Building-Height Regulation: Effects and Measurement of Stringency

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NARSC Conference, November 15, 2019

Introduction

Building heights are regulated in most of the world's cities.

Among most-prominent forms of land-use regulation.

Usually done by restrictions on FAR, the floor-area ratio (total floor space divided by lot size).

FAR equals number of storeys if building completely covers lot.

Restrictions are tight in Washington, DC, Paris, most cities in India, and elsewhere.

Table 1
Center-city FAR values.
Source: World Bank (2012).

City	FAR
Sao Paulo	1
Mumbai	1.33
Chennai	1.5
Delhi	1.2–3.5
Amsterdam	1.9
Venice	2.4
Paris	3
Shanghai	8
Vancouver	9
San Francisco	9
Chicago	12
Hong Kong	12
Los Angeles	13
New York	15
Denver	17
Tokyo	20
Singapore	12–25

Introduction

Talk considers three issues related to height regulation:

- Predicting effects of regulation
- Measuring welfare cost of regulation
- Measuring stringency of regulation (deviation from free market)

Based on four of my coauthored papers: Bertaud and Brueckner (*RSUE*, 2005), Brueckner and Sridhar (*RSUE*, 2012), Brueckner, Fu, Gu, and Zhang (*REStat*, 2017), Brueckner and Singh (2019, working paper).

Height determination

Housing floor space per unit of land (FAR) is given by $h(S)$, where S is 'capital' per unit of land and $h'' < 0$.

Under free market, developer sets S at S^*, which satisfies

$$ph'(S^*) = i,$$

where p = price per square foot of housing, i = capital price.

The price p falls moving away from CBD, and so do S^* and FAR $= h(S^*)$

FAR restriction puts an upper limit on h, requiring

$$h(S) \leq \overline{h}.$$

Effects of FAR restriction

Restriction binds in the central part of city, where buildings would normally be tall (FAR high).

Reduces housing supply, causing city to expand spatially to fit population (sprawl).

Lower supply raises unit housing price p throughout city.

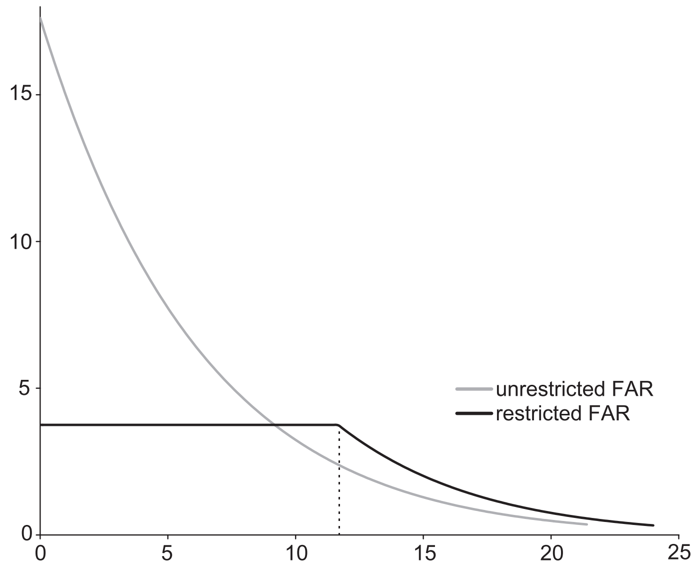

Fig. 1. Simulated FAR patterns.

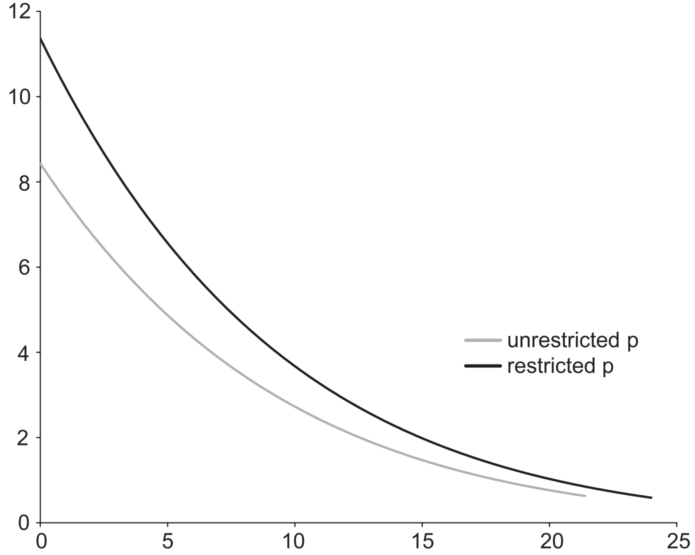

Fig. 2. Simulated housing price patterns.

