

Equilibrium Effects of Housing Subsidies: Evidence from a Policy Notch in Colombia

Juan Pablo Uribe

January 17, 2022

IS A MARKET-ORIENTED HOUSING POLICY EFFECTIVE?

- ▶ Governments implement various **market-oriented** policies to promote housing construction and promote homeownership
- ▶ Subsidies or tax incentives
- ▶ Housing market effect?
 - Prices, quantities, **type of housing**
- ▶ Is this market-oriented approach effective?
 - How big are the efficiency costs?
 - Are there any unintended consequences?
 - To what extent households and developers benefit?
 - What happens if these policies are removed?
- ▶ I use quasi-experimental variation to estimate a model of supply and demand of housing.



COLOMBIAN HOUSING POLICY

► Policy tools:

- Subsidies to low-income households.
- Tax incentives to developers who build low-cost housing.
- A price cap defining eligibility

135 monthly minimum wages (mMW) \approx 40,000 \$USD

► Empirical advantages of Colombian setting:

- Price cap on units qualifying for the subsidy.
 - Discontinuous Budget Constraint.
 - Incentives to developers and households to bunch.
- Unique and novel data:
 - Census data for all new construction projects.
 - Administrative records for the subsidies.
- Subsidy expansion between 2006-18

THIS PAPER

I. Descriptive evidence

- Characterization of observed equilibrium.
- Evidence of housing market responding to the subsidy scheme.

II. Hedonic equilibrium of housing supply and demand

- Product differentiation and heterogeneous developers and households.
- Identification using bunching and policy changes.

III. Proposed policy counterfactual and welfare

- Tax reform in Colombia in 2021– Remove tax incentives to developers.
 - Policy change – phasing out price caps
- Effects on households and developers

RESULTS

I. Behavioural responses induced by the subsidy scheme.

- Bunching at price cutoff
- Larger response as the subsidies increase → market share at cutoff went from 1% to 7%
- Households downsize → they buy units up to 30% percent smaller to benefit from the subsidy

II. Estimate a model that rationalizes the market observed equilibrium

- Elasticity of substitution between on housing and consumption is 0.9

III. Effects of the proposed policies

- Colombian 2021 Tax proposal could create a housing shortage.
- Removing the price cap increases welfare.

LITERATURE AND CONTRIBUTION

Integrates the bunching and hedonic literatures to propose a method to think about welfare consequences of housing policy

Bunching	Hedonic	Housing Policy
<ul style="list-style-type: none">▶ Housing Markets▶ Supply,Demand▶ Identification of SP	<ul style="list-style-type: none">▶ Policy Notch▶ Supply side▶ Identification	<ul style="list-style-type: none">▶ Evidence▶ Method▶ Welfare
<ul style="list-style-type: none">- Housing market applications Best et al. (2019), DeFusco and Paciorek (2017)- Methodology <i>Notches >> Kinks</i>: Kleven (2016), Bertanha et al. (2021), Blomquist et al. (2021)	<ul style="list-style-type: none">- Seminal paper S. Rosen (1974),Epple (1987)- Recent Contributions Bajari and Benkard (2005), Heckman et al. (2010), Epple et al. (2020), Chernozhukov et al. (2021)- Reviews Kuminoff et al. (2013), Greenstone (2017)	<ul style="list-style-type: none">- Developers subsidies Baum-Snow and Marion (2009), Soltas (2020), Sinai and Waldfogel (2005)- Households Subsidies Carozzi et al. (2020)- Incidence and welfare Poterba (1992), Galiani et al. (2015)

I. DESCRIPTIVE ANALYSIS:
DATA, POLICY AND OBSERVED
EQUILIBRIUM

POLICY TOOLS

1. Supply Subsidies

- Value Added Tax (VAT) refund

2. Demand Subsidies

- Downpayment
- Interest rate

Income \leq 4 monthly minimum wages (mMW) classify

3. Targeting tool for the subsidy:

- Only new *low cost* units are eligible

$$\text{Low cost} = \begin{cases} 1 & \text{if } P_t \leq \mathbf{135} \text{ mMW}_t \\ 0 & \text{if } P_t > \mathbf{135} \text{ mMW}_t \end{cases}$$

Note: **135 mMW** \approx 40,000 \$USD



DATA

1. Administrative Records from Minister of Housing

- Subsidy size
- Mortgage information

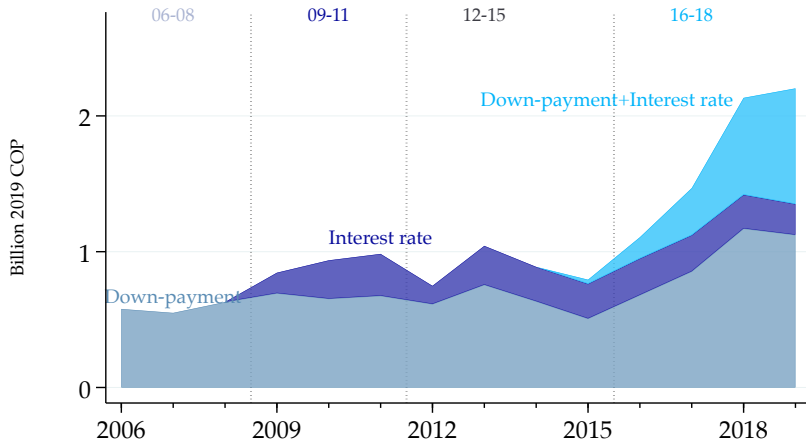
→ Government expenditure on each subsidy

2. New Construction Census (Camacol)

- 126 Municipalities
- Years: 2006-2018
- Sale prices
- Quantities
- Unit Characteristics: **size**, location, # rooms, # bathrooms, etc.
- Everything measure in montly minimum wages (*mMW*) or 2019 *COP*

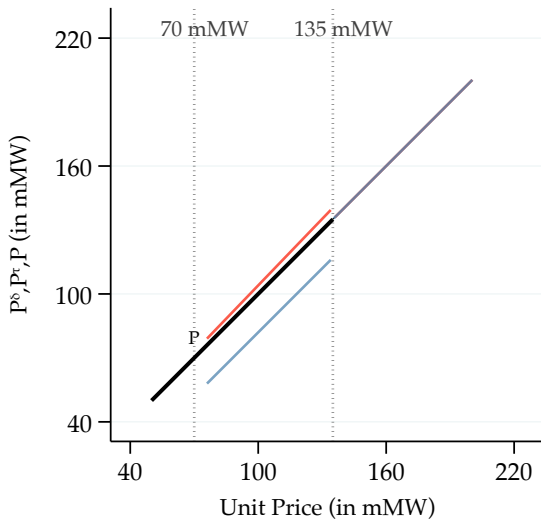
Inflation and *mMW* change

GOVERNMENT EXPENDITURE AND POLICY EXPANSION



- Total housing subsidies beneficiaries 100'000 in 2019
- 2 billion COP \sim 0.25% Colombian GDP
- Colombian Conditional Cash Transfers 3, 6 billion COP for 2.3 million households

THE NOTCH



Transaction Price

P

Developers Price

$$P^\delta = P \cdot (1 + \delta):$$

δ = Tax refund

Households price

$$P^\tau = P - \tau$$

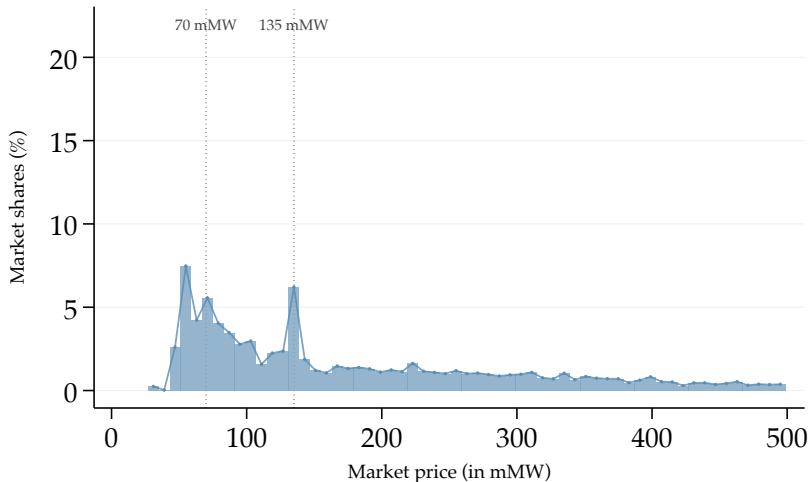
τ = Subsidy

Agents benefit from buying/selling *low cost housing* ($P \leq 135mMW$)

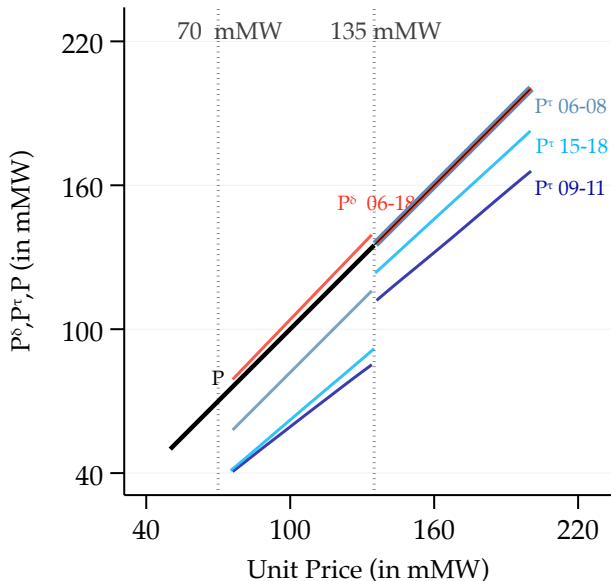
BUNCHING AT THE LOW-COST HOUSING PRICE LIMIT

