The effects of transport infrastructure on housing and prices: the role of land-use regulation*

Hugo E. Silva[1,2], Andrea Herrera[3,4], and Kenzo Asahi[3,5,6]

[1]Depto. de Ingeniería de Transporte y Logística, Pontificia Universidad Católica de Chile
[2]Instituto de Economía, Pontificia Universidad Católica de Chile
[3]Department of Geography and Environment, London School of Economics and Political Science
[4]Millennium Nucleus on Intergenerational Mobility: From Modelling to Policy (MOVI), Chile
[5]Escuela de Gobierno, Pontificia Universidad Católica de Chile
[6]Center for Sustainable Urban Development, CEDEUS

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Abstract

We estimate the impact of new transportation infrastructure on Santiago's housing market using historical microdata and instrumental variables. While subway and highway expansions generally boost residential floor space, housing units, and prices, the aggregate impact masks a heterogeneity driven by land-use regulations. In the wealthiest 20% of the city, highly restrictive regulations, such as low maximum Floor Area Ratios (FAR), effectively limit the impact on multi-family development. Conversely, in the remaining 80% of blocks, the zoning is more permissive, and the infrastructure investment leads to a substantial and homogeneous increase in residential floor space and housing units. These findings suggest that zoning in affluent areas prevents the densification that would otherwise follow major public investments, limiting the city's overall housing growth.

1 Introduction

Increasing floor space and the need for affordable housing have become a critical policy challenge in most large cities worldwide. Major urban centers have experienced an unprecedented housing affordability crisis, substantially burdening urban households. Many individuals face high rents or mortgage payments that consume a significant portion of their income. For example, in the USA, the proportion of cost-burdened renters has doubled from 24% in the 1960s to 48% in 2016, and the median home value has risen by 112%, surpassing the 50% increase in median owner income (Favilukis et al., 2022).[1] Hsieh and Moretti (2019) argue that the scarcity of affordable housing options has underutilized the USA's most productive cities, emphasizing the criticality of addressing this issue. The COVID-19 pandemic further exacerbated the urgency of the affordability crisis.

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[1]Airgood-Obrycki et al. (2021) estimate that the number of renter households in the USA who do not have enough income to afford a comfortable standard of living after paying rent and utilities each month is around 60 percent of working-age renter households (19.2 million).

The situation is equally concerning elsewhere. In the developing world, one-third of urban households experience overcrowding or reside in inadequate housing conditions, lacking access to basic amenities such as water, sanitation, and durable construction materials. This information, reported by United Nations (2016), highlights the significant housing challenges urban populations face in developing countries. Inadequate housing conditions affect individuals' quality of life and well-being, hinder socioeconomic development, and perpetuate inequality. Alves (2021), using data from Brazil, shows that the equilibrium interaction between substantial household mobility and low housing supply elasticities explains how unbalanced urban economic growth leads to slum growth. Addressing the housing needs of urban families is crucial for improving living standards, reducing poverty, and fostering equitable urban growth.

While many factors contribute to these housing supply constraints, this paper investigates a critical puzzle: how can massive, city-wide investments in transport infrastructure lead to significant housing growth in some neighborhoods but little growth in others? We argue that the answer lies in the interaction between land-use regulations and the socioeconomic composition of neighborhoods. Using substantial variation generated by large-scale investments in urban transport infrastructure between 2001 and 2010 in Santiago, Chile, we show that two distinct development dynamics are at play (see Figure 1). In most of the city, comprising lower- and middle-income areas, transport improvements induce a substantial increase in residential floor space and housing units, especially where zoning is permissive. In stark contrast, in the city's wealthiest areas, highly restrictive regulations effectively prevent this market-driven densification, channeling the economic benefits of public investment into higher property prices rather than new housing. Our findings suggest that zoning in affluent areas, consistent with the homevoter hypothesis, acts as a powerful brake on the city's overall housing growth, with profound implications for affordability and equity.

Our empirical strategy is threefold. First, we draw on two unusually rich data sources with fine spatial resolution: a unique block-level panel dataset on maximum building height and floor area ratio (FAR) before and after the transport expansion, and two rare cross-sections of residential floor space at the block level. We combine these with the universe of property transactions in the period, yielding more than 16,000 blocks with information on floor space, housing units, regulations, and prices. Second, we sketch a spatial equilibrium framework, based on recent work in quantitative urban models. This framework delivers a micro-founded log-linear relationship between employment access and residential floor space that helps us mute spillover concerns.[2] Constructing this access-to-employment measure requires data on workplace locations, wages, travel times, and commuter mode choice. We use bilateral commuting flows before and after the investment to obtain wages and estimate mode choice models. Finally, to address the potentially endogenous placement of infrastructure, we use instrumental variables based on planned urban highways and subway lines (while holding wages and modal weights at their baseline levels).

We find that transport infrastructure investment significantly boosts residential floor space: a 10% increase in commuter market access (CMA) leads to a 4% rise in residential floor space, a

[2]This measure mitigates the difficulty of separating spillovers from other location-specific time-varying factors that typically complicate distance-based identification strategies.

4% increase in housing units, and a 14% price surge. For perspective, a typical subway extension increases CMA by 120-130% within 250m of a new station, increasing residential floor space by 50% in these blocks. This highlights the critical role of transport infrastructure in expanding residential floor space through market forces.

We find that the influence of land-use regulation on urban equilibrium outcomes is highly contingent on the socioeconomic composition of city blocks. For blocks predominantly inhabited by the first four socioeconomic quintiles, the market access elasticity of residential floor space is statistically significant only in areas with a high initial FAR, specifically between 1.5 and 5. For these same socioeconomic groups, the elasticities of housing units and prices appear significant and homogeneous across all levels of initial regulation.

On the other hand, for the top socioeconomic quintile, the only consistently significant impact on residential floor space and units is in blocks initially more strongly regulated—with a maximum FAR less than or equal to 1. Unlike in the rest of the city, in this quintile, more than half of the blocks are in this restrictive category (in the other quintiles, the share ranges from 6 to 24 percent). Therefore, multi-family development is effectively prevented. Additionally, property prices increase more than in the rest of the city. However, the effect is lower the more restrictive the regulation, reflecting a negative own-lot effect of regulation as in Turner et al. (2014).

Our results suggest that two different housing development dynamics operate in the city. In most areas, unit development occurs across all regulatory levels, with the more sizable impact on residential floor space where regulation allows multifamily housing. By contrast, in the top socioeconomic quintile, transport infrastructure increases units and floor space when regulation is less permissive, indicating muted multi-family housing development. This pattern is consistent with the home-voter theory of regulation (e.g., Fischel, 2005), but appears to operate only in the wealthiest areas. It is also consistent with evidence that more stringent regulation correlates with homeowners' associations in developed countries such as the USA (Clarke and Freedman, 2019), albeit through a different mechanism.

Our article provides general insights into the recent literature about factors affecting residential floor space. Murphy (2018) estimates a dynamic model of housing supply and shows that pro-cyclical costs incentivize some landowners to build before price peaks and that owners actively "time" the market, which reduces the elasticity of supply. Henderson et al. (2020) develop a dynamic model of housing supply, differentiating the formal and informal technologies. Saiz (2010) and Baum-Snow and Han (2024) study the floor space price elasticity using US data; Saiz (2010) focuses on differences between cities, while Baum-Snow and Han (2024), like us, concentrate on within-city differences. Our results are consistent with Baum-Snow and Han's (2024) findings, who find a substantial variation of floor space elasticities within the cities. However, they find that floor space supply responses increase with distance to the CBD, a heterogeneity that does not hold in our study. We claim that the previous departure from the literature regarding heterogeneity relative to distance from the CBD is because Santiago's central area was relatively underdeveloped in the 2000s. This highlights the value of providing evidence from developing and middle-income country contexts.

Our findings highlight the importance of accounting for heterogeneity in effects, which can vary substantially across countries. Much of the recent literature on quantitative models examining the impact of transport infrastructure within cities assumes a constant price elasticity of floor space (see, e.g., Tsivanidis, 2023; Zárate, 2022; Heblich et al., 2020). Our paper's contribution is the empirical testing and estimation of heterogeneity. Our study is more closely related to Tsivanidis (2023), Severen (2021), and Chen et al. (2024), who analyze the impacts of Bogotá's Transmilenio BRT system, the Los Angeles Metro Rail, and Bengaluru's metro, respectively. Tsivanidis (2023) finds that commuter market access significantly influences real estate prices, employment, worker spatial reallocation, and welfare, but has no detectable effect on floor space.[3] Likewise, Severen (2021) estimates the effects of the Los Angeles Metro Rail on similar urban outcomes, also finding no expansion in floor space. Interestingly, Chen et al. (2024) show that FAR limits can sharply constrain the welfare gains from transport infrastructure. Taken together, these studies suggest limited responsiveness of floor space to transport improvements, whereas our results provide a more detailed picture in which the response depends on both the socioeconomic context and the regulatory environment.

Our paper also contributes to the literature on the spatial distribution of economic activity. While Baum-Snow (2007), Garcia-López et al. (2015), Baum-Snow et al. (2017), Gonzalez-Navarro and Turner (2018), and Baum-Snow (2020) study the decentralization of population in cities due to transport infrastructure changes, they do so by using two aggregate zones for metropolitan areas, namely the city center and suburbs. We study the effect of transport infrastructure on economic activity using microdata at the block level.

Finally, we also contribute to the literature that studies or documents the impacts of regulation. Recent contributions include Turner et al. (2014), Gyourko and Molloy (2015), Severen and Plantinga (2018), Clarke and Freedman (2019), Gyourko et al. (2021), Buitrago-Mora and Garcia-López (2023) and Chen et al. (2024). We complement the literature by providing evidence from Latin America and studying its impact on shaping the equilibrium response to changes in transportation costs within a city.

2 Background and Data

The Greater Santiago Area provides an ideal setting to study the interplay between transport infrastructure and land-use regulation. During the 2000s, the city experienced a period of rapid economic growth,[4] a massive and well-defined expansion of its subway and highway networks, and operated under a fragmented regulatory system with significant variation at the local level. This context allows us to leverage rich microdata to identify how zoning rules shape the housing market's response to accessibility improvements. This section details the specific infrastructure projects, the regulatory environment, and the novel dataset we constructed for the analysis.

Santiago accounts for over 40 percent of the country's population and GDP (Banco Central, 2023). It has an extension of approximately 838 km^2 (INE, 2018), slightly larger than New York City, and in the studied period (2001 to 2010), experienced a population increase of 17.4

[3] There is also substantial evidence that property prices increase in the vicinity of new highways (Levkovich et al., 2016; Theisen and Emblem, 2020) and subways (Gibbons and Machin, 2005; Ahlfeldt, 2013; Bowes and Ihlanfeldt, 2001).

[4] During this decade, Chile's per capita GDP increased almost twofold from 9,937 USD to 18,129 USD (OECD, 2017), transitioning from a middle-income country to a high-income country (World Bank, 2019).

percent, from 6,061,185 to 7,112,808 inhabitants (INE, 2017). Inequality has been an issue in the country and in Santiago for decades. Chile's Gini coefficient in 2000 was 0.55, and Santiago's Gini coefficient has been relatively similar in the last two decades (Asahi, 2015). In 2009, Chile was among the 12 percent most unequal countries according to the Gini coefficient (Asahi, 2015).

2.1 Transport infrastructure and commuting

2.1.1 Subway stations

Santiago's subway system was inaugurated in 1975, and by 2001, the subway network comprised three subway lines with 54 stations and 40 km of tracks. By then, the system encompassed a central line connecting the east and the west and two lines connecting the center with the southern part of the city (see Figure 1, Panel 1a). By 2010, the government had inaugurated over 53 km of additional subway rails, an increase of 133 percent in the network, making up 94 km and 101 stations. Two new lines, lines 4 and 4A, connected the southeastern part of the city (see Figure 1b). Also, 20 stations were added to existing lines, most expanding the network to the city's north.

As Figure 1 reveals, most parts of the city experienced an increase in proximity to the subway network, where the average distance to a station decreased from 6.3 to 4.3 km (city-wide). The metro system recorded over two million daily trips, almost doubling 2001's usage (Metro de Santiago, 2010).

2.1.2 Urban highways

Santiago substantially invested in urban highways during the 2000s. Between 2000 and 2006, the Chilean government planned the construction of 207 km of urban highways in six different projects valued at 1,582 million USD. One of the objectives of this massive intervention was to reduce the so-called infrastructure deficit in the city (Gutiérrez and Fuentes, 2014). The highway network uses a free-flow tolling system (Gobierno de Chile, 2003), with an average toll of 0.32 USD/km.[5]

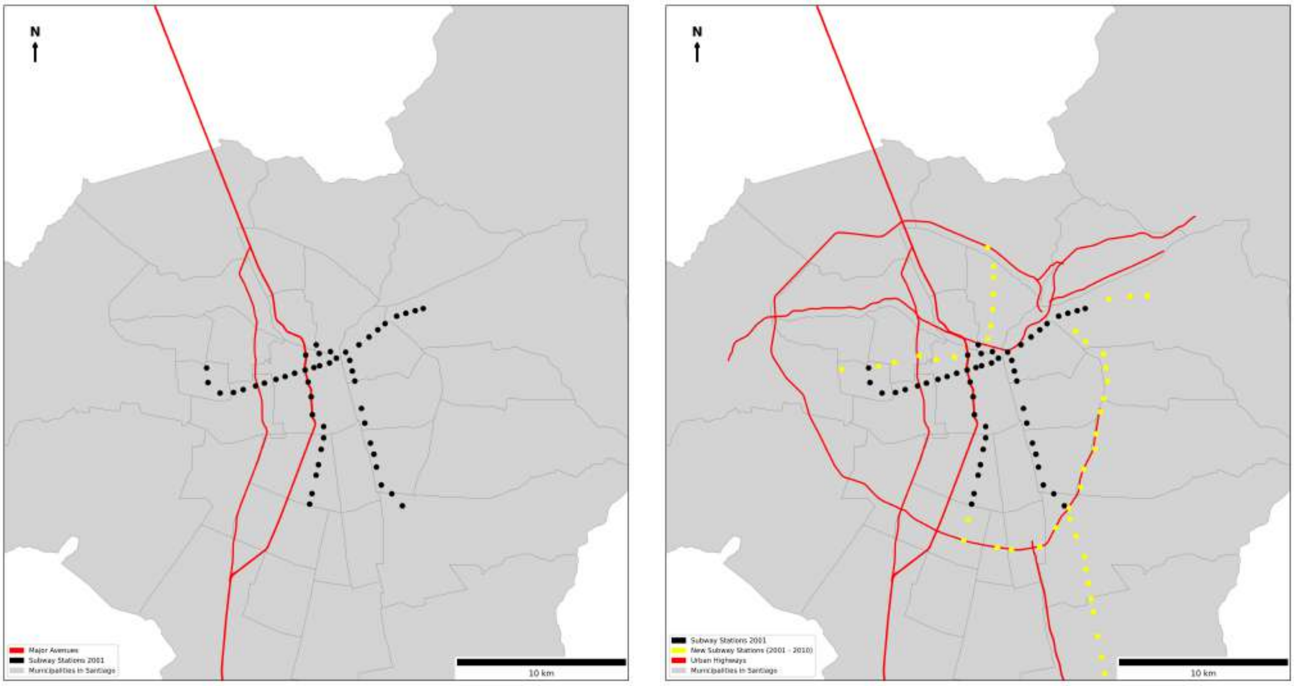
Figure 1 shows a map of Santiago's urban highways. The Autopista Central highway, which spans from north to south, is the urban segment of the country's main intercity highway (Ruta 5) and has an urban extension of 61 km. The Costanera Norte connects east to west and is located in the city's northern area, with an extension of 42 km. The Américo Vespucio ring road, formed by Vespucio Sur (24 km) and Vespucio Norte (29 km), adds up to 53 km of highways.[6] The Acceso Sur highway connects the Vespucio Sur ring road with Ruta 5 in the south. Finally, the Túnel San Cristóbal connects Vespucio Norte with Costanera Norte in the northeastern part of the central city.

[5] As a reference, in the Greater Boston Area, the average toll in the Massachusetts Turnpike I-90 is 0.03 USD/km).

[6] The ring road's missing segment is the Vespucio Oriente highway project, which is under construction as of 2022.

Figure 1: The evolution of Santiago's transport infrastructure (2001 - 2010).

(a) Transport Infrastructure in 2001 | **(b)** Transport Infrastructure in 2010



Notes: Figure 1a shows Santiago's subway and urban highway networks in 2001, and Figure 1b shows the subway and urban highway networks in 2010.
Source: Own elaboration. The maps use georeferenced information on subways and urban highways from Pontificia Universidad Católica de Chile's "Observatorio de Ciudades UC" and the Chilean 2017 pre-census street shapefile.

