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THE VALUE OF A PROMISE

Estimating the effects of a promise to build mass transit infrastructure on housing prices in Ecatepec, Mexico

Onesimo Flores Dewey

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ABSTRACT

This research explores whether the promise to build mass transit infrastructure had an effect on housing prices in Ecatepec, a fully urbanized municipality in the northeastern fringe of the Mexico City Metropolitan Area (MCMA). Prices of properties located within 1 km of an announced Bus Rapid Transit (BRT) corridor are compared to the prices of properties sold within the same distance of a similar corridor where no mass transit is slated to run. This difference is estimated both before and after the announcement. Research finds evidence contrary to the hypothesis of anticipated capitalization, which posits that such project announcements trigger an immediate windfall for property owners, who capitalize before the start of operations on the expected benefits of enhanced accessibility. The price of lower quality properties appear to be unaffected by the announcement, displaying a dynamic that is no different from that observed for similar properties in the reference corridor. In the case of higher quality properties, evidence suggests anticipatory movements in the real estate market, but not in the expected direction. On average, owners of higher quality properties located in the vicinity of the proposed project experience no windfall, but a loss in value approximating 6%.

INTRODUCTION

Previous research suggests that properties located close to *existing* rail stations garner a price premium. In Hong Kong, for example, properties located within walking distance of rail stations sold for a 3.3% premium (So et al, 1997), while in Seoul, South Korea, properties lost an estimated 3% of their value for each additional kilometer separating them from the nearest rail station (Bae et al, 2003). Other studies with consistent findings were recently conducted in Bangkok, Thailand (Chalermpong, 2007) and Izmir, Turkey (Celik and Yankaya, 2006).

While evidence is thinner -perhaps due to the novelty of this technology- proximity to Bus Rapid

Transit (BRT)[1] should also have an impact on property prices. At least in theory, real estate developers and property owners place a premium on the direct level of service improvements, and on the complementary investment momentum associated with BRT technology (Polzin and Baltes, 2002).

Most of the empirical research probing for this possibility has been conducted in Bogota, known internationally for its celebrated *Transmilenio*. A study conducted two years after the implementation of this BRT system found a premium of 6.8-9.8% in the rental price of apartments for every 5 minutes walking time closer to stations (Rodríguez and Targa, 2004). In the same vein, Perdomo et al (2007) found residential properties located within easy access to Transmilenio to enjoy a value premium ranging from 5.8% to 17%, while Rodriguez and Mojica (2009) identified that residential properties close to the BRT were offered in the market for 13-14% more than similar properties in a control area.

Elsewhere, Levinson et al. (2002) refer to land-use benefits following BRT investments in Brisbane and Curitiba while Cervero and Kang (2009) documented how BRT upgrading in Seoul prompted intensified land use in the vicinity of stations, and led to land value premiums in the range of 5-10% for residential properties located within 300 meters of stops.

This emerging body of literature finds that added accessibility due to mass transit –be it rail or BRT- represents a positive property attribute, and that the real estate market capitalizes it through price premiums. However, we have yet to learn more about the dynamics of this market reaction. While scholars such as Dunkerley (1983) have long predicted "anticipatory movements" and "sharp jumps" in property values resulting from the addition of urban infrastructure[2], there is a paucity of empirical studies demonstrating whether this capitalization

1 A Bus Rapid Transit system is *"a rubber-tired light rail transit (LRT), but with greater operating flexibility and potentially lower capital and operating costs."* (TCRP A-23 Project, cited by Levinson et al 2002, p 2)*"* and described as *"... a high quality bus based transit system that delivers fast, comfortable, and cost effective urban mobility through the provision of segregated right of way infrastructure, rapid and frequent operations, and excellence in marketing and customer service. BRT essentially emulates the performance and amenity characteristics of a modern rail based transit system but at a fraction of the cost. A BRT system will typically cost four to 20 times less than a light rail transit (LRT) system and 10 to 100 times less than a metro system."* (Wright and Hook, 2007, 11)

2 An earlier reference to the topic is found in Chapter 11 of Keynes' General Theory of Employment, Interest and Money (1964): *"It is by reason of the existence of durable equipment that the economic future is linked to the present. It is, therefore, consonant with, and agreeable to, our broad principles of thought, that the expectation of the future should affect the present through the demand price for durable equipment".*

triggers when the transit project is announced, when construction starts, or only when the resulting corridor is operational.

In this regard, McMillen and McDonald (2004) offer a reasonable hypothesis of "anticipated capitalization":

> *"Prices begin to rise at the time the project is announced, after which they rise at rate r up to the time the project is completed. Real prices are then constant thereafter. In the more realistic case of uncertainty, expectations may prove to be incorrect. After the project is completed, prices may continue to adjust if the value of the project was assessed inaccurately beforehand. For example, the benefit from being close to the station may be overestimated before the line is constructed, leading to a drop in the gradient after the line has been in place from some time. Ultimately, the time path of the station gradient is an empirical issue" (p 466-467)*

While plausible, this formulation assumes that mass transit infrastructure announcements trigger an upfront windfall for property owners. According to the stated hypothesis, property prices are immediately and positively affected by such announcements, at a rate proportional to benefits expected to materialize after the start of operations. The uncertainty McMillen and MacDonald talk about refers *only* to the magnitude of these benefits, which will not be fully revealed and assimilated until the mass transit project in question is up and running.

However, the connection between infrastructure announcements and uncertainty[3] runs on several tracks. When valuing their property, owners not only manifest their expectation about a project's outcome, but may also factor in their fears and doubts regarding the project's planning and construction stages. After all, one characteristic of big projects is that *"the timeline for their completion is long, economic and political changes occur alongside their development, and rarely do the completed projects conform entirely to the initial proposals"* (Fainstein and Diaz Orueta 2009, p 765). Owners can not be sure if land takings will be required or if the noise and traffic diversions will last for extended periods of time. Furthermore, even property owners convinced that the project will

3 By uncertainty, I mean the "*imprecision in estimates of future consequences conditional on present actions.... the idea is that there is a real world that is imperfectly understood. It can, in principle, be understood -at least up to some irreducible noise"* (March, 1994 p 178)

result in a net locational advantage have to account for the possibility that the promise to build will not be fulfilled, at least not in the exact way as it was promised.

These uncertainties will not necessarily be assuaged by promises made by investors and public officials[4]. The public knows that promoters have a structural incentive to underestimate costs and overestimate benefits (Flyvberg et al 2003), and that their words will not be "tightly coupled" with their actions (March, 1994)[5]. Implementers face competing priorities, limited budgets and unforeseen circumstances, and thus the outcome of their plans is never fully under their control. Therefore, a project's announcement resembles more a statement of intention than an accurate prediction of the future. Surely the real estate market factors these doubts and fears into their prices.

This research attempts to contribute to the field by providing clues about the direction and magnitude of property price fluctuations during the early development stages of a Bus Rapid Transit project. How do prices change, if at all, when such a project is announced? And similarly, is the effect different for different kinds of residential properties?

Our findings suggest that people's time horizons can be shorter than suggested by MacMillen and MacDonald. Despite perceptions about the future desirability of the project, immediate concerns during the initial stages of the project may postpone or inhibit the capitalization of added accessibility. In other words, given the presence of risk, property owners are likely to employ larger discount rates when projecting the future utility that will accrue to them as a result of having property in the vicinity of the announced infrastructure.

This paper is organized in the following manner. Section I reviews studies that explore the "anticipated capitalization" hypothesis. Sections II and III provide readers with the context on our chosen area of study, presenting a brief history of the municipality of Ecatepec, of the

4 For a fascinating discussion on the psychology of promises, see Grant, C.K. (1949).

5 This of course is not necessarily due to manipulation. James March (1994) explains: *"Talk and action are loosely coupled, because talk tends to deal with principles one at the time and action tends to deal with many principles simultaneously but only in a specific limited situation. Talk achieves clarity by ignoring the complications of specific contexts. It reminds decision participants of their beliefs. Action achieves clarity by ignoring its implications for contradictory beliefs. It sustains the beliefs but bends them to meet the exigencies of action. As a result, some things that are easily said are not easily done. Other things can be easily done but not easily said."* (Page 198)

Mexico City Metropolitan Area (MCMA), and of the mass transit system in the region. Section IV introduces BRT, and describes how the proposal to build the Ciudad Azteca-Tecamac corridor (later known as "Mexibus") was announced to the residents of Ecatepec, commenting on the evolution of this project since. Section V presents our data, Section VI outlines the research methodology and finally Section VII presents findings and limitations of this study.

SECTION I.
ANTICIPATED CAPITALIZATION IN THE LITERATURE

Scholars interested in the effect of mass transit projects on residential property prices typically conduct ex post analyses. The literature review conducted for this research revealed few attempts to test for capitalization before operations start, during the early stages of project development. We will discuss five such studies. The fact that none of them focus on a BRT project and that only one refers to a mass transit project outside the United States suggests that we are indeed navigating through unexplored territory.

Damm et al (1980) found price premiums in single-family dwellings in anticipation to the opening of the Washington, DC Metro. Using cross sectional data samples of property sales dated 1969-1976, and taking the number of years to project completion as certain, they estimated the elasticity of price with respect to the number of years of completion to vary from -0.11 to -0.05. In contrast, Gatzlaff and Smith (1993) –using both repeat sales indices and hedonic regression methods- found only weak effects of the announcement to build the Miami Metrorail.

Two studies evaluating the effects of the Chicago Midway line (MacDonald and Osuji, 1995; and McMillen and MacDonald, 2004) concluded that the land market anticipated the opening of this transit line. In fact, the later estimated the aggregate increase in single-family residential property values to be $215.9 million in 1997 dollars, *"nearly half the cost of constructing the transit line"*, and that *"the sharp increase in prices near the stations came during the time before the transit line actually opened"*.

Agostini and Palmucci (2008) produced the only study known to the author that sets out to test for anticipated capitalization in a developing world context[6]. These scholars studied the housing market reaction to the project to build Line 4 of the subway system in Santiago, Chile, arriving to conclusions similar to the previously cited works. Their results show that the average apartment price rose by between 4.2 and 7.9% after construction was announced and by between 3.1 and 5.5% after the location of the stations was identified. Apparently, the property market overestimated the benefits of Line 4, and adjusted downward as inauguration day drew close.

All of the cited studies –except Gatzalff and Smith- find evidence confirming anticipated capitalization: property owners experience a windfall immediately after the mass transit project is announced, which does not preclude a subsequent price adjustment once the level of uncertainty surrounding the promised benefits decreases.

If scholars could generalize from these findings, a plethora of policy options open up for serious consideration. For example, implementation of any of the value capture mechanisms[7] suggested in the literature could be legitimately pursued as soon as the announcement is made, providing an early flow of resources to at least partially finance construction.

However, early capitalization of enhanced accessibility is probably not the only consequence of a mass transit project announcement. Promises to build also trigger concerns about the immediate future, particularly among residents extracting mostly use value from their property. Despite potential for long-term benefits, people don't know how much of their daily lives will be affected by planning and construction decisions, and whether or not this cost will be worth it. This is particularly relevant in contexts with a population accustomed to the inability of political competitors to make credible promises to voters, and where project implementation routinely

6 Rodríguez and Mojica (2009) also found some evidence of anticipatory capitalization in their study on Bogota. However, this issue was not the focus of their study and mentioned in passing.

7 Value capture *"refers to the process by which a portion of or all land value increments attributed to the 'community effort' are recouped by the public sector either through their conversion into public revenues through taxes, fees, exactions and other fiscal means, or more directly in on site land improvements for the benefit of the community."* (Smolka and Amborski, 2001, pp 1)

falls short of expectations[8]. To the degree that people remain skeptical and concerned, infrastructure announcements are taken with significant reservations.

When this is the case, announcements of mass transit project can trigger an initial *negative* response in the property market, at least until the level of uncertainty decreases and the net benefits become visible. While undocumented (to my knowledge) in the public transit literature, such early market response is observed for facilities typically considered as nuisances, known in the planning lingo as “LULUs”[9].

