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**Socio-economic Residential Segregation and Income Inequality in
Bogotá: An analysis based on census data of 2005**

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Presentación

Este documento representa un avance del proyecto de investigación vigente “Estructura productiva regional, pobreza y desigualdad en México””, registrado ante el Consejo Divisional de la División de Ciencias Sociales y Humanidades y con número de registro 1,125 ante la Coordinación Divisional de Investigación. Dicho proyecto está vinculado al programa de investigación “Aplicaciones econométricas en los problemas del desarrollo” de la Línea de Generación y Aplicación de Conocimiento Desarrollo Económico, que se vincula, a su vez, al Seminario de investigación “Laboratorio Cuanti: métodos cuantitativos en economía aplicada”. Su objetivo es relacionar las variables de la estructura productiva sectorial con los indicadores sociales de pobreza y desigualdad de las regiones del país.

El presente reporte de investigación, que lleva por título “Socio-economic Residential Segregation and Income Inequality in Bogotá: An analysis based on census data of 2005”, realiza un análisis de la relación entre segregación residencial y la desigualdad del ingreso en la ciudad de Bogotá, Colombia, en 2005; el análisis de segregación residencial usa el nivel educativo como variable de anclaje de la situación socioeconómica. Los resultados muestran que la segregación residencial en Bogotá pudo ser causada por la dinámica de los mercados del suelo y vivienda en la década de los noventa más que por la desigualdad del ingreso mismo en el periodo de estudio.

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Socio-economic Residential Segregation and Income Inequality in Bogotá: An analysis based on census data of 2005

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Residential segregation is both a cause and consequence of socio-economic inequalities. Since the 1990s, segregation patterns in Latin American cities have changed significantly. This is related to major urban transformations caused by privatization policies related to urban development, commercialization and real estate activity. The main purpose of this chapter is to study residential socio-economic segregation in the city of Bogotá, Colombia in 2005, using educational attainment as an indicator of socio-economic status while considering the drivers of segregation during the 1990s. We also introduce a brief analysis of the relationship between residential segregation and inequality based on a model that allows replicating the income distribution of the population using census variables. This chapter shows that residential segregation in Bogotá is related to per capita income inequality, however, segregation may be caused by the dynamics of land and housing markets rather than inequality.

INTRODUCTION

Residential segregation has become relevant in recent decades due to the economic, social and cultural effects of urban development which depend on the capitalist accumulation model (De Mattos, 2002, 2012). Territories are not homogeneous in their material or symbolic components and Latin American cities are no exception. Segregation patterns may change according to the characteristics of each city which, while adjusting under a neoliberalism logic, reveal the differential

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distribution of population groups, both at a macro and micro scale (Sabatini, 2003). Distribution of population groups is determined by government, market and population interactions in the social production of space, the actions of these actors that territorializes, sectorizes and segregates people as a result of the social and economic relationships developed in their territories.

This chapter focuses on residential segregation of educational groups, and how it is related to income inequality. Addressing this relation is supported by literature that indicates that inequalities and segregation tend to reproduce each other (Elorza, 2013). This happens because economic inequality is attributed to the labour market, which creates varied living conditions for different demographic groups, including differences in access to land and housing, which causes diverse residential location patterns, *i.e.* segregation between groups with different economic resources. Also, belonging to a certain social group allows or constrains access to opportunities to improve one's welfare (Kaztman, 2003) which occurs depending on the role different groups play in the social division of labor (Linares, 2010).

In this chapter, two dimensions of residential segregation between educational groups are considered. First, at the urban scale, characterized through the analysis of location quotients of the main demographic groups with high educational attainment; second, block scale level analysis is used for obtaining the socio-spatial distribution of population groups. The proceeding two sections address the theoretical background and changes in socio-spatial segregation patterns in the city of Bogotá. The methodology is presented in the third section, including data sources and variables used for measuring segregation and inequality. The fourth section presents the results. Finally, conclusions are drawn from the main findings.

CHANGES IN SOCIO-SPATIAL SEGREGATION PATTERNS

When communities are socially segregated or intentionally separated from other social groups, we are referring to the phenomenon of socio-spatial segregation (Kaztman, 2003). This phenomenon is often produced and reproduced through the institutional control of resources which allow barriers that restrict the physical and social contact of internally homogeneous groups with other groups which have

different characteristics based on income, education or any other characteristic (De Queiroz, 2003).

Segregation as a concept has been approached from differences in residential location and unequal access to land and housing. In the first case, within the framework of classic social ecology theory from the Chicago School in the early 20th century, the concept of segregation was developed by Robert Ezra Park and Ernest Burgess as a means to analyze the 'natural concentration' of certain groups in an urban population. Thereafter, segregation was considered as a neutral topic of urban ecology for characterizing spatial differentiation of population groups in the cities (Salas, 2008).

With the arrival of Modern Social Ecology in the 1950s, quantitative studies of the urban social structure and socio-spatial segregation were carried out. The precursors were Shevky and Williams (1949) and Shevky and Bell (1955) who, under a deductive analysis of homogeneous social areas in the urban environment, categorized demographic groups by their social rank, that is, by their socio-economic situation, by variable urbanization which is related to the family situation and by their ethnic characteristics (Buzai, 2003, p. 43). Thus, it was possible to analyze the social differentiation and stratification of a specific group, by means of several variable techniques. Since the 1970s, segregation has been analyzed within the unequal access framework by the classic urban theorists – Lefebvre, Lojkine and Castells –¹ who agree that residential segregation is revealed by the organizational form of space in capitalist societies.

