IMPACT OF TRANSMILENIO ON POPULATION DENSITY AND LAND USE IN BOGOTÁ

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ABSTRACT

While urban sprawl has been the general growth pattern in most developing cities worldwide, the city of Bogotá has undergone a process of densification in specific areas in the past decade. Using a differences-in-differences methodology, we have shown that the bus rapid transit (BRT) network, Transmilenio, built in this period is one of the variables that account for this higher density. Areas served by Transmilenio, especially those in the periphery that have been provided with feeder bus routes, have a higher growth than zones without access to this system. Using a similar methodology for assessing the growth of newly built areas, we have not found a clear relation between the BRT and recent evolution of residential, commercial, or work areas. All the data and analysis developed suggest that households prefer to remain in the city, where they can access jobs and other activities with ease, even if land value in the city is higher than in the municipalities. Moreover, it seems that the population is willing to sacrifice housing quality in order to gain accessibility. Finally, recent scientific literature confirms an impact of the BRT on land value.

Keywords: Land use / transport planning, urban development

INTRODUCTION

Transmilenio is a high-capacity BRT system that has been operating in the city of Bogotá (Colombia) for a decade. It has aroused curiosity among urban planners and transport specialists, not only because of improvements in travel time and a reduction of externalities such as road accidents and pollution along the bus corridors but also because of its impacts on urban form, real estate investment, and land value in its area of influence.

Inspired by the system of Curitiba, Bogotá's BRT has achieved enormous success in terms of efficiency and ridership with a limited infrastructure and operational cost. However, in terms of integration between land-use planning and transport it has not attained the same level of success as the Brazilian city. This result was expected, since there was not a planned integration between land value and transport as happened in Curitiba. Higher density along mass transit corridors, higher land value in proximity to the system, and changes in use are some of the positive externalities that could have been expected from the Transmilenio project; in short, it was an opportunity to drive urban development. This paper aims to evaluate changes brought about by Transmilenio in the past ten years from an urban perspective.

LAND USE /TRANSPORT

A large amount of scientific literature has tried to elucidate the relationship between transport infrastructure and land use. So far, empirical evidence suggests that the introduction of new transit corridors induces a positive response in terms of the real-estate market and urban form. Such response is reflected in increased land values and changes in land use and intensity. These impacts are a consequence of improved transport accessibility and seem to be more significant in locations near stations or stop points, and for more profitable land uses like offices and commerce.

A review of studies relating transit corridors and land use reveals that the aforementioned effects depend on the transport technology implemented. In the case of rail transit, the relationship regarding property values and land use is conclusive. That is, implementation of a new metro or suburban train line implies, in the short term, positive and substantial impacts on property values and urban development in its neighbourhood (Cervero and Duncan, 2002; Rodriguez and Targa, 2004). On the other hand, evidence shows that regular bus transit systems have a weak ability to promote urban development (Cervero and Kang, 2009).

Despite the growing interest in and proliferation of BRT, its impacts on urban development remain uncertain. Unlike metros and regular buses, studies related to BRT yield divergent conclusions. It is well worth noting that, so far, the only case where there is a strong connection between BRT corridors and urban density, land use, and value is Curitiba. It is also worth noting that Curitiba's system was conceived and developed as part of a land use-transport integrated plan (Rabinovitch and Leitman, 1996) and under tight control of urban land. Unlike Curitiba, Bogotá's high densities are mostly a result of social factors, the real-estate market, and a lack of planning, as explained in forthcoming sections.

In the particular case of Transmilenio, some studies conclude that improvements in accessibility and public transport services do not equate to an increase in property values along these corridors, while others establish a statistically positive effect on the real estate market (Rodriguez and Targa, 2004; Perdomo Calvo et al., 2007; Rodriguez and Mojica, 2008; Muñoz Raskin, 2010; Mendieta and Perdomo, 2007). Later on, we will discuss these studies and their results in more detail.

Most models that try to estimate the impacts of mass transit infrastructures on property values use the hedonic price technique. The core of this technique relies on the ability of characteristics of the built environment—location conditions and attributes of the property itself—to define its price (Rosen, 1974). In order to capture the effects of public transport infrastructure on land value, researchers have included variables such as proximity to transit stations and characteristics of the transit service in their models.