For example, Kiel and McClain (1995) found initial price responses to rumors that an incinerator would be located in North Andover, Massachusetts, and strong evidence of depreciation as soon as construction of this facility began. According to these scholars:

> *"The effect of a facility on house values may change over time as neighbors acquire more information, good or bad, on the aesthetic and health consequences of the facility... the uncertainty surrounding the project -whether and where the facility is located and how undesirable the facility might be -will change through time and should be reflected in the prices of houses" (pg 242)*

These insights seem applicable to mass transit projects, and are useful to frame an alternative to the anticipated capitalization hypothesis. Even if the long-term effects of a mass transit project were unquestionably beneficial, the announcement could still trigger a countervailing stimulus, perhaps with enough force to mitigate or even cancel anticipated capitalization. This research tests for this possibility, assessing the housing market response to the promise to build a 16-kilometer BRT corridor -the “Mexibus”- in the municipalities of Ecatepec and Tecamac, Mexico.

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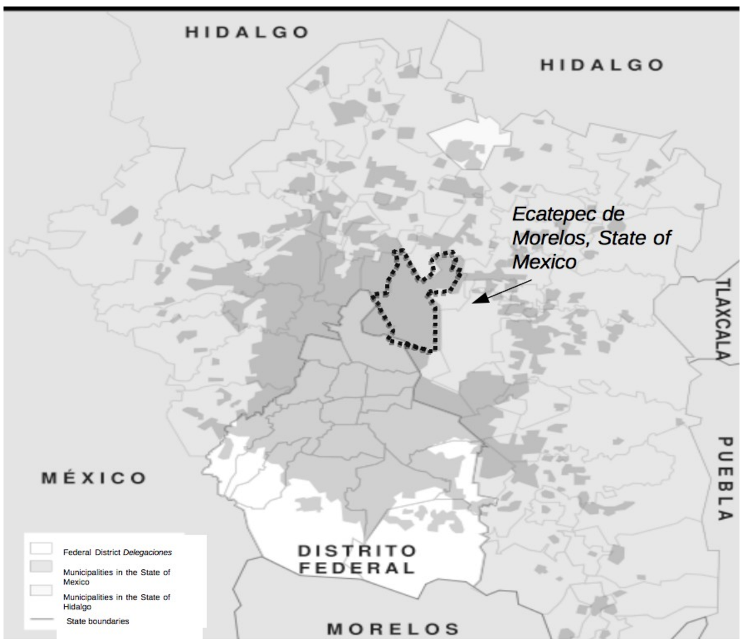
8 See Keefer (2007) for a discussion of the relationship between political credibility and infrastructure investments

9 The acronym “LULU”was coined by Popper (1991) and refers to “locally unwanted land uses”

SECTION II

ECATEPEC AND THE MEXICO CITY METROPOLITAN AREA



Map 1: Mexico City Metropolitan Area: Built area and local political jurisdictions, as of 2005 (Ecatepec dotted) Source: INEGI

In this study, we focus on the evolution of housing prices in Ecatepec[10], a fully urbanized municipality located in the northeastern fringe of the Mexico City Metropolitan Area (MCMA)[11]. With almost 1.7 million people inhabiting its 155 square kilometers, Ecatepec is the most populous municipality in Mexico[12], characterized by the prevalence of low-income, high-density "*colonias populares*" (Gracia Sain, A. 2004, p 132).

The urbanization pattern of Ecatepec is a consequence of three main factors: 1) An expanding supply of cheap land resulting from the desiccation of the *Texcoco* Lake; 2) explosive population growth experienced by Mexico City during 1940-1970 and 3) contradictory urban development

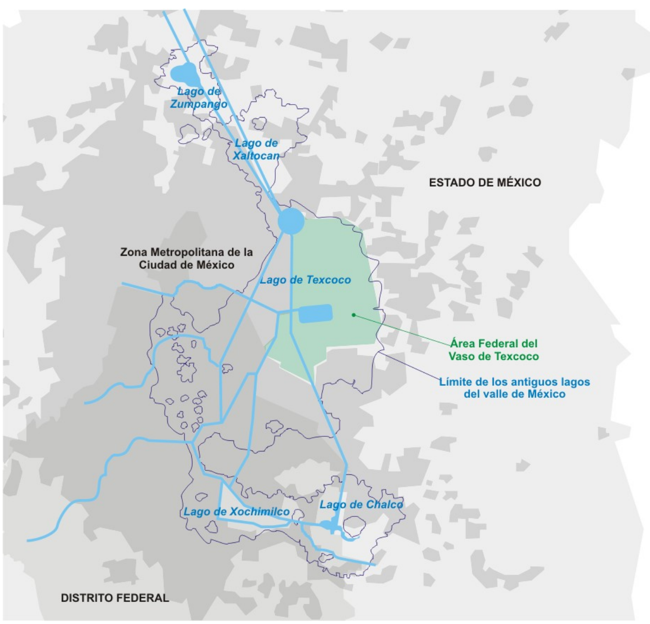
10 While the Bus Rapid Transit corridor of interest runs through the territories of the municipalities of both Ecatepec and Tecamac, this research focuses exclusively on the property market of the former. A brief explanation is justified. Tecamac lies to the north of Ecatepec, and only recently transformed itself from a predominantly agricultural community into an emerging working class"dormitory city". Currently with 270,574 inhabitants, Tecamac displays one of the fastest population growth rates in Mexico, calculated at 9% yearly for the period 2000-2005. Just in this decade, over a hundred thousand residential building permits were authorized in this municipality. Theory predicts that that *"jumps in value are likely to occur at certain transitional points... of these, the most important transition for the rapidly expanding cities in developing countries is usually the initial transfer from rural to urban use"* (Dunkerley, 1983, p7). Thus, the decision was made to omit this recently urbanized municipality. The recency of the land use change, and the predominance of new houses are likely to mask any influence of the BRT announcement on residential prices.

11 By the Mexico City Metropolitan Area (MCMA) I mean the territory comprising not only the Federal District but also 56 municipalities in the State of Mexico and one municipality in the State of Hidalgo.

12 According to the 2005 INEGI Count, Ecatepec is the most populous municipality in Mexico with 1,688,258 inhabitants. It must be noted, however, that the 16 political jurisdictions located inside of the Federal District are not municipalities, but *delegaciones*. If we were to rank these, *Delegación* Iztapalapa would be the most populated local jurisdiction, with 1,820,888 inhabitants.

policies pursued by State of Mexico and Federal District authorities.

The waters of the *Texcoco* Lake once covered a significant fraction of Ecatepec. Since colonial times sustained efforts to desiccate the Lake were undertaken, first to protect Mexico City from the danger of inundations[13], and later to open more land for development. With population growth, major interventions were required to expand drainage capacity. This led to several projects attempting to control and tube most waterways in the area, culminating with a 136-kilometer deep drainage system (1967). These infrastructure projects resulted in the shrinkage of the Texcoco Lake, from 41,000 hectares in 1608 to 14,000 in 1966[14].



Map 2: Contrast between Mexico City's built area and its former hydrological system.

Map 3: Mexico City, 1862. Most of Ecatepec is covered by the Texcoco Lake Source: Espinosa Castillo (2008)

Espinosa-Castillo describes the process in the following manner:

> *"The human incidence over the hydrological system supplied great extensions of land to people already living nearby, who slowly started using and appropriating them for urban use.*

13 The first documented inundation of Mexico City occurred as early as1555, and others followed in 1580, 1604, 1607 and 1624.

14 These and all subsequent references to the desiccation of the Texcoco Lake come from Espinosa-Castillo, M. (2008).

Thus, starting in the forties, the desiccated areas of the Texcoco Lake experienced an intense change in land use. The closeness to the city and the possibility of using this land either for agricultural or urban use stimulated a vibrant market for the land taken from the lake. The former Texcoco Lake supplied the territory settled by immigrants in the fifties, sixties and seventies; territories that that are today part of the Ecatepec and Nezahualcoyotl municipalities." (p 778)

This process coincided with an era of rural stagnation and industrial growth in Mexico, triggered by import substitution policies implemented as early as 1930, but that took off between 1940 and 1970. This period –known as the Mexican Miracle- (Cypher, 1990) brought sustained economic growth, rapid industrialization, and a population migration from the countryside to the capital[15] (Guillermo Aguilar, 1999; Garcia Sain, 2004).

Mexico City grew beyond the formal boundaries of the Federal District, particularly to the north and east, absorbing physically and functionally entire municipalities of the neighboring State of Mexico. In 1950, only 2% of the population of the MCMA lived beyond the Federal District, with Naucalpan and Tlalnepantla as the only fully integrated municipalities. Ecatepec and Chimalhuacán integrated next, completing their conurbation by 1960 (Unikel, 1976).

Most of these newly conurbated municipalities developed hastily, under confusion about land ownership and with little concern for public services and equipment. In 1958, more than a decade after the process of conurbation had started, the State of Mexico enacted its *Ley de Fraccionamientos de Terrenos*, which attempted to curb the sale of plots lacking basic urban infrastructure and public service connectivity. However this law was widely ignored as developers found in the permissive attitude of the authorities in the State of Mexico an escape valve from a strict ban on land development enforced in the Federal District (Schteingart, 1991; Duhau, 1991; Davis, 1994).

15 During 1940-1970, Mexico City experienced population growth rates of 5% per year. While the population boom receded since 1970, it is important to point out that the geographic expansion of the urban area has never slowed down. This is partly explained by massive migration flows from the central areas of the Federal District into conurbated municipalities in the State of Mexico. In fact, *"by 1990 the flow of immigrants from the Federal District represented 59% of the non native residents of the State of Mexico"* (Corona y Luque, 1992).

Population in the Mexico City Metropolitan Area, 1940-2005 (in thousands)

	Years							
	1940	**1950**	**1960**	**1970**	**1980**	**1990**	**1995**	**2000**
Federal District	1758	2923	4846	6874	8831	8236	8489	8605
	100%	*98.02%*	*94.01%*	*79.40%*	*64.30%*	*54.73%*	*50.24%*	*47.98%*
Conurbated municipalities		59	309	1783	4904	6812	8409	9328
		1.98%	*5.99%*	*20.60%*	*35.70%*	*45.27%*	*49.76%*	*52.02%*
Total	1758	2982	5155	8657	13735	15048	16898	17933

Source: Own elaboration with 1940-2000 census data taken from García Sain (2004) and 2005 data taken from Aguilar Guillermo (2008)

Table 1

The combination of land availability, massive population growth and incoherent urban development policies led to fast but chaotic urbanization, characterized by the emergence of informal settlements. The current layout of the street grid, the combination of land uses and the deficit of public infrastructure that we observe in Ecatepec today are a heritage of this period (Espinosa Castillo, 2008).

This expansive process continued throughout the region, and by 2005 the MCMA absorbed 37 municipalities of the State of Mexico and 1 municipality of the State of Hidalgo. By that year, 54.65% of the 19.2 million inhabitants of the megalopolis lived outside of the Federal District[16], and a trend towards a dispersed, but still mono-centric[17] (Suarez Lastra and Delgado Campos, 2007 p 718) urban structure seems to continue. If current trends continue, the population in the State of Mexico municipalities of the MCMA will double the population of the Federal District

16 For a detailed discussion about the population dynamics in the Mexico City Metropolitan Area, see Guillermo Aguilar, A. 2008

17 There is an ongoing debate about whether the MCMA is transitioning toward a polycentric (Graizbord and Acuña, 2004; Aguilar and Alvarado, 2004) or "dispersed monocentric" urban structure (Connolly and Cruz, 2004; Suarez Lastra and Delgado Campos, 2007). I tend to agree with the later camp, as they base their analyses on measures of job accessibility. In their study, Suarez and Delgado find that *"accessibility to jobs has diminished in the periphery of the interior city and in those areas with the highest demographic growth, despite the existence of a proportional increase in number of jobs. On the contrary, those who live close to the interior city enjoy more job opportunities that are appropriate for the occupation sectors and for the income categories of the population of these areas, and therefore there is a generalized spatial mismatch that tends to increase with time, with relation with distance to the center, and that is therefore related with the spatial growth of the city" (pp 694-695)*

by 2020 (Gakenheimer et al 2002, p 217).

In this context of fast, unplanned growth the territory of Ecatepec was transformed from mostly vacant land taken from a lake into the most populous municipality in Mexico.

