BRT-Oriented Development in Quito and Bogotá

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with support from William Fernando Camargo Triana

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Abstract

This report summarizes a study that combines different methods to understand the land development impacts of bus rapid transit (BRT) investments in Quito and Bogotá. Intervention and control zones in each zone are used to quantitatively examine changes in the land market in both cities. Outcomes include land market characteristics such as built area added per year (both cities), units added (Quito), and building permits issued (Bogotá). We use qualitative analyses to examine interviews conducted with 44 key informants in both cities to understand the factors that explain the presence or absence of land developments around BRT stops and terminals. The land market analysis reveals heterogeneous impacts in both cities. Although increased building activity tends to concentrate in intervention zones, comparisons with controls suggest that the impacts are very context dependent. Some stops showed very high building activity and others less so. In Bogotá, the highest activity concentrated in zones that had already received the BRT, suggesting delayed impacts from the earlier investments. In Quito there were important differences across different types of development (houses, apartments, offices). Nine themes emerged as important explanations for the (lack of) impacts of BRT investments around particular stops: *Calle 100*, BRT Terminals *Portal 80*, *Suba* and *Usme* in Bogotá, and *La Ofelia*, *Rio Coca*, *Quitumbe* and *El Recreo* in Quito. The themes differ in scope and characteristics, but they underscore the importance of accessibility gains provided by the BRT, land market conditions, agency coordination and vision, land availability, and timing of development vis a vis the BRT investment. We also identify the challenges of providing affordable housing in BRT oriented development, and discuss several cases in which land prices increased so that land otherwise suitable for affordable housing became unaffordable due to the investment.

Keywords: built environment, land development, transit oriented development (TOD), bus rapid transit (BRT)

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BRT-Oriented Development in Quito and Botogá

Introduction

Bus rapid transit (BRT) has emerged as an innovative solution to the mobility needs of world cities. As with other mass transit alternatives, BRT can increase the attractiveness of transit, may help mitigate CO2 emissions, and can be a catalyst for transit service reorganization. In coordination with supportive urban development, BRT can decrease motorization (Combs and Rodriguez, 2013) and it will function more efficiently. In addition, when development along a transit corridor is supportive, other transit benefits are attained. For example, the flow of passengers is balanced out and neighborhoods are reinvigorated.

The success of BRT is largely the result of its cost-effectiveness and relative flexibility. BRTs often can mobilize as many passengers as most conventional light rail systems at a fraction of the cost. As with rail systems, however, the cost-effectiveness of BRT hinges on the ability to have demand concentrated along system corridors (Dimitriou and Gakenheimer, 2011). Therefore, in most cases BRTs have been built in corridors with proven demand. As shown by the case of Curitiba (Gakenheimer, Rodriguez, and Vergel, 2011), however, BRTs may also attract dense development that will in turn benefit the BRT system in the future. Notwithstanding Curitiba, and despite the importance of future land development as a strategy that can complement and build on the strengths of BRT, there is limited empirical evidence regarding the development impacts that BRT investments cause.

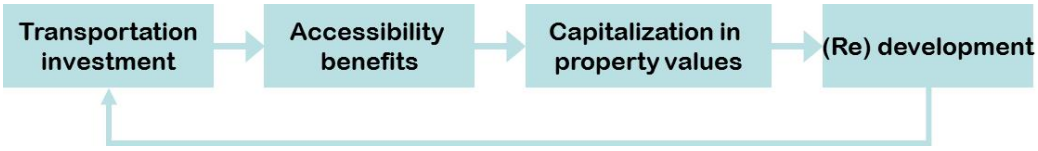
The land development and redevelopment impacts of BRT investments are the focus of this study. We focus on Bogotá and Quito, two cities that have made a variety of BRT investments over the last two decades. Together with Curitiba, Quito and Bogotá have been world pioneers of BRT. In the next section of the paper we review the literature on the land development impacts of BRT. Then, we summarize our methodology, present and discuss our main findings and conclude.

Literature Review

The virtuous cycle between transit investments and land development posits that infrastructure investments create accessibility benefits for dwellers and land owners. Because the number of parcels benefiting from enhanced access is finite, and assuming that access is a scarce good, households and firms valuing such benefits in a competitive market are expected to be willing to pay more for properties with good access over other properties, all else held equal. As a result the access benefits provided by a transportation investment are expected to be capitalized into property prices (figure 1). This capitalization frequently has three expected effects. First, developers will be more likely to invest in the property as expected returns to property are higher than elsewhere. Second, as a result of higher expected returns, investors are likely to acquire land in anticipation of the BRT investments. And third, developers will seek to amortize the higher property costs by building up. This virtuous cycle supports the potential of BRT to spur development around stops and along corridors. Because planning terms have specific

connotations in different cities, we understand land development as development of land parcels, blocks or larger urban areas that include public spaces. It refers to a broad range of urban processes such as greenfield development, redevelopment, revitalization, regeneration, and even renewal.

Figure 1. The Virtuous Cycle of Property Development and Redevelopment



In Curitiba, BRT has been used as a tool to spur development that is transit friendly and mutually reinforcing (Rodriguez and Vergel, 2013). It is considered BRT-oriented development (BRT-OD) because it has a strong pedestrian orientation that supports passenger access to the BRT, strengthen pedestrian safety, facilitates development that is dense and with a mixture of land uses, has a variety of residential, office, and retail options, and encourages multimodal transportation. Despite Curitiba's experience, there is little research supporting the relationship between BRT investments and changes in urban development. Furthermore, little is known about the planning, institutional and market characteristics that spur built environment changes around BRT stops. This is an important gap given the immense popularity of BRT—156 cities have introduced BRT elements into their transit network (GlobalBRTData, 2012), the strategic and operating importance of BRT's potential to guide development, and its impacts on transit demand, societal equity, the environment, and public health.

To date, the majority of the research has focused on examining associations between access to BRT stops and property values. In the case of Bogotá's (Colombia) BRT, researchers have examined the relationship between residential property values and distance to BRT corridor and feeder routes (Munoz-Raskin, 2010; Perdomo and Mendieta, 2007; Rodriguez and Targa, 2004). Studies using quasi-experimental research designs have produced inconsistent findings, with some studies finding property price increases of between 15 and 20 percent (Rodríguez and Mojica, 2009) and others finding null results (Perdomo, 2007). The effects of the introduction of improvements to the BRT system in Seoul, Korea resulted in residential property price increases between 5 and 10 percent for residences within 300m of BRT stops and between 3 and 26 percent for retail and other non-residential uses within 150m (Cervero and Kang, 2011) while the announcement of a BRT corridor in Ecatepec (Mexico) had no impact on property values (Flores Dewey, 2012).

Emerging research has examined associations between BRT and urban development in close proximity to BRT corridors, BRT stops, and in the influence area of BRT feeder routes. In Bogotá the expansion of the BRT was associated with increases in urban density (Bocarejo, Portilla, and Pérez, 2012). In Jinan (China), the oversupply of auto-oriented land uses, midblock crossings on the corridor, lack of pedestrian infrastructure and connectivity, and parking issues were barriers to the introduction of BRT-oriented development (Thomas and Deakin, 2008). Finally, in Seoul (Korea), even though the BRT contributed to increases in development density in urban centers, there were limited effects on residential property values within the influence area of the system (Jun, 2012).

Relative to rail, BRT is perceived to have several disadvantages in stimulating urban development. First, BRT's ability to stimulate economic development may be limited because of its limited locational rigidity and permanence (Dittmar and Poticha, 2004). Accordingly, developers and firms are assumed to be more likely to locate residential, commercial and office developments along a rail line than along a BRT line. Hensher (1999) finds this reasoning unconvincing and for proof suggests that only one BRT line (in Australia) has been taken away. The disappearance of rail in the US and Australia during the last century is also a testament to the limited permanence of public transportation modes.

A second perceived concern is that BRT may be disfavored due to the noise, pollution, and negative image often associated with bus services. Conversely, rail has the allure of newness (Currie, 2006). The stigma of bus-based services appears to be related to technological choices (diesel engines, tire choice, chassis design) that can be addressed more than inherent weaknesses of the mode. In fact, Currie (2006) cites other work suggesting that BRT users tend to have socio-demographic characteristics that appear more like users of rail markets than users of regular bus markets.

In summary, the evidence on the impacts of BRT on land development is equivocal. Some studies have suggested important impacts while others have failed to document either price or development changes. Other research has indicated the importance of market and non-market characteristics in explaining whether transit oriented development materializes. The question propelling this study is what are the planning factors, policies and tools associated with the emergence (or lack) of transit-oriented development around BRT stops? In the next section we develop a conceptual framework based on the literature and explain our hypotheses, followed by the methodology used.

