Scaling Heights: Affordability Implications of Zoning Deregulation in India

Geetika Nagpal*　　Sahil Gandhi†‡

January 9, 2024

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Abstract

Does relaxing zoning regulations increase affordable housing or simply trigger the building of new luxury units? This paper exploits a rule-based relaxation of the regulatory cap on building height and floorspace, the Floor Area Ratio (FAR), to answer this question in Mumbai, India. Leveraging granular panel data and exploiting variation in time and space, we find that the reform increased housing supply in treated areas by 28%, implying an elasticity of housing supply to the FAR of 1.59. The FAR relaxation increases the scale of development, resulting in higher investment in shared amenity space within the building. This increased public good provision facilitates an 18% decline in unit sizes, leading to a 29% decrease in apartment prices that allows lower-income households to access housing. We develop a structural model of housing supply and demand that incorporates the provision of amenity floorspace and shows that after the relaxation, average home buyer incomes are 3.18% lower. We use the estimated model to show that a further 5% rule-based relaxation would amplify the scale economies and increase the affordability gains from deregulation. Taken together, our results show that concentrating FAR relaxation can improve affordability.

*Brown University; Corresponding author: geetika_nagpal@brown.edu

†University of Manchester; sahil.gandhi@manchester.ac.uk

‡Nagpal is extremely grateful to Andrew Foster, Matthew Turner, Nick Tsivanidis, Bryce Steinberg and Dan Björkegren for their continuous support and guidance. We thank Edward Glaeser, Abhay Pethe, Vidhadyar Phatak, Vernon Henderson, seminar participants at Brown University and conference participants at the UEA meetings in Toronto for their helpful comments. We also thank our dedicated research assistants for their contributions to this project. We acknowledge support from Structural Transformation and Economic Growth (STEG), the Centre for Contemporary South Asia, the Orlando Bravo Centre for Economic Research and the S4 Program at Brown University, the University of Manchester and the International Growth Centre. We are grateful to the Population Studies and Training Center at Brown University, which receives funding from the NIH, for training support (T32 HD007338) and for general support (P2C HD041020). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funders.

1 Introduction

Does the relaxation of zoning regulation lead to a substantial increase in housing units and reduce prices, or does it trigger construction of a few large units catering to high-income buyers? With over 2.5 billion people predicted to move into cities by 2050, urban housing supply across the world continues to be constrained by stringent density regulations (United Nations, 2018). The predominant density regulation, Floor Area Ratio (FAR), limits the floorspace that can be supplied on a given unit of land.[1] Advocates of relaxing FAR constraints posit that these regulations impede affordable housing provision and, thus, a relaxation would lead to increased housing for lower-income households (Glaeser *et al.*, 2005a,b; Katz and Rosen, 1987; Quigley and Raphael, 2004, 2005). Opponents argue that a relaxation would only increase the supply of a few large, higher-quality luxury units and is unlikely to enhance housing affordability (Rodríguez-Pose and Storper, 2020).[2]

Our paper overcomes three key challenges. First, there are few examples of large-scale deregulation policies in developing country cities, which face the largest need for new housing.[3] Second, while there is an existing literature showing density regulations affect housing supply, determining what kind of units are constructed requires more granular housing data. Reliable data of that form is especially hard to come by in developing country cities. Last, such deregulation policies may have general equilibrium effects across space, necessitating a model.

This paper exploits uniquely detailed housing market data before and after a 2018 deregulation in Mumbai to understand its effects on housing affordability.[4] The deregulation relaxed the city's FAR, increasing the permitted floorspace on parcels by 10–50%, generating spatial and temporal variation in the degree of relaxation. Using a differences-in-differences (DID) design, we document three results. First, we show evidence of a large supply response: a 1% relaxation in FAR results in a 1.59% increase in the number of units on average. Second, the FAR relaxation induces scale effects in multifamily developments, previously undocumented in the literature. As the scale of the development increases, developers shift the balance from private space to shared space, constructing smaller units that have access to more within-building amenities (such as play areas for children and gyms). Third, this increase in supply and reduction in unit size increases housing affordability. Apartment prices decline by 29%,

[1] Bertaud and Brueckner (2005), Brueckner *et al.* (2017), and Brueckner and Singh (2020) document the presence and stringency of FARs in India, China and the US, respectively.

[2] Rodríguez-Pose and Storper (2020) argue that "changes in zoning are unlikely to improve affordability for lower-income households ... [but] would, however, increase gentrification within metropolitan areas and would not appreciably decrease income inequality."

[3] A notable exception is Anagol *et al.* (2023), which estimates the effects of deregulation on housing supply in Brazil.

[4] Mumbai is the largest city in India, with over 12 million residents, and accounts for over 6% of national GDP, making its economy and population larger than those of many countries (McKinsey, 2010).

improving housing access for lower-income households. In the second part of the paper, we develop a structural model to understand how the deregulation changes housing characteristics by increasing the scale of development and draws in households at different income levels. Our counterfactuals evaluate alternate deregulation regimes to highlight the economic relevance of these scale effects and inform policy design.

We exploit the 2018 FAR relaxation in Mumbai, which provides a natural experiment to quantify the effects of such a deregulation in a highly constrained city. Mumbai's stringent FAR limits, which are much lower than those of comparable megacities, are often criticized for causing housing unaffordability (Bertaud, 2004).[5] The relaxation in 2018 linked a parcel's FAR to the width of its bordering road. Parcels on roads wider than 12 meters received progressive increases in FAR, while those on narrower roads remained ineligible for the relaxation. Our reduced-form specification uses a DID design to compare developments built between 2014 and 2022 on wider roads with FAR relaxation with those on narrower roads that remained ineligible.

We overcome the data challenge by combining three datasets. We compile administrative data on the universe of residential permit applications in Mumbai for the period 2014 to 2021. Building plans filed with these permits contain detailed information on the characteristics of the housing to be constructed. We georeference each permit application and obtain unit-level data on sales prices from transaction records for the developments. Last, we link our housing data to the socioeconomic characteristics of home buyers using mortgage applications submitted to a large Indian bank.

The FAR relaxation results in a significant supply response, driven by less expensive, smaller housing units. Developers fully utilize the FAR relaxation, increasing the average number of apartments in each treated multifamily development by 28% relative to the control.[6] The FAR relaxation creates scale effects, prompting an increase in the within-building amenity floorspace shared by all apartments and an 18% decline in apartment sizes in treated developments. The increased supply and smaller units lead to a 29% relative reduction in apartment prices and a 25% decline in the average income of buyers. We also empirically document local spillover effects in prices. Developments within 3kms of highly-treated zipcodes, i.e. where a large share of parcels benefit from the FAR relaxation, experience a more significant price decrease.

In the second part of the paper, we develop and estimate a discrete model of housing demand and supply. The model serves two purposes. First, relaxing FAR and increasing housing supply on some parcels can lead to a market-wide decline in prices and compete with neighborhoods that receive a lower relaxation. The model allows us to quantify these

[5] In Mumbai, the context studied in this paper, the FAR was capped at 2.7 for all residential developments, while similarly populated cities have ratios at least three times as high.

[6] The relaxation results in a 0.7% aggregate increase in the housing stock added to the city each year.

spillover effects within and across locations, which are not identified in the reduced-form analysis. Second, our reduced-form price estimates capture changes in both apartment size and within-building amenities. However, as the FAR relaxation increases the scale of development, it changes the relative returns to providing within-building amenities. The model introduces a hedonic structure to apartment prices, allowing us to assess the economic relevance of scale effects and evaluate counterfactual reforms.

The core economics of the model stem from the provision of within-building amenity space, a public good with a fixed cost of supply but with returns from all households in the development. Our model allows for two income groups with distinct preferences for housing and within-building amenities. This leads to residential developments segmented by income. Perfectly competitive developers, constrained by the FAR, explicitly trade off residential and within-building amenity floorspace. Developers choose which income group to develop for in each location, and households select a location to move to. Housing characteristics and the share of housing for each income group are determined in equilibrium. Dividing a building into more units allows the cost of amenities to be spread over more units. This facilitates a decline in the housing size, the extent of which depends on the increase in land rents.

We estimate the model using simulated method of moments, leveraging two sources of variation: within-neighborhood variation in FAR from the policy reform and cross-neighborhood variation in the distribution of parcels on wide roads. Within a neighborhood, the FAR relaxation changes land rents and the housing characteristics supplied. Across neighborhoods, the share of parcels receiving FAR relaxation correlates with the changes in land rents, housing supply and the decline in prices.

Our model allows us to quantify the aggregate affordability impacts of rule-based deregulation. Our preference estimates show that low income households have a higher willingness to pay for shared amenity space. Consequently, the increased amenity space and smaller units attract more low income households to move in. We find that the average income of a household moving into new housing is 3.18% lower after the deregulation.

To highlight the economic significance of scale effects, we assess two counterfactual scenarios with direct policy relevance. A first scenario concentrates FAR increases, by relaxing FAR an additional 5% for treated parcels. This leads to more small housing with more amenity space. Given household preferences, the average income of a home-buyer declines by a further 0.05 pp. A second scenario generates an equivalent increase in floorspace, but by relaxing the FAR on control parcels. This mutes the scale effects, as treated and control parcels see lower increases in rents, leading to a smaller supply effect. The housing constructed is larger, with less amenity space, and draws in more higher-income households. Average buyer income *increases* by 0.04 pp from the baseline scenario. Our results show that concentrating FAR relaxation by governments could draw in more lower-income households due to the presence of scale effects.

Our paper contributes to three strands of literature. First, we contribute to a body of work that examines the impact of land-use regulations on housing supply and affordability. This literature has primarily used cross-sectional variation in zoning regulations to quantify their impact on affordability and welfare (Brueckner and Sridhar, 2012; Quigley and Raphael, 2005; Turner *et al.*, 2014).[7,8] More recent work has used within-city deregulation policies to examine their impact on housing supply and prices (Anagol *et al.*, 2023; Manville *et al.*, 2022; Peng, 2022).[9] We build on Anagol *et al.* (2023) in three ways. First, our data allow us to study the margins of response among developers and identify the characteristics of housing units constructed. By linking developments to transaction prices and buyer income, we directly measure effects on housing affordability. Second, we empirically document spillover effects across neighborhoods, demonstrating how they are linked through residential choices. Finally, our model accounts for these linkages between neighborhoods and matches the reduced form moments directly via indirect inference.

Second, our study contributes to a small but growing literature that highlights how land use regulations can limit income convergence across different geographical areas, a phenomenon largely studied in the US (Ganong and Shoag, 2017; Hsieh and Moretti, 2019; Kulka, 2019; Trounstine, 2020). We link housing developments to novel data on buyer characteristics and document that deregulation increases affordability in a developing country setting. Increasing FAR limits expands the scale of development, yielding smaller units which draw in more lower-income households. Our counterfactuals show that targeted FAR deregulation could amplify these scale effects and increase affordability gains from such policies.

Finally, we contribute to a small but growing body of work examining housing markets in India. The existing literature has examined the impact of FAR regulations in India (Bertaud and Brueckner, 2005; Brueckner and Sridhar, 2012; Duranton *et al.*, 2015; Harari, 2020) and other policy levers (Gandhi *et al.*, 2022, 2021; Gechter and Tsivanidis, 2023; Kumar, 2021) to reduce the housing demand–supply gap that they induce. We add to this literature by using a natural experiment to analyze the impacts of the deregulation on the housing market in Mumbai and quantify its effects on affordability. However, our results also have implications for other highly constrained cities in India and across the world.

The rest of the paper proceeds as follows. Section 2 describes the regulatory framework in Mumbai and the policy reform. Section 3 outlines the data sources, and section 4 discusses the empirical strategy and results. Section 5 provides heterogeneity analysis and robustness

[7]For a literature review, see Gyourko and Molloy (2015).

[8]Research has shown that land use regulations affect housing supply elasticities in the US (Baum-Snow, 2023; Baum-Snow and Han, 2023; Saiz, 2010). Duranton and Puga (forthcoming) show that cities that have stringent regulations have a large wedge between residential price and replacement cost at the periphery.

[9]Büchler and Lutz (2021); Greenaway-McGrevy and Phillips (2023) also study zoning deregulation in Zurich and Auckland, respectively, documenting supply increases but a limited price response.

checks. Section 6 describes the structural model of housing demand and supply, and section 7 outlines the model's policy implications. Section 8 concludes.

2 Background and Policy Reform

Mumbai has one of the most stringent density regulations in the world. Floor area ratios, introduced in the city in their current form in 1964, govern how much housing floorspace can be supplied on a parcel. Prior to 2018, Mumbai's FAR was capped at 2.7 for all residential developments, while similarly populated cities have FARs some three times as high.[10] In 2018, the city relaxed its FAR, intending to spur new supply of residential floorspace and housing to accommodate its growing population. This paper utilizes this FAR relaxation to study the implications of zoning regulations for housing affordability in a developing-country city.

2.1 Origins of Zoning Regulations in Mumbai

Density regulations in Mumbai were established during the late 18th and early 19th centuries to address public health concerns related to overcrowding, inadequate light and air circulation, and poor drainage (Beverley, 2011; Dossal *et al.*, 1991; Kidambi, 2004). As new building technologies emerged, the 1964 development plan introduced the more flexible floor area ratio building regulation. FAR limits varied across different city locations and were eventually capped in the 1991 and 2008 reforms at 2.7. The FAR limits not only control urban density but also serve as a government revenue source.

Mumbai's stringent density regulations can be traced to the Bombay Improvement Trust, which implemented a regulatory regime that proved too expensive for the city's residents and exacerbated overcrowding (Issar, 2017). The Trust had been created following the bubonic plague outbreak in 1896 to improve conditions and dedensify the city. However, its stringent regulations on ground coverage, height and light angle limited housing development in the city. This resulted in high prices preventing 30 percent of the population from finding accommodation in the new housing built by the trust, and intensified overcrowding elsewhere in the city (Issar, 2017).

Post Independence in 1947, the introduction of new building technologies marked by a need for more flexible regulation, and the FAR was introduced in the city's first development plan in 1964.[11] The FAR was seen as a more flexible regulation than the previous regime since it specified only the total floorspace that could be constructed on a given plot area.

[10] The FARs for cities with similar population density areas, such as midtown Manhattan and Chicago, are 10 and 12, respectively. Singapore and Hong Kong, island cities facing similar geographic constraints, have FARs of 8 and 10.

[11] New building technologies included reinforced concrete and high-speed lifts.

This provided developers and architects adequate flexibility to design new buildings (Phatak, 2000). The 1964 plan set varying FAR limits for different areas in Mumbai commensurate with infrastructure provision in the areas.[12]

The 1991 development plan altered the FAR regulations to allow the municipal government to incentivize developers to create infrastructure and redevelop slums. The plan stipulated FARs of 1.33 and 1 as the free "basic" FAR allowances in the city and its suburbs, respectively. While the allowance for the suburb remained unchanged, the FAR in the city declined. This created a scarcity of building rights, which was exploited by the state to provide infrastructure. The local government also introduced the use of transferable development rights (TDRs) in 1991, which provided developers an incremental FAR for rehabilitating slums and providing land to the state for construction of new roads, schools, hospitals, etc. Using TDRs, developers could attain an FAR of up to 2 in the city and suburbs. In 2008, the local government introduced a higher FAR limit and a new instrument that would allow it to monetize FAR (Gandhi and Phatak, 2016). Developers could directly purchase an FAR allowance from the state at 50% of the circle rate for housing. This "premium" FAR could be used to extend the limit by 35% over the FAR limit with TDRs. This implied that the FAR limit could be extended to 2.7 for the city and the suburbs using both the premium FAR and the TDR.

2.2 The 2018 Development Plan and FAR Deregulation

The new development plan implemented in 2018 relaxed the FAR limit. While the relaxation aimed to reduce housing prices in the market, early drafts of the plan made public in 2015 were met with extensive public criticism.[13] The plan in its current form was released in May 2016.[14]

The development plan linked the FAR on each parcel to the width of the road it abuts, leading to progressive FAR relaxation. Similarly to the regulations established in the colonial period, this change responded to the rationale that wider roads allow infrastructure that is necessary for higher density: access for fire brigades, water, sewage and sunlight.[15] Wider

[12] The central business district of Nariman Point was allowed an FAR of 4.5, while dense areas such as Kalbadevi and Girgaon had an FAR of 1.66. Areas at the periphery of the city, such as Worli, Dadar and Sion, were assigned an FAR of 1.33. This was perhaps with a view to permitting one additional floor where buildings were constructed according to colonial rules, which allowed for one-third ground coverage and three stories (an implicit FAR of 1). The city of Mumbai received higher FAR limits than its suburbs, where an FAR of 1 was adopted.

[13] "What Went Wrong with the Mumbai Development Plan? I," *Moneylife*, accessed May 8, 2023, https://www.moneylife.in/article/what-went-wrong-with-the-mumbai-development-plan-i/41463.html

[14] "Mumbai Development Plan 2034: Govt Makes 2,300 Changes in Draft," *The Indian Express*, April 21, 2018, accessed May 8, 2023, https://indianexpress.com/article/cities/mumbai/mumbai-development-plan-2034-govt-makes-2300-changes-in-draft-5151944/.

[15] The linking of building heights to road-width to ensure that buildings received enough light and ventilation can be traced to the by-laws of the Bombay Improvement Trust (Issar, 2017).

roads are also less likely to face traffic congestion as density increases. Developments along roads wider than 12 meters received up to 10–50% relaxation in their FARs, while those along roads narrower than 9 meters saw a slight FAR decrease and those along roads with widths between 9 and 12 meters were unaffected. Details of the relaxation for each road width category are in Table 1.[16]

The initial draft of the plan, made public in 2015, had proposed a minimum FAR of 2.5 and a maximum of 8 in crowded transit corridors. The public criticism of this substantial increase was two-fold: that the FAR relaxation would put an excessive burden on the city's overwhelmed infrastructure and that it would not promote affordable housing.[17] Recent experience with the redevelopment of the Mumbai mills had fostered a belief that FAR relaxation would lead to construction of luxury developments and would raise prices (Gechter and Tsivanidis, 2023).[18]

While the final plan was made public in May 2016 and approved in 2017, its overhaul from the first draft in 2015 might have generated some uncertainty regarding its final implementation. We see some evidence of developers' having anticipated projects which would have received slight FAR reductions in Figure B.3.[19]

3 Data

To assess whether developers utilized the higher FAR limits and how this altered the city's housing supply and prices, we construct three unique datasets. We combine administrative data on the universe of permit applications in Mumbai with detailed unit-level data on sales prices from transaction records and mortgage applications.

3.1 Housing Supply and Permit Applications

First, we compile the universe of permit applications filed with the Municipal Corporation of Greater Mumbai (MCGM) from 2014 to 2022. This allows us to measure whether developers make use of the relaxed FAR limits and how this translates into the number of new housing units supplied.

[16] The FAR relaxation was operationalized through increased TDRs and premium FAR allowances, not through higher "free" FARs. The "free" FAR allowances remained constant at 1 and 1.33 for the city and suburbs. However, as shown in Figure 1, developers fully used all sources of FAR allowances before and after the reform.

[17] The plan was particularly heavily criticized by civil society and nongovernmental organizations (Baitsch and Bhide, 2022).