SECTION III
MASS TRANSIT IN THE MEXICO CITY METROPOLITAN AREA

In the late 1950s local and federal authorities became convinced that trams and independently owned buses were insufficient to serve the growing population of the MCMA. A high capacity mass transit system was required moving forward, and initial plans to build an underground subway were drafted. However Mexico City grew with such speed that the authorities lacked the time and money to implement all its plans[18].

Progress was slow, never keeping up with the population explosion. As such, the recently conurbated municipalities developed without subway connectivity, and remained served by small-scale informal and quasi-informal private operators.[19] It would take almost 40 years before the Mexico City subway would travel more than a few meters outside of the political boundaries of the Federal District.

The first three subway lines –forming a ring around Mexico City's downtown- opened between 1969 and 1970. Political pressure by bus operators, organized around the *Alianza de Camioneros,* and the high cost of the initial investment acted in tandem to postpone implementation of Lines 4 and 5 until 1981-1982 and of Line 6, 7 and 9 until 1983-1988[20]. Out of these initial eight lines –comprising 134.8 kilometers and 121 stations- only one station is located outside the borders of

18 For an overview of this phenomenon around the world, see Gakenheimer, R. and C. Zegras (2001)

19 The emergence of informal, or quasi-formal transportation services is observed in many rapidly urbanizing cities where the State is unable to serve demand. By quasi-informal I mean transport operators that enjoy a degree of recognition (or toleration) from the state, but that still operate under an extra-legal framework when it comes to route design, frequencies and other service standards. For an example and description of this process, see Chapter 4 in De Soto (1989). For an account specific to the case of Mexico City, see Navarro Benitez (1991 and 2005) or Gakenheimer et al (2002).

20 Line 8 did not open until 1994.

the Federal District, just by a couple of hundred meters[21].

In an attempt to rationalize transit service[22], the government of the Federal District revoked in 1981 the existing concessions to operate buses for urban transport in the city, consolidating service into a publicly owned company named *Autotransportes Urbanos de Pasajeros -Ruta 100* (Islas 2000; Vasconcellos, 2001; Gakenheimer et al 2002*)*. Given that trams had been nationalized since 1946 (following a major strike), the Federal District faced the opportunity to organize an integrated transit system, with different modes complementing each other, rather than competing.

Not only did this failed to materialize, but no efforts to achieve metropolitan reach were apparently pursued. Instead expanding services beyond the formal boundaries of the Federal District, local officials struggled to keep service afloat, and in any case worked to protect their newly acquired monopoly from State of Mexico competitors. In fact, in 1986, a Presidential decree banned State of Mexico public transportation vehicles from stopping anywhere in the Federal District, except for subway terminals (Garza y Damián, 1991).

This decision strengthened the role of *colectivos* as the main form of public transportation from the State of Mexico into the Distrito Federal. *Colectivos* are mostly gasoline-fueled minivans (carrying up to 12 passengers), that originally operated as shared taxis, but that soon evolved into defined route services. While these vehicles are more expensive, hazardous and less comfortable than buses and rail alternatives, they offer substantial advantages (Gakenheimer et al 2002; Cervero and Golub 2007). One of them is that their ubiquity and flexibility allows them to offer almost door to door service, traveling from unpaved informal settlements in the State of Mexico into subway terminals ("*paraderos*") on the fringes of the Federal District.

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21 The *Cuatro Caminos* Station is located a few meters past the dividing line between the Federal District and the municipality of Naucalpan. Details on the history and building chronology of the Mexico City subway system taken from the official website of the *Sistema Colectivo Metro*. http://www.metro.df.gob.mx/organismo/cronologia.html

22 According to Molinero (2000) (cited in Gakenheimer et al 2002 p 240), *"the aim of creating the state owned Ruta 100 bus company was to provide a clean and efficient service, operating at fixed stops, with good maintenance practices, an integrated fare policy, and well defined routes and hierarchies"*. Other accounts, discussed by Islas (2000) suggest that rather than an attempt to inprove service provision, revoking the conessions was a political move against the Alianza de Camioneros.

Colectivos are difficult to monitor, and routinely violated the presidential ban picking up and dropping off patrons as needed. This behavior represented stong competition, which along with charges of mismanagement and corruption led *Ruta 100* to bankruptcy in 1997, killing any chance for an integrated transit system. (Vasconcellos, 2001, p 95).

During the last decades of the 20th century, a centrifugal demographic trend is observed, with the highest population growth rates concentrating to the north and east of the MCMA (Aguilar, Ward, and Smith 2003). The new spatial location of passenger demand made it clear that expansions of the subway system were needed in those directions.

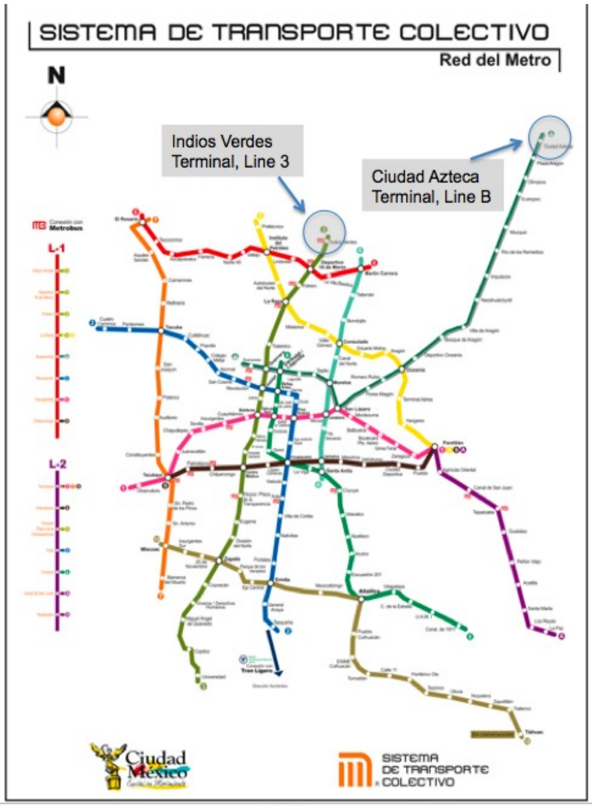
In fact, a Master Plan published in 1985 –the *"Programa Maestro del Metro Horizonte 2010"*- contemplated construction of 8 feeder lines ("*alimentadoras*") that would expand the subway into the State of Mexico. These feeders would be named with letters instead of numbers to distinguish them from the original subway lines, as fare integration was not considered a possibility (Loyola, 1991).

Financial constraints, and perhaps the resistance of Mexico City officials to expand service beyond the Federal District, led the feeder lines project to be continuously revised and eventually cancelled. Only two of the eight proposed lines were finally built: Line A (1991) travels eastward within Federal District territory, but along the southern border of the Nezahualcoyotl municipality in the State of Mexico[23]; and Line B (1999-2000) travels northeast through Ecatepec arriving at the Ciudad Azteca terminal station.

With the addition of these two lines (and of Line 8 in 1994), the Mexico City subway system reached its present size: 201 kilometers of tracks and 175 stations[24]. The subway infrastructure disparity between the Federal District and the State of Mexico is telling. Only 11 of the 175 stations, and 14.5 out of the 201.4 kilometers in the network are located beyond the formal boundaries of the Federal District, where more than half of the population of the MCMA lives.

23 Giving an idea of the importance of these extensions of the subway into the State of Mexico, Navarro Benitez (1991) describes how in 1989, 15,000 buses and *colectivos* -close to one fourth of the total serving the MCMA at the time- ran on routes that converged in the corridor now occupied by Linea A.

24 In 2009 construction of a new subway line that will serve the southern part of Mexico City was initiated. This line will be named "12", a fact that recognizes that Line A and B are in reality Line 10 and 11.



Map 4: Mexico City Subway System, as of 2010

Despite Line A and Line B, the high capacity transit system has been losing modal share to medium and low capacity modes, particularly to *colectivos*. In fact, the Mexico City subway lost 11% of its daily passengers between 1990 and 2000, and the trend seems to continue.[25] A 2007 origin and destination survey suggests that only 17.6% of the trips made using public transportation in the MCMA are served by the subway, compared to 60.2% currently served by *colectivos*.[26] One of the mayor factors explaining this lackluster performance is the loss of population and of employment sources in the central core of the city versus a mass transit system layout that unevenly privileges this part of the city (Casado Izquierdo 2008). To be attractive, high capacity mass transit must take people where they need to go.

Despite the lack of funds for subway expansion, and notwithstanding the difficulties of implementing projects that cut across political jurisdictions, there is no question that further extensions of mass transit into the State of Mexico are vital.

In the meanwhile, for most of the people living in the northeast region of the MCMA, the preferred commuting alternative remains riding a *colectivo* to either the Line B Ciudad Azteca Terminal in Ecatepec, or to the Line 3 Indios Verdes Terminal, in the Federal District (see map

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25 Casado Izquierdo (2008) offers a good review of mobility studies in the Mexico City Metropolitan Area. Interested readers should also refer to Islas (2000).

26 There are 23.48 million vehicle-trip segments served by public transportation every day in the MCMA. Other modes considered by the 2007 Origin and Destination Survey as“public transportation” (and their share of the total) are suburban buses (9.4%), taxis (7.7%), publicly owned buses (2.6%), Metrobus-BRT (1%), trams (0.9%) and light rail (0.5%)

4). The choice is anything but golden. Data from a 1994 origin-destination survey suggests that the *average* trip on public transportation originating in the State of Mexico lasted 65 minutes (Islas 2000). This has grown significantly. According to 2007 estimates by State of Mexico officials, “the time invested by public transport users commuting to work in the MCMA is approximately 2-3 hours to reach their destination”.[27]

Illustration 1: Currently available public transportation options in Ecatepec. Source: Transconsult

27 Segundo Informe de Gobierno, Enrique Peña Nieto, September 5, 2007.

SECTION IV.

A NEW TECHNOLOGY, A NEW OPPORTUNITY

In the early years of this decade, a technological revolution shook the public transportation field in the developing world. Successful experiences in Curitiba, Quito and Bogota convinced governments around the world that articulated buses running on dedicated corridors represent an affordable, high quality alternative to heavy rail. This new technology is known as Bus Rapid Transit, or BRT[28].

Illustration 2: Transmilenio, Bogotá's BRT. Source: Author's photograph, 2008

In a recent evaluation of BRT systems in Latin America and Asia, Hidalgo and Graftieaux (2008) concluded:

28 In fact, the technology now known as BRT was pioneered in the seventies in the City of Curitiba, Brazil, under the leadership of Mayor Jaime Lerner. However, it was not until the Transmilenio experience in Bogotá gained notoriety that BRT systems started popping up around the world.

"Most systems reviewed have greatly improved their local travel conditions and the quality and performance of public transport. The main achievements have been in travel timesaving and enhanced reliability. As efficiency has improved, systems have also reduced energy consumption and emissions. Urban enhancements are also evident in Curitiba, Sao Paulo (Passa Rapido), Bogota, Quito Trolebus, Pereira and Guayaquil, where the appalling conditions of the corridors prior to system implementation have been dramatically improved" (p 87)

While more evidence is needed to demonstrate that BRT constitutes a good substitute to rail based systems, it is hard to argue that this technology does not represent significant improvements over the status quo in many cities in the world, particularly in those relying on independently managed minibuses or *colectivos*. If well implemented, BRT promises a faster, safer, more comfortable and more reliable service at comparable fares. For governments, this technology also represents an opportunity to professionalize public transportation and regain control over service providers without bankrupting themselves. It is thus no surprise that BRT is on its way to becoming mainstream in many countries in the world, including Mexico.

The first BRT system in Mexico was the "*Optibus*", implemented in 2003 in the City of Leon. The Federal District followed suit in 2005, with a 19.4-kilometer BRT corridor –dubbed "*Metrobus*"- running on the centrally located *Avenida Insurgentes.* In 2009 a second corridor was added to Mexico City's Metrobus, and Guadalajara inaugurated its "*Macrobus*" with a 16 km corridor. Six additional Mexican cities –Puebla, Veracruz, Aguascalientes, Mexicali, Monterrey, Oaxaca and Chihuahua- have requested federal funds to conduct feasibility studies regarding this technology[29].

