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Employment Agglomerations and Spatial Mismatch in the Metropolitan Area of Bogota

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EMPLOYMENT AGGLOMERATIONS AND SPATIAL MISMATCH IN THE METROPOLITAN AREA OF BOGOTA♠

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Abstract

This paper examines the wage premium of being located inside the Central Business Centre (CBD) or employment sub-centres in the metropolitan area of Bogota. Then, following literature on spatial mismatching, analyses potential impacts of agglomerations on social and productive exclusion. The core argument is that socially or productively excluded groups in Bogota do not benefit from positive externalities arising from agglomerations because they face multiple spatial barriers that prevent their effective access. Based on spatial statistics and estimations, I find an elasticity or 'wage premium' close to 6% and huge disparities between UPZs and municipalities in the metropolitan area of Bogota. This means, CBD and employment sub-centres in Bogota work as exclusive locations. Consequently, policies should be focused on increasing strategic accessibility through housing, transport, economic development through land-use regulations and institutional arrangements.

Key words: Strategic Accessibility, Central Business District, CBD, employment sub-centres, wage premium, agglomerations economies, Bogota, Spatial Mismatching.

JEL Classification: R10, R12, R23.

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1   INTRODUCTION

The increasing importance of cities as production and employment centres has created the need for a deeper understanding of determinants and drivers of city-size and how firms and households are organised inside those functional areas. Broadly speaking, one instrument identified by the literature to justify the city-size is the existence of agglomeration economies. However, most studies have assumed cities to be homogenous spaces without separating the distributional effects of agglomeration inside them. For instance, most cities today are characterised by some disparities between core and peripheral areas in terms of income, infrastructure and, employment. Some explanations consider that households sort themselves in the city based on their socioeconomic characteristics. In the US context, literature shows that high unemployment rates faced by peripheral minorities can be explained by residential segregation or disconnection from job opportunities (Dujarin et al., 2008).

On the one side, the New Economic Geography and non-mono-centric city-models were the first attempts in considering the relationship between economy and space, conceiving that smaller distances between people and firms determine the spatial structure of the city (Krugman, 1991; Fujita and Ogawa, 1982). In this line, the literature shows positive impacts of agglomeration on wage premiums, productivity spill-overs, new business, specialization and, diversification. Ciccone and Hall (1996) established that agglomerations are crucial to explaining GDP differences between regions and, Ellison and Glaeser (1999) argued that those are related to labour market efficiency. Finally, other studies found that agglomerations benefit the specialization and diversification of metropolitan areas and the growth of employment (Duranton and Overman, 2008; Duranton and Puga, 2005).

On the other side, Fujita and Krugman (2004) included land rents, commuting times, congestion and, other pure diseconomies as the main centrifugal forces of agglomeration inside cities. This means agglomerations can increase urban costs related to spatial segregation of low-skilled workers —spatial mismatch—, higher prices of land and housing, as well as more congestion and pollution. Contrary to positive externalities, the main literature of urban costs generated by agglomerations has concentrated on establishing distance gradients for population density or housing development (Davis and Heathcote, 2007; Davis and Palumbo, 2008; McMillen, 1996) and, also shows that larger cities tend to have higher levels of interpersonal inequality and social exclusion compared to small and medium cities (Glaeser et al., 2009; Baum-Snow and Pavan, 2014).

Agglomerations economies have been mechanisms to promote economic growth, specialization and, human capital accumulation and through them, integrate people who are socially or productively excluded. Martinez and Sanchez-Ancochea (2013) presented the concept of *market incorporation*, referring to the need of creating trajectories that involve productive inclusion as a complement to social inclusion schemes for ensuring capabilities and labour opportunities that encourage full participation of citizens in all life's spheres.

This research aims to examine whether exists a wage premium of being located inside the Central Business Centre (CBD) or employment sub-centres in the metropolitan area of Bogota.

Then, following literature on spatial mismatching, analyse the potential impact of agglomerations on social and productive exclusion. The data sources are the 2017 Multi-purpose Survey and the 2017 Economic Establishment Survey —Section 4.3. for more details—. From a public policy perspective, this paper is useful to determine what are groups that benefit most and least from agglomerations and where other strategies for ensuring effective trajectories to overcome exclusion are needed. The core argument is that socially or productively excluded groups in Bogota do not benefit from positive externalities arising from agglomerations because they face multiple spatial barriers that prevent their effective access.

The document is structured as follows. The first section presents a literature review focused on the causes of city-sizes, the relation between city-size and inequality and, the spatial mismatch inside cities. It also includes a brief overview of social and productive inclusion/exclusion. Then, the context of Bogota and Colombia is presented, followed by methodology and data description. The fifth section outlines the results of estimations and descriptive statistics. The last three sections discuss results based on the literature review and analytical framework, reflect on implications for policy and offer some conclusions.

2 BACKGROUND

2.1 LITERATURE REVIEW

2.1.1 Agglomerations' externalities and city-size determinants

Thinking about agglomerations and their implications for economic and social development, involve an analysis of the foundational models of urban economics focused on explaining the existence and city-sizes. The first work in that direction was presented by Henderson (1974) and his main concern was to determine the optimum city-size —which maximizes the welfare of all agents in the economy— by establishing that an efficient city occurs when the increasing cost per capital of larger cities is compensated by the benefits of scale economies in the traded good production and savings in transaction costs. The main conclusion of Henderson (1974) is that city-sizes vary because of their specialization degree.

Likewise, Behrens and Robert-Nicoud (2015) establish that the main causes to explain cities-size are: location fundamentals, agglomeration economies, the spatial organization of heterogeneous agents and, self-selection. Location fundamentals focus on identifying the endowments heterogeneity in natural resources, accessibility (e.g. roads and presence of navigable rivers) and, climate. Ellison and Glaeser (1999) identified that location fundamentals explain one-fifth of the city-size. However, those effects are rarely analysed in isolation from other causes.

The second cause —agglomeration economies— dates from Marshall (1890), who focused on explaining positive externalities generated by the high density of workers and firms on other economic agents. Those externalities were classified in sharing, matching and, learning (Duranton and Puga, 2004). The concept of sharing underpins in the indivisibility of public

goods or facilities, which make it more efficient to share them indeed of using individually (e.g. Industrial Parks), it means the cities and sub-cities speed up sharing markets, public goods and, facilities. Therefore, firms and workers prefer to maximize benefits by locating closer. The mechanism of matching relies on the rationality that stronger competition and a higher supply of inputs improve the quality of the matching (Helsley and Strange, 1990). For instance, good matchings between job positions and workers in the labour market will improve factor productivity. Finally, the mechanism of learning implies that cities are ideal spaces to bring people together and exchange knowledge, acquire skills and facilitate innovation and new ideas.

The third cause of the city-size related to sorting heterogeneous agents focused on identifying the differences in composition between cities from the most basic characteristics as the industrial structure to the functions they perform in the global economy. Also, cities differ in the human capital and the type of firms and workers they attract. In this sense, Combes et al. (2008) found that up to 40-50% of the higher productivity generated by agglomeration economies is explained by workers' skills quality —more qualified labour force—.

The last cause —self-selection—establishes that workers and firms decide to move towards bigger cities because of their intrinsic characteristics. Behrens and Robert-Nicoud (2015) conclude that there is not conclusive literature related to the self-selection mechanism and its direction. However, some facts that allow inferring presence of self-selection related to higher rates of firms' turnover in bigger cities, higher self-employment and, smaller average firms' size. All four causes presented above shape city-size, productivity, skills and, income distribution.

Broadly speaking, the effects of agglomeration economies have been estimated on some variables. The most important fact is the causality that city-size has on productivity (Rosenthal and Strange, 2004, which is robust even when mechanisms of sorting and selection are included (Combes et al., 2012). Likewise, Behrens and Robert-Nicoud (2015) present some relevant facts —based on US-cities— for this research. The first shows that on average the unconditional elasticity of mean earning is 8%, meaning an increase in 10% of the population increases in 8% the mean salary of workers. Second, the proportion of workers with higher education increases while city-size increases. Third, the Gini coefficient of income is higher in larger cities. Fourth, the urban productivity premium is higher for highly educated workers.

Related to middle-income countries, Duranton (2016) found strong agglomeration effects in the Colombian informal sector — a common characteristic of less advanced economies—, he also estimated the wage elasticity with respect to city-population in 5%, which is larger than elasticity estimated by Puga (2010) for cities in developed countries, but smaller than elasticity found in less advanced developed countries. To sum up, evidence suggests that agglomeration effects are higher in the first steps of cities or countries' development.

Empirically some hypotheses have suggested that agglomerations benefit mainly highly skilled workers and highly productive firms. In this sense, Glaeser et al. (2009) and Baum-Snow and Pavan, (2014) found that larger cities tend to be more unequal places, which means they exhibit

higher Gini coefficients compared to small and medium cities. Human capital has a crucial role in mitigating inequality because the elasticity of the Gini-coefficient falls from 0.011 to 0.008 when the share of workers with higher education is included in estimations (Behrens and Robert-Nicoud, 2015). Figure 1 suggests higher income elasticity for workers and firms at the top of the earnings distribution.

Figure 1: Inequality and city-size
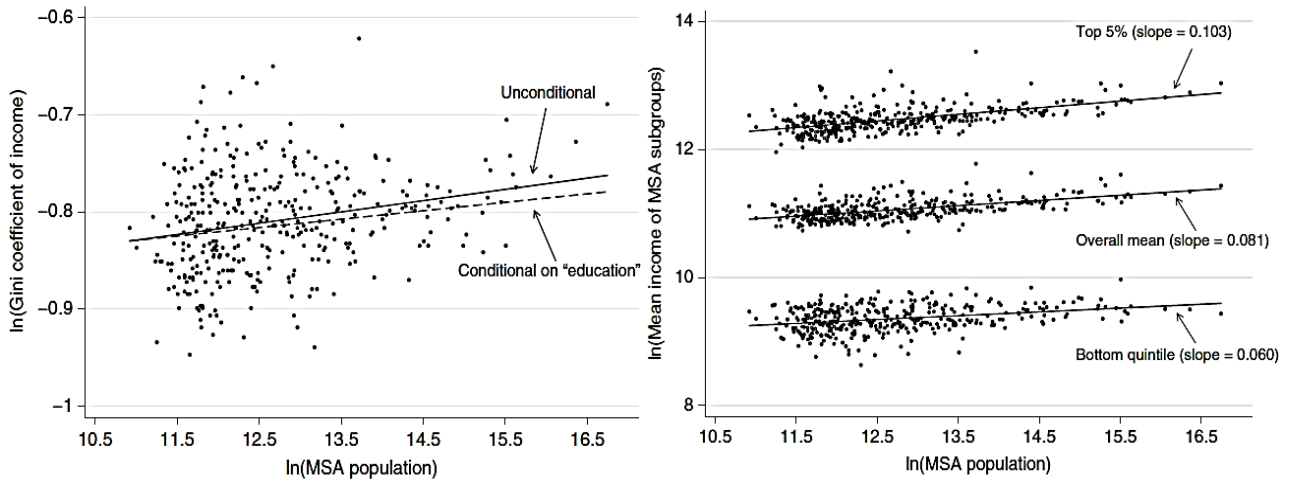
Source: Behrens and Robert-Nicoud (2015).

In the line of distributional effects, Davis and Dingel (2014) established that larger cities have higher Total Factor Productivity compared to smaller cities, making those locations more attractive to more skilled individuals and facilitating the cities-specialization in skill-intensive output. The authors concluded that larger cities are skill-abundant and suggested that general welfare is greater in larger cities due to the most skilled individuals residing there. Coming back to the idea of inequality, Baum-Snow and Pavan (2014) found that around 23% of the variation in the hourly wage in the United States between 1979 and 2007 is explained by the wage-inequality in large cities compared to smaller cities. The authors suggest that results about the direct relationship between inequality and city-size are consistent with the hypothesis of skills upgrading and the returns to specific soft and technical skills in large agglomerations found by Autor et al. (1998) and Bacold et al. (2009).

To conclude, there is a vast literature related to the impact of agglomerations on productivity, land prices, and wages but most of them assuming representative or average agents (Beckman, 1976; Fujita and Ogawa, 1982; Lucas and Rossi-Hansberg, 2002; Mossay and Picard, 2011). However, there is not enough evidence about the distributional effects of agglomerations on low-income workers' welfare and socially excluded groups in the city.

