcelona

Place of Birth	High immigration to low immigration			Low immigration to high immigration			High immigration to low immigration		
	Mean Ranks		p-value	Mean Ranks		p-value	Mean Ranks		p-value
	2007-2008	*2009-2015*		*2009-2015*	*2016-2019*		*2016-2019*	*2020-2021*	
Spanish-born	59.32	87.68	0.000	82.49	64.51	0.010	73.21	73.79	**0.933**
Foreign-born	65.95	81.05	0.031	96.60	50.40	0.000	62.04	84.96	0.001
EU15 + DC.	65.18	81.82	0.017	81.52	65.48	0.022	68.85	78.15	**0.184**
Other Europe	69.44	77.56	**0.246**	93.15	53.85	0.000	73.18	73.82	**0.928**
Maghreb	61.47	85.53	0.001	93.04	53.96	0.000	67.82	79.18	**0.104**
Sub-Saharan Africa	61.31	85.69	0.000	90.10	56.90	0.000	71.68	75.32	**0.604**
Latin America	68.45	78.55	**0.149**	99.84	47.16	0.000	54.67	92.33	0.001
Asian	64.14	82.86	0.007	93.22	53.78	0.000	83.73	63.27	0.003
Total	62.04	84.96	0.001	86.96	60.04	0.000	64.99	82.01	0.015
Madrid									
Spanish-born	112.84	142.16	0.001	128.83	126.17	**0.773**	129.21	125.79	**0.710**
Foreign-born	122.33	132.67	**0.262**	168.80	86.20	0.000	115.36	139.64	0.008
EU15 + DC.	111.92	143.08	0.001	130.81	124.19	**0.473**	113.20	141.80	0.002
Other Europe	118.24	136.76	0.044	177.89	77.11	0.000	160.58	94.42	0.000
Maghreb	117.34	137.66	0.028	163.21	91.79	0.000	136.72	118.28	0.045
Sub-Saharan Africa	123.77	131.23	**0.418**	151.98	103.02	0.000	117.24	137.76	0.025
Latin America	124.53	130.47	**0.519**	175.02	79.98	0.000	106.66	148.34	0.000
Asian	120.61	134.39	**0.135**	168.66	86.34	0.000	147.46	107.54	0.000
Total	118.77	136.23	**0.058**	144.23	110.77	0.000	119.67	135.33	**0.089**

Notes: The table reports the results of the Mann–Whitney U test comparing intra-urban migration rates between consecutive periods by place of birth. Mean ranks are reported for each group. A higher mean rank indicates a tendency toward higher migration rates relative to the comparison group. Statistical significance is reported at the 5% level ($p < 0.05$).

Annex II: Significant Pairwise Differences in Intra-Urban Mobility Rates by Place of Birth (Tukey HSD), City and Period. Barcelona and Madrid

City	Period	Homogeneous group (mean)	Significant differences
Barcelona	2007-2008	Spanish-born (34.20)	Spanish-born < all other groups
		EU15 + DC (73.62), Sub-Saharan Africa (85.09), Maghreb (92.15	EU15/Sub-Saharan/Maghreb < Other Europe/Latin America/Asian
		Other Europe (133.65), Latin America (156.76), Asian (164.70)	
	2009-2015	Spanish-born (40.17)	Spanish-born < all groups
		EU15 + DC. (83.27), Sub-Saharan Africa (101.94)	EU15 < Maghreb/Other Europe/Latin America/Asian
		Sub-Saharan Africa (101.94), Maghreb (121.47)	Sub-Saharan Africa < Other Europe/Latin America/Asian
		Other Europe (130.40)	
		Latin America (159.18), Asia (192.84)	
	2016-2019	Spanish-born (36.06)	Spanish-born < all groups
		EU15 + DC. (74.90), Sub-Saharan Africa (72.36), Maghreb (74.5	EU15/Sub-Saharan/Maghreb < Other Europe/Latin America/Asian
		Other Europe (98.56), Latin America (104.64), Asia (123.40)	
	2020-2021	Spanish-born (36.18)	Spanish-born < all groups
		EU15 + DC. (79.48), Sub-Saharan Africa (73.16), Maghreb (80.9	EU15/Sub-Saharan/Maghreb < Other Europe/Latin America/Asian
		Other Europe (99.21), Asia (106.49), Latin America (125.49)	
Madrid	2007-2008	Spanish-born (40.4)	Spanish-born < all groups
		EU15 + DC. (59.6)	EU15 < Sub-Saharan/Maghreb/Other Europe/Asian/Latin America
		Sub-Saharan Africa (112.4), Maghreb (116.9), Other Europe (123	Sub-Saharan/Maghreb/Other Europe < Asian/Latin America
		Asian (178.5)	
		Latin America (198.1)	
	2009-2015	Spanish-born (44.1)	Spanish-born < all groups
		EU15 + DC. (68.3)	EU15 < Sub-Saharan/Maghreb/Other Europe/Asian/Latin America
		Sub-Saharan Africa (113.1)	Sub-Saharan Africa < Maghreb/Other Europe/Asian/Latin America
		Maghreb (128.0), Other Europe (128.0)	
		Asian (187.0)	
		Latin America (198.4)	
	2016-2019	Spanish-born (43.8)	Spanish-born < all groups
		EU15 + DC. (66.5)	EU15 < Maghreb/Other Europe/Sub-Saharan/Asian/Latin America
		Maghreb (81.3), Other Europe (87.5), Sub-Saharan Africa (89.0)	Maghreb/Other Europe/Sub-Saharan < Asian/Latin America
		Asian (129.1), Latin America (136.7)	
	2020-2021	Spanish-born (44.0)	Spanish-born < all groups
		Other Europe (71.8), Maghreb (73.8), EU15 + DC. (75.2)	EU15/Other Europe/Maghreb < Sub-Saharan/Asian/Latin America
		Sub-Saharan Africa (103.8)	
		Asian (111.8)	
		Latin America (149.7)	

Note: One-way ANOVA was applied separately for each migratory period and city to test whether intra-urban mobility rates differed significantly by place of birth. When the overall F-test was significant, Tukey's HSD post-hoc test was used to identify group differences. Groups listed together in the same row do not differ significantly, whereas groups appearing in different rows display statistically significant differences ($p < 0.05$).

ANNEX 3

Calculation of Global Moran's I

$$(1)\ I\ =\ \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n}w_{ij}}\frac{\sum_{i=1}^{n}\sum_{j=1}^{n}(y_i-\underline{y})(y_j-\underline{y})}{\sum_{i=1}^{n}(y_i-\underline{y})}\ for\ i\ \neq\ j$$

where n is the number of spatial units i and j, y_i is the i^{th} spatial unit, $\underline{y}$ is the mean of y, and w_{ij} is the spatial weight matrix, where j represents the regions adjacent to i. Moran's I can take on values [-1,+1], where – 1 represents strong negative autocorrelation, 0 no spatial autocorrelation and 1, strong positive autocorrelation.

Calculation of LISA (Local Indicator of Spatial Association)

The Moran Local Index (Ii), known as the Local Indicator of Spatial Association (LISA) and developed by Anselin (1995), provides a measure of the intensity and direction of spatial autocorrelation at the municipal level.

The measure for LISAs is defined as:

$$(2)\ I(d)\ =\frac{(y_i-\underline{y})\sum_{j=1}^{n}w_{i\,j}(y_i-\underline{y})}{\frac{\sum_{i=1}^{n}(y_i-\underline{y})}{n}}\ for\ i\ \neq\ j$$

where the global mean is assumed to be an adequate representation of the variable of interest y.