The availability and low cost of BRT technology, the visibility of successful experiences, and the proximity of elections in the State of Mexico created in 2005 a window of opportunity[30] to revive the 1985 "feeder line" plan to extend high capacity mass transit into the conurbated

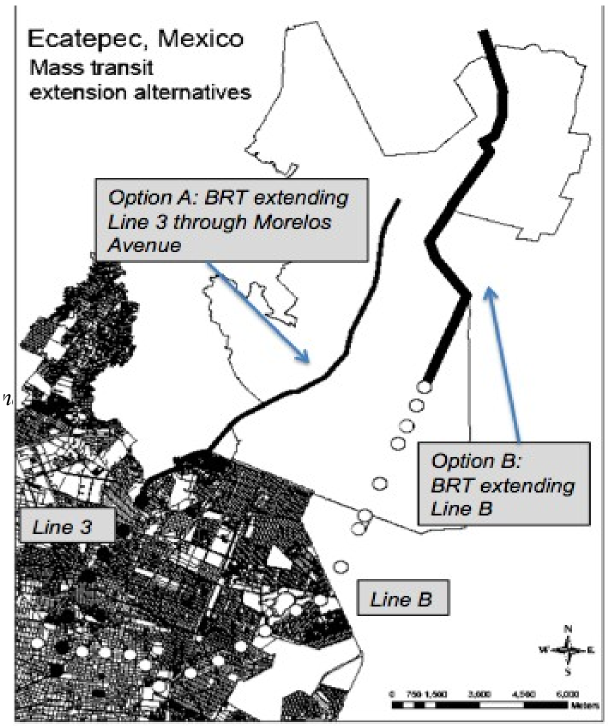
29 Correspondence with Mr. Eugenio Amador Quijano, official at FONADIN, Mexico's National Infrastructure Fund. *October 24, 2008.*

30 In his classic study, John Kingdon (1984) defined "windows of opportunity" as junctures in time when *"a problem is recognized, a solution is available, the political climate makes the time right for change, and the constraints do not prohibit action"* (p 88). Arturo Ardila (2004) draws on this concept while analyzing the implementation of BRT systems in Bogota, Colombia and Curitiba, Brazil.

municipalities.

As shown in the highlighted region in Map 5, two of the 1985 feeder line proposals ran through Ecatepec. The feeder line to the left runs along the *Via Morelos* corridor and was never built. The

Map 5: 1985 Master Plan of the Mexico City Subway, showing the location of considered extensions. Source: Comisión de Vialidad y Transporte Urbano, México



Map 6. Two options to extend mass transit into the State of Mexico.

line to the right is known today as Line B .

The fundamentals considered in the 1985 Master Plan still held twenty years later. Both corridors were suited for mass transit, and continued to be main points of entry to the Federal District from Ecatepec[31]. Any project to extend mass transit through this municipality would have

31 The Indios Verdes Terminal serves 867,000 daily passengers. The Ciudad Azteca Terminal, located 15 kilometers into Ecatepec, serves 180,000 (CIC, 2010). Much of the difference has to do with the fact that people choosing to enter through Line B have several stations where boarding is possible.

to consider any of the two alternatives in Map 6[32]:

> ***Option A***) Extending *Linea 3* from the Indios Verdes Terminal using *Via Morelos*, an avenue that runs over the old Mexico-Pachuca highway, or
>
> ***Option B***) Extending *Linea B* from the Ciudad Azteca Terminal, crossing Ecatepec and entering into Tecamac, a rapidly urbanizing municipality to the north.

The 2005 elections for Governor of the State of Mexico, provided clarity on which would be undertaken.

Illustration 4: Candidate and then Governor Enrique Peña Nieto

---

Enrique Peña Nieto ran for Governor under the slogan "*Compromiso*" (commitment). His campaign strategy was to commit publicly to concrete projects in each municipality. Radio and TV ads showed close up images of him looking into the camera while announcing: *"Te lo firmo, y*

32 Information for this section comes from the author's interviews with state and municipal officials during the summer of 2008, particularly with Mr. Pablo Suarez Coello, *Director General de Infraestructura para el Transporte de Alta Capacidad* of the State of Mexico.

te lo cumplo"[33]. During the course of his campaign, Peña Nieto signed 617 such "*compromisos*", mostly relating to the continuation of ongoing State Government initiatives, and to new infrastructure projects like schools, hospitals and highways (Zamitiz and Peña León, 2006).

In a rally held on April 28, 2005, with a notary public present, Peña Nieto committed his administration to the *"development of a mass transit system, from Ciudad Azteca to Tecamac"*[34]. This promise was widely publicized in Ecatepec, and became one of the rallying cries of Peña Nieto's campaign in this municipality.

Given the electoral importance of Ecatepec, Peña Nieto ended his statewide campaign with a massive rally held in this municipality on June 30th. With an estimated 60,000 supporters present, he signed a notarized document containing all 617 of his *compromisos* –including the Ciudad Azteca-Tecamac corridor-, and stated: *"I'm ready to start delivering on the commitments I have signed… ready to lead a government that elicits trust and that delivers results"*.[35]

The strategy worked. The July 3rd election resulted in a landslide victory for Peña Nieto and his coalition. The final count yielded 47.57% of the votes for his candidacy vs. 24.73% for his closest competitor. Peña Nieto was sworn in as Governor on September 15, 2005. Since then, "*Compromiso*" became the motto of his administration, and building a mass transit line extending Line B became a concrete, public and visible goal.

Peña Nieto charged the Ministry of Communications of his government with planning and implementing this *compromiso.* A taskforce was assembled and the consulting firm *Transconsult* was hired to prepare the technical and financial feasibility studies for the corridor[36]. The preliminary reports made clear that BRT was the most cost effective alternative, particularly given the aim of

33 A good translation is:"I sign, and I will deliver"

34 All 617 *compromisos*, are posted in the website of the State of Mexico Government. Visitors can read about each project, including current status. http://www.gem.gob.mx/compromisos/cg/

35 Moises Sanchez *"Peña Nieto afirma que su triunfo sera contundente e inobjetable",* La Cronica de Hoy, June 30, 2005, http://www.cronica.com.mx/nota.php?idc=189519 (accessed May 16, 2010)

36 The author worked for two months during the summer of 2007 for the Ministry of Communications of the State of Mexico, at the office coordinating the cited taskforce. Many of the details in this section were offered by people directly involved.

operating service with no subsidy with an estimated demand of 90,000 trips/day (Transconsult/Logitrans 2006, pg 89). By early 2006 negotiations with current service providers were ongonig, and presentations to Ecatepec's Mayor and Councilmen were taking place.

On September 5, 2006, the Governor delivered his first "*Informe de Gobierno*"[37], reaffirming his commitment to the Ciudad Azteca-Tecamac corridor, and justifying the decision to employ BRT technology:

> *"It is a proven fact that mass transit, running with articulated buses on confined lanes, is one of the accessible ways –both technically and economically- to elevate the standard of service of public transportation. My administration believes that the development of this type of systems can no longer be postponed, and to this aim we are inviting both private investors and current service providers to participate... The feasibility studies for the Ciudad Azteca-Tecamac corridor, in the Ecatepec and Tecamac municipalities are currently on their way".*

On that date, Governor Peña Nieto announced a partnership with a private developer to build and operate a new intermodal transfer station (CETRAM) in Ciudad Azteca, complete with underground docks for articulated buses and *colectivos*, pedestrian bridges connecting with the subway terminal, public restrooms, restaurants and three floors of boutiques[38]. Construction of this transfer station began in July 2007[39], providing Ecatepec residents the first physical evidence of a mayor transformation.

37 The yearly "*Informe de Gobierno*" is similar in format to the USA's "State of the Union". Governors present the State Congress with a report of their administration, and typically deliver a widely broadcasted speech.

38 This station -conceived independently of the BRT corridor- opened in 2009 and completely reorganized passenger transfer between colectivos and the subway, improving passenger experience in a significant manner. The CETRAM transformation in Azteca is increasingly hailed as a success story, and plans to replicate the scheme are currently on their way.

39 El Universal, *"Con atraso de seis años, edificarán paradero"*, July 2, 2007. Available at: http://www.el-universal.com.mx/ciudad/vi_85157.html

Illustration 5: Construction of the Ciudad Azteca multimodal transfer station, June 2008. Photo by Armando Priego

Illustration 6: Conditions prevailing in the vicinity of the Ciudad Azteca Terminal Station circa 2006. Source: José Miguel Bejos (2010)

In December 2007, Transconsult presented the State's authorities with the BRT corridor's executive project and business plan –marking the specific location of 24 stations and 3 terminals along a 16-kilometer route -. Soon after, owners of properties needed for the other terminals at *Ojo de Agua* and *Central de Abastos* were approached and purchase negotiated[40].

However, actual construction of the BRT corridor did not start until May 2008, and the tender process to select a concessionaire in charge of station management, fare collection and system logistics did not conclude until July. Most of 2008 was spent negotiating the integration of bus route associations serving the corridor[41] into a single operating company. It was not until March 2009 that a 30-year operating contract was signed with *Transmasivo*, the company that resulted from the merger of 12 route associations. In April, *Transmasivo* announced the purchase 63 articulated buses from Volvo[42].

Illustration 7: Sign reads: "The Government of the State of Mexico builds the Ciudad-Azteca confined corridor", located in Ecatepec. Photograph taken by the author, July 2008

40 Author's interview with Pablo Suarez Coello, *Director General de Infraestructura para el Transporte de Alta Capacidad*, at the State of Mexico Ministry of Communications, November 11, 2008.

41 The area of influence of the Ciudad Azteca-Tecamac BRT corridor is currently served by 32 bus and colectivo cooperatives, running 2,517 public transport units of different types and sizes. (Transconsult, 2007)

42 Oscar Romero, "*Proveerá Volvo 63 unidades del Mexibus*", Milenio, April 26,2009, http://impreso.milenio.com/node/8565716

The rest of the process has not been devoid of tension, with non-participating bus operator groups and people squatting on the BRT blockading construction at various moments. Furthermore, unexpected discoveries of oil ducts running under the proposed corridor has

UNCERTAINTY LEVEL	DATE		EVENT DESCRIPTION
	1985	-	Mexico City Subway Master Plan. Two "feeder lines" running into Ecatepec considered
	1999-2000	-	Line B of the Mexico City inaugurated, subway travels into Ecatepec for the first time, reaching Ciudad Azteca
	2005	*28-Apr*	Candidate commits to the *"development of a mass transit system, from Ciudad Azteca to Tecamac"*
		30-Jun	Campaign closes with rally in Ecatepec. Commitment to build the Ciudad Azteca transit corridor reafirmed and notarized
		3-Jul	Enrique Peña Nieto elected as Governor of the State of Mexico
		15-Sep	Inauguration day
	2006	*Jan*	Ministry of Communications charged with planning and implementation. Taskforce assembled
		Feb	Consulting firm hired to conduct technical and financial feasibility studies
		-	Project discussed with Ecatepec Mayor, city councilmen, current service providers and other relevant actors
		5-Sep	Private developer selected to build and operate the Ciudad Azteca multimodal transfer station
	2007	*3-Jul*	Start of construction of the Ciudad Azteca multimodal transfer station
		Dec	Executive Project of the corridor presented, including specific station locations
	2008	*Feb-April*	Purchase of properties necessary for the Ojo de Agua and Central de Abastos terminals
		20-May	Start of construction of the BRT corridor
		July	Selection of concessionaire in charge of station management, fare collection and system logistics
		-	Negotiations with bus operator associations currently serving the corridor
	2009	*March*	Operating contract signed with Transmasivo
		April	Purchase of 63 Volvo articulated buses announced
		-	Start of operations of the Ciudad Aztec-Tecamac BRT corridor (tentative)

Table 2: Timeline of the Ciudad Azteca-Tecamac BRT corridor

significantly slowed down construction. As a result, several widely publicized deadlines to begin operations have been missed. At the latest revision to this paper (May 2010), the exact inauguration date remains uncertain.