[18] "DP 2034: Architect Reacts to Backlash, Says Not Designed to Contain Densities," *The Indian Express*, April 27, 2018, accessed May 8, 2023, https://indianexpress.com/article/cities/mumbai/dp-2034-architect-reacts-to-backlash-says-not-designed-to-contain-densities/.

[19] We show the robustness of the results to dropping developments receiving FAR reductions in Table H.7.

The permit applications allow us to track the construction of residential developments in Mumbai at a granular level. Each housing project is required to file for a permit with the MCGM, laying out the floor plan and details about the project, before construction can commence. Each permit application contains the project location, identified by a Chain and Triangulation Survey (CTS) number, and the width of the road that the parcel abuts. Each application is also required to file a layout plan that outlines the built FAR of the project, the area of the plot being developed, total residential and public (nonresidential) floorspace, and the number of units in the project. The public floorspace is used for the provision of amenities in the residential development. We digitize each of these permit applications and geolocate them using the CTS number.[20]

The permit applications measure housing supply and characteristics of the housing constructed. Our measure of housing supply is the number of units or apartments in each housing development. We calculate average unit sizes as the ratio of the total residential floorspace to the number of units in each project. Public floorspace used to provide communal amenities is measured as the nonresidential floorspace in the housing development.

Our sample consists of 3300 residential permit applications filed from 2014 to 2022. Since 2016, the permit application filing system has been fully online, and the MCGM has progressively uploaded older permit applications to the online system.[21] We restrict the data to start in 2014, as this is the first year with high coverage of permit applications filed.[22] The yearly counts of total new building permits are plotted in Figure B.3. We obtain 3300 permit applications during this period, of which 97% are multifamily residential developments and 3% are single-family developments. Table 2 provides an overview of the characteristics of the developments constructed in Mumbai prior to 2018.

Treatment status is determined by the road width from the approved MCGM permit application, supplemented by AInsight's road width data when the permit lacks this information.[23,24]

[20]CTS numbers identify land parcels in a specific neighborhood and are the most granular geolocation identifiers within the administrative data. There are over 150,000 CTS numbers in the Mumbai region.

[21]"Building Approval Process in Mumbai to Go Online by May 15," *The Times of India*, May 5, 2016, accessed May 8, 2023, https://timesofindia.indiatimes.com/city/mumbai/Building-approval-process-in-Mumbai-to-go-online-by-May-15/articleshow/52155025.cms.

[22]The number of permit applications jumps from 91 in 2013 to 390 in 2014, which is consistent with the average yearly number of applications in the 2015–2022 period.

[23]Approximately 8% of the permit applications filed with the municipal corporation are missing a road width.

[24]AInsight is a Mumbai-based GIS software firm that maps and maintains data on physical infrastructure in Mumbai.

3.2 Transaction Prices and Mortgage Data

We obtain unit-level sales prices from PropEquity and mortgage applications to one of India's largest private mortgage lenders, to measure how changes in housing supply affect prices. To match these data to the permit applications, we use unique government identifiers and the project location.

We use transaction records digitized by PropEquity as our primary data source for unit-level sale prices. PropEquity, a real estate analytics firm, maintains a subscription real estate information portal for the Indian market.[25] PropEquity aims to provide data on all new real estate projects in India with potential revenues over 10 million rupees (approximately US$200,000). For each multifamily development, we observe the developer, number of apartment units, unit size and number of bedrooms, and amenity information. Since 2008, the firm has digitized transaction deeds for each apartment in the projects in its database. The prices in its database therefore correspond to those registered with the government, which are subject to governmental levies.

We use the CTS numbers and a unique government identifier to match projects from PropEquity to our permit application data. In 2017, the government of Maharashtra made it mandatory for real estate developers to register their projects with a newly created regulatory agency, the Real Estate Regulatory Authority (RERA). Each project is assigned a unique RERA number, which can be mapped back to the CTS number and permit applications. We leverage both the CTS and the RERA number to match projects from PropEquity to our permit applications and obtain 73,482 unit-level transactions for the projects in our sample.

We complement the PropEquity data on unit-level transaction prices with a proprietary database of mortgage applications from one of India's largest private mortgage lenders. The data contain details on 51,000 mortgage applications approved by the lender in Mumbai from 2011 to 2020. Each approved application contains information about the property for which the mortgage is taken out and applicant characteristics. Each mortgage applicant reports her age, occupation, gender and income in the process. The application contains the price and area of the apartment to which the mortgage application corresponds, the loan amount requested, the unit location, and the RERA number of the development. We use the RERA numbers to match the data to our permit application data and match 6,479 applications made for the new residential constructions in our sample.

We use two sources of data on unit-level transaction prices, as there may be reporting errors. The property price data from PropEquity come from registry deeds; as these are used by the government to collect stamp duty and registration charges on the property as a propor-

[25] PropEquity is a for-profit analytics firm whose subscribers are real estate investors, banks and real estate developers, which primarily use the data to understand trends in local prices and quantities of new residential projects being developed.

tion of the property price, it is likely that the prices are underreported.[26] Anagol *et al.* (2022) find that properties in Mumbai with mortgages from private banks are least subject to underreporting, and consequently, we supplement our transactions data with mortgage data from a private bank.[27]

4 Empirical Analysis and Results

We use a difference-in-difference (DID) strategy and the variation generated by the 2018 policy reform to compare the evolution of housing supply and prices on parcels with different treatment status. The granularity of our data allows us to compare projects that received differential FAR relaxation within a given administrative unit (ward) and year. A potential threat to our identification is that developments on wider roads had differential trends in housing supply and prices prior to the reform. This section elaborates the scope of these potential violations of our identification assumptions and documents the reduced-form impacts of FAR relaxation on housing supply, characteristics and prices and the implications of these changes for buyers of different income levels. Second, while the reduced form allows us to compare parcels witnessing similar shocks over time, the FAR relaxation may induce general equilibrium effects that are likely to bias our estimation of the treatment effects. To address this, we estimate a structural model of housing supply and demand in section 6.

4.1 Reduced-Form Analysis

The core variation in treatment is derived from the linking of FARs to road widths. Parcels on roads wider than 12 meters witnessed a 10–50% FAR relaxation and form our treatment group. Parcels that abut a road narrower than 12 meters were unaffected or received a slight decline in their FARs. To motivate our DID identification strategy, we show preperiod project characteristics and evidence of parallel pretrends in our outcome variables.

The construction of the treatment and control groups is similar to that used in other papers in this literature, with one key difference. Anagol *et al.* (2023) and Peng (2022) use block-level variation to identify the effects of an FAR deregulation to estimate a spatial regression discontinuity. Similarly to these authors, we compare groups that witnessed a FAR increase with those whose FARs were unchanged or reduced. However, given the nature of the policy ex-

[26] The city of Mumbai collects a duty of 5% of the property price when a transaction is registered, with 80% of this fee collected as stamp duty and the remainder corresponding to the Metro cess. A further registration charge of INR 30,000 is levied for properties worth above INR 3,000,000. Properties worth less than INR 3,000,000 are charged 1% of the property value.

[27] Anagol *et al.* (2022) find that transactions in Mumbai with no associated mortgage exhibit the greatest extent of underreporting. Transactions with mortgages from public-sector or cooperative banks have a higher degree of underreporting than those with mortgages from private-sector banks.

periment, parcels on treated and control roads are within the same block or neighborhood (as seen in Figure A.1). This has the advantage of allowing us to compare developments with similar location fundamentals and amenities. We leverage the variation in road widths and rely on a DID framework for our reduced-form analysis. An alternate empirical strategy would leverage discontinuities in road width and compare plots on roads on either side of a narrow band around 12 meters. However, road widths are discontinuous in nature, with bunching around multiples of 10 or 15 feet. Figure J.1 plots the distribution of the road width along which FARs are claimed, i.e., the widest road width abutting the plot, and shows evidence of this bunching.

Our DID strategy compares the evolution of housing supply and prices in response to the change in FARs on treated and control parcels. Panel A of Figure 1 shows the distribution of the prereform FARs claimed on building permits for plots by the treatment status of the road to which they are adjacent. The FAR constraint of 2.7 is binding, as approximately 50% of the applications are approved at this limit value in Mumbai. Even after the reform, the FAR cap of 2.7 still binds for the applications corresponding to control parcels; however, applicants for building permits on treated plots can now apply for the higher FAR permitted under the new policy regime, as shown in Panel B. The bunching observed in the FAR distribution in the treated group after the reform coincides with the caps of 2.97, 3.25 and 3.38, as seen in Table 1, which reflect a 10–30% increase from the FAR cap of 2.7.

Our key identification assumption is that, in the absence of this reform, outcomes in the treated and control units would have evolved similarly. Figures 2a and 2b assess the validity if this assumption by showing the evolution of the housing supply and the FAR claimed prior to the reform in 2018. We find no evidence of differential trends in these outcomes. Although the FAR levels are similar in treated and control applications, plots along wider roads tend to be larger and consequently to have more housing units (as shown in Table B.1).

To formally estimate the effect of the relaxation in the FAR cap, we estimate the following DID model:

$$Y_{iwt} = \alpha + \beta_1 \cdot Treatment_i + \beta_2 \cdot Treatment_i \times Post_t + \gamma_w \times Post_t + \gamma_w + \delta_t + \varepsilon_{iwt}, \quad (1)$$

where Y_{iwt} is the outcome for project i in ward w in year t. $Treatment_i = 1$ if the maximum width of the road adjacent to the plot is greater than 12 meters, and $Treatment_i = 0$ if the no road adjacent to the plot exceeds 12 meters in width. $Post_t$ is an indicator variable that takes value 1 if the application was filed in or after 2018 and 0 otherwise. We control for unobservable ward-level characteristics and aggregate-time shocks through ward $\times$ post fixed effects ($\gamma_w \times Post_t$) and ward and year fixed effects (γ_w and δ_t). The coefficient β_2 identifies the effect of relaxing the FAR constraint on our outcomes of interest. Standard errors are clustered at the ward level.[28]

4.2 Results

Using the DID strategy and the variation in road widths, we find that developers do utilize the higher FAR limits on treated parcels, resulting in a 28% higher housing supply in treated developments than in the control. We find—in contrast to the predictions of the opponents of FAR deregulation—that apartments in treated developments shrink in size by 18%, leading to a 29% decline in apartment prices from those in the control group. This price decline enables lower-income households to access housing.

4.2.1 Housing Supply

In this section, we assess the impact of the FAR relaxation on housing supply in the city. Whether a relaxation increases housing supply depends on the restrictiveness of the FAR cap. As shown in Figure 1, FAR caps were binding for approximately 50% of the permit applications prior to 2018. We use data from permit applications to measure changes in the FARs of projects being built by developers and how these changes translate into changes in the number of units (apartments), which is our measure of housing supply.[29]

Table 3 shows estimates from eq. (1) and documents an increase in floorspace and housing supply as a result of the FAR relaxation. The 10–50% FAR relaxation induced by this policy reform leads to an 18% realized relaxation in FAR. The floorspace developed increases by 26%, which is realized through a combination of an increase in the FAR and a marginal increase in the parcel size.

How does this increase in built FAR translate into changes in housing supply? Column 3 of Table 3 shows that the number of apartments in treated developments increases by 28% relative to that in the control. This implies that a 1% increase in FAR built results in a 1.59% increase in the number of apartments constructed. Figure 2b shows that the number of apartments in the control developments does not significantly decline in response to the relaxation, indicating limited general equilibrium effects in housing supply. Consequently, the aggregate supply response from the FAR relaxation translates into a 0.7% increase in the housing stock, consistent with recent estimates in the literature on other growing cities (e.g., Peng (2022) for New York).[30]

[28]Alternate specifications with varying combinations of fixed effects are reported in Appendix C.

[29]We find no evidence of changes in the number of permit applications filed in response to the FAR relaxation (Figure B.3.

[30]Figure B.4 shows that the total housing added to the stock every year increases from approximately 1.6% prior to the reform to approximately 2.3% after the reform.

4.2.2 Housing Characteristics

Measuring housing supply only by changes in floorspace can mask substantial heterogeneity in unit characteristics. A principal concern with zoning deregulation is that it will increase apartment sizes rather than increasing the number of apartments available per unit of land, producing an inadequate supply response. Our permit application data enable us to create apartment size metrics, addressing these concerns directly.

Developers have the option of allocating their constructed floorspace for two different uses: constructing residential units or creating communal amenity spaces. Within-building amenity spaces in the context of Mumbai consist of indoor play areas for children, gyms, etc. Consequently, allocating space to amenity areas, which are shared among the residents of all units in the development, comes at the expense of residential floorspace. As the FAR relaxation increases the number of apartments in a development, it may affect the returns to providing public floorspace and the trade-off between residential and public floorspace.

Figure 3a displays the trends in floorspace allocated to amenity provision in both treated and control developments before and after the FAR relaxation. Following the relaxation, there is a significant increase in amenity provision in treated projects, whereas no such change occurs in control projects. Figure 3b provides evidence of the trade-off, as housing sizes decrease in response to the FAR relaxation. Figure C.2 shows that the overall decline in housing size is largely driven by the treated developments, although the control developments witness a marginal but insignificant increase in housing size.

The increase in the number of units, as discussed in section 4.2.1, affects the relative cost of amenities, enabling developers to offer more amenities. The provision of amenity space almost doubles, as shown in Table 4, with this change being equivalent to the floorspace of approximately 2 apartments.[31] However, this expansion in public space is offset by a 18% reduction in apartment size, suggesting that a relaxation in the FAR limit alters developers' trade-off between residential and nonresidential floorspace.[32]

4.2.3 Implications for Prices

To understand the price response generated by the increase in housing supply and declining unit sizes documented in sections 4.2.1 and 4.2.2, we bring together two new sources of unit-level transaction price data. Obtaining reliable price data on property prices in India is a challenge, as property values are often underreported. We combine data from transactions registered with the government and digitized by PropEquity and mortgage applications made

[31] While we do not see a change on the extensive margin in the provision of amenity space, conditional on its provision, the FAR relaxation results in a 34% increase in public space.

[32] Appendix E provides suggestive evidence that developers provide more indoor amenities like gyms, play area for children and community halls, which are valued by households.

to one of the largest private lenders in India. We find similar results using our two data sources, which is reassuring as they are subject to differential underreporting (see Anagol *et al.*, 2022).

We document impacts on price per unit area and the overall price of the apartment.[33] Figure 4 illustrates the trends in prices from the PropEquity data before and after the reform. Prior to the reform, there are no discernible differential trends in the price per square foot between the treated and control properties. While prices for the treated group fall more than prices for the control group in response to the increase in housing supply, as shown in Figure 4, there are market-wide effects of the FAR relaxation. Figure C.3 shows that prices for control projects situated within the same neighborhoods as treated projects also decline after the FAR relaxation, suggesting general equilibrium effects of the relaxation on housing prices. Following the initial decline, prices for apartments in the treated projects begin to recover starting in 2020. Prices for treated projects continues to stay lower than their prereform levels by 12%. This suggests that the FAR relaxation had a sustained medium-term effect on prices.[34]

Table 5 shows that the deregulation leads to a 16% decline in the price per square foot. However, consistent with the evidence presented in Table 4, which shows a 19% reduction in apartment sizes, we see a larger decline in the price of an apartment.[35] This is because the apartments in treated developments were on average larger than those in control developments prior to the reform. The data from mortgage applications show a similar decline in housing prices, as shown in Appendix Table C.5. This decline is in contrast to the small and often insignificant effects on prices observed in other contexts. While Anagol *et al.* (2023) and Peng (2022) find similar supply responses to the FAR relaxation, they document much smaller price responses.[36]

The impact on prices reflects the net result of opposing forces. A market-wide increase in housing supply and a decline in housing sizes would predict a decline in prices. However, an increase in amenity provision, both within the project and at the neighborhood level, could result in an appreciation in prices from the FAR relaxation. We show that the treated projects do not differ in neighborhood-level amenities after the reform (Table G.4) but that within-project amenity provision increases.

Impacts on Existing Projects Using our data on the universe of residential developments

[33] Apartments in India are listed in the market using price per square foot of the apartment size.

[34] Market prices assessed by PropEquity, which are taken by Anagol *et al.* (2022) to be the true measure of prices in the city, also show a similar decline and recovery (see Figure D.1).

[35] In November 2016, the government of India announced demonetization of all ₹500 and ₹1,000 banknotes to curb "black" money and the use of undocumented cash. This could potentially lead to a decline in the reported transaction price for new units. However, we do not find this to have led to a decline in the price of new developments across all cities in Figures D.2a and D.2b around Q4 2016 and Q1 2017.

[36] Anagol *et al.* (2023) find a small price decline of 0.4–0.9% in response to a larger supply response of 1.4%. On the other hand, Peng (2022) finds insignificant effects of a zoning reform on floorspace values in New York in the short term, with prices responding only after 10 years.

constructed since 2008, we are able to document the effects of the FAR relaxation on prices in existing developments. We find a small decline in prices in neighborhoods where a higher proportion of parcels are along wide roads and consequently a larger number of projects are located (Table F.1).

Local Spillover Effects We document evidence of local spillovers in prices. We classify zipcodes in Mumbai as having either high or low share of treated plots, i.e. over the 75th percentile in the zipcode level distribution of the share of treated plots.[37] Developments within 0-3km of zipcodes having a high share of treated plots witness an additional 10-13% decline in prices, as shown in Table 7. These spillover effects are local, and we observe no additional effect of being within 3-5 kms of zipcodes with a high share of treated plots.

We show that these effects are being driven by projects competing for similar consumers. We measure pre-reform average apartment prices in each zipcode, and classify them into one of four price bands. The price bands are demarcated using the 25th, 50th and 75th percentiles of the price distribution across zipcodes. Table 7 shows that the decline in prices within 0-3km of a zipcode with a high share of treated plots is driven proximate zipcodes which are in similar price bands. This is consistent with proximate zipcodes in the same price band directly competing with zipcodes that have a higher potential increase in housing supply.

4.2.4 Implications for Households

Whether the supply response to the FAR relaxation allows households with lower incomes to access housing is unclear. One argument against zoning deregulation is that the new housing generated might only be accessible for the rich (Baitsch and Bhide, 2022, pp. 94–95). However, tracking the characteristics of the households moving into developments in developing countries is challenging. We utilize unique data from mortgage applications to overcome this challenge.

We find that the 29% reduction in prices allows lower-income households to access housing following the deregulation, as shown in Table 6.[38] We find that lower-income households move into treated developments after the FAR relaxation. Figure 5 shows evidence of this decline and a lack of differential pretrends in the relative income of the households moving into treated and control developments. Second, although younger households in particular struggle to access affordable housing in urban settings, we find no effects of the deregulation on their ability to access housing.

Last, using data from the mortgage applications, we assess whether the construction of

[37]The 75th percentile corresponds with 33% of the plots in the neighborhood being adjacent to a road over 12 meters in width.

[38]The decline in prices is also reflected in lower loan amounts taken out by households (see Table C.5).

new market-rate housing after the FAR relaxation facilitates housing access for lower-income households in existing developments, i.e., whether "filtering" happens in the market (Mast, 2023). We do not find evidence of filtering in our context. Table F.2 shows that the relaxation does not impact the income of households moving into existing residential developments in high-treatment-intensity areas.