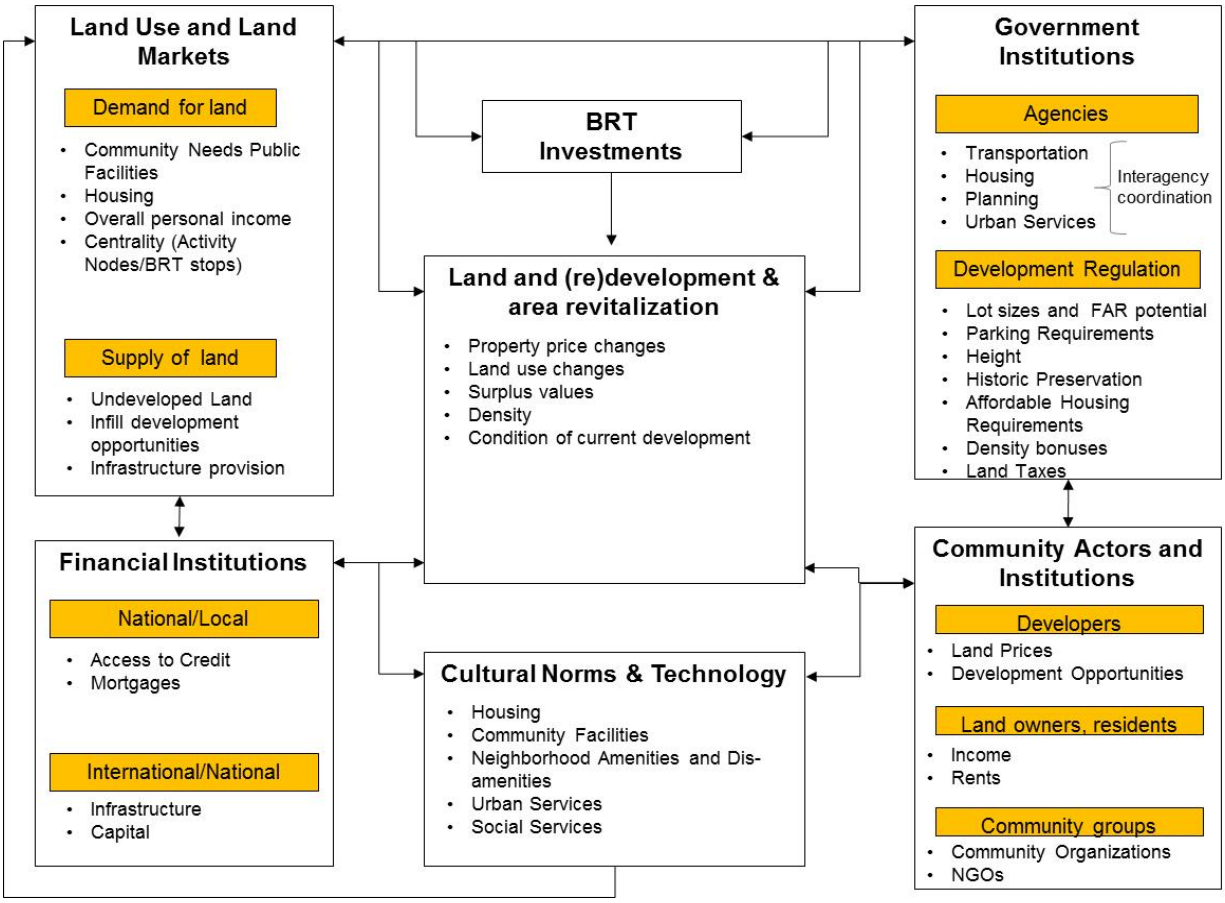
Conceptual Framework

The emergence of BRT-OD is likely to be the result of complex interactions among institutional forces (figure 2). A first group of actors is composed of government institutions. These represent a variety of sectors, from transportation, to land planning, and housing. They partly determine the location of BRT investments; they control development regulations; and they determine related policies that influence the supply and demand for land and housing.

A second group of actors are categorized under the rubric of community. They include developers, land owners, residents, and interest groups, including users of the transportation system. These community actors interact with governmental institutions by demanding government attention to infrastructure, greater land availability, and access to financial credit for housing. As described by the virtuous cycle between transit investments and land development, developers seek development opportunities and potentially acquire land that benefits from the accessibility improvements of transit investments. Landowners reap the land value increases due to BRT investments, and depending on the context and related conditions, might seek to sell or improve their land to take advantage of the increased attractiveness of their location. Residents and tenants, current and future, can influence the housing and transportation demands. Community groups represent the needs of residents and the demand for urban services including

facilities and public space. They also interact with individual decisions to develop, redevelop, or add on to existing property through formal or informal processes.

Figure 2. Institutional Actors Influencing BRT-Oriented Land Development



Financial institutions provide funding for developers, for home owners, and for investors. Such institutions are increasingly globalized, channeling funds from international sources in order to provide an adequate return to investors. At the local level, not all citizens may have access to formal credit, and thus community actors often play a role in bridging the impact between local and international access to credit related to urban development.

Governmental institutions are influenced by and influence cultural norms (Castells, 1977). Furthermore, cultural norms and technology determine the types of development that are possible in a particular context (low or high density housing, for example) and their location. For Castells (1983), the social-spatial structure of the city is a process involving economic, religious, political and technological dynamics. Thus, the value of amenities, such as access to open space, city views, or the appetite for land vis-a-vis the difficulty of commuting long distance reflect norms and values that also influence urban form.

Together, government, community actors, financial institutions, and cultural norms and technologies make up the land market where land and properties are exchanged and investments

are made or deferred. Land use and land markets (formal and informal) determine the demand for land in order to develop facilities, housing, commercial areas and to generate public spaces according to different income groups and their spatial distribution within the city.

The conceptual framework provides a departure point for considering the factors that explain the emergence of BRT-OD. The arrows that connect the boxes are as important as the boxes themselves. The arrows depict the reciprocal and often simultaneous relationships that exist between the different actors in the urban land market. Given the complexity of actors and relationships among them, we tackle the question regarding the planning factors, policies and tools associated to the emergence of transit-oriented development around BRT stops by positing two major hypotheses.

Our first hypothesis, is that the level of pro-active planning and land management by government agencies around BRT stops is very limited or almost non-existent. Rather, we expect high heterogeneity in the changes in land development regulations around BRT stops, largely the result of responses to development proposals, especially in areas with vacant land. The latter—a reaction to a private sector request, contrasts with a pro-active approach from the public sector to encourage transit oriented development and reap its benefits. The specific reasons why planning for BRT-OD has been largely ad hoc and unsystematic perhaps are partly due to a variety of factors, including the limited and ineffectual use of land planning and land management instruments and that planning for redevelopment and revitalization in consolidated areas is particularly difficult and may require higher institutional capacity than greenfield development.

The second hypothesis is that market dynamics, as determined by the public and private sectors interacting, play a pivotal role in determining the outcomes of BRT-OD. For example, we expect that developers have a considerable understanding of the opportunity that BRT-OD presents but uncertainty of the response of planning institutions mitigates their enthusiasm. At the same time, credit financing for BRT-OD is expected to be fairly undeveloped but changing rapidly. For example, lenders have a limited understanding of BRT-OD and its potential. Finally, we also expect to find a lack of market demand studies, which severely limits the discussion of BRT-OD as a development alternative. Taken together, these two hypotheses will contribute to explain the heterogeneity of development options identified in earlier work (Rodriguez and Vergel, 2013).

Methods

Study Zones

We selected Quito and Bogotá, two cities whose BRT and land development patterns had been examined in earlier studies (Bocarejo et al., 2012; Munoz-Raskin, 2010; Rodríguez ans Mojica, 2009; Rodriguez and Vergel, 2013). Bogotá has a mature BRT system now with nine trunk corridors and 114 stops covering 84 km (GlobalBRTData, 2013). Quito was an earlier adopter of BRT, introducing it in 1995. Currently the city has four BRT corridors, accounting for 35.6 km of network, 79 stops, and 11 terminals (GlobalBRTData, 2013). Bogotá and Quito are also similar in terms of urban structure (historical downtowns) and geography (with a chain of mountains bordering them).

Despite similarities in geography and the adoption of BRT, there are several differences that motivate the selection of these two cases. First, Colombia and Ecuador have different land planning frameworks. Ecuador is just beginning to implement a land planning framework similar to Colombia's, while Colombia has almost two decades of experience with a fairly sophisticated framework. For example, Bogotá has many decades of experience with the use of land management tools and at least a decade with value capture tools applied when land use designations change. Second, in some corridors Quito used electricity while Bogotá has relied on diesel to power its buses.

There are additional unique land market characteristics of importance in Bogotá. First, by late 1990s homeowners were recovering from a major bust in home prices that left many owners underwater. Prices only began to recover by 2004. Second, the city is bounded by geographic constraints that limit its growth: Mountains to the east and south and a river to the west. The city is running out of developable land and as a result prices have increased. Third, congestion has also increased over the past decade, as short-term measures like prohibiting the circulation of cars based on the last digit of license plates have been outlived. By 2007 the economy began to improve, partly due to high fossil fuel and mineral prices and because of increased investor confidence, a trend that continues until today.

As Bogotá, Quito also faced a steep recession by the end of the 1990s. In 1999, for example, inflation was 60 percent. In 2000, then president Mahuad introduced the US dollar as the country currency and with it, made one of the most important economic reforms of the country in recent memory. By 2005, the real estate market began its recovery to the point that some believe that the boom may be artificial (Ospina Lozano, 2010). A second factor is specific to Quito and contrasts with Bogotá. Quito has surrounding municipalities in valleys that have attracted significant growth in the past decade. Although Bogotá has witnessed high growth in surrounding municipalities (two to seven times greater growth than in the city of Bogotá), this growth pales in comparison with the growth observed in Quito. Thus, the land market in Quito has used the valley lands surrounding it as an important relief valve. Fare increases are a third factor that differentiates the two cities. Even though fares are flat for the BRTs in both cities, they have increased at varying rates. In Bogotá there have been periodic and consistent fare increases, resulting in the current fare of ~ US$0.90, whereas Quito has kept its fare at US$0.25 for more than a decade.

Land Market Analysis

For this study, we used a mix of different methods and sequential design described by Creswell and Plano-Clark (2007). We first conducted a descriptive, before and after, analysis of real estate activity around selected stops of the two BRT systems and respective control zones. This analysis is a preamble to the qualitative analysis attempting to explain why some land development changes happened and why others did not happen. The majority of the metrics examined focus on real estate activity (such as changes in land use or new area built) to emphasize the right hand-side box of the virtuous cycle depicted in figure 1.

Bogotá

We examined: a) new area built (in square meters per area of each zone, 2001–2010) by year; b) the number of building permits given per area of each zone (2001–2010) by year; and changes in actual land use between years (in square meters per area of each zone, 2005, 2008 and 2011). These data were obtained from the Cadastral Office of Bogotá, the National Department of Statistics (*Departamento Administrativo Nacional de Estadística*—DANE), and the Planning Secretariat of the Capital District (*Secretaría Distrital de Planeación*—SDP), respectively.

Data on new area built every year comes from the national Census of Buildings conducted every three months by the DANE for the metropolitan areas of Bogotá, Medellín, Bucaramanga, and Cucuta and the urban areas of 11 other cities in Colombia. Regarding the building permit data, one shortcoming is that it may incorporate speculative behaviors by developers which may or may not translate into actual building activity. Permits lag construction activity by one to three years, but in some cases the permit can lag five or more years. The longer lags became particularly pronounced when Bogotá approved an instrument as part of its spatial plan that allowed the municipality to identify priority development lots (*Declaratoria de Desarrollo y Construcción Prioritarios*). These priority lots require that land owners develop the parcels within a two to three year time frame. Land owners (erroneously) believe that by having a building permit their land would be exempted from being considered as a priority development lot. The land use change outcome focuses on the area (in square meters) that changed its land use (say from commercial to residential); it does not include changes in zoning for uses that have not materialized. For example, an undeveloped lot zoned for residential that is rezoned as commercial but that remains undeveloped would not be counted in the land use change data.

Seven stops in Bogotá were examined: Calle 26 (opened 2000), Humedal Cordoba (opened 2006), Calle 100 (opened 2001), Calle 80 Terminal (opened 2000), Norte Terminal (opened 2002), Suba Terminal (opened 2006), and Usme Terminal (opened 2001). The first four are stops that have a higher degree of BRT orientation than the last three stops. The opening dates suggest that a clean before and after analysis with controls can only be achievable for the Suba Terminal and the Humedal Cordoba stop. All other stops and terminals had TransMilenio since early in the 2000s. For these stops the examination of development changes after the BRT was implemented allows us to understand market dynamics post-BRT. However, we cannot isolate the effects of the BRT investment from other local market trends preceding or coinciding with the BRT investment. Thus, any results would be indicative of impacts but not fully able to attribute them to the BRT investment.