2.1.2 Spatial Mismatch

The spatial mismatch hypothesis (SMH) has been used from the mid-1960s to explain social differences between black neighbourhoods in many US-cities. Even though it was initially used to refer to the US-labour market, a vast literature has adapted the concept to explore the outcomes of low-skilled minorities in the labour market because of disconnection they face from urban job opportunities (Gobillon *et al,* 2007). Typically, studies have used labour market outcomes and some measures —gradients— of the distance between residences and job locations, finding that distance to jobs is partly responsible for the negative labour outcomes exhibit by some social groups (Gobillon *et. al*, 2007). Some mechanisms were presented by Gobillon *et. al*, (2007) to close the gap between the evidence and the theoretical models related to labour supply and demand:

> *"1) Workers may refuse a job that involves commutes that are too long; (2) Workers' job search efficiency may decrease with distance to jobs because job seekers get less information; (3) Workers residing far away from jobs may not search intensively; (4) Workers may incur high search costs that cause them to restrict their spatial search horizon at the vicinity of their neighbourhood; (5) Employers may discriminate against residentially segregated workers (6) Employers may refuse to hire or prefer to pay lower wages to distant workers because commuting long distances makes them less productive; (7) Suburban employers may think that their local customers are unwilling to have contact with minority workers." (Pag. 2408)*

Policies aim to address spatial mismatch include helping minorities and excluded workers to move to suburban locations, which implies reducing access barriers to the housing where they would have better job accessibility. Other policies focused on implementing incentives' schemes to relocate firms in those segregated zones, invest in infrastructure — e.g. transport, internet connection, and flexible work— to connect these minorities to markets or increase the attractiveness of zones they are living in, schemes to reduce asymmetric information related to vacancies and campaigns against discrimination.

2.1.3 Vulnerability and social and productive exclusion/inclusion

A broad definition of social exclusion can be found in Levitas et al. (2007) as:

> *"A complex and multi-dimensional process. It involves the lack or denial of resources, rights, goods and services, and the inability to participate in the normal relationships and activities, available to most people in a society, whether in economic, social, cultural or political arenas. It affects both the quality of life of individuals and the equity and cohesion of society as a whole" (Pag. 9)*

At the same time, the authors presented the concept of "deep exclusion" referring to the accumulation of disadvantages that ends up in severe negative consequences for the personal welfare and quality of life. Barnes (2005) identified the domains of social exclusion as the

financial situation (income poverty), material possessions, housing circumstances, neighbourhood perception, social relations, civil life, physical health, and mental health. In this line, it is crucial to recognize that poverty is directly linked to social exclusion because it prevents people with different traps to fully participate in economic and political life (Atkinson and Marlier, 2010).

During the last two decades, concerns about social exclusion and poverty made countries around the world started to collect and process data for measuring the dimensions of exclusion, including the lack of financial resources (income poverty) and the multidimensionality of poverty. As Alkire et al. (2015) show, many conceptualisations and frameworks have been developed to explain social exclusion and poverty determinants: human rights, livelihoods, social justice, social protection, and capabilities, among others. Those analytical approaches have been used to design integral strategies to support excluded and poor people based on the multidimensionality of vulnerability.

As a complement, Martinez and Sanchez-Ancochea (2013) introduced the idea of market incorporation referring to the need of implementing schemes of productive inclusion to social inclusion trajectories, mainly when excluded people are close to overcoming vulnerability that prevents them the full participation in social, economic and political life. It means productive inclusion (economic inclusion) implies focusing on improving the economy's performance to generate well-paid formal jobs for people who are inside the trajectory of overcoming social exclusion. Following the capabilities approach presented by Sen (2009) the productive inclusion can be the driver to ensure freedom and well-being for overcoming exclusion.

2.2 ANALYTICAL FRAMEWORK: DO EMPLOYMENT AGGLOMERATIONS ACCELERATE SOCIAL AND PRODUCTIVE INCLUSION OR CONTRARY THEY INCREASE SPATIAL MISMATCH?

The analytical framework (Figure 2) is based on the literature review. It mainly incorporates positive externalities of agglomerations and their urban cost, both framed as part of the research focused on explaining the determinants of city-size and the drivers for specialization inside the cities.

The analytical framework starts by considering that local authorities worldwide establish policy objectives to integrate different dimensions of Urban Development in their daily actions. Economic growth has been the core element throughout Cities Development Strategies (CDS), becoming a constant concern of public authorities due to discourses related to more social welfare to be reached requires higher financial resources. At the same time, social change[1], social mobility, less vulnerability, and less fragmentation of urban fabric are the main drivers

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[1] Understood the simultaneous patterns of social and productive inclusion. That means, the trend of double inclusion along the period of analysis (Angulo, 2015).

for the social policies inside cities. Therefore, both economic and social policies include specific instruments to operationalise each objective.

In the case of economic growth and based on available literature and benchmarking with other cities, agglomeration economies seem to be one instrument to achieve high-performance of city economy due to positive impacts on productivity, knowledge spill-overs, specialization and diversification, wage premiums, among others. In the case of social mobility and social change, the main instruments are comprised by social inclusion —subsidies, housing interventions, training, among others—, for supporting all the spheres where the individuals are vulnerable before getting into the labour market, and productive inclusion or market incorporation, for ensuring pertinent skills, competences and networks to remain them connected to markets as a long-term strategy to overcome vulnerability.

The analytical framework used in this dissertation incorporates the relationship between employment agglomerations and social and productive exclusion, particularly it explores if employment agglomerations accelerate or consolidate social mobility and inclusion trajectories. The phenomena described previously rely on theoretical and empirical literature focused on explaining the city-sizes determinants. In this sense, the present research analyses in-deep if promoting agglomerations as a mechanism of economic growth is the best tool to mitigate exclusion in the metropolitan area of Bogota since larger cities tend to exhibit higher inequality.

Finally, agglomeration economies, together with intrinsic characteristics of each location "location fundamentals" and individual preferences for spatial locations, are the city-size determinants. For instance, while a city-population is growing it is more likely that agglomerations in some spatial spots take place. However, at the same time inequality tend to be higher in larger cities and agglomeration economies to be correlated with some levels of social and productive exclusion. It means, agglomeration economies could not work for the whole population because of city fragmentation, as well as the pre-existing inequalities in terms of income, human capital accumulation, social capital, accessibility and land tenure.

Figure 2: Analytical framework: Do agglomerations accelerate social and productive exclusion or contrary they increase spatial mismatch?
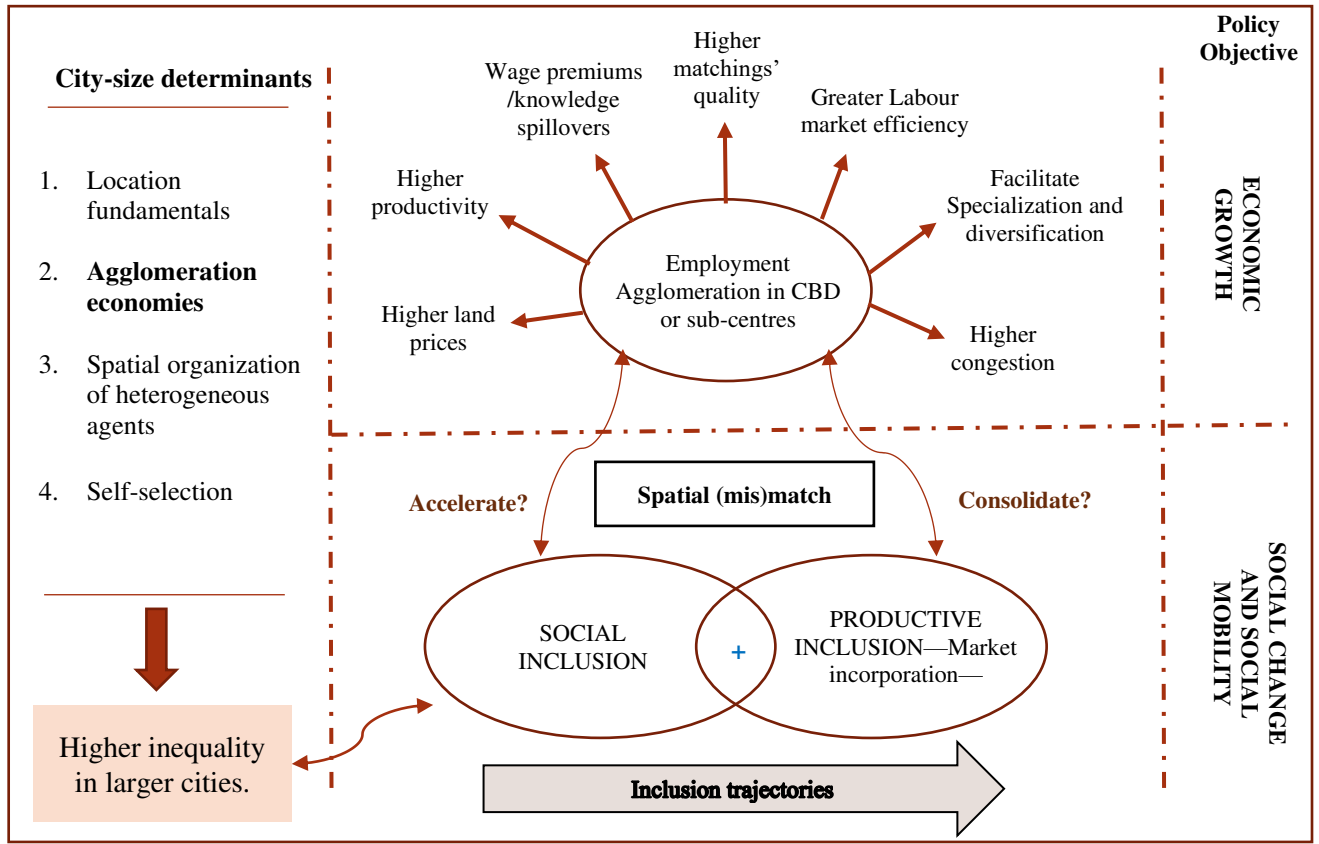
Source: own elaboration based on literature review.

3   BOGOTA AND COLOMBIAN CONTEXT

Bogota is the political and economic Colombian capital; its population is about 10 million people considering the functional area and commuting patterns. National Constitution of 1991 defined Bogota as Capital District, which implies more autonomy, easier access to national transfers and instruments to facilitate city management through 20 smaller spatial units called localities. In urban planning terms, the city has been divided into smaller units than localities called Zonal Planning Units —UPZs to establish guidelines related to land-use and infrastructure provision.

Economically, added value in 2017 was compounded by the services sector (60%), retail, hotels and restaurants (16.3%), manufacturing (9.3%), and construction (5.9%). These sectors have increased their participation between 2000 and 2017, except manufacturing that has decreased. Table 1 shows the increasing importance of the tertiary sector in the local economy from the early 1960s. It means, currently the city-economy is compounding mainly by financial, real estate and professional services.

Table 1: GDP distribution by sectors, Bogotá, 1960-2016.

| Period	Primary	Secondary	Tertiary	Taxes
1960-1970	1.1	30.9	68.1	NA
1971-1975	1.3	30.8	67.9	NA
1976-1980	0.4	30.8	64.5	4.3
1981-1990	0.3	26.3	67.1	6.3
1991-2000	0.4	26.3	63.3	10
2001-2010	0.3	21.2	69.7	8.8
2011-2016	0.2	18.1	72.4	9.2

Source: Valencia *et al.* (2016).