However, segregation is a phenomenon that has been present since the time when cities emerged, and is not only present in capitalist societies. Urban segregation is expressed differently depending to the age in which it is studied. Until the 1980s, the traditional pattern of socio-spatial segregation in Latin America was characterized by the residential localization of high-income population groups near

¹ Henri Lefebvre (1976, 1978b, 1978a) pointed out that segregation was an implicit analytical category in the space's production and appropriation, while the sociologist Jean Lojkine (1979) considered that the concept guided an investigative work and Manuel Castells (2008) established a definition of urban segregation based upon dimensions, intra homogeneous status and different from others, and as a process because such inequalities tend to perpetuate through time.

the historical downtown in a concentrated way, while low-income populations were concentrated in suburbs and dangerous areas of the city (Sabatini, 2003; Sabatini & Cáceres, 2005). There are additional layers that make segregation patterns more complex, including (a) the demographic diversity of middle-income populations in the historical downtown, (b) a duality of the city with stigmatized areas related to poverty conditions and (c) other zones that have emerged in the modern city.

On its own, patterns of segregation are expressed in the urban structure where (a) high-income population groups are becoming increasingly scattered throughout the city and not concentrated in a high rent area in the city center, (b) construction of new commercial and service sub-centers are located outside the traditional center with the aim of gaining new markets, (c) a rise in land prices that isolate low-income groups into suburban zones with low-cost housing, and (d) urban renovation in the deteriorated downtown areas in the form of gentrification (Sabatini, 2003).

This new spatial expression emerged in the 1990s, at the beginning of the neoliberal age when land started to be treated like merchandise since . It was at this point when the government downgraded its role to that of a regulator by means of laws and norms, and real-estate and other market actors obtained a stronger role in the housing market, especially when it came to the supply of new housing (Janoschka & Glasze, 2003; Moura, 2003; Sabatini & Cáceres, 2005; Torres *et al.*, 2009). Such dynamics have allowed the extension of existing affluent neighbourhoods and the dispersion of the concentrated elites to the suburbs due to capital concentration and the liberalization of land markets (Sabatini & Cáceres, 2005).

In this context, it can be said that housing access in Bogotá is determined by the laws of: "(...) housing distribution and therefore, produces re-grouping in function of the social capability of people in the capitalist system" (cf. Castells, 2008, p. 203), in which a user-client-consumer relationship develops (Aprile & Mosquera, 1984). Then, it is possible to state that socio-spatial segregation appears when there is a contradiction between the production of space in the city and private appropriation

(Alessandri, 2013), where land and housing become a trade value rather than a usage asset.

To be more specific, three main agents intervene in the segregation process, the government, the real estate market and the population (Ábramo, 2003). These agents are related to the three relevant causes that produce such process: the economic inequality between people generated in the labour market, land valorization through the real estate market and the urban legislation regulated by the state (Torres, Marques, Ferreira and Bitar, 2003).

The living conditions of different social groups are attributable to the labor market since it is partly responsible for economic inequality, which leads to unequal access to land and housing and, therefore, residential segregation between different demographic groups. Members of different social groups may or may not have access to opportunities for improving their welfare (Kaztman, 2003) and, as a consequence, are differentially positioned across urban socio-spatial dividing lines (Linares, 2010).

On its part, the geography of opportunity theory suggests that the physical proximity between varied population groups (based on their socio-economic level, race, religion, etc.) could overcome social problems by means of opportunity structures and positive socialization (Howell-Moroney, 2005). However, this approach presents a neoliberal bias since it indicates that the proximity between poor and rich areas encourages social mixing, which is needed in order to improve the standard of living of the poor (Ruiz-Tagle & López, 2014). This approach ignores the fact that behind such an “opportunity” is an implicit market-oriented assumption (Ruiz-Tagle, 2016), which does not take into account the role that institutions must carry on to secure a just redistribution of resources and opportunities that mitigate the formation of enclaves. In this way, the activities of the three main urban agents and the consequent spatial order of cities also contributes to the reproduction of urban socio-spatial inequalities.

RESIDENTIAL SEGREGATION IN BOGOTÁ

The phenomenon of residential segregation in Bogotá is not new, and some studies have corroborated that from the colonial model to the fragmentary model that characterizes the city today (Bäbr & Borsdorf, 2005), the city has shifted from a macro to a micro scale of segregation (Ríos, 2010; Secretaría Distrital de Planeación, 2011). Since the 1950s, Bogotá has been characterized by urban expansion driven by population displacement due to the search for better opportunities and by migration caused by political violence in rural areas (Aliaga & Álvarez, 2010).

In the colonial era, the city (until 1920), maintained its spatial configuration around the main square, which matches a concentric residential differentiation model (Cardeño, 2007) characterized by the fact that high-income population resided near the administrative, commercial and political zone. It can be said that segregation at that time was low. Later, technological advancements in transport, road networks and the increase of cars in the city paved the way to the growth of industry in the city. In the late 1930s, Bogotá shifted from an economy based on commercial capitalism to an industrial one, with its spatial model characterized by sectoral differentiation focused on growth around and along main roads and to areas with sufficient workforce, following a north-south expansion and leading to a mixed commercial and residential land use (Salas, 2008). In other words, industrial activities were located along the main roads and to areas with a sufficient workforce, leading to a mixed commercial and residential land use. It is important to stress that the city's expansion in this era was not continuous since working-class neighborhoods were built in a scattered way over the Bogotá savanna. High-income residential neighborhoods consolidated to the north of the city with the aim of ratifying its economic and social power, while neighborhoods in the southern zone provided shelter to lower socio-economic groups (Cardeño, 2007).

Around the mid-20th century, due to the rural in-migration to the city caused by the civil war,² population growth intensified, shaping the segregation at a macro scale because the newly arrived people did not have sufficient income to buy a

² The population of the city of Bogotá increased from 330,000 to 1,130,000, between 1938 and 1958, the urbanized area went from 2,514 m² to 8,084 m² in the said years (Salas, 2008).

house. The construction of houses for those displaced from violence took place in peripheral areas and at the same time, the high-income population was more worried about its social status –from the center to the northeast– as it happened in other Latin American countries (Aliaga & Álvarez, 2010). The high-income population had low a population density, residing near green areas such as the Oriental Hills, and in neighborhoods with quality infrastructure, aspects that commonly determine higher land and housing values (Salas, 2008). So, low-income populations clustered in the formal and informal settlements in the peripheral zone, generating irregular urbanization patterns in the form of neighborhoods that lacked basic public services (Aliaga & Álvarez, 2010). In this manner, a dual city was developed, with a rich north and a poor south.