5 Heterogeneity and Robustness Checks

In this section, we assess whether the consequences of the FAR relaxation depend on the extent of the relaxation and the sample under consideration. The FAR relaxation may have implications for neighborhoods amenities, which could alter the characteristics of control developments and would necessitate comparison of spatially proximate projects. Second, since the FAR relaxation results in a decline in FARs for roads under 9 meters in width, we test for sensitivity of the results to dropping projects receiving FAR reductions. Last, we conduct placebo tests to assess whether our results are driven by changes in demand along treated roads.

5.1 Heterogeneity

Supply Heterogeneity To understand which types of plots and neighborhoods are more responsive to zoning reform, we employ a triple-difference specification by interacting the FAR shock with local characteristics. The results from this analysis are presented in Table G.1. Our findings indicate that local characteristics do not significantly influence the FAR or the number of units built. However, neighborhoods with higher existing residential density exhibit reduced responsiveness to the FAR relaxation.

Treatment Intensity We assess the heterogeneity in the housing supply response by treatment intensity. The FAR relaxation was implemented progressively by road width, with variations in the degree of relaxation between the city and suburbs. We categorize roads with an FAR relaxation of 10–20% as having "low" treatment intensity and those with a relaxation exceeding 30% as having "high" treatment intensity. Table G.2 demonstrates similar supply responses across both treatment intensities. However, the reduction in unit size appears to be primarily driven by projects subject to greater FAR relaxations, indicating that a more substantial relaxation provides developers with greater flexibility to adjust housing size and supply. This is also evident in the increased space allocated for amenities resulting from the larger FAR relaxation, as shown in Table G.3.

Distance from Wide Roads One concern with our reduced-form specification is that we may be comparing projects that are differentially substitutable. Consequently, projects further from wide roads may attract a different set of buyers and have different housing characteristics. Table 8 shows the robustness of our results to our comparing projects on roads over 12 meters to those at varying distances from such a road. Even with the most conservative comparison against developments within 200 meters of a treated road, we observe significant effects of the relaxation on housing supply. As we progressively compare more distant developments, the supply response increases.

5.2 Robustness Checks

Sensitivity to Alternate Control Groups We assess the sensitivity of our results to the sample selection. Plots in our control group witness either no change or a decline in their FAR cap. Our main specification follows previous literature in including both of these types of plots in our control group. Table H.7 replicates our preferred specification in Table 3, dropping those plots where the FAR cap declines. We find a qualitatively similar but slightly larger increase in FAR of 21% and in housing supply of 38%.

Sensitivity to Missing Data Our data on permit applications are obtained through digitizing information made public by the municipal government. As a result, the information released may not contain the full set of information on the number of units proposed and the size of the unit, leading to data missingness. Table H.10 presents results from the sample with nonmissing information for each of our three outcome variables: FAR, total floorspace and number of apartments. The results are quantitatively and qualitatively similar to those from our main specification in Table 3.

Sensitivity to Spatial Proximity In our main specification, we compare the treated and control applications within a given ward–year. However, wards, while small in area, may still have treatment and control applications not located in close proximity to each other. [39] To address these potential differences, we conduct a comparison where each treated project is matched with its nearest control neighbor. The results of this matching process are presented in Tables H.6 and H.9. These results suggest that our main estimates are not driven by projects located in isolated or distant locations.

Changes in Control Projects We identify the treatment effect of zoning rules relaxation by comparing permit applications for parcels that received an FAR relaxation to those that did not. However, an FAR relaxation may alter neighborhood-level amenities and have consequences for the characteristics of control projects. We see no changes in the housing characteristics of control projects after the FAR relaxation. However, Table H.12 does seem to suggest

[39]On average, each ward covers an area of approximately 20 square kilometers. Some of the larger wards in Mumbai, such as the K-West Ward, cover an area of approximately 30 square kilometers, while some of the smaller wards, such as D-Ward, cover an area of approximately 10 square kilometers.

some spillover effects in built FARs. Projects in the control group claim slightly higher FARs after the reform, primarily starting in 2020.

Placebo Test for Demand on Treated Roads Given our reliance on spatial and temporal variation, there is a concern that our results may be influenced by unobservable shifts in demand along treated roads that align with the treatment timing. To address this concern, we utilize transaction data from residential developments launched on roads wider and narrower than 12 meters between 2008 and 2014, which precedes our analysis period. We examine changes in demand using transaction data from 2014 to 2022. Table 9 presents the findings, indicating no differential changes in prices on treated and control roads. This suggests no discernible differential shifts in demand between treatment and control areas during the analyzed time period.

Placebo Test for Prices in Large Cities To assess whether the decline in prices observed in Mumbai is indicative of a nationwide trend in new residential development prices, we gather data on prices across major cities in India. Our findings reveal no evidence of a similar price decline in either other major Indian cities (Figure D.2a) or cities located within the same state as Mumbai and in proximity to it (Figure D.2b) in 2018.

6 Structural Model of Housing Demand and Supply

To better understand the economic relevance of the change in housing characteristics as the scale of development increases, we set up a discrete choice model of housing demand and supply to estimate preferences for within-building public amenities and (private) apartment floorspace. The model addresses two key challenges in the reduced-form specification. First, parcels eligible and ineligible for the relaxation are located in the same neighborhood. Increasing FAR and housing supply on eligible parcels can impact housing prices and land rents for residential developments on parcels ineligible for the relaxation. Neighborhoods with large increases in supply also compete with neighborhoods with fewer eligible parcels. The model allows us to quantify these spillover effects within and across locations, which are not identified in the reduced-form analysis. Second, our reduced-form price estimates capture changes in both private apartment floorspace and public amenity floorspace provided within the development. As the FAR relaxation changes the relative returns to providing within-building amenities, the model allows us to introduce a hedonic structure to apartment prices.

The key economics of the model operate through the provision of within-building amenity space, a public good with a fixed cost of supply but with returns shared by all households in the development. As the scale of development increases, it increases the relative returns to providing amenity floorspace. The scale effect, which arises from the increased returns to investing in public floorspace, allows for the construction of a larger number of smaller and more affordable housing units. The extent of the decline in unit sizes generated in response depends on the increase in land rents. The magnitude and resulting economic returns from the scale economies have policy implications for the implementation of FAR relaxation.

The model follows a conventional discrete choice framework commonly employed in the quantitative spatial economics literature, with two key differences. Unlike standard urban economics models that focus solely on private residential floorspace provision, our framework introduces a trade-off for developers between public and private floorspace, resulting in scale economies in multifamily developments. Second, to incorporate the hedonic pricing in our context, we simplify the location space, which allows us to emphasize the trade-offs in housing development across neighborhoods experiencing varying degrees of the FAR shock.

6.1 Model Setup

The city is populated by households belonging to income group $g \in \{H, L\}$, with preferences for nonhousing consumption, housing (h), and within-building public space (A). We assume that demand is partially inelastic. Perfectly competitive developers choose which income group to construct housing for and supply two types of floorspace in each development: public amenity floorspace (A), which is shared among all residents of the building, and private residential floorspace. We assume that the developments are segregated by income group: high-income (low-income) households can move into housing constructed for their type. We allow four locations κ in the model, distinguished by their proximity to a wide road and the distribution of parcels on wide roads within their respective neighborhoods. Consequently, locations are characterized as either being on wide or narrow roads, $w \in \{T, C\}$ (equivalent to treatment and control in the reduced form) and are situated in areas that have a high (low) share of parcels that receive the FAR relaxation.

6.2 Demand

A household in group g chooses a possible destination κ to move to in the city. Households derive utility from consumption of a numeraire good ($C_{g\kappa}$), consumption of residential floorspace ($h_{g\kappa}$) and within-building public amenity space($A_{g\kappa}$). Income groups differ in their preferences for the consumption of each of these goods. Households are heterogeneous in their preference for living in location κ, $\epsilon_\kappa(i) \sim T1EV(\theta)$, where θ captures their intrinsic preference for different locations. In our static model, we assume that the number of people who want to move in any period is given by $\bar{M}_g$.[40] Their reservation utility $\bar{u_g}$ determines whether they move in a given period.

[40]This implicitly assumes that the FAR relaxation does not alter the population of potential movers.

$$U_{g\kappa(i)} = \alpha_g \ln C_{g\kappa} + \beta_g \ln(h_{g\kappa}) + (1-\alpha_g-\beta_g)\ln(A_{g\kappa}) + \theta\epsilon_\kappa(i) \tag{2}$$
$$s.t.\, C_{g\kappa} \leq Y_g - p_{g\kappa}$$

The first-order conditions, in Appendix I.1, show that the levels of housing consumption and public floorspace demanded varies by income group, $h^*_{g\kappa}$ and $A^*_{g\kappa}$. The share of households in income group g that choose to live in location κ takes the standard discrete choice form given by:

$$\lambda_{g\kappa} = \frac{\exp\left(\dfrac{\tilde{U}_{g\kappa}(h^*_{g\kappa}, A^*_{g\kappa}, p^*_{g\kappa})}{\theta}\right)}{\exp \bar{u}_g + \sum_{\kappa' \in \kappa} \exp\left(\dfrac{\tilde{U}_{g\kappa'}(h^*_{g\kappa'}, A^*_{g\kappa'}, p^*_{g\kappa'})}{\theta}\right)} \tag{3}$$

where $\tilde{U}_{g\kappa} = \alpha_g \ln(Y_g - p^*_{g\kappa}) + \beta_g \ln(h^*_{g\kappa}) + (1-\alpha_g-\beta_g)\ln(A^*_{g\kappa})$.

Aggregate Housing Demand The aggregate demand of group g for housing is given in equation 4. The reservation utility, $\bar{u}_g$, allows the aggregate demand for housing to be lower than the total number of households seeking to move, $\bar{M}_g$:

$$\mathbb{N}^D_g = \sum_\kappa \lambda_{g\kappa} \times \bar{M}_g \tag{4}$$

6.3 Supply

Developers build a parcel of area L up to the FAR limit f and supply two types of floorspace: residential floorspace and public amenity space ($A_{g\kappa}$).[41] Residential floorspace is supplied as $N_{g\kappa}$ units of size $h_{g\kappa}$ each. We assume that residential floorspace and amenities cost the same to provide per unit area, c_g.[42] The rental rate of land varies by location κ, and the FAR allowance varies by the proximity of the parcel to wide roads within each location, w.

Profits are governed by the following equation, subject to a floorspace constraint:

$$\pi_{g\kappa} = p_{g\kappa}N_{g\kappa} - c_g f_w L - r_\kappa L \tag{5}$$
$$s.t.\;\; f_w L = N_{g\kappa}h_{g\kappa} + A_{g\kappa} \tag{6}$$

[41]Our reduced-form estimates show that parcel area does not respond to FAR relaxation. This implies that land assembly frictions are likely to bind over the time horizon that is the focus of our empirical analysis (Brooks and Lutz, 2016).

[42]This is in line with the features of the residential construction market in Mumbai, wherein housing for higher-income households costs approximately 30% more to construct.

We assume that the market is perfectly competitive and that developers make zero profits, i.e., $\pi_{g\kappa} = 0$.[43] The rents in the market accrue to the landowners. Maximizing pre-rent profits for each of these income groups determines the housing characteristics that will be supplied for each income group g in each location κ, as shown in Appendix I.1.

Aggregate Housing Supply Developers choose which income group $g \in \{H, L\}$ to supply housing for in location κ on the basis of demand and the land rents, r_κ. The implied aggregate housing supply function $\mathbb{N}_g^S$ will be the sum of [units per parcel]×[number of parcels of land available for development]×[share of plots developed for income group g] across all locations in the neighborhood. We take the number of plots being developed, K_κ, as exogenous in the model.[44] The share of developers that choose to supply housing to each income group, $\rho_{g\kappa}$, and the characteristics of each housing type, $A_{g\kappa}$ and $h_{g\kappa}$, are determined endogenously in equilibrium. The total supply of housing for each income group g is then given by:

$$\mathbb{N}_g^S = \sum_\kappa K_\kappa \times N_{g\kappa} \times \rho_{g\kappa} \tag{7}$$

6.4 Equilibrium

Given exogenous characteristics $\{\bar{M}_g, K_\kappa\}$ and model parameters $\{\alpha_g, \beta_g, f_w, c_g, \bar{u_g}\}$, a static equilibrium is a tuple $\{r_\kappa, A_{g\kappa}, h_{g\kappa}, N_{g\kappa}, \rho_{g\kappa}\}$ such that

1. households maximize utility (2) and developers maximize profits (5);
2. developers make zero profits; and
3. the market for housing clears (3) (7) for each location κ.

In equilibrium, high- and low-income households are segregated into different developments and developers specialize in providing housing for a given income type in each neighborhood. Therefore, the share of parcels allocated for housing for a given income group g in location κ, $\rho_{g\kappa}$, is determined endogenously to match demand. Rents r_κ adjust till demand matches supply.

These equilibrium conditions also imply that the housing characteristics demanded by each income group must match the supply. The joint maximization of utility and profits yields

[43] This assumption aligns with the nature of the supply environment in Mumbai. Gechter and Tsivanidis (2023) show that the environment in Mumbai is more competitive than that most other large Indian cities in that there are more developers per million square feet of built floorspace than expected based on the relationship in other cities.

[44] This implicitly assumes that plots randomly come up for development and that the FAR relaxation does not differentially incentivize development across plots in proximity to wide and narrow roads. Figure B.3 shows evidence for this assumption.

the following closed-form solutions for housing characteristics:

$$A_{g\kappa} = \frac{(1-\alpha_g-\beta_g)f_\kappa L}{(1-\alpha_g)} \tag{8}$$

$$h_{g\kappa} = \frac{\beta^2 f_\kappa Y_g}{(1-\alpha)(\alpha+\beta)(r_\kappa + cf_\kappa)} \tag{9}$$

$$N_{g\kappa} = \frac{(\alpha+\beta)(r_k + cf_\kappa)}{p_{\kappa g}} \tag{10}$$

6.5 Comparative Statics

Abstracting from the neighborhoods and income groups within the city allows us to develop a simple intuition for the presence of these scale effects. Through the lens of the model, we discuss how the cost of amenity provision changes with FAR relaxation and the conditions that we need for the general framework to reconcile with our results. When we use equations 8, 9, and 10, the comparative statics show that a relaxation in the FAR unambiguously increases the number of units supplied in that project. This increase affects the trade-off between the size of each unit and the provision of amenities. The elasticity of land rents to the FAR, i.e., the stringency of the regulation, determines the supply response and the extent of this trade-off. We drop the location κ and income group g subscripts for ease of exposition.

Comparative Static 1: An increase in the FAR increases r.

As FAR regulations reduce the profitability of development, they reduce the developer's willingness to pay for the land and thus its value. Accordingly, a higher allowed FAR, by loosening the constraint on development, will raise the land price for the parcel. This implies that the elasticity of land rents to the FAR $\eta_r > 0$. Brueckner *et al.* (2017) show that the elasticity of land rents to FARs depends on their stringency. In particular, this elasticity is large when the regulated FAR is particularly low relative to the unconstrained FAR. Thus, relaxing a highly stringent FAR limit leads to a greater percentage increase in land price than relaxing a less stringent limit.

Comparative Static 2: An increase in the FAR increases N.

As FARs are a density regulation, an FAR relaxation will allow the developer to supply more floorspace and units. The increase in the number of apartments in response to the FAR relaxation depends on the regulation stringency and demand elasticity, as shown below, where η_r is the elasticity of land rents to the FAR and is $\eta_r > 0$, as outlined in Comparative

Static 1.

$$\frac{dN}{df} = \frac{(\alpha+\beta)L}{\beta Y} * \left[\frac{f\eta_r}{r} + c\right] > 0$$

Comparative Static 3: An increase in the FAR increases A and can decrease h. Households value both apartment size and public space. However, the provision of public space incurs a fixed cost in terms of floorspace. The FAR increase enables construction of more units, leading to a reduction in the per-unit cost of providing public space. Therefore, amenity provision increases with an FAR relaxation.

Whether the apartment size decreases in response to an FAR relaxation depends on two opposing forces. In partial equilibrium, a decline in prices from the supply increase will induce households to increase housing consumption (the income effect). This partial equilibrium effect (governed by β) is countered by an increase in land rent in response to the FAR relaxation, which raises prices and makes housing space costlier to provide. If the FAR constraint is highly binding, a relaxation in the constraint could result in a significant increase in land rents. Our model shows that, if $\eta_r > 1$, housing sizes decline, which is indicative of a substantial difference in housing supply and demand at the constrained FAR. Relaxation where the FAR constraint does not bind as strongly may not result in a decline in apartment sizes.

$$\begin{aligned}\frac{dA}{df} &= \frac{(1-\alpha-\beta)L}{(1-\alpha)} > 0 \\ \frac{dh}{df} &= \frac{\beta^2 Y r}{(1-\alpha)(\alpha+\beta)}\left[\frac{1-\eta_r}{(r+cf)^2}\right]\end{aligned}$$

General Equilibrium Effects for Control Parcels

In general equilibrium, parcels eligible for FAR relaxation will witness an increase in land values. However, parcels that remain ineligible for the relaxation in the same neighborhood become comparatively less profitable to develop.[45] This will result in a decline in land prices on ineligible parcels. Further, the decline in land rents has differential impacts on unit sizes and amenities within a housing project. A decline in land rent on ineligible parcels leads to a decline in the number of apartments and an increase in housing sizes, while amenity

[45] Moon and Ahn (2022) find that a lower maximum FAR allowance is correlated with lower land values.

provision is unaffected.

$$\frac{dh}{dr} = \frac{-\beta^2 fY}{(1-\alpha)(\alpha+\beta)(r+cf)^2} < 0 \tag{11}$$
$$\frac{dN}{dr} = \frac{(\alpha+\beta)L}{\beta Y} > 0 \tag{12}$$
$$\frac{dA}{dr} = 0 \tag{13}$$

6.6 Modeling the FAR Relaxation

Our policy experiment generates variation in the FAR allowances by road width. We model the FAR relaxation as an increase in f_κ for locations proximate to wide roads. We do not model the extensive margin of development and assume that the sampling process of projects is not affected by the FAR relaxation. In principle, the FAR relaxation could induce more developments to be undertaken along wide roads. Alternately, developers may reallocate development from parcels that do not receive the FAR relaxation toward those which do. However, our data show no evidence of this behaviour. Using data that track the universe of projects being developed prior to and after the FAR deregulation in Mumbai, we find that the FAR relaxation did not significantly differentially incentivize projects in the proximity of wide roads (Figure B.3), and we therefore do not include that margin in our model.

6.7 Estimation with Heterogeneous Neighborhoods

We estimate the model using indirect inference, leveraging two sources of variation. We utilize the variation within a neighborhood induced by the FAR relaxation from the policy reform and cross-neighborhood variation in the exogenous distribution of parcels on wide roads for estimation.

The variation across zipcodes in the distribution of parcels on wide roads, i.e., the share of treated plots, allows us to capture the differential effects of rents and FAR on housing characteristics and prices. We classify a neighborhood as having high treatment intensity if the share of treated plots in the neighborhood is over 33%, which corresponds to the 75th percentile. When we take this categorization together with that of parcels on wide roads (treatment) and on narrow roads (control), it generates the four locations κ to which a household can move in the model.

