Bonal, X., Zancajo, A. and Scandurra, R. (2019) Residential segregation and school segregation of foreign students in Barcelona. Urban Studies, (doi:10.1177/0042098019863662).

http://eprints.gla.ac.uk/197406/

Deposited on: 26 September 2019

Abstract

This article examines the dynamics of the relationship between residential and school segregation in Barcelona. The analysis explores which educational and non-educational drivers foster the school segregation of foreign students between the city's neighbourhoods. The article also analyses to what extent the particularities of Barcelona's admissions policy, which combines catchment areas with high levels of school choice, generates specific mechanisms of contextually bound school segregation within the local education market. The results confirm that residential segregation and educational segregation are two interrelated phenomena in Barcelona. In addition, the supply of publicly subsidized private schooling in the neighbourhoods is a main factor of both educational segregation and isolation, especially in those neighbourhoods with a high concentration of foreign pupils. Based on the results, the article elaborates on the challenges for local education policymaking to address the dynamics of school segregation in urban spaces.

Introduction

Social inequalities have increased in many urban spaces in the globalized world. Economic growth and social development have been unequally distributed and have caused urban fragmentation and segmentation across neighbourhoods. Globalization and polarization have

occurred simultaneously, even within cities in countries with strong welfare regimes (Musterd et al. 2017). Moreover, the increase in social inequality since the mid-1970s and the incapacity of governments to use public and social policies to reduce it (Atkinson, 2015) have contributed to a worsening of socioeconomic segregation in major cities. Socioeconomic spatial segregation has increased because of all these trends, although its intensity and characteristics vary, depending on factors such as pre-existing urban segregation, the processes of economic restructuring, the development and transformation of welfare states or the characteristics of housing policies (Musterd and Ostendorf, 1998; Tammaru et al., 2015). Socioeconomic fragmentation and urban polarization particularly affect migrant groups in the context of increasing immigration flows. A recent report by the OECD (2018a) underlines significant clustering and isolation processes of migrant population in EU cities, higher levels of spatial concentration of the poorest migrant groups and a positive relationship between their spatial segregation and urban poverty (OECD, 2018a: 16).

Barcelona has not been immune to processes of social fragmentation and increasing spatial inequalities, which have affected especially migrant population. The arrival of more than 300,000 people in one decade (Galeano and Bayona, 2015: 119) altered the social and ethnic composition of Barcelona's districts and its metropolitan area. Between 2000 and 2016, the foreign population rose from 46,091 to 284,907 inhabitants[1], an increase of 518% and they nowadays represent 16.6% of the total population of the city. Migration starts mainly in Asia (25.2%), South America (21.7%), Southern Europe (12.6%) and North Africa (5.6%). The most represented countries of origin are Italy (9.7%), Pakistan (7.2%), China (6.9%), Morocco (4.7%) and Bolivia (3.5%) (Ajuntament de Barcelona, 2016). Migrant groups have particularly

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[1] Data from Institut d'Estadística de Catalunya
http://www.idescat.cat/poblacioestrangera/?b=0&geo=mun:080193&nac=d208).

suffered the effects of economic crisis regarding unemployment, material deprivation or access to housing (Alonso et al. 2015).

Migration inflows reaching Barcelona and other Spanish cities have substantially increased the share of foreign students in the Spanish education system. In 2000, the number of students with non-Spanish nationality accounted for only 2% of all students in primary education, yet by 2009, that figure had reached 12%, it then stabilized after the international economic crisis to around 9% (MECD, 2017). Migration inflows and demographic trends have put pressure on education authorities to integrate foreign pupils into preschool and compulsory education. While access to compulsory education has been guaranteed for all children, between-school segregation of foreign and low Socio-Economic Status (SES) students has increased significantly, so that Spain is one of the European countries that has a higher social segregation of schools (Alegre and Ferrer, 2010: 447).

Residential segregation, middle-class families' strategies of school choice and the school supply characteristics at a local level are key drivers of school segregation of vulnerable students (van Zanten, 2005; Maloutas, 2007; Boterman, 2013). The interaction between all these factors produces strong school segregation, as well as a concentration of foreign students in specific schools within city neighbourhoods, which is significantly higher than their residential segregation (Bonal, 2012).

This article seeks to analyse which local and contextual factors influence school segregation of foreign students focusing on the case of Barcelona as an example of a city that has experienced

large migration inflows in the last decades[2] as well as experiencing a significant impact of the economic crisis on spatial inequalities. High unemployment rates, a significant increase in income inequality, an increase in poverty rates and a lack of social housing have increased residential segregation in the city between the foreign and non-foreign population and among income groups (Nel·lo and Blanco, 2014; Sánchez Castro, 2014). The close link between residential and school segregation (Frankenberg, 2013; Hamnett and Butler, 2013) has undoubtedly transferred these spatial tensions to the school level, especially in a city that had already experienced significant levels of school segregation between foreign and non-foreign students even before the economic crisis (Síndic de Greuges, 2008). The case of Barcelona is of particular interest since school segregation may be favoured by a quasi-market system that provides a significant choice to families. In addition, the distribution of different nationalities among districts and neighbourhoods (Bayona and López-Gay, 2011) and their patterns of school choice may potentially explain the different relationship between residential and school segregation.

The article is structured as follows. In the next section we describe the main characteristics of the spatial distribution of foreign students in Barcelona by world region's nationality. The section after presents the main characteristics of the Spanish quasi-market education system, including a description of the school admissions policy and the school catchment area system in Barcelona. We proceed by describing first the data and the methods used for analysing the school segregation and concentration (or isolation[3]) of foreign pupils. The section after that evaluates the relationship between the school distribution of foreign pupils and different

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[2] Catalonia, and Barcelona in particular, received a high number of migrants from Southern Spanish regions in the 1960s and 1970s. This internal migration was estimated to involve one million people in the mid-1970s and constituted a great challenge in terms of social and educational integration.
[3] The isolation index is the most common way to measure concentration. The index estimates the probability of an immigrant student sharing a school with other immigrant students. In this context, isolation and concentration can be taken as synonymous.