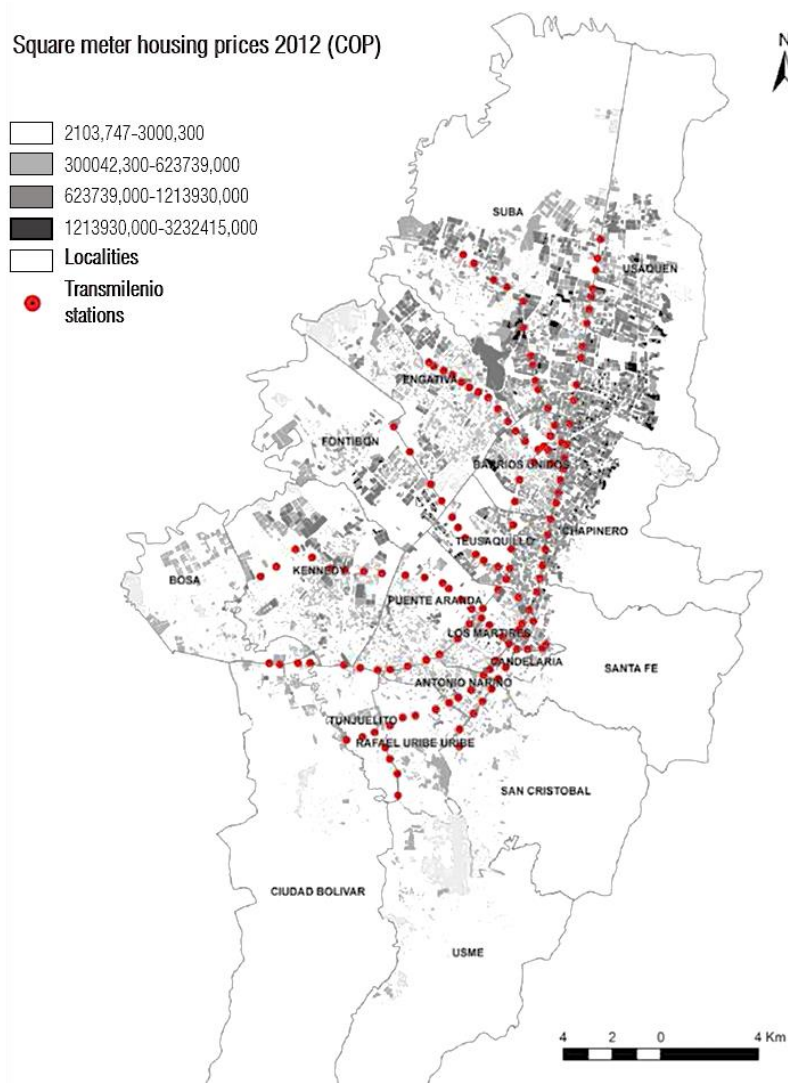
As a consequence of this duality, some zones grew in value and other urban zones lost value, and the functioning of a private market for the production and construction of new housing sorted people into those neighborhoods according to the buyer's payment capacity. However, since the 1980s, due to the promotion of gated housing complexes for the upper middle class, fitted with private security and high-end equipment to, the center welcomed again such a population. As a result, a mixture of rich and poor people with different characteristics and population densities emerged. Nevertheless, this micro scale segregation is embedded within the persistent macro scale segregation in Bogotá (Aliaga & Álvarez, 2010).

In relation with land and house prices in different localities, Amézquita, Sánchez & Abaunza (2017) discovered that higher housing prices were found in Usaquen in the Northhand Chapinero in the Northeast, while lower prices were found in Bosa, Ciudad Bolívar, Usme and San Cristóbal in the Southwest. This situation again reinforces the link between land and housing prices, and segregation , especially related to the broader socio-economic stratification³ of the city. For example, there is diversified stratification in the neighborhoods of Usaquen and Suba in the North and Chapinero in the Northeast. However, higher social classes (4 and 5) predominate in the north area, while in the South there is less stratification (1 and 2) and are located in the localities Bosa, Ciudad Bolívar, Usme and San Cristóbal

³ It is a classification that seeks differentially to grant subsidies in the payment of domiciliary public services.

(Amézquita, Sánchez, & Abaunza, 2017). This shows an important correlation between the price of land and housing, and the socio-economic stratification of the city (Figure 1). It must be noted that Bogotá is the capital of Colombia, with an approximate population of 6 840 116 habitants in 2005 (Rubiano, 2017). The city has an administrative political division of 19 localities. Among the most notable locality is Chapinero, where the city's historic core is located (Appendix 1).

Figure 1. Square meter housing prices in Bogotá, 2012



Source: Amézquita, Sánchez and Abaunza (2017, pp. 275–276)

Educational level is another factor related to segregation. Dureau, Roux & Piron (2012) found a positive relationship between the level of education and the social status index (SSI) ⁴. Table 1 shows a relationship between educational level and social class in 1993 and 2005. Households heads with a higher level of education mainly belong to the higher SSI classes (5 and 6), and household heads with lower levels of education mainly belong to the lower social SSI classes (Dureau, Roux, & Piron, 2012).

Table 1. Social Status Index and educational level by head of household for the urban area of Bogotá, 1993 and 2005.