2.2 Urban regulation in Chile

The urban land-use planning process in Chile involves several agents and policies. We provide a concise overview of the process. The Ministry of Housing and Urbanism is responsible for formulating regional and inter-municipal plans. Yet, the local land-use plans and detailed neighborhood-level plans are developed by municipalities.[7] These plans typically involve maximum FAR, height, and land use allowed, among others, and are strictly enforced (OECD, 2017). As the metropolitan area has 34 municipalities, coordination is challenging and has been shown to result in higher cross-jurisdictional commuting costs and more dispersed employment (Bordeu, 2023).

The leading actors in the Chilean regulatory process that directly concern block-level regulation are the municipal mayor, the Municipal Council, and the urban planning advisor. In the USA, for example, as Glaeser and Gyourko (2018) summarize, land-use regulation is under local control and minimum-lot-size regulation is widely used and usually strict in the suburbs.

In Chile, the primary instruments used to regulate building heights are the maximum floor area ratio (FAR) and the maximum building height. By contrast, in many developed countries—such as the United States—height and residential density are often constrained through zoning that limits development to single-family units. For instance, in many US cities, roughly 75% of

[7]This holds for municipalities with more than 50,000 inhabitants that employ an urban planner, which is the case for all municipalities in the Greater Santiago Area.

residential land is zoned exclusively for single-family housing (Badger and Bui, 2019). Furthermore, "most single-family houses constructed in the United States in recent years are part of a common interest development (CID), governed by a homeowners association (HOA)" (Clarke and Freedman, 2019). These HOAs are estimated to add, on average, a 4% premium to housing prices Clarke and Freedman (2019). In Santiago, however, this restriction is rarely applied and does not play a significant role for housing developers (Waintrub et al., 2016).

2.3 Data sources

We obtained the floor space data from the Chilean Internal Revenue Service (Servicio de Impuestos Internos, SII). The SII categorizes the floor space into different land uses and disaggregates such information at the SII block level. We use the data for 2001 and 2010. The land uses include residential, commercial, educational, industrial, and services.[8] This study focuses on residential land use. Our sample consists of the blocks in the urban area within a 3-kilometer radius of a new subway station or an urban highway entry or exit. We explain the criteria used to define the sample in more detail in Section 3.

We compute socioeconomic covariates at the SII block level—such as socioeconomic decile, population, and number of households—using Chile's 2002 Population Census (Instituto Nacional de Estadísticas, INE). We also use GIS tools to derive proximity measures from each block's centroid, including distances to subway stations, urban highways, and the CBD. The georeferencing of 248 highway entrances and 259 exits required substantial effort and resources.

For this paper, we constructed a novel municipal land-use regulations database, focusing on zoning plans and ordinances enacted between 2000 and 2010. We organized a team of research assistants—several of them trained geographers—who, under our supervision, systematically collected all local ordinances and zoning plans, including their subsequent amendments, for every urban municipality in Santiago. Most ordinances were obtained from the Official Gazette of the Republic of Chile (Diario Oficial) and the Library of the National Congress. At the same time, zoning plans were retrieved from multiple sources, including the Ministry of Housing and Urbanism, the National Archive, and municipal planning departments. To the best of our knowledge, this process allowed us to track and compile all local ordinances and their modifications during the study period, and transform them into a standardized dataset. Once collected, we manually extracted all land-use provisions from the ordinances into standardized tables for each municipality. We georeferenced the data based on these extracted rules and the zoning plans, enabling us to map the regulatory framework governing every lot in the study area. For the analysis presented in this paper, we track two primary variables, namely the maximum floor area ratio (FAR) and building height allowed.

This unique dataset describes maximum height, floor-to-area ratio, building coverage ratio, population density, and allowed land use for 2001 and 2010. As the information is at the level of the lot, we compute the weighted average of the lots' indicators for each block using each plot's area as weights. Additionally, we compute the difference between the maximum and the

[8]The land-use purposes are commerce, education, residential, industrial (industrial and mining activity), services (including public administration, offices, and health), a category named 'not considered' (that includes vacant land, agricultural land, forests, and everything not defined and without information), and others (including hotels, motels, sports and recreation, worship and others) (Suazo, 2017).

actual floor area ratio, i.e., the additional floor space that can be built. We denote this measure as a block's real estate potential (REP).

We obtained the universe of transactions in the period through a collaboration with TOCTOC, a Chilean real estate platform. TOCTOC georeferenced the transactions retrieved from the regional authority that holds all the property records. Although the data are rich, obtaining prices for the entire city is challenging, as not all properties are sold. To overcome this, we use transactions between 1998 and 2001 for the pre-treatment, and between 2010 and 2012 for the post-treatment. Prices are per square meter of floor space and adjusted for inflation.

The sample of blocks that are within the urban limit and three kilometers or closer to the post-expansion subway stations or urban highway entry or exit, which have data on all relevant variables, and zoning allows for residential use, is 16,712 blocks. We then removed the bottom and top 0.1 percent of the sample based on the change in the three outcome variables. Finally, we winsorized the lowest 1 percent of the sample with data on regulation based on the value of REP.[9]

We also rely on the 2001 and 2012 Santiago Origin–Destination Surveys (Encuesta Origen–Destino, EOD), nationally representative household mobility surveys conducted by SECTRA. Each wave covers about 60,000 individuals and provides detailed commuting diaries, including trip purposes, modes, travel times, and socio-demographic characteristics, across a consistent zonal system. These data allow us to recover bilateral commuting flows and estimate mode choice models, which in turn are used to compute block-level commuter market access (CMA) before and after the expansion of Santiago's subway and highway networks. The two waves thus provide a consistent and comparable view of commuting patterns and generalized travel costs surrounding the city's major transport investments of the 2000s. Further details on the 2001 and 2012 EOD surveys are provided in Appendix C.

2.4 Descriptives

Table 1 reports descriptive statistics for the sample blocks and baseline covariates. On average, blocks had a surface area of 9,150 square meters, 134 inhabitants, and 38 households. The mean population density was 23,929 inhabitants per square kilometer. The sample's average residential floor space was 3,230 m^2 in 2001 and increased to 3,758 m^2 in 2010. The median block fell in the 7th socioeconomic decile of the country, reflecting that Santiago is relatively wealthy.[10] On average, the distance to the closest subway station declined from 4 km in 2001 to 2 km in 2010. In 2010, the average block was 10 km from the city's central business district and 1.5 km from the nearest urban highway.

Figure 2 shows the spatial distribution of blocks according to socioeconomic quintiles of our sample. Darker colors represent blocks whose residents, on average, are in the highest socioeconomic quintile of the sample. There is a significant concentration of high-income families

[9] These are 127 blocks with a REP lower than -250 percent for each year, meaning 250 percent built above the regulatory limit. This scenario is technically possible as the norm is not retroactive, and regulation could have decreased over time in already developed blocks. Further descriptions of the winsorizing process and the outliers are in Appendix 5.

[10] The Chilean 2002 Census dataset reports a socioeconomic status index that takes discrete values from 1 to 10.

Table 1: Descriptive statistics of the sample of blocks studied.

	Mean	SD	Min	Max
Socioeconomic decile	7.42	1.58	1.00	10.00
Population per block	133.82	106.88	1.86	2,261.00
Households per block	38.15	35.70	0.43	776.00
Block area (m^2)	9,149.90	19,613.63	52.00	672,075.06
Population density (population/km^2)	23,928.67	19,621.22	9.89	587,410.38
Block radius (m)	46.76	27.15	4.07	454.83
Residential floor space 2001 (m^2)	3,230.01	4,722.91	7.00	82,512.00
Residential floor space 2010 (m^2)	3,758.38	5,637.61	54.00	86,148.00
Min. distance to a subway station in 2010	2.05	1.66	0.05	10.04
Min. distance to a subway station in 2001	3.99	2.71	0.06	12.65
Min. distance to a new subway station in 2010	2.40	1.71	0.05	10.04
Min. distance to an urban highway	1.48	1.08	0.02	5.68
Min. distance to a main road in 2001	2.01	2.09	0.01	10.32
Min. distance to the CBD	9.59	4.39	0.17	21.60
Observations	16,516			

Notes: "Socioeconomic decile" refers to the block's median socioeconomic decile from Chile's 2002 census. The minimum distances are all expressed in kilometers. CBD stands for central business district (CBD). The sample and data sources are detailed in Section 2.3.

in the city's east, especially in the northeast. On the other hand, in the West, there are relatively more blocks from the lowest socioeconomic quintile than in the rest of the city.

Table 2 summarizes the initial floor-to-area ratio and the change in log floor space by socioeconomic quintiles between 2001 and 2010. The average floor space growth is 16 percent and the proportion of blocks without changes is 7 percent. These changes differ by socioeconomic quintile, where blocks in the lowest socioeconomic quintile experienced an increase in floor space of 23 percent, seven percentage points higher than the average increase. Table 2 also shows that the sample's average initial floor space density is 0.49, increasing with the block's wealth. The difference in the changes in floor space by socioeconomic quintiles may be due to low initial density levels in these blocks.

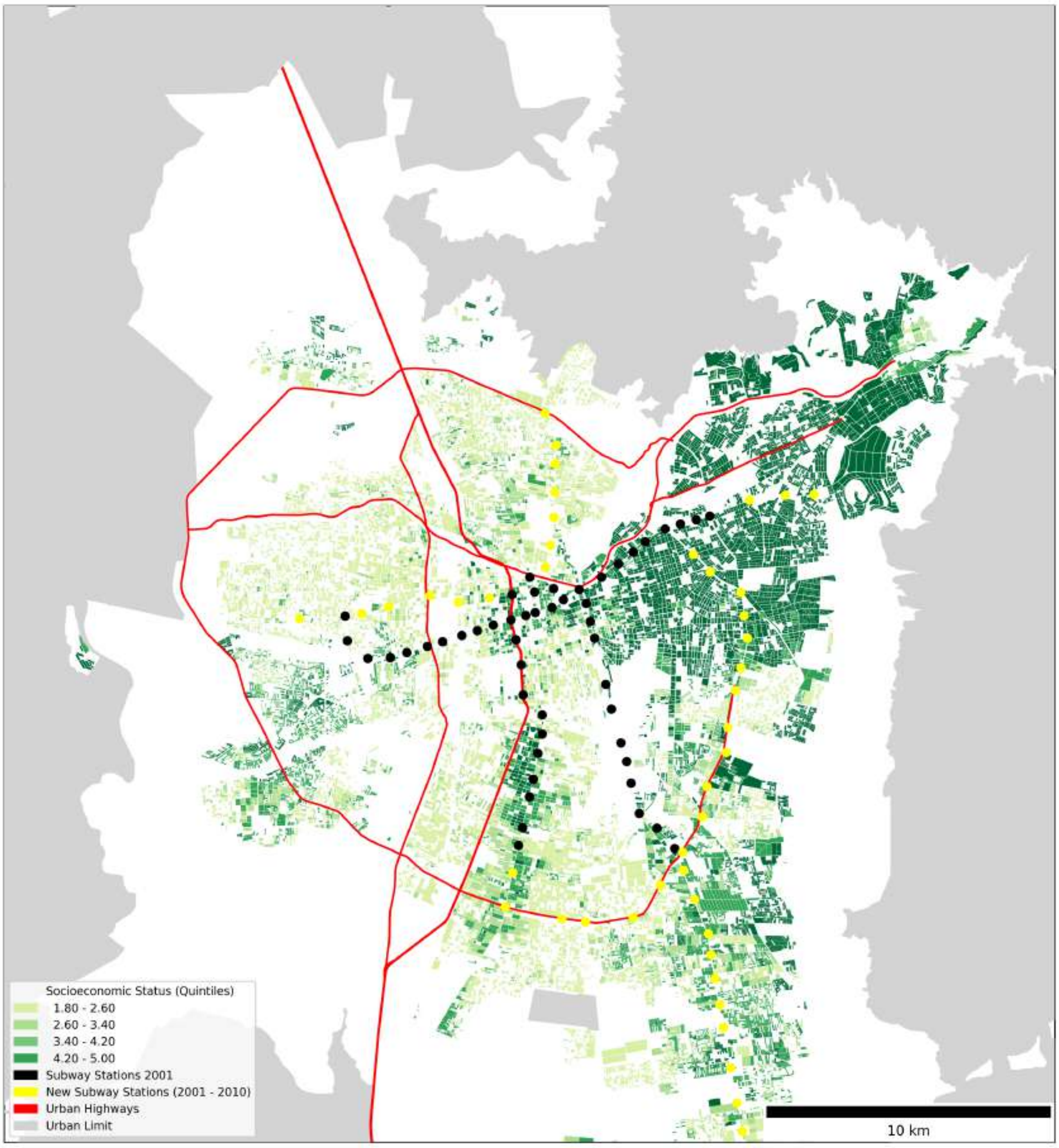
Table 2: Change in log floor space by socioeconomic status (2001 - 2010).

	Mean	SD	Median	Proportion of blocks with no change in floor space	Baseline residential floor space density
Low	0.206	0.051	0.369	0.122	0.304
Medium/Low	0.138	0.061	0.233	0.087	0.389
Medium	0.105	0.143	0.215	0.053	0.54
Medium/High	0.109	0.139	0.244	0.063	0.634
High	0.126	0.101	0.288	0.047	0.590
Total	0.137	0.099	0.278	0.071	0.491
Observations	16,516				

Notes: The table shows summary statistics of the change in the log floor space from 2001 to 2010 and the floor-to-area ratio in 2001, by socioeconomic status (quintiles) of our sample. The sample and data sources are detailed in Section 2.3.

To provide intuition on how the changes in floor space are related to the proximity to the new urban transport infrastructure (subway stations and urban highways), Figure 3 presents the spatial distribution of the variation in log floor space between 2001 and 2010 for residential land-use. It shows an increase in floor space near subway stations and urban highways. There are increases in floor space in the city's periphery, close to the new urban highways, which could represent an incipient suburbanization tendency, as found in Baum-Snow (2007) and

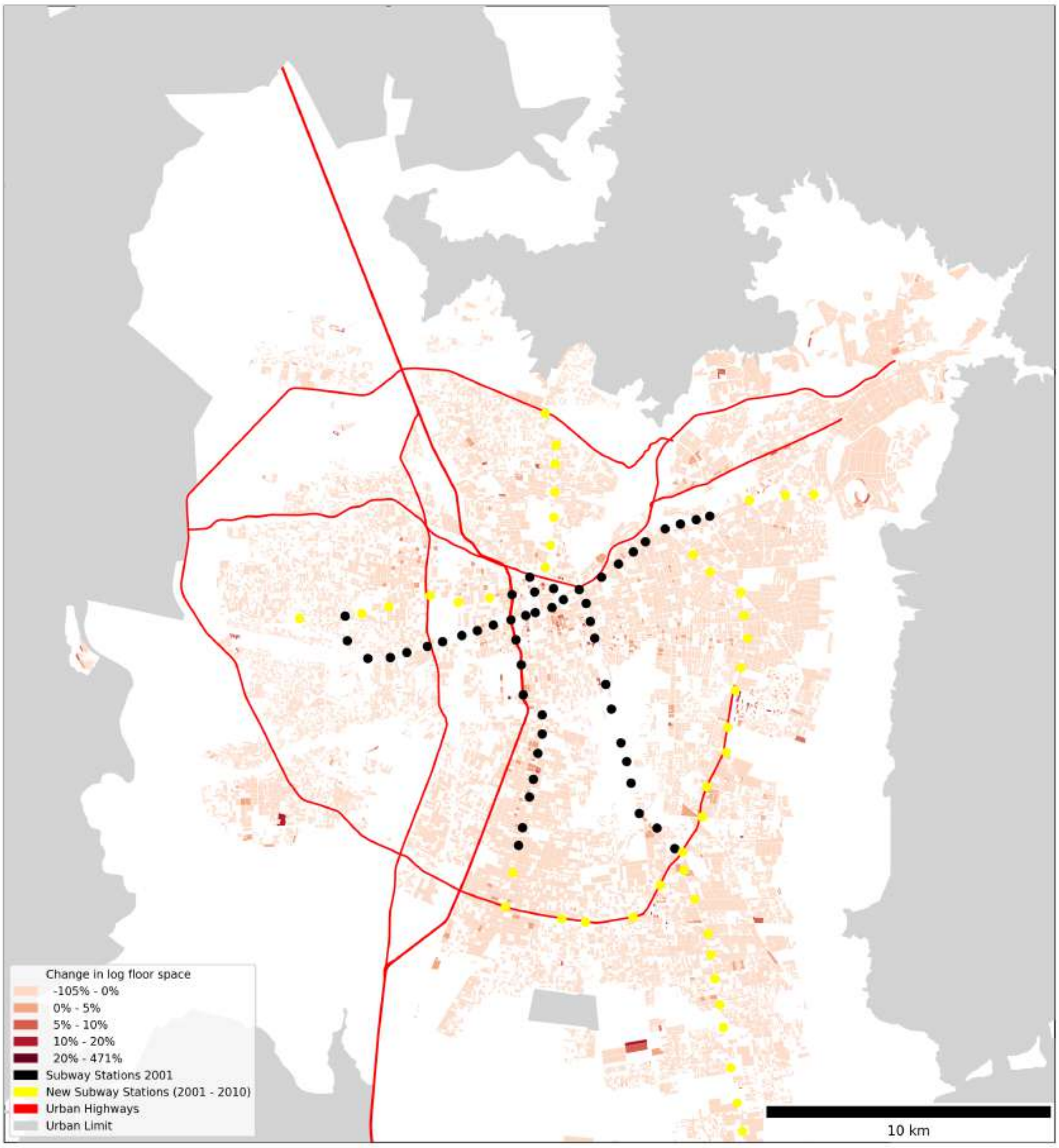
Figure 2: Socioeconomic status in 2001 (quintiles).