Table 10 outlines the differential effects across the four locations from our data. Using the following triple-difference regression, where $\mathbb{1}_{p75}$ is an indicator variable equal to 1 if zipcode

z has high treatment intensity[46]:

$$Y_{izt} = \alpha + \beta_1 \mathbb{I}_{p75,z} \times Treatment_i \times Post_t + \beta_2 \mathbb{I}_{p75,z} \times Treatment_i + \beta_3 Treatment_i \times Post_t + \beta_4 \mathbb{I}_{p75,z} \times Post_t + \beta_5 \mathbb{I}_{p75,z} + \beta_6 Treatment_i + \beta_7 Post_t + \mathbf{X_z} + \varepsilon_{izt} \quad (14)$$

Here, $\mathbf{X}_z$ includes distance from the central business district, the number of retail establishments and the pre-existing residential density, which allows us to purge out some location-specific characteristics. The estimates from these regression are consistent with larger general equilibrium effects in locations with a higher share of treated plots.[47]

The model outlines two forces: changes in relative returns to investment in public amenities and private floorspace and a change in the rental rate of land, which have differential implications for housing characteristics and prices in each location. The comparative statics show that public amenity space increases with FAR relaxation but does not dependent on the rental rate of land. Table 10 shows that this is supported by the data: public amenity space increases in both high- and low-treatment-intensity neighborhoods. The impact on h across different locations depends on the relative strength of the income effect from the price decline and the increase in land rents. Locations with a low share of parcels on wide roads witness a higher increase in land rents. Our data show that, in these locations, the latter effect dominates and housing sizes fall. In locations with a high share of treated plots, increases in land rents are lower, and the two forces cancel each other out. Last, the impact on prices in equilibrium depends on the increase in land rents and housing supply in each location. High-treatment-intensity neighborhoods witness a lower increase in rents and a larger increase in supply, leading to a significant decline in prices. The effects are smaller and insignificant in low-treatment-intensity neighborhoods.

We match the six key-reduced form moments, outlined in Table 10, ensuring the model captures the key forces present in the data and increasing confidence in its counterfactual predictions (Kline and Walters, 2019). These six moments allows us to capture systematic changes between changes in relative land rents and the supply of eligible parcels. We simulate the data-generating process according to the system of equations in the model (section 6.4). The equilibrium in each period can be characterized by a fixed point in land rents. We then introduce the FAR relaxation as a shock to the system (on wide roads w in locations κ) and recompute the resulting equilibrium in the economy after the zoning change. We run the same regression as in equation 14 on our simulated data. We minimize the mean squared error between our data moments and the simulated moments to estimate the preference parameters of interest α_g, β_g. Since we are estimating only 4 parameters, the model is over-identified.

[46] There are 104 zipcodes in the city.

[47] The model implicitly assumes that all other unobservable neighborhood-level amenities are additively separable and do not vary with the FAR relaxation. Consequently, they are differenced out in the estimation process.

Further details on the estimation and model inputs are outlined in Appendix I.2.

Our model matches the quantitative moments on prices and housing size. Figure 6 compares the data estimates in Table 10 and the simulated estimates from the model. The model is able to qualitatively and quantitatively match the estimates from the data on housing size and prices across both high- and low-treatment-intensity locations. However, the model over-predicts the changes in amenities. This suggests that households may not value amenities linearly, as in the model, but that returns from amenities might be decreasing for households in the real world. We also assess goodness of fit by comparing the data and model predictions for a moment not explicitly targeted in the estimation process, income. While the reduced-form estimates predict a 25% relative decline in income between the treated and the control, the model suggests a more modest 9% decline in income.

Our model also predicts changes in land rents in response to the FAR relaxation, which can be used to compute the stringency of FAR regulations in Mumbai. Land rents on treated parcels increase by 30% in high-intensity treated zipcodes and by 51% in low-intensity treated zipcodes, consistent with our comparative statics. Taken together with the average FAR increase on parcels in high- and low-treatment-intensity zipcodes of 19% and 17%, respectively, this implies an elasticity of land rents to the FAR of between 1.58 and 3.

The preference parameter estimates from the model in Table 11 show that lower-income households place a larger weight on public space whereas higher-income households value private residential space. This is in line with intuition that richer households have larger apartments and place more value on private space. Further, on average, households in the model having a housing expenditure share of 0.25, which is comparable to the average share for Mumbai computed by Gechter and Tsivanidis (2023).

Aggregate Effects To compute the aggregate effects of the deregulation on affordability, we use our parameter estimates from Table 11 and calculate the change in the income of the average household that moves in after the FAR relaxation. This also allows us to account for changes in the overall housing market, prices and housing characteristics in our setting. We estimate that the FAR relaxation results in a decline of 3.18% in the average income of a household moving into new housing. This is because the FAR relaxation allows both high- and low-income households to move in response to the increase in housing supply and these effects offset each other.

7 Policy Counterfactuals

While the negative consequences of strict zoning regulations are widely recognized, there is far less consensus among academics and policymakers about how to effectively employ deregulation to increase housing supply. Given the preference parameter estimates from section 6, we compare two counterfactual policy regimes. We find that concentrating FAR relaxation on parcels amplifies the gains from deregulation. However, spreading the relaxation over more parcels mutes the affordability gains, as it draws in more higher-income households.

Cities worldwide have implemented various forms of FAR relaxation to enhance housing affordability, yet recent research offers limited guidance on their relative effectiveness. In Mumbai, FAR deregulation was implemented along wider roads because of congestion concerns. Similar approaches in other cities have taken the form of transit-oriented development. In other cities, such as Delhi, FAR relaxation has been implemented uniformly across all parcels in the city.

Our model facilitates a comparative analysis of FAR relaxation policies: targeted deregulation on specific city parcels versus a city-wide relaxation. In the first counterfactual, we simulate the model allowing for a further FAR increase of 5%, over and above the relaxation in 2018, on parcels on roads wider than 12 meters. This generates a larger increase in rents than under the 2018 relaxation. As documented in comparative static 2 and 3, the higher FAR increases the relative returns to investment in amenities and leads to smaller units. As more smaller units are added to the market, prices decline further, drawing in more lower-income households to move into new housing.

The second counterfactual assesses the impacts of a uniform relaxation across locations in the city, as practiced by several cities across the world. We allow for a floorspace response equivalent to that in the first counterfactual, which implies a 15% increase in FAR across all parcels not on wide roads. As more parcels benefit from the FAR relaxation, this results in a smaller increase in rent across all parcels. This generates a smaller decline in housing size and therefore a smaller increase in housing supply.

Comparing the counterfactuals assessing targeted and uniform relaxation, we find that the targeted reform leads to larger increases in aggregate housing affordability in the city. The average income of a household moving into new housing decreases by 3.23% in the case of targeted relaxation, i.e 0.09 pp more than the decline observed in the case of the uniform FAR relaxation counterfactual.

As governments progressively implement zoning deregulation in cities worldwide, our counterfactuals hold significant policy implications for city governments in shaping these policies. Because of the scale economies identified in our paper, our counterfactual results show that FAR relaxation generates economically relevant scale economies resulting from within-building amenity provision in multifamily developments. Recognizing and leveraging these scale economies in zoning deregulation could allow governments to maximize the impact of such policies.

8 Conclusion

The issue of housing affordability in productive cities remains a significant policy challenge, with a vigorous debate about the efficacy of zoning deregulation as a solution. Our paper examines the affordability implications of a rule-based zoning deregulation in Mumbai, one of the fastest-growing cities in India.

We find that the 2018 FAR deregulation in Mumbai resulted in substantial increases in housing supply, driven predominantly by the construction of smaller units, ultimately enhancing housing affordability and access for lower-income households. We highlight the mechanism for this increase in affordability in Mumbai: scale effects in multifamily developments. By expanding the scale of development, the FAR relaxation in Mumbai allows developers to alter the characteristics of housing supplied on the market. We show that a 1% FAR increase results in a more-than-proportional response in housing supply. Using a DID design, we show that the FAR relaxation resulted in a 28% increase in the average number of apartments in multifamily developments in treated developments relative to the number in control developments. We find that the supply effect is driven by the construction of 18% smaller apartments. The increase in supply and reduction in size of the apartments boost housing affordability. Housing prices decline by 29%, allowing lower-income households to access housing.

To control for general equilibrium effects resulting from FAR relaxation, we develop a structural model of housing demand and supply. The model allows us to understand the drivers of these scale effects and their economic relevance. Using estimates from our model, we show that the FAR deregulation in Mumbai leads to a 3.18% decline in the average income of a buyer for new housing in Mumbai. We show that the FAR regulations in Mumbai are highly restrictive, and we compute an elasticity of land rents to the FAR in the range of 1.58 to 3.

Last, as an increasing number of cities aim to deregulate their zoning, determining the most effective method of implementing this deregulation becomes crucial. Our model allows us to contribute to the policy debate by comparing alternate scenarios of FAR implementation. We find that recognizing the presence of scale effects in residential development and leveraging them in the design of deregulation policies can amplify the affordability implications of such policies.

References

Anagol, S., Balasubramaniam, V., Ramadorai, T. and Uettwiller, A. (2022) A bad bunch: Asset value under-reporting in the mumbai real estate market, *Available at SSRN*.

Anagol, S., Ferreira, F. V. and Rexer, J. M. (2023) Estimating the economic value of zoning reform, Tech. rep., National Bureau of Economic Research.

Baitsch, T. and Bhide, A. (2022) Politics of land use regulations, in *Politics of Urban Planning: The Making and Unmaking of the Mumbai Development Plan 2014–2034*, Springer, pp. 83–105.

Baum-Snow, N. (2023) Constraints on city and neighborhood growth: The central role of housing supply, *Journal of Economic Perspectives*, **37**, 53–74.

Baum-Snow, N. and Han, L. (2023) The microgeography of housing supply, *Journal of Political Economy, forthcoming*.

Bertaud, A. (2004) Mumbai fsi conundrum: The perfect storm: The four factors restricting the construction of new floor space in mumbai, *Presentation available on www. alain-bertaud. com*.

Bertaud, A. and Brueckner, J. K. (2005) Analyzing building-height restrictions: predicted impacts and welfare costs, *Regional Science and Urban Economics*, **35**, 109–125.

Beverley, E. L. (2011) Colonial urbanism and south asian cities, *Social History*, **36**, 482–497.

Brooks, L. and Lutz, B. (2016) From today's city to tomorrow's city: An empirical investigation of urban land assembly, *American Economic Journal: Economic Policy*, **8**, 69–105.

Brueckner, J. K., Fu, S., Gu, Y. and Zhang, J. (2017) Measuring the stringency of land use regulation: The case of china's building height limits, *Review of Economics and Statistics*, **99**, 663–677.

Brueckner, J. K. and Singh, R. (2020) Stringency of land-use regulation: Building heights in us cities, *Journal of Urban Economics*, **116**, 103239.

Brueckner, J. K. and Sridhar, K. S. (2012) Measuring welfare gains from relaxation of land-use restrictions: The case of india's building-height limits, *Regional Science and Urban Economics*, **42**, 1061–1067.

Büchler, S. and Lutz, E. C. (2021) The local effects of relaxing land use regulation on housing supply and rents, *MIT Center for Real Estate Research Paper*.

Dossal, M. *et al.* (1991) *Imperial designs and Indian realities: the Planning of Bombay City, 1845-1875*, Oxford University Press, USA.

Duranton, G., Ghani, S. E., Goswami, A. G., Kerr, W. and Kerr, W. R. (2015) The misallocation of land and other factors of production in india, *World Bank Policy Research Working Paper*.

Duranton, G. and Puga, D. (forthcoming) Urban growth and its aggregate implications, *Econometrica*.

Gandhi, S., Green, R. K. and Patranabis, S. (2022) Insecure property rights and the housing market: Explaining indiaâs housing vacancy paradox, *Journal of Urban Economics*, **131**, 103490.

Gandhi, S. and Phatak, V. K. (2016) Land-based financing in metropolitan cities in india: The case of hyderabad and mumbai, *Urbanisation*, **1**, 31–52.

Gandhi, S., Tandel, V., Tabarrok, A. and Ravi, S. (2021) Too slow for the urban march: Litigations and the real estate market in mumbai, india, *Journal of Urban Economics*, **123**, 103330.

Ganong, P. and Shoag, D. (2017) Why has regional income convergence in the us declined?, *Journal of Urban Economics*, **102**, 76–90.

Gechter, M. and Tsivanidis, N. (2023) Spatial spillovers from high-rise developments: Evidence from the mumbai mills, Tech. rep., Working Paper.

Glaeser, E. L., Gyourko, J. and Saks, R. (2005a) Why is manhattan so expensive? regulation and the rise in housing prices, *The Journal of Law and Economics*, **48**, 331–369.

Glaeser, E. L., Gyourko, J. and Saks, R. E. (2005b) Why have housing prices gone up?, *American Economic Review*, **95**, 329–333.

Greenaway-McGrevy, R. and Phillips, P. C. (2023) The impact of upzoning on housing construction in auckland, *Journal of Urban Economics*, **136**, 103555.

Gyourko, J. and Molloy, R. (2015) Regulation and housing supply, in *Handbook of regional and urban economics*, Elsevier, vol. 5, pp. 1289–1337.

Harari, M. (2020) Cities in bad shape: Urban geometry in india, *American Economic Review*, **110**, 2377–2421.

Hsieh, C.-T. and Moretti, E. (2019) Housing constraints and spatial misallocation, *American Economic Journal: Macroeconomics*, **11**, 1–39.

Issar, S. (2017) Codes of contention: Building regulations in colonial bombay, 1870-1912, *Journal of Historical Sociology*, **30**, 164–188.

Katz, L. and Rosen, K. T. (1987) The interjurisdictional effects of growth controls on housing prices, *The Journal of Law and Economics*, **30**, 149–160.

Kidambi, P. (2004) 'an infection of locality': Plague, pythogenesis and the poor in bombay, c. 1896–1905, *Urban History*, **31**, 249–267.

Kline, P. and Walters, C. R. (2019) On heckits, late, and numerical equivalence, *Econometrica*, **87**, 677–696.

Kulka, A. (2019) Sorting into neighborhoods: The role of minimum lot sizes, in *Conference paper, APPAM 41st Annual Fall Research Conference, Denver, CO*.

Kumar, T. (2021) The housing quality, income, and human capital effects of subsidized homes in urban india, *Journal of Development Economics*, **153**, 102738.

Manville, M., Lens, M. and Monkkonen, P. (2022) Zoning and affordability: A reply to rodríguez-pose and storper, *Urban Studies*, **59**, 36–58.

Mast, E. (2023) The effect of new market-rate housing construction on the low-income housing market, *Journal of Urban Economics Insight*, **133**, 103383.

McKinsey (2010) India's urban awakening: Building inclusive cities, sustaining economic growth., available at: https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Operations/Our%20Insights/Urban%20awakening%20in%20India/MGI_Indias_urban_awakening_executive_summary.pdf.

Moon, B. and Ahn, S. (2022) The effects of a far regulation in a model of durable building with redevelopment: The case of new york city, *Regional Science and Urban Economics*, **95**, 103775.

Peng, X. E. (2022) The dynamics of urban development: Evidence from zoning reform in new york, *Unpublished Manuscript*.

Phatak, V. (2000) *Developing Land and Real Estate Markets: The Case of Mumbai Metropolitan Region (2000)*.

Quigley, J. M. and Raphael, S. (2004) Is housing unaffordable? why isn't it more affordable?, *Journal of Economic Perspectives*, **18**, 191–214.

Quigley, J. M. and Raphael, S. (2005) Regulation and the high cost of housing in california, *American Economic Review*, **95**, 323–328.

Rodríguez-Pose, A. and Storper, M. (2020) Housing, urban growth and inequalities: The limits to deregulation and upzoning in reducing economic and spatial inequality, *Urban Studies*, **57**, 223–248.

Saiz, A. (2010) The geographic determinants of housing supply, *The Quarterly Journal of Economics*, **125**, 1253–1296.

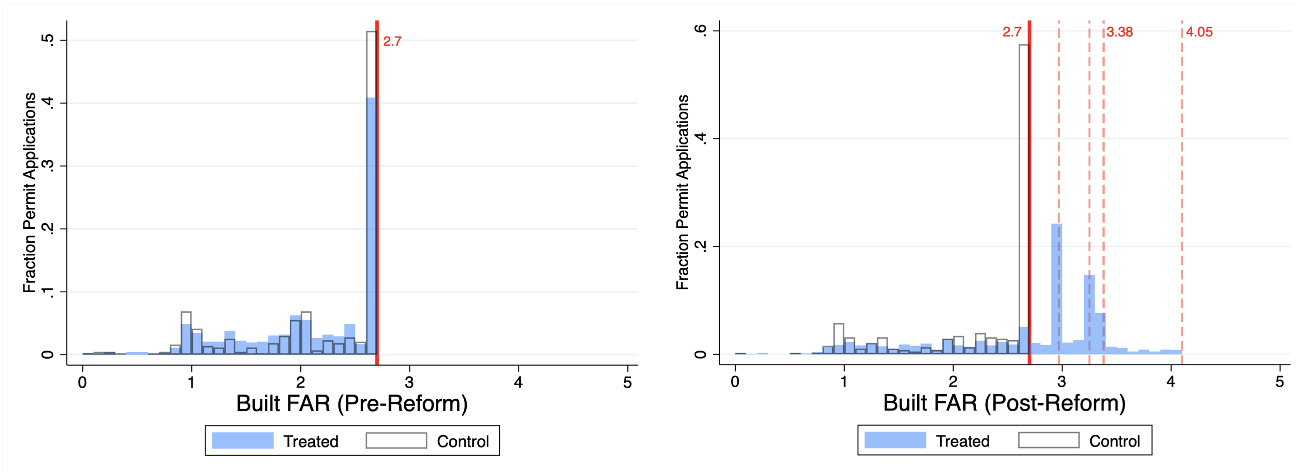
Trounstine, J. (2020) The geography of inequality: How land use regulation produces segregation, *American Political Science Review*, **114**, 443–455.

Turner, M. A., Haughwout, A. and Van Der Klaauw, W. (2014) Land use regulation and welfare, *Econometrica*, **82**, 1341–1403.

United Nations (2018) 68% of the world population projected to live in urban areas by 2050, says un, available at: https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.