educational and non-educational factors for the 10 city districts and for all their neighbourhoods. This section precedes the analysis of the plausible drivers of school segregation and isolation in the city neighbourhoods of Barcelona. Finally, we conclude, considering some policy implications of our results.
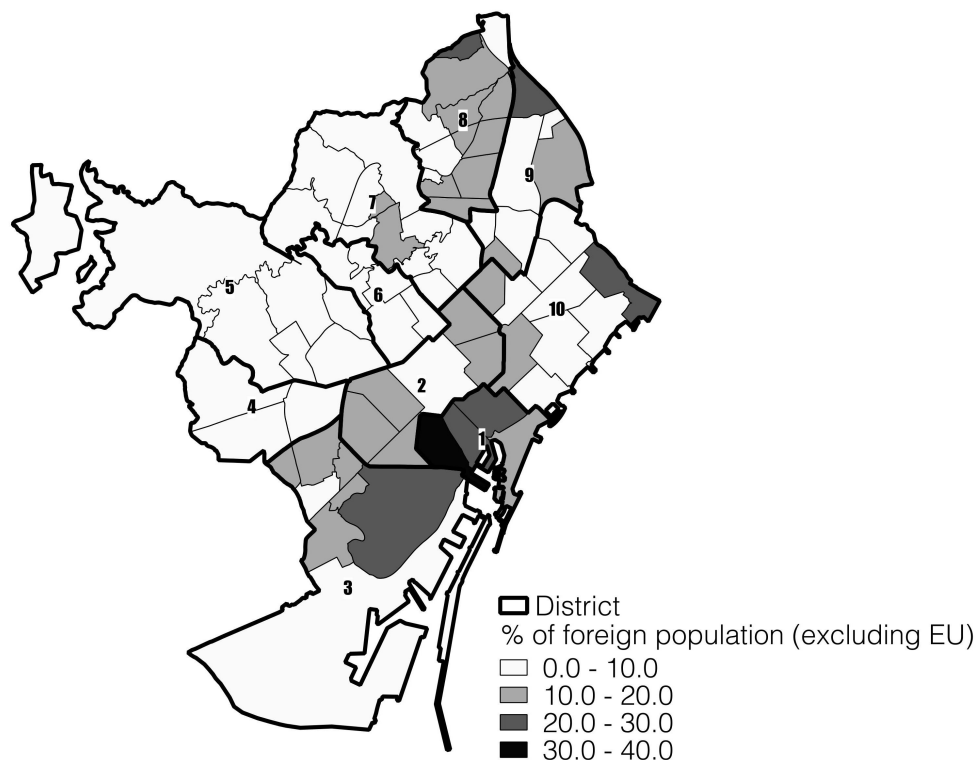
Migration and residential segregation in Barcelona

The rapid increase of migration in Barcelona was particularly acute at the beginning of the 21st century. According to the city council's estimates, while foreign residents accounted for 3.5% of all residents in 2000, this figure reached 18.1% in 2009. After that year, the economic crisis decelerated the arrival of foreign population to the city (Melguizo and Royuela, 2017) and in 2016, 16.6% of the city's population were foreign and 23% were born abroad (including foreign-born people who had obtained Spanish citizenship) and around 30% had a foreign background (OECD, 2018b).

Despite the reduction in the arrival of foreigners after the economic crisis, the residential segregation of the foreign population increased after 2009 (Nel·lo and Blanco, 2015). Income inequality widened in the wake of the economic crisis, especially between foreign residents (women in particular) and Spanish nationals (OECD, 2018b: 34). The economic crisis particularly affected migrant groups regarding labour market participation and income and converted foreign origin is one of the key factors that increases the probability of being poor or belonging to the bottom sector of income distribution (Parella, 2016).

In Barcelona, the level of concentration of different ethnic groups varies. Moroccans and Pakistanis have higher residential segregation indexes, while Latin American or Western

European migration shows more peripheralization (Arbaci and Malheiros, 2009: 237; Dominguez et al., 2010: 8). Figure 1 shows the spatial distribution of the non-EU foreign population in the city. District 1 has the highest concentration of non-EU citizens, with Pakistani and Chinese groups being the most represented. This is the historic urban centre of the city, which is a place of arrival and settlement. However, the most reproduced residential pattern is the presence of non-EU foreign populations in peripheral working-class neighbourhoods (Bayona and López-Gay, 2011: 384).

Figure 1: Distribution of non-EU immigrant populations by neighborhood.

Source: Authors' elaboration from Barcelona City Council database.

Despite the unequal spatial distribution of foreign populations, the overall level of residential segregation may be considered moderate, with recent estimations of a general dissimilarity index of 0.3 for the overall foreign population and under 0.5 for most nationalities (Galeano and Bayona, 2015: 122). Still, while this model of urban segregation might explain lower levels

of inter-district segregation of the foreign population, it does not exclude high levels of intra-district segregation. At the neighbourhood level, foreign population segregation could be equal or higher than that observed in Northern European cities (Musterd and Fullando, 2008). In short, relatively low segregation values do not correctly report the exclusion of residential marginalization derived from limited access to good housing and labour informality. Interestingly, the specificities of the spatial dispersion and residential marginalization of the foreign population in the city make it particularly relevant to observe within-district and within-neighbourhood processes of spatial polarization. The internal inequalities within neighbourhoods and the particularities of local education markets can play a decisive role in understanding processes of school segregation.

School admissions policy in Barcelona in a quasi-market education system

Despite the existence of a common curriculum in compulsory education and the absence of early tracking (Mons, 2007), the level of social inclusion in Spanish schools is below the OECD average[4]. The quasi-market characteristic of the Spanish education system contributes to a greater social school segregation. This is because of higher parental school choice, unequal access of different social groups to public and publicly subsidized private schools and different patterns of choice among social groups, including native 'white flight' and migrants' school closure and emulation (Farre et al., 2018).

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[4] The PISA index of social inclusion measures the degree to which students from different socioeconomic backgrounds attend the same school or the degree to which different schools have students with different socioeconomic profiles (OECD, 2015: 3). The index varies between 0 and 100. The higher value of the index the higher level of social inclusion. According to PISA 2015, the index of social inclusion for Spain was 69, while the OECD average was 76.5.

The historical inhibition of the state in education consolidated a private education sector which has retained a significant share of the education market, even following a progressive increase in the quality and quantity of public education since the democratic transition (Bonal, 2012). Today, the publicly subsidized private sector accounts for 25% of the student population. In Barcelona, the proportion of children in compulsory schooling attending private subsidized schools is 56.6%, while 41.2% of students attend public schools, with only 2% enrolled in private independent schools (CEB, 2017). Private subsidized schools are highly diverse, both regarding their school ethos and their economic conditions. Around 60% of all private subsidized schools are Catholic schools, while the rest adopt different legal forms such as associations, cooperatives or foundations. While some schools are "like public schools" and are open to all students, others charge *de facto* high school fees[5] (in the form of voluntary contributions), which prevent most low-income students from attending. Despite these differences, all private subsidized schools are under the same regulations as public schools regarding school admissions, curriculum obligations and other requirements and standards regarding material resources, facilities and teaching staff (Villarroya, 2000). However, the formal equality of the system does not impede public schools from assuming the highest share of foreign students (81.1%), while only the 13.6% of them attend private subsidized schools and the rest are enrolled in private independent schools (MECD, 2017).

School admission policy in Spain was originally established by the 8/1985 Organic Law of the Right to Education[6]. This Education Act constructed a unique system of admissions policy to

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[5] A recent study carried out in the city of Barcelona estimates that despite formal gratuity, most publicly subsidized private school and many public schools charge *fees* to parents (in the form of voluntary contributions). The average private cost of schooling in the richest district of Barcelona is 1640€, while this cost is 634€ in the poorest district (with a reduced presence of publicly subsidized private schools) (Bonal and Zancajo, 2019).

[6] In Spain, basic education is organized into three education levels: preschool (3-5 years-old); primary (6-11 years-old) and lower secondary education (12-16 years old). Despite the fact that preschool is not a compulsory education level, it is almost universal (the rate of enrolment is over 94%). As a result, the school admission process takes place at the preschool education level.

both public and private subsidized schools. According to these regulations, all publicly financed schools should be free of charge, not allowed to select their student population and had to guarantee the participation of parents and teachers in school decision-making through school council bodies. Parents have the capacity to express their school preferences and students are assigned following the Boston mechanism[7]. In cases of overly high demand, applications are prioritized using different criteria, which include residential proximity, the enrolment of siblings at the school and household income. This system of school access converts the Spanish education system into a quasi-market model: families can choose a school freely but the state has the capacity to intervene in situations of overdemand, while schools have no formal capacity to select their student population.