Only downpayment subsidy

2006-08



THE DEMAND NOTCH INCREASES OVER TIME



Supply Notch δ

2006-18 4%

Demand Notch τ_t

2006-08: 19.7 mMW

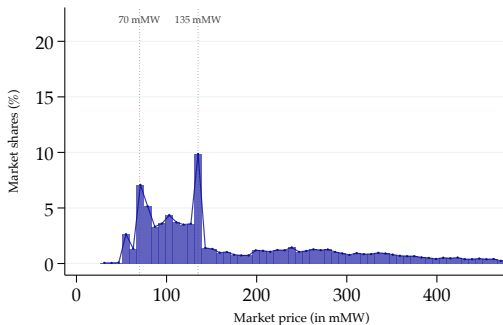
2009-11: 26.4 mMW

2016-18: 33.1 mMW

2012-15 Too many changes and
free housing at 70mMW

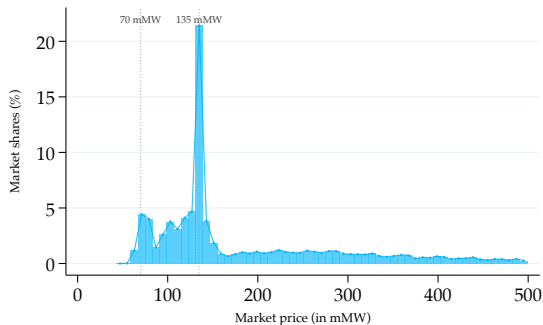
LARGER BUNCHING AS NOTCH INCREASES

Downpayment and interest rate subsidies
2009-11



Notch: 19.7 mMW

Subsidy expansion
2016-18

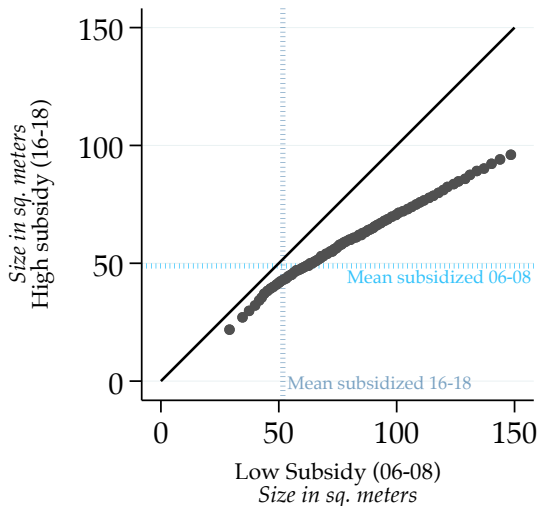


Notch: 33.1 mMW

CHANGES IN HOUSING STOCK CHARACTERISTICS

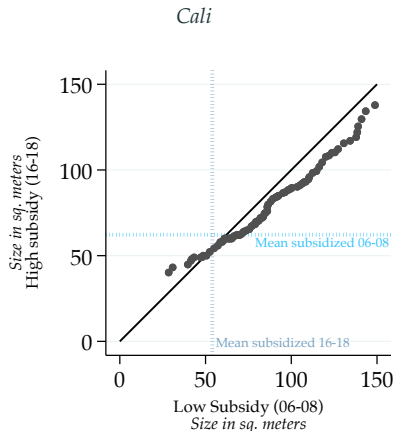
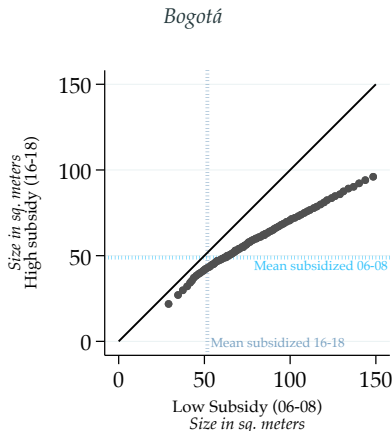
- Changes in unit size (quantile to quantile to q plot)

Bogotá



CHANGES IN HOUSING STOCK CHARACTERISTICS

► Changes in unit size



► Why size?

- Continuous, easy to measure, monotonic relationship with price and income.
- In contrast to most datasets, I observe it.

II. EQUILIBRIUM MODEL OF HOUSING SUPPLY AND DEMAND

A STYLIZED HOUSING MARKET MODEL

1. Housing

- Differentiated product described by its size $h \in \mathcal{H}$
- Price depends on size $P(h)$

2. Households $i \in I$, Heterogeneous in Income $Y_i \sim F_Y$

- Choose h_i and consumption C_i to maximize Utility $U(C_i, h_i; \theta)$

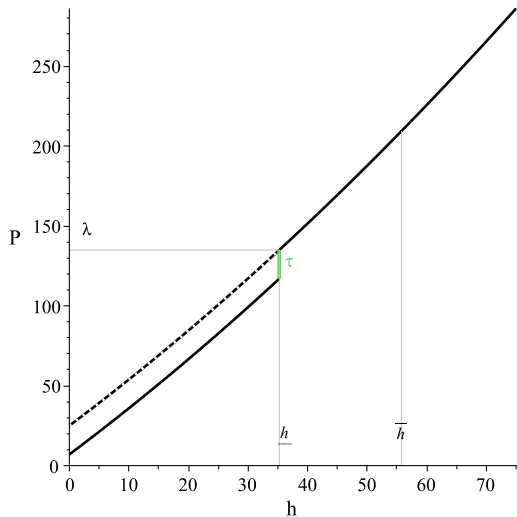
3. Developers $j \in J$, Heterogeneous in Productivity $A_j \sim G_A$

- Choose h_j to maximize profits
- Building costs $B(A_j, h_j, Q(h_j); \beta)$

4. Competitive Market Equilibrium

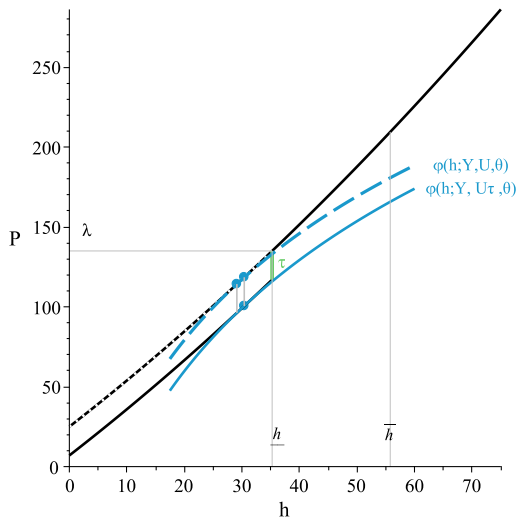
- Price function $P(h) \rightarrow$ clears the market $\forall h \in \mathcal{H}$

HOUSEHOLDS' OPTIMAL CHOICES



- Implicit Price Function: $P(h)$
- Subsidy τ

HOUSEHOLDS' OPTIMAL CHOICES



- **Implicit Price Function:** $P(h)$

- **Subsidy** τ

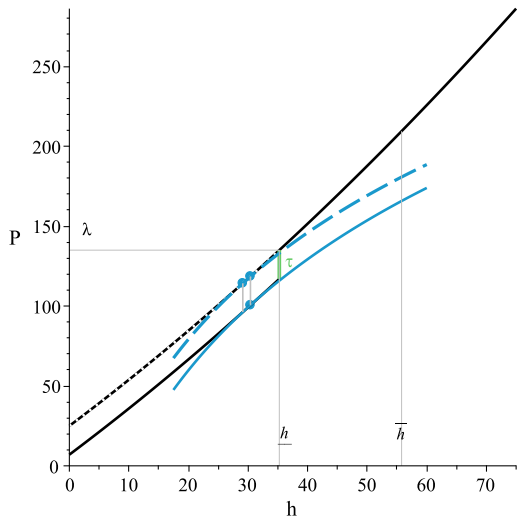
- **Bid functions** $\varphi_D(h, Y, \bar{U}; \theta)$

$$\bar{U} = U(h, Y_i - \varphi_D; \theta)$$

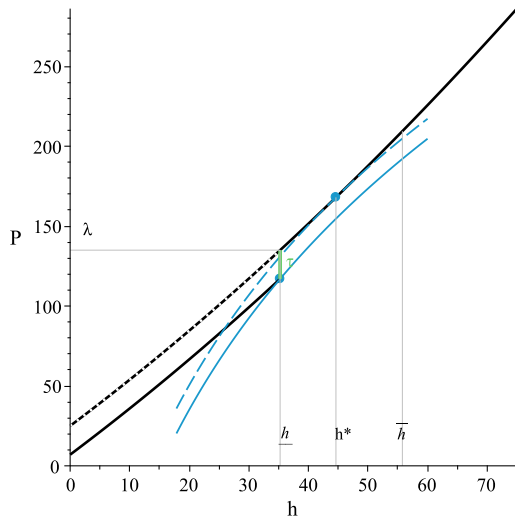
$$\bar{U}_\tau = U(h, Y_i - \varphi_D + \tau; \theta)$$

