

# **The Effect of Location-based Subsidies on the Housing Market**

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2022 AREUEA National Conference

June 2, 2022

Brown University

## THIS PAPER

- ▶ I estimate the effect of a location-based public utilities subsidies and a differential property tax in Bogotá, Colombia on the housing market.
  - Probability of new construction.
  - Housing Characteristics (age, quality, and size).
  - Assessed prices.
- ▶ I use a Regression Discontinuity Design using a cutoff on neighborhood quality index defining which places are subsidized

### Findings

1. Subsidized blocks have a 43% higher probability of having new housing units.
2. This is reflected in a lower average age of housing stock in those areas.
3. Subsidy's capitalization into housing prices.

## WHY IS THIS AN IMPORTANT QUESTION?

Should we subsidize people or places?

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1. **People:** We know more about targeting subsidies and policies
  - CCT, EICT and other mean-tested transfer  
(Hanna & Olken, 2018)
2. **Places:** We know less and have contradicting views.
  - No conclusive evidence for the effectiveness of location based subsidies  
(Kline & Moretti, 2014).

→ **Debate**

- Gaubert, Kline, and Yagan (2020) call to re-asses the *Urban Economist mantra*:  
*"Help poor people, not poor places"* Glaeser et al. (2008)
- How important are the capitalization effects?
- Limited evidence particularly for developing countries.  
(Hilber, 2017; Lutz, 2015; Chen, Glaeser, & Wessel, 2019; Bayer, Ferreira, & McMillan, 2007; Black, 1999; Medina & Morales, 2007; Gallego, Montoya, & Sepúlveda, 2016)

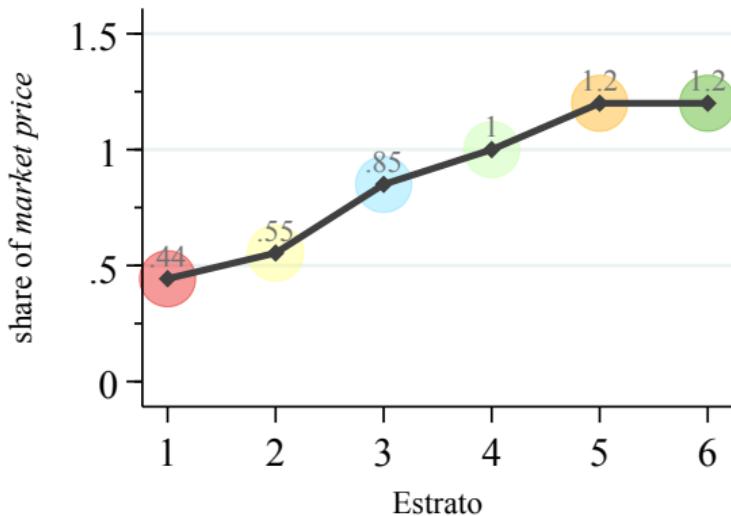
→ **Contribution:** Alternative research design for an understudied location based targeting tool and type of policy.

# INSTITUTIONAL CONTEXT: THE *Estratos* AND THE SUBSIDIES

## The subsidy:

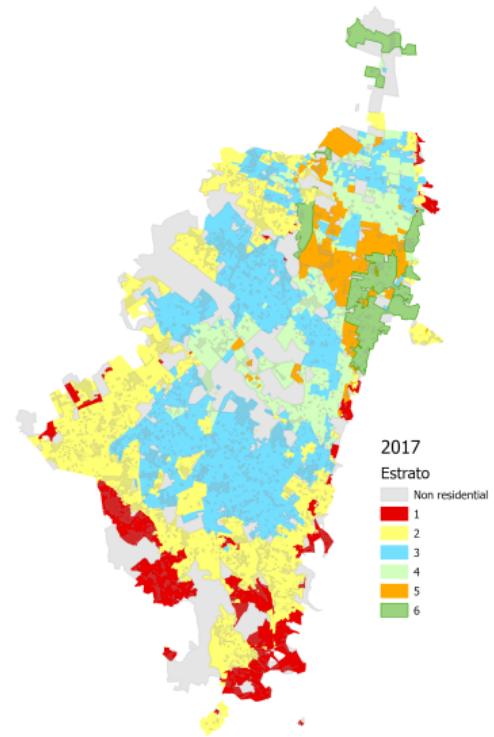
- Cross-price subsidy for utilities.
- Differential property tax.

ELECTRICITY PRICE SCHEME



## The targeting tool—the *estratos*:

- A code from 1 to 6.
- Assigned first in 1997.



## DATA AND VARIABLES

- ▶ Combine different sources of administrative and census data.
- ▶ The unit of observation is a residential block.

### 1. Stratification Census

- Raw data used to determine the estratos.
- I use it to replicate the assignment score.

### 2. Cadastre Census (2011)

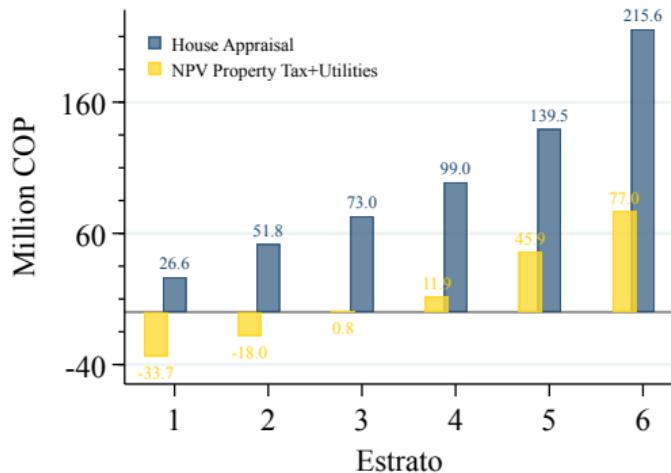
- Construction Date: Age of the structure, Probability of new construction.
- Prices: Land,Structure and total assessed price per  $m^2$

### 3. Population Census 1993 and Shape-files and geo-location of blocks.

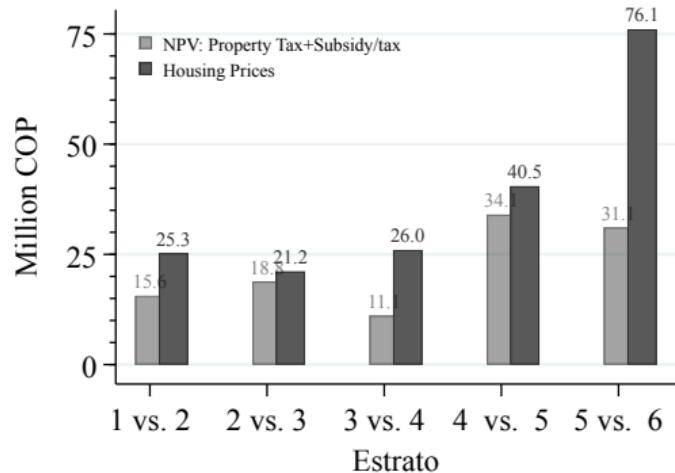
- I use these to check for balance in pre-existing characteristics.

