Scaling Heights: Affordability Implications of Zoning Deregulation in India

Geetika Nagpal (Brown) & Sahil Gandhi (Manchester)

January 9, 2024

Motivation

- Housing supply has failed to keep pace with rapid urban population growth.
  - India is projected to add 416 million urban residents by 2050.
  - 17% of urban India lives in slums (2011).
- Stringent zoning regulations exist in most growing economies.
  - Restrict scale of development
  - Limit supply, affordability
- Can deregulation increase affordable housing supply?
  - What are the characteristics of housing developed?
  - Who benefits from the new housing?

Impact of Deregulation is Ambiguous

Traditional View:

- $\uparrow$ Housing Supply
- Prices $\downarrow$
- Resident Income $\downarrow$

Impact of Deregulation is Ambiguous

Traditional View:

- ↑ Housing Supply
- Prices ↓
- Resident Income ↓

Alternative View:

- New housing is luxury
- Apartment size ↑
- Small supply effect
- Resident Income ↑

The New York Times

Taller Towers, Fewer Homes

New boutique condo towers, some with fewer apartments than the buildings they replace, are squandering high-density sites in Manhattan, urban planners say.

Give this article 615

By Stefanos Chen

Sept. 23, 2022

This Paper

- What is the housing supply response to deregulation? Who benefits?
- **Setting:** Mumbai, highly regulated housing-constrained city

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- **Identification:** spatial and temporal variation in FAR (diff-in-diff)
- **Granular data** on multi-family developments from 2014-2021:
  - Housing characteristics and unit-level transaction prices
  - Mortgage data with buyer characteristics
- Develop a **structural model** of housing supply and demand
  - Scale and spillover effects of relaxation
  - Evaluate counterfactuals for alternate policy designs

Preview of Findings

- How responsive is housing supply to changes in regulatory environment?
  - Large increase in housing supply: 1% $\uparrow$ in FAR $\implies$ 1.59% $\uparrow$ in units

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  - Housing prices $\downarrow$ by 29%
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- Does this result in more affordable housing?
  - Housing prices $\downarrow$ by 29%
  - Aggregate effects: average buyer income 3.18% lower
- How can we design FAR relaxation policies?
  - Further 5% rule-based relaxation $\rightarrow$ average buyer income 0.05 p.p. lower

Contribution

- **Effects of land-use regulation changes**
  - Cross-sectional variation in zoning: effect on quantity and price of housing (Katz and Rosen, 1987; Glaeser et al., 2005; Gyourko and Molloy, 2015; Song, 2021; Baum-Snow and Han, 2023)
  - Within-city effects of zoning regulation changes (Anagol et al., 2022; Peng, 2022; Chiumenti et al., 2022; Buechler and Lutz, 2022; Manville et al., 2022; Liao, 2022; Greenaway-McGrevy and Phillips, 2023).
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  - Predominantly studied in the US [Ganong and Shoag (2017); Trounstine (2020); Hsieh and Moretti (2019); Kulka (2019);Asquith et al. (2021)]
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  - This paper: Link projects to residents, deregulation benefits lower-income HHs
- **Zoning and Housing Supply in Indian cities**
  - Theoretical analysis of welfare costs of FAR [Bertaud and Brueckner (2005);Brueckner and Sridhar (2012)]
  - Other policy levers in Mumbai [Kumar (2021); Gandhi et al. (2021); Gechter and Tsivanidis (2023)]
  - This paper: Natural experiment to empirically assess effect of deregulation

Outline

Setting and Policy Reform

Data

Empirical Strategy and Reduced Form Analysis

Model and Counterfactuals

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Mumbai: One of India's fastest growing cities

- Grew from 6 million in 1971 to over 12 million in 2011.

Source: Our World in Data

FAR governs housing supply in Mumbai

- FAR (floor to area ratio) $= \frac{\text{Total Floorspace (all floors)}}{\text{Area of Plot}}$

"Stringent" FAR limits in Mumbai

- In 1991, FAR cap was formally adopted in a Development Plan (DP).
- Prior to 2018, FAR was capped at 2.7 for residential development.

Location	FAR cap
Mumbai	2.7
Midtown Manhattan	12
Chicago	12
Singapore	8
Hong Kong	10

FAR relaxed at the road-width level

- New Development Plan changed FAR caps by road-width.
- The Plan was made public in May 2016, and implemented in Sep 2018.