Social policies implemented in the last two decades have been effective to reduce poverty (
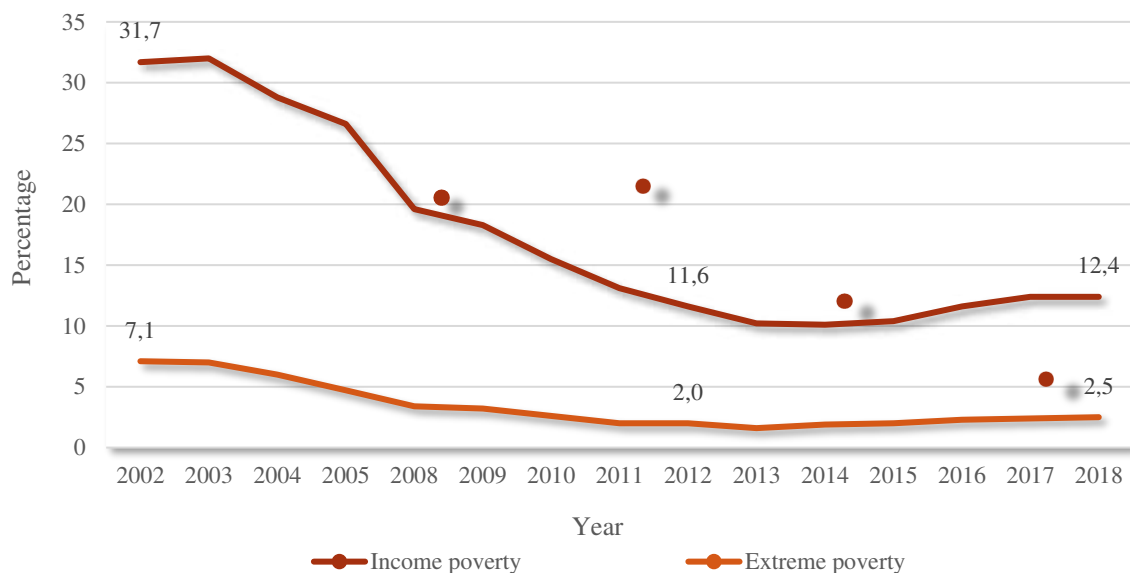
),
both seen as dimensions of social exclusion, particularly the lack of financial resources. Also, the Gini coefficient — income inequality measure— although very high, has reduced from 0.571 in 2002 to 0.504 in 2018. Colombian government designed and implemented the Multidimensional Poverty Index (MPI) as a tool to follow up results of social policies. In Bogota, the MPI has dropped between 2010 and 2018 (Table 2), which means that about 535,000 people overcame multidimensional poverty.

Figure 3: Income poverty and extreme poverty. Bogota, 2002-2018 (%).
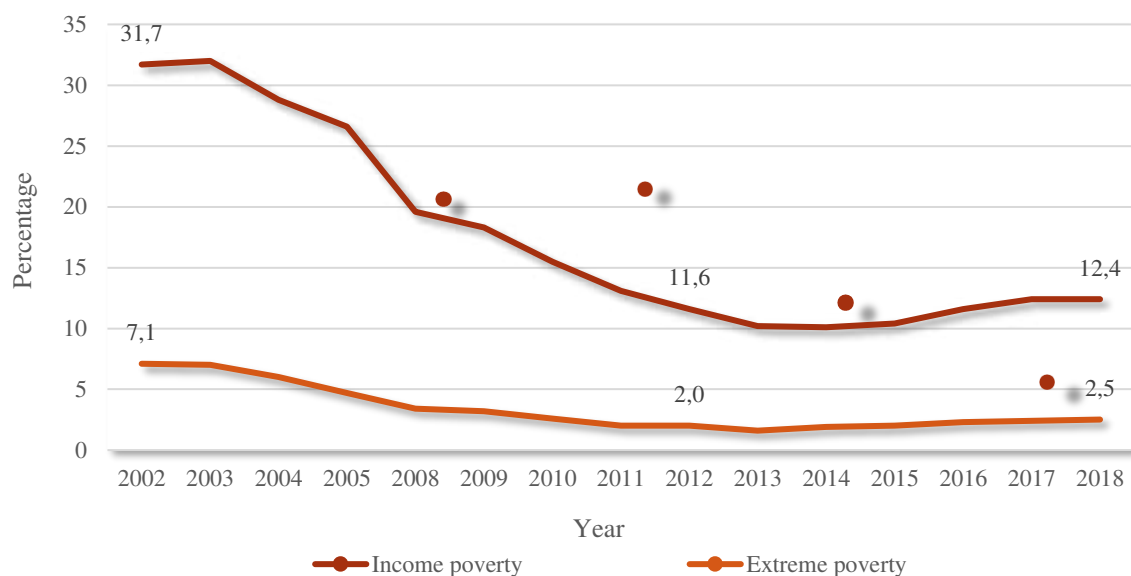
Source: Colombian National Department of Statistics (DANE, for its Spanish acronym).

Table 2: Share of the population classified as multidimensionally poor. Bogota, 2010-2018.

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Multidimensional poverty (%)	12.1	11.9	11.1	8.7	5.4	4.7	5.9	N/A	4.3
Multidimensional poverty (absolute)	890,000	887,000	841,000	672,000	418,000	368,000	469,000	N/A	355,000

Source: Colombian National Department of Statistics (DANE, for its Spanish acronym). **Note**: 2017 is not comparable with the historical series.

Public authorities have been focused on the international promotion of Bogotá as a city with scope for growth and business development, by harnessing the results of the Global Cities Index (2017), the Doing Business (2018) and the mark as World City in the Globalization and World Cities (2018). Likewise, together with the private sector defined between 2014 and 2016 the Intelligent Specialization strategy by prioritising five core areas as drivers to the city economy: i) Bio-Polo: pharmaceutical, advance medicine and bio cosmetics; ii) Bogota Creative Region: software and content design, creative industry, music production and cinema; iii)Business services: Finance, e-Health, extensions services for small and medium enterprises and specialized professional services, iv) Hub of advanced knowledge: research and development services, tertiary education and innovation and, v) Sustainable City-Region: intelligent transport, circular economy and improve the integration of the Bogota River into the economic and urban development (CCB, 2015).

Finally, the Intelligent Specialization Strategy has been complemented by boosting the performance of 13 clusters around the city. The objective is to remove bottlenecks

that prevent the growth of the following activities inside the functional —metropolitan— area: leather, footwear and leather goods, jewelry, business tourism and events, music, gastronomy; creative industry and content; graphic communication, energy, health; dairy products; cosmetics; and Software and IT (SDP, 2016).

3.1.1   Previous Research on Colombia and Bogotá

Duranton (2016) estimated agglomeration economies' effects for Colombian cities and found that the elasticity of wages to the city population is about five percent and, that young workers tend to have higher returns to city size compared to older workers. Alvarez (2013) studied economic agglomerations in Bogotá and their impact on productivity. She found that effectively there are some agglomerated economic sectors in Bogota and, that the manufacturing industry is less concentrated than other economic activities such as commerce and services.

Besides, Ruiz et al. (2017) studied Bogota's CBD and the employment sub-centres in the metropolitan area, based on Lee (1982) who found a new decentralised structure, characterised by changes in population density patterns and land prices. Araque et al. (2008) identified 16 economic agglomerations in the urban area of Bogota in 2001. They also found an employment expansion outside the traditional city-centre —mainly towards the north and west of the city-boundaries— and a proliferation of peripheral economic sub-centres. The last research showed that a multicentre model better explains the current structure of Bogota's labour market (Avendaño, 2012, cited by Ruiz et al., 2017).

4   EMPIRICAL STRATEGY

4.1   METHODOLOGY

The methodology is based on Duranton (2016) who estimated agglomeration economies' effects in Colombian cities, also in models implemented by Rauch (1993) and Moretti (2004), who explored the impact of city education on wages and possible learning effects related to larger cities found by Glasser (2001). In this sense, this paper explores in-depth the impact of being located inside the CBD or employment sub-centres found by Ruiz et al. (2017). For using the CBD and employment sub-centres found by Ruiz et al. (2017), a correlative table between UPZs and JICA's Zones was constructed.   A UPZ is defined by local authorities as *"Sets of neighbourhoods or urban sectors sharing identity to specify, define and adapt the guidelines of the Territorial Ordering Plans of the city".* In the case of JICA's Zones, those areas were defined by the Japan International Co-operation Agency (JICA) in 1996 when they designed Mobility and transport plans for Bogota.

The main functional estimation is:

$$LogW_{iu(i)} = \propto LogEA_{upz(i)} + \beta X_i + \gamma Z_{upz(i)} + \varepsilon_{iupz(i)}$$

Where the dependent variable is the log of the monthly wage of the worker i who is in the UPZ $u(i)$. The coefficient $\propto$ shows the elasticity of the being in UPZs $u(i)$ that comprised Bogota's CBD or employment sub-centres to wages. The equation also includes a vector of individual characteristics X_i, a vector of UPZ characteristics $Z_{upz(i)}$, and an error term $\varepsilon_{iupz(i)}$. Measuring agglomeration economies benefits through wages has been a tradition and the rationality behind this is that, due to agglomeration effects, wages should increase with higher employment agglomerated.

The ideal estimation would have the same worker in different locations —*counterfactual*— and, after controlling for the place's characteristics, compare their elasticity. However, it is not possible for two reasons: the first because the person cannot be in two different places at the same time, and the second, due to the nature of the data used in the present research, which is cross-sectional.

Potential biases come from 1) the workers choose the place to work —self-selection— and 2) some omitted variables can be correlated with the employment agglomeration or wages. For both equivalent problems, the inclusion of as many control variables as possible can reduce the bias. The functional equation will be estimated for the whole workers targeted in the 2017 Multipurpose Survey. The spatial controls are share of workers with post-secondary education, 2017 population, internet connectivity rates, natural gas connection rates, number of schools, number of economic establishments, informality, labour density, and average day's amount of garbage collection. The individual characteristics to reduce the potential biases are: age, square age, gender, number of schooling years, parents' education, and time laboured in the same company, firm size, ethnicity, and informality condition.
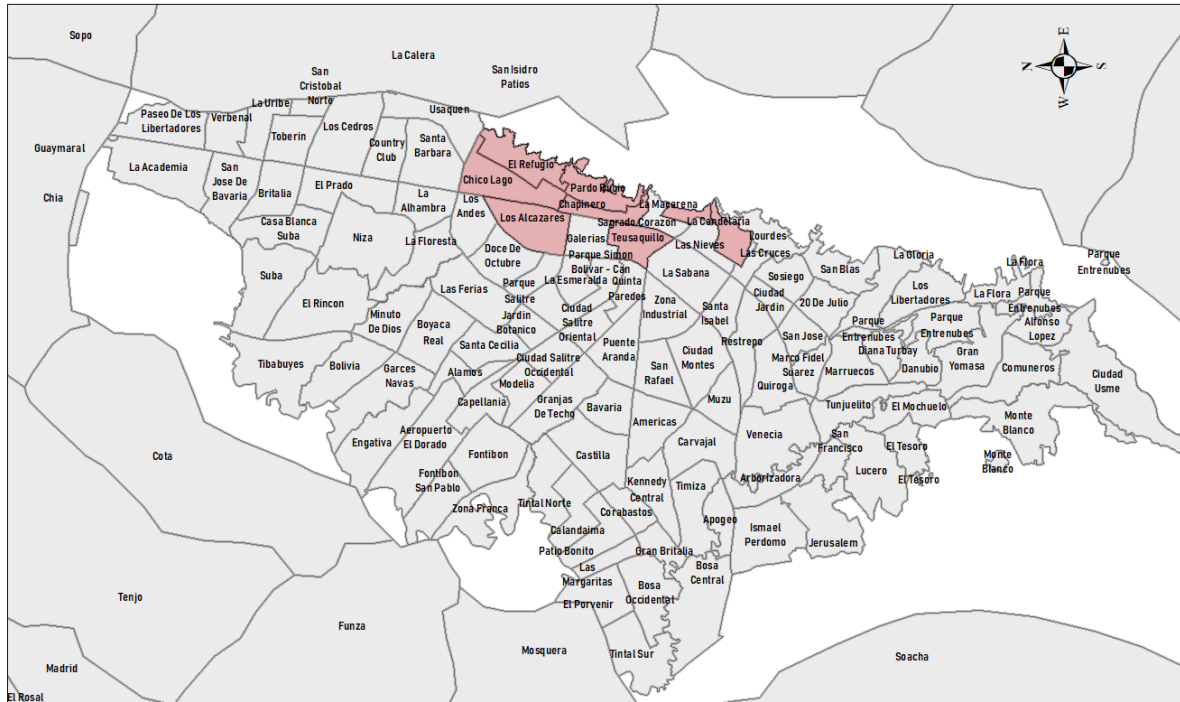
4.2 CBD AND EMPLOYMENT SUB-CENTRES

The identification of the Central Business District (CBD) and employment sub-centres is based on Ruiz *et al*. (2017) who used the information of the 2011 Bogota's Mobility Survey to identify origin-destination work trips, obtaining an approximate estimation of labour spots for the whole metropolitan area of Bogota. The methodology implied to define the CBD based on labour density criteria —more than use the traditional CDB—. Then, the authors identified employment sub-centres to determine what their impact on labour density is and what is their relationship with the people's location and economic activity in the metropolitan area of Bogotá.

To use the results found by Ruiz et al. (2017), a correlative[2] table between JICA Zones and UPZs was built (Appendix 1). Map 1 and Map 2 show the CBD and employment sub-centres respectively. The CBD used in this paper is bigger than the traditional one defined by other studies, which conceived just La Macarena and Las Nieves as the main agglomerated spot in

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[2] A mechanism to correspond two classifications and make them comparable.