# SUBSIDY RELATIVE TO HOUSE PRICES AND NAIVE PRICE DIFFERENCES

a. *NVP of subsidies and housing prices*



b. *Difference between estratos*



- Subsidy: mean subsidy for each estrato
- Property Tax: mean calculated property tax using assessed price and the tax formula
- Capitalization benchmark:  $\Delta$  NVP Property Tax + Subsidy

$$NPV = \sum_{t=1}^{30} x/(1 + \beta)^t : (\beta = 0.0692 \text{ (10 year national bonds)})$$

# IDENTIFICATION CHALLENGE AND SELECTED ESTRATOS

## ► Identification Challenge:

1. Targeted areas are systematically different:

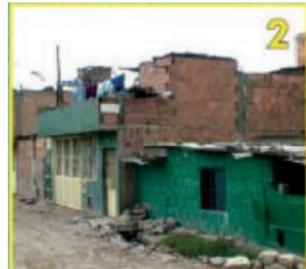
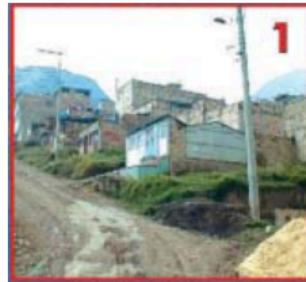
- Poorer
- More polluted
- More crime

→ Hard to find a valid counterfactual.

2. The subsidy encourage people to move to take advantage of the subsidy.  
→ Usual RD like Geographic Discontinuities may be invalid

## ► I focus on *Estratos* 2 and 3.

1. Concentrate 57% of the units.
2. Enough observations around the cutoff.
3. Both receive a subsidy, and are considered poor.
4. The appraisals models are the same.



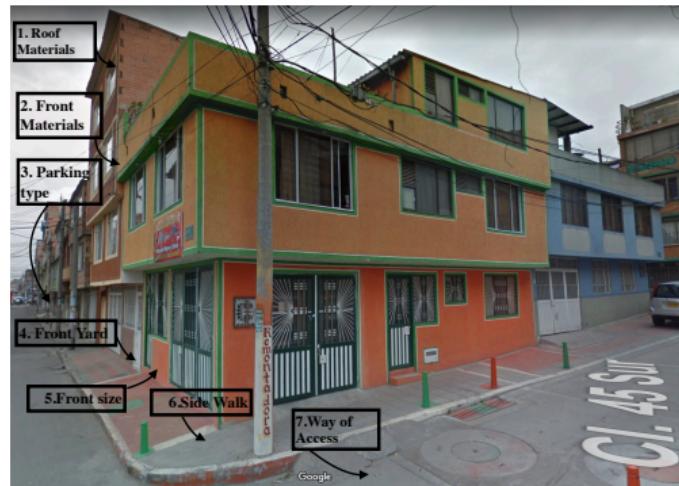
## Estratos: ASSIGNMENT FORMULA

The codes use:

1. *Habitat zone*: Urban areas with homogeneous set of characteristics.  
(e.g Residential with low density, Industrial ...)
2. *Block level score*: Calculated using 7 characteristics (see figure)  
→ transformed into a single score for each block using a savage score transformation.

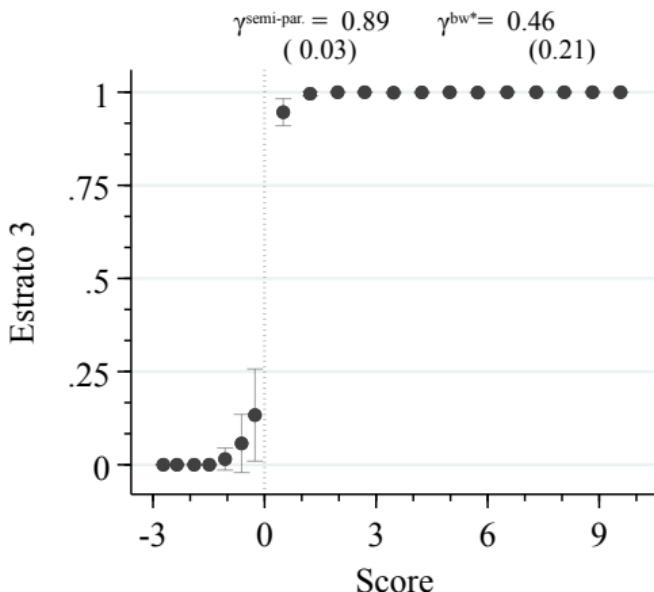
Assignment based on:

- A *neighborhood quality score*
- Arbitrary cutoffs.
- RDD.



# RESEARCH DESIGN

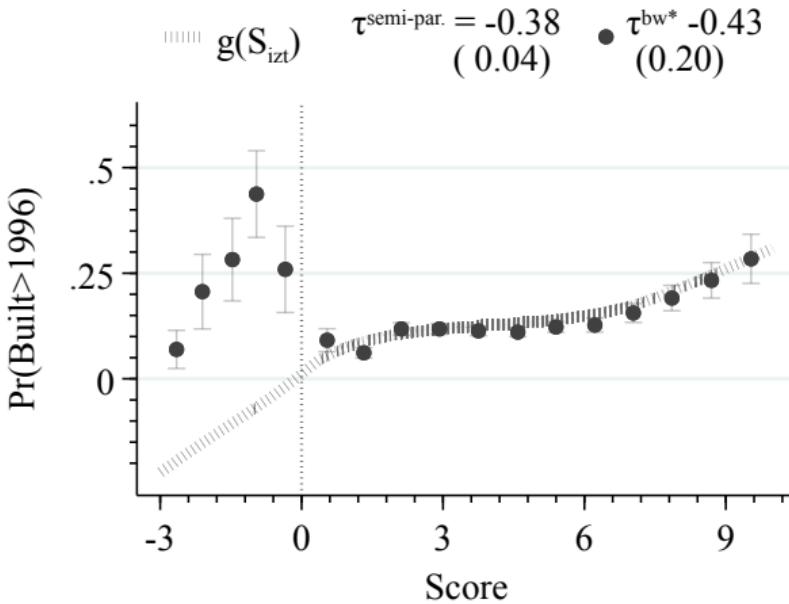
## First Stage



Discrete changes at the threshold allows me to use a RDD Main identifying assumptions:

1. No manipulation at the threshold:
  - I cannot reject the  $H_0$  of equal distribution around the cutoff.  
McCrary Manipulation test p-value 0.55
  - Code assigned to blocks  $\neq$  individuals.
  - Uses clear formula and algorithm hard to predict by individuals.
2. Only discrete change when policy is implemented is the subsidy level.
  - Balanced characteristics based on 1993 census.'