As a means of evaluating the performance of a policy or programme, social scientists use impact evaluation methodologies. These methodologies try to identify a causal relationship between the implementation of a policy and its outputs (Aedo, 2005). The main concern of these techniques is to calculate the difference between the output variable of a beneficiary and the expected outcome if the same individual had not been affected by the programme. Since the former is a hypothetical case, it is necessary to find an individual as similar as possible to the one being treated; such an individual is known as a counterfactual. The population sample is divided into a treatment group and a control group, the first composed of the beneficiaries of the programme and the second composed of counterfactuals, that is, individuals not affected by the intervention but similar to those in the treatment group (Bernal and Peña, 2011).

Differences in differences (Diff-Diff) is one of the impact evaluation methodologies applied to transportation projects. It explains the change in the output variable between two particular points in time by the difference between groups. That is, it takes into account double differences—between groups and time—before and after the intervention. Mathemathically, this takes the form:

$$\Delta Y = Y_{t_2} - Y_{t_1} = \alpha_0 + \alpha_1 D + \alpha \quad (1)$$

where:

Y_{t_k}: Output variable in time t_k, for $1 \le k \le 2$
D: Dummy variable that takes a value of 1 if an individual belongs to the treatment group and 0 if it belongs to the control group
X_j: Characteristic of individuals for $1 \le j \le n$ in time 1
u : Unobservable characteristics

To determine statistically if the programme had an impact, equation (1) is estimated as a multiple linear regression, so the significance of the coefficients will be given by comparing the p-value result from a t-test to a level of significance. According to (1), the coefficient α_1 indicates if there is a difference between individuals of control and treatment groups, that is, the impact of the programme.

BACKGROUND

Bogotá is the largest and most populous city in Colombia. The city extends across 1,637 square kilometers, 355 of which are urban (Seretaría Distrital de Planeación, 2011b). In 2010, there were close to 7.3 million inhabitants in the urban area (Secretaría Distrital de Planeación, 2010) and its population density was about 20,500 inhabitants per square kilometre. Compared to other cities and metropolitan areas, Bogotá is one of the most densely populated in the world.

The planning department of Bogotá has divided the urban area into 112 Unidades de Planeación Zonal (UPZ), that is, territorial units of analysis, planning, and management, whose purpose is to define and regulate urban land use in detail.

The spatial distribution of population and activities shows important differences throughout the city. Low-income households are settled in the southern and western border UPZs. These peripheral zones have the lowest formal employment densities and the highest population densities. The latter are related to overcrowding rather than high-rise developments (Secretaría Distrital de Planeación, 2011a). On the other hand, northern and central locations are characterized by high-rise developments, lower population densities, and a high concentration of formal employment. According to official statistics, 83% of households in the city belong to the low-income category.

Since its conception, the aim of Transmilenio has been to improve poor public transport service conditions in Bogotá. In 2006, the Transportation Master Plan defined a strategy based on restriction of car use, fostering non-motorized modes of transport and transit. Therefore, the BRT became the backbone of the mass transit system.

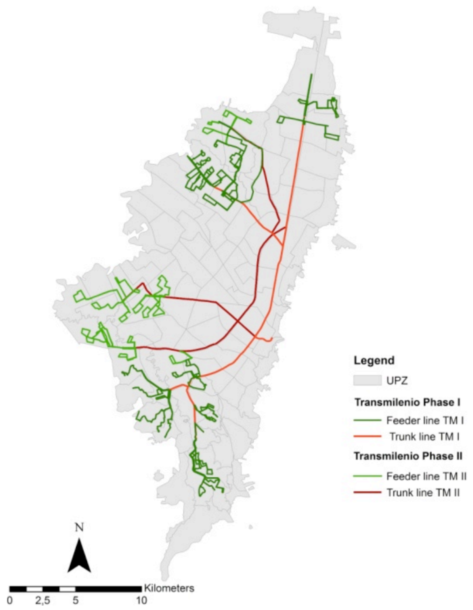

Figure 1 Transmilenio network and UPZ division

The BRT system integrates trunk corridors and feeder services, achieving wide coverage in the city (see Figure 1). It uses high-capacity articulated and bi-articulated buses circulating through the trunk corridors' exclusive lanes, and feeder services that operate along local roads in the proximity of trunk lines, exposed to mixed traffic. Coordination between trunk lines and feeder services takes place at terminals and specific stations in between.