SECTION V.
DATA

Previous sections describe how the mass transit project of interest to this paper evolved from a rumor into a concrete political promise. A summary of events is presented in Table 2. While the demographic trends observed in the MCMA during the later decades of the 20th century made a northeast expansion of the high capacity mass transit system into a necessary and almost natural next step, no efforts consistent with this objective were apparent since the 2000 inauguration of Line B. Yet, the campaign and subsequent election of Enrique Peña Nieto as Governor of the State of Mexico provided enough specifics. A *"mass transit system"* would be built, *"from Ciudad Azteca to Tecamac"*.

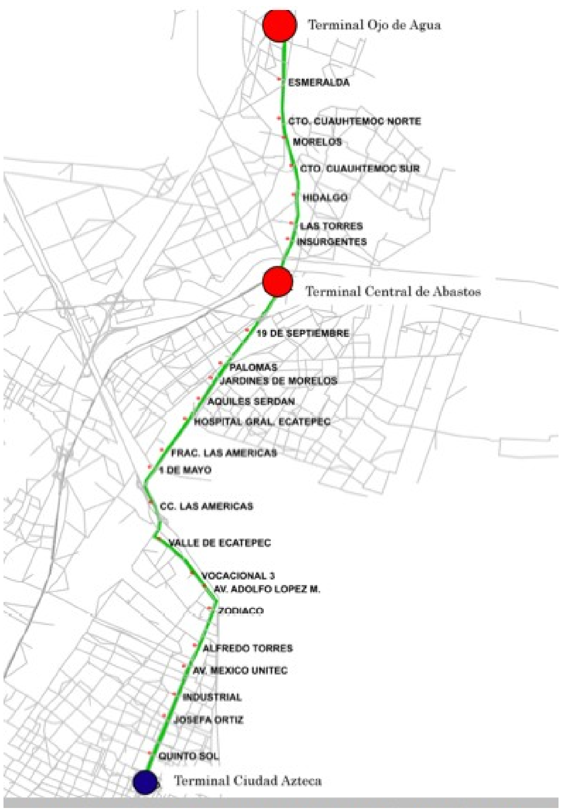


Illustration 8: The Ciudad Azteca-Tecamac BRT corridor, with station location, as presented by Transconsult

Details would take longer to materialize. The decision to pursue BRT was not taken until 2006. The specific location of stations was undefined until 2007. Construction of the corridor would not start until 2008 and the date of the start of operations remains uncertain at the time of this writing, in 2010. However, people attentive to the news, attending the political rallies or reading the campaign literature in Ecatepec knew that the Peña Nieto administration would not take a *compromiso* lightly. Those interested in the real estate market knew something big was coming, and that the Government of the State of Mexico would invest its efforts and resources to expand Line B towards Tecamac, and not on expanding Line 3 through *Via Morelos*.

This state of affairs represents a rare opportunity to test for anticipated capitalization within the context of a developing world city building a BRT system. The anticipated capitalization literature suggests that that the prices of properties should begin to rise at the time the project is announced, and that this appreciation should disproportionately affect properties located within the area of influence of the proposed corridor.

To explore this possibility, this research draws from a sample of 1825 residential property sales, occurring in Ecatepec during the years 2000, and 2004-2007. This dataset was obtained from *IGECEM*[43], the State of Mexico's cadastre authority, which provided access to its archives in the state capital of Toluca during the early months of 2008. Significant data assembly, data capture and geo-referencing work was required. Unfortunately, data from 2001-2003 was not available.

Further details on the origins of this database are in order. In 1999, a Constitutional amendment reformed the property tax system in Mexico. Among the changes came a requirement for State Legislatures and municipalities to adopt measures "in a coordinated manner" to ensure that property value assessments used for taxing purposes reflect market prices[44]. Ecatepec alone has 395,000 properties within its territory, making it impossible to assess every single one. To keep value assessments up to date (and to comply with the Constitution), the State of Mexico's reformed its Financial Code, instructing each municipality to divide its territory into ad hoc polygons (defined to reflect a dominant land use and type of construction) and to present IGECEM with yearly proposals regarding changes to the base values that should be applied to properties located within each polygon. Article 195 of this Code establishes the following procedure:

> *"To maintain homogeneity and technical congruence of the information, the Municipality will present IGECEM with the proposals accompanied with the technical file that justifies them, during the period spanning January 1 and June 30 of every year. The technical file will consist on documentation from studies that demonstrates that the proposed land and construction values are comparable to market values.*
>
> *By market values, this Title refers to the expression in monetary terms by unit of measure that results from an investigation on the price of comparable properties located within the area of study, obtained in a reasonable time and in a real estate market where current conditions are such that there is no coercion on supply or demand, allowing, through statistical analysis, to obtain an average value that can be applied to the entire zone."*

43 IGECEM stands for *Instituto de Información Geografica, Estadística y Catastral del Estado de Mexico.* Unfortunately, data from 2001-2003 was neither in municipal nor IGECEM archives.

44 Properties in Latin America are seldom assessed above 70% of their market values. (Smolka and Ambroski, 2001)

When accepted by IGECEM, a proposal results in a "homogeneous value" which City Councils apply for property tax calculations, to the population of properties located in the polygon. If however IGECEM officials judge that the proposals are not "comparable to market values", the Legislature can intervene ordering a new price investigation.

Francisco Zacatecas, the IGECEM official in charge of overseeing this process in Ecatepec, describes the process as follows:

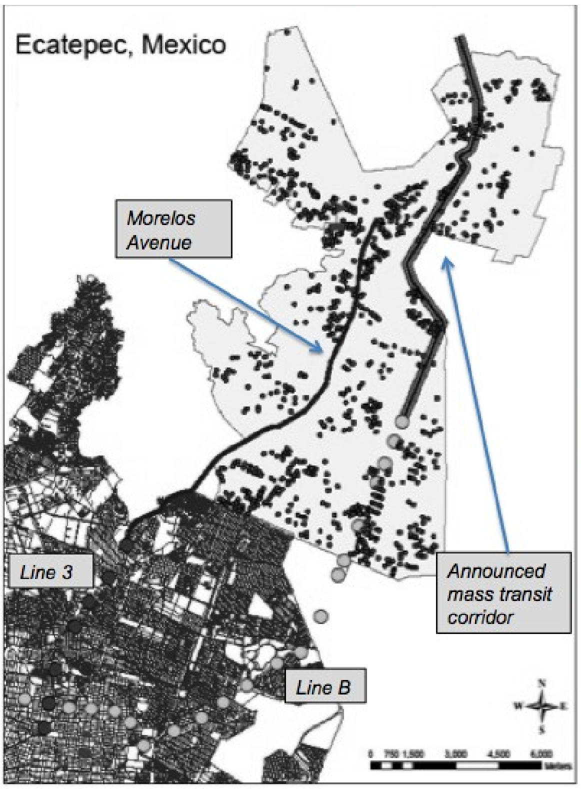
> *"Between February and June of every year, municipal cadastre officials take note of advertised properties and survey realtors or proprietors, acting as potential buyers. They gather information on price, property attributes and location, and then complete each case file with direct site observation and data from public records. A photograph often accompanies each case file. Once they are done, by June at the latest, the files are sent to IGECEM's offices in Toluca".*

Data used in this study consists of those "case files" that the Municipality of Ecatepec submitted for approval to IGECEM, and that were still available in this agency's archives.

Readers will realize that this source provides with asking prices in lieu of assessment values. This represents a departure from some of the previously cited anticipated capitalization studies –such as McMillen and MacDonald (2004) and Gatzlaff and Smith (1993)-, which draw from data contained in transaction tax records under the intuition that this source represents the best available approximation of clearing prices. However, in the case of Ecatepec, transaction tax records seem the least protected from individual case manipulation from buyers, sellers and officials trying to avoid tax burdens extralegally. In addition to this, access to the archives of this municipality was not granted for this research[45]. While far from perfect, the value proposals prepared by municipal authorities for IGECEM represent a rarely available data source involving a consistent data collection methodology that is audited by multiple levels of government.

45 This was requested during two visits to the Municipality, parallel to the failed effort to find the 2001-2003 value proposal datasets that were missing at IGECEM. Other alternatives to obtain a dataset consisting of clearing prices were explored, but were unfeasible due to lack of resources and privacy and security concerns.

The yearly distribution of the properties in the full dataset is shown in Table 3 and plotted in Map 7.



Map 7: Spatial distribution of property sales, full sample

Year	Number of observations
2000	98
2004	111
2005	255
2006	219
2007	45
TOTAL:	728

Table 3: Property sales per year, full sample

In addition to the address, year of sale and recorded asking price, the sample made available by IGECEM includes substantial information about each property, including several "structural" factors typically found in the literature to drive property values. For example, the database provides plot and construction size, number of floors and age of building, length of street frontage, and a categorical indicator of construction type that serves as a relatively good proxy for construction quality.

This *construction quality* indicator needs further description. In an effort to standardize data received from municipalities, IGECEM bylaws consider a construction typology that distinguishes properties according to the basic quality of the materials employed, with particular attention to foundations and roofing, electric and hydraulic installations, finishes, iron and carpentry work. This typology sorts properties into 7 "classes", with three "categories" each -low, medium and high. The combination of these construction classes and categories yield a total of 21 possible construction "types". Of these, only 4 classes comprising 13 types are present in our

Ecatepec sample.

Class	Category	Frequency
HA-Precarious	*Low*	14
	Medium	14
	High	3
HB- Economic	*Low*	133
	Medium	136
	High	82
HC- "Interés Social"	*Low*	99
	Medium	88
	High	69
HD – Regular	*Low*	69
	Medium	16
	High	4
HE – Good	*Low*	1
	Medium	0
	High	0
		728

Table 4: Construction types present in the sample, with frequencies

For the purposes of this research these "types" were incorporated into two groups -attempting to capture "higher" and "lower" quality of construction- through the indicator variable *Constructtype-dummy*. While the original intention was to consider "precarious" and "economic" as lower-quality, and "interés social", "regular" and "good" as higher quality, exploration of the dataset suggested that while generally correct, the cutoff point between HB and HC types does not necessarily follow a linear pattern. Conversations with IGECEM officials as well of visual inspections of type examples confirmed that in practice, an "HB-economic" property of the "high" category (Mean price $484,812) represents better construction quality than a "HC-interés social" property of the low category (Mean=$222,912)

After making this adjustment, the higher-quality group in *Constructtype-dummy* has n=329, while the lower quality group has n=399. Images of typical-properties for each type are included in Appendices A and B.

Beyond the structural characteristics of each property, municipalities include in their submissions to IGECEM statistics on public service delivery, such as trash collection, and infrastructure availability, such as paved roads. Also, a categorical indicator of cadastral area type -similar to the construction type discussed above- is associated to each polygon[46]. This typology considers location, dominant property regime, dominant land use, density, typical plot characteristics and socioeconomic characteristics of neighbors. Only the four lower quality cadastral area types -H1, H2, H3 and H4- are present in our sample, from 6 possible. They are incorporated into the database through 3 dummy variables, using H1 as reference. Together, this set of neighborhood measures provides authorities with a better sense of the utilities and dis-utilities experienced by property owners in each polygon, and quite conveniently, provides us with a set of "neighborhood specific" variables[47].