# SUBSIDIES INDUCED CONSTRUCTION OF NEW UNITS



1. Bin scatter: Even spaced bins (IMSE).
2. Partially Linear Model:

$$Y_b = \alpha + \tau \mathbb{1}_{[S=3]} + k(S_{izt}) + \varepsilon_b$$

- First Stage:

$$\mathbb{1}_{[S_i=3]} = \beta_1 + \gamma_{2,3} \mathbb{1}_{[S_{izt} \geq \delta_2^3]} + h(S_{izt}) + \epsilon_{izt}$$

- Reduced Form:

$$Y_{izt} = \beta_0 + \tau_{2,3} \mathbb{1}_{[S_{izt} \geq \delta_2^3]} + g(S_{izt}) + \varepsilon_{izt}$$

- Parameter of interest:

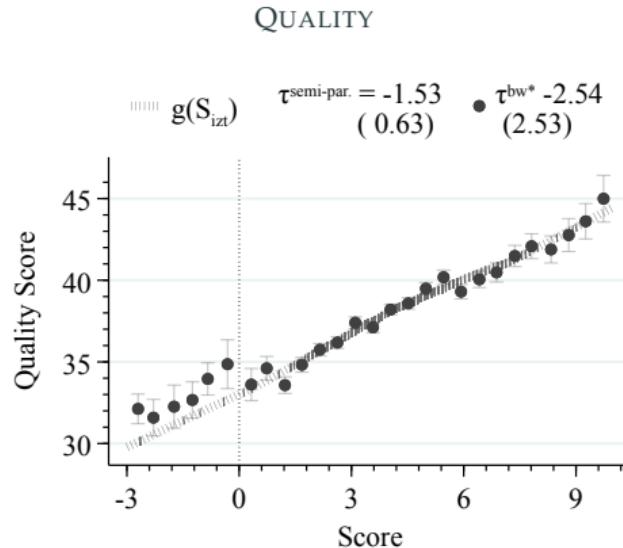
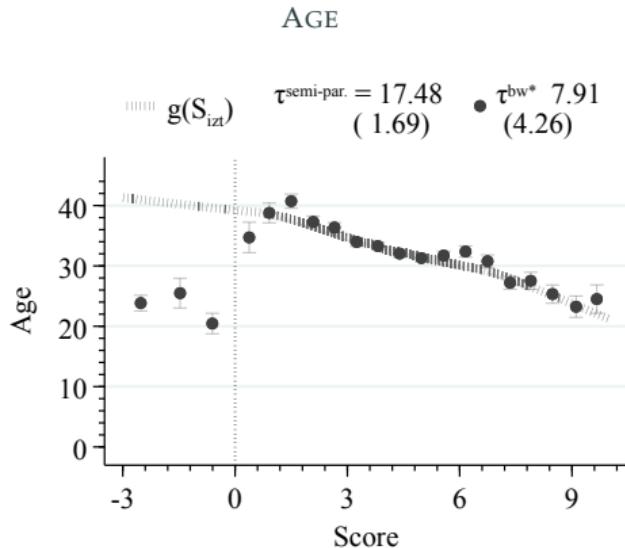
$$\theta_{2,3} = \frac{\tau_{2,3}}{\gamma_{2,3}}$$

3. Non parametric Approach:

- Optimal bandwidth
- triangular kernel

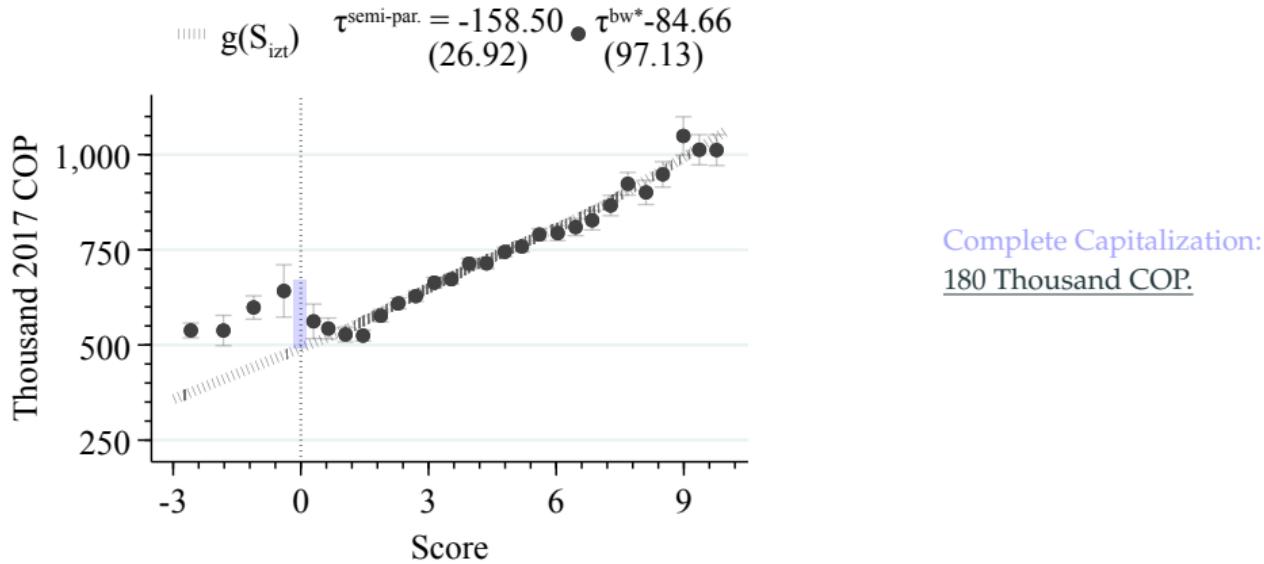
	Partially linear		Non-parametric	
Sh. built after 1996	-0.43*** (0.05)	-0.43*** (0.05)	-0.39+ (0.24)	-0.54* (0.21)
Controls	No	Yes	No	Yes
Char. 1993	No	Yes	No	Yes

## SUBSIDIES INDUCED NEWER BUILDINGS AND BETTER HOUSES



	Partially Linear		Non-parametric	
Age	19.64***	22.08***	15.80***	10.76***
	(1.71)	(1.89)	(4.73)	(3.11)
Quality Score	-1.72**	-2.04**	-3.94 <sup>+</sup>	-3.94*
	(0.64)	(0.66)	(2.18)	(1.98)
Controls	No	Yes	No	Yes
Char. 1993	No	Yes	No	Yes