Bogota, particularly it adds Teusaquillo, El Refugio, Pardo Rubio, Chico-Lago, and Los Alcazares as complementary UPZs to the extended CDB. Furthermore, employment sub-centres are: Country Club, Granja de Techo, Puente Aranda, Ciudad Salitre Oriental and Zona Industrial. It is relevant to mention that none of the municipalities around Bogota is part of the CBD or employment itself for the metropolitan area. However, they have their own CBD when analysed as isolated spatial units.

Map 1: Central Business District by UPZ, Metropolitan Area of Bogota, 2017.

Source: own elaboration based on Ruiz et al. (2017). Scale: 1300000.

Map 2: Employment sub-centres by UPZ, Metropolitan Area of Bogota, 2017.
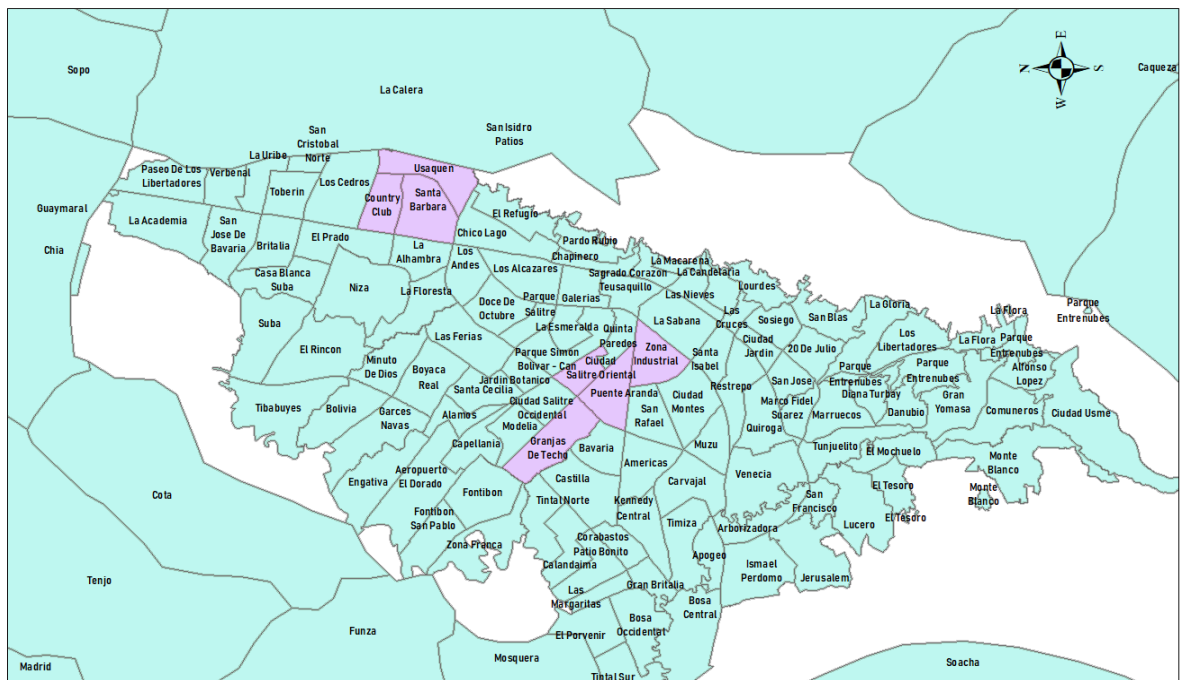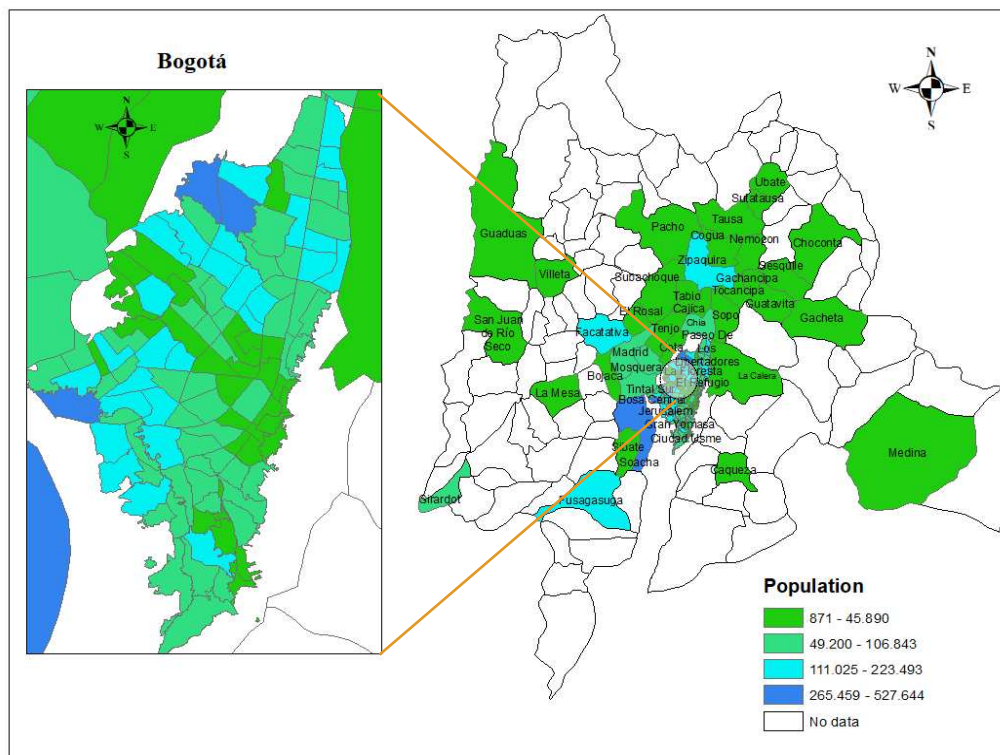

Source: own elaboration based on Ruiz et al. (2017). Scale: 1300000.

4.3 DATA

4.3.1 2017 Multipurpose Survey

The multi-purpose survey of 2017 is the third household study carried out by the National Department of Statistics and financed by the Bogota Planning Secretary (SDP, for its Spanish acronym). The Survey aims to obtain statistical information to follow up crucial variables needed to design and evaluate social, economic and urban dimensions of households and inhabitants of Bogota and 37 surrounding municipalities. The main difference between this version and the previous one is representativeness. The 2017s version included 19 urban localities —including their respective UPZs—, the rural areas of Sumapaz, Usaquen, Chapinero, Santa Fe, San Cristobal, Usme, Ciudad Bolívar and Suba, and the urban area of 37 municipalities[3] around Bogota. The sample is comprised of 77,025 households in Bogotá and 32,086 in the municipalities around it (Map 3).

Map 3: Population ranges in sample units of analysis, the metropolitan area of Bogota, 2017.

Source: Own elaboration based on 2017 Multi-purpose survey. **Note:** data for Bogota is to UPZ level. Scale: 1300000.

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[3] Bojacá, Cajicá, Cáqueza, Chía, Chocontá, Cogua, Cota, El Rosal, Facatativá, Funza, Fusagasugá, Gachancipá, Gachetá, Girardot, Guaduas, Guatavita, La Calera, La Mesa, Madrid, Medina, Mosquera, Nemocón, Pacho, San Juan de Río Seco, Sesquilé, Sibaté, Soacha, Sopó, Subachoque, Sutatausa, Tabio, Tausa, Tenjo, Tocancipá, Villa de San Diego de Ubaté, Villeta y Zipaquirá.

4.3.2 2017 Economic establishment survey

The main objective of the Economic Establishments Survey is to identify economic units located in the metropolitan area of Bogota and their territorial distribution. The methodology focused on counting the number of establishments (georeferenced census) and afterward sampling to collect data from the main economic sectors in the region: industry, services, commerce and agriculture.

Survey implementation was assigned to the National University of Colombia by the Cundinamarca's provincial[4] government and Bogota's government. The rationality behind exploring the functional metropolitan area of Bogota relies on the results of the Cities System developed by the Colombian National Planning Department that found that Bogota has functional relations with 23 municipalities. However, new calculations of the RAPE — Administrative and Special Planning Region— found that agglomeration for Bogota includes 35 territorial units or municipalities. In this new 'functional area' 9.7 million people live, with a COP 201 billion (US$ 58.6 billion) of added value.

4.3.3 Other Sources

Spatial Data Infrastructure for the Capital District — IDECA, for its Spanish acronym—, is a platform designed by the local authorities. It was used to get control variables for UPZs or localities and through them avoid or mitigate the bias generated for missing data. Also, the Municipal Panel-Data, constructed by Andes University, provided the information of municipalities located in the functional metropolitan area of Bogota as population, kilometres of urban area and number of schools.

5 RESULTS AND ANALYSIS

5.1 DESCRIPTIVE STATISTICS

Table 3 shows some statistics for different spatial units and allows us to infer some disparities inside the metropolitan area of Bogota. Initially, the average monthly income[5] in the metropolitan area is around US$ 245.8, while for people located in the CDB it is around US$ 347.87 and US$ 220 for Bogota's surrounding municipalities. Intuitively people located in the main employment spots seem to

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4 Colombia is comprised of 32 departments or regions. Cundinamarca is in country-centre; its capital is Bogota. However, for being both country-capital and region-capital, legally Bogota is not part of Cundinamarca. In urban terms, some of Cundinamarca's municipalities belong to the 'functional metropolitan area of Bogota' despite it has not been legally created.
5 2017 constant prices

earn more (Appendix 2) and have a higher average household income per capita. However, estimations presented in section 5.2 establish the magnitude or elasticity of location on the monthly income by controlling for the main wages' determinants.

Table 3: Descriptive statistics. Different spatial units, 2017.

Variable	Total metropolitan area	CBD	Sub-centres	Bogotá without CBD and Sub-centres	Municipalities without Bogota
Average monthly income Cop/US$	$855,978.03 (US$ 245.8)	$1,211,052 (347.87)		$873,269 (250.85)	$766,814 (US$ 220)
Average age	33.6	38.65	38.6	33.6	31.86
Schooling years	10.93	14.38	15.16	11.02	9.32
Average years worked	6.60	7.13	8.97	6.59	6.14
Average per-capita household income Cop/US$	$899,864.97 (US$ 258.49)	$2,495,500 (US$ 716.83)	$3,760,265 (US$ 1080.14)	$908,908 (US$ 261.08)	$615,382 (US$ 176.77)
% women	50.5%	50.4%	50.3%	50.5%	51.2%
% income poverty	16.36%	6.45%	4.38%	15.38%	23.9%
% multidimensional poverty	5.38%	1.56%	1.66%	5.05 %	7.91%
% informality (no contribution to pensions)	40.36%	32.72%	24.75%	39.89%	46.68%

Source: Own elaboration.

Concerning the average age, there is an interesting pattern; in the CBD and employment sub-centres the average worker is about 38.6 years old compared to the municipalities from the metropolitan area where the average is 31.8. Likewise, inside the CBD and employment sub-centres the average schooling years is close to 15, while for the metropolitan area it is closely 11, this means just the basic education required for most of the Colombian labour market opportunities, even for non-skilled jobs.

Following the trend of the variables presented above, workers in the main Bogota's employment centres show higher levels of experience —measured as the cumulative years in the same job— compared to workers in the whole metropolitan area. The main agglomeration spots also exhibit lower rates of multidimensional and income poverty (Map 4 and Map *5*). At this point, it is relevant to clarify that it is difficult to establish the driver for these results because there is not enough data and evidence to identify if poor people have been expelled from those zones or if agglomerations provide the conditions to accelerate social inclusion[6]. The employment sub-centres exhibit the lowest informality rate[7] —as a measure of productive

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[6] This hypothesis can be proved through a data panel or at least by continuing collecting the Multi-purpose survey to UPZ level.
7 For this study, informality is defined as no contribution to pensions.

exclusion—, followed by the CDB and the surrounding municipalities excluding Bogota (46.7%).