While the main regulations of school admissions are common, regional governments have an extensive capacity for defining their own education policies. Regional governments may decide on the characteristics of school supply (e.g., opening schools or closing/opening new classrooms), define the limits of school catchment areas if applicable (public and private subsidized schools share the same areas) or establish criteria for compensatory policies and school budget distribution. In addition, regional governments establish criteria aiming to ensure a balanced distribution of Students with Special Needs (SSN) among all schools. Schools must reserve a number of places for SSN pupils[8] until the end of the pre-enrolment process. Those schools without demand for SSN may then fill the available places with other pupils. While this system leaves no margin for schools to select their student population, the absence of

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[7] The so-called 'Boston mechanism' is a student placement procedure, through which students (or their families) submit their preference lists. Given the reported preferences, the allocation of school places follows an algorithm that maximizes students' preferences, subject to the pre-specified priorities of students at each school; places at each school are allocated based on students' rank.

[8] SSN students include those with physical or mental disabilities as well as socially disadvantaged and migrant students having late enrolment into the education system. Professional teams from the regional Department of Education oversee the identification and classification of SSN students.

demand from SSN students for school places in some schools explains their unequal distribution among public and private schools[9].

In Barcelona, school admissions policy is managed by the *Consorci d'Educació* (CEB), a public body formed by representatives of the Catalan regional government and the city council. In 2006, the CEB established a distinctive system of school choice. Although 29 catchment areas of access to compulsory education were defined, a minimum common choice capacity was established. While each family could choose all the schools located within the catchment area, a minimum of six schools (three public and three private subsidized) should be guaranteed as proximity schools. This system was modified in 2012, widening school choice for all families. The minimum number of schools considered as proximity schools doubled. Considering the oversupply of schools in certain areas of the city, the estimated average of proximity schools per family increased from 7.9 to 16.7 schools. By shifting school choice possibilities, the CEB tried to compensate for the unequal internal distribution of school catchment areas (which differ both in the overall number of schools and in public/private distribution), while attempting to reduce the supposedly strong relationship between residential and school segregation. By allowing for greater choice possibilities, it was expected that families living in poorer neighbourhoods of the city would have a way out of local schools, reducing overall school segregation.

Despite there being no specific assessment of the effects of extending school choice possibilities, school segregation in Barcelona remained stable between 2006 and 2016, increasing slightly even in some districts (Síndic de Greuges, 2016). Thus, as in other European

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[9] In Barcelona, 68.7% of SSN students starting the school year 2018-19 are enrolled in public schools (despite public schools hosting only 49.5% of enrolments) while 31.3% are enrolled in private subsidized schools. See https://ajuntament.barcelona.cat/premsa/wp-content/uploads/2018/09/180907_NDP_inici_curs.pdf.

cities, expanding choice for all families appears not to have altered spatial educational inequalities (see, for instance, articles by Boterman (2019), Ramos Lobato and Groos (2019), or Cordini et al. (2019) in this special issue). This could be related to two main phenomena: firstly, a moderate-weak relationship between residential segregation and school segregation in the city, and secondly, the significant differences in choice patterns between middle and lower classes (and ethnic minorities), which have different demand rationalities, choice possibilities and diverging preferences (Bonal and Zancajo, 2018). Evidence for school choice patterns in Barcelona confirms the heterogeneous choice sets and priorities among families depending on their social origin or their country of origin (Alegre and Benito, 2012). However, there is less evidence regarding the potential effects of residential segregation on school segregation of foreign students, an aspect that we try to elucidate herein.

Interestingly, a moderate level of residential segregation and a potentially equitable school admissions system do not translate into high levels of educational inclusion. Indeed, the school segregation of foreign students is notably high in certain neighbourhoods. Several reasons may explain this apparent contradiction. Firstly, it is true that all Spanish regions can establish income thresholds in order to give priority to low-income families in the case of excessive demand for a specific school. Most regions, however, including Barcelona, set thresholds that apply to very poor families, usually those in receipt of less than the minimum wage. Doing this restricts the choice priority to the very poor rather than to a broader range of low SES families. Secondly, as argued before, while publicly funded private schools cannot charge school fees, some of them do ask for "voluntary" contributions to carry out complementary or extracurricular activities, a practice that *de facto* results in monthly payments. While this is common practice in publicly subsidized private schools, some public schools (through parental associations) also ask for family contributions to provide a richer educational experience for

their children. These practices discriminate directly against the many who cannot afford such extra payments[10] by preventing them from applying to "expensive" schools or even by excluding them from participating in specific school activities (Villarroya, 2000). Thirdly, the rapid increase in foreign students has generated processes of 'white flight', whereby the local population migrates from public to subsidized private schools with the most advantaged socioeconomic school composition. In addition, the raise of foreign population has also boosted processes of cultural emulation in terms of school choice: foreign families copy the options taken by families with similar cultural backgrounds, which increases the concentration of foreign students in particular schools (Bonal, 2012). There have been significant gentrification processes in the most urbanized spaces, but they have not been able to reduce school segregation (Síndic de Greuges, 2016). Strategies adopted by families when choosing schools produce processes of differentiation within gentrified neighbourhoods and make it possible for middle-class families to avoid those schools with a higher proportion of disadvantaged students. As in other European countries (Rostas and Kostka, 2014; Dupriez et al., 2018) and despite the availability of legal and political instruments to regulate such dynamics, education and social policies have been mostly unable to compensate for inequalities in the distribution of ethnic minority students or students from low-income families. Instruments such as the reservation of places at schools for at-risk students, the balanced distribution of latecomers between all publicly funded schools or systems for controlling fraud perpetrated by parents or schools have been disregarded to be used as potential desegregation measures by policymakers (Síndic de Greuges, 2016; Bonal, 2012).

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[10] Cost differences between public and subsidized private schools are explained partly by reduced public funding to private schools, which receive fewer funds per capita than public schools. Private spending in public schools accounts for 38.7% of the private spending in subsidized private schools (Rogero and Andrés- Candelas, 2014).

Data and methods

Our analysis aims to elucidate the main determinants of school segregation of foreign pupils in primary education in Barcelona. We opt for primary education (pupils aged between three and twelve years old) because this is the educational level with the highest school segregation of foreign pupils[11]. We use two data sources. The primary education level data were retrieved from the CEB database and refer to the 2016-17 academic year. They include information about schools, catchment areas, neighbourhoods and districts. The socioeconomic characteristics of the neighbourhoods were extracted from the publicly available statistics produced by Barcelona City Council and refer to 2015[12]. Taken together, they represent the latest currently available data at the time of writing. Due to the limits of the administrative registers, foreign pupils and population can be measured only through their share of the population with non-Spanish nationality, therefore the objective population of the analysis refers only to foreign population and does not include other forms of immigrant background (i.e., based on pupils' or their parents' country of origin). Table 1 shows the distribution of foreign pupils by world regions of origin.[13]

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[11] In Catalonia, in the course of 2013-14 the overall dissimilarity index of foreign students in primary education was 0.48, while for secondary education it was 0.39. The bigger size of secondary schools and a reduced number of schools explains this difference (Síndic de Greuges, 2016).