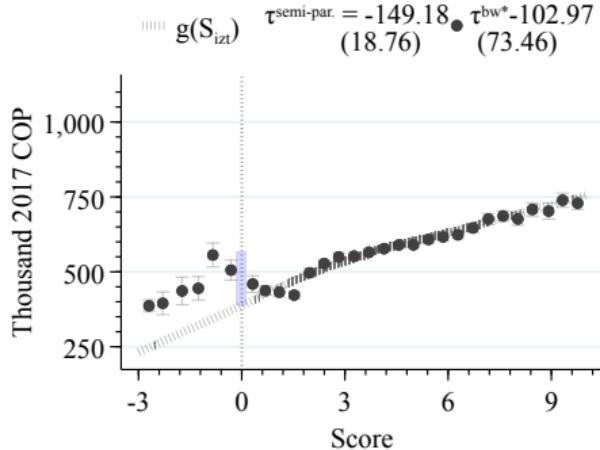
## HIGHER PRICES IN SUBSIDIZED AREAS



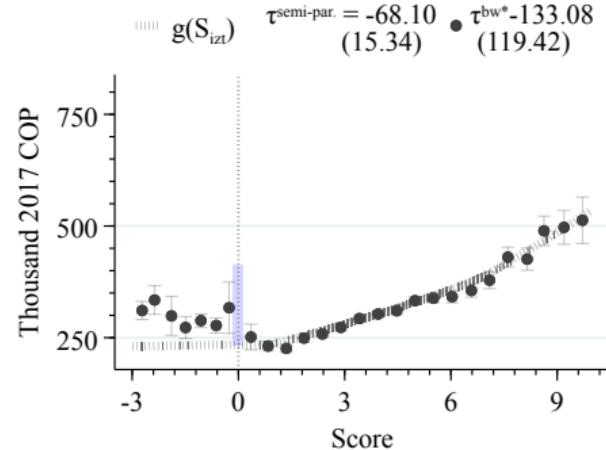
	Partially Linear			Non-parametric		
	Property	-178.09*** (27.80)	-214.58*** (29.03)	-122.17** (38.66)	-193.20 (177.38)	-84.43 (119.01)
Controls	No	Yes	Yes	No	Yes	Yes
1993 Char.	No	Yes	Yes	No	Yes	Yes
House Char.	No	No	Yes	No	No	Yes

# HIGHER PRICES IN THE SUBSIDIZED AREAS

LAND



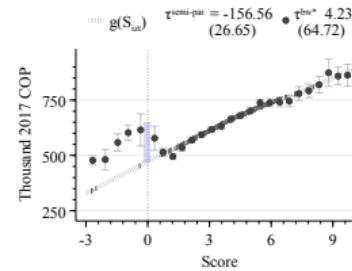
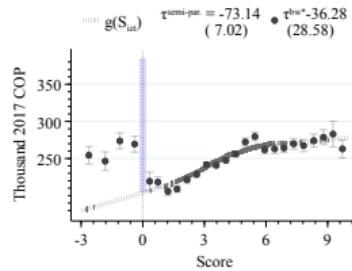
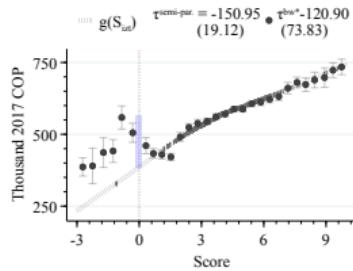
STRUCTURE



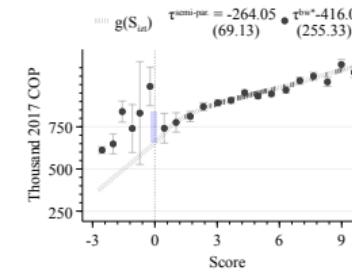
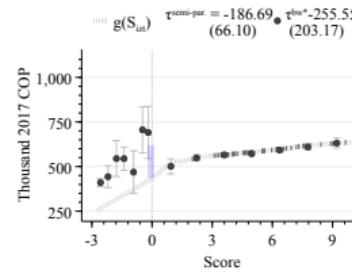
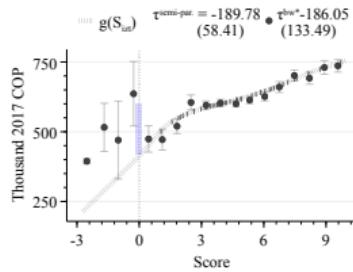
	Semipar			Non-parametric		
Land	-167.62*** (22.65)	-176.78*** (22.16)	-99.31*** (18.03)	-122.79 (118.60)	-38.06 (105.06)	59.56 (122.98)
	-76.52*** (16.88)	-102.75*** (12.35)	-4.93 (7.85)	-112.11 (78.85)	-223.89 (422.83)	-27.03 (36.29)
Controls	No	Yes	Yes	No	Yes	Yes
1993 Char.	No	Yes	Yes	No	Yes	Yes
House Char.	No	No	Yes	No	No	Yes

# HIGHER PRICES IN THE SUBSIDIZED AREAS

## SINGLE FAMILY UNITS



## MULTI FAMILY UNITS



a. LAND

b. STRUCTURE

c. PROPERTY

## CONCLUSIONS:

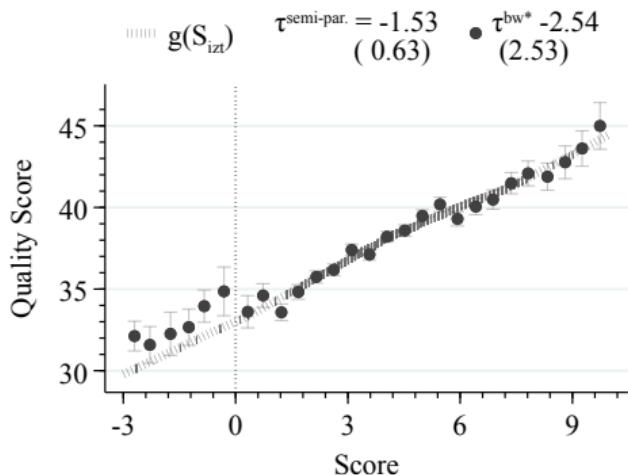
1. I find that blocks with higher subsidies are more likely to have new constructions.
2. Evidence of capitalization of the subsidy into the housing market.
3. This paper provides evidence in favor of the urban economist mantra. Capitalization of subsidies and new construction are potential effects that should be considered and taken into account when assigning subsidies to location and not people.