Map 4: Multidimensional poverty. Metropolitan area of Bogota, 2017.
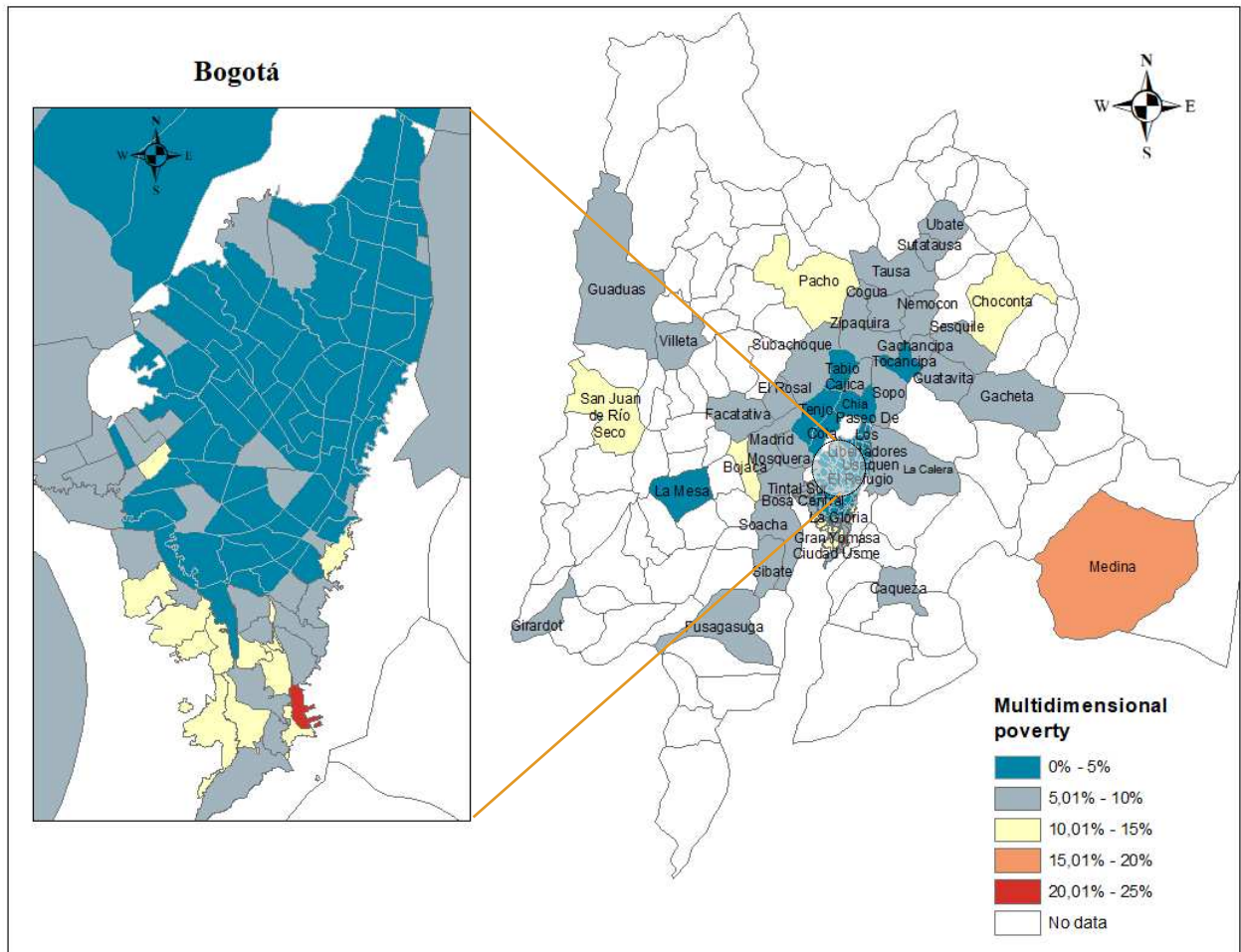
Inside the metropolitan area of Bogota, the UPZs or municipalities with higher labour density tend to have also higher households' income per capita as .

Figure 4 shows. The UPZs at the top right of the figure are: El Refugio, Usaquén, Santa Bárbara, Country Club, Ciudad Salitre oriental, La Floresta, La Alhambra, Niza and Los Cedros. The highlighted points in the bottom left represent all municipalities from Cundinamarca, considered part of the functional area of Bogota, which have lower labour density and households' income per capita. It is interesting to highlight that municipalities from

the metropolitan area exhibit important differences in terms of income and labour density. For instance, in the north, Chia—even with similar labour density— had double the average per capita households' income of Soacha in the south and, has a lower informality rate in 10 percentage points.

Map 5: Income poverty. Metropolitan area of Bogota, 2017.

Figure 4: Labour Density vs per capita household income, UPZs and municipalities, 2017.

Informality is considered a driver of productive exclusion. This means that people are not part of the opportunities and benefits of the formal economy. Even though informal workers are not completely segregated from the productive spots in the city because there is not a 100% formal or informal UPZ (Map 6), ities in the Metropolitan area.

Figure **5** reflects the inverse relationship between informality rate and average households' income per capita. It could be an indication of the importance of economic growth as a mechanism to incorporate informal workers in the productive city-economy. In this sense, economic development strategies — as intelligent specialization implemented by the local stakeholders— are necessary but not enough instruments to overcome productive exclusion.

Map 6: Informal employment rate. Metropolitan area of Bogota, 2017.
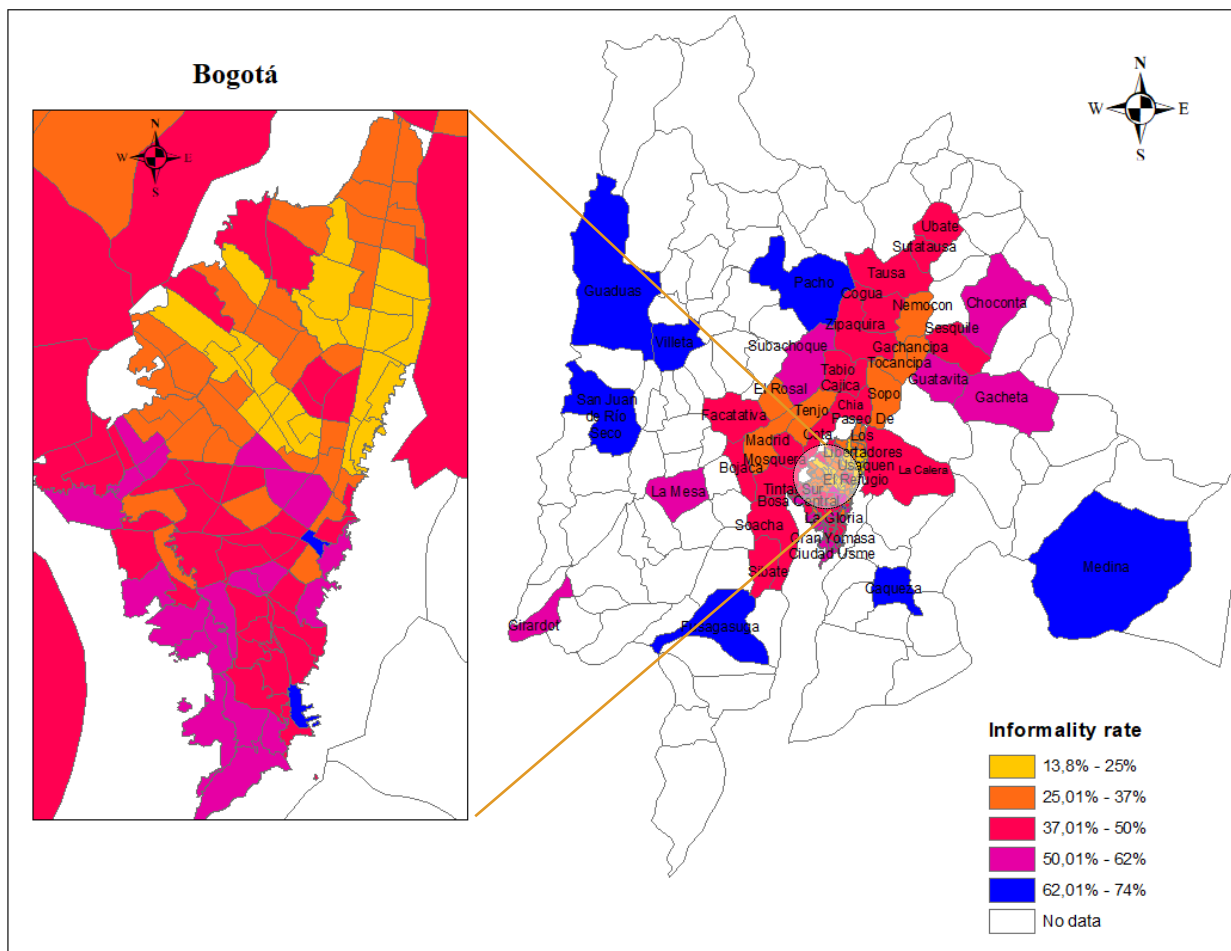
Source: Own elaboration based on the 2017 Multi-purpose survey **Note:** Bogota's data is calculated to UPZ level. Scale: 1300000

Map 7 shows a proxy of UPZs and municipalities' connectivity through the percentage of the population connected to the internet. As observed, the highest connectivity rates —between 80 and 100%— are at the employment agglomerations (sub) centres and surroundings' UPZs. The lowest rates are in the southern UPZs, where the rate is between 40 and 60%. Funza, Chia, Cota, and La Calera are the towns with the highest internet connection rates between the municipalities in the Metropolitan area.

Figure 5: Informality rate vs per capita household income. Metropolitan area of Bogota, 2017.
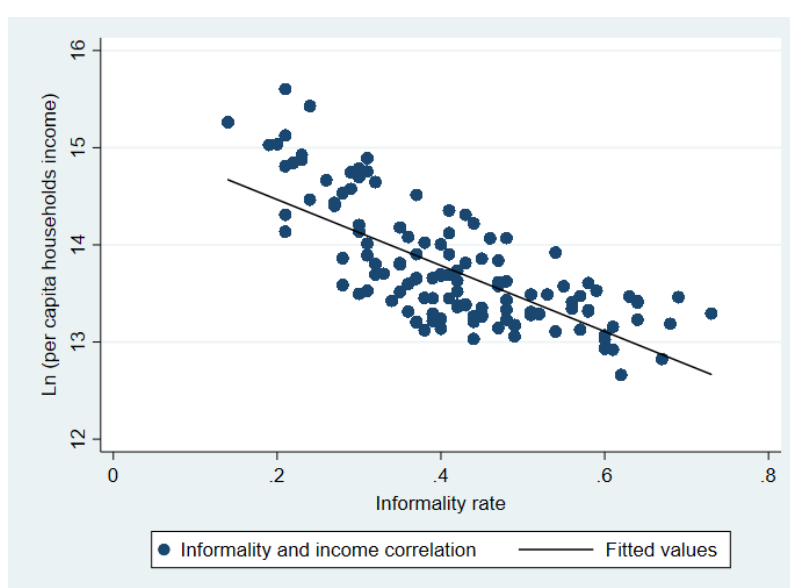
Source: own elaboration. **Note:** monthly income is in Colombian Pesos (COP).