Spatially, we examined activity around 1km of each terminal and 500 meters around each stop. In addition, we also included the zone within 200 meters of feeder routes, which have an integrated fare with TransMilenio. If less than 15 percent of a zone was contained within the study area, then the zone was excluded from the analysis. To control for secular trends in the real estate market, we included two control zones. These comprise a 500m buffer zone along all of Av. 68 (also known as Avenida del Congreso Eucarístico) and along Av. Boyacá between 1st street and 170th street.

Quito

We examined: a) the number of new housing units offered per area of each zone by year; b) the area built in square meters per area of each zone by year; and c) the price per year of units offered in the market, all for 2002–2011. All dollar figures were adjusted for inflation using the consumer price index of Ecuador. The data were purchased from Inteligentarium, which collects information of all new projects that contain more than three units (development projects with three of fewer units are excluded from the data). The data were aggregated to homogenous zones created by Gridcon Cia Ltda. For prices, overall averages were weighted by the area of each project.

Three city zones covering nine stops were included. The first zone is the Corredor Norte, comprising three stops: Terminal de la Ofelia, La Delicia stop and Cotocollao stop. These stops were inaugurated in 2005. The second zone contains only Quitumbe Terminal, part of the extension of the Trolebus BRT corridor. This terminal first opened in 2008, and received additional BRT service (from other southern BRT corridors) in 2010 and 2012. The third zone is Avenida 6 de Diciembre, from Av. Rio Coca south. It contains the Ecovia North Terminal known as "Rio Coca", and Jipijapa, 24 de Mayo, Naciones Unidas, and Eloy Alfaro BRT stops. Service along this corridor was inaugurated in 2004 and 2005. The timing of the opening of stops is such that the longitudinal data collected allow for a before and after analysis in all cases, although for Quitumbe the after period only contains three years.

Of the stops and terminals included, Eloy Alfaro stop and Quitumbe Terminal were included in an earlier study (Rodriguez and Vergel, 2013) in which Quitumbe was described as a stop type that tended to be located far from activity nodes, containing single family attached housing, with vacant land, and with land uses that are not supportive of BRT. As controls we included the zone of Av. Diego Vasquez de Cepeda, north of Terminal La Ofelia (control for Corredor Norte zone), Avenida Maldonaldo at Condor Nan (control for Trolebus zone in Quitumbe), and Avenida 6 de Diciembre north of Av. Río Coca (control for Ecovia zone). Study and control zones for the two cities are shown in figure 3. In the two cases, for Quito and Bogotá, it is clear that the intervention and control zones are of different physical areas—some are larger or smaller than others. Thus, when examining all our land market outcomes we always normalize (divide) by the area of each zone.

Since in both cities the data represent a census of the given populations, we limit our use of statistical analyses to comparisons among subgroups. To examine trends over time and whether they differed for subgroups we used ordinary linear regression in Stata 11 (College Station, TX).

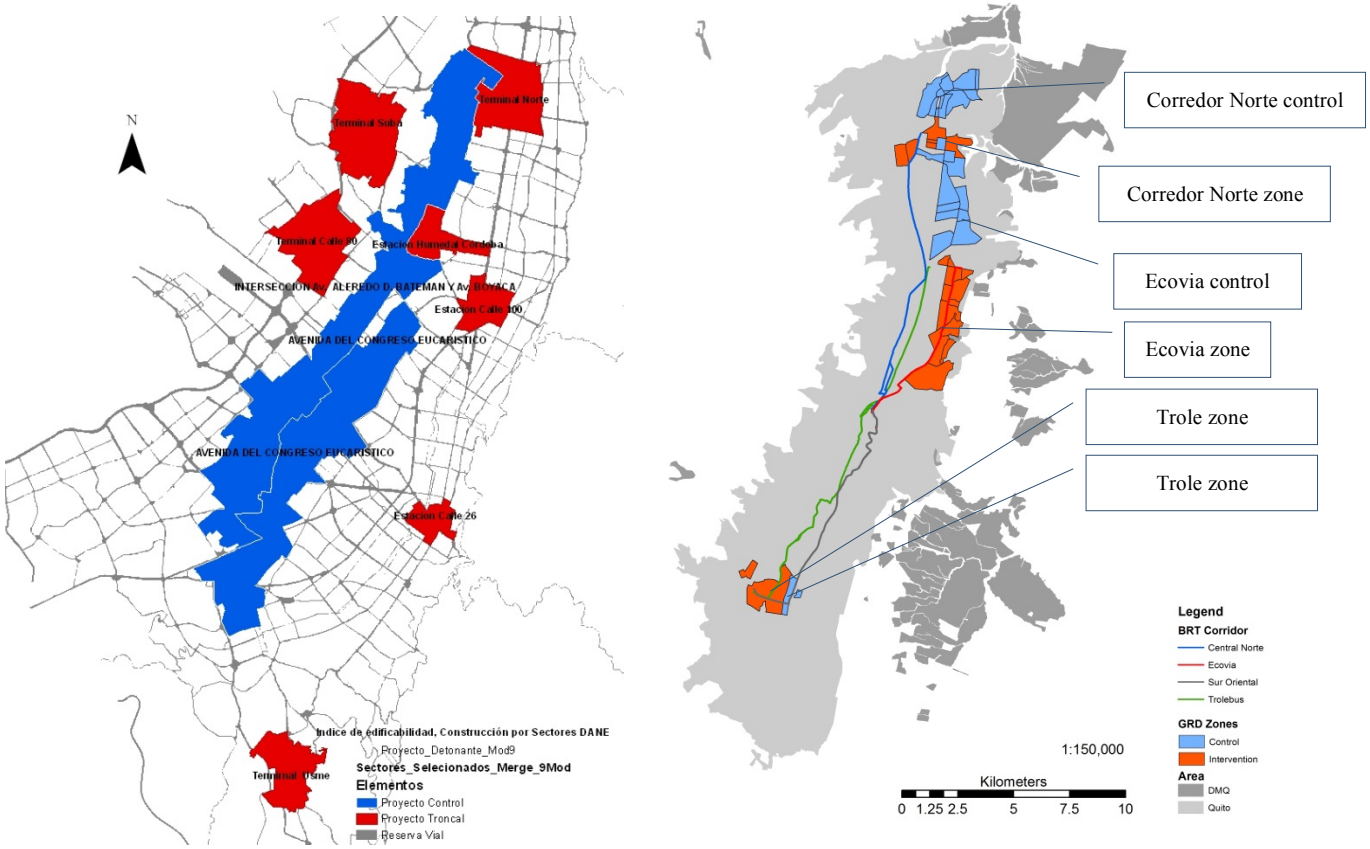
Interviews

We followed the quantitative analysis with qualitative research based on semi-structured interviews. The interviews allow us to provide a more detailed and textured description of the events unfolding around specific stops in both cities. Consistent with our conceptual framework (figure 2), we interviewed planners, developers, land owners, staff from financial and governmental agencies as well as residents and members of the communities living close to the BRT stops. An initial set of participants was selected based on the individual's previous

experience in land use and transportation planning processes in both cities since the introduction of the BRT systems, while community leaders were identified through municipal government contacts. Snowballing techniques were used to identify additional key informants. To guide our conversations, we asked interviewees to consider first the influence of the BRT on the city as a whole, and then we asked about the specific stops under study. Although most interviewees were given the list of stops ahead of time, they were free to consider and discuss other stops in the system. These were just given as examples to begin contrasting outcomes. Participants were also free to discuss issues not considered previously in the set of the questions.

All interviews were recorded (when agreed by the interviewee) and transcribed in Spanish. A preliminary codebook was developed to match the conceptual framework, with categories that included urban development oriented towards transit, bus rapid transit BRT features, land development, land uses, land markets, local actors, and institutions. All transcripts were read initially, allowing for identification of abstract categories across participants and establishing common themes. This also allowed us to determine whether saturation had been reached or whether additional interviews were necessary. When compared to the codebook derived from the conceptual framework, the raw data prompted us to include additional codes. Namely, density, public space, floor area ratio, commuting time and BRT's fare and rates, parking, affordable housing, appraisals and property taxes. An additional topic explaining differences in terms of land market dynamics over time among BRT corridors emerged during interviews in Quito: dollarization of the economy. The transcribed text was examined in Atlas TI using the updated codebook. All interview data collection activities were approved by the UNC Institutional Review Board.

Figure 3. Intervention (red) and Control (blue) Zones for Bogotá (left) and Quito (right)



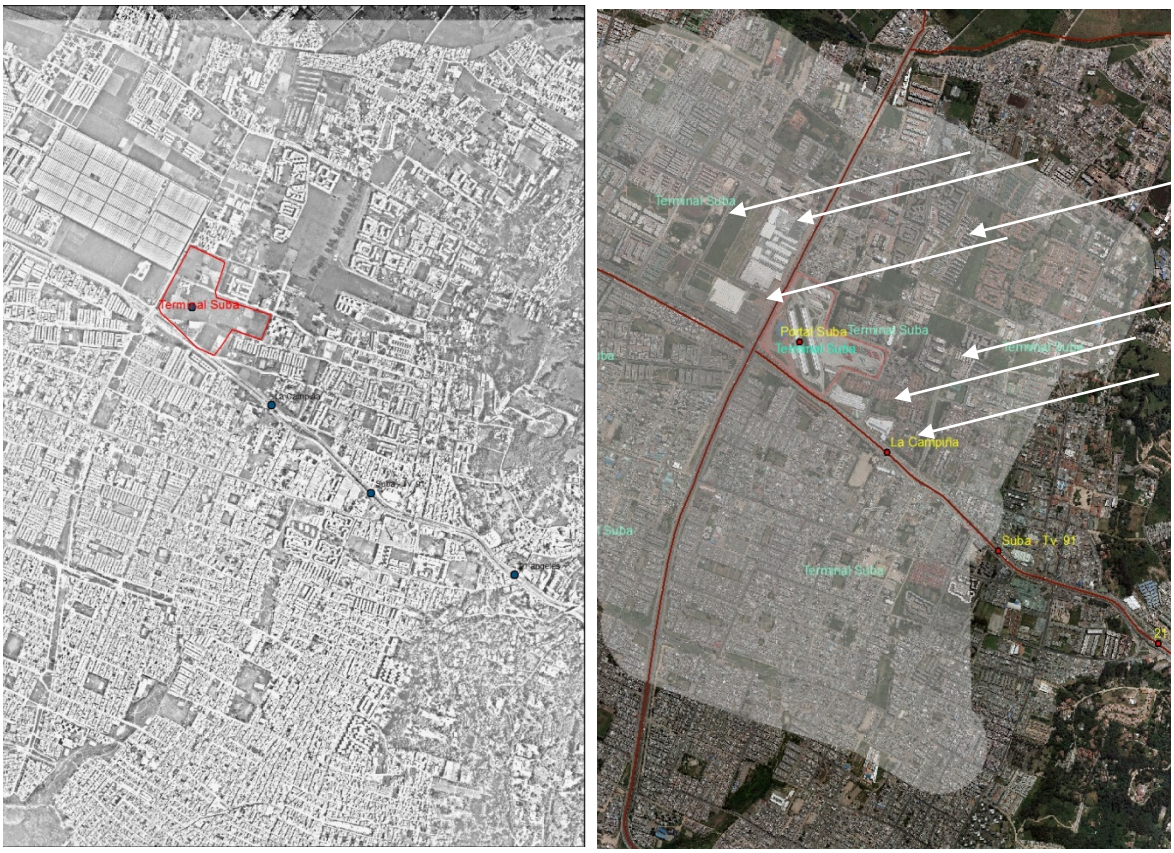
Results

Land Market Analysis for Bogotá

A comparison of aerial imagery before and after the investments suggests important develo changes along some stops. Figures 4 and 5 contain aerial images comparing two stops (Sub Terminal and Calle 100) between 1998 and 2009. In earlier work describing the built environment around BRT stops in Bogotá, these stops were not characterized as strongly oriented towards BRT (Rodriguez and Vergel, 2013). They lacked pedestrian infrastructure limited infrastructure for non-motorized transportation modes, and had big-box developmer which were not considered as BRT-oriented. Yet, the images show considerable changes in development.