## Appendix

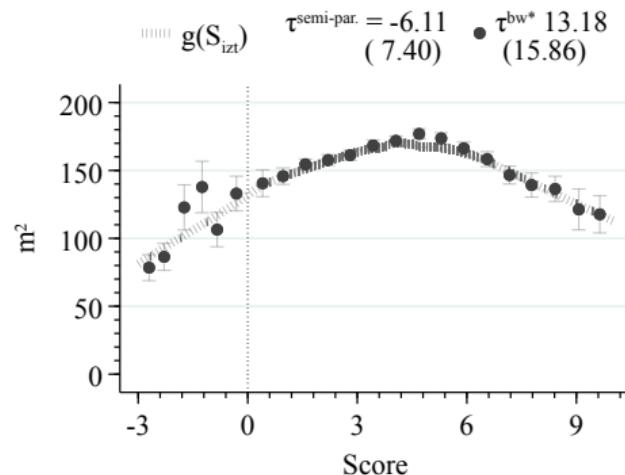
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# HOUSE CHARACTERISTICS

*Quality Score*



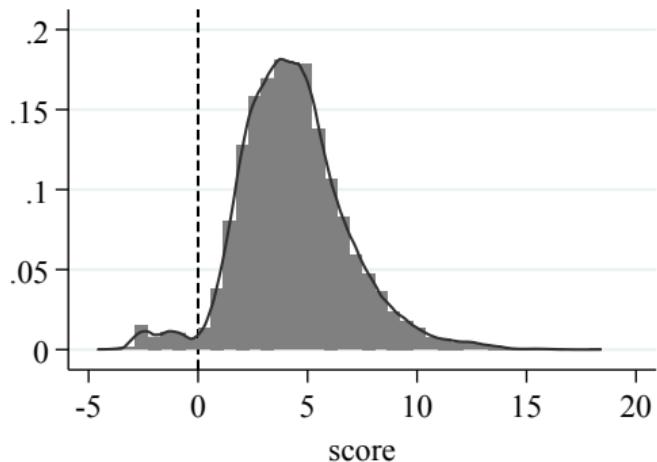
*Size*



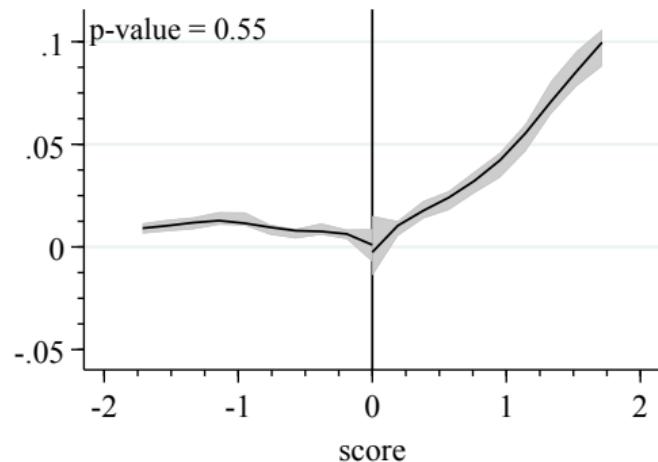
## VALIDITY OF THE DESIGN: NO MANIPULATION

assumptions

a. Density



b. McCrary Manipulation test

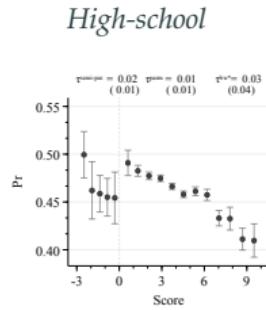
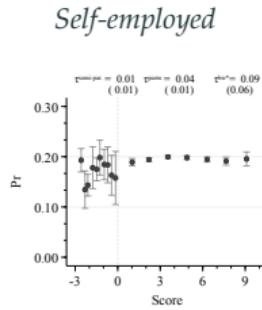
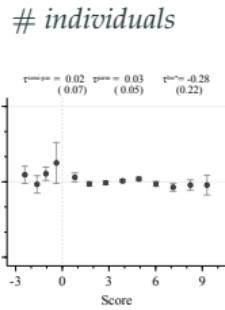
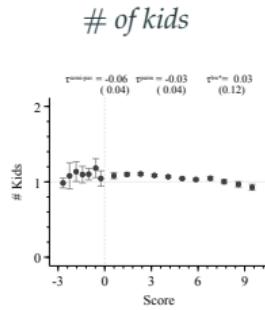


Note:  $H_0$ : The density is the same on the right and on the left. The p-value of the test is on the top of panel b).

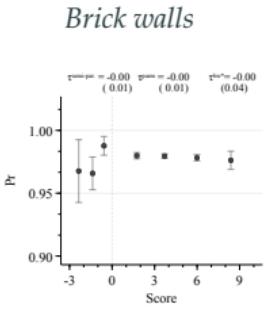
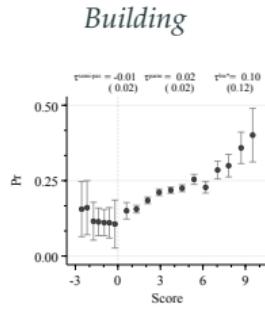
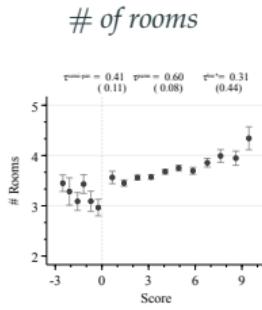
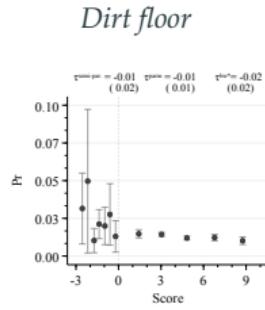
I follow Cattaneo, Jansson, and Ma (2018) to implement the test

# VALIDITY OF THE DESIGN: BASELINE CHARACTERISTICS ARE BALANCED

Individuals Characteristics (in the 1993)

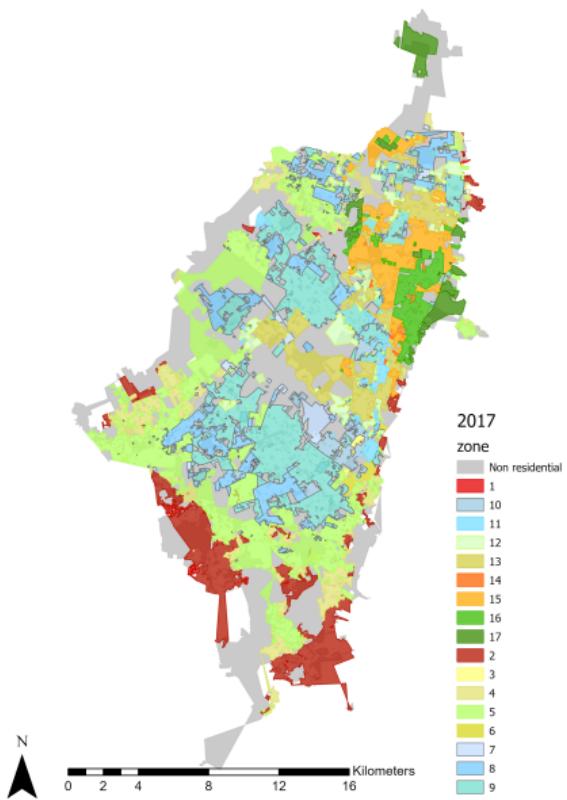


House Characteristics (in the 1993)