Bogotá's BRT system has many characteristics that represent a major turning point from the traditional bus system that still operates in most parts of the city. Transport capacity exceeds 40,000 passengers/hour/direction, similar to a subway line. The fare is integrated, which means that there is no additional cost for feeder services and transfers; payment is made at stations prior to boarding. Buses have priority at intersections, and new scheduling and control technologies, including user information systems, have been implemented. The system is integrated with the pedestrian and bicycle infrastructure, and there is good access for people with disabilities (Hidalgo and EMBARQ, 2010). The BRT network was gradually developed between 2000 and 2005. It was built and implemented in two phases (see Table 1 and Figure 1). Today, the system circulates through 84 km of exclusive lanes; it has 114 stations, 633 km of feeder routes, a fleet of 1,254 trunk vehicles, and 515 vehicles for feeder supply (Hidalgo and EMBARQ, 2010).

Table 1 Transmilenio implementation phases

Phase	Trunk line	Length (km)	Launch year
1	Calle 80	10	2000
	Av. Caracas	17.7	2001
	Autonorte	9.5	2002
	Av. Jiménez	1.9	2001
2	Av. Américas – Calle 13	13	2003–2004
	Av. NQS	20	2005
	Av. Suba	10	2005

Since coming into operation in 2000, demand for the system has grown rapidly. During its implementation period, the demand showed a 12% average annual growth rate. In 2006, the average ridership on a weekday increased to approximately 1.1 million. Even without physical expansion, the system experienced a significant increase in demand, around 300,000 pax/working day, between 2007 and 2010, that is, a 27% growth in three years (Hidalgo and EMBARQ, 2010). The increased demand has also led to a significant change in vehicle occupancy. Today, the system runs with 150 pax/hour/direction/bus and an occupancy level near to 7 pax/m2, which has led to a downward trend of the indicators of user satisfaction.

Transmilenio has the highest capacity and ridership of all BRT systems worldwide. Operation of articulated buses on trunk lines presents high performance standards: 45,000 passengers/hour/direction in the most heavily loaded section, a commercial speed of 27 km/h, and 1,356 passengers per bus per day (Hidalgo and EMBARQ, 2010).

In addition to undeniable improvements in public transport services, Transmilenio has contributed to improved public spaces due to renovation of areas in its proximity (Muñoz-Raskin, 2010). Since its implementation, Transmilenio has shown a transforming potential in the areas surrounding terminal stations, which makes it possible to build commercial areas and other developments that previously had no place in peripheral zones of the city (Ruíz Estupiñán, 2006). This is evidenced by the construction of shopping centres and supermarkets in the vicinity of the portals since the system alignment was announced. Nonetheless, it must be noted that such developments are side effects; they were not considered by local authorities but capitalized on by private developers, and most of them can be attributed to lack of planning and unenforced regulations.

DATA AND TOOLS FOR ANALYSIS

To evaluate the impact of Transmilenio on densification and land use in the city, we analyzed as dependent variables the changes in population density, housing, commercial, and office built areas. Population density data included population projections and official urban area data. The main data source was the statistics inventory available from the city planning department. As for built area data, the National Department of Statistics (DANE) collects information on building activity, i.e., the building census, on a monthly basis. Only data related to new and finished developments were employed. The time period of analysis was from 2001, when expansion of the BRT network had just started, to 2008, when it was completed.

Table 2 Methodology

Process	Description
Data collection	From statistics inventory available in the city planning department: • Population projections • UPZ area • Number of facilities From the building census: New and finished housing, commercial, and office built areas
↓ Dependent variables computation	• Changes in population density • Changes in housing, commercial, and new office built areas
↓ Group definition	• **Treatment group**: UPZs located within a buffer of 500 m from trunk lines as well as feeder routes • **Control group:** UPZs not in the area of access to the Transmilenio system
↓ Hot spot analysis	Establish clustering patterns of high and low values of : • Changes in population density • Changes in housing, commercial, and new office built areas
↓ Diff-Diff model estimation	Evaluation of the impact of Transmilenio on dependent variables was divided into two steps. 1. The Diff-Diff model considered membership of control or treatment groups 2. If Transmilenio had an impact on the model as previously estimated, another estimation was made including other explicative variables that reflects the condition before Transmilenio

In addition to the dummy variable that defines the membership of the treatment group—those UPZs located within a buffer of 500 m from trunk lines as well as feeder routes—or the control group—UPZs that are not served by the BRT system—we considered as possible explicative variables the number of facilities in the UPZ, average household income, and distance to the central business district (CBD). The last one was calculated by means of a geographic information system (GIS).

A hot spot analysis tool from the ArcGIS software was used to establish spatial clustering of the values associated with the UPZ features. The tool provides a method to identify hot and cold spots by statistical means. A hot spot occurs when a feature with a high value is surrounded by other features with high values. Meanwhile, a cold spot occurs when a feature with a low value is surrounded by other features with low values. Therefore, the tool is a means of determining if an observed cluster on a map is statistically significant.