HOUSEHOLDS' OPTIMAL CHOICES

A. Subsidized

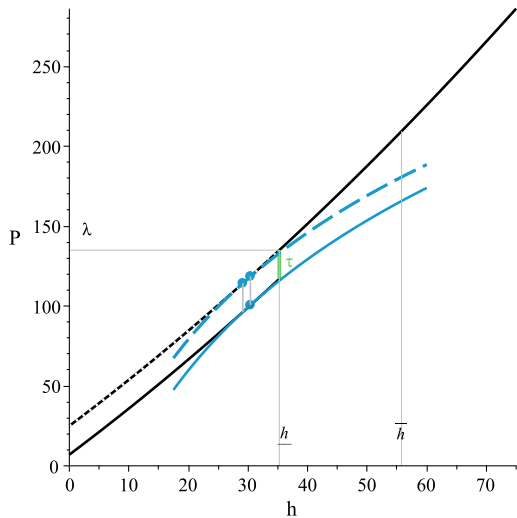


B. Marginally Subsidized and Bunchers

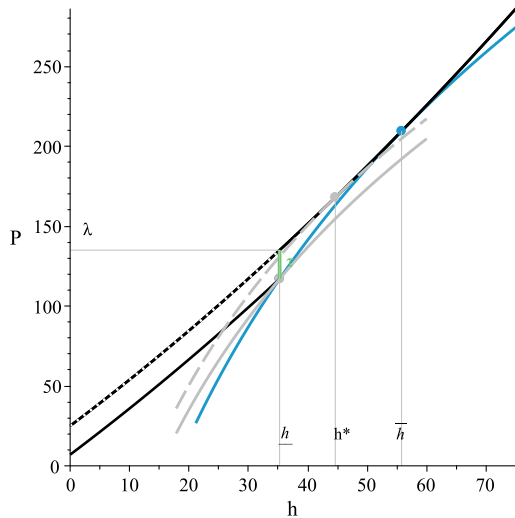


HOUSEHOLDS' OPTIMAL CHOICES

A. Subsidized



B. Marginally Subsidized and Bunchers



HOUSEHOLDS' DEMAND FUNCTION

Tangency conditions: $h^*(Y_i, \tau; \theta, \boldsymbol{\rho}, \lambda)$

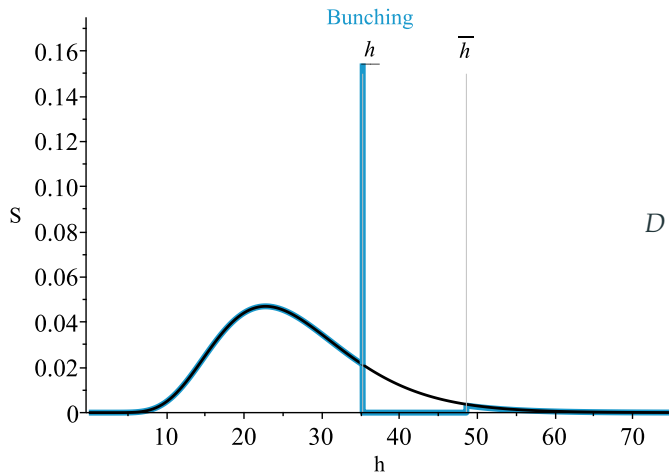
► Housing demand:

$$h^D(Y_i) = \begin{cases} h^*(Y_i, \tau; \theta, \boldsymbol{\rho}, \lambda) & \text{if } Y_i \leq \underline{Y} \\ \underline{h} & \text{if } \underline{Y} < Y_i < \bar{Y} \\ h^*(Y_i, \tau; \theta, \boldsymbol{\rho}, \lambda) & \text{if } \bar{Y} \leq Y_i \end{cases}$$

► How to aggregate?

- Income and unit size: $Y_i = \tilde{Y}(h, \tau; \theta, \boldsymbol{\rho}, \lambda) = h^{*-1}(h_i, \tau; \theta, \boldsymbol{\rho}, \lambda)$
- change of variable formula using the distribution of income

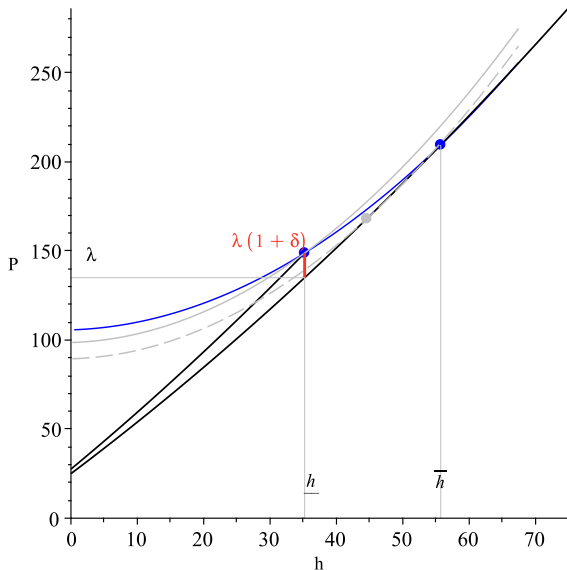
AGGREGATE DEMAND DENSITY



$$D(h) = \begin{cases} f_{h^*}(h) \, dh & \text{if } h < \underline{h} \\ f_{h^*}(h) \, dh + \int_{\underline{h}}^{\bar{h}} f_{h^*}(h) \, dh & \text{if } \underline{h} = h \\ 0 & \text{if } h \in (\underline{h}, \bar{h}) \\ f_{h^*}(h) \, dh & \text{if } \bar{h} \leq h \end{cases}$$

DEVELOPERS' CHOICES

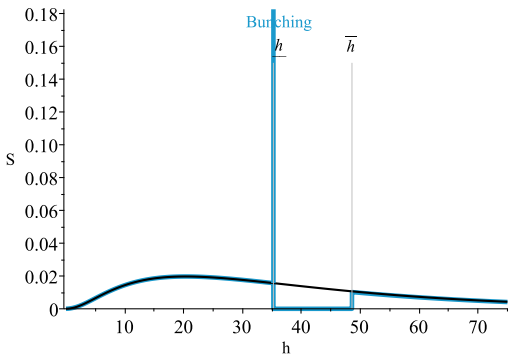
Marginally Subsidized and Bunchers



- **Implicit Price Function:** $P(h)$
- **Tax incentives:** $P(h) \cdot (1 + \delta)$
- **Offer Functions**
 $\varphi_S(h, A_j, \bar{\pi}, \beta)$
 $\bar{\pi} = (h, A_j, P(h), \beta,)$
 $\bar{\pi}_\delta = (h, A_j, P(h) * (1 + \delta)), \beta,)$

DEVELOPERS AGGREGATE SUPPLY DENSITY

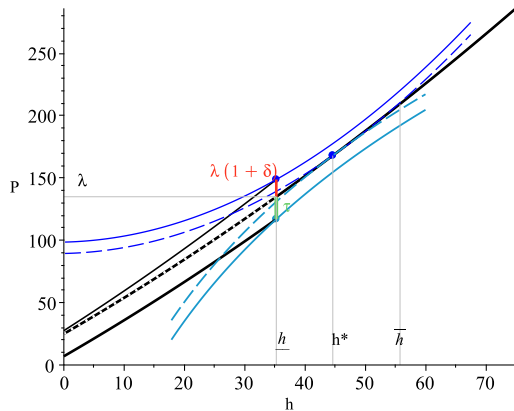
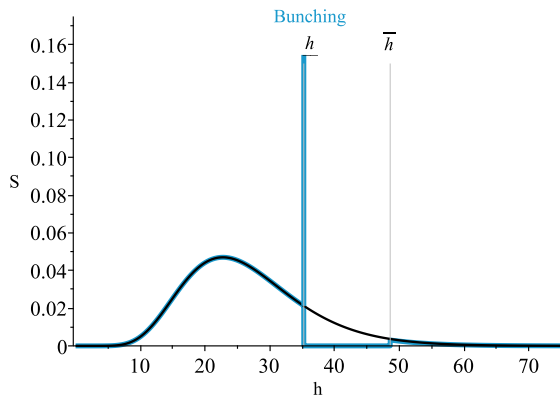
Density function $g_h(h)$



$$S(h) = \begin{cases} g_{h^*}(h) \cdot Q(h) & \text{if } h < \underline{h} \\ \left(g_{\underline{h}^*}(\underline{h}) + \int_{\underline{h}}^{\bar{h}} g_{h^*}(h) \, dh \right) \cdot Q(\underline{h}) & \text{if } \underline{h} = h \\ 0 & \text{if } \underline{h} < h < \bar{h} \\ g_{h^*} \cdot Q(h) & \text{if } \bar{h} \leq h \end{cases}$$