Level of education of the head of household	Social class of SSI (1993)						Total	% 1993	% 2005
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6			
Without education	56,13	19,89	16,10	6,57	1,12	0,19	100	2,40	2,30
Primary level	18,80	26,55	30,65	30,65	4,82	1,13	100	34,60	27,60
Secondary level	3,03	13,58	28,54	28,54	13,80	7,55	100	41,40	40,90
Upper level	0,07	0,78	5,47	5,47	37,21	31,03	100	21,60	29,20

⁴ SSI= Average years of education of household members over 15 years of age / Overcrowding of housing. This is a proxy variable of the social class in which every home in the city is located (Salas, 2008).

Total	9,36	15,75	24,27	25,68	15,07	9,87	100	100,00	100,00
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Source: Dureau, Roux, & Piron (2012, p. 5)

Furthermore, while it is true that in Colombia, residential segregation has been studied more from an economic view via the dimensions proposed by Massey & Denton (1988), it is also true that this phenomenon has been addressed from the perspective of land prices in Bogotá (Fuentes, 2010), social housing in Medellín (Velasquez, 2011), and urban development and segregation in the Municipality of Barrancabermeja (Molina, 2008). The main findings for segregation in Bogotá from a socio-economic view are the following. According to the residential segregation index, housing prices are a key factor that increases segregation. The socio-economic segregation index shows that the segregation is high. We used large spatial units to measure segregation, using smaller spatial units would show even higher levels of segregation (Sabatini et al., pág. 24-25, 2008). Therefore, some authors (Ríos, 2010; Secretaría Distrital de Planeación, 2007, 2013) propose that public policies must be oriented to diminish both exclusionary and discriminatory practices in order to reduce the gap between the rich and the poor.

For its part, the analyses of residential segregation indexes (spatial autocorrelation) reveals spatial dependence, that is, higher valuations of property or land are linked with their residents and that in turn have high neighborhood values of said variable (Secretaría Distrital de Planeación, 2013). Another investigation renders that educational level is a key determinant for a higher residential segregation in both Bogotá and Medellín (Aliaga & Álvarez, 2010; Medina, Morales, & Núñez, 2008), which means that population groups are spatially localized and segregated according to their human capital.

METHODOLOGY

In order to be able to determine segregation levels and their relationship with income inequality for the city of Bogotá, we rely on two data sources. The 2005 Population Census which covers nearly 6,8 million persons living in more than 35 thousand blocks of the city, and the 2007 Life Quality Survey-Bogotá that provides information on the income of people. Both data sources are published by the Statistics National Administrative Department (DANE, by its Spanish acronym). The census data was made compatible with the census codes of the National Geostatistics Framework established by the DANE, so that it was possible to form a harmonized data set for analyzing the spatial differentiation of the variables studied. We used educational attainment of the household head as the variable to analyze segregation because in the Colombian census, income is not available. However, education level also differentiates, separates and segregates population. Education levels may also have a positive effect on segregation as it is “the main way of social mobility and privileged scope for the social integration of new generations” (Kaztman, 2001).

Table 2 shows an increase of people with the highest level of education (higher and postgraduate), while the proportion of people with basic levels of education (preschool and primary) decreased during the period between the two censuses of 1993 and 2005 in Bogotá. Since there is no income variable in the 2005 census, we constructed a representative variable for average income distribution at the block level based on the 2007 Life Quality Survey-Bogotá. It is harmonized with the Colombian population and housing census and it provides and an additional perspective for analyzing the relationship between residential segregation and inequality.

Table 2. Variation of population groups by education level in Bogotá, 1993-2005

Education level	1993		2005		Intercensal variation 1993-2005	
	N	%	N	%	N	%

Higher and postgraduate	507.064	24,9	1.003.857	32,5	496.793	98,0
High School	962.309	47,2	1.429.509	46,2	467.200	48,5
Preschool and primary	547.770	26,8	624.484	20,2	76.714	14,0
None	23.165	1,1	35.349	1,1	12.184	52,6
Total	2.040.308	100	3.093.199	100	1.052.891	51,6

Source: Fuentes (2012, p. 283)

Dissimilarity index (*DI*) was used⁵ to determine city-wide levels of segregation. The *DI* compares levels of segregation between specific groups (Massey & Denton, 1988), and we express it in an unitary interval where values near zero imply low segregation and one indicates high segregation. Its interpretation suggests that the group's proportion in focus must change its spatial unit with respect to the rest of the population in the same area, in order to accomplish an equal distribution (Martori, Hoberg, & Surinach, 2006). However, spatial indexes such as the *DI* don't reveal statistical significance (Garrocho & Campos-Alanís, 2013). For this reason, we used the spatial autocorrelation index in order to determine the existence of a random distribution between adjacent units for the same variable, as well as the Morán

$$^5 D = \frac{1}{2} \sum_{i=1}^n \left| \frac{x_i}{X} - \frac{y_i}{Y} \right|$$

Where: x_i = group's population in the spatial unit i ;
 X = group's population in the whole city;
 y_i = reference group's population in the spatial unit i ; and
 Y = reference group's population in the whole city.

Global Index (IGM, by its Spanish acronym)⁶ (Reardon & O’Sullivan, 2004) which allows researchers to determine the existence of clustered population groups in a given geographical space.

In order to measure inequality in light of the non-available information regarding income and employment structure, we built a representative variable of average income distribution at the block scale using micro data from the 2007 Bogotá Quality of Life Survey and the exercise was replicated with the 2005 census. We estimated a linear regression model with the 2007 Bogotá Quality of Life Survey data to identify the weight or factors of population and housing characteristics regarding the average income distribution at the block level. Then the obtained weights were applied to the census variables in order to estimate a measure for average income distribution for the 2005 census.⁷

This exercise was initiated with an estimation, adjustment and aggregation at the block level (geographical scale) for the variable of the 2007 Bogotá Quality of Life Survey in order to make them equivalent with those in the 2005 census.⁸ The response variable selected in the model was the per capita income logarithm per block. A correlation analysis was made between the available variables and the response variable in order to identify those variables with higher explanatory power. The model considered 17 variables grouped in three analytical dimensions in order to explain the income: *i*) human capital and employment, *ii*) demographic structure, and *iii*) housing and services. Table 3 presents an estimation of all variables. With this set of determinants, the least weighted squares regression model was estimated

$$I = \frac{n \sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - y_j)(y_j - y_i)}{(\sum_{i=1}^n (y_i - y)^2) (\sum_{i \neq j} w_{ij})}$$

Where: y_i = variable or attribute value in each spatial unit i ;
 y_j = variable or attribute value in each adjacent spatial unit j ;
 w_{ij} = proximity between spatial units i and j ; and
 n = number of spatial units.