Finally, IGECEM provided the cadastre code for each property, which allowed geo-referencing of every observation in the database. This information was then employed to create a set of

Descriptive summaries of property characteristics by area and time period

Variable	Description	BRT corridor buffer (intervention area)				Via Morelos corridor buffer (control group)			
		Pre announcement (n=227)		Post announcement (n=139)		Pre announcement (n=237)		Post announcement (n=125)	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Sale Price	Asking price (Mx$2002)*	310875.5	156133.5	308259.1	148118.5	396202.4	197529.8	493014.2	245863.8
Log-sale price	Natural log of sale price	12.55	0.43	12.55	0.41	12.8	0.41	13	0.47
Structural attributes									
Construction quality	= 1 if higher	0.42	0.49	0.39	0.49	0.46	0.5	0.56	0.5
Plot area	Square meters	119.25	79.74	94.99	48.51	151.43	82.04	117.95	48.94
Construction area	Square meters	93.28	56.1	85.85	56.36	128.8	64.51	139.18	81.86
Frontage	Street facing meters	7.96	2.97	8.03	3.54	8.8	2.03	7.96	1.33
Building Age	Number of years built	14.05	6.72	13.51	6.66	18.35	7.37	17.38	6.58
Floors	Number of floors	1.63	0.69	1.72	0.5	1.63	0.61	1.8	0.64
Location within the block	= 1 if corner	0.08	0.27	0.04	0.2	0.12	0.32	0.11	0.32
Neighborhood attributes									
Public lighting	Number of light posts/hectare)	10.48	3.7	11.16	3.15	12.26	4.18	12.92	4.6
Trash collection	Days per week	3.44	0.84	3.22	0.42	3.48	1.24	3.74	1.54
Road density	Square q meter/hectare	1958.08	1274.06	2094.12	1217.64	2418.73	984.75	2391.48	1059.37
Cadastral area type H2	= 1 if H2, = 0 if H1	0.48	0.5	0.27	0.44	0.57	0.5	0.42	0.5
Cadastral area type H4	= 1 if H4, = 0 if H1	0.04	0.18	0.01	0.12	0.22	0.42	0.24	0.43
Locational attributes									
Distance to Mexico City's downtown	Meters	21012.71	3681.7	21205.88	2924.48	17403.41	3498.36	18822.84	3169.77
Distance to Ecatepec's City Hall	Meters	5281.12	1599.83	4434.22	1474.39	3982.43	3016.57	2879.85	2725.09
Distance to nearest school	Meters	1192.44	649.7	1011.73	716.81	2150.19	1485.65	1485.38	1247.25
Distance to nearest church	Meters	542.56	362.15	513.34	269.44	564.34	419.1	525.38	330.38
Distance to nearest market	Meters	1075.44	788.97	875.94	632.78	711.35	470.62	548.88	308.96
Distance to nearest recreation facility	Meters	1971.3	941.76	2241.41	996.73	1654.02	925.33	1936.81	953.13
Distance to nearest cemetery	Meters	2253.49	1034.24	2457.01	899.72	1313.99	663.51	1322.9	610.19
Distance to nearest health clinic	Meters	2547.33	780.98	2567.93	517.48	1248.81	627.15	1322.74	659.22

* $US 1= Mx$ 13.10 as of May 2010

Table 5

"location" attributes, measuring straight-line distance from each property to different types of facilities, such as schools and cemeteries, and to destinations such as downtown Ecatepec and Mexico City[48].

Some of the variables included in the database were dropped from consideration due to little variability among the observations (such as availability of sidewalks and police presence) or because of displaying high correlation with other variables (such as the dummy associated with the H3 neighborhood type and distance to subway station, both with VIF >10). Nonetheless, data permits us to account for 6 structural, 4 neighborhood and 8 locational property attributes, which plausibly exert influence on prices. Summary statistics of these explanatory variables is presented in Table 5

SECTION VI.
METHODOLOGY

With this data, we estimate a price model for houses sold in Ecatepec, before and after Governor Peña Nieto's *compromiso* to build a mass transit line through this municipality, In doing so, we follow the intuition of the hedonic modeling technique developed by Rosen (1974), and assume that the implicit price for each attribute of a good can be inferred from the observed willingness to pay for that good (understood as a "bundle of attributes").[49] The dependent variable in the models run in this study is the asking sale price reported in Ecatepec's value proposals to IGECEM, adjusted for inflation (base Mx$ of 2002)[50].

Hedonic models are limited in that a multitude of unobservable factors influence property prices. Other scholars have addressed this problem by employing repeat sales analysis. By observing multiple sales of the same house, they effectively account for everything except the treatment of their interest. Unfortunately, no such dataset was available in Ecatepec. To reduce the exposure

48 IGECEM also provided the geo-referenced database of these facilities.

49 For a good overview of hedonic models in the context of real estate see Chapter 3 of Rothenberg, Galter, Butler and Pitkin (1991) "The Maze of Urban Housing Markets: Theory, Evidence and Policy" University of Chicago, Chicago, Il

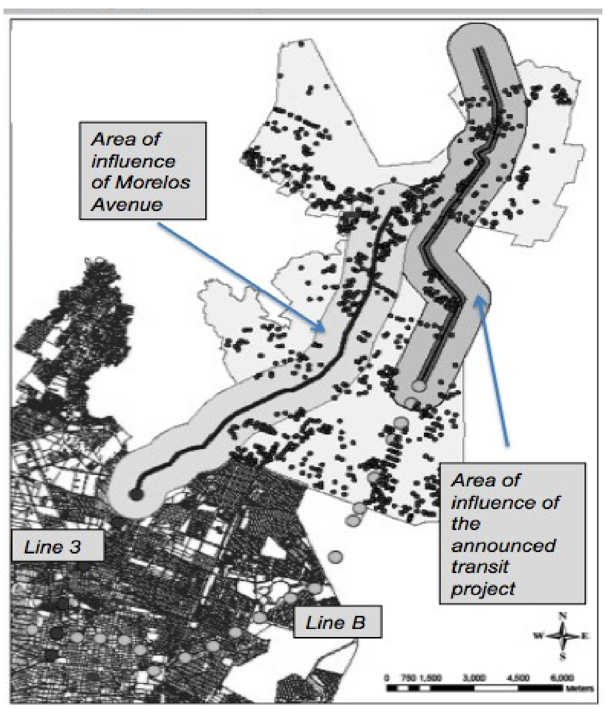
50 National Consumer Price Index, Banco de México. Available at http://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCuadro&idCuadro=CP151&sector=8&locale=es

of results to omitted variable bias this study pursues instead a comparative approach, as suggested by Gatzlaff and Smith (1993):

> *"… since it is not possible to devise a scientific experiment in which all factors except the transit factor are controlled, we must rely on rough comparisons of one area with transit service to another without it, or of property values after transit with property values before transit" (p. 58).*

This research strategy is operationalized here through the incorporation of two dummy variables: *BRTbuffer-dummy* and *Periodofsale-dummy.*

The first of these indicators distinguishes properties located within the area of influence of the corridor slated for BRT service (x=1) from properties located within the area of influence of our chosen corridor of reference, Via Morelos (x=0). The "area of influence" is defined as a one-kilometer buffer to either side of each corridor, under the rationale that this distance can be comfortably walked in roughly 10 minutes[51].



Map 8

Only properties located within the area of influence of either corridor are considered relevant for this study. After eliminating properties outside of either buffer, our working sample consists of 728 observations: 366 within one kilometer of the Ciudad Azteca-Tecamac transit corridor and 362 within the same distance of Via Morelos.

51 The literature does not seem to follow consistent criteria in this regard. For example, Martinez and Viegas (2008) used properties located 666 meters from the transit line, while MacMillen and MacDonald (2004) used all properties located within 1.5 miles.

Year	Number of observations	In the BRT buffer	In the Morelos buffer
2000	283	35	63
2004	288	37	74
2005	608	155	100
2006	535	126	93
2007	111	13	32
Total	1825	366	362

Table 6: Distibution of observations by sale and corridor

While prices in both corridors are not expected to be originally identical, we assume that other than the announcement, they are subject to the same price drivers. Both corridors share similar land uses, and run almost parallel to each other following a north south direction. The populations living close to them have similar socioeconomic characteristics. *Via Morelos* has two to three lanes each way, running over the old Mexico-Pachuca highway, which was reverted to municipal authority once a toll road was built to the west in the early nineties. The announced transit corridor continues on *Avenida Centra*l on the path marked by Line B, and then over *Avenida Nacional*, also with 2-3 lanes each way. Between both corridors lies a canal; helping reduce the influence that one corridor has on the other.

The fact that the 1985 master plan considered both corridors for expansions, suggests that they have long been the most important points of entry from the northeast of the MCMA into the Federal District. Speculators attempting to buy ahead of an eventual mass transit expansion in the area did not have a clear-cut choice between these corridors until the project was announced, as suggested by a local public official well attuned with the property market:

> *"Since 2000 there were rampant rumors that the subway would reach Tecamac, but it was never clear if it would come from Indios Verdes (Via Morelos) or from Ciudad Azteca. Once Peña was elected, it was clear that it would run from Ciudad Azteca"*[52].

While a perfect control group is unavailable, Via Morelos represents the most comparable

52 Author's interview with Francisco Zacatecas, field office director of IGECEM in Ecatepec July 2008

corridor to our area of interest.

The second indicator variable, *periodofsale-dummy*, distinguishes sales occurring in the pre-announcement period 2000-2005 (x=0) from sales occurring in the post-announcement period 2006-2007 (x=1). A choice was made to consider 2005 data as pre-announcement. Although the formal announcement of the project took place during a campaign rally in April 28th, 2005, the promise was socialized throughout the duration of the campaign, and Peña Nieto was not elected until September. Several of the cited anticipated capitalization works use a time window, instead of a specific date, to mark the project announcement. For example, Gatzlaff and Smith (1993) recognize that the Miami Metrorail "announcement" did not happen at a specific event, but during a period that included primary public hearings, announcements, and principal local newspaper accounts.

We feel confident with this choice, especially given the fact that the data collection process ends by May of every year at the latest. Out of our 728 observations, 464 occurred pre announcement (2000-2005), and 264 post announcement (2006-2007).

The combination of *BRTbuffer-dummy* and *periodofsale-dummy* yield a set of four subgroups to be contrasted: Properties located within the BRT buffer, sold before (n=227), or after the announcement (n=139), and properties located within the Morelos buffer, sold before (n=237) or after the announcement (n=125).

To compare them, we first probe for the unmoderated effect of location on price, testing whether the price of properties sold prior to the announcement within the area of influence of the Ciudad Azteca-Tecamac corridor was statistically different than the price of properties sold in the same period in the area of influence of the corridor of reference.

Second, we ignore location and probe for the unmoderated effect of the period in which the sale occurred on the observed price. We test whether the property prices of residences sold in *any* of these two corridors in the post-announcement period was significantly different to the price of similar properties sold before the announcement.

Both of these tasks establish a baseline for comparison, and are approached in Model I following this specification:

$$log(Y) = a + b1\ periodofsale\text{-}dummy + b2\ BRTbufferdummy + \ldots.\ b_i\ X$$

Next, we explore the possibility that the magnitude and/or direction of the effect of the announcement on prices was different for each corridor. The underlying objective is to distinguish changes in price that result from the habitual real state dynamics in Ecatepec from changes that can be plausibly attributed to the infrastructure announcement. Presumably, only properties located in the BRT buffer should be affected by news of the incoming project.

Statistically, we probe whether or not the relationship between our explanatory indicator of *period of sale* and our dependent variable *sale price* is moderated by our indicator of *location.* A moderator refers to a variable Z that affects the direction and/or the intensity of the relationship between an independent variable X and a dependent variable Y, in such way that the effect is significantly different across various levels of Z (Baron and Kenny, 1986). To explore this, a cross product variable *BRTbuffer-dummy*periodofsale-dummy* is inserted into a new model specification, following the Moderated Multiple Regression (MMR) technique (Agunis, 2004).

This task is approached in Model II:

$$log(Y) = a + b1\ periodofsale\text{-}dummy + b2\ BRTbufferdummy + \\ b3\ BRTbuffer\text{-}dummy{*}periodofsale\text{-}dummy \ldots.\ b_i\ X$$

Readers will note that the explanatory variable in both Model I and II was log-transformed. This is done to correct for the positive skew in the distribution of sale prices and to deal with heteroscedasticity found in exploratory model runs[53]. While this approach is becoming the norm in several academic realms (Russell and Dean, 2000, p 167), it still has problems. One of the

53 For example, an earlier version of Model II, run with the untransformed sale price as Y, was discarded because of failing to comply with parametric assumptions. A Breush-Pagan test suggested a notable level of heteroscedasticity (chi2=117.35 Prob > chi2=0.0000). In contrast, once the independent variable was log transformed, we were able to confirm homoscedasticity (chi2=0.26 Prob > chi2=0.6073).

negative side effects of this strategy is that the transformation violates the basic assumption of linearity between the independent and dependent variables, resulting in a lower statistical power and thus on higher chances of facing a Type II error (concluding from the sample that the hypothesis of no moderating effect is tenable when it is truly false) (Aguinis 2004, p 66-67 and 72). Given that *"log transformations can yield spuriously low estimates of moderator effect sizes"*, Russell and Dean (2000, p 169) recommend bootstrapping the data.