Map 7: Percentage of the population connected to the internet. Metropolitan Area of Bogota, 2017.
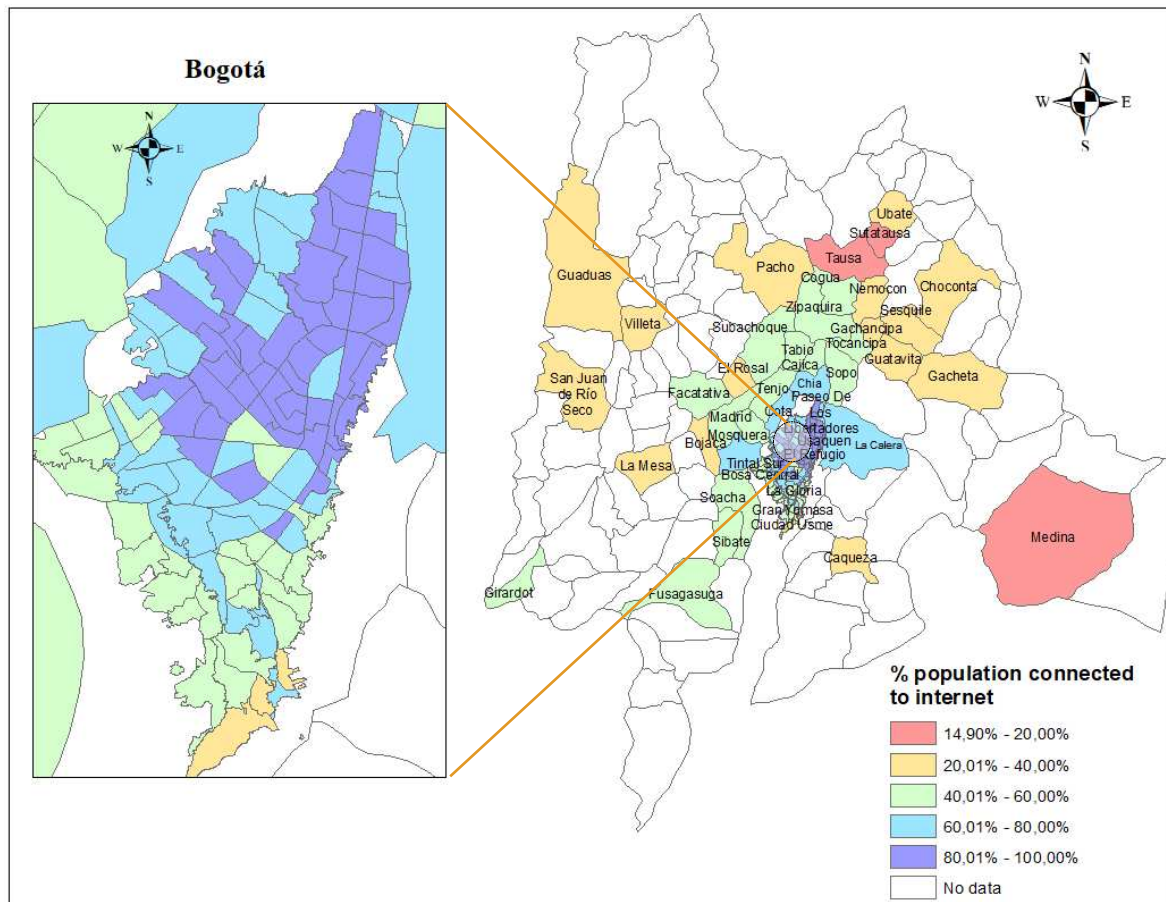
Source: Own elaboration based on 2017 Multi-purpose survey. **Note:** Bogota's data is calculated to UPZ level. Scale: 1300000.

As mentioned previously, literature has shown the importance of higher education alongside agglomeration processes. The Colombian education system includes eleven years between primary and secondary education. Data presented in Map 8 is based on any type of studies after secondary school. Particularly, it shows that around 80% of workers located in the CBD, employment sub-centres, and their surroundings' UPZs, has higher education, while the city-south and municipalities belonging to the metropolitan area exhibit rates between 41% and 60%. This means, highly skilled workers are in the main productive spots, with better connectivity and higher labour density. The predominant strata —instrument from 1 to 6 used to classify housings and neighbourhoods based on their characteristics— in the UPZs with highly educated workers is 4, while in UPZs with low educated workers is 2 (Appendix 3). Because strata reflect location preferences conditioned by budget constraints, the pattern showed allow us to infer about the effective spatial city-fragmentation and higher land prices in high-income workers' locations.

Map 8: Percentage of population with post-secondary education in the Metropolitan Area of Bogota, 2017.
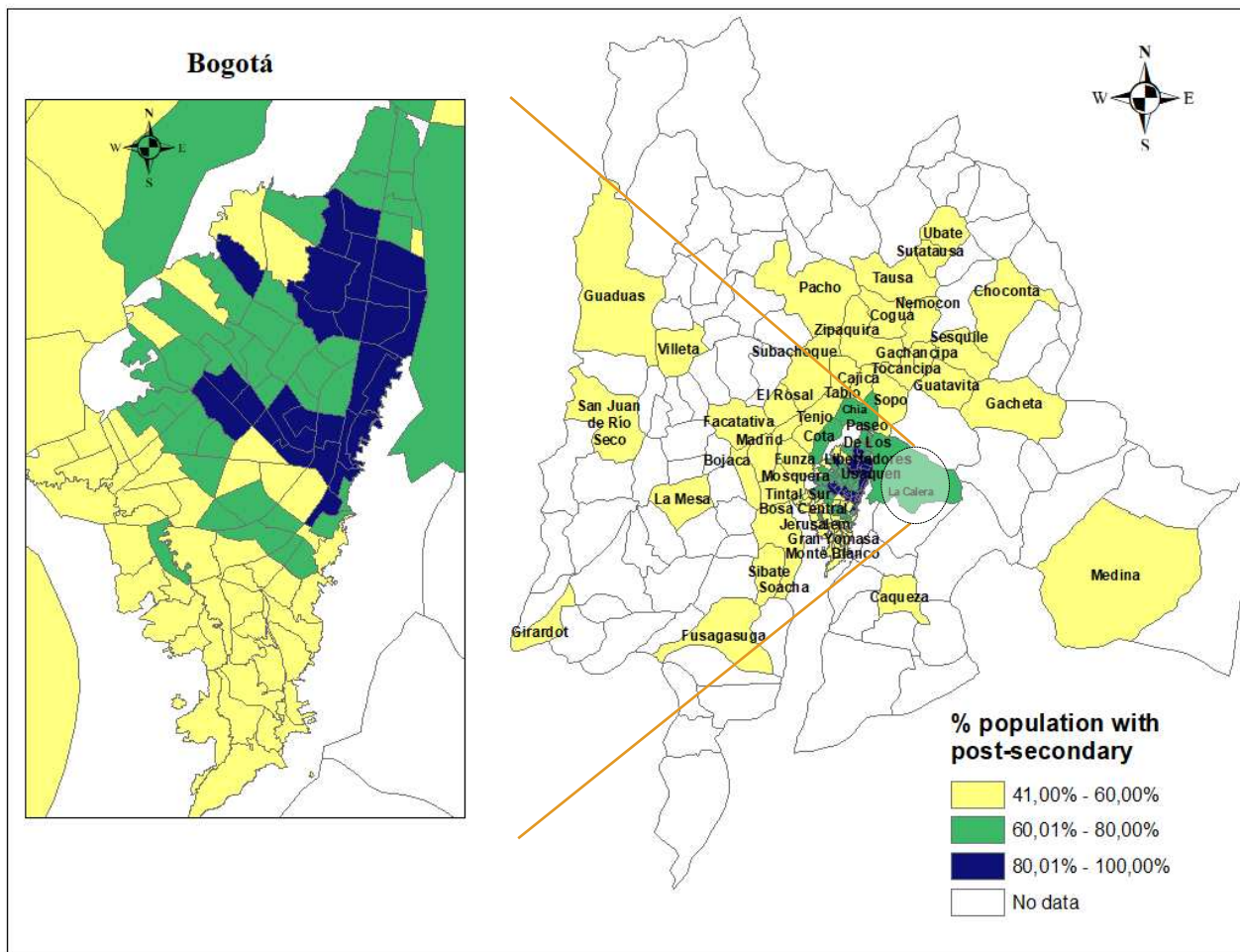
Source: Own elaboration based on 2017 Multi-purpose survey. **Note:** the data of Bogota is calculated to UPZ level. Scale: 1300000.

5.2 ESTIMATION RESULTS

Available data capture members from the formal and informal sector, family helpers with no earnings as well as money earned by self-employed. Ideally, public servants need to be excluded from estimations because they are not hired by market-driven mechanisms. So, before estimating, those observations were excluded from the database. Likewise, the monthly income was calculated including transport allowance for workers earning less than two minimum salaries[8].

Table 4 presents results from the functional equation used to estimate the premium of being in the Central Business District. The equations a wage premium between 13% and 16% compared

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[8] The Colombian law defined mandatory a monthly minimum salary. In 2019, it is about US$ 263. For workers earning below two minimum salaries, the employer must add a transport allowance of 10% monthly income.

to people outside the CDB. Likewise, one additional year of education and age, working in big firms, and living in UPZs with higher average households' income per capita are correlated with positive impacts on the monthly income. The square age allows confirming the income decrease after some age. At the same time, men have higher levels of income than women and, being an informal worker imposes a penalty on monthly income compared to workers in the formal economy.

Table 4: Estimations. Bogota and Metropolitan Area of Bogota.

VARIABLES	(1) Bogotá	(2) Metropolitan area	(3) Metropolitan area	(4) Bogotá
Central Business District=1	0.151***	0.138***	0.153***	0.163***
	(0.0322)	(0.0320)	(0.0320)	(0.0322)
Ln (Labour density)	0.00347	0.00684***	0.00794***	0.00334
	(0.00784)	(0.00149)	(0.00148)	(0.00781)
Schooling years	0.0611***	0.0616***	0.0547***	0.0550***
	(0.00172)	(0.00121)	(0.00123)	(0.00175)
Proxy experience	0.00852***	0.00937***	0.00978***	0.00882***
	(0.000915)	(0.000673)	(0.000672)	(0.000914)
Age	0.0477***	0.0487***	0.0456***	0.0453***
	(0.00290)	(0.00208)	(0.00208)	(0.00290)
Square age	-0.000579***	-0.000592***	-0.000558***	-0.000554***
	(3.47e-05)	(2.51e-05)	(2.51e-05)	(3.47e-05)
Gender	0.219***	0.243***	0.235***	0.214***
	(0.0123)	(0.00919)	(0.00916)	(0.0123)
Ln (households' income per capita)	0.0523***	0.0544***	0.0416***	0.0412***
	(0.0148)	(0.0135)	(0.0134)	(0.0148)
Firm size	0.319***	0.337***	0.213***	0.224***
	(0.0132)	(0.00955)	(0.0111)	(0.0148)
Informal	--	--	-0.298***	-0.251***
			(0.0109)	(0.0143)
Constant	10.99***	10.89***	11.38***	11.41***
	(0.210)	(0.179)	(0.180)	(0.210)
Observations	90,129	130,095	130,095	90,129
R-squared	0.047	0.063	0.068	0.051

Robust standard errors in parentheses[9]
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Following Glaeser (2009), individuals decide whether to live in a specific place based on economic returns (wages), noneconomic returns (amenities), and the financial cost of living there (i.e. housing prices). For that reason, Table 5 shows equation once incorporated as many UPZs and municipalities control variables as possible: Labour density (number of workers per square kilometre), percentage of households connected to natural gas and internet (proxy to connectivity), number of economic establishments, 2017 population, average day's number of

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[9] The presence of heteroscedasticity is confirmed (Appendix 4), for that reason robust standard errors are implemented.

garbage collection (a proxy of urban environment quality) and number of schools (a proxy of urban amenities).

Table 5: Estimations for Bogota and the metropolitan area including spatial controls

VARIABLES	Model 1	Model 2
Central Business District (CBD=1)	0.0621*	0.0602*
	(0.0336)	(0.0336)
Schooling years	0.0623***	0.0554***
	(0.00122)	(0.00124)
Age	0.0500***	0.0470***
	(0.00208)	(0.00208)
Square age	-0.000568***	-0.000534***
	(2.51e-05)	(2.51e-05)
Gender	0.254***	0.247***
	(0.00914)	(0.00912)
Firm size	0.337***	0.213***
	(0.00958)	(0.0111)
Informal	--	-0.300***
		(0.0109)
Ln (Labour density)	0.0329***	0.0370***
	(0.00496)	(0.00494)
% households connected to natural gas	0.149***	0.140***
	(0.0279)	(0.0276)
Number of schools	0.000646**	0.000749***
	(0.000281)	(0.000280)
% households connected to internet	0.130***	0.0815**
	(0.0349)	(0.0348)
Number of economic establishments (standardised)	0.0333***	0.0348***
	(0.00560)	(0.00559)
Ln (2017 Population)	-0.121***	-0.129***
	(0.0105)	(0.0105)
Average day's amount of garbage collection	0.0253**	0.0363***
	(0.0105)	(0.0104)
Constant	12.39***	12.77***
	(0.0863)	(0.0865)
Observations	130,095	130,095
R-squared	0.062	0.068

Robust standard errors in parentheses[10]
*** p<0.01, ** p<0.05, * p<0.1

In this case, wage elasticity to being inside the CBD is 6.2% higher in comparison to workers outside CBD. As same as previous estimations, education, age, and firm-size have positive impacts on monthly salary. Contrary, working in informality penalises the income. The results also show an income gap between men and women, even by controlling for the main variables that determine the salary, this finding is consistent with literature focused on examining gender

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[10] After using the Breusch-Pagan test (statistic 16349 and p-value 0.000), the presence of heteroscedasticity is confirmed. For that reason, robust standard errors are implemented.

gaps, which has established that labour market penalises pregnancy and maternity, among others.