[12] Unfortunately, socioeconomic statistical data of catchment areas are not available.

[13] The world regions' categories are those used by the Catalan Education Department.

Table 1. Foreign students by region of origin in primary education. Academic year 2016-2017

			North America		Asia and Oceania		Central and South America		Maghreb		Rest of Africa		Rest of Europe		European Union	
		% foreigners	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Barcelona		13,5	1,2	194	36,2	5964	24,1	3977	10,5	1735	2,3	371	7,6	1256	18,1	2978
	1	43,1	0,7	15	59,3	1361	10,4	238	14,2	327	0,8	18	1,5	34	13,2	302
	2	13,7	2,2	50	47,5	1061	18,7	417	4,4	99	0,9	21	4,7	106	21,4	478
	3	21,6	0,5	11	45,2	959	24,4	517	11,8	251	1,4	30	5,2	111	11,4	242
	4	7,6	3,7	27	23,0	168	23,4	171	3,4	25	1,6	12	15,7	115	29,2	214
District	**5**	3,9	4,1	30	19,9	147	17,5	129	2,0	15	1,9	14	15,6	115	39,0	288
	6	9,9	2,0	17	26,4	230	26,3	229	5,9	51	1,0	9	6,7	58	31,8	277
	7	9,9	0,8	10	19,5	250	36,3	466	11,2	144	2,3	30	10,7	138	19,2	247
	8	21,4	0,2	4	22,7	530	40,7	950	13,9	324	6,0	141	9,0	210	7,4	173
	9	10,7	0,4	5	26,3	331	31,1	391	15,8	199	4,4	55	10,3	129	11,7	147
	10	14,9	1,0	25	35,5	927	18,0	469	11,5	300	1,6	41	9,2	240	23,4	610

As the data included in the table show, pupils from both Asia and Oceania and Central and South America are the most represented sub-groups of foreign pupils in the city, as well as in each of the ten districts. To capture the heterogeneity of foreign pupils and how school segregation affects different sub-groups, we have constructed two additional school segregation measures for these sub-groups.

All the measures in the regression analysis in Section 6 are percentages of the reference population and are centred by subtracting their mean[14]. Neighbourhoods were selected as units of analysis because they optimally capture school enrolment dynamics. While the average district population in Barcelona is 165,995 inhabitants, the neighbourhoods' average population is 22,049 inhabitants. The income of the neighbourhoods is set at 100, which is the average income of the city of Barcelona[15] and the variable low level of educational attainment

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[14] The reference population is given by the label of each variable included in the model. Given the fact that all our independent variables are continuous and to foster the interpretation of the results, we have proceeded to centre the variables by subtracting their mean. This is a common practice, which also has the advantage of reducing collinearity issues.

[15] The mean of this indicator is 97.42, because we have excluded those neighbourhoods that have only one school, as reported at the end of Section 3.

refs to the share of people in the neighbourhood with lower secondary education as a highest

level of attainment. Table 2 presents the summary statistics of the variables used.

Table 2. Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
School segregation (DI) index	61	0.331	0.113	0.020	0.590
School segregation (DI) index Central and South America students	61	0.363	0.164	0.000	0.930
School segregation (DI) index Asia and Oceania students	61	0.371	0.157	0.010	0.930
Adjusted isolation index	61	0.089	0.065	0.000	0.280
Adjusted isolation index Central and South America students	61	0.033	0.028	0.000	0.110
Adjusted isolation index Asia and Oceania students	61	0.041	0.043	0.000	0.230
Residential segregation index	61	0.126	0.056	0.010	0.310
Income average 2015, base 100	61	97.416	45.107	34.500	250.500
Low ed. attainment, % of population	61	47.193	16.107	18.400	80.600
Foreign population, %	61	16.043	8.144	5.400	47.900
Private enrolment, %	61	49.592	26.377	0.000	100.000
Immigrants students, %	61	16.639	10.609	2.400	49.300

For each neighbourhood, the Dissimilarity Indexes (DI) of residential and school segregation

for foreign populations and foreign pupils were calculated as follows:

$$DI = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{x_i}{X} - \frac{y_i}{Y}\right|$$

where x_i is the number of foreign of the unit i (census sections[16] in the case of residential

segregation and schools in the case of school segregation), X is the number of foreigners in the

neighbourhood, y_i is the number of natives of the unit i, and Y is the total number of natives in

the neighbourhood.

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[16] Census sections are administrative units used in Spanish statistical registers. These units divide each municipality into units, which range between 1,000 and 2,500 inhabitants.

In addition, the adjusted isolation index of residential and school segregation for foreign population and foreign pupils is calculated as:

$$AI = \frac{I - P}{1 - P}$$

where *P* is the percentage of foreigners in the neighbourhood and I is the isolation index, which is calculated as:

$$I = \sum_{i=1}^{n} \left(\frac{x_i}{X}\right)\left(\frac{x_i}{t_i}\right)$$

where t_i is the total population of the unit *i* (census sections in the case of residential segregation and schools in the case of school segregation). The adjusted isolation (AI) index is used, instead of the simple isolation index, because it allows for controlling of the different proportions of foreign and native pupils among the spatial units (neighbourhoods) included in the analysis (Iceland et al., 2002).

Both measures (dissimilarity and adjusted isolation) have a range between 0 and 1. Higher values indicate higher levels of segregation of the reference group among the units or higher levels of concentration of foreign populations, respectively.

The results reported in the article refer to different units. Barcelona is divided into 10 districts and a total of 73 neighbourhoods. The dissimilarity and isolation indexes refer to those neighbourhoods that have more than one school. For this reason, the final sample of neighbourhoods includes 61 cases (see Table A1 in the Appendix for details on the number of units in each neighbourhood).

Residential segregation and school segregation of foreign pupils in Barcelona

The rapid increase in foreign population in Barcelona has directly affected school enrolments in the city. As Figure 2 shows, between 2001 and 2008 (before the economic crisis), the percentage of foreign pupils increased from 5.1% to 13.2%, then decreased slightly in the period of the economic crisis and stabilized after 2013-14. The evolution of foreign pupils enrolled in public and private schools reveals that public schools enrol a higher share of foreign pupils than subsidized private schools.[17] Nowadays, 19.1% of pupils in public schools are foreign, while this proportion decreases to 5.3% in private ones.