Main Figures and Tables

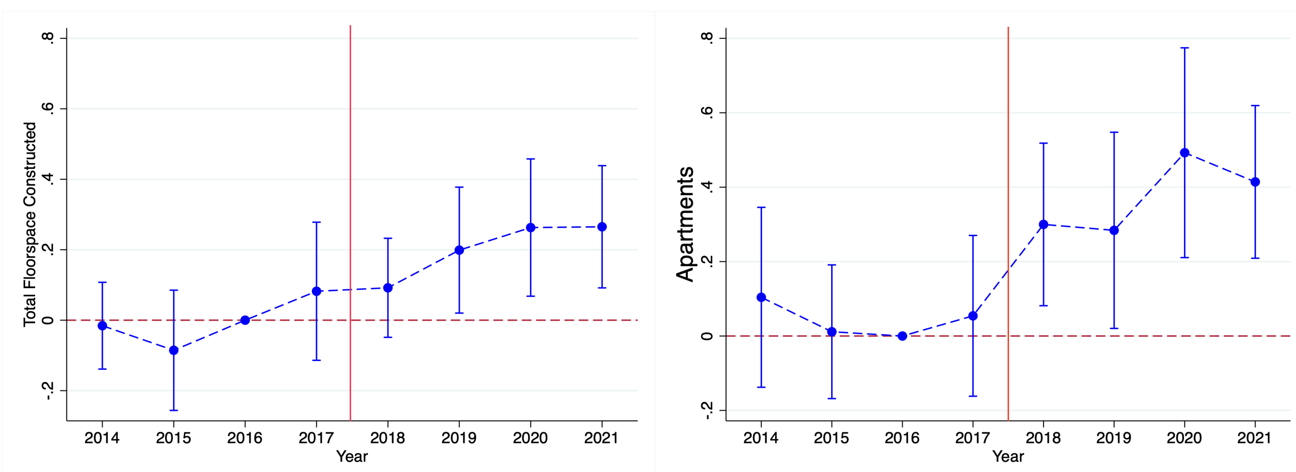
Figures



(a) Pre-2018 FAR (b) Post-2018 FAR

Figure 1: Built FAR

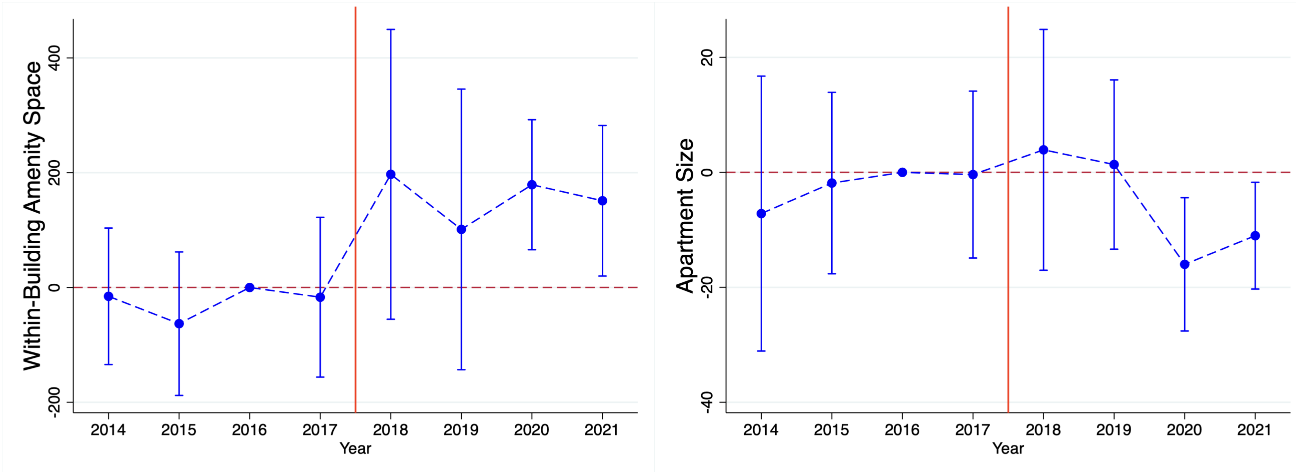
Note: The vertical red line marks the prereform maximum FAR that projects could apply for, i.e., FAR = 2.7. The dashed lines show the differential postreform FAR caps of 2.97, 3.25, 3.38, and 4.05, which reflect a 10, 20, 30 and 50% increase in the FAR allowance from the pre-reform cap of 2.7. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group.



(a) Total Floorspace (b) Apartments

Figure 2: Impact of Deregulation on Housing Supply

Note: The data are sourced from permit applications. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the preperiod from the postperiod, indicating the FAR relaxation in 2018. We normalize the difference by 2016, the year of the relaxation announcement, to account for any anticipation effects of the policy.

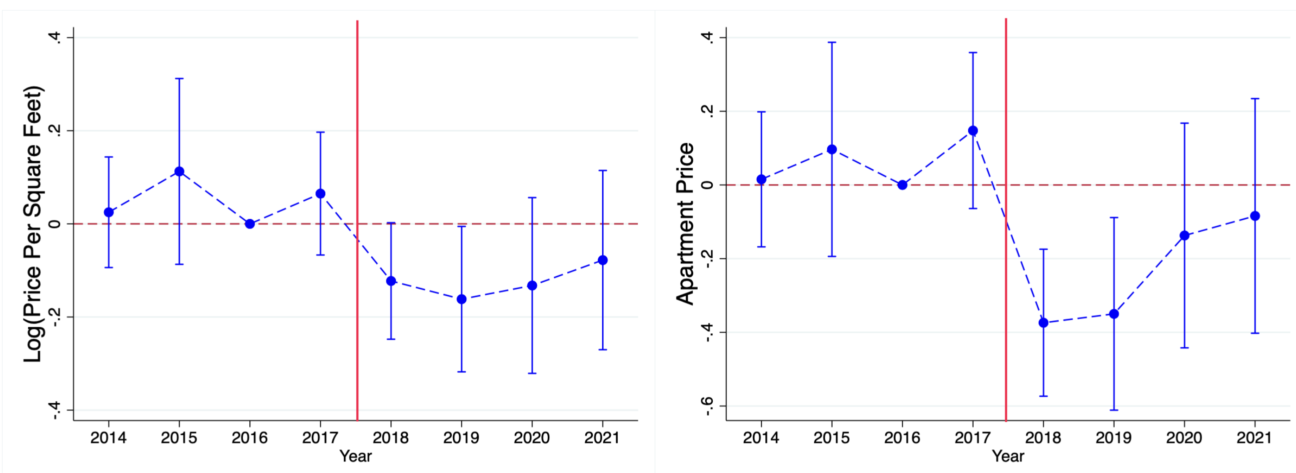


(a) Within-Building Public Amenity Space

(b) Apartment Size

Figure 3: Changes in Housing Characteristics

Note: The data are sourced from permit applications. Public space and apartment sizes are measured in square meters. Public space is constructed from the difference between the total developed area and the area of all apartments. We plot the difference in the outcome variable normalized by 2016, the year of the relaxation announcement, to account for any anticipation effects of the policy. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the preperiod from the postperiod, indicating the FAR relaxation in 2018.



(a) Price (Per Square Foot)

(b) Apartment Price

Figure 4: Impact of Deregulation on Prices

Note: Apartment prices are sourced from PropEquity data. We plot the difference in the outcome variable normalized by 2016, the year of the relaxation announcement, to account for any anticipation effects of the policy. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the preperiod from the postperiod, indicating the FAR relaxation in 2018.

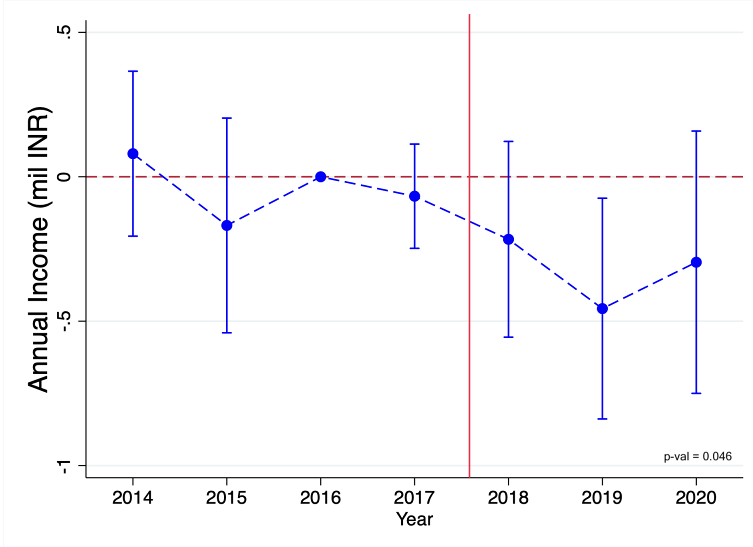


Figure 5: Effects of Deregulation on Buyer Income

Note: Data are sourced from mortgage applications. We plot the difference in the outcome variable normalized by 2016, the year of the relaxation announcement, to account for any anticipation effects of the policy. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the preperiod from the postperiod, indicating the FAR relaxation in 2018.

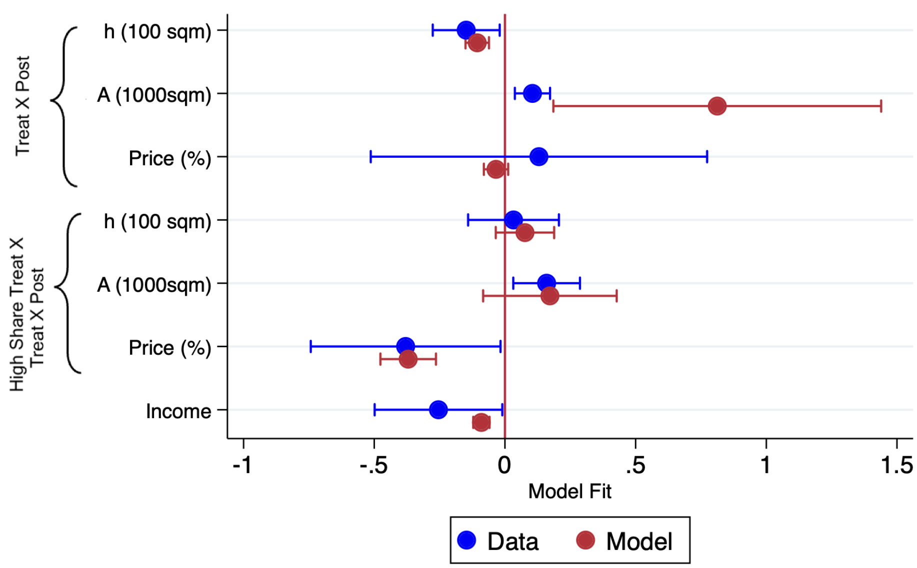


Figure 6: Assessing Model Fit

Note: The estimates for the data are from Table 10. The figure reports 90% confidence intervals. Full model estimates are reported in Appendix I.2.

Tables

Table 1: DCPR 2034: FAR regime change

Road Width (in m)	Pre-2018 FAR Cap	Post-2018 FAR Cap	
		City	Suburb
<9	2.7	1.8	1.35
$\geq$ 9 and <12	2.7	2.7	2.7
$\geq$ 12 and <18	2.7	3.24	2.97
$\geq$ 18 and <27	2.7	3.65	3.24
$\geq$ 27	2.7	4.05	3.38

Note: The numbers are taken from Table 17 of the DCPR 2034. The pre-2018 and post-2018 FAR caps represent the maximum FARs that developments can obtain from all potential sources, including both the free FAR allowance and the allowance that can be acquired through payment to the MCGM.

Table 2: Prereform Project Characteristics

	Mean
Built FAR	2.18
	(0.61)
Net Area of Plot	2409.24
	(6207.28)
Number of Units Developed	49.11
	(95.26)
Average Unit Size	92.51
	(99.68)
Number of Projects	1243

Notes: The observations are residential projects in the period 2014–2017. The built FAR is the FAR reported by the developer on the permit application and approved by the municipal government. Area of plot and average unit size are reported in square meters.

Table 3: Effects of Deregulation on Housing Supply

Dependent Variable:	FAR	Total Floorspace	# Units
Treat * Post	0.39***	909.12*	12.72**
	(0.06)	(473.74)	(5.15)
Treat	-0.04	2139.821**	19.08***
	(0.05)	(540.79)	(4.53)
Preperiod Mean	2.18	3981.47	44.75
Number of Applications	3014	2358	2558
Ward X Post FE	X	X	X
Ward FE	X	X	X
Year FE	X	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014–2022, and the data are sourced from permit applications. Columns (1)–(3) show effects of the deregulation on the FAR, total floorspace area, and number of apartments, respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes value 1 if a project files building plans following the FAR deregulation in 2018. Total floorspace is measured in square meters. The data have missing values for total floorspace and number of units. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Effects of Deregulation on Housing Characteristics

Dependent Variable:	Unit Size	Public Space
Treat * Post	-17.36*	159.44**
	(9.68)	(43.53)
Treat	8.69*	122.48***
	(4.79)	(25.89)
Preperiod Mean	92.46	165.43
Number of Applications	2581	2667
Ward X Post FE	X	X
Ward FE	X	X
Year FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014–2022, and the data are sourced from permit applications. Columns (1)–(2) show effects of the deregulation on apartment size and public amenity floorspace, respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes value 1 if a project files building plans following the FAR deregulation in 2018. Unit size and public floorspace are measured in square meters. The data have missing values for unit size and public floorspace. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Effects of Deregulation on Prices

Dependent Variable:	% Change in Price	
	per sq ft	Apartment
Treat * Post	-0.16*	-0.29*
	(0.08)	(0.16)
Treat	0.22***	0.56***
	(0.05)	(0.11)
Preperiod Mean	23213.02	20.6 mil
Number of Applications	71036	71967
Ward X Post FE	X	X
Ward FE	X	X
Year FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are transactions for projects in the period 2014–2022 and are sourced from PropEquity. Columns (1)–(2) show effects of the deregulation on price per unit area of the apartment and the total cost of the apartment. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes value 1 if a project files building plans following the FAR deregulation in 2018. Means are reported in INR. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Effects of Deregulation on Household Characteristics

Dependent Variable:	Income	Age
Treat * Post	-8.29*	-1.08
	(4.78)	(1.17)
Treat	10.66***	0.83
	(2.10)	(0.48)
Preperiod Mean	32.56	39.74
Number of Transactions	6479	6479
Controls	X	X
Ward FE	X	X
Year of Transaction FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are mortgage applications for projects launched in the period 2014–2022 and are sourced from a large private bank in India. Columns (1)–(2) show effects of the deregulation on annual income of buyers and their age, respectively. Annual income is reported in lakhs ($= 10^5$ INR). The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes value 1 if a project files building plans following the FAR deregulation in 2018. Controls include applicant age and gender in column (1) and only gender in column (2). Standard errors are clustered at the the project and transaction-year level. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Local Spillover Effects on Prices

Dependent Variable:	% Change in Prices			
0-3km of High Treat Intensity * Post	-0.10*	-0.13**	-0.01	-0.02
	(0.05)	(0.06)	(0.07)	(0.07)
3-5km of High Treat Intensity * Post	-0.01	-0.00	0.09	0.11
	(0.05)	(0.05)	(0.07)	(0.07)
0-3km of High Treat Intensity * Same Price Band* Post			-0.16**	-0.17**
			(0.08)	(0.08)
3-5km of High Treat Intensity * Same Price Band * Post			-0.03	-0.05
			(0.08)	(0.08)
Pre-period Mean	19179.67	19179.93	19179.67	19179.93
Number of Transactions	69509	69507	69509	69507
Ward FE	X	X	X	X
Year FE		X		X

Notes: The table presents difference-in-difference results of the impact of the being proximate to zipcodes with a high share of treated plots. Zipcodes are classified as high treatment share if over 33% of their plots are treated, i.e. over 75th percentile on the distribution of share of treated plots. The 0-3 km and 3-5km variable capture projects within 3 or 5 km of a highly treated zipcode. Price bands are constructed using the distribution of the total price of a unit in the pre-period. The price bands are demarcated using the 25th, 50th and 75th percentiles of the price distribution, generating four bands. The same price variable indicates whether the zipcode is in the same price band as the highly treated zipcode it is proximate to. The sample comprises of projects launched between 2014-2022. The transaction prices are sourced from the PropEquity data. Post takes the value 1 following the FAR deregulation in 2018. Standard errors are clustered at the pincode level. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Heterogeneity by Distance to Treated Roads

	1-200m			201-500m			501-800m		
Dependent Variable:	FAR	Res Floorspace	# Units	FAR	Res Floorspace	# Units	FAR	Res Floorspace	# Units
Treat * Post	0.33***	1740.31**	10.46*	0.33**	2125.25**	18.95**	0.72**	2751.69**	26.48*
	(0.08)	(687.41)	(5.89)	(0.09)	(844.75)	(6.08)	(0.28)	(996.60)	(14.99)
Treat	-0.03	2269.08**	19.49**	-0.05	3150.73**	19.46**	-0.29**	1484.84**	7.72
	(0.08)	(1008.01)	(7.40)	(0.06)	(885.08)	(5.88)	(0.12)	(648.82)	(11.64)
Preperiod Mean	2.16	4730.31	47.26	2.15	5045.48	50.40	2.16	5281.11	51.56
Number of Applications	2316	2060	1940	2093	1846	1731	1939	1716	1602
Ward X Post FE	X	X	X	X	X	X	X	X	X
Ward FE	X	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1). The observations are residential projects in the period 2014–2022, and the data are sourced from permit applications. Columns show results of the deregulation on FAR, total floorspace area, and number of apartments. The treatment group consists of developments on parcels on roads wider than 12 meters. The control group includes developments within 1–200 meters, 201–500 meter, and 501–800 meters from roads wider than 12 meters respectively. Post takes value 1 if a project files building plans following the FAR deregulation in 2018. Total floorspace is measured in square meters. The data have missing values for total floorspace and number of units. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Placebo Test for Demand

Dependent Variable:	% Change in Price	
	per sq ft	Apartment
Treat * Post	-0.06	-0.14
	(0.06)	(0.08)
Treat	0.10*	0.21**
	(0.06)	(0.08)
Preperiod Mean (INR)	17988.94	18.3 mil
Number of Applications	61438	61586
Ward X Post FE	X	X
Ward FE	X	X
Year FE	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1). The observations are transactions for projects launched between 2008 and 2013 and are sourced from PropEquity. Columns (1)–(2) show effects of the deregulation on price per unit area of the apartment and the total cost of the apartment. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes value 1 if a project files building plans following the FAR deregulation in 2018. Means are reported in INR. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Data Moments

Dependent Variable:	Unit Size	Public Space	Ln(Price)
High Treat Intensity * Treat * Post	3.28	159.51**	-0.38*
	(10.53)	(77.32)	(0.22)
Treat * Post	-14.82*	105.29***	0.13
	(7.76)	(40.79)	(0.39)
Preperiod Mean	84.73	246.87	18.75 mil
Number of Observations	2215	2316	66,249
Controls	X	X	X

Notes: *** indicates significance at 1% level, ** at 5% level, * at 10% level. The table reports estimates from eq. 14, which are the moments from the data matched in the model. High Treat Intensity is an indicator variable for zipcodes over the 75th percentile in the distribution of the fraction of plots on treated roads, i.e., over 12 meters in width. The treatment group comprises of applications on roads over 12 meters in width. Permit applications on roads below 12 meters in width form our control group. Post = 1 following the FAR deregulation in 2018. Standard errors are clustered at the zipcode level.

Table 11: Preference Parameter Estimates

Parameter:	Estimates	
	High Income	Low Income
α	0.784	0.745
β	0.143	0.05
$1-\alpha-\beta$	0.073	0.205

Notes: α, β and 1-α-β are preference weights for each income group g in the utility function in eq. 2.

Table 12: Counterfactual Estimates

Scenario	Baseline	5% FAR increase to treated	15% FAR increase to control
Avg Income of Buyers	-3.18%	-3.23%	-3.14%

Notes: Baseline scenario is the 2018 FAR reform wherein treated plots received a 10-50% FAR increase. The 5% FAR increase to treated allows for an additional increase (over the new 2018 FAR caps) for plots on roads wider than 12 meters. The 15% FAR increase to control allows for plots on roads narrower than 12 meters an FAR relaxation of 5%. Plots on roads wider than 12 meters continue to get the new FAR caps from the 2018 reform.