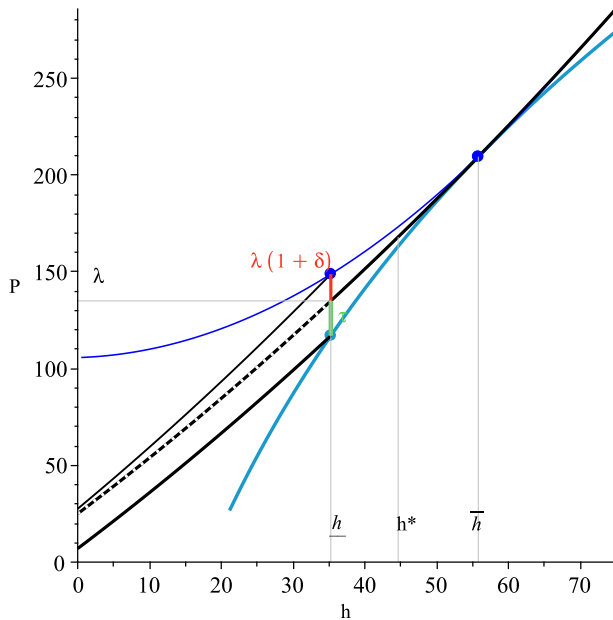
ASSUMPTION: $Q_j = \alpha_0 + \alpha_1 \cdot h_j$ (*exogenous*)

EQUILIBRIUM



IDENTIFICATION

MARGINAL BUNCHER CONDITION



MARGINAL BUNCHER CONDITION

Marginal Buncher Condition

Household	$V_D = U\left(\bar{Y} - P\left(\bar{h}\right), \bar{h}; \theta\right) - U\left(\bar{Y} - P^\tau\left(\underline{h}\right), \underline{h}; \theta\right) = 0$
Developer	$V_S = \pi\left(Q\left(\bar{h}\right), \bar{A}, P\left(\bar{h}\right); \beta\right) - \pi\left(Q\left(\underline{h}\right), \bar{A}; P^\delta\left(\underline{h}\right); \beta\right) = 0$

Optimality Conditions

Income	$\bar{Y} = \tilde{Y}\left(\bar{h}; \theta, P(h), \lambda\right)$
Productivity	$\bar{A} = \tilde{A}\left(\bar{h}; \beta, P(h), \lambda\right)$

Functional Forms

Implicit Price	$P = \rho_0 + \rho_1 \cdot h + \rho_2 \cdot h^2$
Utility	$U = \left[\frac{1}{2} \cdot C^\theta + \frac{1}{2} \cdot h^\theta\right]^{\frac{1}{\theta}}$
Unit Supply	$Q = \alpha_0 + \alpha_1 h$
Cost	$B = A_j \cdot Q \cdot h^\beta$

ESTIMATING THE MODEL

STEP I. Equilibrium Characterization

1. Using the observed hedonic equilibrium

- Price function: $\rho_t = \rho_{0t}, \rho_{1t}, \rho_{2t}$
- Size threshold: $\underline{h} = P^{-1}(\lambda; \rho)$
- Standard Unit Size: h

2. Behavioural Responses:

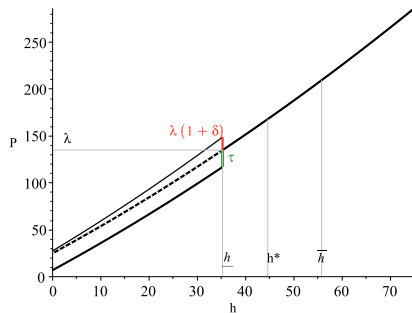
- Housing size for marginal buncher: \bar{h}

3. Unit Supply Function:

- $Q = \alpha_0 + \alpha_1 \cdot h_{ltc}$

4. Policy Parameters:

- Notches: τ_t, δ



ESTIMATING THE MODEL

STEP I. Equilibrium Characterization

1. Using the observed hedonic equilibrium

- Price function: $\rho_t = \rho_{0t}, \rho_{1t}, \rho_{2t}$
- Size threshold: $\underline{h} = P^{-1}(\lambda; \rho)$
- Standard Unit Size: h

2. Behavioural Responses:

- Housing size for marginal buncher: \bar{h}

3. Unit Supply Function:

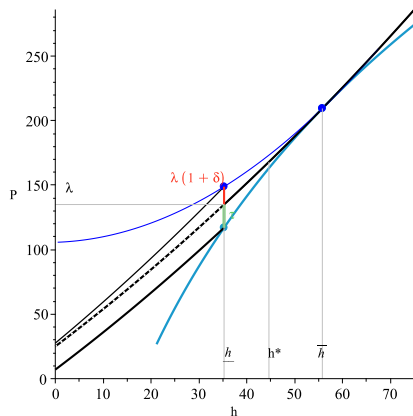
- $Q = \alpha_0 + \alpha_1 \cdot h_{ltc}$

4. Policy Parameters:

- Notches: τ_t, δ

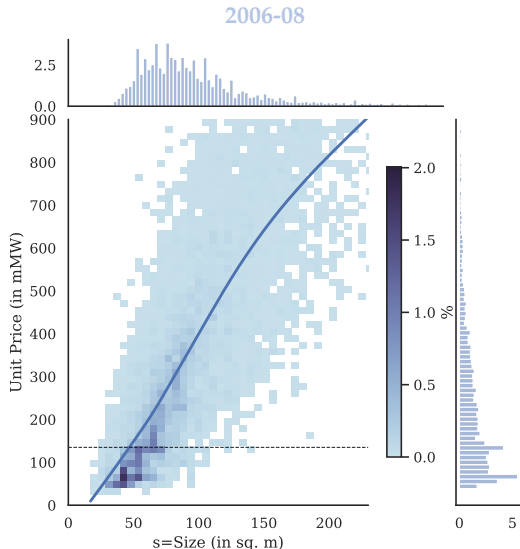
Step II. Structural Parameters

- $V_D \left(\theta | \underline{h}, \bar{h}, P(h), \tau, \tilde{Y}(\bar{h}, \theta, P(h), \lambda) \right) = 0$
- $V_S \left(\beta | \underline{h}, \bar{h}, P(h), \alpha, \delta, \tilde{A}(\bar{h}; \beta, P(h), \lambda) \right) = 0$



STEP I. EQUILIBRIUM CHARACTERIZATION

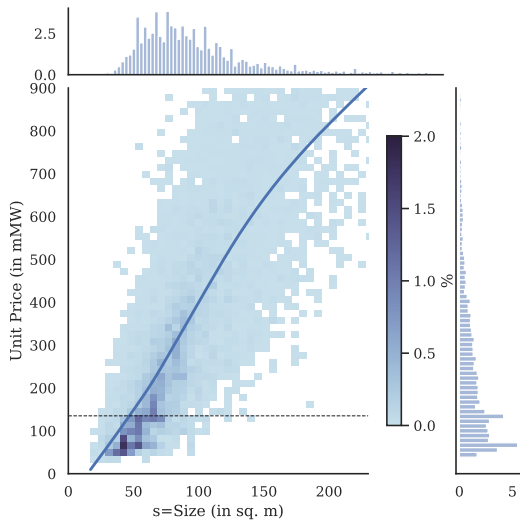
OBSERVED EQUILIBRIUM: PRICES, QUANTITIES, AND SIZE



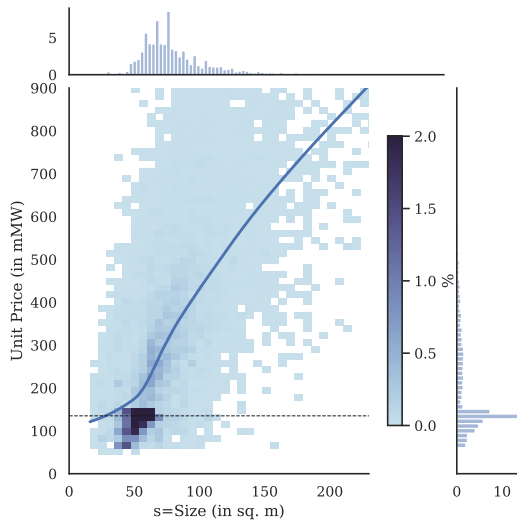
1. Observed Bunching
2. Solid line shows the relationship between size and Prices
→ hedonic price function
3. Multiple characteristics
→ Reduce to a single characteristic

OBSERVED EQUILIBRIUM: PRICES, QUANTITIES, AND SIZE

Only downpayment subsidy
2006-08



Subsidy expansion
2016-18



HEDONIC PRICES AND STANDARDIZED HOUSING UNIT

- Hedonic price/Implicit price for housing size

$$P_{ltc} = \rho(s_{ltc}) + \Gamma'X_{ltc} + \omega_{ltc} \quad (1)$$

l , development, t year, c city

- Standard Unit Size h_{ltc}

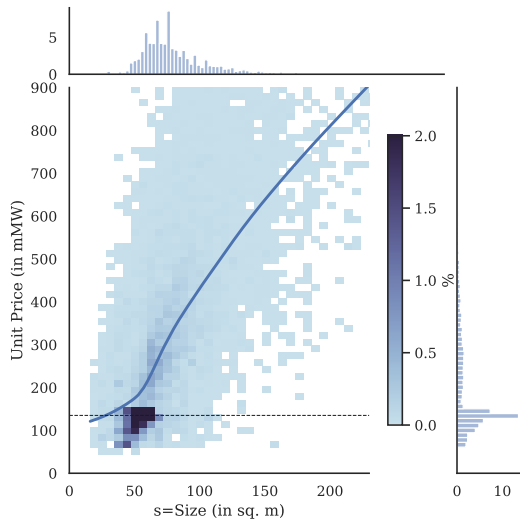
$$\rho(h_{ltc}) + \Gamma'\bar{X} + \bar{\omega} = \rho(s_{ltc}) + \Gamma'X_{ltc} + \omega_{ltc} \quad (2)$$