Welfare loss

These effects make city's residents worse off.

Countervailing benefits may exist (e.g., fewer building shadows, less congestion), but these gains are unclear.

Loss component comes from a combination of higher housing prices and longer commutes.

For city's edge resident, housing price is always anchored by agricultural rent, so loss is entirely from longer commute.

Measuring the loss

To make use of this result, following regression is run, using cross section data from Indian cities:

$$URBAN\_LAND\_AREA = \alpha + \beta FAR + \delta POP + \gamma INCOME + \tau AG\_RENT.$$

FAR limit pertains to city center, and last three variables are suggested by standard urban model.

Estimated FAR coefficient < 0, so allowing taller buildings makes city spatially smaller.

Measuring the loss

Unit increase in FAR limit reduces area of average-size city by 20%, cutting edge-resident commute distance by about 0.5 km.

Then multiply 0.5 km by estimated time and money cost per km of commuting, annualized.

Edge commuting cost falls by a bit more than 500 Rupees/yr, or 0.7% of income.

This (big) number is the per capita welfare gain from relaxing FAR limit by 1.0.

In a similar-size US city (900,000 population), a 0.7% income gain would aggregate to about $1 billion annually.

Stringency of building-height regulation

How much taller would buildings be in the absence of height regulation?

If the answer is "much taller", then the regulation is highly stringent.

Can measure stringency by studying the effect of FAR regulation on land value.

Measuring stringency

The cost of land reduces the housing developer's profit to zero, with free-market land value given by

$$r^* \;=\; ph(S^*) \;-\; iS^*.$$

Requiring FAR to equal $\overline{h}$ means S must equal $\overline{S}$, where $h(\overline{S}) = \overline{h}$.

Regulation reduces land value, which now equals

$$\overline{r} \;=\; ph(\overline{S}) \;-\; i\overline{S} \;<\; r^*.$$

So raising $\overline{h}$ (and thus $\overline{S}$) increases land value.

Measuring stringency

Key theoretical result (which assumes Cobb-Douglas production):

> Relaxing a tight FAR limit raises land value by more than relaxing a loose limit.

More formally,

$$\text{Elasticity of land value w.r.t. } \overline{h} \quad = \quad F\left(\frac{h(S^*)}{\overline{h}}\right), \; F' > 0.$$

Therefore, θ coefficient in following regression is an FAR stringency measure:

$$\log(r) \quad = \quad \nu \; + \; \theta \log(FAR) \; + \; \text{other variables}$$

Stringency results

To estimate regression, need parcel-level data on selling price of vacant land along with parcel's FAR limit for future construction

First study uses Chinese data, relying on huge number of land-lease transactions data in rapidly expanding cities.

Follow-up study focuses on five US cities: New York, Washington, DC, Chicago, Boston and San Francisco.

Uses zoning data for FAR values and CoStar data on vacant-land sales.

Stringency results

Washington, DC, has largest θ, reflecting very stringent regulation due to its strict height limit.

New York is second most stringent.

Chicago is least stringent of 5 cities (Boston and SF in between).

Estimating stringency separately for 5 NYC boroughs, Manhattan is most stringent borough, even though it has tallest buildings.

Assuming a particular value for β (Cobb-Douglas production parameter), can compute $\overline{h}$ as share of free-market h $(= \overline{h}/h(S^*))$.

Table 9: Calculation of $h(\overline{S})/h(S^*)$

	estimated θ	$\beta = 0.6$	$\beta = 0.8$
New York	0.322	0.77	0.70
Washington, D.C.	0.381	0.72	0.63
Chicago	0.093	0.94	0.92
Boston	0.239	0.84	0.78
San Francisco	0.116	0.93	0.90

Conclusion

As extension, stringency approach could be applied to other land-use regulations (e.g., minimum-lot size regulations, set-back requirements).

In addition, Jason Barr, Remi Jedwab and I are using data on almost 15,000 tall buildings worldwide to measure "building-height gaps" at the country level.

Gap gives the difference between the country's actual building heights and those that would be predicted if development followed patterns in other countries with light regulation.

The gap seems to be a good proxy for land-use regulation more generally, helping to explain housing-price levels and urban sprawl.