A Mumbai

A.1 Location of Treatment and Control

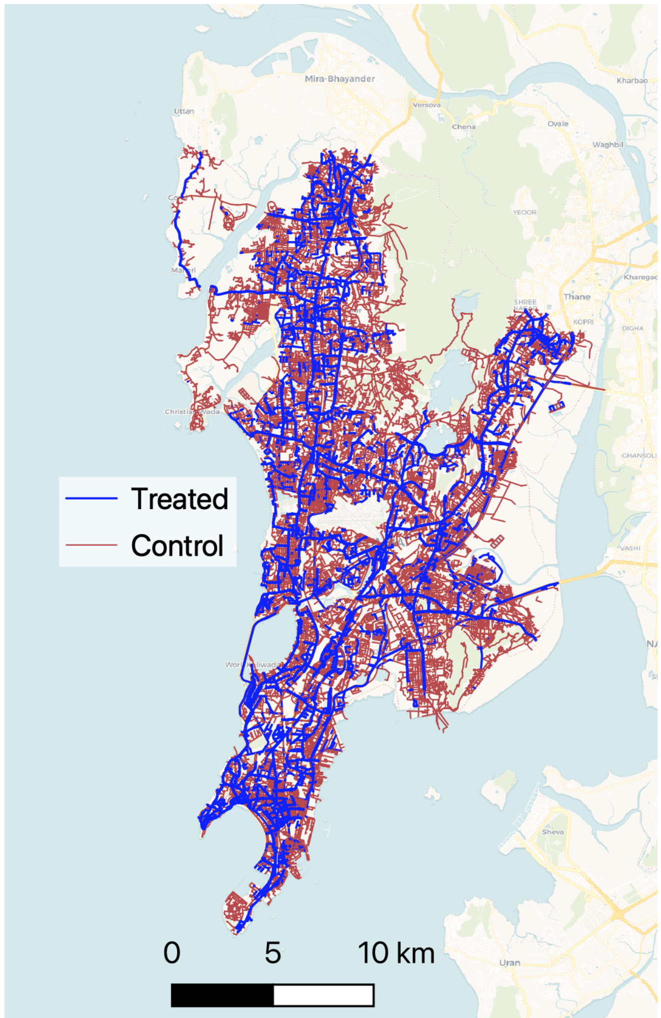


Figure A.1: Treatment and Control Roads in Mumbai

Source: AInsight roads data layer.

B Application Permit data

We obtain the application permit data by digitizing the permit applications filed with and approved by the Municipal Commission of Greater Mumbai (MCGM). Figures B.1 and B.2 show permit applications before and after the implementation of the reform.

B.1 Permit Example

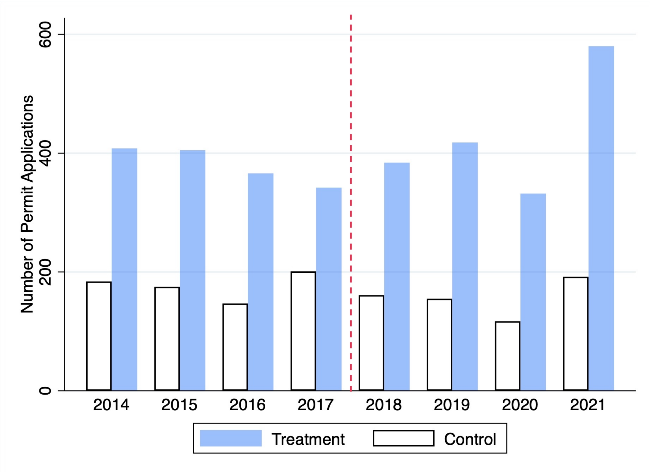
		PROFORMA – A	
A) AREA STATEMENT			SQ.MTS.
1.		AREA OF PLOT	492.40
2.		DEDUCTION FOR	
	A	ROAD SET BACK AREA	--
	B	PROPOSED ROAD	--
	C	ANY RESERVATION	--
		TOTAL (A + B + C)	--
3.		BALANCE AREA OF THE PLOT (1 – 2)	492.40
4.		DEDUCTION FOR R. G.	--
5.		NET AREA OF PLOT (3 – 4)	492.40
6.		ADD FOR F. S. I.	--
	2A	100%	--
	2B	100% PROPOSED ROAD SET BACK AREA	--
7.		TOTAL AREA (5 + 6)	492.40
8.		F.S.I. PERMISSIBLE	1.00
9.		F.S.I. CREDIT AVAILABLE BY DEVELOPMENT RIGHTS PROPOSE SLUM T.D.R. D.R.C. NO. SRA/1114/CONST.	250.00
		ADDITIONAL FOR FLOOR SPACE INDEX 0.50 FSI AS PER GOVT. NOTIFICATION (50% OF 492.40)	242.40
10.		PERMISSIBLE FLOOR AREA	984.80
11.		TOTAL PROPOSED BUILT UP AREA	984.80
12.		F. S. I. CONSUMED ON NET PLOT	2.00
B) DETAIL OF RESIDENTIAL NON RESIDENTIAL AREA			
1.		PURELY RESIDENTIAL BUILT UP AREA	984.80
2.		REMAING NON – RESIDENTIAL BUILT UP AREA	--
C) DETAIL OF FSI AVAILABLE AS PER DCR 35(4)			
1.		FUNGIBLE B.U.A. COMPONENT PERMISSIBLE VIDE DCR 35(4) FOR REHAB RESIDENTIAL (492.40 x 35%)	172.34
2.		FUNGIBLE B.U.A. COMPONENT PERMISSIBLE VIDE DCR 35(4) FOR SALE RESIDENTIAL (492.40 x 35%)	172.34
3.		FUNGIBLE B.U.A. PROPOSED FOR REHAB RESIDENTIAL	172.34
4.		FUNGIBLE B.U.A. PROPOSED FOR SALE RESIDENTIAL	172.34
5.		TOTAL FUNGIBLE AREA (3 + 4)	344.68
6.		TOTAL GROSS BUILT UP AREA PROPOSED [A(11)+C(5)]	1329.48
7.		TOTAL F. S. I. CONSUMED ON NET PLOT	2.70

Figure B.1: Pre-2018 permit application

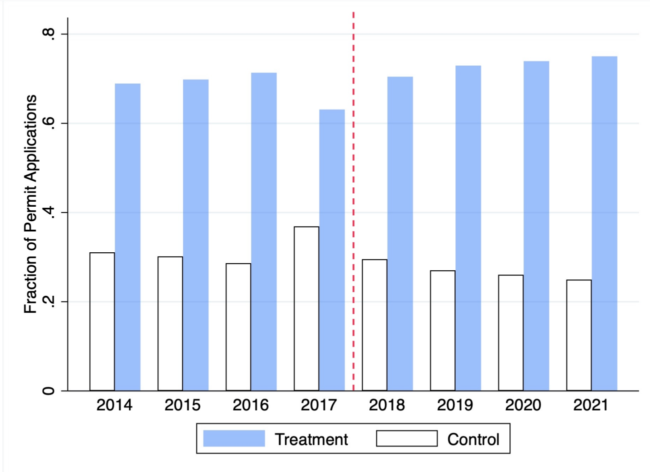
	PROFORMA-A	TOTAL AS PER DCPR 2034
I	AREA STATEMENT	
1.	AREA OF PLOT	666.20
a)	Area of Reservation in plot	
b)	Area of Road Set back	NIL
c)	Area of D.P. Road	9.00
2.	DEDUCTIONS FOR	NIL
A.	For Reservation/Road Area	NIL
	a) Road setback Area to be handed over (100%) Reg. No. 16	9.00
	b) Proposed D.P. Road to be handed over (100%) Reg. No. 16	NIL
	c) Reservation Area to be handed over (100%) Reg. No. 17(ii)	NIL
	d) Reservation Area to be handed over as per AR(100%) Reg. No.17	NIL
3.	TOTAL DEDUCTIONS [{2(A)+2(B)}+2(C) as and when applicable]	9.00
4.	BALANCE AREA OF PLOT (1-3)	657.20
5.	Plot area under Development after areas to be handed over to MCGM/ Appropriate Authority as per Sr. No. 4 above	657.20
6.	Zonal (basic) FSI 1.00	1.00
7.	Built up Area as per Zonal (basic) FSI (5X6)	657.20
8.	Additional Built up Area for land handed over as per Reg. 30(A)	18.00
9.	Built up Area in lieu of cost of construction of built up amenity to be handed overequal to area of land handed over as per Reg. 30(A)	NIL
10.	Built up Area due to "Additional FSI on payment of premium" as per Tab No. 12 of Reg. No. 30(A) on remaining/ balance plot.	328.60
11.	Built up Area due to admissible "TDR" as per Table No. 12 of Reg. 30(A and 32 on remaining/ balance plot. (0.90 X 657.20= 591.48 S.MTS.) 591.48-18= 573.48	573.48
12.	Permissible Built up Area	1577.28
13.	Proposed BUA	1577.28
14.	TOTAL PERMISSIBLE BUILT UP AREA	
a)	i. Permissible Fungible Compensatory Area for Rehab component without charging premium	142.97
	ii. Fungible Compensatory Area for Rehab component without charging premium	142.97
b)	i. Permissible Fungible Compensatory Area by charging premium	409.08
	ii. Fungible Compensatory Area availed on payment of premium	408.88
15.	Total Built up Area proposed including Fungible Compensatory Area [13 + 15(a)(ii) + 15 (b)(ii)]	2129.13
16.	FSI consumed on Net Plot (13/4)	3.24

Figure B.2: Post-2018 permit application

B.2 Residential Developments



(a) Number of applications



(b) Proportion of applications

Figure B.3: Impact of deregulation on number of applications

Note: The data are sourced from permit applications. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the pre-period from the post-period, indicating the FAR relaxation in 2018.

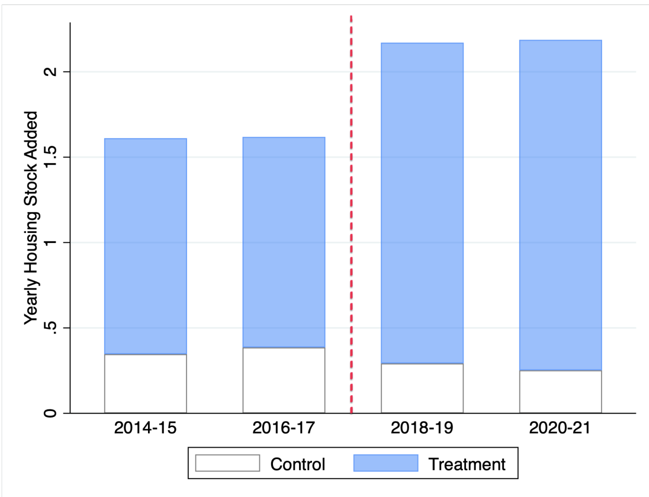


Figure B.4: Supply of treatment and control apartments relative to housing stock

Note: This figure plots the number of aggregate number of apartments in treatment and control projects as a proportion of the housing stock in 2012. The bars represent two-year averages to smooth out the year to year variation in the data. The data are sourced from permit applications and from supplementary property tax data from 2012 with details of the housing stock. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the pre-period from the post-period, indicating the FAR relaxation in 2018.

B.3 Descriptive Statistics

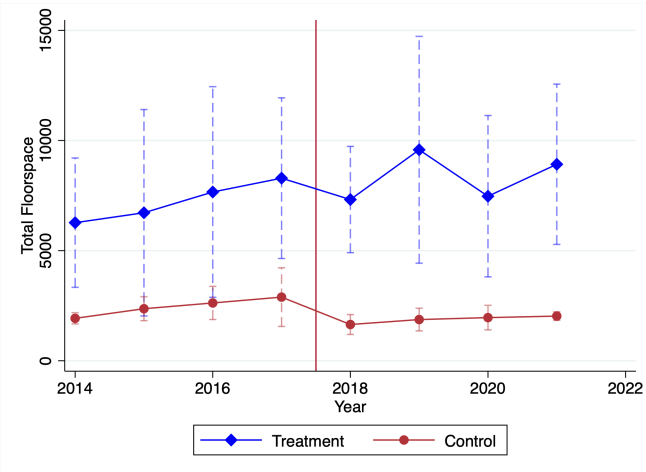
Table B.1: Pre-reform descriptive Statistics by Groups

	Treatment mean	Control mean	p-value(Treatment = Control)
Built FAR	2.15	2.21	0.125
	(0.60)	(0.63)	
Net Area of Plot	4534.63	1248.86	0.000
	(12684.87)	(4916.70)	
Number of Apartments Constructed	61.45	31.53	0.000
	(117.13)	(38.30)	
Average Apartment Size	97.79	84.46	0.038
	(97.81)	(100.98)	
Number of Projects	795	463	

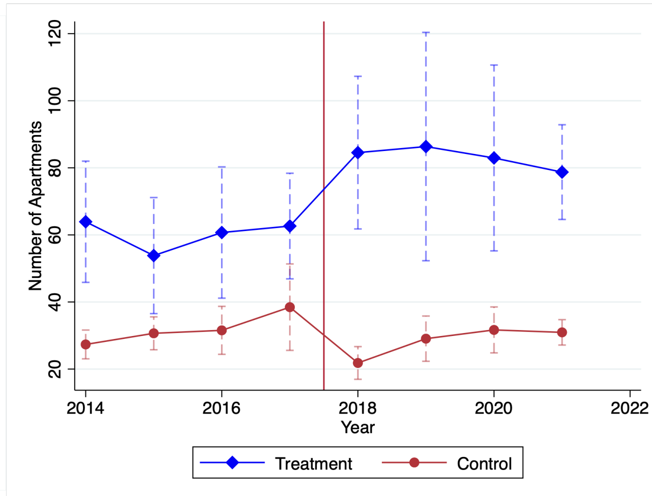
Notes: The observations are residential projects in the period 2014-2017. The built FAR is the FAR reported by the developer on the permit application, and approved by the municipal government. Area of plot and average unit size are reported in square meters.The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group.

C Extended Results

C.1 Figures



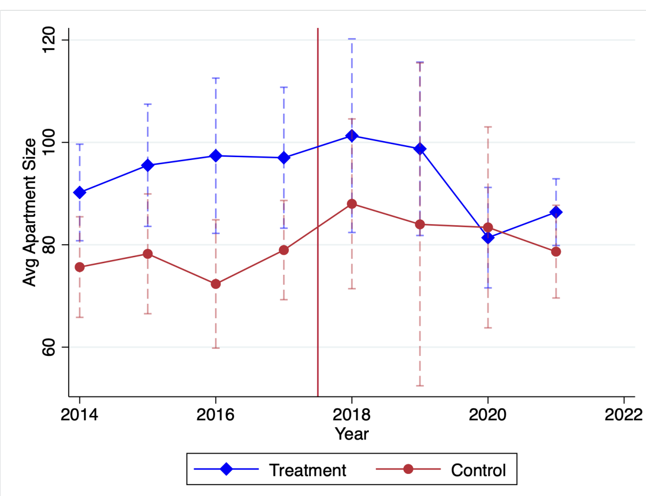
(a) Area of Plot Developed



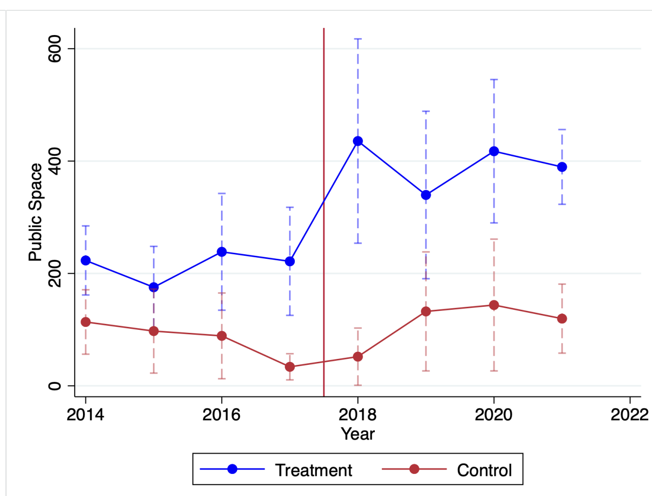
(b) Number of Apartments

Figure C.1: Impact of FAR deregulation on housing supply

Note: This figure plots the means of total floorspace and the number of apartments in the treatment and control group for residential projects in the period 2014-2022. The data are sourced from permit applications. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the pre-period from the post-period, indicating the FAR relaxation in 2018.



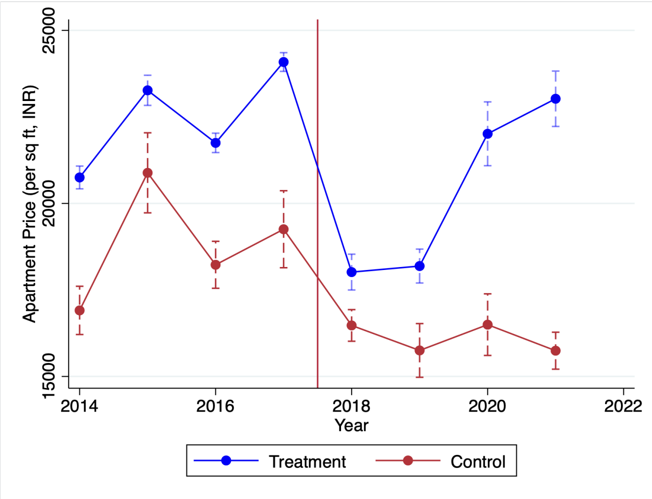
(a) Average Apartment Size



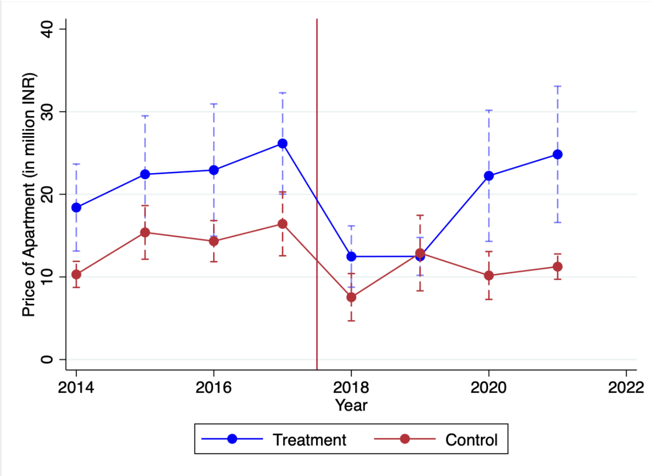
(b) Public Amenity Space

Figure C.2: Impact of FAR deregulation on housing characteristics

Note: This figure plots the means of apartment sizes and public space for residential projects in the period 2014-2022. The data are sourced from permit applications. Public space and apartment sizes are measured in square meters. Public space is constructed using the different between the total developed area less the area of all apartments. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the pre-period from the post-period, indicating the FAR relaxation in 2018.



(a) Price (per square feet)



(b) Total Price of Apartment

Figure C.3: Impact of FAR deregulation on apartment prices

Note: This figure plots the means of apartment prices and revenues per project for residential projects in the period 2014-2022. The apartment prices and price per square unit area are sourced from PropEquity data.The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. The vertical red line demarcates the pre-period from the post-period, indicating the FAR relaxation in 2018.