- Characteristics of the standard house: $\bar{X}, \bar{\omega}$
- Simplifying assumption: $\rho(s_{ltc}) = \rho_1 \cdot s_{ltc} + \rho_2 \cdot s_{ltc}^2$
- Identifying assumption: $E(s_{ltc}|X_{ltc}, \omega_{ltc}) = 0$

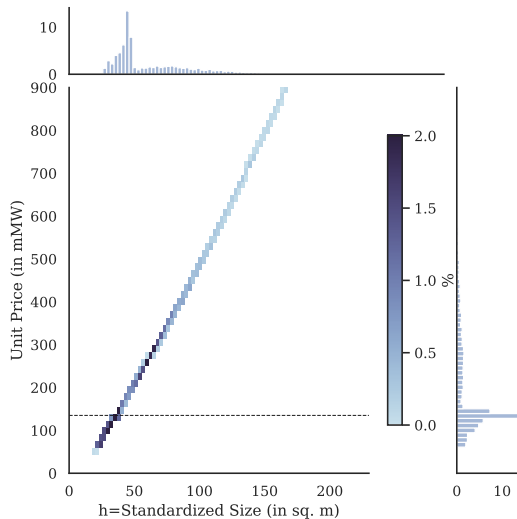
FROM SIZE s TO STANDARDIZED SIZE h

Subsidy expansion 2016-18

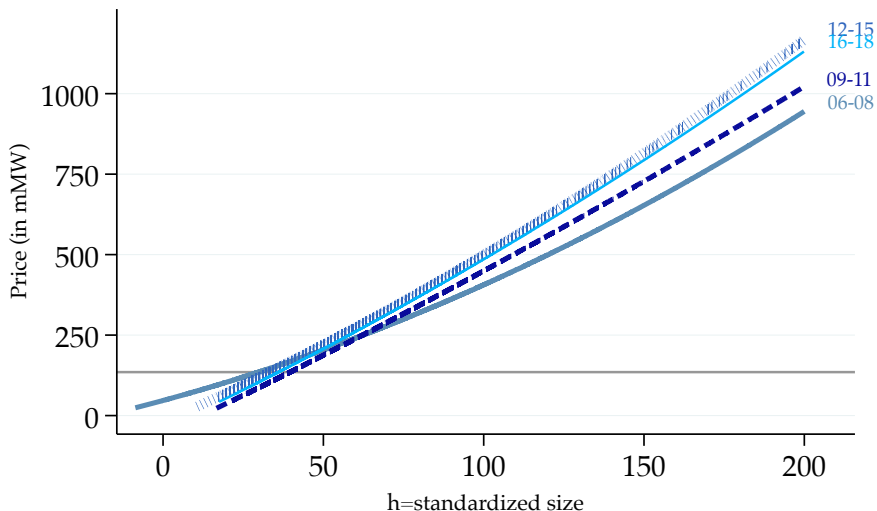
Observed size



Standardized Unit

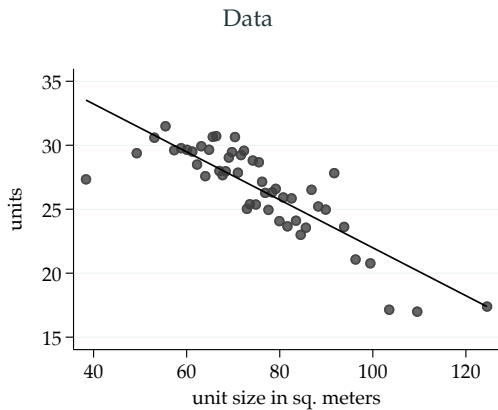


IMPLICIT PRICES FOR HOUSING SIZE OVER TIME



Plotted lines: $P_{ltc} = \hat{\rho}_1 \cdot h_{ltc} + \hat{\rho}_2 \cdot h_{ltc}^2 + \Gamma' \bar{X} + \bar{\omega}$

UNIT SUPPLY FUNCTION



$$Q_{ltc} = \alpha_0 + \alpha_1 s_{ltc} + \alpha'_x X_{ltc} + \epsilon_{ltc}^Q$$

	06-08	09-11	12-15	16-18
α_0	70.5	12.7	81.1	33.3
α_1	-0.068	-0.020	-0.020	-0.042

NOTCHES

► Demand Notch Overtime

	Notch (<i>in mMW</i>)			# Subsidies (<i>in thousand</i>)		
	τ^M	τ^i	τ	<i>down payment</i>	<i>i rate</i>	<i>Mi Casa Ya</i>
2006-2008	18.0	.	18.0	47.1	.	.
2009-2011	20.0	5.85	25.9	46.4	16.7	.
2012-2015	19.9	9.55	29.5	41.1	22.2	.
2016-2018	25.3	7.24	32.6	44.5	23.4	16.8

► Supply Notch: 4 percent

BEHAVIOURAL RESPONSES INDUCED BY THE POLICY

- Recovered by comparing observed and counterfactual distribution

Observed $f_{h^*} \rightarrow$ histogram

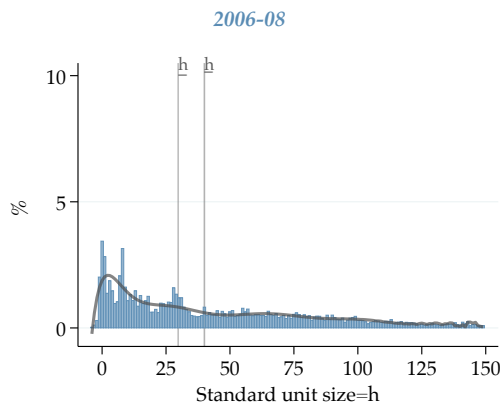
Counterfactual $f_{h_0} \rightarrow$ predicted density excluding observations around the cutoff
(Kleven, 2016)

$$h_b = \sum_{p=0}^T \hat{\iota}_p h_b^p + \sum_{k=L}^H \kappa_k \cdot \mathbb{1} [h_k = h_b] + v_b$$

$$\hat{f}_{h_0} = \hat{l}(h_b) = \sum_{p=0}^T \hat{\iota}_p h_b^p$$

Choice parameters: bin size, bounds for excluded area (L,H) and polynomial degree p

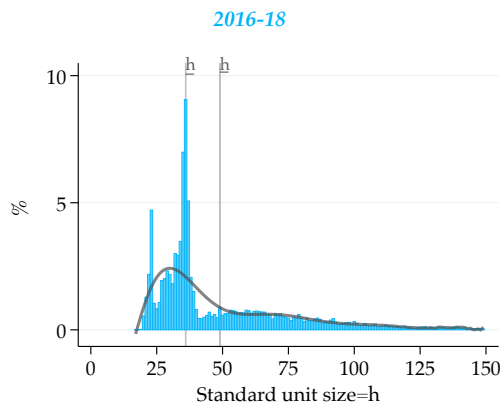
BUNCHING IN HOUSING CHARACTERISTICS (SIZE OF STD. UNIT)



Notch: 19.7 mMW

Bunching: 1.53 % market share

Δh 11.2 m^2



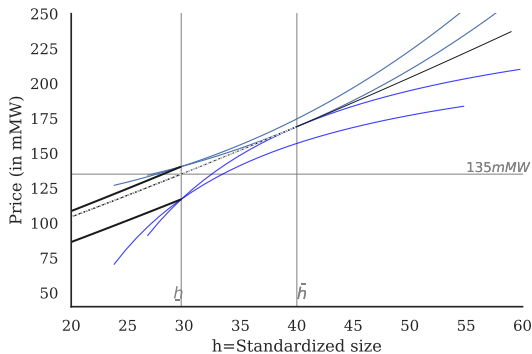
Notch: 33.1 mMW

Bunching: 14.2 % market share

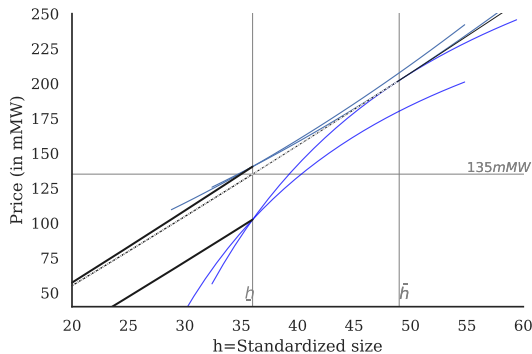
Δh 13 m^2

GRAPHICAL REPRESENTATION OF THE EQUILIBRIUM

2006-08



2016-18



Structural Parameters

	2006-08	2009-11	2012-15	2016-18
β	2.53	1.67	1.77	1.70
σ	0.85	0.97	0.90	0.90

$$\text{Elasticity of Substitution: } \sigma = \frac{1}{1 - \theta}$$

III. Policy Evaluation:

COUNTERFACTUAL POLICY I: PROPOSED TAX REFORM.