Notes: The figure presents the distribution of the socioeconomic status of our sample of blocks. The sample and data sources are detailed in Section 2.3.

Baum-Snow et al. (2017).

Figure 3: Difference in log floor space (2001 - 2010).



Notes: The figure presents the change in log floor space distribution for residential land use between 2001 and 2010. The sample and data sources are detailed in Section 2.3.

Table 3 shows descriptive statistics of the two relevant regulation variables in our baseline, 2001, and Figure 4 displays the spatial distribution of the FAR limit categories. As Table 3 shows, the main regulatory variable is the Maximum FAR: 61% of the blocks in our sample have a FAR limit defined by the corresponding municipality, while the remaining 39% do not have a restriction. On the other hand, the maximum height is fixed only for 32% of the blocks. For this reason, we study the heterogeneity of the market access impact concerning the maximum FAR. We define four categories: the tertiles of the maximum FAR allowed when it is a numeric value, and a fourth category for the unrestricted blocks.

In 2001, the maximum FAR allowed by regulation ranged from 0.03 to 5. Because many blocks were concentrated at FAR values of 1.2 and 1.4, it was not possible to construct three equally sized groups without overlap. Instead, we classify blocks into four categories. About 21% of blocks fell into the Low category, with an average FAR limit of 0.57. The Medium category comprised blocks with FAR limits ranging from 1.2 to 1.4, representing 25% of the sample. Another 15% of blocks had FAR limits between 1.5 and 5, with an average of 2. The remaining 39% had no regulatory FAR limit.

Table 3: Descriptive statistics of FAR regulation for residential land-use

Regulation category	**Mean**	**SD**	**Min**	**Max**	**Observations**	Share
			Panel A: Maximum FAR			
Low	0.57	0.21	0.03	1.00	3,431	0.21
Medium	1.36	0.08	1.20	1.40	4,138	0.25
High	2.06	0.54	1.50	5.00	2,555	0.15
Unrestricted	.	.	.	.	6,392	0.39
			Panel B: Maximum Height			
Low	7.19	0.75	6.00	8.50	1,840	0.11
Medium	11.26	1.00	9.00	12.00	2,644	0.16
High	17.71	6.99	13.50	50.00	771	0.05
Unrestricted	.	.	.	.	10,901	0.68

Notes: This table reports block-level summary statistics of the maximum floor-area ratio (FAR) and building height limits in 2001. Details on the sample and data sources are provided in Section 2.3.

3 Framework and empirical strategy

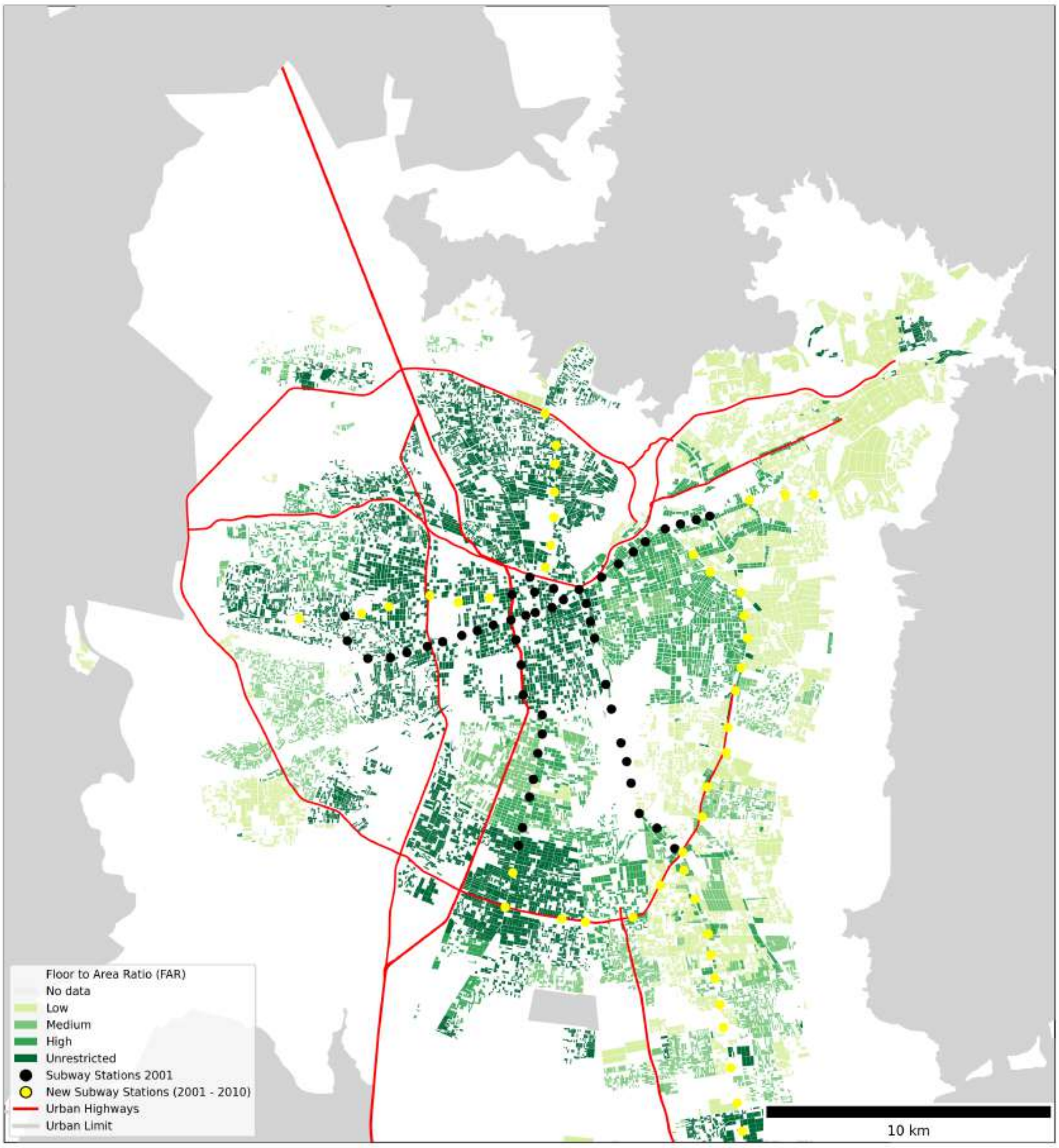
Recent literature has advanced the understanding of the internal city structure by developing quantitative spatial models of cities. These models have generalized the relationship between the density of economic activity and access to transportation infrastructure (see, e.g., Ahlfeldt et al., 2015). Accounting for agglomeration, residential externalities, amenities, and production, this class of urban models has shown that a single measure of accessibility summarizes the effect of a city's entire transit network on any location (Tsivanidis, 2023). The measure, usually referred to as commuter market access (CMA) or residential market access (RMA), reflects the access to jobs and considers the commuting times from a location to all others weighted by some measure of employment.

This strand of literature provides the theoretical foundation for our reduced-form estimation of the impact of increased CMA on residential floor space. A higher CMA increases the willingness to pay for floor space—a demand-side effect—which induces the developers' response. By looking at the effect of market access on the residential floor space, we study the changes in the equilibrium quantity of floor space.

We sketch an urban spatial model that captures individual labor and housing decisions to conceptualize the relationship between transportation investments and housing demand. We then complement the model with a simple housing supply model, which allows for solving the equilibrium and provides theoretical support for our reduced-form strategy.[11]

[11] For details about the urban models that deliver the relationship between outcomes and CMA, see Redding and Rossi-Hansberg (2017) for a review of the topic, and Ahlfeldt et al. (2015), Tsivanidis (2023), and Heblich et al. (2020) for recent studies.

Figure 4: Regulation in 2001 (four categories).



Notes: The figure presents the distribution of the maximum FAR of our sample by categories. Low, Medium and High, are tertiles of the maximum FAR when it has a numeric value and unrestricted is the group of blocks without a FAR limit. Identical FAR values were kept on the same category, so the tertiles are not exactly of equal size. The sample studied is detailed in Section 2.3.
Source: Own elaboration using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII) and data from the INE's 2002 population Census.

3.1 The model

The model draws elements from Ahlfeldt et al. (2015), Tsivanidis (2023) and Baum-Snow and Han (2024), but abstracts from modeling worker heterogeneity, externalities, and nested choices to focus on the central intuition. Moreover, we focus on the workers' side of the model to derive the structural relationship between residential floor space and commuter market access.

3.1.1 Workers

A continuum of individuals with unit mass choose where to live and work and have Cobb-Douglas preferences over a numeraire good and housing. This implies that individuals spend a constant share of their income on each good (β for the numeraire and $1-\beta$ for housing). An individual living in i and working in j earns a salary of w_j and has a disutility from commuting d_{ij}, which is a function of the travel time t_{ij}. Let amenities be A_i, and commuting affect utility multiplicatively, and p_i be the price per unit of residential floor space, the indirect utility that individual ω receives from a pair of residential and work locations (i,j) is:

$$v_{ij} = \frac{A_i w_j p_i^{\beta-1}}{d_{ij}} z_{ij} \tag{1}$$

where z_{ij} is an idiosyncratic shock and varies with the individual's blocks of residence and employment.

The elements from the model that depend on the commuting pair i,j (the commuting disutility and the shock) can be interpreted in two ways. One interpretation is that traveling reduces the effective labor supply at the workplace, so the income received is w_j/d_{ij}, and z_{ij} is a productivity shock. The second interpretation is that d_{ij} directly affects the utility and is unrelated to productivity or wages, and z_{ij} is a utility shock.[12]

The shock captures that individuals can have idiosyncratic reasons for living and working in different areas. As is common in the literature, we assume that the shock z_{ij} is drawn from a Frechet distribution with shape parameter θ and scale parameter $s=1$:[13]

$$F_z(z_{ij}) = e^{-z_{ij}^{-\theta}},\ \theta > 1 \tag{2}$$

This is the simplest way to model the heterogeneity in the utility derived by choosing the commute pair (i,j). Using the properties of the Frechet distribution, the probability that a worker chooses to live in i and work in j is:[14]

$$\pi_{ij} = \frac{(A_i w_j p_i^{\beta-1}/d_{ij})^{\theta}}{\sum_r \sum_s (A_r w_s p_r^{\beta-1}/d_{rs})^{\theta}} \tag{3}$$

[12] Thisse et al. (2021) provide an interpretation where a continuum of types of individuals is represented with preferences over all origin-destination pairs.

[13] Ahlfeldt et al. (2015) assumes that the shape parameter depends on origin- and destination-specific values. Tsivanidis (2023) and Baum-Snow and Han (2024) introduce nested preference shocks over residential locations that allow for modeling an additional margin of substitution in demand for residential locations.

[14] The key to derive the result is that the distribution of the indirect utility follows a Frechet distribution with the same shape parameter θ and a scale parameter of $(A_i w_j p_i^{\beta-1}/d_{ij})$. Moreover, the maximum also follows a Frechet distribution with shape parameter θ and a scale parameter of $\sum_{i,j}(A_i w_j p_i^{\beta-1}/d_{ij})$. The full derivations are in the Appendix of Ahlfeldt et al. (2015).

Intuitively, places with higher amenities and lower prices are more attractive, and higher wages and low commuting costs attract workers.

Summing over all destinations j, we can write the resident supply to block i as:

$$\pi_i = \lambda_P \left(A_i p_i^{\beta-1}\right)^{\theta} \mathrm{CMA}_i \tag{4}$$

$$\text{with } \mathrm{CMA}_i \equiv \sum_j \left(w_j/d_{ij}\right)^{\theta} \tag{5}$$

where λ_P is constant across locations, and CMA_i is block i's Commuter Market Access.

Equation (4) shows that in equilibrium, the population of block i is increasing in the CMA, conditional on prices, as it has better access to employment. Before the shock is revealed, the expected income of living in i, $\bar{y_i}$ is:

$$\bar{y_i} = \mathbb{E}\left[\max_j w_j z_{ij\omega}/d_{ij}\right] = \lambda_R \mathrm{CMA}_i^{1/\theta} \tag{6}$$

where $\lambda_R = \Gamma(1 - \frac{1}{\theta})$ is a constant.

Using that individuals spend a share of $1 - \beta$ of the income on housing and Eq. (6), the aggregate housing demand in block i follows:

$$H_i = \lambda_R \frac{\pi_i(1-\beta)}{p_i} \mathrm{CMA}_i^{1/\theta} \tag{7}$$

Equation (7) predicts that the housing demand increases with commuter market access and amenities and decreases with price. Importantly, it provides the intuition for the direct effect of an investment in infrastructure. Impacting commuter market access, conditional on prices and population, induces a housing demand shock. However, as shown below, the indirect effect through equilibrium changes is relevant and can also be expressed as a function of CMA.

3.1.2 Housing supply

We close the housing market by modeling the supply of residential floor space. We follow Brueckner et al. (1987) and Brueckner et al. (2017) and consider a perfectly competitive market where firms use the fixed amount of available land per block $\bar{L_i}$ and capital K to produce housing, according to the concave constant returns function $H_i(K, L)$. These firms rent land and capital at prices r and ι, respectively. Let S be the capital-land ratio and $H(S, 1) \equiv h(S)$, giving floor space per land unit. The profit per unit of land of a developer in block i is then:

$$p_i \cdot h_i(S) - \iota \cdot S - r_i \tag{8}$$

As customary in the literature, we assume that the production function has the following Cobb-Douglas form $H_i(K, L) = B_i L_i^{1-\alpha} K_i^{\alpha}$. This implies that $h_i(S) = B_i S^{\alpha}$ and, using profit maximization, the supply of floor space per unit of land in block i is given by:

$$h_i = b_i \cdot \left(\frac{\iota}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} \cdot p_i^{\frac{\alpha}{1-\alpha}} \tag{9}$$

with b_i a transformation of the block productivity shifter B_i. h_i can be transformed into aggregate supply per block by multiplying it by $\bar{L}_i$.

As for the regulation, we follow Brueckner et al. (2017) and model a FAR limit as a maximum value of $h_i(S)$, which, in turn, implies a maximum value of the capital to land ratio. If the unrestricted supply is beyond this limit, then the supply becomes inelastic and equal to the limit $\bar{h_i}$. In summary, the aggregate housing supply in block i is:

$$H_i^S = \begin{cases} \bar{L}_i \cdot b_i \cdot \bar{\alpha} \cdot p_i^{\frac{\alpha}{1-\alpha}} \text{ if } & \bar{\alpha} \cdot p_i^{\frac{\alpha}{1-\alpha}} \leq \bar{h_i} \\ \bar{L}_i \cdot \bar{h_i}, \quad \text{otherwise} \end{cases} \tag{10}$$

where $\bar{\alpha} \equiv (\iota/\alpha)^{(\alpha/(\alpha-1))}$.

3.1.3 Housing market equilibrium

Combining the population supply equation in (4) with the market-clearing condition for housing, we can solve for the residential floor space as a function of CMA. In particular, by equating demand in (7) and supply in (10), we can relate the price per unit of floor space at block i with population supply π_i and CMA_i. Then, we obtain the structural relation between prices and commuter market access by plugging in the expression for π_i from (4). Substituting this into the housing supply function, we obtain our main equation:

$$\ln H_i = \ln a_i + \frac{(1+\frac{1}{\theta})\alpha}{1+\theta(1-\beta)(1-\alpha)} \ln \text{CMA}_i \tag{11}$$

Where $\ln a_i$ is the log of the product between equilibrium constants, block i's area $\bar{L}_i$, productivity shifter b_i and its amenities A_i. The housing supply elasticity depends on the individuals' preferences through β, the housing supply technology via α, and the dispersion parameter of the Frechet distribution. Intuitively, the market access elasticity of residential floor space is larger if the housing supply is more elastic to capital (larger α), if there is more dispersion in idiosyncratic preferences over residence and workplace pairs (smaller θ), and when housing is less critical in the utility (larger β).

Crucially, Equation (11) provides the theoretical foundation for our empirical strategy by establishing a clear, log-linear relationship between our outcome of interest, housing supply (H_i), and our key treatment variable, Commuter Market Access (CMA_i). This justifies our choice to estimate the elasticity (δ) in a first-differenced model, which isolates the impact of transport improvements from time-invariant local characteristics.