The hot spot tool creates a new UPZ feature class with an associated z-score and a p-value. The z-score resulting from the analysis evaluates the null hypothesis, where the cluster pattern is the result of random chance. Thus, a hot spot occurs for statistically significant positive z-scores and a cold spot occurs for statistically significant negative z-scores. Consequently, the higher or lower the significant z-score, the more intense is the clustering pattern.

By doing a hot spot analysis of the difference in UPZ variables considered in this research between 2001 and 2008, it is possible to spatially describe the impact of the Transmilenio system based on the clustering patterns.

IMPACTS ON POPULATION DENSITY

While urban sprawl has been the general growth pattern in most developing cities worldwide, the city of Bogotá has undergone a densification process in specific areas during the last decade.

According to available data previously described in section 4, overall density in Bogotá has increased by 8% between 2001 and 2008 (see Table 3), which means an increase of almost 1,400 inhabitants/km^2. A closer look at the data shows that, on average, population density in the treatment group was higher than in the control group for both years. That is, areas served by the Transmilenio network have increased by around 1,700 inhabitants/km^2, while control areas have a more moderate growth.

Table 3 Average population density by group and year

Variable	Control group (without BRT)	Treatment group (with BRT)	Total
Population 2001 (inhabitants/UPZ)	38,000	64,400	58,000
Population 2008 (inhabitants/UPZ)	38,500	71,700	63,700
Density 2001 (inhabitants/km^2)	12,000	17,700	16,300
Density 2008 (inhabitants/km^2)	12,200	19,400	17,700
Δ Density (inhabitants/km^2)	200	1,700	1,400

Since aggregated data suggested important differences between groups, a hot spot analysis was done, which revealed a clustering pattern of high and low changes in population density values. As Figure 2 shows, high values are concentrated in the north- western zone of the city, with the highest values located in areas served by feeder buses. On the contrary, the lowest changes are clustered along southern segments of trunk lines, where the main land use is not residential.

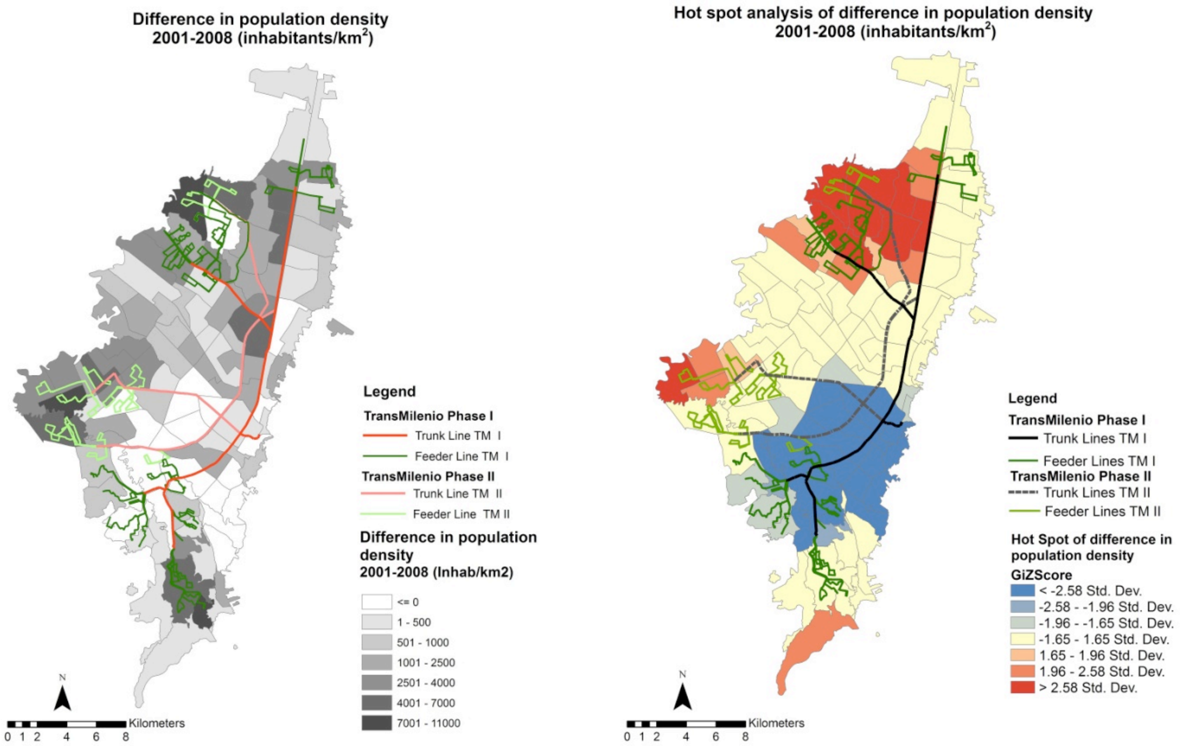

Figure 2 Differences in population density: spatial distribution and hot spot analysis