C.2 Tables

Table C.1: All Specifications: Housing Supply

Dependent Variable:			FAR					Total Floorspace					# Units		
Treat * Post	0.40***	0.41***	0.40***	0.39***	0.34***	1445.72**	1705.05**	1704.01**	2103.67**	2065.68***	12.62**	13.74**	13.51**	13.74**	11.64**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.08)	(680.07)	(626.45)	(608.77)	(564.80)	(479.49)	(5.42)	(5.36)	(5.34)	(5.13)	(4.15)
Treat	-0.06	-0.04	-0.04	-0.04	-0.02	3024.51**	2536.63**	2542.43**	2242.44**	2162.24**	20.28**	18.41**	18.63***	18.05***	17.71***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(895.98)	(740.10)	(737.54)	(662.52)	(730.09)	(5.96)	(4.93)	(4.89)	(4.38)	(3.96)
Post	0.15**	0.16**	0.21**			-446.77**	-588.92*	889.65			-1.87	-3.15	-0.44		
	(0.05)	(0.04)	(0.06)			(215.41)	(309.21)	(586.98)			(2.51)	(3.14)	(3.83)		
Pre-period Mean	2.18	2.18	2.18	2.18	2.19	4273.70	4273.70	4273.70	4273.70	4237.97	44.20	44.20	44.20	44.20	43.95
Number of Applications	3014	3014	3014	3014	2894	2698	2698	2698	2698	2592	2557	2557	2557	2557	2450
Ward FE		X	X	X				X	X		X	X	X	X	X
Pincode FE				X											
Year FE			X	X	X			X	X	X			X	X	X
Ward x Post FE				X											
Pincode x Post FE	X	X	X												

Notes: The table presents difference-in-difference results of the impact of the treatment with different levels of fixed effects. The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. The table show results of the deregulation on FAR, total floorspace area, and number of apartments respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Total floorspace is measured in square meters. The data has missing values for total floorspace and number of units. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table C.2: All Specifications: Housing Characteristics

Dependent Variable:	Unit Size (sq m)					Public Space (sq m)				
Treat * Post	-18.83*	-19.11*	-18.36*	-17.36*	-19.99	143.27**	148.94**	149.09**	159.44**	150.12***
	(9.45)	(9.22)	(9.68)	(9.68)	(13.13)	(44.52)	(47.81)	(48.42)	(43.53)	(35.23)
Treat	13.91**	8.82*	9.35*	8.69*	6.71	125.58***	132.18***	131.37***	122.48***	121.33***
	(5.32)	(4.70)	(4.64)	(4.79)	(7.11)	(28.62)	(27.11)	(27.52)	(25.89)	(27.14)
Post	14.14	9.67	18.26			28.51	26.35	-40.16		
	(8.76)	(8.43)	(15.07)			(22.76)	(24.55)	(41.03)		
Pre-period Mean	92.46	92.46	92.46	92.46	92.85	165.43	165.43	165.43	165.43	163.00
Number of Applications	2581	2581	2581	2581	2475	2667	2667	2667	2667	2560
Ward FE		X	X	X			X	X	X	
Year FE			X	X	X			X	X	X
Ward x Post FE				X					X	
Pincode FE					X					X
Pincode x Post FE					X					X

Notes: The table presents difference-in-difference results of the impact of the treatment with different levels of fixed effects. The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. The table show results of the deregulation on apartment size and public amenity floorspace respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Unit size and public floorspace are measured in square meters. The data has missing values for unit size and public floorspace. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table C.3: All Specifications: Apartment Prices

Dependent Variable:	% Change in Price									
	per sq ft					Apartment				
Treat * Post	-0.12	-0.15**	-0.17**	-0.16**	-0.22**	-0.14	-0.20	-0.28	-0.29	-0.31*
	(0.08)	(0.07)	(0.07)	(0.06)	(0.08)	(0.22)	(0.20)	(0.20)	(0.22)	(0.16)
Treat	0.22***	0.23***	0.23***	0.22***	0.20***	0.53***	0.53**	0.56**	0.56**	0.50**
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.13)	(0.14)	(0.15)	(0.16)	(0.14)
Post	-0.05	0.02	0.04			-0.28	-0.15	-0.03		
	(0.04)	(0.06)	(0.06)			(0.17)	(0.12)	(0.20)		
Pre-period Mean	23191.52	23191.52	23191.52	23191.52	23214.06	2.06e+07	2.06e+07	2.06e+07	2.06e+07	2.06e+07
Number of Applications	71193	71193	71193	71193	71032	72126	72126	72126	72126	71965
Ward FE		X	X	X			X	X	X	
Year FE			X	X	X			X	X	X
Ward x Post FE				X				X		
Pincode FE					X					X
Pincode x Post FE					X					X

Notes: The table presents difference-in-difference results of the impact of the treatment with different levels of fixed effects. The observations are residential projects in the period 2014-2022, and the data is sourced from PropEquity. The table shows effects of the deregulation on price per unit area of the apartment, and the total cost of the apartment.The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Means are reported in INR. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1

Table C.4: All Specifications: Household Characteristics

Dependent Variable:	Income				Age			
Treat * Post	0.96	-8.46	-9.99*	-8.29*	1.74	-0.64	-1.26	-1.26
	(7.66)	(5.48)	(5.07)	(4.78)	(1.57)	(1.20)	(1.28)	(1.15)
Treat	8.46***	11.39***	11.63***	10.66***	0.26	1.01**	1.12**	1.08**
	(1.44)	(1.92)	(2.38)	(2.10)	(0.41)	(0.39)	(0.52)	(0.49)
Post	-2.00	6.82	5.28		-1.43	0.34	1.74	
	(6.79)	(4.84)	(7.52)		(1.65)	(1.20)	(1.62)	
Pre-period Mean	32.56	32.56	32.56	32.56	39.74	39.74	39.74	39.74
Number of Applications	6479	6479	6479	6479	6867	6867	6867	6867
Controls	X	X	X	X	X	X	X	X
Ward FE		X	X	X		X	X	X
Year FE			X	X			X	X
Ward x Post FE				X				X

Notes: The table presents difference-in-difference results of the impact of the treatment with different levels of fixed effects. The observations are mortgage applications for projects launched in the period 2014-2022, and are sourced from a large private bank in India. The table show effects of the deregulation on annual income of buyers and their age respectively. Annual income is reported in lakhs (= 10^5 INR). The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Controls for regressions on income include age and gender of the applicant, and only gender for regressions on age. Standard errors are clustered at the the project and year of transaction level. *** p<0.01, ** p<0.05, * p<0.1.

Table C.5: Effects of Deregulation on Mortgages

Dependent Variable:	Price/sq ft	Loan Amount
Treat * Post	-0.19*	-0.31**
	(0.09)	(0.13)
Treat	0.19***	0.41***
	(0.04)	(0.05)
Pre-period Mean	21842.64	115.94
Number of Transactions	6391	6479
Controls	X	X
Ward FE	X	X
Year of Transaction FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are mortgage applications for projects launched in the period 2014-2022, and are sourced from a large private bank in India. Columns (1)-(2) show effects of the deregulation on price per unit area and the loan amount respectively. Loan amount is reported in lakhs ($= 10^5$ INR). The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Controls include age and gender of the applicant. Standard errors are clustered at the the project and year of transaction level. *** p<0.01, ** p<0.05, * p<0.1.

D Property Price data

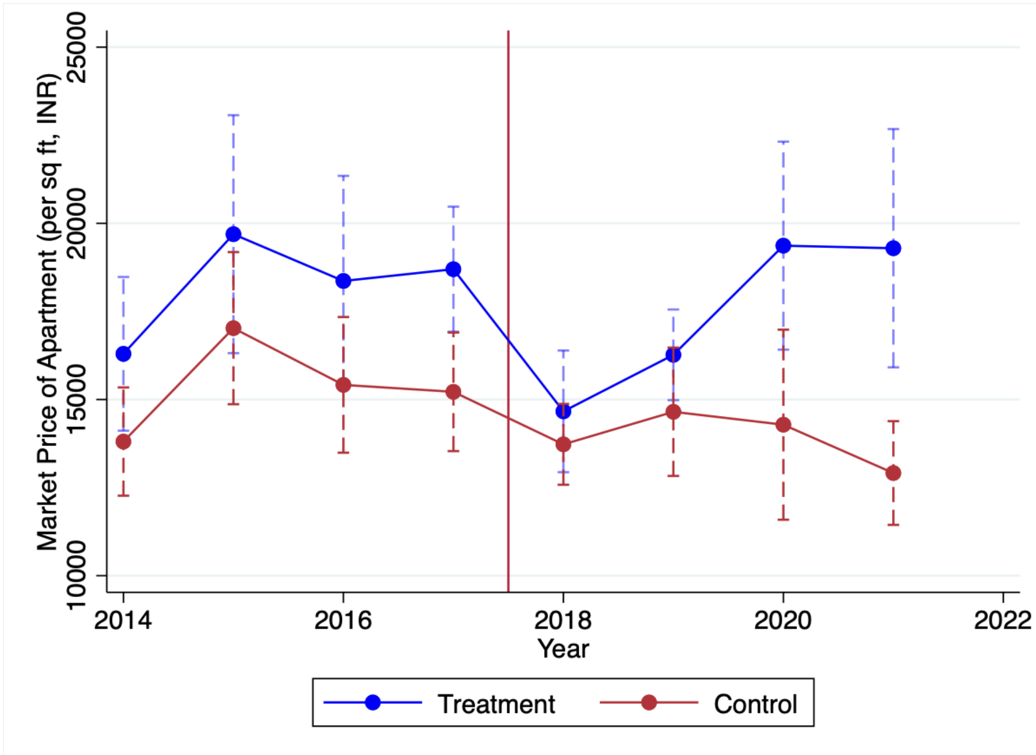
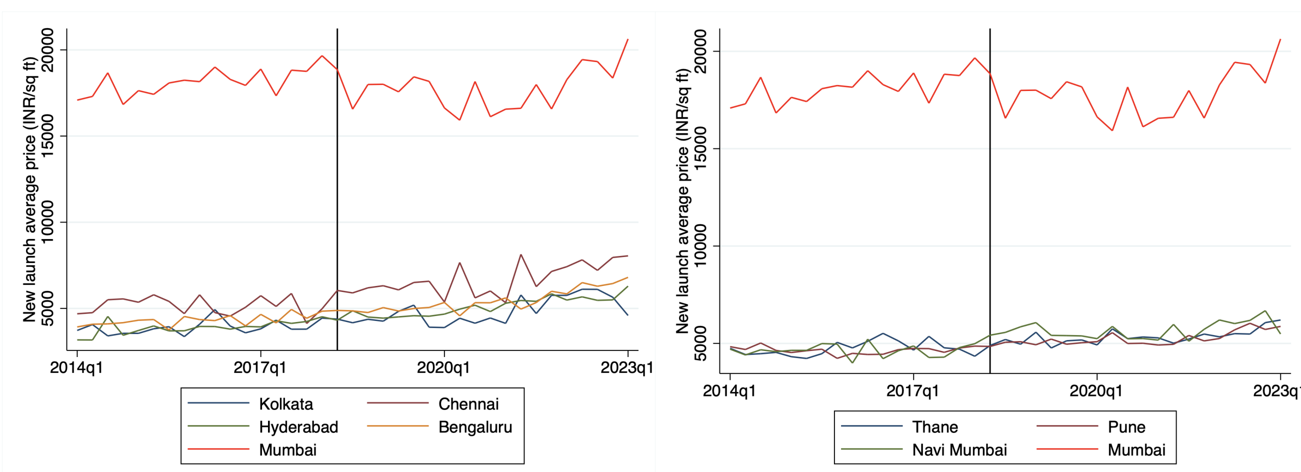


Figure D.1: PropEquity assessed market prices of new apartments price (per sq ft, INR)

Note: This figure plots the number of distributions of market values of units in residential projects in the period 2014-2022, and the data are sourced from PropEquity. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group.



(a) Top Metro Cities in India

(b) Cities in Maharashtra

Figure D.2: Average Price of New Launches (INR/sq ft)

Note: This figure plots the average price of new residential projects launched in the period 2014-2022, as reported by PropEquity. The vertical black line indicates Q3 of 2018 when the FAR reform was introduced.

E Amenity Classification

PropEquity uniformly collects amenity information across projects for 13 types of amenities. We classify amenities as outdoor or indoor. Indoor amenities includegym, sports courts, and indoor play area/community halls. Outdoor amenities include mediation area, swimming pools, and outdoor play area. The increases in indoor amenities are largely driven by gyms and indoor play area/community halls. We see no changes in luxury amenities like swimming pools, sports courts.

Table E.1: Effects of Deregulation on Amenity Provision

Dependent Variable:	Indoor	Outdoor
Treat * Post	0.14*	0.03
	(0.07)	(0.07)
Pre-period Mean	0.66	0.35
Number of Projects	1094	1094
Ward FE	X	X
Year FE	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1) on the provision of luxury amenities. The data are sourced from PropEquity. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Standard errors are clustered at the the project and year of transaction level. *** p<0.01, ** p<0.05, * p<0.1.

F Effects for Existing Housing Market

How does the increase in FAR affect the prices of existing developments? Using data on transaction prices for projects constructed between 2008 and 2014, we document that projects in zipcodes with a high share of treatment plots witnessed an 11% decline in prices after the FAR relaxation.

Table F.1: Effects on Existing Projects

Dependent Variable:	% Change in Prices (per sq ft)		
	(1)	(2)	(3)
High Share Treat * Post	-0.11*	-0.11*	-0.11*
	(0.06)	(0.06)	(0.06)
Pre-period Mean	19718.72	19718.72	19720.43
Number of Projects	66201	66201	66177
Controls		X	X
Year FE			X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1) on the prices of projects launched between 2008-2014. The transaction prices are sourced from the PropEquity data. The high treatment share variable comprises of zipcodes where over 33% of the plots are treated, i.e. over 75th percentile on the distribution of share of treated plots. Post takes the value 1 following the FAR deregulation in 2018. Standard errors are clustered at the pincode level. *** p<0.01, ** p<0.05, * p<0.1.

Developments launched between 2008 and 2014 in pincodes with high and low share of treated plots transacted for similar prices between 2015 and 2018. However, one year after the FAR relaxation, prices of older developments fall in pincodes with higher share of treated plots, as shows in Figure F.1. The differences persist for three years after the FAR relaxation. However, these declines in prices do not translate into a decline in the income of the households moving into older developments. We find small but insignificant effects on income of households moving into these older developments, as shown in Table F.2.

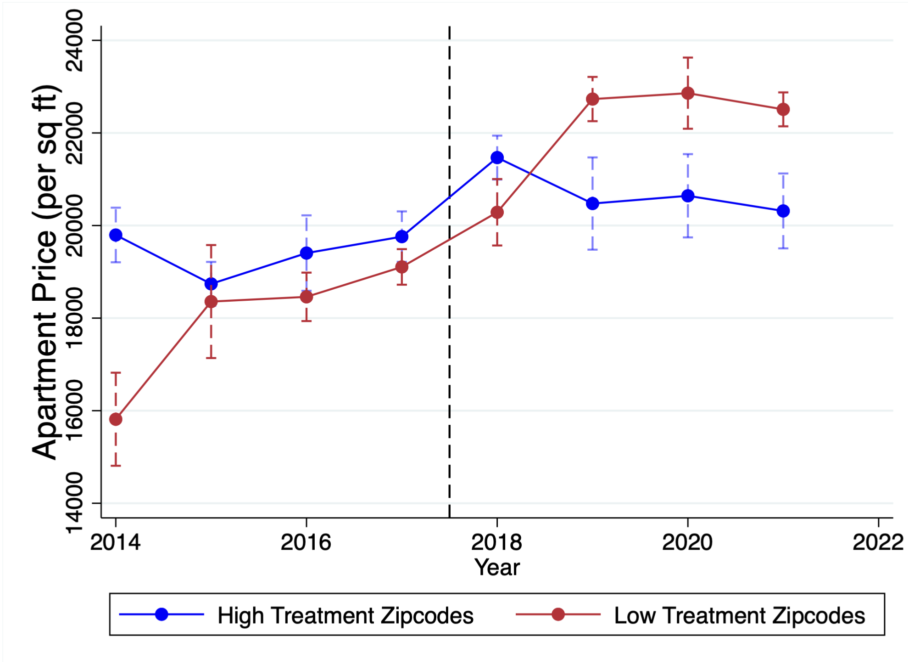


Figure F.1: Price of existing projects (per sq ft, INR)

Notes: The figure plots the transaction prices from PropEquity data over time. The high treatment share group comprises of zipcodes where over 33% of the plots are treated, i.e. over 75th percentile on the distribution of share of treated plots. The vertical red line demarcates the pre- period from the post period, i.e. when the FAR was relaxed in 2018.

Table F.2: Income Changes in Existing Projects

Dependent Variable:	Income	Age
High Share Treat * Post	-0.74	-0.02
	(0.84)	(0.25)
High Share Treat	-0.73	0.01
	(1.32)	(0.29)
Pre-period Mean	22.59	39.14
Number of Transactions	32035	32035
Controls	X	X
Year of Transaction FE	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1) on the income and demographic characteristics of households moving into projects constructed in the period 2008-2014, and sourced from the mortgage data. Annual income is reported in lakhs (= 10^5 INR). The high treatment share group comprises of zipcodes where over 33% of the plots are treated, i.e. over 75th percentile on the distribution of share of treated plots. Post takes the value 1 following the FAR deregulation in 2018. Controls in column (1) include age and gender of the applicant. Standard errors are clustered at the project and year of transaction level. *** p<0.01, ** p<0.05, * p<0.1.