Figure 2. Evolution of the share of immigrant students in primary education by school sector in Barcelona, 2001-2016.
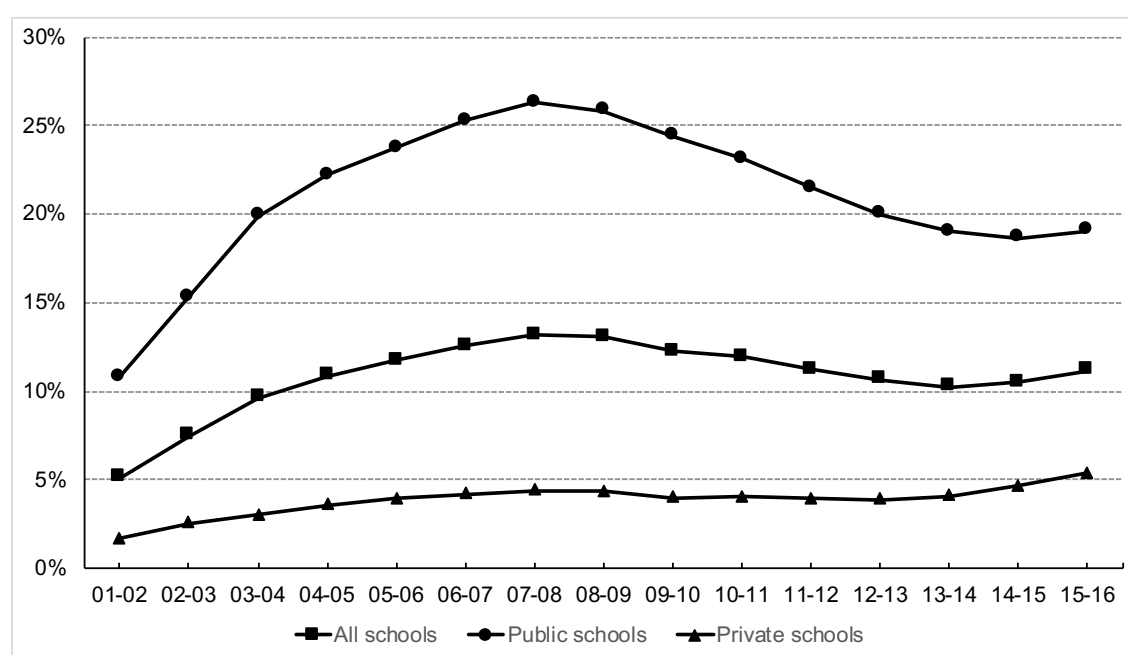

Source: Author's elaboration from CEB database.

Figure 3 shows the spatial distribution of foreign populations and foreign pupils in the city, which is notably unequal among neighbourhoods. The neighbourhoods of the three poorest

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[17] Since the admission conditions for public and subsidized private schools are formally equal by law, we should expect a similar share of migrant students.

districts (1, 3 and 8) are those with the highest proportion of both foreign populations and foreign pupils enrolled. On the contrary, the neighbourhoods of the most affluent districts (4 and 5) are those with fewer foreign residents and a residual presence of foreign pupils, whose numbers are significantly less than the proportion of foreign populations living in the districts.

Figure 3: Distribution of the immigrant population as the percentage of total population and distribution of immigrant students as the percentage of total students in Barcelona's city districts.
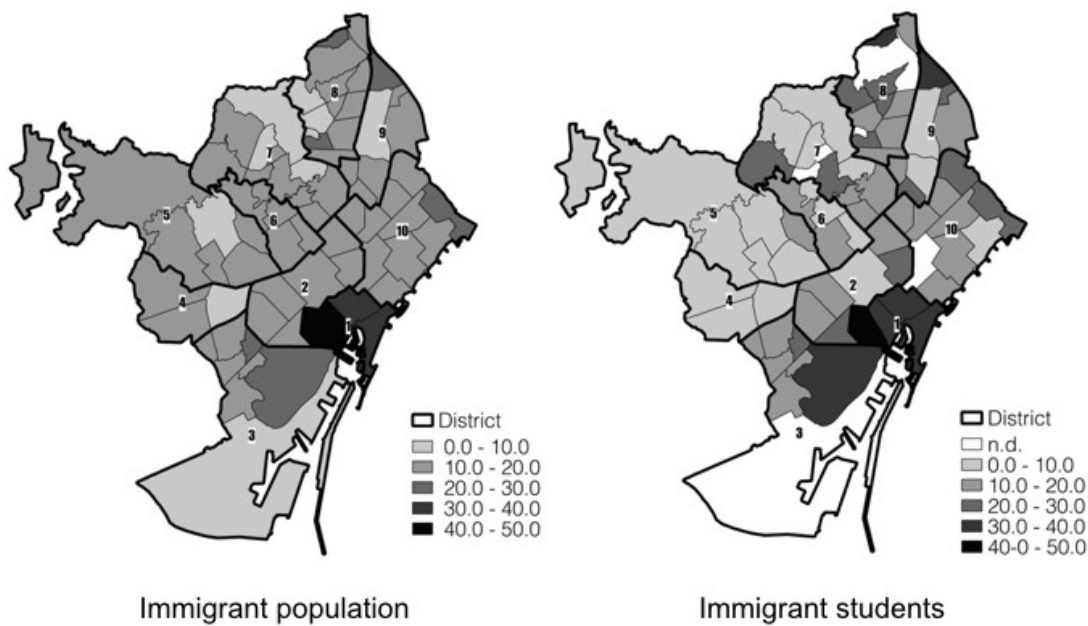

Source: Barcelona City Council Statistics and CEB database for 2016-17.

Barcelona shows a notable divergence between residential (D=0.24) and school segregation (D=0.47), as well as between residential (AI=0.06) and school adjusted isolation (AI=0.18). School segregation is notably higher than residential segregation in most neighbourhoods and for all districts (Figure 4). The same occurs with the isolation of foreign pupils in schools, which is also higher than the residential isolation of foreign populations. However, these differences are higher in some neighbourhoods than others, for both segregation and isolation indexes. Again, although levels of residential segregation of foreign populations are moderate

compared to other European cities (see, for example, the cases of Dutch cities or Helsinki in this special issue), this does not exclude their importance in explaining school segregation patterns.

Figure 4: Dissimilarity and isolation indexes of residential and school segregation of migrant populations in Barcelona.

Dissimilarity Index (Residential)

Dissimilarity Index (School)

Isolation Index (Residential)