Finally, in order to evaluate the impact of Transmilenio on population density, two *Diff-Diff* models were estimated using data for 112 UPZs (see Table 4). The first model, estimated exclusively on the basis of membership of the treatment group, confirms the hypothesis. The coefficient indicates that there is a difference in population density of 1,437 inhabitants/km^2 between treatment and control groups in the period of analysis. The coefficient was statistically significant at the 1% level.

To reduce possible bias in the coefficient of interest, some other variables were included. However, of those initially considered, the only one that was statistically significant was the number of facilities in the UPZ (see Table 4). Therefore, although Transmilenio still had an impact on population density, it was considerably reduced compared to the previous estimation. The impact was 1,715 inhabitants/km^2 between treatment and control groups in the period of analysis.

Table 4 Differences - in - differences models

Variable	Model 1 Δ Density	Model 2 Δ Density
TM	1,437**	1,181*
	(532.6)	(541.6)
Facilities		4.706***
		(2.387)
Constant	185.5	-188.9
	(464.0)	(495.8)
Observations	112	112
R-squared	0.062	0.094

p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.10

CHANGES IN BUILT AREA

A similar analysis to the previous one was performed to evaluate the impact of the BRT system on the urban form of Bogotá. According to building census data, 75% of new built area was intended for residential use. This represents an increase of 22.5 million square metres. As for office and commercial built area, the growth was moderate. Average values show that UPZs in the treatment group experienced a slight increase in housing built area compared to those in the control group (a difference of 3.7 thousand metres). Commercial and office built area presents the opposite behaviour (see Table 5).

Table 5 Average changes in built area by group and use

Variable	Control group (without BRT)	Treatment group (with BRT)	Total
Δ Housing built area (thousand m^2)	198.9	202.6	201.8
Δ Office built area (thousand m^2)	44.4	32.5	35.3
Δ Commercial built area (thousand m^2)	9.1	6.9	7.47
Δ Total built area (thousand m^2)	273.6	266.5	268.2

Hot spot analysis shows two well-defined patterns of change in new housing built area (see Figure 3). There is evidence of a hot spot in the north-western zone of the city, around trunk lines and notably in areas served by feeder routes. On the other hand, a cold spot was found on the south side. Although this analysis does not reveal a cluster in the west—an area not served by Transmilenio—the spatial distribution of changes in new housing built area indicates significant growth.