Around the Suba Terminal (figure 4), several undeveloped lots and several industrial-type u 1999 were filled with residential and commercial developments. Changes to the Calle 100 s (figure 5) are more subtle as the zone was largely developed by 1998. Most changes came f more intense development, noticeable on the right hand side of the image, along the eastern of the BRT corridor. White arrows point to selected new developments in the 2009 photogr figures 4 and 5.

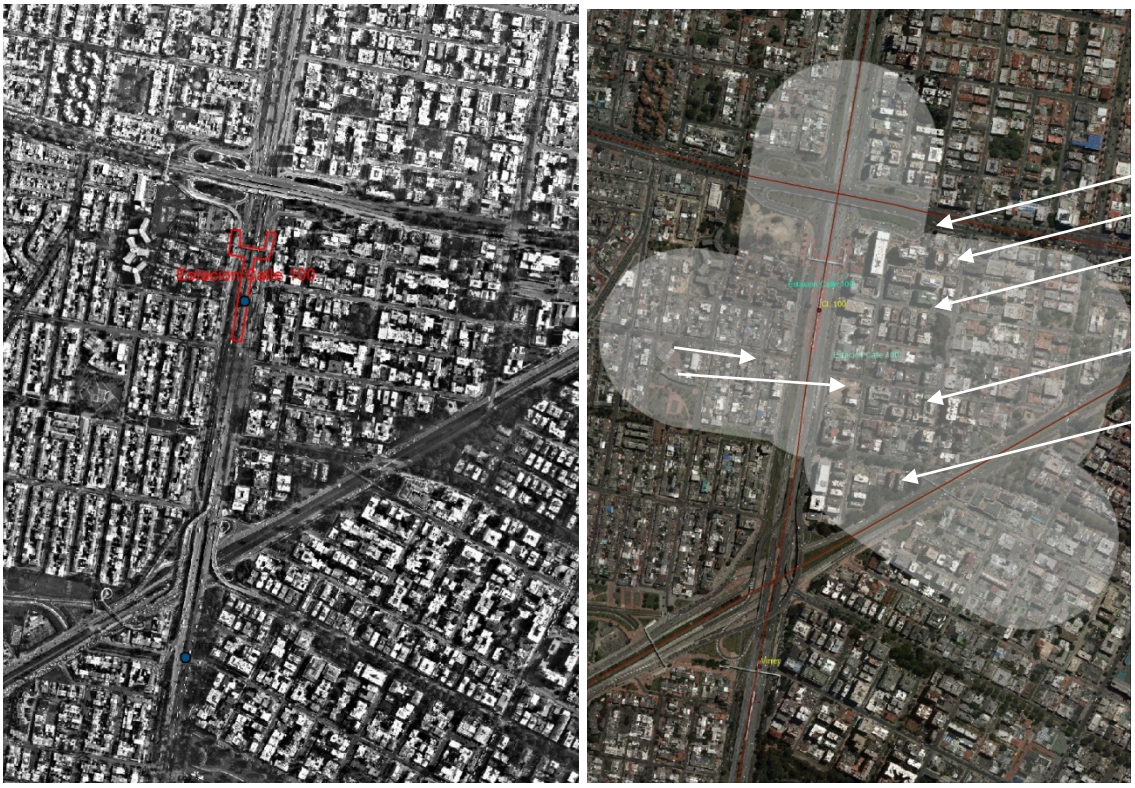
Figure 4. Suba Terminal, 1998 (left) and 2009 (right)



Source: SDP, Bogotá.

The three outcomes (area built, building permits and area of land use change) are presented next. To reiterate, all outcomes were divided by the area of each zone to account for the different zones around terminals, stops, and control zones. Zonal areas vary widely: the Av Boyacá control zone contains 3,300 ha and the Av Congreso Eucaristico control zone 2,200 ha. Terminals studied have a total of 3,400 ha and the stops 7,200 ha, of which the Suba Terminal has 751 ha and the Humedal Cordoba stop has 273 ha.

Figure 5. Calle 100 Stop, 1998 (left) and 2009 (right)



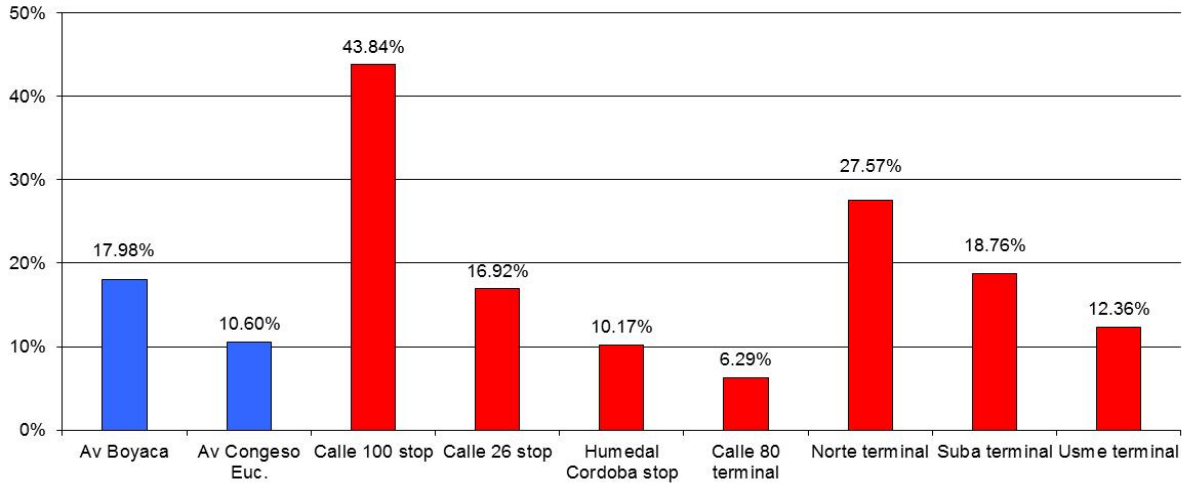
Source: SDP, Bogotá

Area Built

Figure 6 shows the total increase in built area between 2001 and 2010 for control zones and each of the terminals and stops examined. The Av Boyacá control zone increased its stock of built space by 5.9 million m2 or almost 18 percent of its zonal area, while the Av. Congreso Eucaristico increased its stock by 2.4 million m2 or 10.6 percent of its zonal area. Of the intervention stops and terminals, some have high activity and others less so. When normalized by zonal area, locations with smaller areas (e.g., Calle 26 or Calle 100) had higher ratios than locations with larger areas (e.g., Calle 80 Terminal). This is partly explained also by land use regulations. The "Calle 26" stop is close to the traditional city center, an area where building heights have few height limits for developments involving entire blocks. The "*Calle 100*" BRT stop has commercial and office land uses in an area defined as a health services node facing Autopista Norte. Both BRT stops experienced these developments only several years after the introduction of the first phase of the BRT system.

Among the terminals, Norte Terminal had the highest activity followed by Suba Terminal, relative to control zones. The Norte Terminal includes land developments from areas in close proximity such as *Cedritos*, where redevelopment processes have increased densities significantly in recent years. Usme had less concentration of building activity, partly due to constraints related to land management around the BRT Terminal (Pinilla, 2013), but also due to the high attraction for affordable housing in the west and southwest parts of the city ("*Bosa*"and Soacha). The Calle 80 BRT Terminal had the least concentration, especially due the presence of already-consolidated neighborhoods such as "*Bochica*", "*Bachué*", "*Bolivia*" and "*Ciudadela Colsubisidio.*"

Figure 6. Square Meters Built as Percentage of Zonal Area, 2001–2010



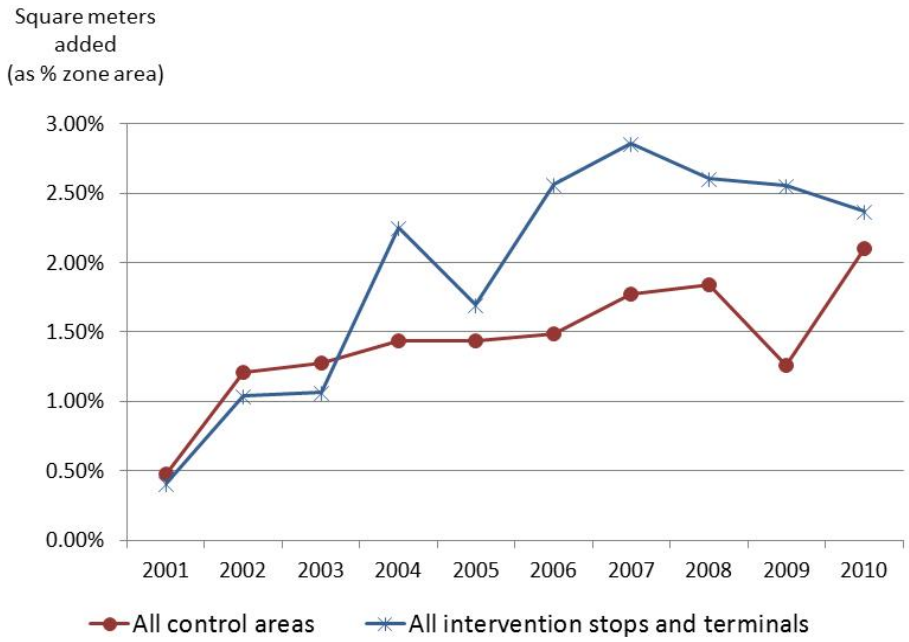
The addition of built area over time in Bogotá is shown in figure 7. It shows a distinct pattern that favors building activity in areas that received or will receive the BRT investment relative to the control zone. The time trend for the intervention zones has a slope that is higher than the slope of the time trend for the control zones (p=0.015). Table 1 provides additional detail by displaying the data from 2001–2005 and 2006–2010. This is useful to understand the impact of the Suba Terminal and Humedal de Cordoba stop, both of which were inaugurated in 2005 and are lumped in the intervention group of figure 7. The Suba Terminal increased its building activity by almost 60 percent relative to the before period, while the increase for the Humedal Cordoba stop was 35 percent. The increase in Humedal Cordoba is consistent with a small area plan (plan parcial) led by private developers to build middle- to high-income multifamily high-rises. The other TransMilenio stops examined had even larger increases in building activity (261 percent) while other terminals saw their building activity decrease by 37 percent. By contrast the control zones increased their building activity by 58 percent, led by Av. Boyacá which saw an increase of 114 percent and Av. Congreso Eucaristico which saw a decrease of 22 percent.