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

Opposition

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Opposition

Where was FAR relaxed?

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1. Universe of residential permit applications (2014 - 2021):
   - Treatment status
   - FAR
   - Housing Supply: Total floorspace, Number of units
   - Housing Characteristics: Apartment size, Public "amenity" space
2. Unit-level transaction data from PropEquity (2014-2021)
   - Property price
   - Building amenities
3. Mortgage data from a large private bank (2011-2020)
   - Homebuyer characteristics: Income, Age
   - Property price, Mortgage amount

Demolitions Example

What does housing in Mumbai look like?

Source: 99acres, Indian real estate website.

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FAR constraint is binding

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Counts

FAR constraint is binding

Counts

Reduced Form Specification

$$Y_{iwt} = \alpha + \beta_1 \cdot Treatment_i + \beta_2 \cdot Treatment_i \times Post_t + \gamma_w \times Post_t + \gamma_w + \delta_t + \varepsilon_{iwt}$$

- Y_{iwt}: Outcome of interest
- Treatment Classification of project i:
  - Road Width $<$ 12 m $\Rightarrow$ Control
  - Road Width $\geq$ 12 m $\Rightarrow$ Treatment
- $\text{Post}_t = 1$ if $t \geq 2018$
- Ward (w) and Year (t) FE
- SE clustered at ward level

Project Characteristics Road Widths

Fact 1: Housing supply increases

Total Floorspace

Apartments per project

▸ Counts ▸ Stock ▸ Units ▸ Land Size ▸ Table

Fact 2: Unit size shrinks

Avg Apartment Size

Size Table

Fact 3: Within-building public space increases

Public Amenity Space

Level Amenities Amenity value Table

Fact 4: Prices decline in response

Total apartment price

Source: PropEquity data.

Prices Price Floorspace Market Prices Table Revenue

Fact 5: Lower-income households move in

Source: Mortgage data from large private bank.

Mortgage Table

Robustness and Extended Analysis

- Robustness
  - Spatial proximity ▸ NNM ▸ Het by distance
  - Control group specification ▸ Drop U9 ▸ Change in Control
  - Missing data ▸ Go
- Extended Analysis
  - Is this driven by particular neighborhoods? ▸ Go
  - What is the public space being used for? ▸ Go
  - Are there local spillover effects on prices? ▸ Go
  - How does the relaxation affect existing housing stock?
    - Prices decline ▸ Go
    - No evidence of filtering ▸ Go

Summary

- FAR relaxation increases the scale of development
  - Increased provision of public amenity space
- Unit size in treated developments shrinks by 18%
- Apartments in treated developments become more affordable
  - Prices in treated developments fall by 29%
  - Lower-income buyers move into treated developments
- But what are the aggregate affordability effects of the deregulation?
- Can we draw any policy implications from this reform?

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Model

- Reduced form captures relative changes, but not spillover effects:
  - Treatment and control are in same neighborhood
  - Neighborhoods with large supply increase compete with other areas
- What is a change in apartment prices capturing?
  - Apartment is a bundle of building amenities and apartment size
  - FAR relaxation changes both these characteristics

Model

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  - Treatment and control are in same neighborhood
  - Neighborhoods with large supply increase compete with other areas
- What is a change in apartment prices capturing?
  - Apartment is a bundle of building amenities and apartment size
  - FAR relaxation changes both these characteristics
- How does the model address these?
  - Allow for spillovers between treatment and control
  - Allow for movement of households across neighborhoods
  - Hedonic pricing of apartments

Model Overview

Potential Buyers

Income group $g \in \{H, L\}$; $\bar{M}_g$

Get T1EV preference shock

↓

Move to location κ; $\bar{u}_g$

↓

Housing Chars. (given p)

Demand Supply Equilibrium

Model Overview

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Housing Chars. (given p)

Perfectly Competitive Developers
Fix num. + location of devpts.

Assigned parcel of area L, FAR $= f$

↓

Develop for group g

↓

Housing Chars. (given p, f)

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↓

Equilibrium for each κ

↓

Demand = Supply $\implies$ Land rents (r), Prices (p), Housing for g

↓

Profit, Utility Maxm $\implies$ Housing Chars.