Bootstrapping is a method in which *"the sample is re-conceptualized as a pseudo-population that represents the broader population from which the sample was derived, and the sampling distribution of any statistic can be generated by calculating the statistic of interest in multiple resamples of the dataset"* (Preacher, Rucker and Hayes 2007, p 190). When a large enough number of resamples is conducted, this technique frees researchers from normality assumptions when conducting inferential tests.

This approach was pursued for this study using the statistical software package Stata. 1000 resamples were taken from our original sample (following the steps suggested by Poi 2004), and 95% confidence intervals for each of our variables of interest were calculated, with the 25th and the 975th largest values constituting the lower and upper limits.

After confirming the significance of the moderation effect through the bootstrapping method, we return to a log-transformed specification to test for the presence of a "three-way-interaction". This probes for the plausible possibility that the relation between a dependent variable X and and independent variable Y is contingent not only on Z but also on another variable W (Dawson and Ritcher 2006). For example, we are interested in testing whether the combined effect of location *and* timing of sale on the price is in turn moderated by socioeconomic characteristics.

The idea is that presumably properties inhabited by lower income people (who are likely to be transit captive) would be more advantaged by the announcement than properties inhabited by higher income people (who are more likely to enjoy transportation alternatives). In other words, the anticipated capitalization hypothesis relies on the expectation of future effects of a proposed infrastructure, but there is no reason why this expectation should be equal across different types of properties.

While we do not have specific socioeconomic data at the property level, we do have a construction quality indicator (*Constructtype-dummy)*, which is used as proxy. This indicator is included in our previous specifications as an independent variable, but is now interacted with both *BRTbuffer-dummy* and *periodofsale-dummy*. Thus, Model III incorporates the three pairs of cross product terms, as well as the product term of all three:

$$\log(Y) = a + b1\ BRTbuffer\text{-}dummy + b2\ periodofsale\text{-}dummy + b3\ Constructtype\text{-}dummy$$
$$+ b4\ BRTbuffer\text{-}dummy * periodofsale\text{-}dummy + b5\ BRTbuffer\text{-}dummy * Constructtype\text{-}dummy$$
$$+ b6\ periodofsale\text{-}dummy * Constructtype\text{-}dummy +$$
$$b7\ BRTbuffer\text{-}dummy * periodofsale\text{-}dummy * Constructtype\text{-}dummy + \ldots\ b_i X$$

This specification divides each subgroup of properties across higher and lower construction quality groups. The significance of $b7$ would be consistent with the intuition that the announcement of the new infrastructure affects the prices of nearby properties of different qualities with different intensity and/or direction.

Finally, the three-way interaction estimated in Model III is plotted to illustrate simple slopes of property prices before and after the announcement in each corridor, at higher and lower construction qualities. The analysis concludes with a test of the significance of the difference *between pairs* of slopes relevant to our study, conducted using the technique suggested by Dawson and Ritcher (2006).[54]

Results for all three models are presented in Table 7 below, and the findings of this research are discussed next.

54 The test method is described in four steps by its authors: *"First, one calculates generic formulas for simple slopes of the relation between X and Y at high and low levels of Z and W. Second, one calculates the difference between any two pairs of slopes. Third, one calculates the standard error of the difference of pairs of slopes. To determine whether slopes differ from each other, it is necessary to put the slope difference in relation to its standard error. Therefore, the final step requires one to test whether the ratio of the difference between pairs of slopes and its standard error differs from zero"* (Dawson and Ritcher 2006, p 919)

SECTION VII.
FINDINGS AND DISCUSSION

Model I provides us with a clear baseline to begin. The coefficient of the "period of sale" indicator in Model I (see Table 7) suggests that regardless of location, and after controlling for our set of structural, neighborhood and locational attributes, properties sold during the post announcement period attain on average, a higher price than similar properties sold during the pre-announcement period. This premium is estimated at approximately 11%, and is statistically significant ($B = 0.113$, $t = 5.02$, $p<0.001$).

Similarly, the coefficient for the location indicator suggests that regardless of the project announcement period, properties located in the vicinity of the Via Morelos sell, on average, for a higher price than similar properties near the corridor of interest to this study. The price gap approximates 21%, and is statistically significant ($B = -0.218$, $t = -3.94$, $p<0.001$).

According to our hypothesis –and maintaining the assumption of comparability across groups- news about the project should solely affect prices in the BRT buffer, as only people with real estate interests in this area would adjust their expectations about the advantages and disadvantages associated with their property as a result. In contrast, changes in price observed in the Via Morelos buffer -where no major work is foreseen- can be viewed as the normal market dynamic in Ecatepec.

We expect that after the announcement the gap in prices across corridors will shrink if there is anticipated capitalization or widen if the project is perceived negatively. In either case, if there is any type of anticipatory movement, the baseline difference in property prices between both corridors cannot remain stable.

Hedonic price model of the announcement and quality of construction effects on the price of residential properties located within the area of influence of the Ciudad Azteca-Tecamac corridor in Ecatepec, n = 728.

Variables	**Model I**				**Model II**				**Model III**			
	Coeff.	**SE**	**t-statistic**		**Coeff.**	**SE**	**t-statistic**		**Coeff.**	**SE**	**t-statistic**	
Structural attributes												
Plot size (sq. meters.)	0.001	0.000	4.67	***	0.001	0.000	4.68	***	0.001	0.000	4.81	***
Construction size (sq. meters)	0.003	0.000	13.40	***	0.003	0.000	13.29	***	0.003	0.000	13.30	***
Frontage (meters)	-0.018	0.006	-3.20	**	-0.018	0.006	-3.14	**	-0.020	0.006	-3.34	***
Age of building (years)	0.005	0.002	2.81	**	0.005	0.002	2.82	**	0.005	0.002	3.12	**
Number of floors in building	0.005	0.020	0.26		0.006	0.020	0.29		0.015	0.020	0.77	
Location within the block (1=corner, 0=otherwise)	-0.001	0.039	-0.02		-0.002	0.039	-0.05		0.009	0.039	0.24	
Neighborhood attributes												
Public lighting (light posts/hectare)	0.005	0	1.75		0.005	0.003	1.77		0.005	0.003	1.58	
Trash collection (days per week)	-0.009	0.012	-0.780		-0.010	0.012	-0.83		-0.013	0.011	-1.11	
Road density (100 sq meter/hectare)	0.001	0.001	0.890		0.001	0.001	0.94		0.001	0.001	0.50	
Cadastral area type H2 (ref. type H1)	0.126	0.032	3.950	***	0.125	0.032	3.91	***	0.146	0.033	4.43	***
Cadastral area type H4	0.337	0.050	6.760	***	0.335	0.050	6.71	***	0.358	0.050	7.16	***
Locational attributes (100 meter increments)												
Distance to Mexico City's downtown	0.002	0.001	3.050	**	0.002	0.001	3.00	**	0.001	0.000	2.88	**
Distance to Ecatepec's City Hall	0.002	0.001	2.000	*	0.002	0.001	1.88		0.002	0.001	1.88	
Distance to nearest school	-0.010	0.002	-4.770	***	-0.009	0.002	-4.55	***	-0.009	0.002	-4.67	***
Distance to nearest church	-0.001	0.004	-0.290		-0.001	0.004	-0.29		0.000	0.004	-0.05	
Distance to nearest market	0.003	0.003	1.060		0.003	0.003	1.09		0.002	0.003	0.82	
Distance to nearest recreation facility	-0.003	0.002	-1.550		-0.003	0.002	-1.48		-0.003	0.002	-1.28	
Distance to nearest cemetery	0.000	0.002	0.030		0.000	0.002	0.05		-0.001	0.002	-0.29	
Distance to nearest health clinic	0.001	0.003	0.520		0.001	0.003	0.45		0.000	0.003	0.13	
Indicator variables												
Period of sale (after the announcement=1, before=0)	0.113	0.023	5.02	***	0.134	0.032	4.21	***	0.173	0.046	3.79	***
Location (within 1km of BRT corridor=1, within 1km of Morelos Av.=0)	-0.218	0.055	-3.94	***	-0.198	0.059	-3.33	***	-0.226	0.061	-3.72	***
Construction quality (1= higher, 0 = lower)	0.203	0.027	7.55	***	0.20	0.03	7.54	***	0.20	0.04	5.07	***
Cross product terms												
Period of sale dummy * Location dummy					-0.041	0.044	-0.93		0.034	0.060	0.56	
Period of sale dummy * construction quality dummy									0.128	0.059	2.170	*
Location dummy * construction quality dummy									-0.066	0.062	-1.070	
Period of sale dummy * Location dummy * construction quality dummy									-0.203	0.087	-2.33	*
Constant		11.92		***		11.91		***		11.94		***
Root MSE		0.275				0.275				0.272		
r2		0.6497				0.6501				0.6604		

The dependent variable is the natural logarithm of the property sale price (2002 Mx$). The coefficients of location specific variables and of the road density variable were multiplied by 100, to represent the effect of 100-meter increments, as opposed to 1 meter increments. *, ** and *** denote statistical significance at the 90%, 95% and 99% level of confidence (two-tailed tests), respectively.

Table 7

The cross product term (of the period of sale and location dummies) reported in Model II allows for a first test on both of this possibilities. Its coefficient is not statistically significant (B =-0.041, t= -0.93, $p<0.35$), offering no indication that the effect of the announcement on residential property prices was different among both corridors, and thus no evidence in favor of the hypothesized moderating effect.

As previously discussed, this lack of significance could reflect a Type II error resulting from the use of a log-transformed dependent variable in the model. To explore this possibility, 95% confidence intervals (CI) of our coefficients were estimated through the bootstrap method, using the *un*transformed sale price as our dependent variable. For reference, these confidence intervals are presented in Table 8 along with the estimates of Model IV, following the same specification than Model II, but with the untransformed sale price as Y.

Bootstrap results suggest that in fact there is a moderating effect. The bootstrapped 95% confidence interval around the coefficient of the cross product term of the period of sale and location dummies does *not* contain zero (-78,508, -5,515). This result was not sensible to normal or bias-corrected estimations of the same confidence interval, and is consistent with the intuition guiding this paper.

It should be highlighted that this coefficient has a negative sign. Thus, the price premium associated in Model I with the post announcement period is concentrated among properties close to Via Morelos, and *not* among properties near the corridor considered for mass transit. Contrary to the anticipated capitalization hypothesis, our results suggest that for properties within the area of influence of the proposed BRT corridor the announcement produced no windfall, but a tempering force running against the appreciation trend registered elsewhere in Ecatepec.

Bootstrapped confidence intervals of the announcement effects on the price of residential properties located within the area of influence of the Ciudad Azteca-Tecamac corridor in Ecatepec, N = 728.

Variable	Model IV				Bootstrap Confidence Intervals		
	Coeff.	SE	t-statistic		LL 95% CI	UL 95% CI	
Structural attributes							
Plot area	498	96	5.21	***	281	825	a
Construction area	1411	97	14.60	***	1173	1627	a
Frontage	-1062	2541	-0.42		-5042	3098	
Building Age	464	770	0.60		-1126	2081	
Floors	-6391	8909	-0.72		-20799	7564	
Location within the block	6120	17292	0.35		-33308	44836	
Neighborhood attributes							
Public lighting	2519	1280	1.97	*	234	4774	a
Trash collection	-4858	5113	-0.95		-13187	3018	
Road density	-694	570	-1.22		-1857	334	
Cadastral area type H2	25254	14094	1.79		-3517	51403	
Cadastral area type H4	163335	22042	7.41	***	120983	208588	a
Locational attributes							
Distance to Mexico City's downtown	786	222	3.55	***	357	1252	a
Distance to Ecatepec's City Hall	543	485	1.12		-291	1448	
Distance to nearest school	-2962	901	-3.29	**	-4523	-1622	a
Distance to nearest church	-2724	1565	-1.74		-5453	-158	a
Distance to nearest market	2506	1211	2.07	*	326	4714	a
Distance to nearest recreation facility	-1563	958	-1.63		-3036	141	
Distance to nearest cemetery	1734	989	1.75		-182	3647	
Distance to nearest health clinic	1028	1225	0.84		-824	2678	
Indicator terms							
Period of sale (after the announcement=1, before=0)	74971	14107	5.31	***	47160	103880	a
Location (within 1km of BRT corridor=1, within 1km of Morelos Av.=0)	-78684	26268	-3.00	**	-128763	-28177	a
Construction quality (1= higher, 0 = lower)	70061	11919	5.88	***	47710	90351	a
Cross product term							
Period of sale dummy * Location dummy	-42369	19460	-2.18	*	-78509	-5517	a
Constant	-38025						
Root MSE	120000						
r2	0.636						

The dependent variable is the property sale price (2002 Mx$). The coefficients of location specific variables and of the road density variable were multiplied by 100, to represent the effect of 100-meter increments, as opposed to 1 meter increments. Bootstrap sample size = 1000. CI= Confidence Interval, UL= Upper limit, LL = Lower limit. *, ** and *** denote statistical significance at the 90%, 95% and 99% level of confidence (two-tailed tests), respectively. [a] denotes that the CI does not cross zero.