- Policy proposal: Remove the tax incentives to developers

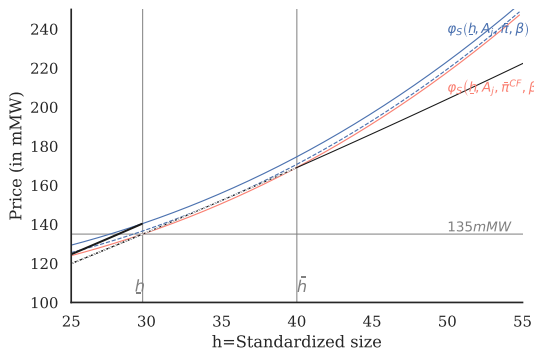
- Developers reaction:

If these items are repealed, in Valle del Cauca we would go from having an offer of SH and sales of 23,000 homes, average year, to one of sales of 4,600 homes El Tiempo (2021)

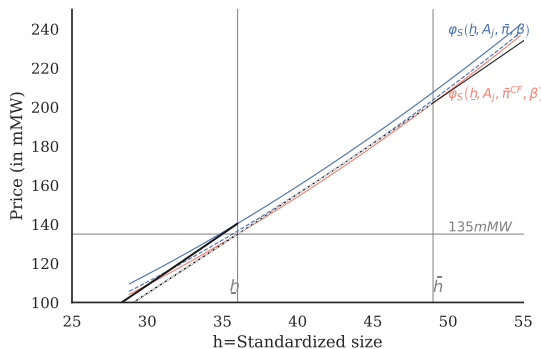
- Question: What happens to the marginally subsidized developers?

EFFECT ON marginALLY SUBSIDIZED DEVELOPERS

2006-08



2016-18



Changes in profits (%)

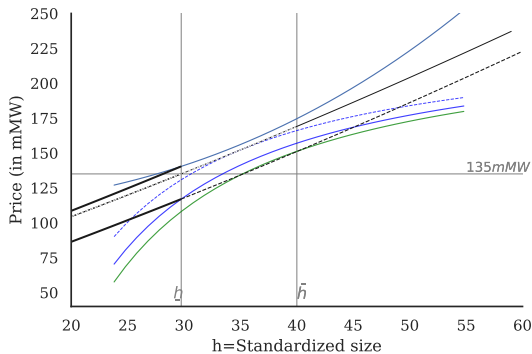
	2006-08	2009-11	2012-15	2016-18
$\frac{\pi - \pi^{PC}}{\pi}$	4.9	15.9	9.3	12.3

COUNTERFACTUAL POLICY II: REMOVE PRICE CUTOFF

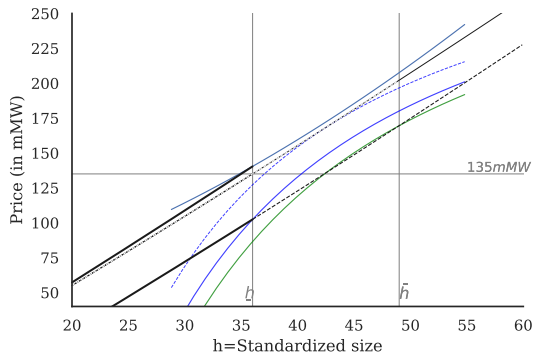
- ▶ Policy change: the same households get the subsidy but they can buy any type of housing.
- ▶ Question: How much better off households are.

EFFECT ON marginally SUBSIDIZED HOUSEHOLDS

2006-08



2016-18



Changes in utility (%)

	2006-08	2009-11	2012-15	2016-18
$\frac{U^{PC} - U}{U}$	2.9	1.9	2.7	2.7
$\frac{U - U^0}{U}$	4.7	3.4	4.5	4.5

CONCLUSION (I): THE PAPER

- ▶ Characterization of the equilibrium.
- ▶ compelling evidence of the market responding to subsidies.
- ▶ An hedonic housing market equilibrium with heterogeneous agents can rationalize the response.
- ▶ Propose a identification strategy to recover the model parameters.
- ▶ Model+estimates \rightarrow Welfare.
- ▶ Policy design matters: need to be careful of how agents respond to incentives.

CONCLUSION (II): GENERALIZATION

- ▶ The method I propose could be used to evaluate housing policy more generally.
- ▶ 2 facts suggest this could be potentially effective.
 1. There is increasing evidence to bunching responses to nonlinear incentives (e.g., help to buy, housing programs in the USA)
 2. Many other sources of non linear incentives in housing markets.

- Abel, J. E., Dey, J., & Coker, T. M. (2017). Productivity and the density of human capital? *Journal of Regional Science*, 52(2), 362–386.

- Angadi, S., Ferreira, P. V. & de Silva, M. (2012, October). *Estimating the economic value of saving options* (Working Paper No. 29482). National Bureau of Economic Research.
- Asanin, D. H., Palmer, J. C. & Palfrey, P. A. (2012). Housing market spillovers: Evidence from the end of rent control in Cambridge, Massachusetts. *Journal of Political Economy*, 120(5), 681-717.
- Bachan, P., & Jahn, M. (2010). *Market power, average tax systems, Corporate location and asset reallocation*. The World Bank.
- Barber, P., & Goodard, C. (2003). Demand estimation with heterogeneous consumers and unobserved product characteristics: A Bayesian approach. *Journal of Political Economy*, 111(2), 1229-1256.
- Bayer, P., Bruehnert, J. C., Kim, K., & Timmerin, C. (2012, May). *A structural exploration approach to evaluate price regressions*. *Journal of Applied Econometrics*, 27(4), 399-426.

- Rosenbloom, N., & Han, S. (2022). The microgeometry of housing supply [Tech. Rep. 1]. [Link](#)
- Rosenbloom, N., & Martin, J. (2020). The effects of low income housing tax credit developments on neighborhoods. *Journal of Public Economics*, 193(1), 452–466. [Link](#)
- Ryan, F., Ferreira, R., & McMillan, K. (2017). A unified framework for measuring preferences for schools and neighborhoods. *Journal of Political Economy*, 125(1), 589–639. [Link](#)
- Stevenson, M., McCallum, B. H., & Noyori, N. (2021). *Relief housing: new evidence*. [Link](#)
- West, M. C., Cramer, J. B., Pivetti, F., & Devere, M. J. (2019, 10). *Redistribution and the economics of homelessness*. [Link](#)

- Reid, M. C., & Kilian, B. J. (2017, 96). Housing Market Responses to Transaction Taxes: Evidence From the U.S. *The Review of Economic Studies*, 83(3), 187-215. [Link](#)

- Bhagwati, R., Naray, W. K., Kumar, A. & Liang, C.-Y. (2017, December). On-bunching and identification of the taxable income elasticity (Working Paper No. 22336). National Bureau of Economic Research, Inc.
- Bhagwati, R., Naray, W. K., Kumar, A., & Liang, C.-Y. (2021). On-bunching and identification of the taxable income elasticity. *Journal of Political Economy*, 129(9), 2000–2050.
- Brown, J. N., & Rosen, H. S. (1982). On the estimation of structural household price models. *Econometrica*, 50(3), 759–768. [Web](#).
- Camacho, A., Capoen, J., & Sanchez, J. (2020). *Un nuevo consenso: impacto de la pandemia económica global sobre las condiciones de vida de los hogares hispanos* (Tech. Rep.).
- Casman, (2014). *Actividad reducida y capacidad reducida* (Tech. Rep.). [Web](#). (Accessed 2021-01-10).

- Cassari, F., Hülten, C., & Yu, X. (2016). On the economic impact of mortgage credit expansion policies: Evidence from Italy's JCRP. Discussion Paper No. 16022. [Link](#)
- Congia, D., Dube, A., Lindane, A., & Zippner, B. (2018, 05). The Effect of Minimum Wages on Low-Wage Jobs*: The Quarterly Journal of Economics, 133(2), 1405–1424. [Link](#)
- Chay, K. Y., & Gyourko, M. (2005). Does air quality matter? evidence from the housing market. *Journal of Political Economy*, 113(2), 376–400. [Link](#)

- Chen, X., Liu, Z., *Business Services*, J. C., & Yu, D. Y. (2021, July). Nothing of investment with corporate income tax cuts in china. *American Economic Review*, 113(7), 2080-2100. [Link](#)

- Charley E. Feinsmidt, J. N. Chou, & Prakash L. (2011, 20). *Admission Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Chinese Tax Records*. *The Quarterly Journal of Economics*, 126(2), 729-804. [Link](#)
- Charley E. Feinsmidt, J. N. & Nare, E. (2013, December). *Using differences in knowledge across neighborhoods to uncover the impacts of the site on earnings*. *American Economic Review*, 103(7), 2683-2701. [Link](#)
- Colles, M., Carrington, M., & Calum, M. (2010, 19). *Urban labor in Latin America: Towards the sustainable development goal?* *Geography*, Colles, M., & Carrington, P. (2010, May). *How do changes in housing tenure choice affect cost and neighborhood quality?* *American Economic Journal: Economic Policy*, 1(2), 62-89. [Link](#)
- DeFusco, A. A., & Dietersch, A. (2017, February). *The interest rate elasticity of mortgage demand: Evidence from bundling at the*

- Diwanee, R., McQuade, T., & Qian, F. (2019, September). The effects of test-union corporations on brains, landfills, and inequality: Evidence from San Francisco. *American Economic Review*, 109(9), 3805–94. [Link](#)
- Finke, L., Fudenberg, A., & Schmeidler, F. (2013, Oct). The Response of Drug Expenditure in Nonlinear Contract Design: Evidence from Medicare Part D. *The Quarterly Journal of Economics*, 128(3), 841–898. [Link](#)
- Harford, J. (2010, Oct). Evidence, uniqueness and efficiency of equilibrium in hedonic markets with multidimensional types. *Economic Theory*, 43(2), 279–315. [Link](#) (Copyright : Springer-Verlag 2010, Document Instance :) Equilibria; Last updated : 2020-02-04