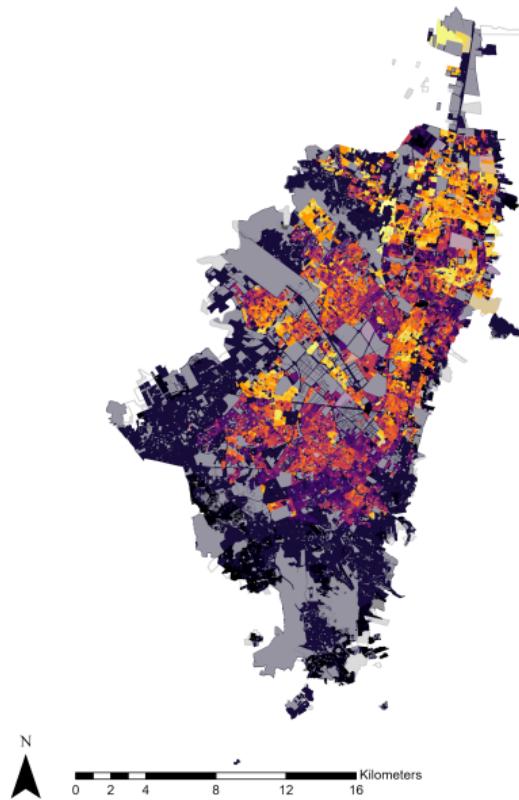


# DISTRIBUTION OF THE ASSIGNMENT VARIABLES IN THE CITY

*Habitat Zones*

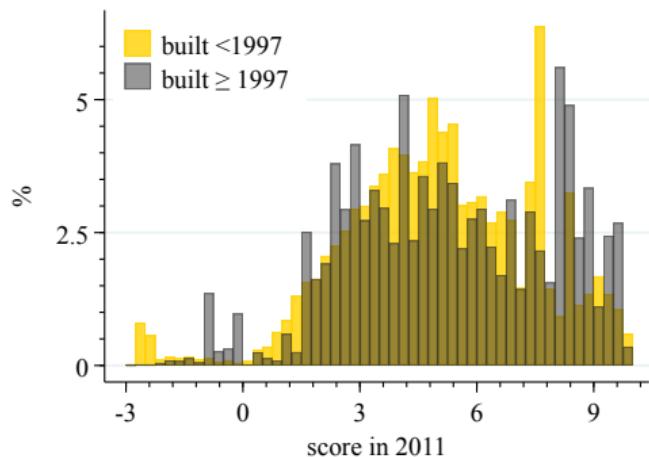


*Quality Score*



# THE NEW CONSTRUCTION, BEFORE AND AFTER THE INTRODUCTION OF THE ESTRATOS

a. PDF of units by score and build timing



b. CDF by construction date

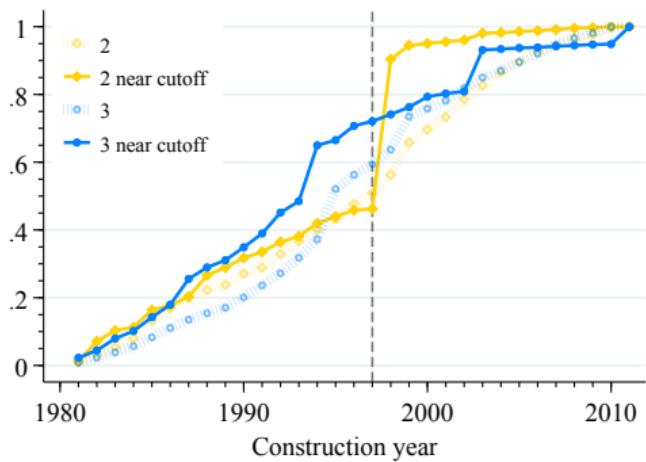
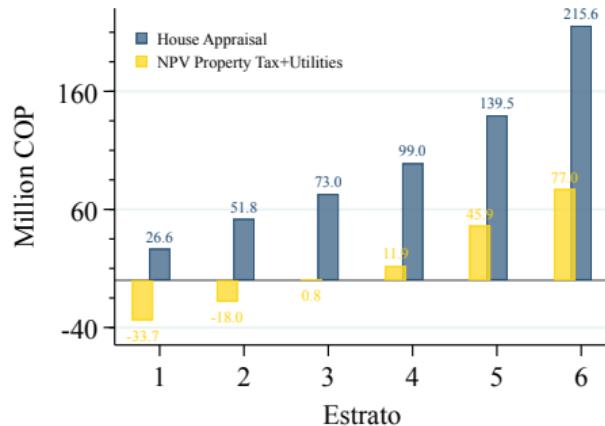


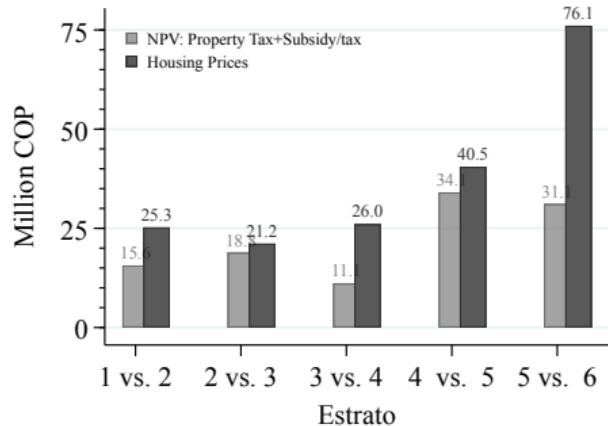
Figure 9: Stock of buildings in 2011 by construction date

# THE SUBSIDY IS BIG

a. *NVP of subsidies and housing prices*



b. *Difference between estratos*



- The subsidy is a **flow** variable and the housing price is a **stock**.
- I calculate NPV of the subsidy on utilities and Property Tax.
- Dividing the difference by the average size of properties ( $104 m^2$ ),
- Benchmark for complete capitalization: **180 thousand 2017 COP**

Notes: Subsidy: mean subsidy for each estrato. Property Tax: mean calculated property (using assessed price and the tax formula)

$$NPV = \sum_{t=1}^{30} x/(1 + \beta)^t : (\beta = 0.0692 \text{ (10 year national bonds)})$$