⁷ This exercise has its empiric background in the estimation of socio-economic levels (NSE, by its Spanish acronym) carried on by the Mexican Association of Market Intelligence and Public Opinion Agencies (AMAI, by its Spanish acronym) in order to classify households by socio-economic groups highly correlated with income levels (AMAI, 2018).

⁸ Even though income information is asked and recollected in tables at individual level, ECV-B2007 is a representative survey with micro data available at household level. On other hand, the access to census’ information has block as maximum disaggregation level given the confidentiality and information protection parameters.

for the average per capita current income, in order to consider the expansion factor associated with each household in the 2007 Bogotá Quality of Life Survey (see Appendixes 2 and 3). The weights estimated by the model are used in the estimation of per capita income with the 2005 census data in order to map the spatial distribution of income in the neighborhoods of Bogotá (Figure 3), and compares the income map with the educational attainment map (Figure 2)⁹.

Table 3. Estimated weights of variables for per capita income

<i>Dependent variable</i>	<i>Dimension</i>	<i>Explicative variables</i>	<i>Estimated weights</i>
<i>Per capita income logarithm</i>	<i>Human capital and employment</i>	1. Persons with less than complete elementary education	-0.017*** (4.02)
		2. Persons with elementary education	-0.027*** (5.45)
		3. Persons without complete high school	-0.016*** (3.82)
		4. Persons with high school	-0.007* (1.79)
		5. Persons with higher education	0.073*** (18.0)
		6. Number of employed persons	0.066*** (23.8)
	<i>Demographic structure</i>	7. Persons under 15 years old	0.015*** (4.18)
		8. Persons over 65 years old	-0.015*** (3.14)
		9. Number of domestic employees	0.128*** (8.85)
		10. Size of average household	-0.013* (1.68)
		11. Total population	-0.339***

⁹ In Bogotá, the population density in 2005 was 175.4 people per hectare and the population density of household head was 50 per hectare (Alcaldia Mayor de Bogotá ; Secretaria Distrital de Planeación, 2010). However, the population density of the head of household may change depending on his geographical location.

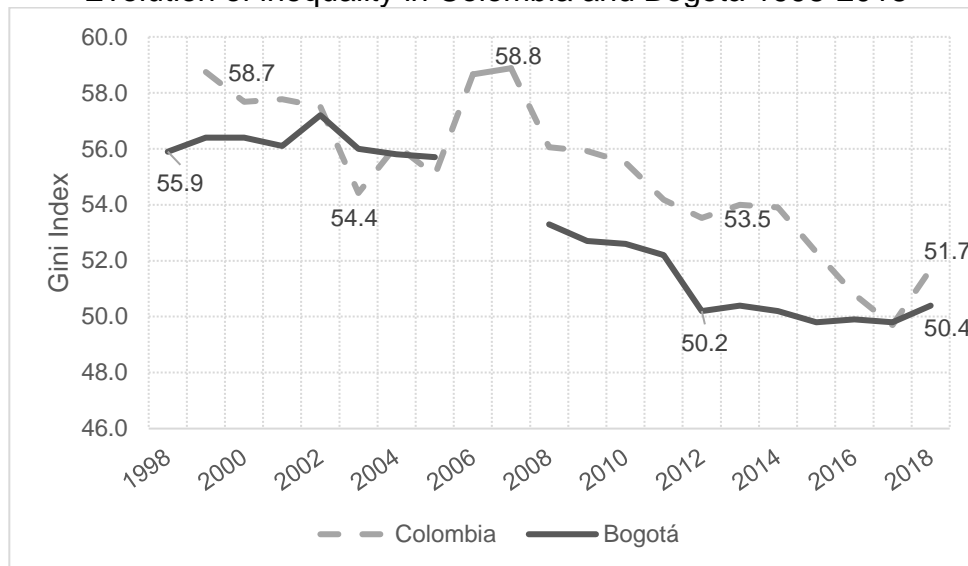
			(4.75)
	<i>Housing and services</i>	12. Telephone availability	0.031*** (6.57)
		13. No sewage system availability	-0.128*** (11.52)
		14. House	-0.060*** (2.67)
		15. Apartment	-0.049** (2.19)
		16. Room	-0.097*** (4.26)
		17. Another residential type	-0.075*** (2.92)

Absolute value of *t*-statistic in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$
Source: Elaboration by the authors based on ECV-B2007 (DANE, 2007).

INEQUALITY AND SOCIO-SPATIAL SEGREGATION IN BOGOTÁ

Before establishing the relationship between income inequality and residential segregation in Bogotá, a brief review is made of the evolution of the Gini Index at a national level and for Bogotá in the last twenty years. Graphic 1 shows that income inequality has decreased both in Bogotá and in the country, but to different degrees. The index has changed in a range between 59 points in the second half of 2000s (Colombia's highest Gini level was in 2008) and 49 towards the end of the analysis period (lowest level in 2017 both for country and Bogotá). Bogotá shows less inequality than the whole country except in the period between 2002 and 2006. However, Sanchez-Torres (2017) and Hoyos (2016) state that Bogotá always was in the top 5 of the most unequal cities in Colombia. Bogotá shows a remarkable decrease in inequality between 2006 and 2012, and since then the Gini Index value indicated no significant variations. By 2017, the city's index value was almost equal to the national average. Nevertheless, in 2018 the level of national inequality showed a rebound in contrast with a decreasing tendency between 2008-2017.