- Thurland, I., Hoxby, C. J., & Noyelle, L. (2002). Identification and estimation of hedonic models. *Journal of Political Economy*, 110(3), 560-578. [Link](#)
- Yipke, D. (1987). Hedonic prices and implicit markets: Estimating demand and supply functions for differentiated products. *Journal of Political Economy*, 95(1), 89-101. [Link](#)
- Yipke, D., Quigley, L., & Hagg, H. (2002). A new approach to estimating equilibrium models for metropolitan housing markets. *Journal of Political Economy*, 110(3), 548-583. [Link](#)
- Franklin, B. (2019). *The demand for government housing: Evidence from Latvia for 200,000 homes in cities*. [Link](#) (Library Catalog: www.demand.lv)

- Galbraith, B., Murphy, A., & Fatas, M. (2007, November). Evaluating neighborhood-choice models: Lessons from a housing assistance experiment. *American Economic Review*, 97(10), 3380-3410. [Link](#)
- Cryer, P. (2012). Housing demand and neighborhood choice with housing vouchers. *Journal of Urban Economics*, 95, 26-62. [Link](#)
- Gilbert, A. (2014, June). Housing policy in Colombia. [Link](#). [Library Catalog: www.ingenta.com/Products/382-294/Publisher-Emailings]
- Gilbert, A., & G. (2016). Free housing for the poor: An effective way to address poverty? *Habitat International*, 41, 283-290. [Link](#)
- Chambers, E., & Shapiro, J. M. (2007). The benefits of the home mortgage interest deduction. *The Policy and the Economy*, 37, 37-62. [Link](#)

- Cheney E. L., & LaTourne, F. F. (2020, September). The utilization of branding under rent control. *American Economic Review*, 110(9), 1627-1636. [Link](#)
- Coiffé, L. (2021). *Transfer Effects in Reaching Decisions: The Impact of the Federal Christmas Cuts on Households*. (Rep.).
- Concannon, P., & Mehta, S. (2021). A few bad apples? social bias in pricing. *American Economic Review*. [Link](#)
- Correia, M. (2017). The consumer impact of short-term rental: Housing prices and implicit markets. *Product differentiation in peer-to-peer sharing*. *Journal of Urban Economics*, 120(9), 580-592. [Link](#)
- Gruber, J., Jensen, A., & Klevorick, H. (2021, May). The people exposed to the mortgage interest deduction? quasi-experimental

- Marinova, P., & Lindson, A. (2017, August). Who pays for the minimum wage? *American Economic Review*, 107(8), 2695-2727. [link](#)
- Wachman, J. J., Malinin, K. S., & Niehsen, L. (2010). Nonparametric identification and estimation of nonadditive hedonic models. *Econometrica*, 78(5), 1589-1595. [link](#)
- Jalan, H. (2014). Estimating the effects of the minimum wage in a developing country: A density discontinuity design approach. *Journal of Applied Econometrics*, 29(1), 29-51. [link](#)
- Kleven, H. J. (2016). Bunching. *Annual Review of Economics*, 6(1), 439-464. [link](#)

- Chivers, H. J., & Haneson, M. (2014a). Using Networks to Uncover Offshoring Patterns and Structural Heterogeneities: Theory and Evidence from Pakistan *. *The Quarterly Journal of Economics*, 129(2), 649-723. [Link](#)
- Kopynski, W., & Shorroch, T. (2010, May). Migration: The effect of transfer taxes on the residential real estate market. *American Economic Review*, *Economic Policy*, 7(2), 214-97. [Link](#)
- Kumar, T. (2021). The housing quality, income, and human capital effects of a suburbanized home in urban India. *Journal of Development Economics*, 153, 102738. [Link](#)
- Kuminoff, N. V., Smith, V. K., & Timmins, C. (2013, December). The new economics of equilibrium sorting and policy evaluation using housing valuations. *Journal of Environmental Economics*, 10(4), 1387-62. [Link](#)

- McMillen, D., & Singh, K. (2020). The market rent and the distribution of rents in Los Angeles. *REI*, 103397. [Link](#)
- OECD. (2021). *Phil 2 housing policy objectives and indicators* (Working Paper). [Link](#)
- Palmquist, R. E. (2008). Property value models. In K. G. Miller & J. E. Viscusi (Eds.), *Handbook of environmental economics* (Vol. 3, Vol. 3, pp. 769-819). Elsevier Inc.
- Preussner, F. (2020). *Social insurance and the mortgage market*. *Journal of Political Economy*, 128(1), 292-306. [Link](#)
- Poterba, J. M. (1992). Taxation and housing: *Key questions, new answers*. *The American Economic Review*, 82(2), 237-242. [Link](#)
- Quigley, J. M. (1992). Nonlinear budget constraints and consumer demand: An application to public programs for residential housing. *Journal of Urban Economics*, 32(2), 177-201. [Link](#)

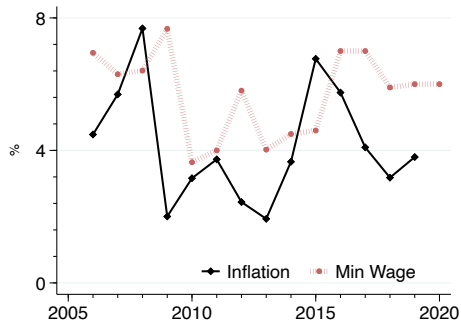
- Enom, H. S. (1988). Chapter 7 housing subsidies: Effects on housing decisions, efficiency, and equity. In (Ed. 1, p. 379–420). Elsevier. [Link](#)
- Enom, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy*, 82(3), 54–65. [Link](#)
- Hare, F. (2010). The language/benefit at risk puzzle? *American economic journal economic policy*, 2(3), 180–212.
- Hare, A. (2010). The geographic determinants of housing supply? *The Quarterly Journal of Economics*, 125(3), 1253–1296. [Link](#)
- Hare, T., & Waldoff, J. (2009). Do low-income housing subsidies increase the accepted housing stock? *Journal of Public Economics*, 93(11), 2127–2144. [Link](#)

- Wolman, J., Voth, C., & Wian, H. (2017). The behavioral response to housing transfer taxes: Evidence from a matched change in tax policy. *Journal of Urban Economics*, 100, 127–153. [Link](#)
- Yulish, E. (2010). The price of inclusion: Evidence from housing desegregation behavior. [Link](#) [Library Catalog: www.dunham.com]
- Yulish, J. (2013). *The effect of location based subsidies on the housing market*. [Link](#)
- van Zuijlen, M. (2016). *The socio-economic consequences of housing assistance*. University of Chicago Kenneth C. Griffin Department of Economics, web.mst.edu/papers/0-40/0-40-16-01.pdf.
- Woolridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.
- World Bank. (2016). *Urbanization: Addressing the challenges of rapid growth*. www.worldbank.org/urban. [Link](#)

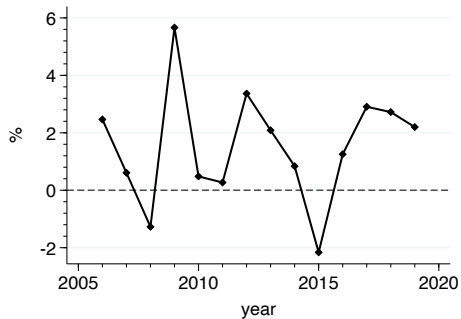
- Yingos, J. (2015). Historic markets and sorting equilibria: Bid function envelopes for public services and neighbourhood amenities. *Journal of Urban Economics*, 80, 4–20. [link](#)

Appendix

Inflation and minimum wages.



a. Min wage and Inflation



b. Min wage and Inflation

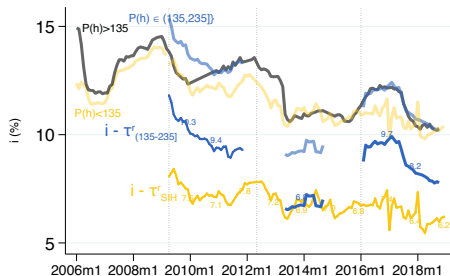
Data

DATA: MORTGAGES AND INTEREST RATES

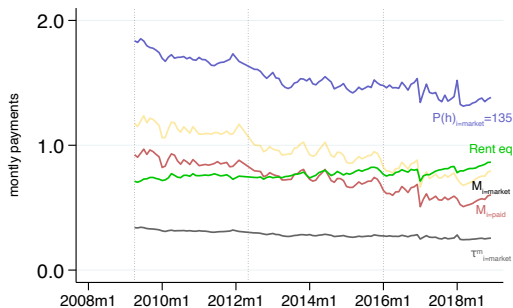
rent equivalent ((?, ?), (Bishop & Timmins, 2019) assume it is 0.05)

- Size of the mortgages and interest rate.
- Identifier for SIH.