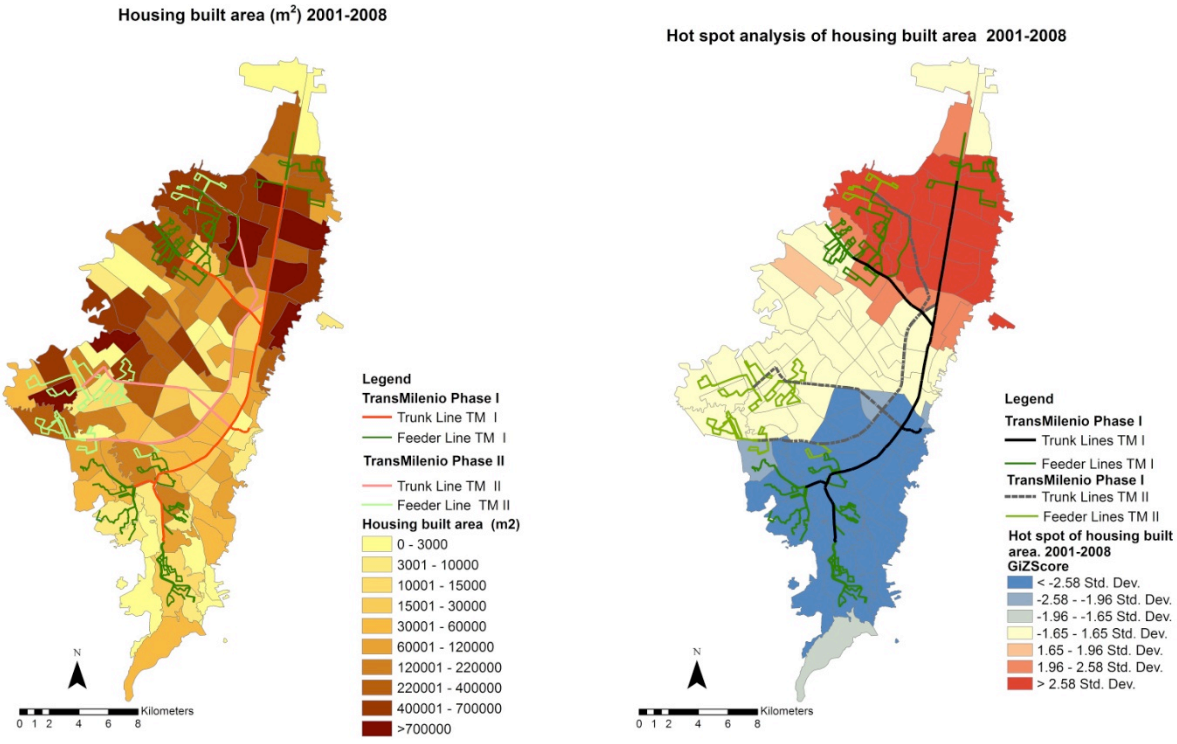

Figure 3 Changes in housing built area: spatial distribution and hot spot analysis

Regarding variations in new office development areas, the hot spot pattern differs from that for housing (see Figure 4). In this case, the hot spot shifted to the west; however a small high-value cluster remained in an area served by Transmilenio feeders in the northern part of the city. In contrast to results shown in Figure 3, a reduction in size and intensity of the cold spot area can be seen in Figure 4. Changes are particularly low in southern feeder route zones, although spatial distribution indicates significant increases in office areas in the north-eastern zone around the Transmilenio corridor.

Hot spot analysis for changes in new commercial developments yields completely different patterns. The cold spot disappears and high values are grouped around the CBD and north-western trunk lines. Important increases are registered in the western area.

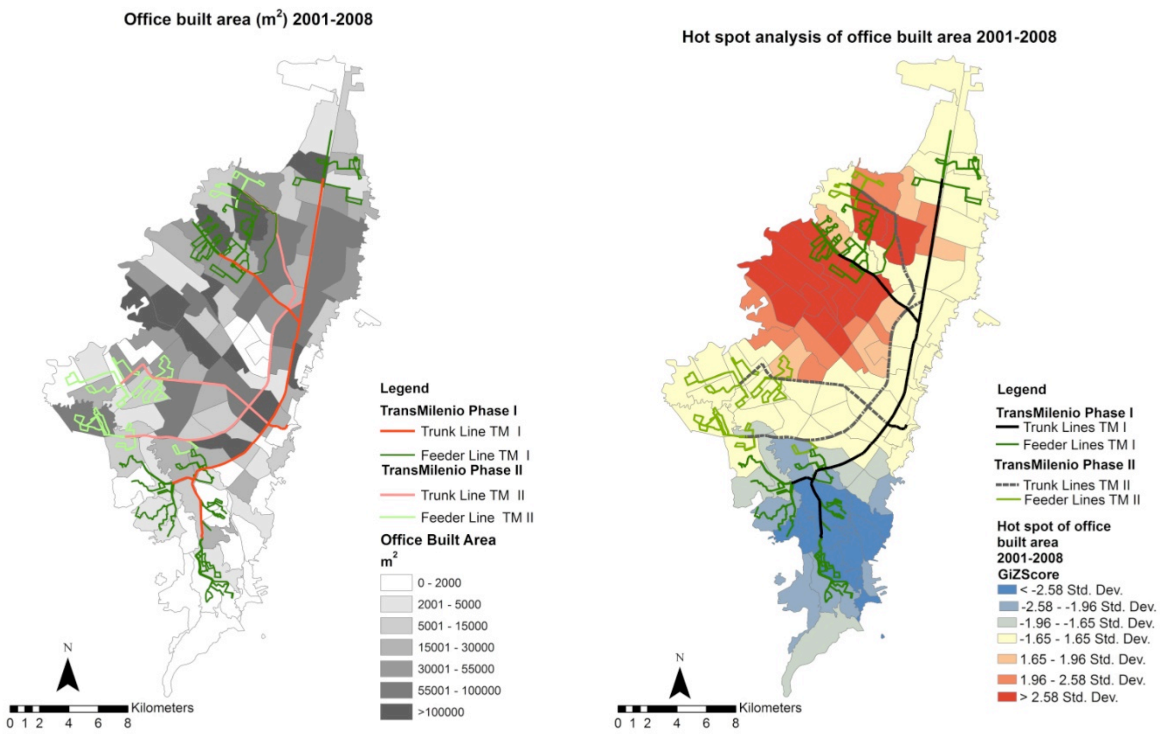

Figure 4 Changes in office built area: spatial distribution and hot spot analysis