Table 1. Square Meters Built and Licenses Approved for Intervention and Control Zones, Before and After Intervention

	Square meters (% of area)			Licenses issued (per ha)		
	2001-2005	2006-2010	% change	2001-2005	2006-2010	% change
Suba Terminal	7.31%	11.45%	56.54%	0.65	0.81	24.63%
Humedal Cordoba stop	4.31%	5.86%	35.81%	0.20	0.24	16.41%
All other terminals	5.90%	3.75%	-36.46%	0.58	0.89	53.88%
All other stops	7.87%	20.57%	161.46%	0.25	0.39	57.27%
Boyacá control zone	5.72%	12.26%	114.15%	0.31	0.34	10.04%
Av. Congreso Euc. control zone	5.94%	4.66%	-21.54%	0.32	0.41	28.46%

The results for Av Boyacá are not surprising, because the street was extended from Calle 127 to Calle 170 in 1998. This opened significant areas for development and attracted land development, which explains increases in built area shown. In this sense, the Av. Congreso Eucaristico is a much better control zone as it has remained stable and without major extensions or infrastructure investments.

Figure 7. Square Meters Built as Percentage of Zonal Area, 2001–2010

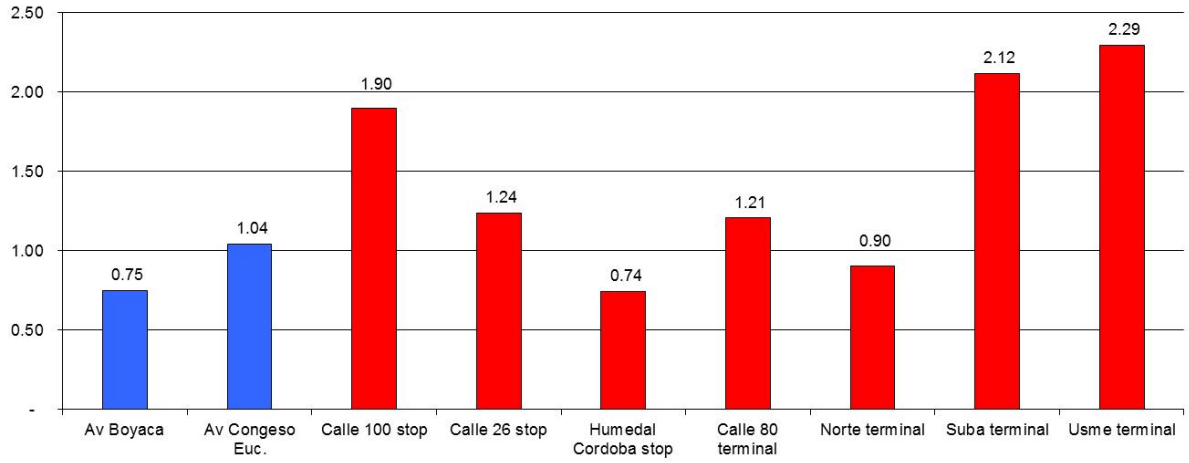


Building Permits Issued

Figure 8 shows the total change in building permits between 2001 and 2010 for control zones and each of the terminals and stops examined. Consistent with the previous results for building activity, the Calle 100 stop had a high density of building permits (1.9 permits/ha), while Humedal Cordoba had the lowest (0.75 permits/ha). However, permits around terminals tell a

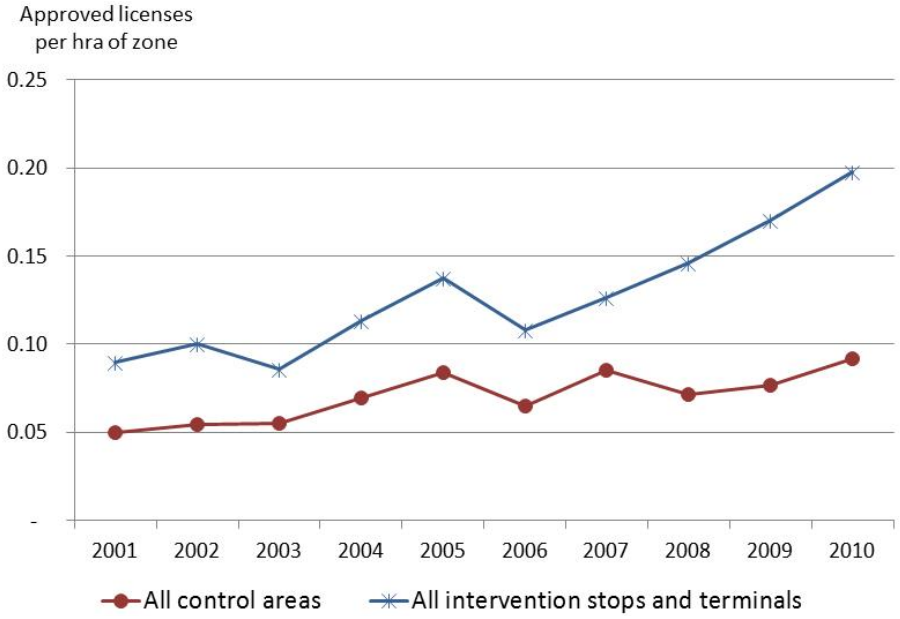
different story. Among the terminals with high densities of permits, Usme and Suba Terminals had the highest activity (2.29 and 2.12 permits/ha, respectively), while the Norte Terminal had the lowest density of permits among terminals studied (0.80 permits/ha). Permits issued in the Av Boyacá control zone and the Av. Congreso Eucaristico zones increased by 0.75 and 1.04 per ha of zonal area, respectively. Part of the difference in results between building permits and area built is that permits do not account for the size of the development. A single permit may add hundreds of thousands of square meters, or just hundreds of square meters.

Figure 8. Total Building Licenses Approved per Hectare of Zonal Area, 2001–2010



The change in building permit density over time is shown in figure 9 for all intervention and control zones. As with built area, it shows a distinct pattern that favors permitting activity in areas that received or will receive the BRT investment relative to the control zones. The trend for the intervention zones has a slope that is higher than the slope of the time trend for the control zones ($p<0.00$). When considering the data from 2001–2005 and 2006–2010 (table 1), permit density for the Suba Terminal increased by 24 percent relative to the before period. The Humedal Cordoba stop increased its permitting activity by 16.4 percent. The other TransMilenio stops and terminals had even larger increases in permitting activity, while the control zones increased permit density by 24 percent, led by Av. Congreso Eucaristico which saw an increase of 28 percent and Av Boyacá which had an increase of 10 percent.

Figure 9. Yearly Building Licenses Approved per Hectare of Zonal Area, 2001–2010



Changes in Land Use

Examination of changes in land use (table 2) shows that most changes resulted in residential and commercial uses, and that these tended to occur in intervention zones. The changes are most pronounced for the two zones for which before and after data are available: Humedal Cordoba stop gained commercial uses and gained but then lost some residential uses, while Suba Terminal gained commercial and residential uses and lost some public spaces. Both had high levels of changes in land uses ("Total change" Row in table 2) relative to control stops and other terminals. Land use changes in the control zones tended to be smaller. The gains in commercial and residential uses came from losses in institutional, industrial, and public spaces. Variations in industrial land use show why the entire Av. Boyacá zone may be a weak control. The zone gained industrial space while most other zones lost or had the same area devoted to industrial uses over time.

Table 2. Square Meters of Change in Land Use by Zonal Area, 2005–2008 and 2008–2011***

	Humedal Cordoba		Suba Terminal		Other Terminals		Other Stops		All control zones	
	2005-2008	2008-2011	2005-2008	2008-2011	2005-2008	2008-2011	2005-2008	2008-2011	2005-2008	2008-2011
Commercial	0.73	4.70	0.80	2.49	0.33	2.33	-6.07	-2.55	0.04	0.91
Institutional*	-5.81	0	-0.22	0	-0.73	0	-0.96	0	-0.12	0
Public Spaces**	0	0.09	0.04	-2.25	2.55	0.26	0	0	0.58	0.16
Industrial	0	0	0.08	0	-0.95	0	-0.95	0	-0.41	0.50
Residential	12.59	-4.57	3.96	6.39	0.25	4.81	1.59	-16.85	-0.63	0.21
Total change(| |)	19.13	9.35	5.11	11.13	4.81	7.40	9.58	19.40	1.78	1.78

*Includes public and private, as well as recreational areas

**includes public lands, roads, and public space

***Numbers do not add up to zero because some categories were left out

Summary

Each of the three outcomes studied for Bogotá tell different but related stories. The building activity data in Bogotá paints a mixed picture, partly because the Av. Boyacá control experienced a major road extension that made land developable. Comparisons of control zones, stops, and terminals suggest that the impacts are very context dependent. Some stops showed very high building activity and others less so. Yet, there was more building activity in intervention zones, some of it likely resulting from the delayed impacts of earlier TransMilenio investments.

A clearer picture of the role of terminals and stops in building activity emerges from the building permit data. The time trend exhibited a more consistent pattern for intervention areas. The strongest effects appear to concentrate in terminals and stops that were built in the early 2000s, as opposed to the most recent Suba Terminal and Humedal Cordoba stop. This likely reflects the lag of development relative to transportation infrastructure investment. The land use change data shows convincing impacts of TransMilenio on land uses. The two intervention zones with before and after data show important changes in land use relative to the control areas. Land uses reorganize with BRT investments.

Land Market Analysis for Quito

The three outcomes (housing units, area built, and price per square meter) are presented next for apartments, houses, and offices for 2002–2011. As before, there is considerable variation in the area of zones, with areas ranging from 57 ha for the control zone of Trole to 490 ha for the control zone of Ecovía. Thus, outcomes were divided by the area of each zone.