Isolation Index (School)
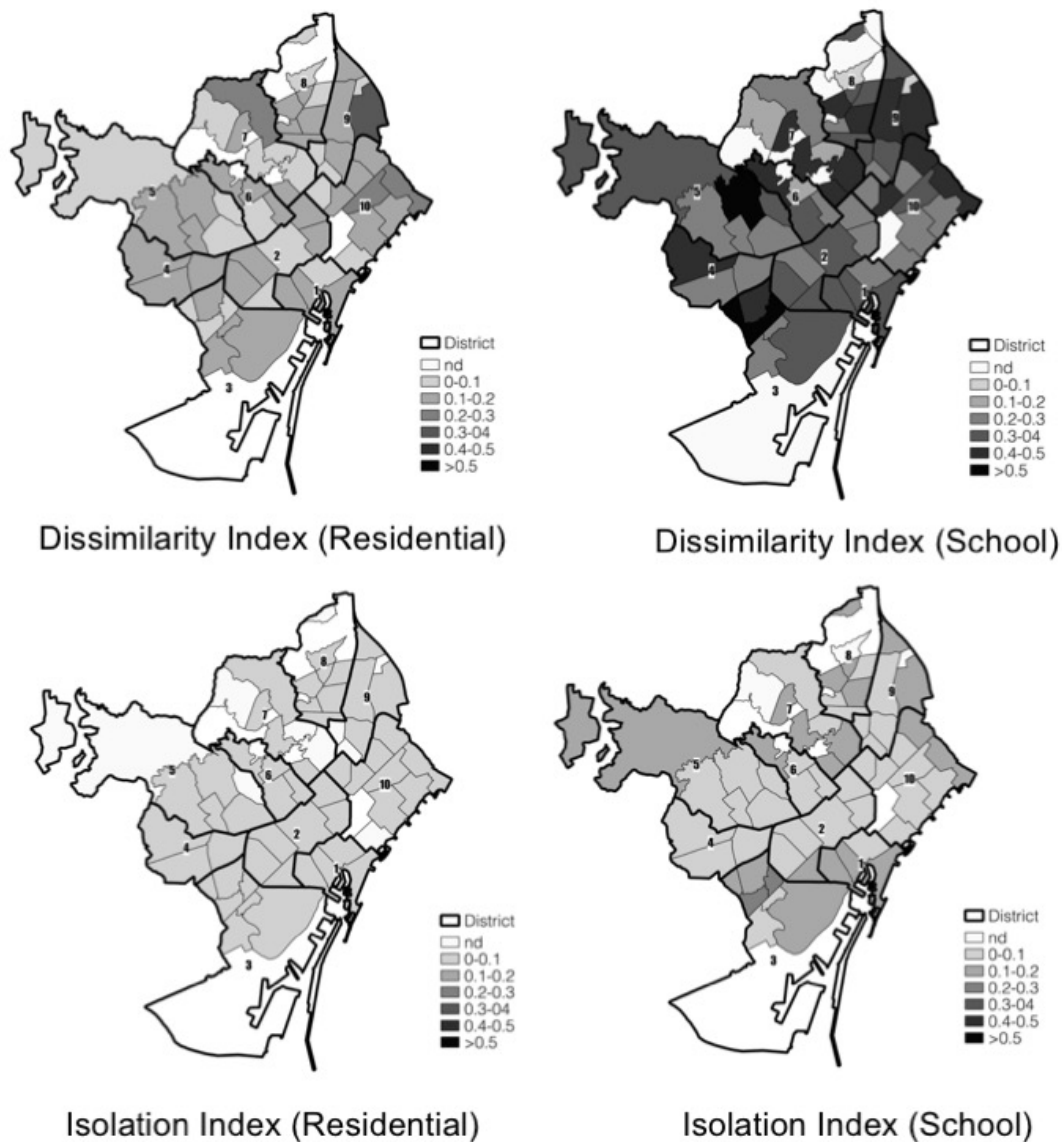
Source: Authors' own elaboration based on CEB data for 2016.

Figure 5 confirms the existence of a positive but low correlation between residential and school segregation (r=0.27) in Barcelona. In both graphs, the bisector further shows how, in most

neighbourhoods, school segregation and isolation indexes are higher than the residential ones. However, it also shows that there is a significant dispersion in this relationship between neighbourhoods. Some of them display unequal levels of school segregation of foreign pupils, even in the context of similar levels of residential segregation. The same occurs with the school isolation index, which is notably higher than residential isolation ($r=0.12$) and very low in the city.

Figure 5. Relationship between school and residential segregation according to Barcelona's neighborhoods (dissimilarity and isolation indexes).
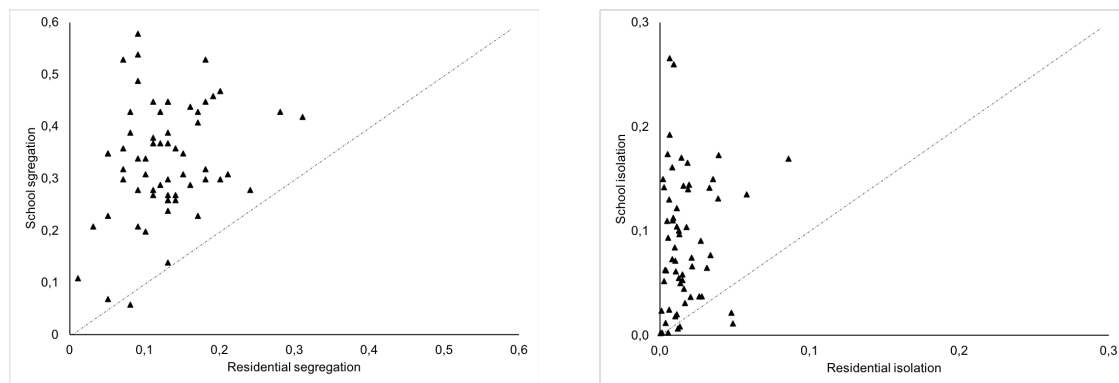
These differences among neighbourhoods could confirm the existence of distinctive territorial dynamics within specific catchment areas which exacerbate processes of school segregation and isolation for foreign pupils in the city. While access to schooling is moulded by residential segregation, other factors have to be accounted for when trying to understand the school segregation and isolation processes for foreign pupils, with social, spatial and educational factors possibly interacting as complex drivers of spatial inequality. The next section focuses on the analysis of such aspects.

Drivers of school segregation in Barcelona

To observe how social and educational factors shape school segregation and isolation in Barcelona city neighbourhoods, we carry out a sequence of OLS regressions. The modelling

follows a sequential process to describe the complex interrelation of the phenomenon. We examine the dissimilarity index (DI) and the adjusted isolation index (AI) for foreign pupils (Tables 3 and 4). To account for the heterogeneity among different groups of foreign pupils, we construct two additional measures of DI and AI for the most represented groups (i.e., Central-South American and Asian and Oceanian). The results using these measures are reported in columns 4, 5 and 6 for Central-South American pupils and 7, 8 and 9 for Asian and Oceanian pupils.

The variables are introduced sequentially; first, the socioeconomic and spatial characteristics of the neighbourhoods in columns 1, 4 and 7 (e.g., residential segregation -measured by the dissimilarity index-[18], income level, share of population with low educational attainment and share of foreign population). As a second step, we add schooling system-related factors, such as the share of foreign pupils in the school and the share of private enrolment in the neighbourhood (columns 2, 5 and 8). Finally, in columns 3, 6 and 9, we examine the interactions between the variables that, in the general model, have a significant effect. Each parameter should be interpreted as a percentage change in the mean of the dependent factor for a single change in the independent factor under consideration (e.g., 0.2 should be interpreted as a 20% change).[19]

Table 3 reports the estimates for the foreign pupils' educational segregation in Barcelona. We focus on the effect of social characteristics of the neighbourhoods. Results show that the effect of residential segregation is significantly related to educational segregation (standardized coefficient 0.605, $p<0.05$). The result holds when controlling for school characteristics in column 2, leading to a slight decrease of 13% compared to the first model. This means that the

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[18] We have also constructed a measure for residential isolation, however the association between this variable and dependent variables were not significant. These results are available upon request to the authors.
[19] By centring the mean of the independent variables, the constant should be interpreted as the mean of the dependent variable when all the other covariates are set around their average values.

average income, the share of the population with low educational attainment and the share of foreign populations have a non-significant effect on foreign pupils' school segregation (DI) for the overall population. This is reinforced when we examine the difference in the variance accounted for in the model between column 1 and 2. Among the school-related factors, we find a positive effect of the share of private enrolment on school segregation (standardized coefficient 0.165, $p<0.05$). This effect decreases (standardized coefficient 0.153, $p<0.05$) when we add the interaction effect (column 3) between private enrolment and residential segregation. The interaction is not significant, which indicates that the effect of private enrolment on school segregation does not vary at different levels of residential segregation. However, the higher presence of private schools seems to be related to higher levels of school segregation. These results indicate that the presence of private providers is a more important driver of school segregation than residential segregation. The presence of private providers may be reinforcing and amplifying the effect of residential segregation by allowing native families to develop some level of social closure in private subsidized schools which are less accessible for foreign students due to their costs or to the existence of religious or cultural barriers. Another possible mechanism to explain the low impact of residential segregation on school segregation is the possibility of students moving to a different neighbourhood. In the case of Barcelona, the data available show that a significant percentage of students are enrolled in a school outside their catchment area of residence and that this mobility is significantly higher than in the case of non-foreign students (Bonal and Zancajo, 2019).