Concerning location characteristics, places with higher labour density and higher connectivity tend to have positive impacts on monthly workers' income, as well as being in UPZs or municipalities with a higher number of economic establishments. An interesting result is that being in places with a higher population could potentially have negative impacts on income, it could be explained by the existence of informal jobs with low productivity in densest UPZs and municipalities. Finally, it is crucial to highlight that once the sample is restricted to informal workers, the variable of CBD has a positive impact, which can likely imply that informal workers located in the CBD or close to employment agglomeration are benefited too.

The main inference based on the results is that being in the CBD implies better living conditions, better accessibility in terms of education, connectivity, labour density, and less productive exclusion —lower informality rates—, as well as better households' income per capita. In this sense, evidence suggests that Bogota has spatial mismatching between employment agglomerations and low-income workers' location. Consequently, policies aim to improve the urban, economic and social environment for those excluded from the agglomerations should focus on increasing the accessibility to transport, housing, training and employment services and spatial ordering targeted at reducing spatial inequalities.

6 IMPLICATIONS FOR POLICY

The existence of a wage premium for being located in the CBD, the high concentration of jobs and economic opportunities in specific spots in the city, and the spatial mismatch observed in Bogota are the main elements that justify the need to explore a holistic approach to the city economy, more than prioritising economic efficiency through public investments in the strategy of intelligent specialization and clustering networks.

The idea of strategic accessibility as a mechanism to foster opportunities should guide city-economic development strategies. In this sense, two drivers to operationalise strategic accessibility and mitigate the spatial mismatch in the city are: i) to connect excluded people to the main spots in the city via training and skills upgrading to the needs of the firms located in the CBD or employment sub-centres, better transport and housing accessibility or, ii) to identify and foster economic development plans for UPZs and municipalities with higher social exclusion indicators, as a mechanism to close the spatial mismatch by accessing to opportunities city creates, through specific regulations such as mix uses of land combined with fiscal incentives to urban regeneration in the spatial development plan (POT, for its Spanish acronym) that is revised every ten years.

Nevertheless, the second driver also implies consolidating the governance of the functional —metropolitan— area of Bogota. The main hurdles to ensure effective governance across the metropolitan area of Bogota are the heterogeneity of interest between local governments, the

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political economy, and legitimacy, the lack of incentives from the regulation to facilitate the implementation and the availability of human and financial resources.

Even though this issue has been discussed in recent decades, there are still concerns from all the parts to advance in the formal consolidation of a metropolitan area. ProBogota— a private think tank focused on promoting sustainable development in Bogota and the region — claims for including the Metropolitan Area of Bogota into the Metropolitan Regions Law [11] (ProBogota, 2018). However, the main bottleneck to achieving it is political. Currently, as a substitute, the Territorial Integration Committee (CIT, for its Spanish acronym) —constituted in 2015 as a mandate of Law 614/2000—joins up nearly all municipalities, the regional government, environmental authorities and the Housing Ministry to promote metropolitan initiatives like the multi-modal transportation system, Bogota's river decontamination, solid waste integral management, among others.

Besides, whatever institutional arrangement used to promote governance should address informality as a cross-cutting issue inside the metropolitan area, particularly what Daude et al. (2017) call triple informality: housing, transport, and employment. Inside the metropolitan area, policies have not been targeted the whole dimensions of informality and some of them have criminalised the phenomenon, confusing it with illegality. Therefore, strategies need to be holistic and tackle linkages between informality dimensions and overlapping within the formal economy.

Finally, coming back to the idea that connecting excluded people to agglomerations relies on increasing strategic accessibility, conceived as reducing distances between firms and workers and guaranteeing conditions to encourage citizens to enjoy what they consider a 'good life'. In this sense, greater accessibility for excluded workers has three main determinants —land-use regulation, supply and transport infrastructure, and housing market— that need to be addressed to reduce the spatial mismatch. It also implies providing pertinent skills to workers for getting in high-value jobs inside agglomeration spots in the city.

6.1 SPATIAL DEVELOPMENT PLANNING

Spatial Development Planning has a crucial role in reversing social and productive exclusion. In the case of Bogota, the territorial occupation model has been historically fragmented and characterised by exclusion, inequality, increasing socio-territorial gaps, and a high concentration of low-productivity activities in the city-south (mining, landfill, tanneries, bus parking, among others). Public policies have ignored the informal dynamics through the lack of public equipment, the little political will to improve neighbourhoods' accessibility, confinement of low-income population to the periphery, and lack of policies that enable mixed

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[11] The metropolitan Regions Law was established (Law 1625/2013) as an instrument to facilitate metropolitan governance but it excluded Bogota.

land uses and higher socioeconomic mix. At the same time, urban planning has not addressed properly the lack of high-value activities in the city-south (ONU Habitat, 2018).

Currently, local authorities have a great opportunity to close the spatial mismatch through the POT project that will be discussed with the district council in the second semester of 2019. Ideally, the new POT should incentivise supplier chains in UPZs far from the CBD and employment sub-centres, promising new sectors and socioeconomic mix. At the same time, should mark out the formulation and development of partial plans[12] that stimulate urban regeneration and Transport Oriented Development projects in specific spots on the metropolitan area, as schemes to increase access to housing, transport, and job opportunities.

Nonetheless, the Territorial District Planning Council[13] (CTPD, for its Spanish acronym) — once reviewed the POT proposal— considers it generates socio-environmental risks, reduces territorial equity, and does not prioritise the needs of people outside formal regulation (CTPD, 2019). Additionally, it does not include needs of different social groups (women, Internal Displaced People, migrants, disabled, ethnicities, youngsters, LGBTI community, among others), as well as processes of regionalization and urban equipment decentralization. A big issue in the project presented is that incentives are focused on promoting intelligent specialization strategy leaving aside other sectors and more important, potential economic strategies to close the spatial mismatch. Likewise, the project does not develop treatment of integral improvement —aimed to integrate informal areas into the urban structure and highly relevant to the economic and social equity—. To sum up, the current project of spatial development plan does not include a holistic vision to mitigate spatial mismatch, if it is approved in current terms it will potentially increase city-fragmentation.

6.2 HOUSING POLICIES

The 2017 Multipurpose Survey shows that around 21.895 households could not get new housing in Bogota. Then, they had to opt for the informal market or regional offer. Also, 45% of households live in rented accommodation and 60% of them earn income below four minimum wages. Besides, the scarcity of land and ineffective land value capture instruments increasingly difficult to locate housing for low-income families (Oviedo, 2017). Consequently, housing and land markets present some bottlenecks that prevent effective access to decent housing for some social groups, although it is defined by the Colombian constitution as a right for the population (article 51).

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[12] used to articulate spatial planning objectives with those of land management specifying the technical, legal, economic-financial, and urban design conditions for new urban uses or the transformation of previously existing urban spaces.
13 Highest instance of Participatory Planning in Bogotá that based on legal guidelines included in Law 152/1994 and was created through Agreement 12/1994 of Bogota's Council.

In this line, increased accessibility implies moving forward housing policies towards integrated solutions focused on higher habitability and social cohesion more than guarantee accommodation itself. That means that the current housing scheme needs to balance the residence location to the employment opportunities, basic services, amenities, and other people in the city. Nonetheless, the low affordability of housing is explained by higher prices of buying or renting, added to the low households labour income and lack of easy access to mortgage credits. In this line, Daude et al. (2017) established that a household in Bogota needs three monthly incomes to acquire a square meter of median housing price.

Also, the spatial mismatch between the CBD and employment sub-centres from the rest of the city is closely related to the coexistence of both formal and informal housing markets, which need to be addressed by increasing the income generation capacity and adjusting the requirements to get credits from low-income households. In this line, the program concentrated in relocating informal settlements should increase accessibility instead of moving them to peripheral areas far from economic centres. As specific actions, the local authorities need to strengthen the relocation program for settlement with non-mitigable risk, the tenure regularization program, boost the improvement housing program addressed to low-quality neighbourhoods, and articulate national and local schemes of subsidies and incentives to access to a housing solution.

Finally, the policy objective is to guarantee access to quality housing, but it does not establish an instrument itself. That is why the renting markets should be fostered towards higher accessibility by removing cumbersome regulations and avoiding price controls. For instance, the District Habitat Secretary should design and implement a social leasing housing program that supports the re-densification of traditional neighbourhoods closer to the agglomeration spots in the city.

6.3 TRANSPORT

Mobility, infrastructure, and transport have a central role in enabling physical access to the city and consequently mitigate social exclusion faced by some social groups. However, in this specific field, the metropolitan authority is indispensable because of the commuting and suburbanization patterns, both present in Bogota and its surrounding municipalities. As mentioned before, Bogota has prioritised economic efficiency rather than mitigation of the city-fragmentation and spatial inequalities, through transport investments. Therefore, some higher-income groups have segregated themselves from the rest of the urban fabric in places with higher connectivity, better networks for social and human capital accumulation, higher wage-premiums, and productivity (Oviedo, 2017).

Even though, the development of Transmilenio — a network of Bus Rapid Transportation (BRT) serving Bogotá and Soacha compound by 12 lines—, the improvements of public space and restrictions to car use resolved partly transport needs of some areas in 1999, over time the city-growth exceeds the implementation speed of transport solutions. For instance, Oviedo (2017) shows that by 2016, Transmilenio had implemented just the third of the six phases

proposed at the beginning and, the implementation of the Integrated Public Transport System —compound by Transmilenio, Transmicable, Zonal routes, and the first subway line—is still incipient and has been implemented disjoint from the district development plans (Contraloría, 2018).

The first phases of Transmilenio have been focused on connecting high-income areas, employment clusters leaving some low-income populations disconnected from the main productive spots. Then, low-income workers that commute to the CBD or employment sub-centres use low-quality and informal modes of transport to access economic opportunities located in those agglomerations. Besides, limited instruments for land value capture have incentivised price increases around the BRT network, making new housing developments less affordable for people with limited income (Bocarejo et al., 2014, cited by Oviedo, 2017).

To increase the accessibility mainly for excluded social groups, the first step is moving towards a multimodal transportation system that incorporates characteristics of less advantaged groups in the city, particularly those far from the productive agglomerations. Even though the term multi-modalism implies subjective interpretations, it could be an effective mechanism to mitigate spatial mismatch. Nevertheless, that strategy needs to be articulated with economic development plans, housing policies, and schemes of training and socio-occupational orientation. In the short term, the local authorities must expand metro-cable lines, improve bicycle lines' infrastructure and define potential uses of Transport Oriented Development as a catalyst to increase the accessibility of excluded groups.

6.4   TRAINING AND EMPLOYMENT SERVICES

Added to housing, transport and land-use policies, education, training, and employment services have the potential to reduce social exclusion and spatial mismatches in the metropolitan area of Bogota. However, those schemes need to be implemented at the same time as economic development strategies. For instance, the local authorities prioritised the intelligent specialization as the core element for the city-economic growth and productivity, then it is urgent to identify qualifications required by those sectors and through agreements with the tertiary education institutions —e.g. District University— define training schemes for excluded social groups.

Also, as was mentioned previously, spread out the employment public services to UPZs and municipalities with higher informality and poverty rates as a mechanism to identify potential routes to incorporate excluded workers to the CBD and employment sub-centre skills requirements. Likewise, entrepreneurship investments should be articulated with promising sectors in the faraway locations from the agglomerations, identified as part of the guidelines included in the POT design (Section 6.1.).

7 CONCLUSIONS

This paper focused on exploring the externalities of being inside Bogota's Central Business District, founding an elasticity or 'wage premium' close to 6%, and huge disparities between UPZs and municipalities in the metropolitan area of Bogota. This means people located in the CBD or employment sub-centres in Bogota have higher accessibility to opportunities offered by the City, reproducing spatial mismatch where low-income groups are socially and economically excluded through higher land and housing prices and lower human capital. Overall, this paper provided strong evidence to infer that CBD and employment subcentres are exclusive locations and do not work for all. Unfortunately, data used does not allow to identify people's flow over time, and therefore, it is not possible to establish if agglomeration expels households through higher land prices, or contrary, it creates the conditions to promote social mobility and productive inclusion.

Informality ——slums, informal workers, informal firms, informal transport —is correlated with the way cities have been shaped. The existence of productive and modern sectors accompanied by informal workers and firms, in many cases, has a strong relationship with cities' fragmentation. Even though informal workers are better if they are located close to the main productive spots in the city, Bogota can be defined as a dual city with high-value sectors, a large proportion of informal workers, and a deeply fragmented urban fabric. Consequently, class polarization is present the way the city has been shaped. For instance, housing, education, health, transportation, and skills accumulation reflect a deep fragmentation. Also, it is crucial to highlight that Bogota has been the main destination of internal migrants, mainly Internal Displaced People who end up located in socially excluded places.