Table 3 shows the average yearly figures for the before and after periods for intervention and control zones. For apartments, Ecovía and Corredor Norte added more units per year in the after period than the control zones. Even though Trole more than doubled the number of units per year in the after period relative to the before period, its control zone had even higher growth. The

differences are similar for yearly area built per ha, with Ecovía and Corredor Norte exhibiting higher growth than the control zones. In terms of prices, appreciation was lowest for Ecovía and highest for Trole and the Corredor Norte. The qualitative analysis section next provides insight into the origin of these price increases.

Table 3. Yearly Units, Area Built, and Prices of Houses and Apartments for Intervention and Control Zones, Quito, 2002–2011

	Yearly units (per ha)			Yearly area built (m2 per ha)			Yearly price/total built m2 (2012 $)		
	Before	After	Change	Before	After	Change	Before	After	Change
HOUSES									
Ecovia*	-	-		-	-		-	-	
Control	132.3	109.7	-17.1%	39.2	35.7	-8.7%	749.6	759.13	1.3%
Trole**	149.2	305.8	105.0%	33.3	93.2	179.9%	445.5	604.3	35.7%
Control	3.3	-	-100.0%	4.0	-	-100.0%	507.7	-	-100.0%
Corredor Norte*	12.3	1338.3	10825.2%	10.1	45.6	350.1%	696.4	798.8	14.7%
Control	298.8	297.3	-0.5%	88.9	91.2	2.6%	718.7	752.8	4.8%
APARTMENTS									
Ecovia*	2.5	4.7	84.1%	234.6	420.1	79.1%	1137.9	1237.3	8.7%
Control	0.7	1.2	76.3%	54.5	69.1	26.6%	750.9	836.7	11.4%
Trole**	0.3	0.80	178.8%	19.6	58.9	200.7%	474.1	613.3	29.4%
Control	0.3	1.0	208.1%	19.4	61.8	219.0%	750.5	924.3	23.2%
Corredor Norte*	1.2	1.7	41.4%	104.1	152.4	46.4%	748.4	860.8	15.0%
Control	0.6	0.5	-4.9%	55.3	59.8	8.1%	678.3	756.7	11.6%
OFFICES									
Ecovia*	0.3	1.6	454.4%	27.8	134.5	383.5%	3.6	18.8	421.4%
Control	0	0	--	0	0	--	0	0	--
Corredor Norte*	0.04	0.03	-33.3%	1.9	1.2	-33.3%	0.1	0.1	-39.2%
Control	0	0	--	0	0	--	0	0	--

*The before period is 2002–2005 and the after period is 2006–2011

**The before period is 2002–2007, and the after period 2008–2011

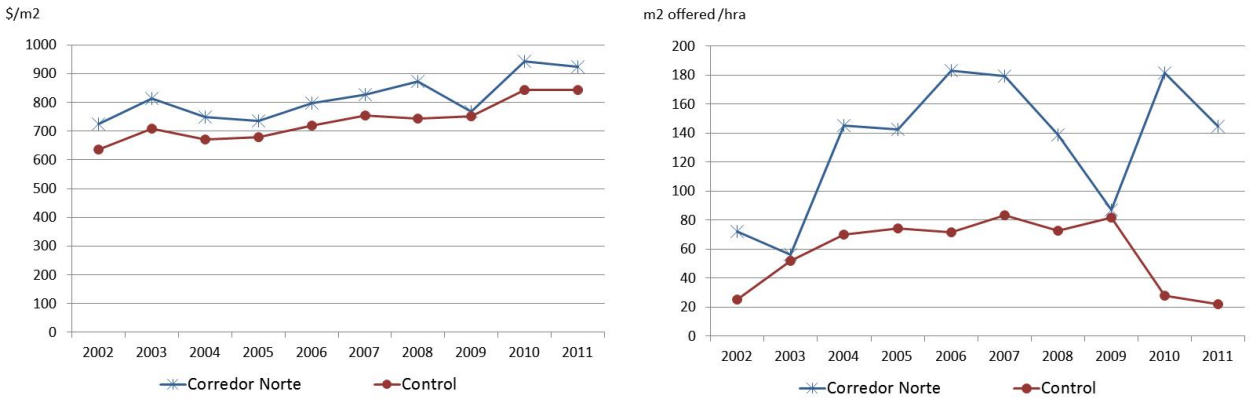
The trends for single family houses mirror trends for apartments except that Ecovía did not have any activity (table 3). This is not surprising given the consolidated nature of the development along this corridor. However, the Trole zone exhibited important growth in single family

housing. Even more remarkable is the dramatic expansion in the number of housing units per ha in the Corredor Norte relative to the control zone. These same growth trends are supported by the yearly area built for each zone. In terms of prices, the Trole zone had the highest appreciation followed by the Corredor Norte zone.

Examination of the same outcomes for offices suggests a different pattern. All new office space activity was concentrated in the Ecovía corridor and Corredor Norte. None of the controls or of the Trole zones had any new office activity and activity decreased in Corredor Norte. Office prices per total built square meters, and the yearly units per hectare increased by more than fourfold over the study period.

The change of new square meters per ha and of price per square meter over time is shown in figure 10 for Corredor Norte. This figure visually confirms the trend shown in table 3, with prices of the intervention and control zones tracking closely but with an offset ($p<0.00$). From 2006 on, the trends begin to diverge although this difference is not statistically significant. With the same exception of 2009, a more pronounced difference between the Corredor Norte zone and its control is shown when considering m2 per ha offered. Such difference began to increase even before the BRT investments were made in 2005. Similar trends exist for Ecovia and Trole (not shown) although differences comparing to the control zone are not as pronounced.

Figure 10. Yearly Square Meters Offered per Hectare of Zonal Area and Price per Square Meters, Quito, 2002–2011



Summary

Taken together the Quito stops show heterogeneous impacts that are heavily depend on real estate market subproducts. For example, the Ecovía zone is located in what planners in Quito call the "hipercentro"—an extension of the historic center that now houses important financial and related economic activities. The emphasis there has been on offices and apartments, and most building activity has involved redevelopment from single family homes to these higher and more intense uses. Similarly, variations in the Trole zone around Quitumbe should be understood in the context of the development of the zone over time. That zone was the focus of important affordable housing developments before the Trole. However, the arrival of Trole has increased land prices such that it is no longer viable to build affordable housing in the zone. The effects of

Corredor Norte zone relative to the control zone are quite clear. They depict increasing real estate activity reflected in increases in price, built area, and supply of housing units.

Interviews

Both the Bogotá and the Quito cases contain examples of successful land development around the BRT investments as well as little or no activity. Why have some zones succeeded in attracting development and others have received limited development attention? This section describes the findings from the qualitative analysis aimed to elucidate the reasons why development is and isn't attracted to BRT stops in these two cities. We conducted a total of 44 interviews, 21 in Quito and 23 in Bogotá. The distribution of disciplines and expertise covered was similar in both cities. We interviewed seven city planners, four developers, and three community leaders in each city. In Bogotá we interviewed six transportation planners, one real estate expert, and two financial sector experts, whereas in Quito we interviewed four transportation planners, two real estate experts, and one financial sector expert. As part of the iterative analysis of the transcribed interviews text, we identified eight emerging themes. Our themes aim to explain why certain land development occurred, why it did not occur, and why its characteristics are or are not oriented towards the BRT.

Accessibility Gains

Consistent with a land rent framework (figure 1), the introduction of the BRT transformed the levels of accessibility of different areas of the city. In Bogotá, TransMilenio extensions to Suba and Usme greatly improved the accessibility of those areas. Traditionally, Suba had been separated from the rest of the city by a set of hills. Access to Suba was limited by a narrow road, at times having only one lane in each direction. Then-mayor Penalosa strove for extending TransMilenio to Suba and investing in a road extension that provided alternative routes to Suba residents. TransMilenio also brought important accessibility benefits to Usme. A developer articulated the virtuous cycle of transportation investments and land development by describing the attractiveness of the Usme Terminal in terms of travel time savings (accessibility) which would then translate into a higher willingness to pay for well-located properties. In words of one of the developers:

> The incidence of the BRT Terminal is a complete attraction or focal point…because people want to be close, especially in that group of population (low-income), to the transportation supply. They are the users that in the end use the transportation system the most. We prioritize that location because of the marketing alternatives it provides.

In Quito, several stops also resulted in high accessibility gains, but their geographic location varied. As expected, peripheral locations benefitted from this additional access. For example, a transportation planner noted that in the Corredor Norte, zone development was strongly tied to the accessibility improvements provided by the system: "… neighborhoods …which did not have accessibility to public transportation, or they used to have twice the transportation costs (in comparison with other areas)…got consolidated…so that prompted more people to come and settle down." In contrast to peripheral locations, the center of Quito also benefitted from the additional accessibility. Before the BRT investments, travel times to the city center were high,

and pollution a concern. After Trolebus, a planner noted, "…one of the major accomplishments [is] to have consolidated the activities in the historic center; the accessibility provided by the Trolebus to the historic center has the benefit of keeping it alive, and to decontaminate it as well." The spatial dynamics between South and North in Quito began to change after the introduction of Trolebus.

One explanation why the land development impacts of BRT are not uniform across the city is that accessibility gains are also different from location to location. But accessibility hardly is a sufficient condition. Many locations saw significant accessibility improvements and little induced development. Other forces are likely at play. Among them, the land market is probably an important determinant.

Land Market Conditions

Three concepts emerged repeatedly to illustrate the land market characteristics that were important for land development. First, the overwhelming majority of development around BRT stops occurred through private sector initiative. There was little public sector leadership in facilitating the land development process. Interviewees from both public and private sectors agreed that the public sector played a largely reactive role to development around stops. The case of the Calle 100 stop in Bogotá is illustrative. Even though this stop was built more than a decade ago, it took some time for land re-development to occur, as shown in the land market analysis section above.

> All developments are purely private initiative…allowed building heights are 12 stories, and I think the regulations already existed there. Perhaps the only density exception [around Calle 100 stop)] could be between 106th and 108th streets, at the west side, because the office buildings have a higher height.

This reactiveness of the public sector resonates with Campanella's (2011) critique of planning as having become too procedural and less innovative and inspirational. It is also in line with Lopes de Souza's proposal for Latin American planners to focus more on implementation of plan (which he calls urban management) (Lopes de Souza, 2010).

The second relevant aspect regarding the land market is its role in determining the type of real estate product being built. Gakenheimer et al (2011) argued for public sector led market studies to ensure that there is enough demand for the type of development being proposed. This is consistent with that recommendation, as market demand is a critical factor in determining not only whether development happens but the type of development that will happen. Continuing with the Calle 100 stop case, financial backing was enabled by the strong belief regarding market demand for office space. A financial sector expert recalled, "All [development] used to be one-story houses, so developers razed them and more intense development took place. We financed a high-rise building in that area…….that area has become a business sector, with a lot of strength."