When looking at the dissimilarity index for most represented minorities, we find two negative associations between low-educated population and income neighbourhoods for Central and South American pupils. However, this effect is very weak. In the case of Asian-Oceanian pupils, the percentage of private enrolment positively affects the dissimilarity index for this sub-group. However, when the interaction terms are included, this effect is not significant,

while the interaction between private enrolment and residential segregation shows a negative association with school segregation.

In the light of the results presented in Table 3, the effect of residential segregation on school segregation (DI) is statistically significant only when all foreign pupils are analysed, while in the case of the most represented minorities (Central and South American and Asian-Oceanian), the effect is not significant.

In Table 4, we follow the same sequential process as in Table 3 by considering the AI for foreign pupils in schools as a dependent variable. Among the social factors, we find that only the percentage of foreign population is related to the AI for the overall population in the neighbourhoods of Barcelona (column 1). When looking at the two most represented groups of foreign pupils, we find that neighbourhoods with a higher share of foreign population are associated with higher levels of educational isolation of Asian and Oceanian pupils (standardized coefficient -0.00192, p<0.01) as compared to those with very small foreign populations (column 7). Therefore, contrary to school segregation, foreign pupils' isolation does not seem to be affected by the level of residential segregation and only by the percentage of foreign population when neighbourhoods' characteristics are considered (column 8), as well as the percentage of low-educated population in the case of Asian-Oceanian pupils.

School-related factors are relevant for explaining educational isolation as shown in columns 2, 5 and 8. We find a positive and significant effect regarding the share of foreign pupils for the overall population (standardized coefficient 0.521, p<0.01, e.g., column 2). The same association holds for the educational isolation of the two most represented groups of pupils, that being for Central and South American pupils (standardized coefficient 0.236, p<0.01, column 5) and for Asian and Oceanian pupils (standardized coefficient 0.32, p<0.01, column 8).

The share of private education enrolment has an effect on foreign pupils' isolation (standardized coefficient 0.079, p<0.05, column 2). When we include the interaction effect between the share of private educational enrolment and the percentage of foreign pupils, we find that both the sizes of the main effects increase by 18% and 14% respectively and the interaction is significant (standardized coefficient 0.78, p<0.05). Therefore, we find that the share of foreign pupils and private enrolment is positively associated with the level of educational isolation. Additionally, the interaction effect shows that higher levels of both independent factors have a significant effect on higher educational isolation. The results report a significant interaction between private educational enrolment and foreign pupils when analysing the AI of Asian-Oceanian pupils (standardized coefficient 0.5, p<0.05, column 9). In short, foreign pupils' isolation seems to be affected, contrary to foreign' school segregation, not just by the presence of private schools and the share of foreign pupils in the neighbourhood, but also by the combination of these factors. This means that the effect of private schools on foreign pupils' isolation is greater when the neighbourhood exceeds a threshold of foreign pupils. It could be hypothesized that private schools are demanded by non-foreign families as a strategy to avoid school diversity only in those neighbourhoods where the proportion of foreign students is perceived as a threat to schools' social homogeneity.

These analyses confirm that residential and educational segregation are two interrelated phenomena in Barcelona. In addition, the supply of private subsidized schooling in the neighbourhood (here reflected by the share of pupils enrolled) is a main factor in understanding both educational segregation and isolation. Differences are reinforced in those neighbourhoods where both foreign population and private education enrolment are highly concentrated.

Table 3. Drivers of school segregation of foreign students in Barcelona city neighbourhoods.

VARIABLES	DI Tot.			DI Central-South America			DI Asia-Oceania		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Residential segr.	0.605**	0.582**	0.506*	0.384	0.349	0.260	0.373	0.337	0.0893
	(0.267)	(0.269)	(0.290)	(0.382)	(0.411)	(0.445)	(0.358)	(0.376)	(0.397)
Foreign pop., %	-0.000618	-0.00492	-0.00421	-0.00279	-0.00324	-0.00241	-0.00236	-0.00573	-0.00341
	(0.00180)	(0.00355)	(0.00370)	(0.00257)	(0.00543)	(0.00567)	(0.00241)	(0.00496)	(0.00506)
Low educ. pop, %	-0.00186	-0.00294	-0.00250	-0.00629**	-0.00641**	-0.00591*	-0.000984	-0.00184	-0.000425
	(0.00191)	(0.00196)	(0.00206)	(0.00274)	(0.00300)	(0.00316)	(0.00257)	(0.00274)	(0.00282)
Income neigh.	-0.000571	-0.000891	-0.000760	-0.00208**	-0.00222**	-0.00207*	0.000806	0.000495	0.000925
	(0.000674)	(0.000664)	(0.000692)	(0.000964)	(0.00102)	(0.00106)	(0.000905)	(0.000929)	(0.000946)
Foreign stud., %		0.505	0.421		0.0647	-0.0333		0.402	0.128
		(0.330)	(0.352)		(0.505)	(0.540)		(0.462)	(0.481)
Priv. ed. enroll., %		0.165**	0.153**		0.0575	0.0434		0.151*	0.112
		(0.0628)	(0.0653)		(0.0961)	(0.100)		(0.0878)	(0.0893)
Priv. ed. enroll., %* Residential segr			-0.735			-0.859			-2.406*
			(1.028)			(1.576)			(1.406)
Constant	0.331***	0.331***	0.333***	0.363***	0.363***	0.365***	0.371***	0.371***	0.377***
	(0.0143)	(0.0136)	(0.0139)	(0.0205)	(0.0208)	(0.0213)	(0.0192)	(0.0190)	(0.0190)
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.090	0.208	0.216	0.112	0.118	0.123	0.147	0.196	0.238
R-squared Adj	0.0246	0.120	0.112	0.0488	0.0200	0.00713	0.0857	0.107	0.137

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4. Drivers of school isolation of foreign students in Barcelona city neighbourhoods.