Market interest rate i and subsidy τ^r



Monthly payments and monthly equivalent for relevant values. $P(h) < 135$

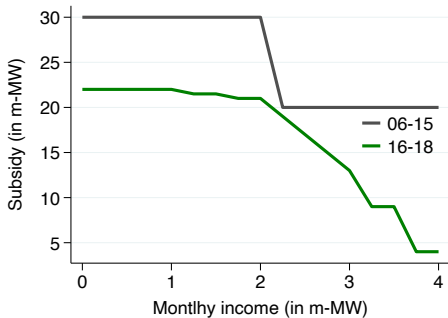


- To convert the magnitudes into monthly payments I use:

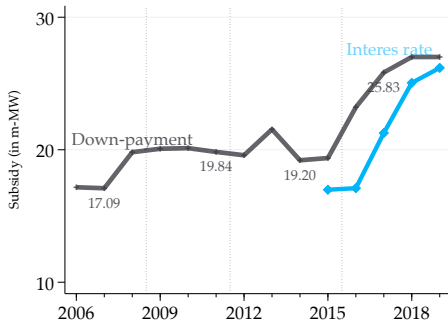
$$X_{\text{monthly}} = X \cdot \kappa(i, n); \kappa(i, n) = \frac{\frac{i}{12} \cdot \left(1 + \frac{i}{12}\right)^{12 \cdot n}}{\left(1 + \frac{i}{12}\right)^{n \cdot 12} - 1}$$

THE NOTCH: DOWN PAYMENT SUBSIDY

Subsidy by household income

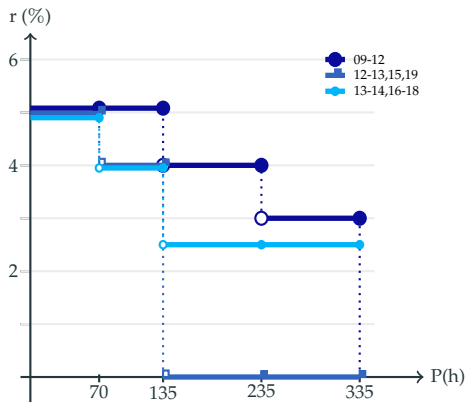


Average subsidy over time

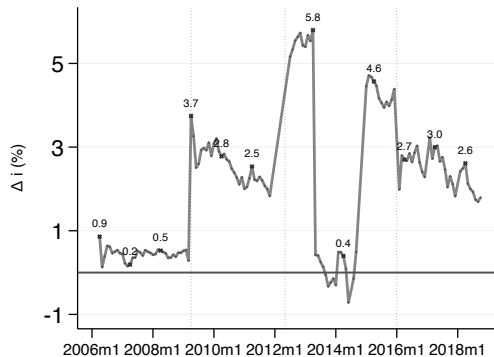


- Varies by income.
- Increase in 2016.
- Expanded trough *mi casa* YA

THE NOTCH: INTEREST RATE SUBSIDY



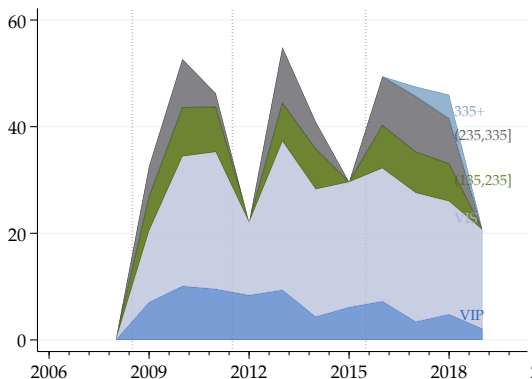
Comparing monthly payments around $P(h)=135$ m-MW



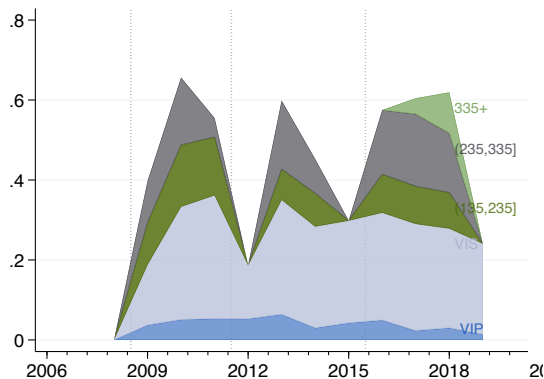
SUBSIDIES AND GOVERNMENT EXPENDITURE (VIP- $P(h) < 70$)

This figure shows interest rate subsidies to all the different price levels

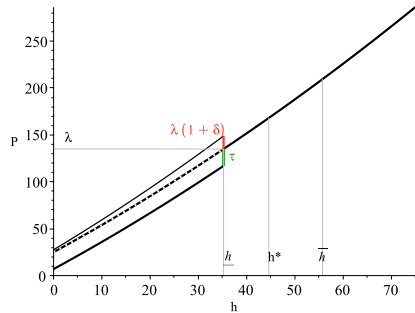
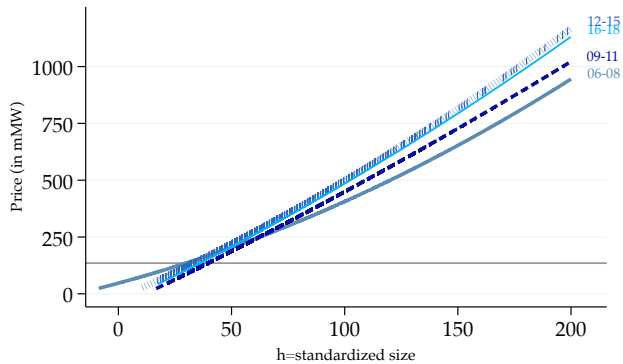
a. Total # of subsidies



b. Total amount of subsidies



PRICES



back

THE POLICY EFFECT ON OBSERVED OUTCOMES

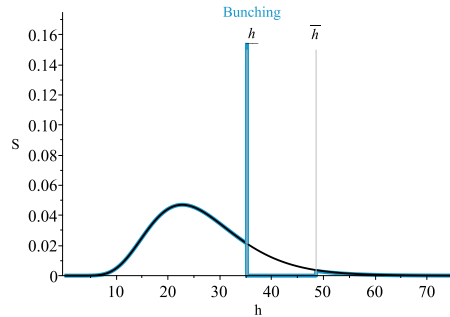
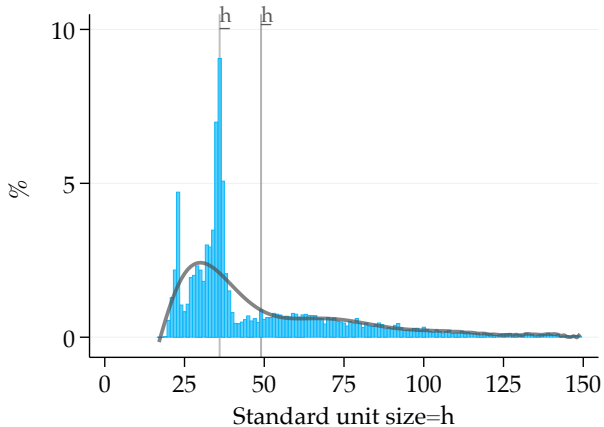
Table 1: Behavioral Responses Estimates'

	06-08	09-11	12-15	16-18
$\int_{h_{min}}^{\underline{h}} T(h)dh$	1.03	0.86	3.83	7.28
$\hat{T}(\underline{h})$	0.50	2.02	4.02	6.97
$\int_{h_{min}}^{\underline{h}} T(h)dh$	1.53	2.88	7.85	14.2
$\int_{\underline{h}}^{\bar{h}} T(h)dh$	-0.096	-6.25	-4.13	-3.42
$h_{h^0}(\underline{h})$	0.72	1.28	1.06	1.44
h_{min}	26	37	29	32
\underline{h}	29.8	39.4	33.0	36.0
\bar{h}	40	53	45	49

back

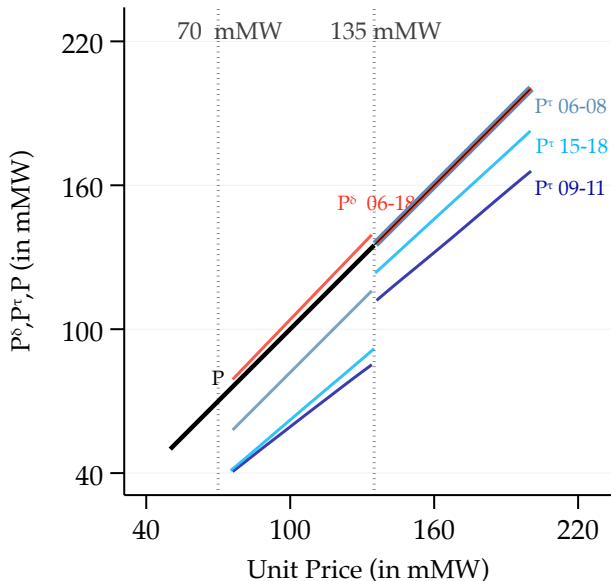
BEHAVIORAL RESPONSES

2016-18



[back](#)

THE DEMAND NOTCH INCREASES OVER TIME



Supply Notch δ

2006-18 4%

Demand Notch τ_t

2006-08: 19.7 mMW

2009-11: 26.4 mMW

2016-18: 33.1 mMW

2012-15 Too many changes and
free housing at 70mMW

ALTERNATIVE REPRESENTATION OF THE EQUILIBRIUM.

DEMAND AND SUPPLY FOR SIZE