Graphic 1
Evolution of inequality in Colombia and Bogotá 1998-2018

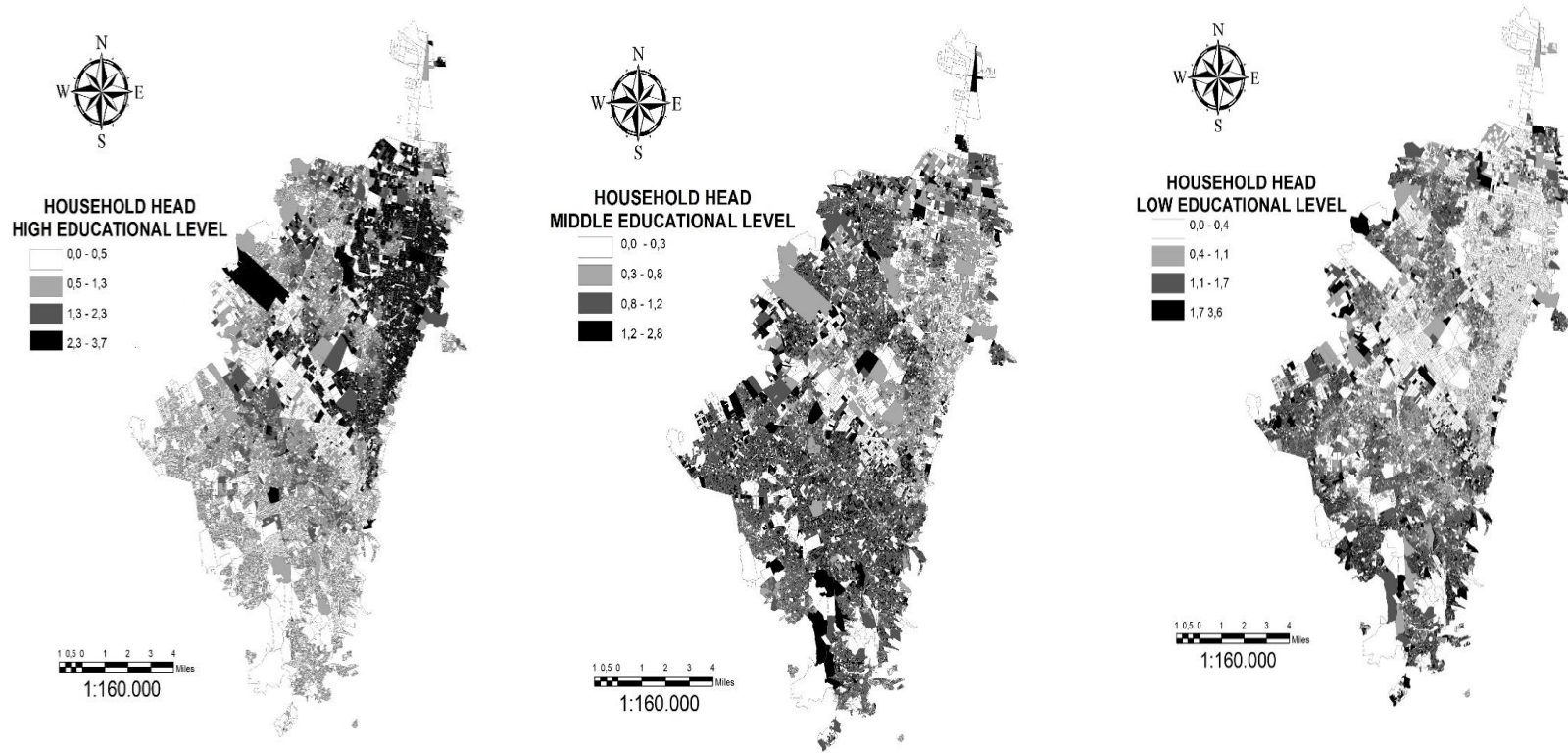


Source: Elaboration by the authors base on National Planning Department (DNP) report with data from Continuous Employment Surveys.

When considering the location quotient (see Figure 2), household heads with a high education level are concentrated in the Northeast of the city, where there is a medium to high socio-economic stratification (Secretaría Distrital de Planeación, 2007). It is very unlikely to find households heads with low education level in this urban zone. Block level segregation, as indicated by the DI, between household heads with a high education level is 0.57, while block level segregation household heads with a low educational level is 0.67. These results are as expected, considering previous research which used the same index for Bogotá (cf Salas, 2008; Aliaga & Álvarez, 2010).