Although built area data do not suggest major differences between groups (see Table 5), it was intended to use three *Diff-Diff* models, one per land use, to statistically evaluate if Transmilenio had an impact on housing, commercial, and office built areas. As expected, results indicate that the BRT system had no effect in terms of these variables.

All the analysis and data presented so far show that the city of Bogotá has continuously increased its population density instead of following a sprawl process. Although during the last decade Bogotá's transport system has achieved a significant improvement, its metropolitan transit system has not been modified. Connection between Bogotá, where employment and activity are concentrated, and neighbouring municipalities is based on inefficient traditional buses. Regional connectivity by private transport is even more deficient. Thus, it can be hypothesized that households prefer to remain in the city, where they can access jobs and other activities with ease, even if land value in the city is higher than in the municipalities. Also, perceived security conditions may have contributed to containing the city's expansion.

Spatial distribution, hot spot analysis, and variation in available area per new inhabitant may suggest that an overcrowding phenomenon is experienced in UPZs served by Transmilenio, particularly in those areas near trunk lines. Therefore, it seems that the population is willing to sacrifice housing quality in order to gain accessibility.

EVOLUTION OF LAND VALUE

Many studies have investigated the relationship between the BRT development and property values (see Table 6). There appears to be a consensus regarding commercial property value: Transmilenio has a positive impact on property price; as expected, the price decreases with increasing distance from corridors. On the other hand, four of the five studies found an impact on residential property prices, but the magnitude of the effect varied depending on the study.

Table 6 Summaries of Transmilenio and land value - selected studies

Author	Data and model	Selected results
(Muñoz-Raskin, 2010)	**Sample:** 1,495 residential properties Model: Hedonic prices	• Properties within the immediate vicinity of feeder lines (0–5minute walk) were valued higher than those requiring a 5–10 minute walk. • High-value properties were valued higher if they were close to a feeder, but in the case of trunk lines, the effect was the opposite. Changes in value depended on socioeconomic strata.
(Mendieta and Perdomo, 2007)	**Sample:** 1,547 residential, commercial, and mixed-use properties Model: Hedonic prices	• Property prices decreased between 1.13 and 0.36%, depending on the distance to the BRT.
(Perdomo Calvo et al., 2007)	**Sample:** 304 residential and commercial properties Model: Propensity score matching	• Properties located in the area of influence of the Transmilenio enjoy a “premium” that is reflected in their value of between 5.8% and 17% for residential buildings. • Average square metre price of

Author	Data and model	Selected results
		commercial properties having access to Transmilenio is between 257% and 367% higher than those with no access.
(Rodriguez and Targa, 2004)	**Sample:** 494 residential properties Model: Hedonic price	• Detected a premium of 6.8 to 9.3% for every 5 minutes walking time closer to a BRT station. • Properties on the busway, not necessarily close to a Transmilenio station, had a lower premium, presumably due to the negative noise and pollution effects of bus traffic.
(Rodriguez and Mojica, 2008)	**Sample:** Residential properties within 1 km of BRT Model: Regression analysis	• Properties already served by Transmilenio benefited from the extension, with increased prices relative to control properties (15–20%), and more than properties that did not have BRT service before. • Properties that gained local access increased in value after the extension, but the increase was similar to that of control properties and higher only in some years.

Studies also show different impacts on residential property price according to economic strata. Particularly, Muñoz-Raskin (2010) found that the low-income residential market did not pay more for housing with easy access to the Transmilenio system. Similarly, for high-income properties, proximity to the BRT did not infer a premium value; rather, the value reflected nuisances caused by the system. On the contrary, results show that new middle-income stratum properties in the proximity of Transmilenio trunks and feeder routes had premium values.

INSTITUTIONAL REGULATION OR FREE MARKET?

Since the late eighties, national government has transferred to local authorities the responsibilities to manage, plan, and promote the economic, social, and environmental development of their territory. These measures commit the mayor to defining policies related to land use and transport among others, according to general legal frameworks outlined by national government.