In Quito, the case of Ecovia shows the importance of market studies in determining the demand for apartments. "Ecovía is for a specific group, a middle to middle-high income target group, because Ecovía…does not continue towards the edges which would imply low-income

population" recalled a city planner. These middle- to high-income groups also have easier access to home-buying credit, which further helps their ability to locate along the Ecovia corridor.

And third, we also found that the land market provided entrepreneurial opportunities for local residents. The case is more noteworthy given that these tended to be low income families that began accumulating capital and believed that real estate investments in their neighborhood were attractive investment opportunities. A community leader explained the rationale: "There are a lot of people that have been saving all their lives, and given that now there are many development companies and several multifamily apartments in the area…people decide to invest their savings there one way or another". The extent to which these investments are sporadic or anecdotal remains to be determined. But if it were more than that, it would support an unusual asset building strategy related to BRT investments in low income areas. Understanding the genesis of such behaviors and how they came to be about is worth further study.

Affordable Living

With localized accessibility gains and market demand, prices rise. Affordability is in fact an important outcome that needs attention as BRT-OD is planned. Some interviewees readily connected public transportation fare policies with urban spatial structure. In both Quito and Bogotá fares are flat—they do not vary with distance. In Bogotá, fares between feeder routes and TransMilenio are integrated so that a user that transfers to or from TransMilenio to a feeder route will not be charged twice. With the poor located in the periphery, flat fares (and low fares) have a progressive impact. However, they also perpetuate peripheral locations for the poor (where land is least costly). According to a city planner,

> …to generate differential charges by distance, would end up affecting not only the location of these people but also their quality of life, and the accessibility will be much less, while the areas of the city with higher income groups are much closer to the city centers, or zones with higher attraction of jobs, schools or commerce. The flat rate was a response to this matter.

A flat fare is only one way in which a progressive fare policy can be implemented in cities like Bogotá or Quito. Subsidies going directly to transit users, and geographically-determined subsidies, may be viable alternatives with fewer leaks and with fewer secondary market distortions.

In tandem with transportation costs are housing costs. An expected consequence of land market forces and improved accessibility is land price increases. Land prices are often a barrier for affordable housing developments close to BRT corridors. This topic emerged in stops were affordable housing was being targeted. Quitumbe (in Quito) and Usme and Suba (in Bogotá) experienced significant price increases. A real estate expert commented "in Suba, there used to be affordable housing projects, in the medium range and not close to the price ceiling, but nowadays they do not exist anymore, basically (now) there are housing units of 100 to 125 thousand dollars."

Interviewees also alluded to positive spatial externalities of development. Risk aversion among developers motivates them to wait until others make an initial investment and test the waters. A developer in Quito argued "the construction of the Trole (BRT), the construction of the shopping mall Quicentro Sur …and the development of the ground transportation regional terminal…are heavy factors that increase land prices." This highlights the importance of having pilot or demonstration projects that can raise additional interest among other developers by reducing uncertainty.

Limited Vertical Coordination

The planning and implementation of BRT-OD usually involves several public agencies. Lack of coordination is often seen as a culprit in public sector work. In Bogotá's case, lack of vertical coordination undermined early efforts to envision BRT investments as more than mobility projects. Priorities between the municipal and the central government regarding what the BRT investment should comprise differed.

During TransMilenio Phase 1, the influence area of the project was defined from curbside to curbside. No sidewalk or accesses were improved. In Phase 2, the influence area was defined from façade to façade: "We were more daring with the architectural intervention, we improved sidewalks and we built pocket squares" said a transportation planner. Since the central government covered 70 percent of capital costs of TransMilenio, after TransMilenio Phase 2 the central government asked the city of Bogotá not to include any costs that were not exclusive to the mobility system. Why TransMilenio has had a relatively narrow focus in terms of its influence area is unclear. The absence of central government financial support, the political benefits of showing infrastructure results quickly and other explanations are possible. This limited scope hindered better integration between land development and BRT investments. Since then this policy has changed, and the central government now actively encourages land, environmental, and economic development intervention associated with the BRT investments.

Similar concerns were expressed regarding the pattern of urban intervention in Quito's Trolebus (Rio Coca Terminal) zone. A city planner recalled: "The BRT Rio Coca Terminal has been always heavily criticized due to the lack contribution to public spaces from the perspective or development opportunity it could have generated." The same concern was espoused regarding the isolated manner in which BRT is implemented, not generating connections through public spaces with current residents in Quito's Quitumbe Terminal.

In both Quito and Bogotá, there are active efforts to promote transit oriented development. In Quito, the subway being planned will enhanced urban development opportunities while the redevelopment plan of the recently closed airport aims to use land readjustment tools and density bonuses to encourage high density developments. In Bogotá, the updated comprehensive plan for the city encourages transit-oriented redevelopment around BRT and subway stops.

Vision of BRT: Mobility or Accessibility?

A common challenge emerging from both cities lies in the vision of the very essence of the transportation investment: a purveyor of mobility, of accessibility, or of both? In Bogotá, several

planners mentioned that BRT corridors were determined based on the origin-destination matrices, underscoring a mobility view of the BRT. Others disagreed: "The BRT corridor along Autopista Norte was built to provide an alternative to people with private vehicles… there were a lot of private vehicles, but if somebody takes a look from the transportation perspective, well, it was not the place for it [BRT]." This alternative view of how the main BRT alignments were chosen continues to espouse a mobility-based perspective. The same tension of defining the role of BRT in the city emerged in Quito: "…it is unclear if the introduction of the BRT had a direct impact on pedestrian infrastructure or the provision of public spaces…..I would say the Metrobus-Q tried to introduce a system on the existing city rather than the development of an urban project," recalled a city planner. In both cities, the BRT systems aim at connecting peripheral residential sites with core employment areas, dominated by a large center.

Often these differing visions came from different disciplines (urban planners vs. transportation planners). The disagreement highlights challenges related to horizontal coordination, which is the ability to coordinate across agencies of the same jurisdiction (for example, across municipal agencies). In fact, the lack of agreement on what constitutes the appropriate scope for a BRT investment also plagued municipal agencies. Whether the BRT is defined from curbside to curbside, from façade to façade, or from influence area to influence area has impacts on cost and on the potential development impacts that the system might have. But the land planning instruments and funding should support such vision. Criticizing some of the outcomes of the TransMilenio Phase 2, a planner concluded that there were "negative urban effects because the budget…only …involved sidewalks, lanes and BRT stops, but land acquisition and land readjustment were not involved. What façade will the buildings facing the BRT will have…has not been part of the process." Referring to the Suba Terminal, where an ample plaza surrounding a municipal administrative center was built, another planner added "something people tend to like are those small commercial stores, but we do see that square at Suba Terminal…those 500 meters are completely desolate."

It is also reasonable to have a scope that adapts depending on context: in some stops it may be fine to have a narrow scope of a BRT project whereas in others the scope may be much wider. "There will be never accessibility benefits if you have a BRT in the middle of a freeway, and passengers have to access with pedestrian bridges …We have to move from a 'people mover' transportation scheme towards a people connector scheme." These different visions underscore the importance of cross-agency project preparation in defining and working together towards a project scope. Often the creation of a new, temporary organization, with members from relevant agencies can be helpful in enhancing coordination possibilities. In the words of a transportation planner in Bogotá, "the members of the Board of Directors of different public agencies related to transportation, land use planning, and housing should all be the same….this is a good way to keep…the decision making process aligned with the same objectives."

A differing, and sometimes contradictory definition of what public space is, may be a contributing obstacle to developing a consistent view regarding what the BRT should do and defining its area of influence. Transportation planners explained how the intervention on the public space took place within two realms: access links (sidewalks, bridges) and pocket plazas. By contrast, some planners argued that sidewalks should not be considered public space because they should be considered part of the mobility system. If following the latter definition, then

TransMilenio mostly created public spaces at BRT Terminals, where pocket squares and parks were built as part of the system. Critiques about dead public spaces generated by the intervention of the BRT also emerged:

> It is noticeable how in some BRT corridors, like Calle 80, Carrera 30 and Av. Suba, the construction of the BRT has generated, on the contrary, negative urban effects because the budget for the transportation systems only deals with building those belts, which involved sidewalks, lanes and BRT stops, but land acquisition and land readjustment are not included, what façade building will have towards the BRT or the public space is not part of the process either.

Even with a common vision of BRT that favors access relative to movement, which implies development or redevelopment around bus stops, the land planning agencies must have the right tools and capacity to implement the project. It is hardly surprising to say institutional capacity of local governments is an important determinant of the role that the public sector can plays on land development, particularly in consolidated areas. "The most important barrier here is land management, eminent domain and integration of land parcels [land assembly]" said a city planner in Bogotá. The concern with capacity, however, is more refined than simply the ability to manage land development. It relates to the limited toolbox that exists to manage the development. This is important because Colombia and Bogotá specifically, have a set of development tools that is considered as more sophisticated and advanced than the tools used in most of Latin America. The focus on ability to manage the development process is particularly important given earlier results suggesting that the vast majority of BRT stops examined were in areas that already were built up (Rodriguez and Vergel, 2013). Managing a process of land redevelopment is likely to be more complex than greenfield development. A planner described this difficulty, "the other issue is land acquisition, which is complex, because a developer can buy 10 or 11 parcels but if the developer does not buy the last parcel of the block, the project is dead. In order to solve that, there are numerous mechanisms …that have never worked out."

Development Regulations

Even if visions of what the BRT could or should be differ among agencies, land planners can and sometimes do attempt ex-post (admittedly more difficult) approach to BRT-OD. They would do this by implementing land use regulations that would support this type of development. In other cases, stubborn regulations or related factors stood in the way of development or redevelopment consistent with BRT-OD.

In Quito, several participants suggested that land use regulations explain differences in development outcomes between the Trolebus zone and the Ecovia zone. After the introduction of the Trolebus, parking availability was significantly reduced. "The Trole was built…but it meant that thousands of parking lots were eliminated." This had significant impacts on stores that formerly relied on automobile-based shoppers, which now had to cater to transit users. Parking requirements also differ between both zones, with minimum requirements being higher in the Trole area because it has a stronger commercial orientation.

Some of the land use planning challenges identified harks back to the limited horizontal coordination among agencies or units within agencies. In Bogotá, the comprehensive plan (POT for its initials in Spanish) largely did not account for potential redevelopment along corridors to allow for more intense uses, even though the plan and TransMilenio Phase 1 are cotemporaneous. The POT gave the general designation of 'stability areas' to roughly 80 percent of the TransMilenio areas, thereby disallowing major redevelopment within the area. Furthermore, to implement the comprehensive plan, smaller spatial units called *Unidades de Planeamiento Zonal* (UPZ) were responsible for developing regulations to implant the plan. According to a city planner,

> There is no coherence between the planning model defined in the POT, specifically by giving importance to public transportation, and the specific land development regulations defined by the UPZs…UPZs have distorted, in a radical manner, the model defined by the POT.