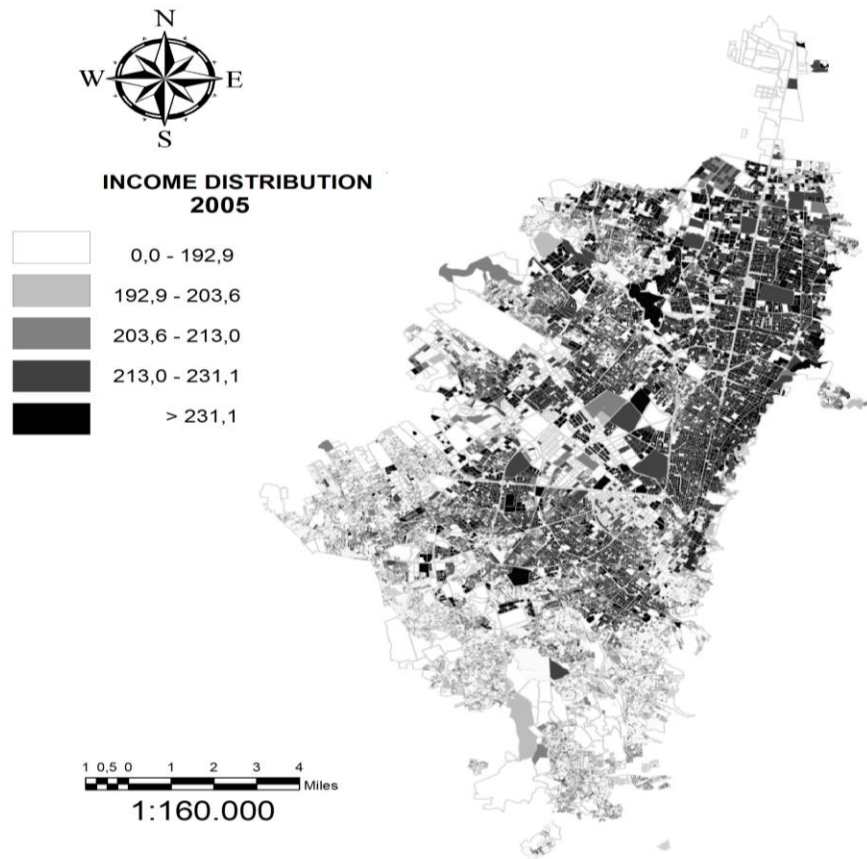
The previous results contrast with those of the Morán Global Index (see Appendix 4), which shows that the probability for each group to be distributed randomly in the city is low and household heads with a high education level are the most residentially segregated (0.44), clustering in Bogotá's northeast neighborhoods (See Figure 3). This findings are similar with discovered those of census sector geographic scale for the average years of education of the household head which in 2005 rendered a higher value (0.72) in relation with the other variables, such as poor households and households by socio-economic class (Aliaga & Álvarez, 2010).

Figure 2. Location quotient for household leader by high, medium and low education level in Bogotá, 2005



Source: Elaboration by the authors based on Population Census DANE (2005).

Figure 3. Estimation of per capita current income in Bogotá, 2005



Source: Elaboration by the authors based on ECV-B2007 (DANE, 2007) and Population Census DANE (2005).

Regarding the inequality index, income inequality in Bogotá is 56%, which coincides with other works for the same year and a different source (DANE, 2012). This result, in addition to suggesting that inequality is related to segregation, shows which the neighborhoods with a higher concentration of high and low income populations when considering the spatial distribution of the current estimation of income at block scale (see Figure 3). Nevertheless, to claim that inequality is a direct cause of segregation may be an arbitrary statement when taking into account that it is possible that land and housing markets are responsible for socio-spatial segregation in Bogotá (Aliaga & Álvarez, 2010; Almonacid, 2014; Salas, 2008). The

latter is due to the strong relationship between public and private agents in shaping which individuals have access to certain types of housing and which individuals don't (Salas, 2008). The former is due to the relegated role of the State in housing provision and promotion, mainly through subsidies and norm setting, i.e the state's ability to influence the land and housing markets is not relevant. Rather, private agents are the key players who develop real estate projects and who provide housing for those population groups that want to and are able to buy homes at a higher price point in order to obtain maximum gains. This is achieved by private agents localizing medium-high socio-economic groups in a differential and fragmentary way. This is the way in which residential segregation plays a role in the functioning of land and housing markets.

CONCLUSIONS

The socio-spatial segregation analysis for Bogotá presented new insights into the segregation dynamics of the city. Bogotá is commonly referred to as the city with a rich north and a poor south, when considering the education levels of the heads of the households and average per capita income. Despite these two differentiated macro areas of Bogotá, it is clear that small concentrations of individuals with a low level of education and a low income can be found across the entire city. This is not evident in the case of individuals with higher educational levels. This group mainly resides in the Northeast of the city. It is important to mention that despite the fact that segregation exists between the North and South in terms of social status, segregation is also amplified at a small scale. The fact that education level segregates the population in a similar way to per capita income implies that it is possible that these two variables have an effect on social capital due to the fact that when education segregates it may affect mobility and social integration (Kaztman, 2001).

Accordingly, it can be said that land value may be a more significant determinant of land concentration for a few individuals rather than income, due to the fact that land policies may be able to counteract such concentration. This is because there are housing and territorial organization policies, as well as norms and

laws, which regulate the pursuit for an urban equality in order to eliminate privileges in the distribution of urban equipment (of education, sport, culture, others) independently of the localization of a certain population group.

This is how the actions of social agents, such as urbanists, have changed the way in which segregation manifests, because they have intervened in the city under the logic of land and housing market liberalization. This liberalization manifests as the differentiation of segregated residential areas that have an effect on the social structure of class by making it more complex. In turn, this complexity reproduces certain production relations (between capitalist and the proletariat) and at the same time reinforces class diversity, which may stress the symbolic value that individuals give to the territory by means of their behavior and in the choice of different types of housing, a consideration that has been scarcely studied and that would be important to address in future investigations about the subjective dimensions of segregation.