FORMULARIO ESTRATIFICACION SOCIOECONOMICA URBANA DE BOGOTÁ, D.C.										LOCALIDAD	0						
<b>I. IDENTIFICACIÓN</b>					<b>II. CONTEXTO URBANISTICO</b>												
1 <input checked="" type="checkbox"/> Urbano/Rural	4 <input checked="" type="checkbox"/> Barrio/Suburbio	10. Croquis de la manzana					La manzana pertenece a la zona <input type="checkbox"/>										
2 <input checked="" type="checkbox"/> Circuito/Término	5 <input checked="" type="checkbox"/> Manzana:																
3 <input checked="" type="checkbox"/> Sector/Vivienda																	
6. Dirección en Terreno																	
Calle(s) _____ Carrera _____																	
7. Nombre del Barrio: _____																	
<b>Ciudad Hayuelos</b>																	
8. Nombre del Conjunto: _____																	
9. Código Sectorización: <b>006320</b>																	
<b>III. CARACTERISTICAS DE LA VIVIENDA Y SU ENTORNO</b>																	
<b>PREGUNTAS</b>		<b>RESPUESTAS</b>		Cód.		Lados de Manzana											
				A	B	C	D	E	F	G	H	I	J	K	L		
1. En el lado de manzana hoy viviendo con Crédito Principal		Sí <input type="checkbox"/> No <input type="checkbox"/>		1													
2. Vías de Acceso		Sendero o clavero <input type="checkbox"/> Pavedal <input type="checkbox"/>		1													
La Calle o la Vía del lado de la Manzana es :		Vehicular en tierra <input type="checkbox"/> Vehicular en recinto - balasto o gravilla <input type="checkbox"/> Vehicular en recinto - concreto, asfalto o adoquín <input type="checkbox"/>		1													
3. Tamaño del terreno		Más de 7 metros <input type="checkbox"/> Entre más de 7 y 9 metros <input type="checkbox"/> Entre más de 9 y 12 metros <input type="checkbox"/> Menos de 12 metros <input type="checkbox"/>		1													
4. Andén		Sí Andén <input type="checkbox"/> Prescinde en el lado de la Manzana universales <input type="checkbox"/>		1													
5. Arbolado		Sí Arbolado <input type="checkbox"/> Prescinde en el lado de la Manzana Universales <input type="checkbox"/>		1													
6. Gajones		Sí Gajones ni Pergolas <input type="checkbox"/> Prescinde en el lado de la Manzana Universales <input type="checkbox"/>		1													
7. Material de las Fachadas		En Gresia, Caja, Estrella, Tablo y Desechos <input type="checkbox"/> Sin calzado: Jardinería, teja plana, placa prefabricada, ladrillo o ladrillo cerámico <input type="checkbox"/> En Revoco - Polvo o Repello - Sin Pintura <input type="checkbox"/> En Revoco - Polvo o Repello - Con Pintura <input type="checkbox"/> Con Pintura - Ladrillo Polvo o en Madera Pisa <input type="checkbox"/>		1													
8. Material de los Techos		Deseches, Teles Artificiales ó Pedazos de Tejas <input type="checkbox"/> Placa de Gresite <input type="checkbox"/> Tejera, Cobre o Cebolla Sencilla <input type="checkbox"/> Ligosa u Ondasorbible <input type="checkbox"/>		1													
<b>IV. LISTADO DE VIVIENDAS ATÍPICAS</b>																	
Tenga en cuenta que esta sección es de firma/calcado difiere del resto de la manzana por presentar vivienda atípica en el tamaño, los materiales, el tratamiento, el artefacto de calefacción o construcción.																	
Lado de Manzana:	Descripción:	Justificación:	Almacénelo (an)														

Figure 11: Stratification census form

## Annex: Score calculation-Savage Score/Dalenius-Hodges

The savage scores for each variable are defined as:

$$h_i^k = \left( \sum_{j=N-r_i+1}^N \frac{1}{j} \right) - 1$$

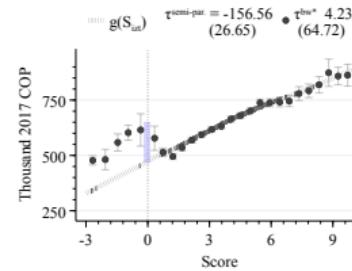
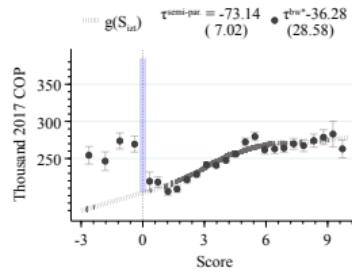
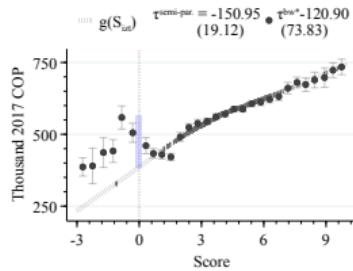
house,  $k = 1, \dots, 7$ , for side l of the block i. We define

- ▶  $h_i^k$  is the savage score for variable  $k$  in the block  $i$
- ▶  $r_i$  is the rank of  $i$  in the ascending ordered sample according to  $\bar{z}_k$ .
- ▶  $z_{i,l}^k$ , categorical indicative variable of exterior quality of the houses in the block side.
- ▶  $\bar{z}_i^k$  as the average as the average of the sides.

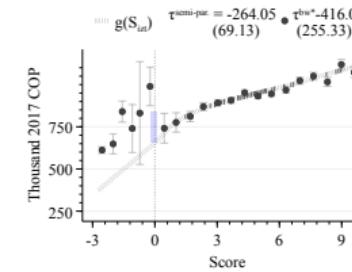
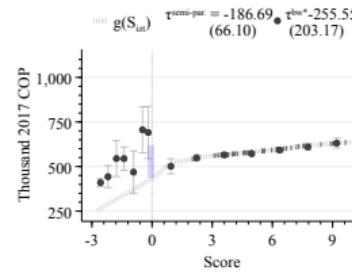
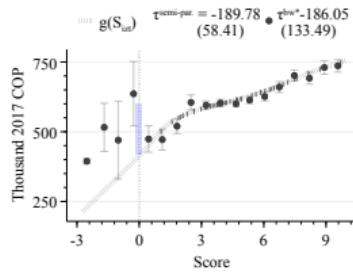
In this case this is combined with the *zona habitad*. back