Note that Equation (11) applies only when the FAR limit is non-binding and that the regression estimates an average elasticity, with later sections probing heterogeneity across regulatory regimes.

3.2 Empirical strategy

We estimate the first difference version of Eq. (11):

$$\Delta \ln H_i = \delta \cdot \Delta \ln \text{CMA}_i + \phi \cdot X_{i0} + \epsilon_i \tag{12}$$

By estimating the time-differenced equation, we control for time-invariant unobserved characteristics of blocks. We also control for pre-treatment (before the transport infrastructure expansion) baseline variables (X_{i0}), such as block surface and socioeconomic variables.

Our main identification concern is that the infrastructure is not located randomly. If changes in the transport infrastructure (hence, in commuter market access) are correlated with changes in the time-varying unobservables, our estimates would be biased. This would happen if, for example, planners located the new subway lines based on expected structural density trends to enhance the city's growing areas or assist declining municipalities. We deal with the potentially endogenous location of the infrastructure using planned and historical routes as instrumental variables for the new infrastructure.

A second threat to identification, as described in Redding and Turner (2015), is that separating spillovers from other location time-varying factors requires additional assumptions in the presence of general equilibrium effects of transport infrastructure. We argue that this is less of a concern for two reasons. First, the treatment is continuous; thus, the identification is not based on differences between pure treated and control groups. Second, as our model shows, our measure is based on quantitative spatial models of the city that deliver a log-linear relationship between outcomes and CMA.

Lastly, the changes in CMA rely on using endogenous outcomes, such as post-treatment employment. To deal with this issue, we instrument for the difference in market access by keeping labor outcomes and modal shares fixed at previous levels (more details below). In this way, we isolate the effect of travel time changes induced by the new infrastructure.

3.3 Planned route instrumental variable

To account for the potentially endogenous location of subways and urban highways, we apply a "planned route" instrumental variable (see, e.g., Baum-Snow, 2007; Duranton and Turner, 2012; Redding and Turner, 2015; Brinkman and Lin, 2024).

In the 1950s, Santiago comprised 17 municipalities and began to experience the typical problems of a rapidly developing large city. In response, the government implemented the first metropolitan regulation in 1960. The so-called *Plan Regulador Intercomunal de Santiago* established a common rule for the municipalities, defined the urban limits, and established land use zoning for the entire city. A second effort to address urban growth was made in 1966, when the Chilean government called for a study of the transport system for Santiago. The study, awarded to a consortium of French companies and a Chilean consulting office, was delivered to the Chilean authorities at the end of 1967.

Based on the study described above, in 1968, the Chilean government published a transportation investment and regulatory plan. This is the primary source for our planned route instrument. The study includes analyses, projections, and general transportation schemes for the envisioned future of Santiago's Metropolitan Region. Our instrumental variable is based on the general outline and maps of a proposed solution based on public transportation and investments in the road network. The public transportation solution was based on a metro network, comprising three urban and two suburban lines, supported by a dense network of bus lines. We only use this proposed metro network to instrument the subway lines. The 1968 study also proposed a new road infrastructure scheme for the following years, which we use as the instrument for the highways. Figure 5 shows the planned public transportation and road infrastructure network, where Panels (a) and (b) show the original maps and Panels (c) and (d) the digitized version. We instrument the changes in accessibility from 2001 to 2010, using changes in accessibility between our baseline year (2001) and a situation where the planned network was built.

Regarding the validity of our proposed instrument's exclusion restriction, a primary concern with our instrument is that the planned location of the metro stations and the high-speed roads can directly impact the residential floor space development. This could happen if the urban planning process followed the 1968 study and implemented housing policies in the places planned to be connected. However, this is unlikely given the radical break in urban policy during the Pinochet dictatorship (1973-1990), as we explain below. The identification concern may also arise if the 1968 transportation infrastructure plan anticipates housing growth. To address this concern, we control for proximity to the CBD and the transport infrastructure.

There are other reasons why the planned routes will likely have little direct effect on outcomes. In 1973, Augusto Pinochet led a coup d'état against Salvador Allende's government, which gave rise to a dictatorship led by him that lasted until 1990. The dictatorship's economic policy motto was liberalization, and urban planning was no exception. The dictatorship introduced a new urban development policy that significantly revised the guidelines established in the 1960s. The implemented procedure established that urban land was not scarce and defined a flexible planning system that freed investors from restrictions such as urban limits or suburban protection strips (Biblioteca Nacional de Chile, 2023).

As documented by Rojas Ampuero (2022), between 1979 and 1985 the military regime implemented a program of forced slum clearance. This policy led to a large-scale reallocation of residents to peripheral municipalities of the Metropolitan Region—areas that were poorly connected to the urban core and characterized by limited services and nascent housing markets. A notable example is Puente Alto, a municipality located outside Santiago Province, which subsequently became one of the region's most populous areas. Reflecting this demographic shift, the 2005 construction of Subway Line 4—originally planned in 1968 to link the city center with San Bernardo to the south—was instead built to connect Puente Alto, located roughly 10km to the east. This deviation from the 1968 plan provides evidence in favor of the plausibility of our instrument's exclusion restriction.

3.4 Commuter market access

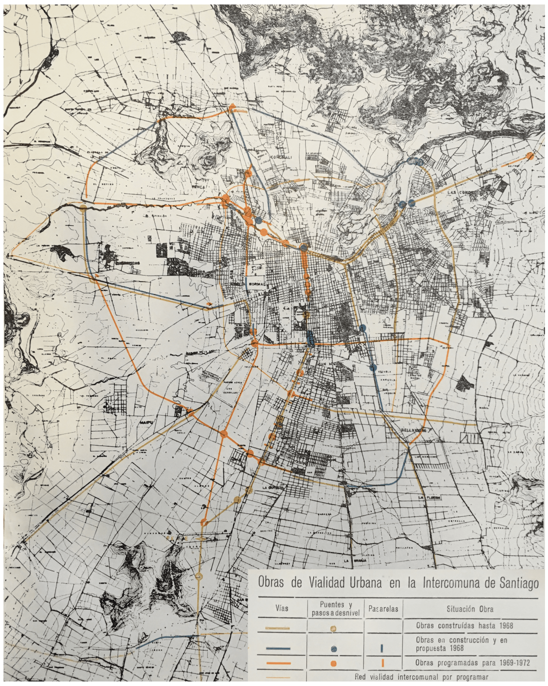
As equation (5) shows, the commuter market access of a block i is given by $\sum_j (w_j/d_{ij})^{\theta}$, which reflects that nearby well-paid jobs are preferred. Conceptually, the Commuter Market Access (CMA) index can be thought of as a 'job gravity' score for each residential block. A block has stronger gravity if it offers a short commute to many high-paying jobs. The transport expansion reshuffles this gravity map, making some areas more attractive.

Usually, the CMA is computed by solving a system of equilibrium equations that relies on the employment at each location instead of requiring georeferenced wage data. In summary, it calculates the market access for each location consistent with the following observed data to be

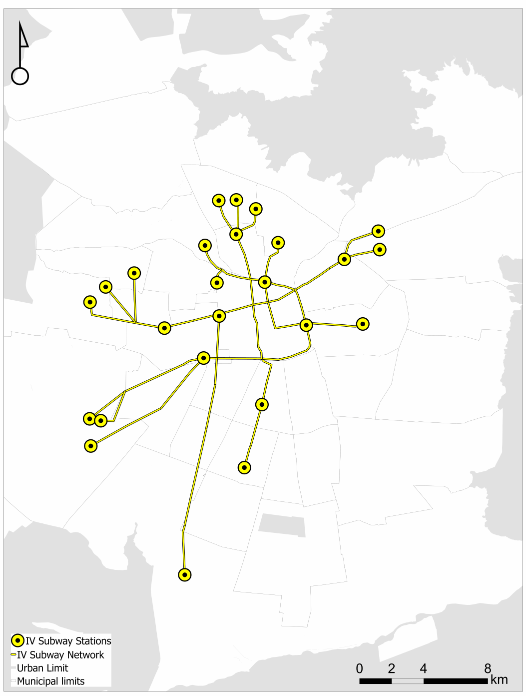
Figure 5: 1968 Planned infrastructure, Ministry of Public Infrastructure and Transport

(a) Raw Subway Map 1968

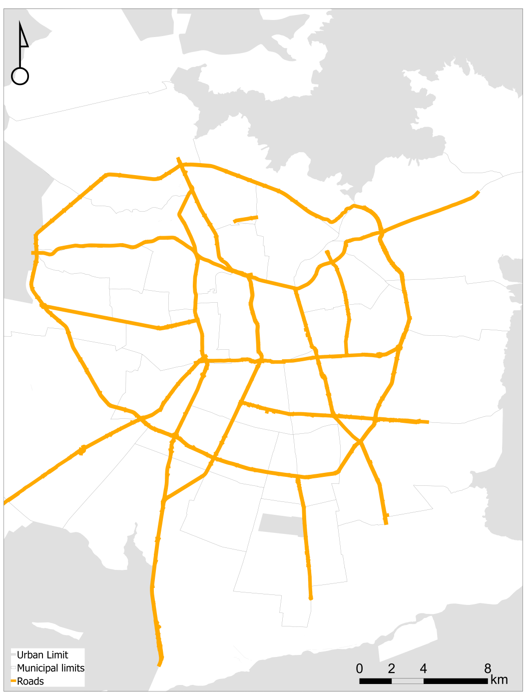
(b) Raw Road Map 1968



(c) IV Subway map



(d) IV Urban Highways map



Notes: Figures 5a and 5b present the 1968 plans of the Ministry of Public Infrastructure and Transport for subway and roads in Santiago. Figures 5c and 5d present the digitalized 1968 plans and the 2001 and 2010 transport networks for subway and urban highways. **Source:** Center of documents of the Housing Ministry of Chile.

the model's equilibrium: workplace and residential employment per block, floor space prices, and commuting costs. To our knowledge, georeferenced disaggregated employment data is not available for Santiago.

Nevertheless, we can take advantage of the Origin-Destination surveys of 2001 and 2012 that provide bilateral commuting flows before and after, and allow for computing wages at destination. As for the proximity, which is a decreasing function of commuting times, T_{ij}, we follow Ahlfeldt et al. (2015) and use the following function:

$$d_{ij} = \exp(\kappa \cdot T_{ij}) \tag{13}$$

where κ is a parameter set to 0.01 based on Ahlfeldt et al. (2015) and Tsivanidis (2023).

As discussed above, the weights in the post-treatment year are mechanically endogenous. We construct Δln(CMA) with baseline wages and instrument it with the CMA change implied by the 1968 plan. As we rely on origin-destination surveys, we use Chile's Estraus zones as the spatial unit of destination. The Ministry of Planning constructed these zones to analyze transport systems in the country's main cities. For the Santiago Metropolitan area, there are 618 Estraus zones (see Niehaus et al., 2016, for details); consequently, for each of the approximately 16,000 blocks, we calculate the market access considering 618 destinations weighted by the observed wage.

We must compute the travel time between origin-destination pairs for each available mode: car, bus, and subway. We calculate the minimum travel times for each block i to the 618 Estraus zones using ArcGIS's Network Analysis Tools and speeds reported in SECTRA (2001) and SECTRA (2012). We also consider that in 2007, a fare integration for buses and the subway was implemented, changing the decision-making process of individuals traveling on public transportation. Due to this change, in 2010, public transport users could use buses and the subway for different trip stages, paying only the subway fare. Therefore, in the post-treatment year 2010, we allowed combining both modes.

We must also consider that modes are used with different intensities in different city areas. For example, a highway in areas where the predominant mode is public transport should have a less significant impact than a subway line. We therefore estimate a mode choice model to aggregate over modes to account for this. We follow Ahlfeldt et al. (2015) and measure overall travel times by weighting each mode's minimum travel time using the share of trips undertaken by each available mode. We estimate a Logit mode choice model for each year using Santiago's 2001 and 2012 Mobility Survey. We then predict shares for each mode and each origin-destination pair to use as weights. Because the post-treatment weights are mechanically endogenous, as mentioned in Section 3.4, the weights for our instrumental variable are also fixed at a predetermined level, using the information only from 2001, while travel time changes come from using the 1968 plan.

3.5 Predicted commuter market access

Table A1 summarizes our sample's changes in log CMA from 2001 to 2010. Market access increased by 117 log points on average, with a standard deviation of 12, a median of 117, and a 90th percentile of 132. Changes are similar among socioeconomic quintiles, with the first four quintiles experiencing an increase in market access of approximately 120 log points. The difference in the wealthiest quintile was, on average, 106.

Figure 6 shows the change in market access. In the Appendix, we detail the changes induced by the instrumental variable (Figure A1), and Figure A2 presents a close-up of the west part of the subway network. Darker colors stand for more significant changes in accessibility, varying within the treated area. The scattering observed in these figures is expected for these types of indexes (Gibbons and Machin, 2005), and it provides a visual representation of the variation in the space.

4 Results

4.1 Main Results

Table 4 shows the estimation of the market access elasticity of residential floor space, residential units, and prices from our first-difference model in equation (12). In this and in subsequent specifications, we control for log distance to: main roads (Alameda, Ruta 5, and Vespucio), the nearest subway station in 2001, and the central business district. We also control for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, log non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block.[15] The OLS estimation shows that a one-percent increase in our measure of market access increases the residential floor space by 0.10, the units by 0.22, and prices by 0.86. While not causal, the results are consistent with the idea that prices react more quickly than residential construction.

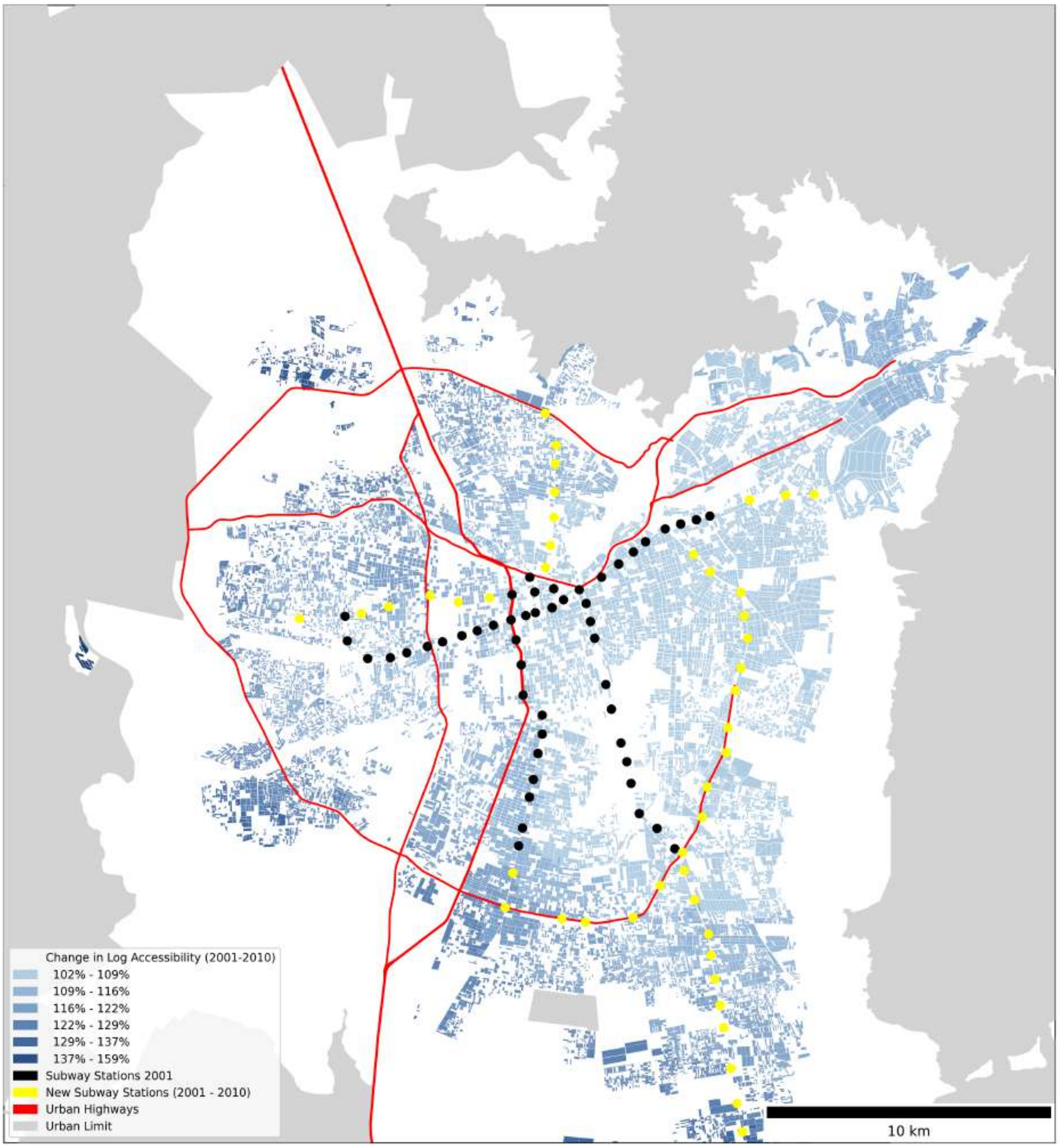
Table 5 reports the results using an instrumental variable for the change in log commuter market access between 2001 and 2010. As detailed in the empirical strategy section, the instrument relies on 1968 planned routes, 2001 wages to weight employment destinations and on 2001 bilateral commuting flows to weight mode-specific travel times. Together, these choices help address concerns related to endogeneity in workplace attractiveness. Importantly, the effect of the infrastructure is instrumented using the changes in travel times that the planned route would have generated. For simplicity, we denote the full instrument as $\Delta \ln(\text{CMA}_{IV})$.