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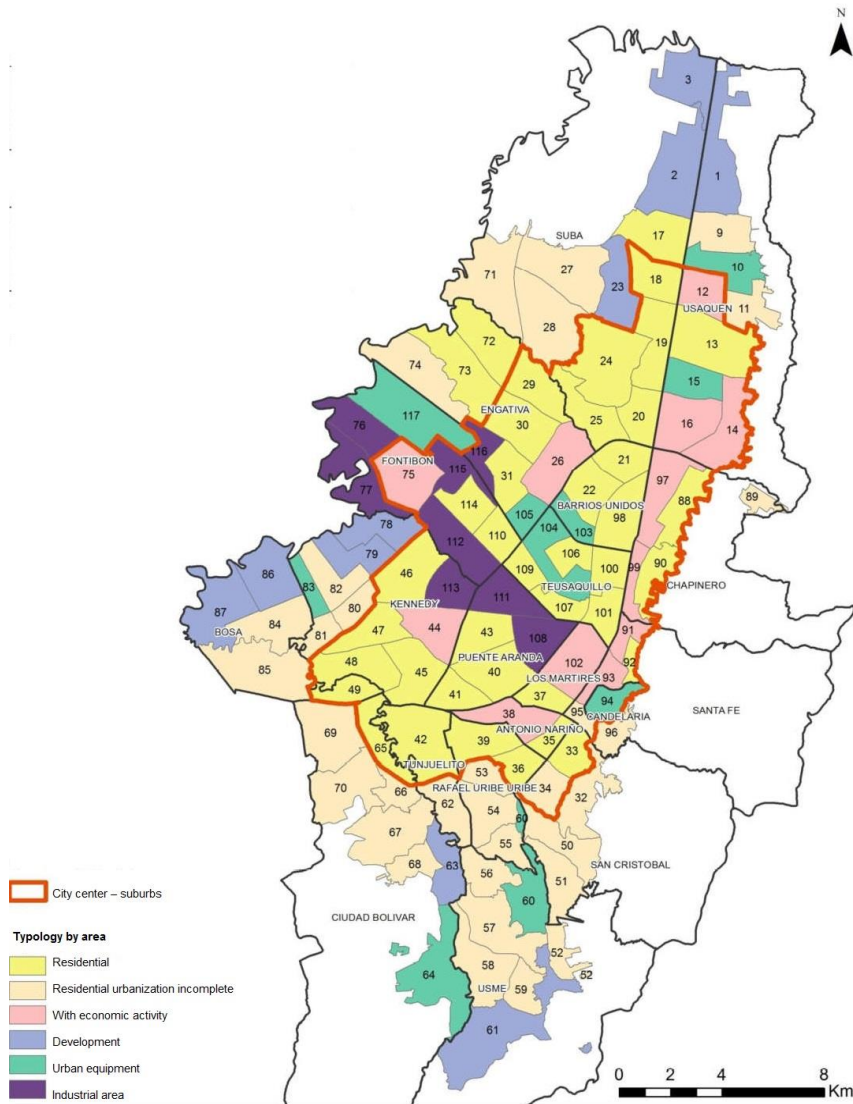
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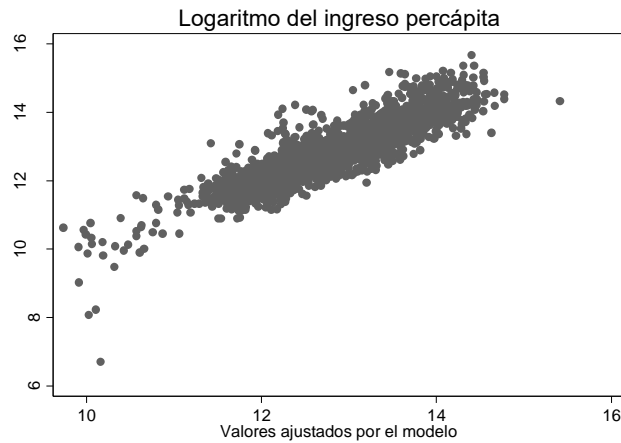
ANNEX

Appendix 1. Typology by area in Bogotá



Source: García y Gascón (2016).

Appendix 2. Fitting of the least weighted squares linear model that estimates the current per capita income



Source: Elaboration by the authors based on ECV-B2007 (DANE, 2007).

Appendix 3. Estimation of the least weighted squares linear model for the current per capita income

Source	SS	df	MS	Number of obs	=	2,601
Model	1424.67088	17	83.8041695	F(17, 2583)	=	606.50
Residual	356.91183	2,583	.138177247	Prob > F	=	0.0000
				R-squared	=	0.7997
				Adj R-squared	=	0.7983
Total	1781.58271	2,600	.68522412	Root MSE	=	.37172

lingper	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
prim_	-.0165961	.0041335	-4.02	0.000	-.0247015	-.0084908
primaria5	-.0265898	.0048754	-5.45	0.000	-.0361499	-.0170297
bach_	-.0159715	.0041857	-3.82	0.000	-.0241791	-.0077639
medial1	-.0069301	.0038716	-1.79	0.074	-.0145219	.0006618
sup_pos	.0733994	.0040776	18.00	0.000	.0654038	.081395
tot_int	-.0127919	.0076004	-1.68	0.092	-.0276954	.0021117
men15	.0149817	.0035801	4.18	0.000	.0079616	.0220018
edad65	-.0147386	.0046992	-3.14	0.002	-.0239532	-.0055239
ocup_hog	.0662102	.0027873	23.75	0.000	.0607446	.0716758
tel	.0306508	.0046637	6.57	0.000	.0215058	.0397958
domest	.1251668	.0141402	8.85	0.000	.0974396	.1528941
casa	-.0595623	.0223135	-2.67	0.008	-.1033165	-.0158081
apto	-.0490865	.0223945	-2.19	0.028	-.0929995	-.0051736
cuarto	-.0970028	.0227486	-4.26	0.000	-.1416101	-.0523956
otra_viv	-.0749666	.0257108	-2.92	0.004	-.1253824	-.0245508
no_alcant	-.1282143	.0111345	-11.52	0.000	-.1500478	-.1063809
tam_hog	-.3390432	.0713715	-4.75	0.000	-.4789943	-.199092
_cons	13.416	.2346505	57.17	0.000	12.95588	13.87612

Source: Elaboration by the authors based on ECV-B2007 (DANE, 2007).

Appendix 4. Correlation spatial index for a group at block scale in Bogotá, 2005

Variable	IGM
Household head with kindergarten	0,0123
Household head with elementary school	0,3379
Household head with high school	0,3332
Household head with higher education	0,4386
Household head without education	0,1540

Source: Elaboration by the authors based on 2005 Population Census (DANE, 2005).