Regardless of the causality direction between agglomerations and city fragmentation, increasing strategic accessibility should be the focal point of urban and social policies in the metropolitan area of Bogota. Multidimensional accessibility has the potential to enable an effective 'right to the city' for excluded and vulnerable social groups, as well as remain them connected to markets. I find evidence that spatial mismatch requires a holistic vision to be addressed because urban outcomes reflect the relevance that CBD and employment sub-centres have had in urban planning, ending up with higher fragmentation and low-income households confined to peripheric areas.

Overall this paper concludes that institutional arrangements also have the potential to accelerate the transition to reduce spatial mismatch and fragmentation in Bogota and its metropolitan area. For that reason, advance towards the formal consolidation of the metropolitan administrative area is essential to deal with social demands in terms of transport, housing, and economic opportunities. Even though this process has been difficult due to political will, currently local authorities in Bogota and surrounding municipalities are more conscious about the importance of creating metropolitan governance.

Further research should be conducted to examine transitions of workers located in the main productive spots of the city by testing, ideally, with a data panel if those spots expel people or contrary consolidate social inclusion trajectories. Likewise, analyse in-depth specific labour

market requirements in terms of skills and qualifications and compare with competences of people living outside CBD and employment sub-centres, means complement spatial mismatch analysis with labour market dynamics.

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Appendix 1: Correlative constructed between Zonas JICA and UPZs

Table A.1: correlative between Zonas JICA and UPZs for the CBD

CBD	Zonas JICA	UPZ (2017 cod. Multipurpose)
Las nieves	16	817, 816, 814,92,98,101
La Macarena	15	
Teusaquillo	76	
Refugio	10	
Pardo Rubio	11	
Chico-lago	9	
Los Alcazeres	73	

Source: own elaboration based on Ruiz et al. (2017).

Table A.2: correlative between Zonas JICA and UPZs for the employment sub-centres

Employment sub-centres	Zonas JICA	UPZ (cod. 2017 Multi-purpose)
Country club	7	803, 112, 109, 809
Granja de Techo	48	
Puente Aranda	98	
Ciudad Salitre oriental	82	
Zona industrial	93-95	

Source: own elaboration based on Ruiz et al. (2017).

Appendix 2. income distribution, metropolitan area of Bogota and other spatial units, 2017.
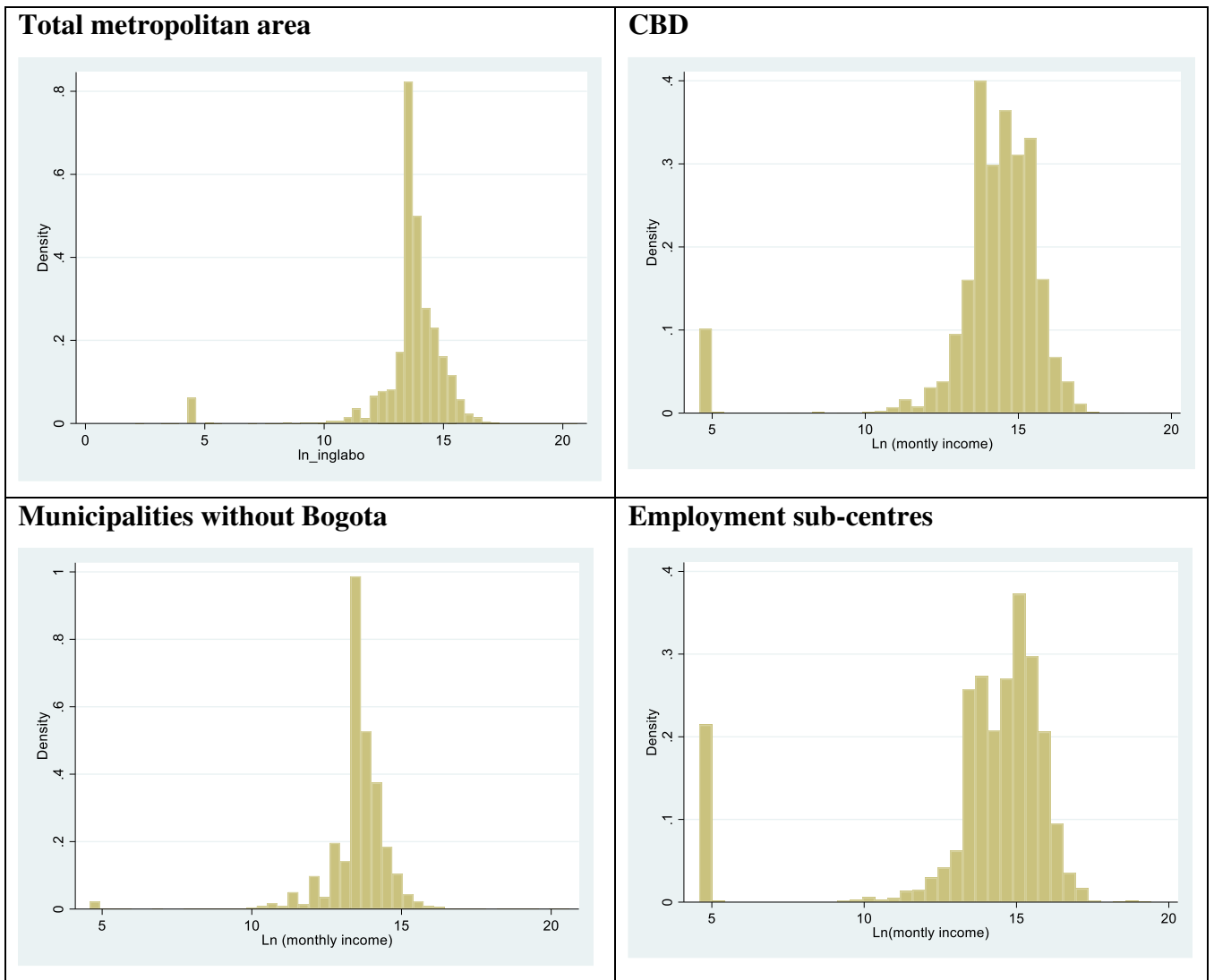
Appendix 3. Predominant strata and per capita households' income by UPZ and surroundings' municipalities.

UPZ or municipality	Predominant strata	Average household income per-capita (COP)
San Cristobal Norte	3	$ 887.806
Toberín	4	$ 2.048.025
Los Cedros	4	$ 3.385.621
Britalia	3	$ 1.852.603
El Prado	4	$ 2.412.449
Los Andes	4	$ 2.137.413
Casa Blanca Suba	4	$ 2.701.801
Niza	5	$ 3.363.163
Las Ferias	3	$ 1.438.083
Suba	3	$ 1.047.609
El Rincón	2	$ 853.908
Minuto De Dios	3	$ 1.091.817
Boyacá Real	3	$ 1.079.695
Sosiego	3	$ 981.586
20 De Julio	2	$ 787.668
Ciudad Jardin	3	$ 1.285.524
Santa Isabel	3	$ 1.289.947
Restrepo	3	$ 1.042.837
Quiroga	3	$ 826.758
Ciudad Montes	3	$ 1.304.334
Muzú	3	$ 1.022.743
Venecia	2	$ 830.485
San Rafael	3	$ 997.653
Americas	3	$ 1.359.445
Carvajal	3	$ 818.443
Kennedy Central	3	$ 875.316
Timiza	3	$ 741.029
Apogeo	2	$ 922.644
La Gloria	2	$ 544.286
Los Libertadores	2	$ 522.631
La Flora	1	$ 315.554
Marruecos	2	$ 680.591
Diana Turbay	2	$ 526.933
Gran Yomasa	2	$ 510.889
Comuneros	1	$ 473.988
San Blas	2	$ 590.467
Tunjuelito	2	$ 624.446
Arborizadora	2	$ 847.026
San Francisco	2	$ 585.665
Lucero	1	$ 453.350

Ismael Perdomo	2	$ 617.773
Jerusalém	1	$ 492.766
Tibabuyes	2	$ 693.696
Bolivia	3	$ 1.637.352
Garces Navas	3	$ 1.217.706
Engativá	2	$ 696.136
Fontibon	3	$ 985.413
Fontibon San Pablo	2	$ 676.102
Zona Franca	2	$ 885.614
Tintal Norte	2	$ 795.105
Calandaima	2	$ 803.776
Corabastos	2	$ 517.244
Gran Britalia	2	$ 602.853
Patio Bonito	2	$ 583.981
Las Margaritas	2	$ 743.706
Bosa Occidental	2	$ 577.469
Bosa Central	2	$ 591.422
El Porvenir	2	$ 574.787
Tintal Sur	2	$ 548.795
San Isidro Patios	2	$ 605.828
La Macarena	3	$ 1.712.428
La Candelaria	2	$ 1.499.531
Las Cruces	2	$ 701.833
Lourdes	2	$ 502.465
Los Alcazares	3	$ 1.639.124
Galerias	4	$ 2.338.046
Teusaquillo	4	$ 2.535.067
La Sabana	3	$ 1.110.593
Quinta Paredes	4	$ 2.643.827
Ciudad Salitre Oriental	4	$ 4.244.426
Ciudad Salitre Occidental	4	$ 2.800.176
Granjas De Techo	4	$ 2.560.076
Modelia	4	$ 2.293.933
San Jose	2	$ 812.055
Marco Fidel Suarez	2	$ 812.055
Bavaria	3	$ 1.475.164
Castilla	3	$ 1.475.164
Country Club	5	$ 5.016.374
Santa Barbara	5	$ 5.016.374
Usaquén	5	$ 5.016.374
La Uribe	3	$ 1.378.767
Paseo De Los Libertadores	3	$ 1.378.767
Verbenal	3	$ 1.378.767
La Alhambra	5	$ 3.709.113

La Floresta	5	$ 3.709.113
Guaymaral	4	$ 1.797.763
La Academia	4	$ 1.797.763
San Jose de Bavaria	4	$ 1.797.763
Doce De Octubre	3	$ 2.009.942
Parque Salitre	3	$ 2.009.942
Parque Simon Bolivar - Can	4	$ 3.034.417
La Esmeralda	4	$ 3.034.417
Zona Industrial	2	$ 785.242
Puente Aranda	2	$ 785.242
Alamos	3	$ 1.376.611
Jardin Botánico	3	$ 1.376.611
Santa Cecilia	3	$ 1.376.611
Alfonso Lopez	1	$ 408.485
Ciudad Usme	1	$ 408.485
Danubio	2	$ 591.466
Parque Entrenubes	2	$ 591.466
Aeropuerto El Dorado	4	$ 1.914.493
Capellania	4	$ 1.914.493
Sagrado Corazon	3	$ 2.936.293
Las Nieves	3	$ 2.936.293
El Mochuelo	1	$ 412.835
El Tesoro	1	$ 412.835
Monte Blanco	1	$ 412.835
Chapinero	4	$ 2.882.765
Pardo Rubio	4	$ 2.882.765
Chico Lago	6	$ 5.976.347
El Refugio	6	$ 5.976.347
Bojacá	2	$ 507.275
Cajicá	2	$ 854.450
Caqueza	2	$ 664.660
Chia	3	$ 1.228.892
Choconta	2	$ 614.067
Cogua	2	$ 644.968
Cota	2	$ 1.208.393
El Rosal	2	$ 542.474
Facatativá	2	$ 652.256
Funza	2	$ 647.181
Fusagasuga	3	$ 592.891
Gachancipa	2	$ 545.398
Gachetá	2	$ 720.437
Girardot	2	$ 665.029
Guaduas	2	$ 556.509

Guatavita	2	$ 720.993
La Calera	2	$ 1.091.204
La Mesa	3	$ 749.889
Madrid	2	$ 726.892
Medina	2	$ 371.432
Mosquera	2	$ 562.116
Nemocón	2	$ 605.774
Pacho	2	$ 533.549
San Juan de Río Seco	2	$ 674.694
Sesquilé	2	$ 634.045
Sibate	2	$ 629.794
Soacha	2	$ 468.499
Sopo	3	$ 892.966
Subachoque	2	$ 709.931
Sutatausa	2	$ 456.985
Tabio	3	$ 883.259
Tausa	2	$ 498.884
Tenjo	2	$ 996.235
Tocancipá	2	$ 748.915
Ubate	2	$ 556.733
Villeta	2	$ 706.916
Zipaquirá	2	$ 694.150