There was lack of coordination despite the fact that several interviewees recall mayor Penalosa endorsing densification of corridors as a complementary strategy to the BRT investments. Why this view did not sift through the planning bureaucracy remains unanswered.

Other land planning challenges underscore the limited responsiveness of the public sector. When needed, the updating of land use regulation was slow and untimely. Quito's Quitumbe Terminal began its development as a zonal plan mainly for affordable housing. However, the land price increases due to the BRT investments priced out future affordable housing developments. Yet, the land use regulations continued to call for such development. Developers and real estate experts mentioned that current land prices make difficult to generate affordable housing in Quitumbe: "It is difficult to find it [land at low prices] in an area still close [to the city center]…. in Quitumbe current land prices are 90 dollars [per square meter], and that is expensive." A market monitoring function that Vernez-Moudon and Hubner (2000) call for, allowing for regulations to quickly adapt to changing market conditions remains weak or undeveloped.

Given the land use and building activity changes documented in the land market analysis section of this report, there were important planning changes that supported changes in development. Whether the resulting development was oriented towards BRT or not is not fully known, although other work (Rodriguez and Vergel, 2013) suggests that it is likely that many of these changes were not particularly supportive of the BRT investments.

The development regulation changes were hard to document with the interviews, partly because interviewees did not take part in those specific land use decisions. However, we did identify cases in which legal concerns impeded changes in land development regulations. The concerns are twofold. First, by law in Colombia public officials are personally liable for their public decisions. If a land regulation change is challenged in court by a third party, the official may be liable for some of the financial consequences of the action. Second, even if a regulation change proves to be legal, it may create a precedent for other parts of town. On this, a planner commented "If a public servant authorizes a building height of 20 meters along Av. Caracas…after that he will be pressured to do the same along Av. Suba. If he does not do it, then the landowner in Av. Suba can sue the civil servant."

Urban Expansion and Land Supply

With one or two exceptions, the most significant impacts of the cases studied tended to occur in Terminals located at the periphery of both cities, were land is ample and prices low relative to well-located central places. "The influence of TransMilenio has been on the Terminals… on the corridors not much has happened; there are even corridors in which…the city has decayed" said a planner. It is no coincidence that other research (Rodriguez and Vergel, 2013) has identified a handful of peripheral terminals as having the most promising BRT-OD features of the 81 stops studied in Bogotá.

Furthermore, these peripheral locations have, perhaps inadvertently, encouraged further growth away from central places. Calle 80 Terminal in Bogotá illustrates the dynamics regarding land availability and induced growth. In close proximity to the BRT Terminal, many neighborhoods were built prior to TransMilenio. This explains the high number of feeder routes at the BRT Calle 80 Terminal. However, impressive growth has occurred between the BRT Terminal and the Bogotá River (west of the terminal). Some of these developments are served by feeder routes, but they are located closer to the River than the BRT Terminal. A city planner noted, "Towards the new developments that are taking place next to the Bogotá River…TransMilenio…might make them more attractive." A similar expansion occurred around the Suba Terminal. In Quito, La Ofelia Terminal (Corredor Norte) induced similar development: "They extended one road, using land owned by the municipality, in order to increase access to residents in the northern area known as Carcelen. [Prior to this] These areas did not have public transportation supply." The availability of land, the accessibility gains provided by the BRT and the concomitant investments explain the rapid growth around this terminal.

Because it has been private-sector led, much of the growth induced in peripheral areas has been opportunistic and has leapfrogged existing development. In other instances is has filled in vacant lots leapfrogged from previous developments. Community leaders identified potential conflicts with this haphazard growth, including the blocking of access routes to the Usme Terminal while the new developments were being built. In Quitumbe, there was community concern with a Regional Ground Transportation Center being planned just south of the Trolebus Terminal. The community organized to avoid informal retail stands and crime to take over areas around the BRT Terminal, even though this is exactly what happened around the Regional Ground Transportation Center close by. A community leader describes the process:

> The [Regional Ground Transportation] Terminal was relocated here…5 years ago.....then the BRT Terminal was constructed…Quitumbe was selected many years ago as a sector for affordable housing, but take a look at this case, the impact has not been from the [Quitumbe] Terminal towards the community, but instead on how this healthy community has generated a positive impact towards the Terminal, avoiding decay.

Of note is that in these two cases, lower income communities organized to manage positive and negative effects of land development and the BRT investment in their vicinity. The impetus for organizing, however, should not be couched as NIMBYism. In these cases, the community accepted the investments to come but also realized that they were incomplete. Complementary actions were required to avoid urban decay, or to improve access.

Planning Horizons

The final theme that emerged relates to lack of congruence between the timing of transportation investments and the timing of associated land development. Transportation investments have a fairly short implementation time—mostly between two and five years. Land development, by contrast, can take two or three decades. This difference is exacerbated by the focus on land redevelopment. In areas already developed, the land redevelopment process may involve retrofitting existing water and sewer infrastructure, land assembly, and related permitting. "The transportation system moved forward relatively fast, in 10 years we had around 80 kilometers of BRT corridors in operation, but the urban response, even from the public administration, was delayed," said a transportation planner. The delay of land development is the result not only of extra planning complexity, but also of land market dynamics. The Usme Terminal sat with very little development for almost a decade, despite the accessibility benefits described in the above. Currently, that Terminal has had intense development activity.

The mismatch in timing is also reflected in planning practice. In key segments, the TransMilenio was built to consider current densities. Increases in density along key corridors may not yield additional passengers because of simple capacity constraints. A developer suggested that "the structure [of TransMilenio] was not designed with future expansion, a future with higher demand, with higher frequencies…." A transportation planner confirmed that: "if too much density is generated, there are more people, and the BRT stops are not made from rubber, so higher densities could generate capacity problems." Politically, planning a system with spare capacity may be difficult to justify. Even though incrementalism and the ability to adjust to demand seems to be a strategic advantage of BRTs, in the case of Bogotá the system's capacity became its Achilles heel.

One notable exception to the timing mismatch has been big box retailers. Large commercial developments are commonplace around Terminals in Quito and Bogotá. Either they are shopping malls, or a single retailer under one large roof. The attractiveness of the Terminals is the large volume of passengers getting on and off the system. "Next to BRT terminals, commercial developments were built quickly because we have BRT Terminals with 80 thousand passengers per day" recalls a transportation planner. Consistent evidence about these developments emerged for Bogotá and Quito Terminals. Furthermore, in some cases, these commercial developments have been used as a neighborhood redevelopment strategy, in concert with the BRT (but in an uncoordinated way). For example, Quito's El Recreo Terminal was a former industrial area in decay. The coming of the BRT enhanced prospects for redevelopment. A planner commented, "The commercial center itself [in El Recreo] was a negotiation between private actors for the access (to the Terminal)." Similar evidence emerged for la Ofelia Terminal.

Conclusions

We conducted this study using a combination of methods to understand the development impacts of BRT investments in Bogotá and Quito. A land market analysis suggests heterogeneous impacts of BRT on development. These impacts tend to be heavily dependent on contextual conditions. Market factors such as prices and land availability figure prominently in the

quantitative assessment of real estate market activity. For example, land supply seems to play an important role. For Suba Terminal and Corredor Norte, in Bogotá, there was land available in close proximity to the BRT, which facilitated development. In other cases it was land scarcity and high prices that propelled denser redevelopment, renewal, and regeneration (Ecovia, Calle 100). Still, development activity remained limited in some stops that have continued to have relatively low prices (Quitumbe Terminal, Usme and Calle 80 Terminal).

Juxtaposing the land market analysis with results of prior research (Rodriguez and Vergel, 2013) characterizing stops by their transit-oriented development yields insights. Developments in the most active zones in the market analysis (Suba Terminal, Calle 100 stop, Ecovia zone, Corredor Norte zone) were not identified as being strongly oriented towards transit. This paradox highlights a potential failure of planners to channel developer interest in these areas towards transit oriented development. It also raises some questions about the stops that were considered BRT-OD in earlier work. Of the stops included in this study, from Bogotá Calle 80 Terminal, Suba Terminal, and Norte Terminal and from Quito Rio Coca Terminal (Ecovia) were classified as having the most promise in terms of their BRT orientation. Clearly, developer interest, development activity, and availability of land seemed to play an important role in determining transit orientation. Yet, other stops like Calle 100 did not emerge as particularly oriented towards TransMilenio despite the high development activity shown.

The qualitative analysis identified eight themes that played an important role in determining the relative success of some BRT stops. These themes can be classified broadly in terms of public sector characteristics, such as limited coordination across agencies, institutional capacity, and land use regulations; and land market characteristics, such as the availability of land and market demand. In our hypotheses, we had expected market dynamics and the institutional capacity to conduct proactive planning as important explanations of outcomes. Yet, our evidence provided a more nuanced explanation of the factors that explain development outcomes around BRT in the two cities studied. These specific themes help explain the timing and nature of development being attracted to them. For public officers, this study is a lesson on the importance of understanding the land market in order to identify possible areas of intervention. A piecemeal approach to TOD, embedded in a regional strategy, is likely to be more successful than an ambitious all-at-once TOD strategy.

The qualitative analysis also highlights important challenges in the provision of affordable housing around BRT. The Quitumbe Terminal had successful development of affordable housing before the BRT was built. Land price increases, likely resulting from the BRT investments, have diminished developer appetite for affordable housing in the area. The real estate market activity data and the interviews support this interpretation. In Usme, by contrast, affordable housing was not built in large scale before the BRT. Nowadays developers are undertaking affordable housing projects next to the Usme Terminal. The new housing stock and retail areas are aimed at incomes higher than the social housing cutoff, but they remain affordable relative to the median new housing stock in Bogotá.

If land continues to capitalize the accessibility benefits of BRT, and planners make little provision for affordable housing (or for public spaces and other common pool resources), most land will go to the highest and best use. But, are those uses really best? When such uses are

provided at the expense of lower income groups being marginalized and isolated, and when public spaces, parks and schools cannot be built because of a development process that assigns development to the highest bidder, they may not be the best use for society. This is further highlighted by the recurrent view that a more holistic attempt at urban revitalization and regeneration is required. This involves moving away from the atomistic development process that yields little benefit to the city, to one in which developers, land owners, and society gain.

In summary, the question of whether BRT stimulates land development was answered with a resounding, it depends. In some instances developer appetite, market conditions, land availability, and land regulations were such that significant development took place. In other instances development has been more limited. In most cases, the development has not resulted in public spaces such as parks or plazas, or institutional land uses like health centers or schools. When plazas were built, they were criticized on grounds of urban design and articulation with the built environment surrounding them. Thus, a different way of developing urban areas around BRT may be required. One that attempts to find a tenuous balance between the private benefits of development and the public costs it creates. The same attempt should also reconcile the need for clear rules and expediency that the private sector values, with the desire to improve the quality of development while supporting existing transit services. Whether this approach is feasible remains an empirical question.

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