Panel A of Table 5 shows the IV results: the market access elasticity estimated with the instrument is 0.36 for floor space, 0.42 for units and 1.40 for price. The estimate is larger than the OLS coefficient in Table 4 and is statistically significant for all variables. Panel B shows the first-stage results. The instrument is strong, the Kleibergen-Paap rk Wald F statistic is well above the Stock and Yogo (2005) critical value for one endogenous regressor (assuming i.i.d. errors) and a 10% maximal bias of the IV estimator relative to OLS at the 5% level of 16.38.

While increased prices due to improved accessibility have been extensively documented, their impact on residential floor space and units is far less studied. To our knowledge, we can use no direct evidence of this elasticity to compare with our findings. For example, Tsivanidis (2023) finds no impact on floor space and a price elasticity of 0.4 in Bogotá. Our results reveal

[15] As some blocks are 100% residential, we use the logarithm of one plus the non-residential floor space as control.

Figure 6: Change in log commuter market access (2001 - 2010).



Notes: The figure presents the change in log commuter market access index from 2001 to 2010. The sample and data sources are detailed in Section 2.3.

Table 4: OLS Results - Elasticity of residential floor space, housing units and prices to commuter market access (2001-2010).

	Floor space	Units	Prices
	(1)	(2)	(3)
$\Delta \ln(\text{CMA})$	0.10	0.22**	0.86***
	(0.08)	(0.09)	(0.27)
Observations	16,516	16,516	16,516
R^2	0.07	0.26	0.02

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: The table reports coefficients and standard errors clustered on the census tract from the block level regression. The dependent variables are the change in the log floor space, log housing units and log prices of the block. The variable $\Delta \ln(CMA)$ is the change in the log commuter market access from 2001 to 2010. The sample and data sources are detailed in Section 2.3. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block.

Table 5: IV Results - Elasticity of residential floor space, housing units and prices to commuter market access (2001-2010).

Panel A: Two-Stage Least Squares			
	Floor space	Units	Prices
$\Delta \ln(\text{CMA})$	0.36***	0.42***	1.40***
	(0.12)	(0.12)	(0.35)
Observations	16,516	16,516	16,516
R^2	0.07	0.26	0.02
Wu-Hausman	64.55	36.91	17.23

Panel B: First Stage (dependent variable: $\Delta \ln(\text{CMA})$)	
$\Delta \ln(\text{CMA}_{IV})$	1.19***
	(0.04)
Observations	16,516
R^2	0.91
Kleibergen-Paap rk Wald F statistic	901.00
Stock-Yogo weak ID test CV (10%)	16.38

Standard errors in parentheses are clustered at the census tract level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Panel A of the table reports the 2SLS estimate of the elasticity of residential floor space, housing units and prices to commuter market access. Panel B, common to the three columns, reports the first stage regression of the endogenous measure of commuter market access, $\Delta \ln(CMA)$, on the instrument, $\Delta \ln(CMA_{IV})$. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block.

a more responsive market.

While the average elasticities are economically and statistically significant, the results obscure the central finding of our paper: this effect is fundamentally shaped by the interaction of local land-use regulations and the socioeconomic status of neighborhoods. We turn to a detailed examination of this heterogeneity below.

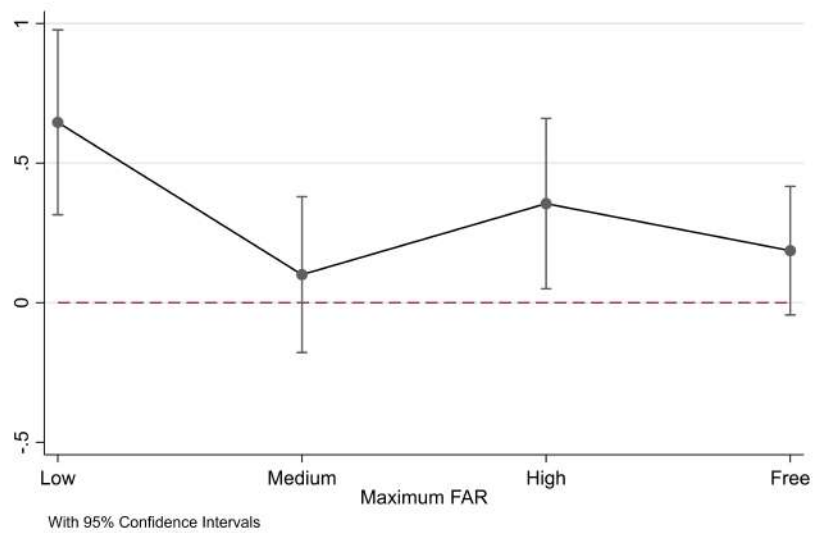
Our results are relatively homogeneous along baseline residential floor space density and distance to the CBD. When considered on its own, SES also shows no differential effect. We take advantage of the micro-scale of our data to study these three sources of heterogeneity. For the initial density and socioeconomic status, we interact our key variable Δln(CMA) with an indicator for five equally sized groups (quintiles) based on the baseline (pre-determined) value of the variable. For the distance to the CBD, we follow Baum-Snow and Han (2024) and interact the change in market access with the distance and the distance squared. Results in Appendix B show that there is no significant heterogeneity.

4.2 Regulation

To understand the regulation's role in shaping the economic activity distribution, we use the unique dataset described in Section 2 that details every block's maximum FAR and height in our sample. With this exercise, we can study the role of regulation in the effects of market access. As Table 3 shows, the main regulatory variable is the Maximum FAR: 61% of the blocks in our sample have a FAR limit defined by the corresponding municipality, while the remaining 39% do not have a restraint. On the other hand, the maximum height is fixed only for 32% of the blocks. For this reason, we study the heterogeneity of the market access impact with respect to the maximum FAR using the four categories described in Section 2.3.

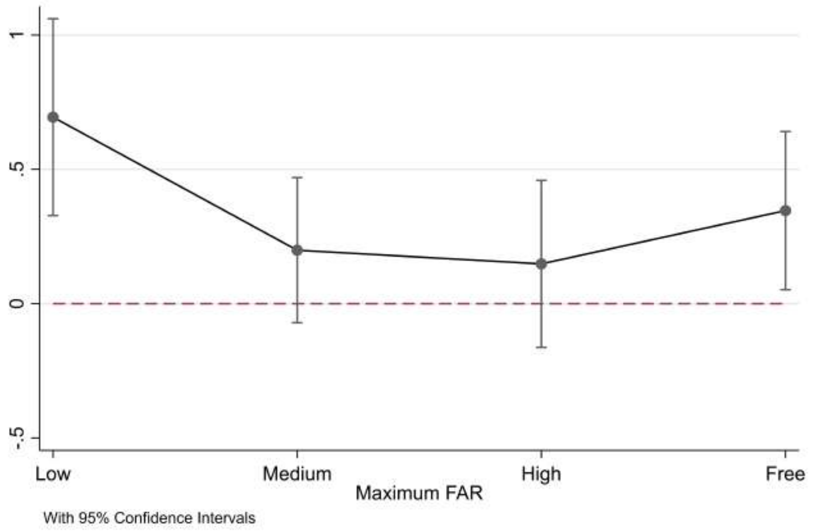
Table A6 shows the results and Figures 7–9 summarize the results graphically. The results show that there is little significant heterogeneity across baseline regulation levels. Thus, the floor space, units and price elasticities are not statistically different to the average elasticities reported in Table 5. If any heterogeneity exists, it indicates a stronger effect on floor space and number of units in places with low maximum FAR.

Figure 7: Heterogeneity in the results: Floor space - Regulation (REG).



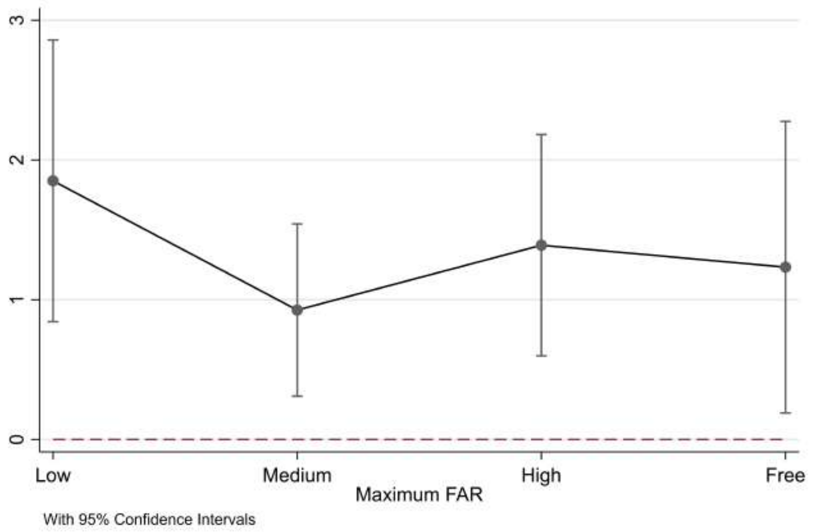
Notes: The figure reports 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the regulation category to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table A6.

Figure 8: Heterogeneity in the results: Units - Regulation (REG).



Notes: The figure reports 2SLS estimates of the elasticity of housing units to commuter market access interacted with the regulation category to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table A6.

Figure 9: Heterogeneity in the results: Prices - Regulation (REG).

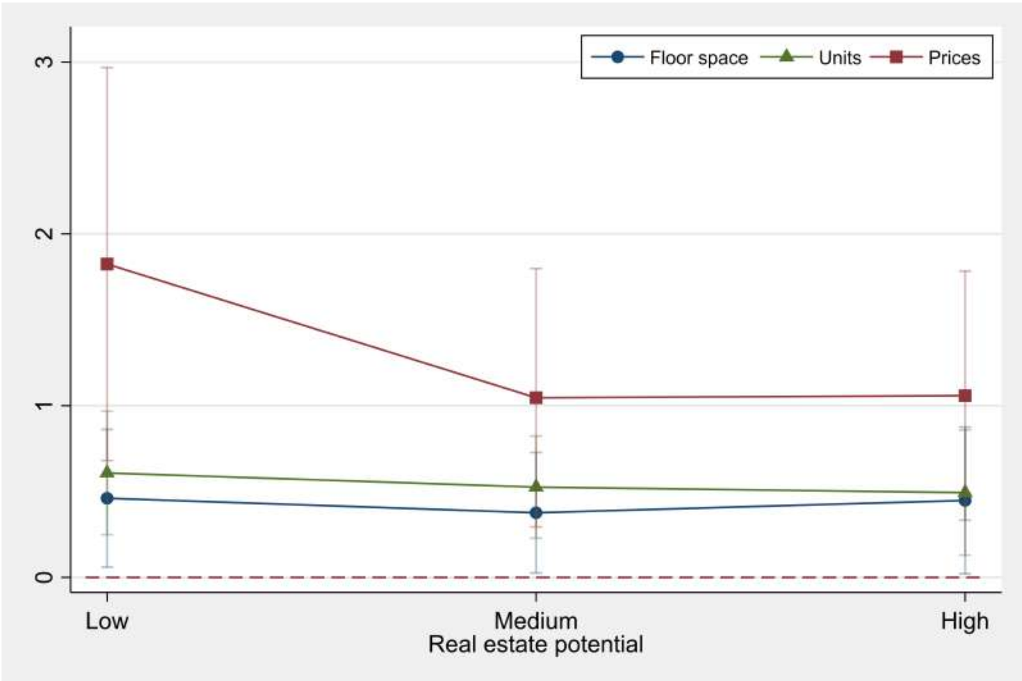


Notes: The figure reports 2SLS estimates of the elasticity of prices to commuter market access interacted with the regulation category to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table A6.

The minimal heterogeneity could stem from the varying stringency of Floor Area Ratio (FAR) regulations. High-FAR zones may already be built to their maximum legal capacity, making the regulation a binding constraint. In contrast, low-FAR zones, particularly if undeveloped, may face a non-binding regulation. To measure this effect, we introduce the Real Estate Potential (REP) index, calculated as the gap between the maximum permitted and the actual built residential floor space in 2001. This index proxies for the effective regulatory stringency and is computed only for blocks with specified FAR limits.

Figure 10 summarizes the results. Again, we do not observe heterogeneity in the floor space and units elasticity. This result discards the possibility that the effect is stronger in blocks where the regulation is less stringent (i.e., high REP). As for the price elasticities, the lowest-REP tertile shows an elasticity of about 1.8, while the two higher tertiles are roughly 1, and these differences reach 10% significance. We discuss this difference below.

Figure 10: Heterogeneity in the results: Real estate potential (REP).



Notes: The figure reports 2SLS estimates of the elasticity of residential floor space, housing units, and prices to commuter market access interacted with the real estate potential of the block (expressed in tertiles). The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table A7 results.

Another possible explanation for the lack of heterogeneity is that a second driver of heterogeneity is masked in the specification above. The two central hypotheses that aim to explain the processes affecting land-use regulations may be behind these results. First is the "growth machine" hypothesis, which states that the real estate industry is the most potent agent behind the decisions taken by city officials on the uses of urban land (Molotch, 1976). On the other hand, the "home voter" theory claims that property owners are today the most influential actors in how cities' land use is regulated (Fischel, 2005; Been et al., 2014; Gabbe, 2018). The real estate industry, thus, would push for relaxing the regulations in places with increased market access to take advantage of the housing demand shock. This pressure aligns with a municipality that maximizes revenue from property taxes. On the contrary, the homeowners would seek to maintain the status quo and prevent densification.

To shed light on the issue, we begin by studying whether there are differences between income groups in the baseline regulation and the elasticities and their heterogeneity concerning regulation. Table 6 displays the regulation descriptive statistics according to the wealth status. The table illustrates the baseline distribution of the maximum FAR allowed in the blocks belonging to different socioeconomic quintiles. Note that the tertiles of maximum FAR are defined using the full sample; therefore, they do not represent tertiles within socioeconomic groups.

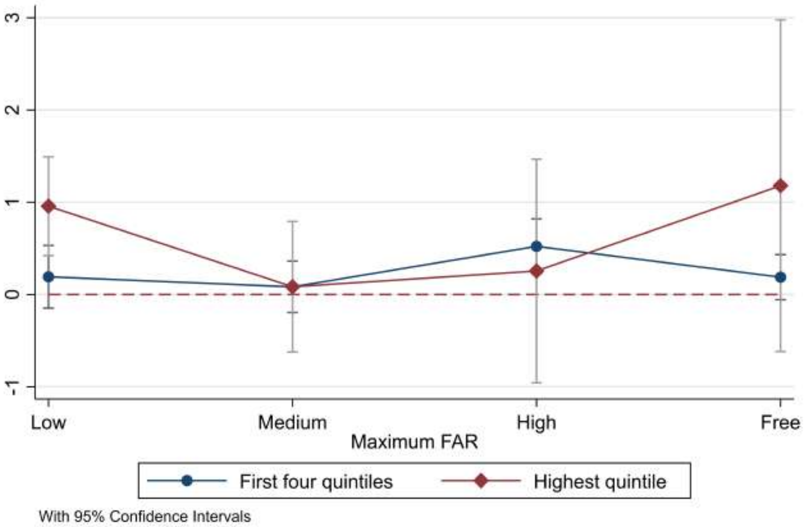
The fact that stands out is that in the baseline, the regulation was significantly more restrictive in the wealthiest quintile's blocks. This difference is explained mainly by the share of blocks with unrestricted maximum FAR. In the first two quintiles of wealth, it is approximately 60%, for the medium group, it is 50%, medium-high, it is 24%, and for the highest quintile, it is only 4% of the blocks. Moreover, in the wealthiest quintile, 53% of the blocks fall in the low maximum FAR category, while for the rest it ranges from 6 to 24 percent.

Table 6: Baseline regulation by wealth status.