Demand Supply Equilibrium

Add amenity space to standard models

- **Buyer** pays p for apartment of size h, with amenity space A:

$$U(p, h, A; Y) = \alpha \ln(Y - p) + \beta \ln h + (1 - \alpha - \beta) \ln A$$

- **Developer** provide residential and public amenity floorspace.
  - p: price of unit, N: units
  - c: construction cost, f: FAR limit
  - r: rental rate, L: parcel area
  - A: public amenity space

$$\pi = p N - c f L - r L$$
$$s.t.\ f L = N h + A$$

FOC

Equilibrium for high (or low) income HHs

- Let f=1, L=10, N=10

Change in FAR for treated developments

- Now f=2

Spillover effect for control developments

Estimation

- Two types of neighborhoods: high (low) share of treated plots
  - High = zipcode has over 33% plots treated (75th percentile)
  - Systematic relation between share of treated plots and land prices
- Data moments capture changes in housing char and prices across locations after relaxation
- Estimate preference parameters via indirect inference
- $U_{g\kappa} = \alpha_g \ln(Y_g - p_{g\kappa}) + \beta_g \ln h_{g\kappa} + (1 - \alpha_g - \beta_g) \ln A_{g\kappa}$

Demand Supply

Data Moments

$$
\begin{aligned}
Y_{izt} =& \alpha + \beta_1 HighShare_z \times Treat_i \times Post_t + \beta_2 Treat_i \times Post_t \\
&+ \beta_3 HighShare_z \times Treat_i + \beta_4 HighShare_z \times Post_t + \beta_5 HighShare_z \\
&+ \beta_6 Treat_i + \beta_7 Post_t + \mathrm{X_z} + \varepsilon_{izt}
\end{aligned}
$$

- Y_{izt}: Outcomes of interest (Housing Size, Amenities, Prices)
- $HighShare_z$ = over 33% plots treated
- $Treat_i = 1$ if Road Width $\geq$ 12 m
- $\mathrm{Post}_t = 1$ if $t \geq 2018$
- X_z: Zipcode (z) controls

Data Moments

Model Fit

Treat X Post
h (100 sqm)
A (1000sqm)
Price (%)
High Share Treat X Treat X Post
h (100 sqm)
A (1000sqm)
Price (%)
Income
-1
-.5
0
.5
1
1.5
Model Fit
Data
Model

Deregulation increased housing affordability

- Lower-income households have higher MRS between amenity space and size.
- Large increase in the number of smaller and cheaper treated units $\implies$ share of lower income HHs $\uparrow$
- Post-relaxation average income of buyers was 3.18% lower
- $U_{g\kappa}(i) = \alpha_g \ln(Y_g - p_{g\kappa}) + \beta_g \ln\ h_{g\kappa} + (1 - \alpha_g - \beta_g) \ln\ A_{g\kappa} + \varepsilon_\kappa(i)$

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

How can governments design deregulation policies?

- Consider two policy options:
  - Rule-based/targeted relaxation
    - Mumbai: along wide roads
    - Other cities: transit-oriented development
  - Uniform relaxation across all locations in the city (e.g. Delhi).
- Which policy design makes new housing more affordable?
- Different policies lead to:
  - different characteristics of housing developed
  - draw in different income households

Initial State of the World

FAR relaxed in 2018

CF 1: Extra 5% relaxation to treated devpts

- Generated more housing compared to 2018. Share of lower income in housing market increases further.

	Treated	Control	Overall
Land Rents	+1.8%	-4.8%	
Supply	+1.8%	-4.5%	+1.5%
Prices	-2.5%	+0.4%	-1%

- Average income falls by 0.05 p.p compared to 2018 reform.

CF 2: 15% relaxation to control developments

- Same floorspace generated as CF1, but results in less housing.
- Mutes scale effects: supply of larger units in treated dvpts. Results in a small supply increase.

	Treated	Control	Overall
Land Rents	-1.4%	+18%	
Supply	- 0.7%	+17%	+0.1%
Prices	+0.5%	-0.5%	+0.1%

- Average income increases by 0.04 p.p compared to 2018 reform.

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- **Contributions:**
  - New granular data to highlight scale effects in housing provision
  - Affordability implications of zoning deregulation in dev megacity
- **Main Takeaways:**
  - Contrary to critics, deregulation can generate affordable housing.
  - Concentrating FAR relaxation can amplify affordability gains in highly regulated cities.
- **Ongoing and Future Research:**
  - Developer incentives in slum redevelopment in Mumbai
  - Formal and informal transit networks in Nigeria

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Appendix

Does development in control go down?