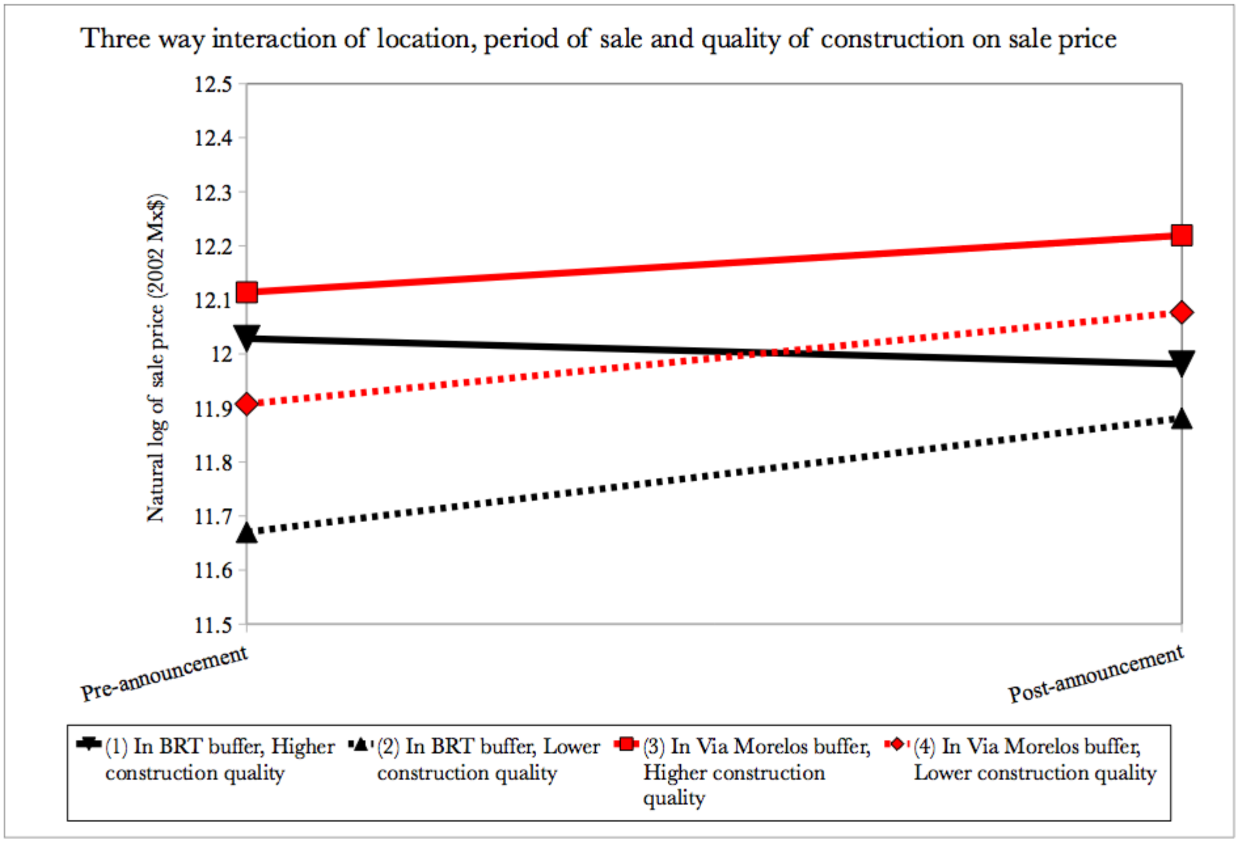
Table 8

According to the bootstrapped CI, before the project was announced, properties in the area of influence of BRT corridor sold, on average, for anywhere between Mx$28,176 and Mx$128,763 less than similar properties close to the Via Morelos corridor (as suggested by the CI around *b2)*. After the announcement, this price gap increased. Properties in the BRT corridor now sold for anywhere between Mx$33,693 and Mx$207,272 less than those close to those in the vicinity of the corridor of reference (as suggested by the CI around $b2 + b3$).

The gain in price for properties located close to the Via Morelos corridor sold after the announcement, relative to observed prices in the same Morelos corridor during the prior period, lies anywhere between Mx$47,160 and Mx$103,880 (as suggested by the CI around $b1$). In contrast, the percentile CI for the before and after difference for properties sold within the area of influence of the BRT corridor crosses zero (-Mx$33,349, Mx$98,363; as indicated by the CI around $b1+b3$), implying that some properties depreciated.

Model III drills deeper into these results, attempting to distinguish if this effect has a different intensity or magnitude depending on the quality of housing, which we use as a proxy for socioeconomic characteristics. We turn back to a model with a log-transformed independent variable, and find that the three-way interaction term of our indicators of location, period of sale and construction quality is in fact statistically significant (B =-0.203, t = -2.33, $p<0.05$).

The estimates in Model III allow us to plot four slopes: (1) properties within the BRT buffer, at higher construction quality, (2) properties within the BRT buffer, at lower construction quality, (3) properties within the Via Morelos buffer, at higher construction quality, and finally (4) properties within the Via Morelos buffer, at lower construction quality. What is evident from observing Graph 1 is that the negative effect appears to be concentrated in the higher quality properties sold in the BRT buffer.



Graph 1

Next, the expected price of lower quality residential properties -in each corridor and in both time periods- is calculated at the mean of all the explanatory variables considered in Model III. The results are presented in Table 9 for properties corresponding to the most prevalent cadastral area type ("H2"), in a non-corner location. Given that the dependent variable was log-transformed in the model, the price estimates were derived into 2002 Mexican Pesos using the following formula:

$$E(Y|x) = \exp(\sigma^2/2) * \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_i x_i)$$

Where x denotes the independent variables and σ^2 is the variance of the error term of the regression (Wooldridge, 2006).

Price estimation for lower quality properties

Slope	Location	Sold pre-announcement	Sold post-announcement	Difference
2	Close to the *proposed* transit corridor	$269,393	$331,212	$61,820
4	Close to the Via Morelos corridor	$337,671	$401,379	$63,708
	Difference	$68,278	$70,166	

Table 9

These estimates suggest that the before and after difference in the price of lower-quality properties was roughly the same *in both* corridors ($63,708 vs $61,820). To confirm this, a slope difference test was conducted using the technique developed by Dawson and Richter (2006), and as foreseen by the parallelism between slopes (2) and (4) in the graph, the difference is non-significant *(t=0.689 p-value 0.491)*. According to these results, the effect of the announcement was trivial or non existing for low quality properties.

Higher quality properties display quite a different dynamic:

Price estimation for higher quality properties

Slope	Location	Sold pre-announcement	Sold post-announcement	Difference
1	Close to the *proposed* transit corridor	$373,621	$351,094	-$22,527
3	Close to the Via Morelos corridor	$412,103	$458,561	$46,459
	Difference	$38,482	$107,467	

Table 10

While higher quality properties in the Morelos corridor sold, on average, for Mx$46,459 more in the post-announcement period, similar properties in the BRT corridor sold, on average, for $22,527 less. As suggested by eyeballing the contrast between slopes (1) and (3) in the graph, the inter-corridor price difference for higher quality properties widened, almost tripling its pre-announcement magnitude. The slope difference test confirms the significance of this finding *(t=-2.623 p-value 0.009)*.

In sum, we find no evidence to suggest that the political promise to build a mass transit extension from Ciudad Azteca to Tecamac triggered anticipated capitalization in Ecatepec. Lower quality properties appear to be unaffected by the announcement, displaying a price dynamic that is no different from that observed in a similar corridor lacking an expected investment in mass transit. In the case of higher quality properties we do find evidence suggesting anticipatory movements, but not in the expected direction. On average, owners of higher quality properties located in the vicinity of the proposed project experienced no windfall, but a loss in value.

This may be simply a transitional effect that will disappear as more information (and proof) about the benefits associated with the project become available. Results may reflect that owners of lower-quality properties in our study doubt that the new BRT will represent an improvement over the current *colectivo* alternative. For all they know, fares for using the new service might be more expensive, or the buses may stop at less convenient places. Similarly, results for higher quality properties may reflect a negative predisposition of their owners toward mass transit in general, or to BRT systems in particular. People are known to dislike externalities brought about by public transportation, such as insecurity and informal commerce, and may fear added congestion from the loss of street lanes to express buses.

But even if we take the net benefits of the project as granted, promises may not be sufficient to trigger capitalization or to assuage fears. People with a positive predisposition to mass transit may hold off any positive adjustments to the price of their properties until more tangible evidence becomes available, while some react negatively in the interim to rumors about possible land takings and disruptive construction processes. If the period of transitional uncertainties is lengthy -as appears to be the case in Ecatepec- doubts may appear confirmed, and loses for some could be substantial.

Kiel and McClain (1995) pointed earlier into this direction:

> *"If after adjustment is complete the facility is regarded as innocuous prices will rebound and the total change in social welfare will be zero. In this case, however, a substantial transfer of welfare may have occurred from buyers to sellers. For example, if a house was sold during a phase when fears of the facility depressed prices, the seller would suffer a capital loss. If those fears are later unrealized and prices rebound, that loss become the buyer's gain, but the net effect on social welfare will be zero"*

All of the above is hypothetical, and further work is needed to probe these possible explanations to the phenomenon observed in Ecatepec. However, what is clear is that the effect of a project announcement -even when it involves a much needed improvement over the status quo- can trigger a negative reaction in the property market, and that the impact is not likely to be homogeneous across different types of properties. At the least, the issue merits further exploration, particularly as implementers struggle with deciding how and when to open their plans to public discussion, and as policy makers study value capture alternatives to finance infrastructure.

Future research should try to overcome the limitations of this study. While rare and thorough, the dataset used contains several shortcomings. Different parties collected, archived, typed and analyzed the sample, allowing for missing files or finger errors. The lack of sufficient repeat sales forced a less than ideal comparison with properties sold close to Via Morelos. Furthermore, important observations corresponding to 2001-2003 were not available.

Follow up work should also be designed with a combination of quantitative and qualitative research in mind. Both property owners and officials with knowledge about the real estate market in Ecatepec were interviewed midway into this research. While their input was an useful guiding post to understand the terrain and make sense of the preliminary model outputs, such qualitative work was not pursued in a scientifically rigorous manner due to time and resource constraints. Furthermore, more qualitative research would allow for a thorough distinction of those factors affecting the *use value* of residential properties, and those affecting their *exchange values*

Despite its faults, this research is the first piece in an incomplete puzzle. Much remains to be explored.

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Appendix B: Higher-quality construction types (n=329)

Construction Class: 'Economic'

High (HB3) n= 82, Mean=$484,818

Construction Class: 'Interés Social'

Medium (HC2) n= 88, Mean=$346,470

High (HC3) n= 69, Mean=$276,019

Construction Class: Regular

Low (HD1) n= 69, Mean=$593,311

Medium (HD2) n= 16, Mean=$802,626

High (HD3) n= 4 Mean=$826,783

Construction Class: Good

Low (HE1)

n=1, Mean=$1,537,686

Appendix A: Lower-quality construction types (n=399)

Construction Class: Precarious

Low (HA1) n= 14, Mean=$291,481

Medium (HA2) n= 14, Mean=$226,080

High (HA3) n= 3, Mean=$166,825

Construction Class: Economic

Low (HB1) n= 133, Mean=$306,507

Medium (HB2) n= 136, Mean=$370,946

Construction Class: 'Interés Social'

Low (HC1) n= 99, Mean=$222,912