In 1997, the Territory Development Law was issued. It commands municipalities to design long-term plans to organize and plan land use. To this end, a new legal figure called the Land Use Plan (POT in Spanish) was created. Bogotá's POT was issued in 2000; it defined for the first time an official vision of the city and the main strategies to achieve it. Other plans were proposed before, but none of them was put into practice (Bocarejo and Tafur Herrera, working paper).

To determine whether regulation has been modified to take into account possible impacts of Transmilenio on land use, administrative acts introducing changes to statutory decrees were reviewed for those UPZs having access to the system (see Table 7). As mentioned in previous sections, the city is divided into 112 UPZs, each one of which is defined and regulated by a statutory decree. Decrees also include rules regarding maximum built height, activities, and land use.

Table 7 Regulatory review summaries

<table>
<tr><th>Dispositions reviewed</th><th>Modification</th><th>Motivation</th><th>Supported by</th></tr>
<tr><td rowspan="5">A total of 62 amending dispositions reviewed</td><td rowspan="2">57 of them corrected mistakes in statutory decrees</td><td>• Define the actual land use for land wrongly defined from the beginning</td><td rowspan="2">Public and private sector</td></tr>
<tr><td>• Eliminate inconsistencies between flat regulation and written regulation</td></tr>
<tr><td rowspan="3">Five of them introduced significant changes</td><td>• Transform under-used areas near main streets including Transmilenio corridors</td><td rowspan="3">Four by private sector, one by public sector</td></tr>
<tr><td>• An increase in maximum built height</td></tr>
<tr><td>• Commercial and office activities allowed</td></tr>
</table>

After the implementation of the BRT corridors, minimal changes were introduced in land use regulation in UPZs served by the system (see Table 7). Only one of the amending dispositions directly recognized the impact of Transmilenio. It aimed to meet new requirements arising from urban dynamics in a north-western zone of the city. New legislation sought to transform under-used areas and foster their development by permitting commercial and office activities as well as an increase in maximum build height.

Amending administrative acts under review reveal that most of the significant changes introduced to regulations have been proposed and supported by the private sector. Thus, the modification previously mentioned was an exceptional one. For instance, major adjustments facilitated the construction of new commercial developments as well as buildings and facilities for complementary uses in strategic places, some of them near BRT corridors.

Since few regulatory adjustments were introduced and building activity in the Transmilenio area of influence was important during the period of analysis, it appears that land use regulation has been quite flexible to meet market needs, otherwise the law has not been fulfilled. The current city planning framework does not take into account potential impacts of Transmilenio on profitability, valuation of land, and accessibility to goods and services. Land-use legislation misunderstands market behaviour derived from the introduction of BRT transit corridors and is only reacting to private sector initiatives. The lack of planning integration between land use and Transmilenio is questionable and is probably driving the city to an uncontrolled development.

Unlike the BRT of Curitiba, Transmilenio was not conceived as part of an integrated land use-transport plan. Therefore, land-use regulation was not adapted to enhance possible impacts generated by this mass transit system. As a result, the city lost the opportunity to drive its urban development in the Transmilenio planning stage.

CONCLUSIONS

Zones with Transmilenio influence have experienced a significant increase in density relative to zones where the system is not available. This increase is even greater in outer zones served by feeder routes. Using a *Diff-Diff* model, we have shown that Transmilenio availability is a variable that has an impact on this increase.

In terms of changes in land use, besides the fact that some important shopping centres have been built around the terminals of the system, the analysis shows that the presence of the BRT does not induce a higher increase in built areas for commercial, office, or even residential use. The analysis may suggest that an overcrowding phenomenon is experienced in UPZs served by Transmilenio, particularly in those areas near trunk lines. Therefore, it seems that the population is willing to sacrifice housing quality in order to gain accessibility.

A review of land-use regulation in the last decade shows that there is no specific policy to produce specific developments in areas close to the BRT system. Changes have been produced by the market. Land-use legislation misunderstands market behaviour derived from the introduction of BRT transit corridors and is only reacting to private sector initiatives.

While most developing cities experience urban sprawl, in the case of Bogotá, growth in the city and particularly in areas with BRT accessibility has been stronger than outside. Transmilenio trunk corridors and feeder routes have had an influence on containing the size of the city by providing adequate access to the CBD and the main employment areas of the city.

Studies reveal that the introduction of the BRT system in Bogotá has had a positive effect on commercial property values. Increased accessibility has increased the value of properties, and this effect is diminished with increasing distance from the Transmilenio corridor. Nonetheless, conclusions regarding residential properties are divergent.

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