- Does development shift from control areas to treatment areas?
  - Very small increase (3 p.p.) in permits filed on treated parcels after 2018.
  - (Small) anticipation effects of deregulation on control roads.

Number of permits

Proportion of permits

Back: Supply Back: FAR

Opposition stemmed from luxury developments

The New York Times

Supertall Buildings Lure Mumbai's Elite

Share full article

Omkar 1973 is a luxury three-tower development being built on a former slum site. Omkar Realtors & Developers

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Opposition stemmed from luxury developments

ANALYSIS URBAN

Mumbai's New Development Plan Is About More Real Estate for Developers

The planning system is oriented increasingly towards servicing elite developments, as opposed to redistributing benefits through the provision of subsidised housing, transport, healthcare and education.

Over the decades, Mumbai's planning system has become a tool to alienate more and more high-value land to private developers, transfer costs of development on new home buyers, enable the government and property developers to extract rents and to create an infrastructure that benefits the very few while neglecting the needs of the very many.

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Example of Permit Application

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Example of Permit Application

	PROFORMA-A	TOTAL AS PER DCPR 2034
I	AREA STATEMENT	
1.	AREA OF PLOT	666.20
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
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	
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

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Road Widths

Sample Road Width

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Illegal Structures are Regularly Demolished

Apex court tells BMC to raze illegal flo in 6 Worli highrises

The fate of more than 500 residents of six highrises in Worli hangs in the balance as the civ administration will soon demolish the additional illegal floors.

Written by Express News Service | April 22, 2013 12:42:53 am

The fate of more than 500 residents of six highrises in Worli hangs in the balance as the civic administration will soon demolish the additional illegal floors. Brihanmumbai Municipal Corporation (BMC) had sent notices to these buildings over 17 years ago.

Following a Supreme Court verdict,BMC will finally demolish the illegal floors in a few weeks,officials said.

This is one of the landmark cases and we plan to take stringent steps to drive home the point that no such illegal buildings will be tolerated in the city, said

Mumbai: BMC gears up to crack down on illegal constructions

Updated on: 26 October 2021 08:08 AM IST | Mumbai

Chetna Sadadekar | chetna.sadadekar@mid-day.com

Share: Text AA AA

Work on overhaul of encroachment tracking system is currently on and should be ready in a month; its website will also be more efficient

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What do projects look like?

Table: Pre-Policy Characteristics

	Treatment mean	Control mean	p-value(Treatment = Control)
FSI utilized	2.19	2.26	0.113
	(0.59)	(0.61)	
Net Area of Plot	2532.99	898.00	0.000
	(5720.40)	(1400.31)	
Number of Units Developed	60.88	30.17	0.000
	(118.95)	(35.76)	
Average Unit Size	95.81	85.31	0.108
	(92.06)	(102.96)	
Number of Projects	589	376	

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Public space as proportion of housing space

$\frac{A}{L}$, i.e. proportion of FAR

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Fact 1: Housing supply increases

Number of units

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0.7p.p. Net Increase in City-Wide Housing Supply

% Housing Stock Added Yearly

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Fact 2: Housing size shrinks

Avg Apartment Size

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Housing size shrinks for projects with amenities

Back: Size Back: Space

Fact 3: Within-building public space increases

Public Amenity Space

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Fact 4: Prices decline in response

Apartment Price

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Fact 4: Prices decline in response

Apartment Market Price

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Fact 4: Prices decline in response

Price per square feet

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How does developer revenue change?

Developer Revenue

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Fact 1: Housing supply increases

Table: Impact of deregulation on supply

Dependent Variable:	FAR	Total Floorspace	# Units
Treat * Post	0.39***	1030.10*	12.72**
	(0.06)	(540.97)	(5.15)
Treat	-0.04	2378.27**	19.08***
	(0.05)	(627.73)	(4.53)
Pre-period 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 observations are residential projects in the period 2014-2022. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1. Back

Fact 2: Housing Size Shrinks

Table: Impact of deregulation on housing characteristics

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

Source: Permit applications. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back: Size

Fact 3: Within-building public space increases

Table: Impact of deregulation on housing characteristics

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

Source: Permit applications. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back: Space