	CI Tot			CI Central-South America			CI Asia-Oceania		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Residential segr.	0.137	0.194	0.230*	-0.0135	0.0207	0.0330	0.0523	0.104	0.127
	(0.144)	(0.140)	(0.136)	(0.0631)	(0.0620)	(0.0614)	(0.0960)	(0.0968)	(0.0947)
Foreign pop., %	0.00172*	-0.00299	-0.00341*	-0.000519	-0.00268***	-0.00282***	0.00192***	-0.00103	-0.00130
	(0.000971)	(0.00185)	(0.00179)	(0.000425)	(0.000818)	(0.000809)	(0.000647)	(0.00128)	(0.00125)
Low educ. pop, %	-0.000182	-0.00133	-0.000554	-0.000153	-0.000678	-0.000416	-0.000898	-0.00161**	-0.00111
	(0.00103)	(0.00102)	(0.00105)	(0.000452)	(0.000452)	(0.000472)	(0.000688)	(0.000706)	(0.000729)
Income neigh.	-0.000531	-0.000612*	-0.000153	-0.000314*	-0.000325**	-0.000170	-0.000387	-0.000385	-9.08e-05
	(0.000364)	(0.000346)	(0.000393)	(0.000159)	(0.000153)	(0.000177)	(0.000242)	(0.000239)	(0.000274)
Foreign stud., %		0.521***	0.599***		0.236***	0.263***		0.320***	0.370***
		(0.172)	(0.170)		(0.0762)	(0.0766)		(0.119)	(0.118)
Priv. ed. enroll., %		0.0790**	0.0954***		0.0264*	0.0319**		0.0297	0.0402*
		(0.0327)	(0.0324)		(0.0145)	(0.0146)		(0.0226)	(0.0226)
Priv. ed. enroll, %* Foreign stud.., %			0.780**			0.263			0.500**
			(0.352)			(0.159)			(0.245)
Constant	0.0892***	0.0892***	0.0979***	0.0330***	0.0330***	0.0359***	0.0410***	0.0410***	0.0466***
	(0.00773)	(0.00707)	(0.00788)	(0.00338)	(0.00313)	(0.00356)	(0.00515)	(0.00489)	(0.00549)
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.189	0.345	0.400	0.187	0.328	0.361	0.176	0.282	0.334
R-squared Adj	0.131	0.272	0.321	0.129	0.253	0.277	0.117	0.202	0.246

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusions

As in many other cities, school segregation of foreign students in Barcelona has increased in the last two decades, as the number of foreign students in the education system augmented rapidly. Urban inequalities in the city are significant in certain neighbourhoods and there is a positive association between residential and school segregation of foreign students. Our analysis shows that spatial educational inequalities cannot be explained simply by the territorial dispersion of foreign populations in the urban space. It also highlights the importance of exploring the role of other potential educational and non-educational drivers that foster the unequal distribution of foreign students. The analysis is highly relevant since other studies in Spain have shown that the level of concentration of foreign students significantly affects educational performance (Cebolla and Garrido, 2011; Calero and Escardíbul, 2016).

Our results report that the moderate effects of residential segregation on school segregation are not necessarily the result of the higher number of schools available for families' choices. Our findings are consistent with other studies that cast doubt on the capacity of school choice to reduce the effects of residential segregation on school segregation (Frankenberg, 2013; Söderström and Uusitalo, 2010). Greater school choice tends to favour middle-class social distinction strategies, which lead to more possibilities of opting out of local schools (Boterman, 2013; Gerdes, 2013). Indeed, school choice may reduce the weight of residential segregation in terms of explaining school segregation; but, far from allowing foreign students to escape from their neighbourhood, it may increase school segregation via middle-class 'white flight'. Research has shown that patterns of school choice and the way in which families enact school choice policies are socially influenced (Ball, 2003; Schneider et al., 2002). Different social or ethnic groups react to an increasing capacity of school choice in very different and unequal ways, which can increase rather than reduce school segregation. In the case of Barcelona,

school choice has enabled middle-class and native families to avoid those schools that enrol higher proportions of foreign students.

The high presence of private subsidized schools seems to play a decisive role in explaining higher levels of school segregation in city neighbourhoods: the higher the level of enrolment in private schools, the higher the school segregation of foreign students, as well as the higher their level of isolation. However, in order to understand how processes of school segregation work, it is necessary to scrutinize how local education markets operate. The particular characteristics of school admissions policy in Barcelona make the analysis of choice patterns within catchment areas particularly noteworthy. The weight of proximity in prioritizing school access and its coexistence with significant margins of school choice in the city make the study of the micro-dynamics of school choice and segregation of particular interest. Differences in the school segregation of foreign students vary between neighbourhoods, with similar indexes of residential segregation and even a similar proportion of public and private school enrolment. This fact calls for undertaking further analyses of how local education markets (with different school characteristics in terms of pedagogic diversity, educational quality or socioeconomic characteristics of the population) generate stronger or weaker processes of segregation among native and foreign students.

Our findings also contribute to the international debate regarding the relationship between school choice and school segregation. As the case of Barcelona exemplifies, a greater capacity of school choice, in terms of choice options or private subsidized alternatives, is not necessarily a silver bullet solution for school segregation. The relationship between school choice and school segregation is complex and the analysis needs to focus on contextual factors at city and neighbour levels to better understand it. Both, educational (e.g. the presence of private schools)

and non-educational factors (e.g., neighbourhood socioeconomic characteristics or residential segregation) may affect significantly how school choice possibilities enact families' choices and their ultimate effects on school segregation.

Of course, our study is not without limitations. We have limited information on the country of origin of foreign students. We also cannot account for measures of entropy within the unit of analysis considered, which we suspect may have a relevant effect on the phenomena of educational segregation and isolation. Despite these limitations, this study has presented cross-neighbourhood evidence of the effect of educational and social differentiation on education phenomena in the city, while providing useful information for policymakers who wish to address and reduce the school segregation of foreign students. Providing detailed policy recommendations is beyond the scope of this paper but we can point to two key lessons that are directly linked to our findings. The first refers to the need to revise the effectiveness and equity of catchment areas. They are quite ineffective if wide margins of school choice are allowed. In the poorest districts, families seem to have many possibilities of opting out of local schools, which potentially increases segregation and reduces the value of proximity. In line with what other studies have suggested (Taylor, 2009; Elacqua et al., 2011), redefining the catchment areas (increasing their total number and making them smaller) and restricting the white flight possibilities of the middle class would probably help to reduce the school segregation and isolation of foreign students in the city. Recent simulations exploring the effects of pupils attending the closest school to their home in the case of Barcelona reveal a potential reduction of 50% in the dissimilarity index of foreign students (Bonal and Zancajo, 2019).

The second lesson refers specifically to the need to ensure mechanisms of redistribution of foreign students among schools, and especially between public and private subsidized schools. Mechanisms to ensure a better balance between the two sectors and within each sector are necessary if equality of educational opportunities is to be granted. As has been previously argued, current regulations include the possibility of establishing minimum thresholds of SEN pupils per classroom, with the objective of ensuring their balanced distribution among schools. However, systems of detection are poorly developed and mechanisms of redistribution of SEN students are only implemented by a few municipalities (Bonal, 2012). In Barcelona, there is evidence that the local education authority (CEB) is developing dynamic policies to improve educational equity and reduce school segregation in the city. However, the potential success of these initiatives will largely depend on the active resistance of interest groups, as well as on the political involvement and commitment of the Catalan regional government.

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