G Heterogeneity

Table G.1: Heterogeneous Effect on Supply

Dependent Variable:	FAR						
Heterogeneity variable	Dist(CBD)	Age	Value per sq ft	Initial Housing	Land Area	Employment	Commercial
Treat x Post x [..]	0.04	0.00	-0.00	-0.04**	-0.00*	-0.00	0.00
	(0.04)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Treat x Post	0.32**	0.25**	0.42***	0.86***	0.45***	0.48***	0.35**
	(0.11)	(0.12)	(0.08)	(0.23)	(0.07)	(0.13)	(0.14)
Pre-period Mean	2.19	2.20	2.19	2.20	2.19	2.19	2.19
Number of Applications	2894	2297	2500	2297	2866	2894	2894
Dependent Variable:	# Units						
Heterogeneity variable	Dist(CBD)	Age	Value per sq ft	Initial Housing	Land Area	Employment	Commercial
Treat x Post x [..]	3.86	-0.36	-0.00	-7.01**	0.00	-0.00	-0.00
	(4.08)	(0.38)	(0.00)	(2.35)	(0.00)	(0.00)	(0.00)
Treat x Post	6.01	21.82*	17.92**	96.75**	4.65	15.49*	19.00
	(8.79)	(12.42)	(7.44)	(30.42)	(6.39)	(8.31)	(12.24)
Pre-period Mean	43.95	41.94	41.94	41.94	43.58	43.95	43.95
Number of Applications	2450	1957	2119	1957	2426	2450	2450
Ward FE	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1). Panel A shows results for FAR and Panel B shows results for the number of units. Column (1) interacts the treat x post with distance to the CBD. Column (2) interacts with the average age of the buildings in that ward. Column (3) interacts with the value of the building per square footage. Column (4) interacts with total housing floorspace measured in the year 2012. Column (5) interacts with land area. Column (6) interacts with employment of the ward. Column (7) interacts with number of commercial establishments in the ward. The observations are residential projects in the period 2014-2022. The treatment group comprises of applications on roads over 12 meters in width. Permit applications on roads below 12 meters in width form our control group. Post takes the value 1 following the FAR deregulation in 2018. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table G.2: Heterogeneity Effects on Supply by Treatment Intensity

	Low Intensity (10-20%)			High Intensity(30-50%)		
Dependent Variable:	FAR	Total Floorspace	# Units	FAR	Total Floorspace	# Units
Treat * Post	0.37***	1572.63**	18.22*	0.37***	1128.33	19.73
	(0.06)	(747.15)	(9.46)	(0.10)	(3557.42)	(17.48)
Treat	-0.05	1362.63**	14.80**	-0.05	11602.04**	81.13**
	(0.05)	(426.19)	(5.40)	(0.08)	(4371.13)	(31.74)
Pre-period Mean	2.24	3175.60	41.87	2.22	5198.07	55.61
Number of Applications	2427	2002	2133	1384	1066	1153
Ward X Post FE	X	X	X	X	X	X
Ward FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1). The observations are residential projects in the period 2014-2022, and data are sourced from permit applications. The treatment group in columns (1)-(3) comprises of applications on roads that received 10-20% relaxation in FAR. This includes roads between 12-27 meters in the suburbs and 12-18 meters in the Island city. The treatment group in columns (3)-(6) comprises of applications on roads that received 30-50% relaxation in FAR. This includes roads over 27 meters in the suburbs and over 18 meters in the Island city. Projects on roads below 12 meters in width form the control group in both specifications. Post takes the value 1 following the FAR deregulation in 2018. The data has missing values for total floorspace and number of units. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table G.3: Heterogeneity Effects on Characteristics by Treatment Intensity

	Low Intensity (10-20%)		High Intensity(30-50%)	
Dependent Variable:	Unit Size	Public Space	Unit Size	Public Space
Treat * Post	-14.90	113.38**	-29.40	274.64**
	(9.60)	(47.06)	(18.18)	(119.73)
Treat	8.15**	90.19**	12.52	302.52***
	(3.21)	(27.61)	(18.55)	(72.10)
Pre-period Mean	89.03	142.50	90.63	147.33
Number of Applications	2200	2255	1201	1236
Ward X Post FE	X	X	X	X
Ward FE	X	X	X	X
Year FE	X	X	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data are sourced from PropEquity. The treatment group in columns (1)-(3) comprises of applications on roads that received 10-20% relaxation in FAR. This includes roads between 12-27 meters in the suburbs and 12-18 meters in the Island city. The treatment group in columns (3)-(6) comprises of applications on roads that received 30-50% relaxation in FAR. This includes roads over 27 meters in the suburbs and over 18 meters in the Island city. Projects on roads below 12 meters in width form the control group in both specifications. Post takes the value 1 following the FAR deregulation in 2018. The data has missing values for total floorspace and number of units. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table G.4: Heterogeneity in Types of Plots Developed

Dependent Variable:	CBD - Nariman Point	CBD - BKC	School	Hospital	Bus	Rail
Treat * Post	0.05	0.04	0.05	-0.00	0.01	0.06
	(0.11)	(0.09)	(0.05)	(0.02)	(0.05)	(0.06)
Pre-period Mean	23.89	9.73	0.79	0.37	1.25	0.90
Number of Projects	3004	3004	3004	3004	3004	3004
Ward FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X

Notes: The table presents difference-in-difference results of the impact of the treatment as described in eq. (1) on the characteristics of plots being developed. Columns (1)-(2) report distances from the two central business districts (CBDs) in Mumbai. Columns (3)-(6) report distances from the nearest school, hospital, bus stop and rail. The data on location of this service infrastructure is obtain from OpenStreetMaps. The treatment group comprises projects on roads over 12 meters in width. Projects on roads below 12 meters in width form our control group. Post takes the value 1 following the FAR deregulation in 2018. Standard errors are clustered at the ward level.

H Robustness

Table H.5: Robustness to Missing Data: Housing Supply

Dependent Variable:	FAR	Total Floorspace	# Units
Treat * Post	0.44***	1176.84**	15.25**
	(0.07)	(446.80)	(5.02)
Treat	-0.05	1643.45**	14.11**
	(0.05)	(463.16)	(4.11)
Pre-period Mean	2.31	3355.96	41.73
Number of Applications	2289	2289	2289
Ward X Post FE	X	X	X
Ward FE	X	X	X
Year FE	X	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications.Columns (1)-(3) show results of the deregulation on FAR, total floorspace area, and number of apartments respectively. Only applications containing all three of these variables are included in the sample. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Total floorspace is measured in square meters. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.6: Robustness to Missing Data and Nearest Neighbor Matching: Housing Supply

Dependent Variable:	FAR	Plot Area	# Units
ATE	0.46***	2323.18***	26.04***
	(0.03)	(367.92)	(4.06)
Pre-period Mean	2.31	3737.59	47.11
Number of Applications	2226	2226	2226
Ward FE	X	X	X
Year FE	X	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. Columns (1)-(3) show results of the deregulation on FAR, total floorspace area, and number of apartments respectively. Only applications containing all three of these variables are included in the sample. We match treated developments to their nearest control development. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Total floorspace is measured in square meters. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.7: Robustness to Alternate Control Groups: Housing Supply

Dependent Variable:	FAR	Total Floorspace	# Units
Treat * Post	0.29**	1886.04*	18.41**
	(0.08)	(936.93)	(6.73)
Treat	-0.04	2871.71***	25.50**
	(0.05)	(734.55)	(6.75)
Pre-period Mean	2.18	4348.59	49.34
Number of Applications	2903	2302	2494
Ward X Post FE	X	X	X
Ward FE	X	X	X
Year FE	X	X	X

The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications.Columns (1)-(3) show results of the deregulation on FAR, total floorspace area, and number of apartments respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads between 9-12 meters in width form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Total floorspace is measured in square meters. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.8: Robustness to Missing Data: Housing Characteristics

Dependent Variable:	Unit Size	Public Space
Treat * Post	-11.57	170.39**
	(10.49)	(45.12)
Treat	2.94	135.07***
	(4.38)	(25.48)
Pre-period Mean	86.75	180.50
Number of Applications	2289	2289
Ward X Post FE	X	X
Ward FE	X	X
Year FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. Columns (1)-(2) show results of the deregulation on apartment size and public amenity floorspace respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Unit size and public floorspace are measured in square meters. Only permit applications with no missing values for unit size and public floorspace are included in the sample Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.9: Robustness to Nearest Neighbor Matching: Housing Characteristics

Dependent Variable:	Unit Size	Public Space
ATE	-33.68*	216.28***
	(17.28)	(33.56)
Pre-period Mean	92.76	162.80
Number of Applications	2487	2572
Ward FE	X	X
Year FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. Columns (1)-(2) show results of the deregulation on apartment size and public amenity floorspace respectively. We match treated developments to their nearest control development. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Unit size and public floorspace are measured in square meters. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.10: Robustness to Missing Data and Nearest Neighbor Matching: Housing Characteristics

Dependent Variable:	Unit Size (sq m)	Public Space (sq m)
ATE	-28.01*	241.35***
	(16.61)	(35.88)
Pre-period Mean	86.74	178.70
Number of Applications	2226	2226
Ward FE	X	X
Year FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. Columns (1)-(2) show results of the deregulation on apartment size and public amenity floorspace respectively. We match treated developments to their nearest control development. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Unit size and public floorspace are measured in square meters. Only applications with both variables missing are included in the sample. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.11: Robustness to Alternate Control Groups: Housing Characteristics

Dependent Variable:	Unit Size (sq m)	Public Space (sq m)
Treat * Post	-11.87	151.95**
	(12.53)	(58.92)
Treat	18.15**	129.95***
	(5.53)	(32.80)
Pre-period Mean	93.15	172.15
Number of Applications	2375	2459
Ward X Post FE	X	X
Ward FE	X	X
Year FE	X	X

Notes: The table shows the difference-in-difference results, capturing the impact of the FAR relaxation as described in eq. (1). The observations are residential projects in the period 2014-2022, and the data is sourced from permit applications. Columns (1)-(2) show results of the deregulation on apartment size and public amenity floorspace respectively. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads between 9-12 meters in width form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Unit size and public floorspace are measured in square meters. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Table H.12: Changes in Control Project Characteristics

	Pre-2018 mean	Post-2018 mean	p-value(Pre = Post)
Built FAR	2.26	2.43	0.000
	(0.60)	(0.55)	
Net Area of Plot	800.51	765.91	0.466
	(716.26)	(612.92)	
Number of Units Developed	30.64	29.37	0.573
	(35.91)	(26.40)	
Average Unit Size	84.40	99.09	0.260
	(102.37)	(249.03)	
Number of Projects	376	437	

Notes: The observations are residential projects in the period 2014-2022 on roads narrower than 12 meters. The built FAR is the FAR reported by the developer on the permit application, and approved by the municipal government. Area of plot and average unit size are reported in square meters. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018.

Table H.13: All Specifications: Placebo Test

Dependent Variable:	% Change in Price							
	per sq ft				Apartment			
Treat * Post	-0.07	-0.06	-0.06	-0.06	-0.15*	-0.13	-0.14	-0.13
	(0.05)	(0.05)	(0.06)	(0.04)	(0.07)	(0.07)	(0.08)	(0.09)
Treat	0.13**	0.11*	0.10*	0.15**	0.25**	0.23**	0.21**	0.28**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.09)	(0.09)	(0.08)	(0.10)
Pre-period Mean	17988.94	17988.94	17988.94	18077.10	1.83e+07	1.83e+07	1.83e+07	1.85e+07
Number of Applications	61438	61438	61438	57173	61586	61586	61586	57320
Year FE	X	X	X	X	X	X	X	X
Suburb X Post FE	X				X			
Suburb FE	X				X			
Zone X Post FE		X				X		
Zone FE		X				X		
Ward X Post FE			X				X	
Ward FE			X				X	
Pincode X Post FE				X				X
Pincode FE				X				X

Notes: The table presents difference-in-difference results of the impact of the treatment with different fixed effects. The observations are transactions for projects in the period 2014-2022, and sourced from PropEquity. Columns (1)-(4) show effects of the deregulation on price per unit area of the apartment, and columns (5)-(8) on the total cost of the apartment. The treatment group consists of developments on parcels on roads wider than 12 meters, while residential developments on parcels on roads narrower than 12 meters form our control group. Post takes the value 1 if a project files building plans following the FAR deregulation in 2018. Means are reported in INR. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1

I Model Appendix

I.1 First Order Conditions

To solve for the housing characteristics in equilibrium, we maximize the utility of potential buyers and the profit of developers.

I.1.1 Demand

The utility for household i in income group g in location κ is given by:

$$\max_{A,h} U_{g\kappa} = \alpha_g \ln(Y_g - p_{g\kappa}) + \beta \ln h_{g\kappa} + (1 - \alpha_g - \beta_g) \ln A_{g\kappa}$$

Solving the maximization problem of the household will give us the following solutions for A and h for each income group g in each location κ:

$$\begin{aligned} h_{g\kappa} &= \frac{\beta(Y_g - p_{g\kappa})}{\alpha \frac{\partial p_{g\kappa}}{\partial h_{g\kappa}}} \\ A_{g\kappa} &= \frac{(1 - \alpha - \beta)(Y_g - p_{g\kappa})}{\alpha \frac{\partial p_{g\kappa}}{\partial A_{g\kappa}}} \end{aligned}$$

I.1.2 Supply

Profits are governed by the following equation, subject to a floorspace constraint:

$$\begin{aligned} \pi_{g\kappa} &= p_{g\kappa} N_{g\kappa} - c_g f_w L - r_\kappa L \\ s.t.\ \ f_w L &= N_{g\kappa} h_{g\kappa} + A_{g\kappa} \end{aligned}$$

Developers choose housing characteristics to develop for each group g in κ. Profit maximization implies different housing characteristics for each group.

$$\begin{aligned} \frac{\partial \pi_{g\kappa}}{\partial h_{g\kappa}} = 0 &\implies h_{g\kappa} = \frac{p_{g\kappa}}{\frac{\partial p_{g\kappa}}{\partial h_{g\kappa}}} \\ \frac{\partial \pi_{g\kappa}}{\partial A_{g\kappa}} = 0 &\implies A_{g\kappa} = f_\kappa L - \frac{p_{g\kappa}}{\frac{\partial p_{g\kappa}}{\partial A_{g\kappa}}} \\ &\quad\ \ N_{g\kappa} = \frac{\frac{\partial p_{g\kappa}}{\partial h_{g\kappa}}}{\frac{\partial p_{g\kappa}}{\partial A_{g\kappa}}} \end{aligned}$$

I.1.3 Equilibrium

In equilibrium, high- and low-income households are segregated into different developments and developers specialize in providing housing for a given income type in each neighborhood. Maximization of utility and profits implies the following, where $p^h = \frac{\partial p_{g\kappa}}{\partial h_{g\kappa}}$ and $p^A = \frac{\partial p_{g\kappa}}{\partial A_{g\kappa}}$.

$$\begin{aligned}
(h_{g\kappa})^S =& (h_{g\kappa})^D \\
\frac{p_{g\kappa}}{p^h} =& \frac{\beta_g(Y_g - p_{g\kappa})}{\alpha_g p_h} \\
p_{g\kappa} =& \frac{\beta_g}{\alpha_g + \beta_g} Y_g
\end{aligned}$$

Similarly, supply and demand of within-building amenity space must be equal in equilibrium for each $g\kappa$:

$$\begin{aligned}
(A_{g\kappa})^S =& (A_{g\kappa})^D \\
f_\kappa L - \frac{p_{g\kappa}}{p_A} =& \frac{(1-\alpha_g-\beta_g)(Y_g - p_{g\kappa})}{\alpha_g p^A} \\
p^A_{g\kappa} =& \frac{Y_g(1-\alpha_g)}{(\alpha_g+\beta_g) f_\kappa L} \qquad (15)
\end{aligned}$$

We can then find the value of A^g in equilibrium:

$$\begin{aligned}
A_g =& f_\kappa L - \frac{p_{g\kappa}}{p_A} \\
A_g =& \frac{(1-\alpha_g-\beta_g) f_\kappa L}{1-\alpha_g}
\end{aligned}$$

Using the floorspace constraint, we know that $Nh = fl - A$. This implies that $Nh = \frac{\beta_g f L}{1-\alpha_g}$. Secondly, we know that $N^g = \frac{r^g L + cfL}{p^g}$ using the zero profit condition. We can then find the value of p^g_h:

$$\begin{aligned}
\frac{\beta_g f_\kappa L}{1-\alpha_g} =& \frac{r_\kappa L + c f_\kappa L}{p_{g\kappa}} * \frac{p_{g\kappa}}{p^h_{g\kappa}} \\
p^h_{g\kappa} =& \frac{(r_\kappa L + cfL) * (1-\alpha_g)}{\beta_g f_{g\kappa} L} \qquad (16)
\end{aligned}$$

Using $N_{g\kappa} = \frac{p^h_{g\kappa}}{p^A_{g\kappa}}$ and equations 15 and 16, we can solve for $N_{g\kappa}$.

$$\begin{aligned}
N_{g\kappa} =& \frac{p^h_{g\kappa}}{p^A_{g\kappa}} \qquad (17) \\
=& \frac{(\alpha_g+\beta_g) * (r_\kappa L + c f_\kappa L)}{\beta_g Y_g} \qquad (18)
\end{aligned}$$

This implies that $h_{g\kappa}$ will be given by:

$$h_{g\kappa} = \frac{\beta_g f_\kappa L}{N_{g\kappa}(1-\alpha_g)} \tag{19}$$

$$= \frac{\beta_g^2 f_\kappa Y_g}{(1-\alpha_g)(\alpha_g+\beta_g) * (r_\kappa L + c f_\kappa)} \tag{20}$$

I.2 Model Estimation

I.2.1 Model Inputs

To simulate the data generating process according to the model, we take the number of applications in each of the four locations κ as given. We construct a variable that measures the underlying distribution of parcels on wide (narrow roads), which allows us to measure the intensity of treatment of each zipcode. Zipcodes are then classified into high treatment intensity if over 33% of the parcels in that zipcode are on wide roads.[48] We take the following steps to simulate the data and compute our estimates:

1. For each application, we take their proximity to a wide road (treatment assignment), zipcode and parcel size from the data.

2. We fix the population of households that want to move in each period, the share of high income households, the reservation utility for each income group. We use the maximum policy-mandated FAR for each parcel in each period.

3. With an initial guess for land rents in each of the four locations, we simulate the equilibrium housing characteristics, demand and supply. We iterate over land rents till demand equals supply. This also provides us with a vector of housing characteristics supplied on each parcel.

4. We repeat step 3 for the post period. FAR is now set at the new maximum as allowed by the policy relaxation.

5. We stack the resulting data from the pre- and post period and the the same estimation as in equation 14.

6. We minimize the mean squared difference between the simulated and data moments, with reweighting to measure each moment in the same units.

Our comprehensive list of estimates are reported below.

[48] This coincides with the 75th percentile of the zipcode distribution of parcels on wide roads.

Table I.14: Data and Model Moments

	Data	Model
High Share Treat X Treat X Post : A	159.51**	172.05
	(77.32)	(154.86)
High Share Treat X Treat X Post : h	3.28	7.65
	(10.53)	(6.76)
High Share Treat X Treat X Post : p	-0.38*	-0.37***
	(0.22)	(0.06)
Treat X Post : A	105.29***	812.43***
	(40.79)	(380.04)
Treat X Post : h	-14.82*	-10.60***
	(7.76)	(2.72)
Treat X Post : p	0.13	-0.03
	(0.39)	(0.028)
Treat X Post: Income	-0.254*	-0.09***
	(0.14)	(0.01)

Notes: Data estimates are those reported in Table 10. *** p<0.01, ** p<0.05, * p<0.1.

J Road Width Data

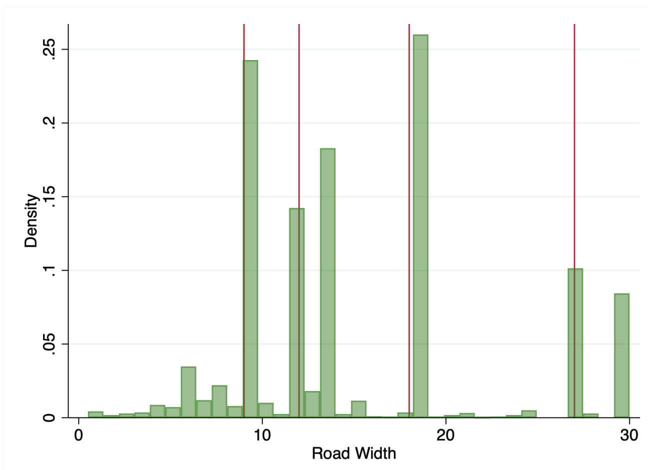


Figure J.1: Road widths against which FAR is claimed

Note: The vertical red lines indicate the road-widths at which FAR was increased progressively: 9, 12, 18 and 27 meters.