Fact 4: Prices decline in response

Table: Impact of deregulation on prices

Dependent Variable:	% Change in Price	
	per sq ft	Apartment
Treat * Post	-0.16**	-0.29*
	(0.06)	(0.16)
Treat	0.20***	0.56***
	(0.05)	(0.11)
Pre-period Mean (INR)	23191.52	20.6 mil
Number of Applications	71193	71967
Ward X Post FE	X	X
Ward FE	X	X
Year FE	X	X

Source: PropEquity. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back

Fact 5: Lower-income households move in

Table: Buyer Characteristics

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

Source: Large private bank. Annual income is in lakhs ($= 10^5$ INR). Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Mortgage Back

Do control projects change?

Table: Control Projects

	Pre-2018 mean	Post-2018 mean	p-value(Pre = Post)
FSI utilized	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	

Back

Selection in type of plots being developed

Table: Distance to external amenities

Dependent Variable:	CBD - Nariman Point	CBD - BKC	School	Hospital	Bus	Rail
Treat * Post	0.06	0.05	0.05	-0.00	0.01	0.06
	(0.11)	(0.09)	(0.05)	(0.02)	(0.05)	(0.06)
Pre-period Mean	23.88	9.73	0.79	0.37	1.25	0.90
Number of Applications	3002	3002	3002	3002	3002	3002
Ward FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X

Back

Robustness: Pure Control

Table: Impact of deregulation on supply

Dependent Variable:	FAR	Total Floorspace	# Units
Treat * Post	0.31***	2388.38***	14.01**
	(0.08)	(456.27)	(4.17)
Treat	-0.05	1797.08**	15.22***
	(0.05)	(519.97)	(3.19)
Pre-period Mean	2.18	4589.50	46.62
Number of Applications	2748	2474	2333
Ward x Post FE	X	X	X
Ward FE	X	X	X
Year FE	X	X	X

Back

Robustness: Nearest Neighbor Matching

Table: Impact of deregulation on supply

Dependent Variable:	FAR	Total Floorspace	# Units
ATE	0.46***	3053.42***	31.32***
	(0.03)	(462.03)	(4.36)
Pre-period Mean	2.19	4361.05	49.78
Number of Applications	2906	2296	2488
Ward FE	X	X	X
Year FE	X	X	X

Back

Robustness: Non-Missing Sample

Table: Impact of deregulation on supply

Dependent Variable:	FAR	Res 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

Back

Robustness: NNM + Non-Missing Sample

Table: Impact of deregulation on 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	

Back

Heterogeneity by Proximity to Wide Roads

	1-200m			201-500m			501-800m		
Dependent Variable:	FAR	Total Floorspace	# Units	FAR	Total Floorspace	# Units	FAR	Total 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)
Pre-period 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

Back

More Relaxation → More Adjustment

	1-200m			201-500m			501-800m		
Dependent Variable:	FAR	Total Floorspace	# Units	FAR	Total Floorspace	# Units	FAR	Total 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)
Pre-period 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

Back

Robustness: Pure Control

Table: Impact of deregulation on housing characteristics

Dependent Variable:	Unit Size (sq m)	Public Space (sq m)
Treat * Post	-5.52	152.94**
	(11.82)	(45.95)
Treat	13.67***	127.46***
	(2.77)	(23.91)
Pre-period Mean	92.12	174.19
Number of Applications	2358	2443
Ward x Post FE	X	X
Ward FE	X	X
Year FE	X	X

Back

Robustness: Nearest Neighbor Matching

Table: Impact of deregulation on housing characteristics

Dependent Variable:	Unit Size (sq m)	Public Space (sq m)
ATE	-33.68*	217.91***
	(17.28)	(33.56)
Pre-period Mean	92.76	162.80
Number of Applications	2487	2572
Ward FE	X	X
Year FE	X	X

Back

Robustness: Non-Missing Sample

Table: Impact of deregulation on housing characteristics

Dependent Variable:	Unit Size (sq m)	Public Space (sq m)
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

Back

Robustness: NNM + Non-Missing Sample

Table: Impact of deregulation on 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

Back

Heterogeneity by distance to wide roads

Table: Impact of deregulation on housing characteristics

	1-200m			201-500m			501-800m		
Dependent Variable:	FAR	Total Floorspace	# Units	FAR	Total Floorspace	# Units	FAR	Total 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)
Pre-period 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

Back

Amenity increase driven by indoor amenities

- Classify amenities from PropEquity as indoor or outdoor
  - Indoor: Gym, sports courts, indoor play area/community halls
  - Outdoor: mediation area, swimming pools, outdoor play area
- Driven by gyms and indoor play area/community halls.
- No change in luxury amenities like swimming pools, sports courts.