Socio-economic quintile		FAR-based regulation category			
		Low	Medium	High	Unrestricted
Low	Mean Max. FAR (2001)	0.52	1.37	2.26	—
	Observations	182	556	642	1,925
	Share (%)	6	17	19	58
Middle-Low	Mean Max. FAR (2001)	0.53	1.36	2.17	—
	Observations	235	670	445	1,952
	Share (%)	7	20	13	59
Middle	Mean Max. FAR (2001)	0.50	1.36	2.04	—
	Observations	472	942	310	1,586
	Share (%)	14	28	9	48
Middle-high	Mean Max. FAR (2001)	0.50	1.37	1.95	—
	Observations	783	1,465	269	781
	Share (%)	24	44	8	24
High	Mean Max. FAR (2001)	0.64	1.34	1.91	—
	Observations	1,759	505	889	148
	Share (%)	53	15	27	4
Total	Mean Max. FAR (2001)	0.57	1.36	2.06	—
	Observations	3,431	4,138	2,555	6,392
	Share (%)	21	25	15	39

As the most notorious difference is between blocks that belong to the wealthiest 20 percent of our sample and the rest, we use an indicator of whether the block belongs to the wealthiest quintile to study the potential impact of baseline regulation on heterogeneous outcomes. We thus estimate the same model of FAR heterogeneity as above (Figures 7–9) but interacting the regulation category with an indicator of whether the block belongs to the wealthiest quintile. Figures 11–13 summarize the results, revealing an underlying difference between income groups in how the market access elasticity of floor space, units and prices varies with regulation. First, the elasticities in the first four socioeconomic groups' blocks are largely stable across all levels of initial regulation, with a higher point estimate in the High-FAR category for floor space. This implies that in these areas, the demand shift due to increased commuter market access implied higher prices and a larger quantity, in line with the typical short-run equilibrium response with an upward sloping supply function.

Figure 11: Heterogeneity in the results: Floor space - Maximum FAR and socioeconomic status.



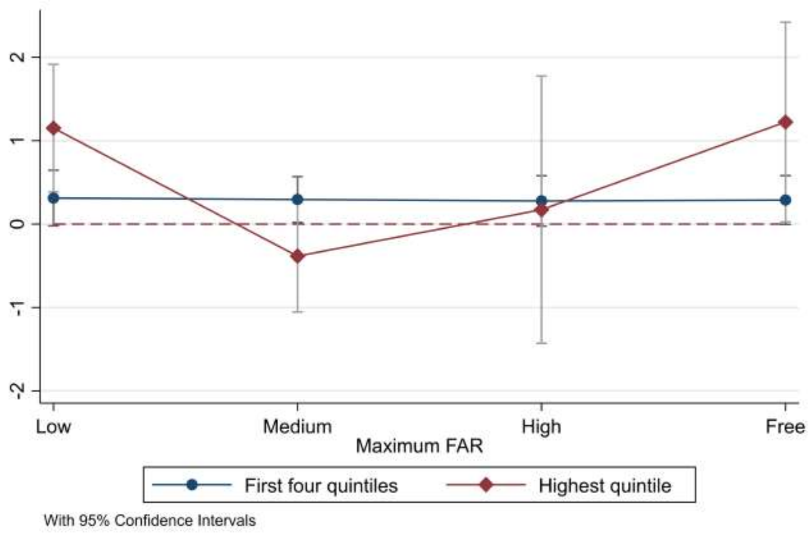
Notes: The figure reports 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the regulation category and a dummy for the socioeconomic status (zero if the block is in the first four quintiles and one if the block is in the fifth quintile). The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from the results in Table A8.

In the wealthiest quintile, however, there is only a significant impact on residential floor space where the maximum FAR allowed is low. For housing units, results are similar, except that we also find a considerable elasticity in the few blocks with unrestricted FAR. Finally, the price elasticity is much larger in wealthy blocks than in the other four socioeconomic groups' blocks, increasing as the regulation is more permissive. This is consistent with regulations imposing a cost and making plots less desirable for real estate development.

The implication is that in most of the city, unit development happens across all regulatory levels and the more sizable impact on residential floor space is where the regulation allows for multifamily housing. On the contrary, in the top socioeconomic quintile, the transport infrastructure increases units and floor space when regulation is less permissive, suggesting a lack of multifamily housing development.

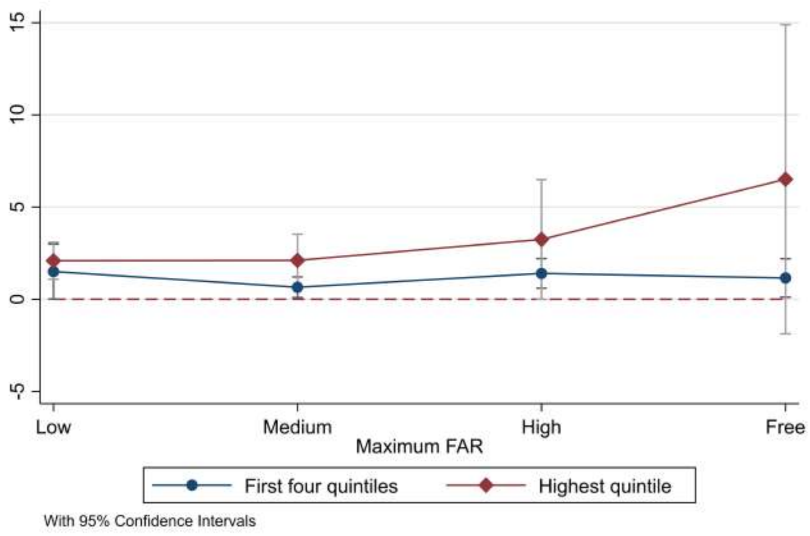
In the top socioeconomic quintile, the elasticity for housing units is also large and significant in the small subset of Unrestricted blocks, but floor-space growth is not significant and such blocks represent only 4% of rich-quintile observations, not altering the interpretation regarding the lack of multifamily development.

Figure 12: Heterogeneity in the results: Units - Maximum FAR and socioeconomic status.



Notes: The figure reports 2SLS estimates of the elasticity of housing units to commuter market access interacted with the regulation category and a dummy for the socioeconomic status (zero if the block is in the first four quintiles and one if the block is in the fifth quintile). The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from the results in Table A8.

Figure 13: Heterogeneity in the results: Prices - Maximum FAR and socioeconomic status.



Notes: The figure reports 2SLS estimates of the elasticity of prices to commuter market access interacted with the regulation category and a dummy for the socioeconomic status (zero if the block is in the first four quintiles and one if the block is in the fifth quintile). The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from the results in Table A8.

4.3 Robustness

We perform a series of robustness checks, which we summarize in this section. In a nutshell, we test the robustness of our results by considering different sub-samples, using alternative market access measures, and including additional and alternative covariates. We also use HAC standard errors to allow for spatial correlation of errors across blocks within 500m of each other. Some results are presented below, while the rest are in Appendix A.

We present the results when no controls are included and add covariates one by one to reach our preferred specification in column (7). Table 7 summarizes the results. Second, Table A2 shows the results when we exclude from the analysis the blocks within 100, 250, and 500 meters from the new infrastructure in columns (2), (3), and (4), respectively. As a reference, column (1) shows the main results with the whole sample, just as in Table 5. The point estimates are very similar across samples, and the differences between the elasticities are not statistically different from zero. Therefore, we can conclude that our results are not driven only by changes in areas surrounding the new subway stations or highway entries and exits.

Table 7: Elasticity of residential floor space, housing units and prices to commuter market access (2001-2010).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: residential floor space							
	0.11**	0.16***	0.23**	0.32***	0.33***	0.33***	0.36***
	(0.05)	(0.05)	(0.10)	(0.11)	(0.12)	(0.12)	(0.12)
Observations	16,516	16,516	16,516	16,516	16,516	16,516	16,516
R^2	0.00	0.00	0.01	0.03	0.05	0.05	0.07
Panel B: housing units							
	-0.80***	-0.61***	0.15	0.44***	0.44***	0.44***	0.42***
	(0.08)	(0.07)	(0.09)	(0.11)	(0.11)	(0.11)	(0.12)
Observations	16,516	16,516	16,516	16,516	16,516	16,516	16,516
R^2	0.12	0.17	0.24	0.25	0.25	0.25	0.26
Panel C: prices							
	0.37**	0.64***	0.91***	1.21***	1.27***	1.27***	1.40***
	(0.17)	(0.17)	(0.28)	(0.34)	(0.34)	(0.34)	(0.35)
Observations	16,516	16,516	16,516	16,516	16,516	16,516	16,516
R^2	-0.00	0.00	0.02	0.02	0.02	0.02	0.02
Log Surface	No	Yes	Yes	Yes	Yes	Yes	Yes
CBD	No	No	Yes	Yes	Yes	Yes	Yes
City dummies	No	No	Yes	Yes	Yes	Yes	Yes
Log Distance to SW 2001	No	No	No	Yes	Yes	Yes	Yes
Log Distance to Main Road	No	No	No	Yes	Yes	Yes	Yes
SES	No	No	No	No	Yes	Yes	Yes
Log Population in 2000	No	No	No	No	No	Yes	Yes
Baseline regulation	No	No	No	No	No	No	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports 2SLS estimates of the elasticity of residential floor space, housing units and prices to commuter market access. Each column is from a different regression; covariates are added progressively in each specification, from Column 1 that does not have any covariates to Column 7 that is the same specification as Table 5.

Third, we use different market access measures and assumptions regarding the destination weights. Table A3 displays the results. Panel A reproduces the main result in Table 5. Panel

B reports the results using industrial and commercial floor space instead of wages to compute the destination weights. Panel C estimates a model that uses commuting flows as destination weights. While the absolute number changes with the specifications, the relative magnitude between elasticities and the statistical significance is maintained.

We also explore the robustness of including other socioeconomic covariates and the baseline residential floor space density. Table A4 summarizes the results. Column 1 shows our preferred specification. In column 2, we control for the number of households per block instead of controlling for the population. Column 3 includes municipality fixed effects; in Column 4, we control for the baseline floor area ratio. Column 5 controls for the real estate potential, i.e., the difference between what the regulation allows for and the floorspace already constructed. The elasticity is large and statistically significant in all cases, with a minor size variation across specifications.

In summary, adding covariates or using alternative density measures does not affect our result. Finally, we compute HAC standard errors to allow for spatial correlation of errors across blocks within 500m of each other. The elasticity estimate is still significant at the 1% level (see Table A5).

5 Conclusions

The response of a city's housing market to major transport investment is a tale of two cities divided by wealth and land-use regulation. Our findings reveal two starkly different dynamics operating within Santiago. In the vast majority of the city, encompassing low- and middle-income areas, new infrastructure successfully induced housing growth where zoning permitted, increasing the supply of both floor space and housing units. In stark contrast, within the city's wealthiest areas, a pre-existing regime of highly restrictive regulation effectively severs this link. There, the economic benefits of public investment are not translated into new housing for a growing city but are instead capitalized into higher property prices for incumbent homeowners, a dynamic consistent with the 'homevoter' hypothesis. This suggests that the political economy of zoning in affluent areas acts as a critical bottleneck for metropolitan housing supply.

Beyond its policy relevance, our analysis contributes to the broader urban economics literature in two key ways. First, by employing a quasi-experimental design with a unique, fine-grained dataset on local regulations, we provide some of the first causal estimates of the crucial interaction between accessibility shocks and zoning constraints at the micro-level. Second, our findings from an emerging economy context provide an important qualification to theories of urban spatial structure. Unlike recent evidence from the U.S. suggesting that housing supply is most elastic at the urban fringe, we find no such pattern in Santiago. We attribute this to the significant redevelopment potential that existed in Santiago's core during our study period, demonstrating that the relationship between distance and supply elasticity is contingent on a city's stage of development.

Our findings also have direct implications for policy. To maximize housing supply, upzoning corridors around new transit stations would be most effective in the lower- and middle-income 80% of the city, where our results show developers are ready and willing to build multifamily housing when permitted. Conversely, land value capture mechanisms would be most potent and justifiable in the wealthiest 20% of the city, where our estimates show public investment generates the largest price windfalls for property owners precisely because new supply is blocked. Without such coordinated policies, transport investments risk exacerbating inequality by delivering housing in one part of the city while increasing values in another.

Future research could build on this framework by deepening the understanding of the consequent sorting of households to understand the full general equilibrium impacts on segregation and welfare, particularly in the rapidly urbanizing cities of the Global South, where these dynamics are most acute.

Given these insights, we emphasize the need for future research on urban land-use regulations' affordability and welfare implications, particularly in emerging economies and the majority world.

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Appendix A - Additional results and descriptive statistics

Table A1: Change in log accessibility by socioeconomic status (2001 - 2010). Entries equal $100 \times \Delta \ln(\text{CMA})$

Socioeconomic Status	**Mean**	**SD**	**Median**	**90th pct.**	**Max**
Low	120	9	121	131	148
Medium/Low	120	10	119	133	149
Medium	120	11	119	136	150
Medium/High	118	11	118	133	157
High	106	11	102	122	159
Total	117	12	117	132	159
Observations	16,516				

Notes: The table shows summary statistics of changes in the log commuter market access from 2001 to 2010, by socioeconomic status (quintiles). The sample and data sources are detailed in Section 2.3.

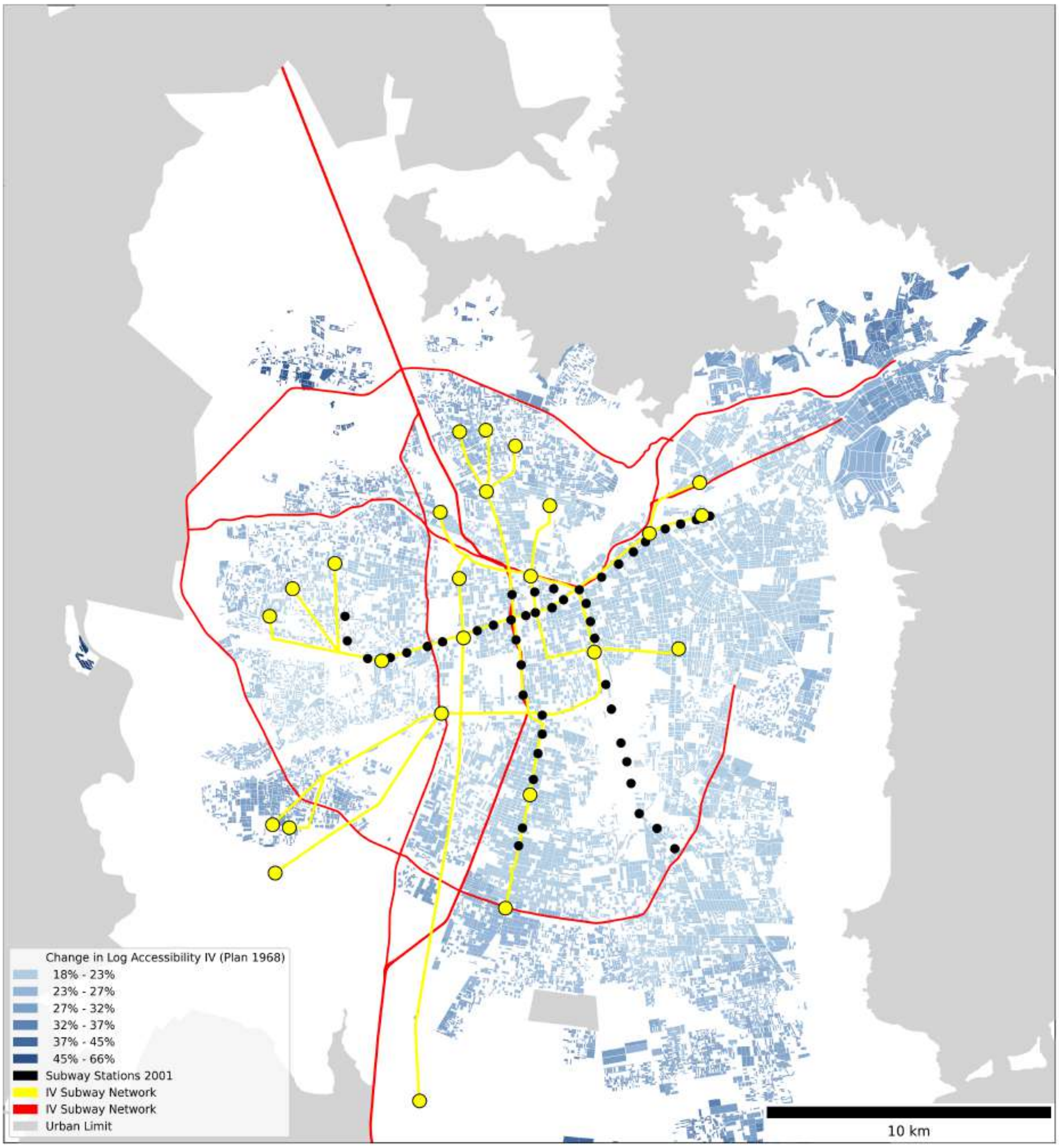
Table A2: Robustness of effects of accessibility on floor space to different subsamples (2001-2010).