# HIGHER PRICES IN THE SUBSIDIZED AREAS

## SINGLE FAMILY UNITS



## MULTI FAMILY UNITS



a. LAND

b. STRUCTURE

c. PROPERTY

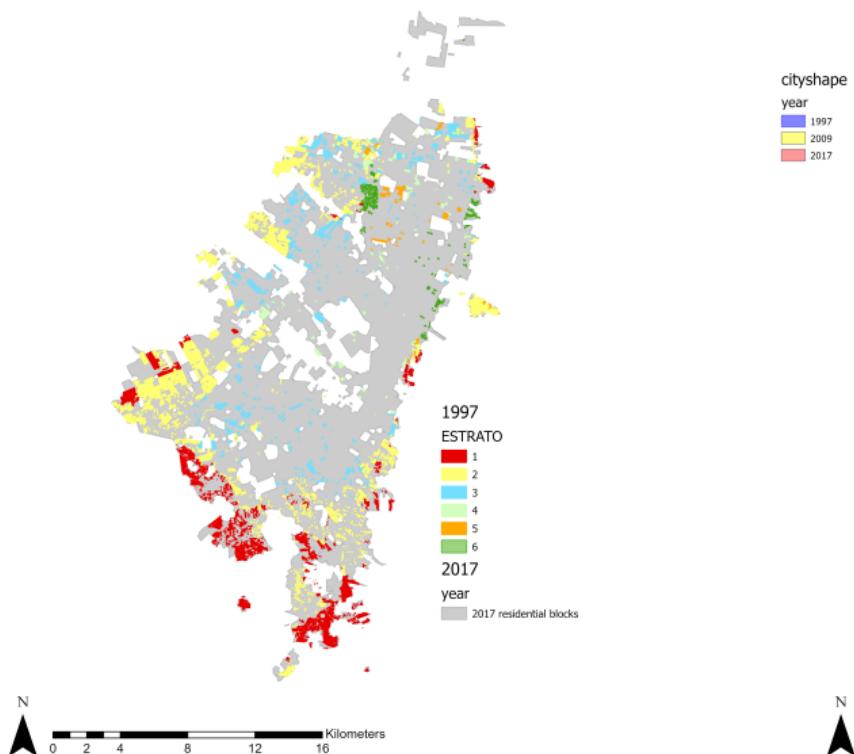
Benchmark for Complete Capitalization: 180 Thousand COP.

# *RD*<sup>fuzzy</sup> ESTIMATES FOR HOUSING PRICES

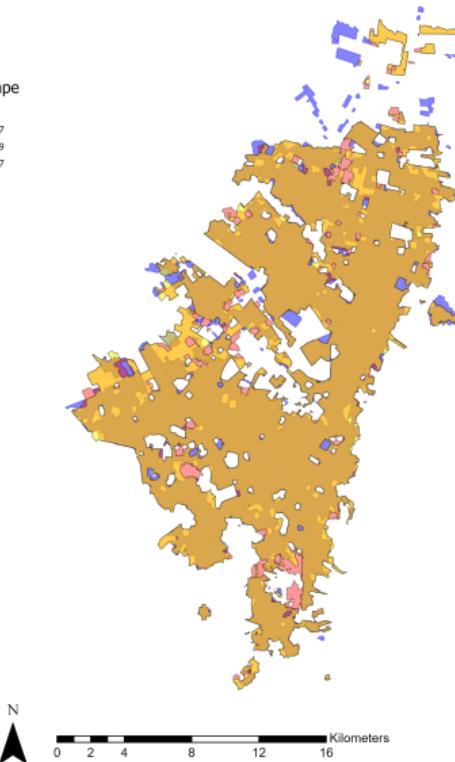
	Semipar			Non-parametric		
	(1)	(2)	(3)	(4)	(5)	(6)
A. Mult-Family Units						
Land	-213.24*	-171.53 <sup>+</sup>	-107.44	-453.05	419.70	19.12
	(107.77)	(100.12)	(78.62)	(408.10)	(765.80)	(163.96)
Structure	-209.76 <sup>+</sup>	-197.26	6.20	-658.88	478.16	28.10
	(117.96)	(126.97)	(64.85)	(662.48)	(1,252.39)	(224.30)
Property	-296.69	-257.83 <sup>+</sup>	-91.25	-847.15	2,106.98	-224.02
	(197.18)	(140.31)	(115.71)	(719.56)	(3,132.02)	(268.62)
B. Single-Family Units						
Land	-169.61***	-176.34***	-114.76***	-169.71	-240.70	106.37
	(15.89)	(21.18)	(17.03)	(160.30)	(343.32)	(150.20)
Structure	-82.18***	-65.35***	-16.42*	-96.49	-6.44	-12.65
	(9.35)	(8.55)	(6.54)	(66.85)	(34.37)	(35.77)
Property	-175.91***	-171.92***	-119.33***	-44.42	45.48	391.54
	(30.36)	(37.08)	(31.59)	(139.36)	(303.01)	(268.22)
Controls	No	Yes	Yes	No	Yes	Yes
1993 Char.	No	Yes	Yes	No	Yes	Yes
House Char.	No	No	Yes	No	No	Yes

# CHANGES IN ADMINISTRATIVE CODES AND CITY BOUNDARIES

*Different administrative code in 1997 and 2017*



*Changes in city boundaries*



## References

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- Bayer, P., Ferreira, F., & McMillan, R. (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of Political Economy*, 115(4), 588-638. [link](#)
- Black, S. E. (1999). Do better schools matter? parental valuation of elementary education\*. *The Quarterly Journal of Economics*, 114(2), 577-599. [link](#)
- Cattaneo, M., Jansson, M., & Ma, X. (2018, November). *Simple Local Polynomial Density Estimators* (Paper). arXiv.org. [link](#)
- Chen, J., Glaeser, E. L., & Wessel, D. (2019, December). *The (non-) effect of opportunity zones on housing prices* (Working Paper No. 26587). National Bureau of Economic Research. [link](#)
- Gallego, J., Montoya, S., & Sepúlveda, C. (2016). Effect of socio-economic stratification on house value in bogotá.
- Gaubert, C., Kline, P., & Yagan, D. (2020). *Place-based redistribution* (Paper). Berkeley. [link](#)
- Glaeser, E. L., et al. (2008). *Cities, agglomeration, and spatial equilibrium*. Oxford University Press.
- Hanna, R., & Olken, B. A. (2018, November). Universal basic incomes versus targeted transfers: Anti-poverty programs in developing countries. *Journal of Economic Perspectives*, 32(4), 201-26. [link](#)
- Hilber, C. A. L. (2017). The economic implications of house price capitalization: A synthesis. *Real Estate Economics*, 45(2), 301-339. [link](#)
- Kline, P., & Moretti, E. (2014). People, places, and public policy: Some simple welfare economics of local economic development programs. *Annual Review of Economics*, 6(1), 629-662. [link](#)
- Lutz, B. (2015, February). Quasi-experimental evidence on the connection between property taxes and residential capital investment. *American Economic Journal: Economic Policy*, 7(1), 300-330. [link](#)
- Medina, C., & Morales, L. (2007). Stratification and public utility services in colombia: Subsidies to households or distortion of housing prices? [with comments]. *Economía*, 7(2), 41-99. [link](#)