Table: Impact of deregulation on amenities

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

Source: PropEquity data. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back: Space Back

Do within-building amenities matter?

Source: 99acres, Indian real estate website.

Back

Do within-building amenities matter?

Source: 99acres, Indian real estate website.

Back

Near high exposure area ⇒ larger price decline

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

Back

Price of existing stock in high exposure areas declines

Impact on Existing Housing Stock

Back

Price of existing stock in high exposure areas declines

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

Source: PropEquity data. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back

No evidence of filtering in the housing market

Dependent Variable:	Income	Age
High Share Treat X 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

Source: Large private bank. Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back

Supply response was largely uniform

Table: Heterogeneity by neighborhood characteristics

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

Back

Price decline → Mortgage amount declines

Table: Mortgage Characteristics

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 X Post FE	X	X
Ward FE	X	X
Year of Transaction FE	X	X

Source: Large private bank. Mortgage amount is in lakhs ($= 10^5$ INR). Standard errors are clustered at the ward level. *** p<0.01, ** p<0.05, * p<0.1.

Back

Number of apts per unit land goes up

Apartments per unit of land

Back Back to Model

Equilibrium Housing Characteristics

$$A = \frac{(1-\alpha-\beta)fL}{1-\alpha}$$

$$h = \frac{\beta^2 fY}{(1-\alpha)(\alpha+\beta)*(r+cf)}$$

$$p = \frac{(1-\alpha)*(r+cf)}{\beta f}$$

Back

What happens when FAR is relaxed?

$$\frac{\partial A}{\partial f} = \frac{(1-\alpha-\beta)L}{1-\alpha} > 0$$

$$\frac{\partial h}{\partial f} = \frac{\beta^2 Yr}{(1-\alpha)(\alpha+\beta)} \left[\frac{1-\eta_r}{(r+cf)^2} \right]$$

Back

Discrete Choice Framework: Demand

- **Static spatial model** with:
  - **Potential Buyers**:
    - Two income groups $g \in \{H, L\}$ with different preferences
    - Choose one of four locations κ to move to:
    - (T , C) $\times$ (High Share, Low Share)

- **Demand:**

$$U_{g\kappa}(i) = \alpha_g \ln(Y_g - p_{g\kappa}) + \beta_g \ln h_{g\kappa} + (1 - \alpha_g - \beta_g) \ln A_{g\kappa} + \theta \epsilon_\kappa(i)$$

where $\epsilon_\kappa(i) \sim T1EV(\theta)$

$$\lambda_{g\kappa} = \bar{M}_g \times \frac{\exp(U_{g\kappa}/\theta)}{\exp(\bar{u}_g) + \sum_{\kappa'} \exp(U_{g\kappa'}/\theta)}$$

Back

Developers choose which income group to serve

- **Static spatial model** with:
  - **Households**:
    - Two income groups $g \in \{H, L\}$ with different preferences
    - Choose: location κ to move to
  - **Developers**:
    - Maximize profits s.t. floorspace constraint
    - Perfectly competitive.
    - Choose: which income group g to develop for

- **Supply:**

$$\pi_{g\kappa} = p_{g\kappa} N_g - c_g f_\kappa L - r_\kappa L$$
$$\text{s.t. } f_\kappa L = N_{g\kappa} * h_{g\kappa} + A_{g\kappa}$$

$$\pi_{g\kappa} = 0$$

Back

Characterizing Equilibrium

- **Static spatial model** with:
  - **Households**:
    - Two income groups $g \in \{H, L\}$ with different preferences
    - Choose: location κ to move to
  - **Developers**:
    - Maximize profits s.t. floorspace constraint
    - Perfectly competitive.
    - Choose: which income group g to develop for
- **Equilibrium:** Fixed point in $r_{\kappa q}$ which:
  - Units Demanded = Units Supplied
  - Utility, Profit maxm
  - $(A_g, h_g)^D = (A_g, h_g)^S$

Back

Counterfactual Estimates

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

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