	(1)	(2)	(3)	(4)
Floor space	0.36***	0.36***	0.40***	0.41***
	(0.12)	(0.12)	(0.12)	(0.13)
Observations	16,516	16,400	15,637	13,455
R^2	0.07	0.07	0.07	0.06
Units	0.42***	0.42***	0.45***	0.49***
	(0.12)	(0.12)	(0.12)	(0.13)
Observations	16,516	16,400	15,637	13,455
R^2	0.26	0.26	0.26	0.26
Price	1.40***	1.41***	1.47***	1.41***
	(0.35)	(0.35)	(0.36)	(0.40)
Observations	16,516	16,400	15,637	13,455
R^2	0.02	0.02	0.02	0.02

Standard errors in parentheses

Notes: The table reports 2SLS estimates of the elasticity of residential floor space to accessibility. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. Column 1 shows the result in Table 5, which is the sample within a 3km radius of a new subway station or an urban highway entry or exit, while columns 2 to 4 drop blocks from the first 100, 250, and 500 meters from a new subway station or an urban highway entry or exit.
Source: Own calculations using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII) and data from the INE's 2001 population Census.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure A1: Change in the log commuter market access (2001 - 2010) using 2001 wages and planned routes traveling times (instrumental variable).



Notes: The figure presents the change in log commuter market access from 2001 to 2010, using the instrumental variable. The sample and data sources are detailed in Section 2.3, and the instrumental variable in Section 3.3.

Figure A2: Change in log accessibility (2001 - 2010) - Close-up of the west of Santiago's subway network.

Notes: The figure presents the change in log commuter market access from 2001 to 2010, zoomed in to the west of the subway network. The sample and data sources are detailed in Section 2.3.

Table A3: Robustness of effects of accessibility on floor space to alternative accessibility measures (2001-2010).

	Floor space	Units	Prices
	(1)	(2)	(3)
		Panel A: Wage-based CMA	
$\Delta \ln(\text{CMA})$	0.36***	0.42***	1.40***
	(0.12)	(0.12)	(0.35)
Observations	16,516	16,516	16,516
R^2	0.07	0.26	0.02
		Panel B: Commercial and industrial floor space-based CMA	
$\Delta \ln(Acc.^{M^2}_{2010-2001})$	0.46***	0.59***	1.73***
	(0.15)	(0.15)	(0.42)
Observations	16,516	16,516	16,516
R^2	0.08	0.26	0.02
		Panel C: Commuter-based CMA	
$\Delta \ln(Acc.^{Commuters}_{2010-2001})$	2.16***	2.22***	6.35***
	(0.77)	(0.71)	(2.28)
Observations	16,516	16,516	16,516
R^2	-0.22	0.08	-0.13

Standard errors in parentheses

Notes: The table reports 2SLS estimates of the elasticity of residential floor space to accessibility. Regressions in each column control for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), quintiles to the central business district, log population, log surface area, and the baseline socioeconomic quintile of the block. Panel A shows the same result as Table 5, which uses built-up surface for commercial land use in 2009 and 2000 as destination weight for each period. Panel B uses a different destination weight for the endogenous variable and the instrument, using commercial and industrial floor space instead of wages. Panel C uses the number of commuters whose destination is the zone as weight.

Source: Own calculations using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII) and data from the INE's 2001 population Census.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Robustness of effects of accessibility on floor space to adding additional controls (2001-2010).

	(1)	(2)	(3)	(4)	(5)
Floor space	0.36***	0.36***	0.36**	0.36***	0.44***
	(0.12)	(0.12)	(0.16)	(0.11)	(0.12)
Observations	16,516	16,516	16,516	16,516	16,516
R^2	0.07	0.07	0.11	0.11	0.10
Units	0.42***	0.43***	0.65***	0.32***	0.42***
	(0.12)	(0.12)	(0.15)	(0.12)	(0.12)
Observations	16,516	16,516	16,516	16,516	16,516
R^2	0.26	0.25	0.29	0.27	0.26
Price	1.40***	1.39***	0.90**	1.31***	1.36***
	(0.35)	(0.35)	(0.44)	(0.34)	(0.35)
Observations	16,516	16,516	16,516	16,516	16,516
R^2	0.02	0.02	0.03	0.02	0.02
Log Surface	Yes	Yes	Yes	Yes	Yes
CBD	Yes	Yes	Yes	Yes	Yes
City dummies	Yes	Yes	No	Yes	Yes
Log Distance to SW 2001	Yes	Yes	Yes	Yes	Yes
Log Distance to Main Road	Yes	Yes	Yes	Yes	Yes
Socio economic level	Yes	Yes	Yes	Yes	Yes
Regulation	Yes	Yes	Yes	Yes	Yes
Log Population in 2000	Yes	No	Yes	Yes	Yes
Log Households in 2001	No	Yes	No	No	No
Municipality Dummies	No	No	Yes	No	No
Initial density	No	No	No	Yes	No
Real estate potential	No	No	No	No	Yes

Standard errors in parentheses

Notes: The table reports 2SLS estimates of the elasticity of residential floor space to accessibility. Regressions show results for residential land use. Each column is from a different regression; covariates are modified in each specification. Column 1 has the same specification as Table 5, controlling for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), quintiles to the central business district, city sector dummies, log population, log surface area, and the baseline socioeconomic quintile of the block. Column 2 changes log population for log housing. Column 3 changes dummies of the part of the city in which the block is located for municipality dummies. Column 4 has the same covariates as column 1 and controls for the initial density of the block. Column 5 has the same covariates as column 1 and controls for the real estate potential in 2001 of the block.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Robustness of accessibility effects on floor space to different correction of standard errors (2001-2010).

	(1)	(2)
Floor space	0.36***	0.36***
	(0.12)	(0.13)
Observations	16,516	16,516
R^2	0.07	0.07
Units	0.42***	0.42***
	(0.12)	(0.15)
Observations	16,516	16,516
R^2	0.26	0.26
Price	1.40***	1.40***
	(0.35)	(0.33)
Observations	16,516	16,516
R^2	0.02	0.02

Standard errors in parentheses

Notes: The table reports 2SLS estimates of the elasticity of residential floor space to accessibility. Regressions in each column control for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), quintiles to the central business district, log population, log surface area, and the baseline socioeconomic quintile of the block. Column 1 shows the same result as Table 5, which shows standard errors clustered on the census tract. Column 2 shows HAC standard errors (heteroskedastic and autocorrelation consistent), accounting for a spatial correlation within a radius of 0.5 km from the centroid of the block.
Source: Own calculations using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII) and data from the INE's 2001 population Census.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Heterogeneity in the results - Regulation (REG).

	Floor space	Units	Prices
$\Delta\ln(\text{CMA})$	0.65***	0.69***	1.85***
	(0.17)	(0.19)	(0.51)
Low $\times$ $\Delta\ln(\text{CMA})$	0.00	0.00	0.00
	(.)	(.)	(.)
Medium $\times$ $\Delta\ln(\text{CMA})$	-0.55***	-0.50***	-0.92*
	(0.18)	(0.19)	(0.50)
High $\times$ $\Delta\ln(\text{CMA})$	-0.29**	-0.55***	-0.46
	(0.14)	(0.17)	(0.44)
Free $\times$ $\Delta\ln(\text{CMA})$	-0.46***	-0.35*	-0.62
	(0.17)	(0.21)	(0.63)
Low	0.00	0.00	0.00
	(.)	(.)	(.)
Medium	0.67***	0.57***	1.04*
	(0.21)	(0.22)	(0.56)
High	0.33**	0.65***	0.42
	(0.15)	(0.19)	(0.47)
Free	0.48**	0.38	0.58
	(0.20)	(0.25)	(0.72)
Observations	16,516	16,516	16,516
R^2	0.07	0.25	0.02

Standard errors in parentheses. The table reports 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the regulation category to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted in Figures 7–9. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Heterogeneity in the results - Real Estate Potential.

	Floor space	Units	Prices
$\Delta\ln(Acc._{2010-2001})$	0.46**	0.61***	1.82***
	(0.20)	(0.18)	(0.58)
Low $\times$ $\Delta\ln(Acc._{2010-2001})$	0.00	0.00	0.00
	(.)	(.)	(.)
Medium $\times$ $\Delta\ln(Acc._{2010-2001})$	-0.08	-0.08	-0.78*
	(0.13)	(0.15)	(0.46)
High $\times$ $\Delta\ln(Acc._{2010-2001})$	-0.01	-0.11	-0.77*
	(0.18)	(0.18)	(0.46)
Low	0.00	0.00	0.00
	(.)	(.)	(.)
Medium	0.14	0.05	0.81
	(0.14)	(0.17)	(0.50)
High	0.13	0.13	0.75
	(0.21)	(0.20)	(0.50)
Observations	10,124	10,124	10,124
R^2	0.11	0.28	0.03

Standard errors in parentheses

Notes: The table reports 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the real estate potential of the block (expressed in tertiles) to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), quintiles to the central business district, log population, log surface area, and the baseline socioeconomic quintile of the block. These coefficients are plotted in Figure 10.
Source: Own calculations using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII), the dataset on regulation described in Section 2.3, and data from the INE's 2001 population Census.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A8: Heterogeneity in the results — Regulation and socioeconomic status.

	Floor space	Units	Prices
Panel A: Accessibility × Regulation			
$\Delta \ln(\text{Acc.}_{2010-2001})$	0.19	0.31*	1.50**
	(0.17)	(0.17)	(0.76)
Medium × $\Delta \ln(\text{Acc.})$	-0.11	-0.02	-0.85
	(0.20)	(0.16)	(0.73)
High × $\Delta \ln(\text{Acc.})$	0.33**	-0.03	-0.10
	(0.15)	(0.16)	(0.70)
Unrestricted × $\Delta \ln(\text{Acc.})$	-0.00	-0.02	-0.35
	(0.17)	(0.18)	(0.81)
Panel B: Accessibility × SES			
Highest quintile × $\Delta \ln(\text{Acc.})$	0.77***	0.84**	0.59
	(0.25)	(0.35)	(0.76)
Panel C: Triple interactions (Regulation × SES × $\Delta \ln(Acc.)$)			
Medium × Highest quintile × $\Delta \ln(\text{Acc.})$	-0.76*	-1.52***	0.87
	(0.43)	(0.44)	(0.99)
High × Highest quintile × $\Delta \ln(\text{Acc.})$	-1.03	-0.94	1.25
	(0.65)	(0.86)	(1.84)
Unrestricted × Highest quintile × $\Delta \ln(\text{Acc.})$	0.23	0.10	4.76
	(0.96)	(0.66)	(4.25)
Panel D: Marginal effects at Regulation × SES			
Low × First four quintiles	0.19	0.31*	1.50**
	(0.17)	(0.17)	(0.76)
Low × Highest quintile	0.96***	1.15***	2.09***
	(0.27)	(0.39)	(0.51)
Medium × First four quintiles	0.08	0.30**	0.65**
	(0.14)	(0.14)	(0.29)
Medium × Highest quintile	0.08	-0.38	2.10***
	(0.36)	(0.34)	(0.72)
High × First four quintiles	0.52***	0.28*	1.40***
	(0.15)	(0.15)	(0.41)
High × Highest quintile	0.25	0.17	3.24*
	(0.62)	(0.82)	(1.66)
Unrestricted × First four quintiles	0.19	0.29*	1.15**
	(0.12)	(0.15)	(0.53)
Unrestricted × Highest quintile	1.18	1.22**	6.51
	(0.92)	(0.61)	(4.28)
Observations	16,516	16,516	16,516
R^2	0.05	0.26	0.02

Notes: 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the block's real estate potential (quintiles) and a SES dummy (1 if block in top income quintile; 0 otherwise). Controls: $\ln(\text{Acc.}_{2000})$, ln distance to Alameda, Ruta 5, Vespucio; ln distance to nearest 2001 subway station; dummies for city area (North/West/East/Center); CBD quintiles; ln population; ln block surface area. Standard errors in parentheses. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations using SII land-use data (2001, 2010), regulation dataset (Section 2.3), and INE 2001 Census.

Appendix B - Additional heterogeneity analysis

Table B1: Heterogeneity in the results - Distance to CBD.

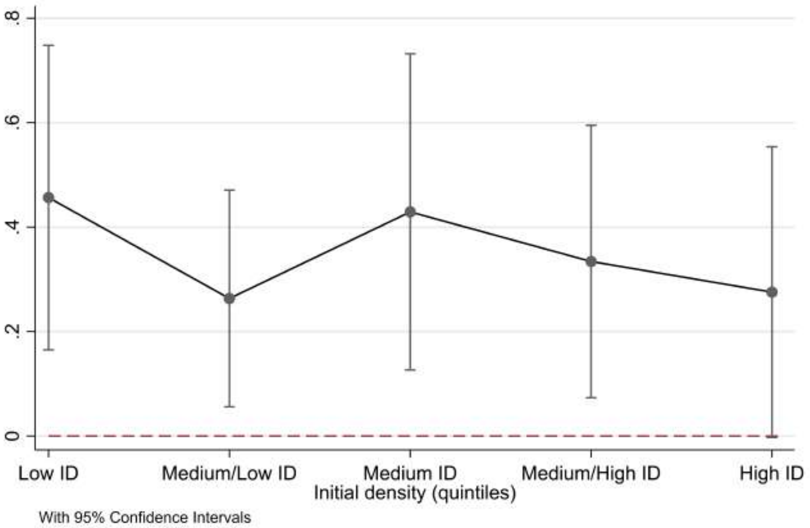
	(1)	(2)	(3)	(4)
$\Delta \ln(\text{CMA})$	1.38***	0.29	1.00***	-0.06
	(0.31)	(0.61)	(0.29)	(0.62)
$\Delta \ln(\text{CMA}) \times$ CBD	-0.04***	0.01	-0.02*	0.05
CBD	0.03	0.08	0.01	0.01
	(0.02)	(0.08)	(0.02)	(0.08)
$\Delta \ln(\text{CMA}) \times$ CBD $\times$ CBD		0.00		0.00
		(0.00)		(0.00)
Initial density	No	No	Yes	Yes
Observations	16,516	16,516	16,516	16,516
R^2	0.06	0.07	0.10	0.11

Standard errors in parentheses

Notes: The table reports 2SLS estimates of the elasticity of residential floor space to accessibility. All regressions control for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, and the baseline socioeconomic quintile of the block. Column 1 shows results for the interaction of $\Delta \ln(\text{CMA})$ with the distance to the CBD, and column 2 shows results for the interaction of $\Delta \ln(\text{CMA})$ with the distance to the CBD (adding the linear and quadratic terms of such distance). Columns 3 and 4 recreate columns 1 and 2, and also controls for the initial density of the block.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure B1: Heterogeneity in the results: Floor space - Initial Density.



Notes: The figure reports 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the initial structural density (expressed in quintiles) to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table B2.

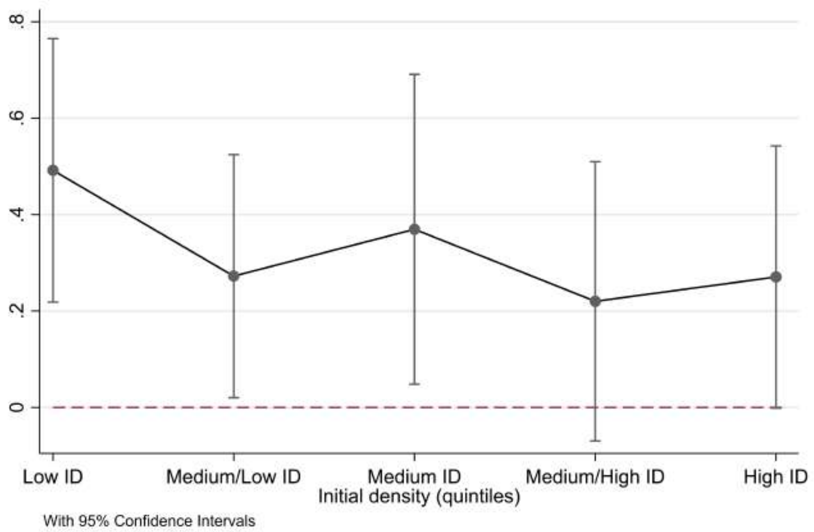
Table B2: Heterogeneity in the results - Initial density (ID).

	Floor space	Units	Prices
$\Delta\ln(Acc._{2010-2001})$	0.46***	0.49***	1.35***
	(0.15)	(0.14)	(0.40)
First quintile ID (lowest) $\times\ \Delta\ln(Acc._{2010-2001})$	0.00	0.00	0.00
	(.)	(.)	(.)
Second quintile ID $\times\ \Delta\ln(Acc._{2010-2001})$	-0.19	-0.22*	-0.48
	(0.13)	(0.13)	(0.33)
Third quintile ID $\times\ \Delta\ln(Acc._{2010-2001})$	-0.03	-0.12	-0.27
	(0.16)	(0.15)	(0.37)
Fourth quintile ID $\times\ \Delta\ln(Acc._{2010-2001})$	-0.12	-0.27**	0.05
	(0.14)	(0.13)	(0.35)
Fifth quintile ID (highest) $\times\ \Delta\ln(Acc._{2010-2001})$	-0.18	-0.22*	0.42
	(0.14)	(0.13)	(0.56)
Observations	16,516	16,516	16,516
R^2	0.10	0.26	0.02

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

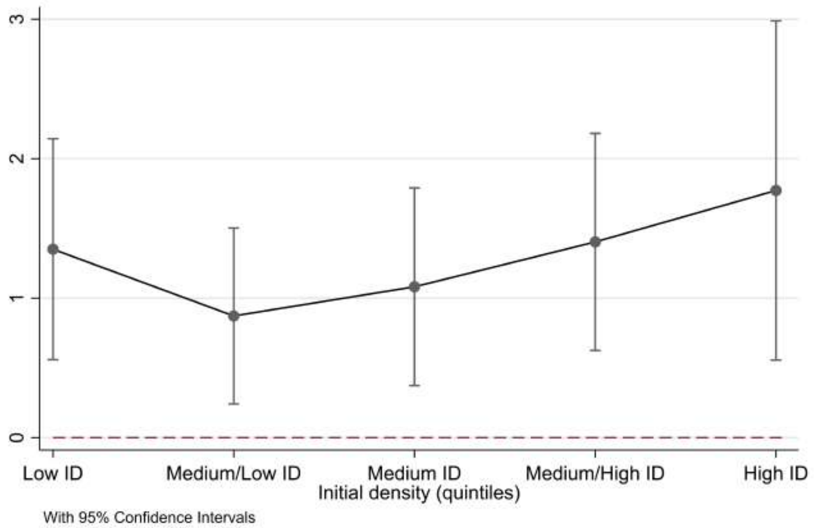
Notes: The table reports 2SLS estimates of the elasticity of residential floor space, housing units and prirces to commuter market access interacted with the initial density of the block (expressed in quintiles). The regressions control for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), quintiles to the central business district, log population, log surface area, and the baseline socioeconomic quintile of the block. These coefficients are plotted in Figures B1–B3.

Figure B2: Heterogeneity in the results: Units - Initial Density.



Notes: The figure reports 2SLS estimates of the elasticity of housing units to commuter market access interacted with the initial structural density (expressed in quintiles). The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table B2.

Figure B3: Heterogeneity in the results: Prices - Initial Density.



Notes: The figure reports 2SLS estimates of the elasticity of prices to commuter market access interacted with the initial structural density (expressed in quintiles). The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table B2 results.

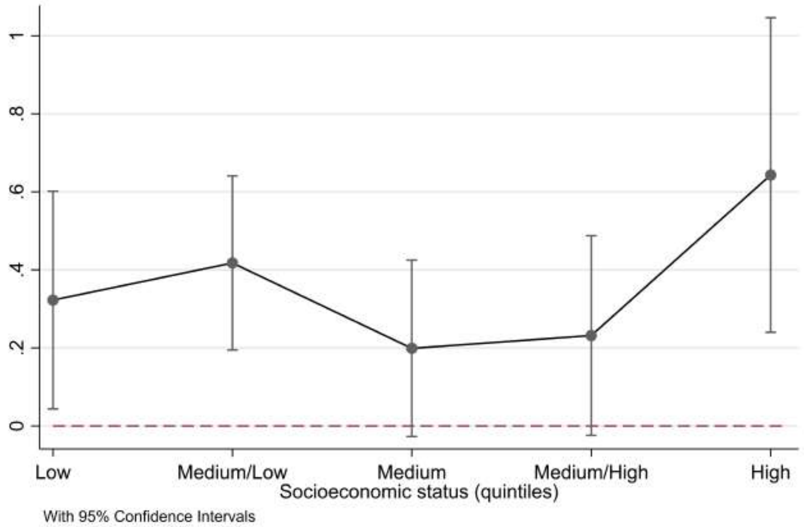
Table B3: Heterogeneity in the results - Socioeconomic status (quintiles).

	Floor space	Units	Prices
$\Delta \ln(Acc._{2010-2001})$	0.32**	0.50***	1.83***
	(0.14)	(0.13)	(0.39)
Low $\times$ $\Delta \ln(Acc._{2010-2001})$	0.00	0.00	0.00
	(.)	(.)	(.)
Medium/Low $\times$ $\Delta \ln(Acc._{2010-2001})$	0.10	0.18*	-1.16***
	(0.12)	(0.10)	(0.37)
Medium $\times$ $\Delta \ln(Acc._{2010-2001})$	-0.12	-0.22*	-0.84*
	(0.14)	(0.13)	(0.47)
Medium/High $\times$ $\Delta \ln(Acc._{2010-2001})$	-0.09	-0.43***	-0.13
	(0.15)	(0.14)	(0.56)
High $\times$ $\Delta \ln(Acc._{2010-2001})$	0.32	0.03	0.48
	(0.22)	(0.22)	(0.54)
Observations	16,516	16,516	16,516
R^2	0.07	0.25	0.02

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

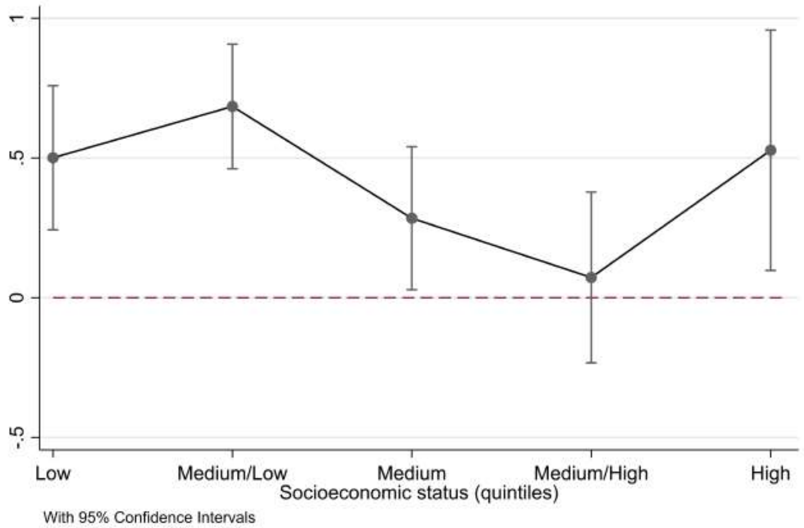
Notes: The table reports 2SLS estimates of the elasticity of residential floor space, housing units and prirces to commuter market access interacted with the baseline socio-economic status of the block (expressed in quintiles). The regressions control for log distance to main roads (Alameda, Ruta 5, and Vespucio), log distance to the nearest subway station in 2001, dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), quintiles to the central business district, log population, log surface area, and the baseline socioeconomic quintile of the block. These coefficients are plotted in Figures B4–B6.

Figure B4: Heterogeneity in the results: Floor space - Socioeconomic status.



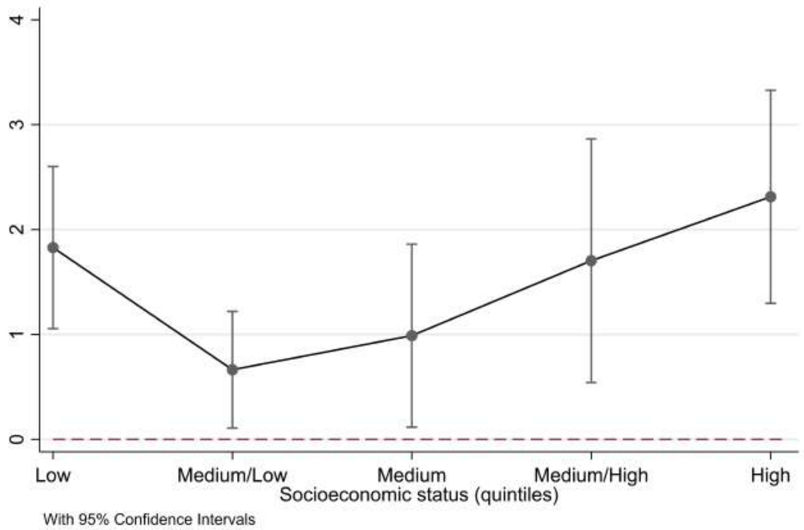
Notes: The figure reports 2SLS estimates of the elasticity of residential floor space to commuter market access interacted with the socio-economic status of the block (expressed in quintiles) to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table B3.

Figure B5: Heterogeneity in the results: Units - Socioeconomic status.



Notes: The figure reports 2SLS estimates of the elasticity of housing units to commuter market access interacted with the the socio-economic status of the block (expressed in quintiles) to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table B3.

Figure B6: Heterogeneity in the results: Prices - Socioeconomic status.



Notes: The figure reports 2SLS estimates of the elasticity of residential prices to commuter market access interacted with the the socio-economic status of the block (expressed in quintiles) to study heterogeneous effects. The regression controls for log distance to main roads (Alameda, Ruta 5, and Vespucio), to the nearest subway station in 2001 and to the central business district. It also controls for dummies of the part of the city in which the block is located (North, West, East, or Center part of the city), log population, log surface area, the logarithm of one plus the non-residential floor space, the maximum FAR category, and the baseline socioeconomic quintile of the block. These coefficients are plotted from Table B3.

Appendix C - Outliers and additional information

Using the trimming option of the Winsor command in Stata, we removed the 0.1% highest values of our three dependent variables, the log change of residential floor space, housing units and prices. We also removed the 1% lowest values of the real estate potential for regulated blocks in the baseline 2001 and endline 2010. The following table summarizes the outliers.

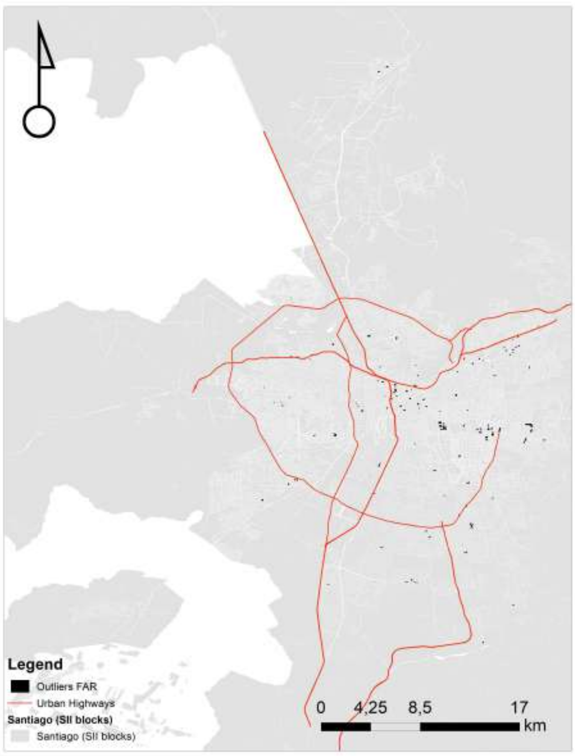
Table C1: Descriptive statistics of outliers.

Variable	Obs	Mean	Std. dev.	Min	Max
Δ Floor Space	20	3.69	0.50	3.01	4.93
Δ Units	21	4.04	1.63	-1.80	6.54
Δ Price	21	13.23	0.58	12.41	14.54
Real estate potential 2001	102	-22.44	18.98	-115.36	-6.62
Real estate potential 2010	103	-18.97	16.93	-97.30	-6.14

Note: As blocks may belong to more than one outlier category, the sum of observations is not the number of blocks considered as outliers.

As shown in Figure C1, these blocks are scattered over the city, reducing our concern about biases produced by the exclusion of these observations.

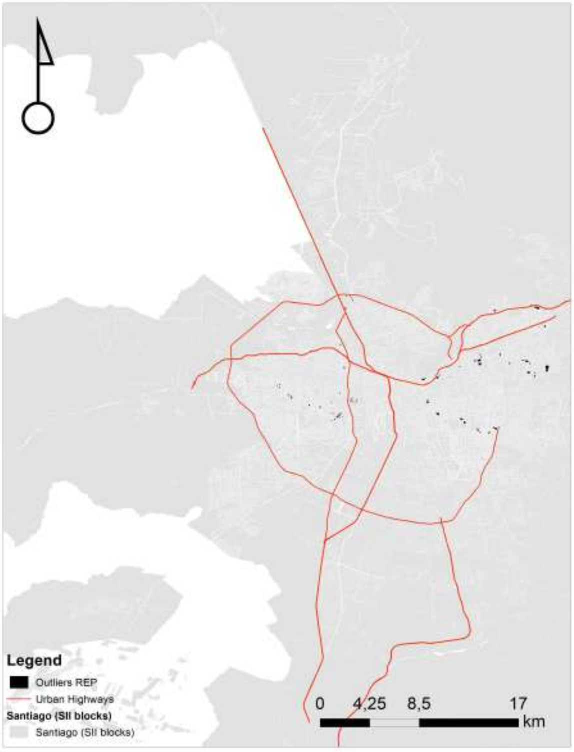
Figure C1: Identification of outliers based on FAR



Notes: The figure presents the location of FAR outliers from the sample of blocks from the Chilean National Taxing System dataset.

Source: Own elaboration using information from the Chilean Internal Revenue Service (SII) for 2001 and 2010.

Figure C2: Identification of outliers based on REP



Notes: The figure presents the location of outliers based on the real estate potential (REP) criteria.
Source: Own calculations using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII) and the dataset on regulation described in Section 2.3.

Table C2: Descriptive statistics of real estate potential of outliers.

	Mean	SD	Min	Max	N
2001	-20.11	18.62	-115.36	0.42	118
2010	-16.61	16.88	-97.30	0.82	119
Change	3.42	8.59	-8.05	64.00	118

Notes: The table provides summary statistics of real estate potential (REP) for outlier blocks.
Source: Own calculations using land-use information for 2001 and 2010 from the Chilean Internal Revenue Service (SII) and the dataset on regulation described in Section 2.3.

Table C3: Inauguration dates of transport infrastructure.

Highway of Subway Line	Number of Stations	Type of Highway	Inauguration
Line 5	2		31/Mar/04
Line 2	2		08/Sep/04
Line 2	2		22/Dec/04
Line 2	2		25/Nov/05
Line 5	1		30/Nov/05
Line 4	9		30/Nov/05
Line 4	8		30/Nov/05
Autopista Vespucio Norte		Upgrade	04/Jan/06
Line 4	5		02/Mar/06
Vespucio Sur Express		Upgrade	27/Apr/06
Autopista Central		Upgrade	08/May/06
Line 4A	6		16/Aug/06
Line 2	3		21/Dec/06
Costanera Norte		New	04/Oct/07
Túnel San Cristóbal		New	03/Jul/08
Line 4	1		05/Nov/09
Line 1	3		07/Jan/10
Line 5	5		12/Jan/10
Autopista Acceso Sur		New	01/Apr/10

Notes: The table shows the opening dates of the transport infrastructure and their type.
Source: Information from Chile's Concessions and archives of the Metro of Santiago.

C1 Inauguration Dates

Appendix D - Origin Destination Survey Data (EOD, 2001 and 2012

We use the 2001 and 2012 Santiago Origin–Destination Surveys (Encuesta Origen–Destino, EOD), both conducted by SECTRA, Chile's transport planning authority. These household mobility surveys are the standard data source on commuting and travel behavior in Santiago and are fielded roughly once per decade.

The 2001 EOD surveyed about 15,000 households (around 12,000 in the normal season and 3,000 in the summer season), covering approximately 60,000 individuals (Pontificia Universidad Católica de Chile, Departamento de Ingeniería de Transporte, 2003). It documented daily mobility patterns in Greater Santiago, where households generated more than 16 million trips on a typical working day (2.8 trips per person, 10.8 per household), of which roughly 37% were walking trips. The survey covered 38 municipalities (32 in Santiago Province plus San Bernardo, Calera de Tango, Puente Alto, Pirque, Colina, and Lampa) encompassing about 5.5 million inhabitants. Methodologically, the 2001 EOD introduced key innovations compared to 1991, such as the "aviso previo" technique (advance notification and diary keeping), inclusion of all household members, the recording of short trips below 200 meters, and improved trip-purpose classification. These changes substantially reduced underreporting and yielded higher-quality data.

The 2012 EOD followed a comparable design, surveying 18,264 households, representing around 60,054 individuals and capturing 113,591 trips (Ministerio de Transportes y Telecomunicaciones, 2015; Vielma Segura, 2017). For each household member, it recorded socio-demographic characteristics, trip purposes, modes, origins and destinations, and travel times. Using both waves in combination provides a consistent pre- and post-expansion view of commuting flows, mode choice, and travel costs across Santiago's major transport infrastructure investments of the 2000s.