Taxing Property in Developing Countries: Theory and Evidence from Mexico

Anne Brockmeyer
World Bank

Karina Ramírez
Secretaría de Hacienda

Alejandro Estefan
University of Notre Dame

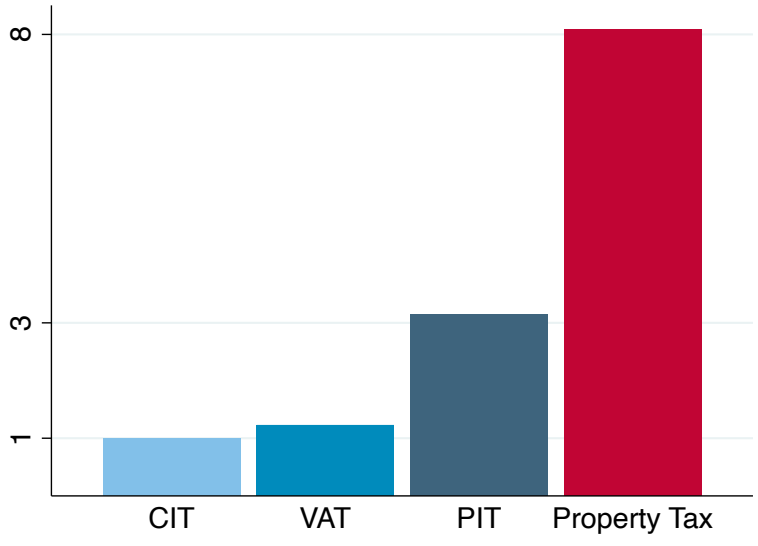
Juan Carlos Suárez Serrato
Duke University & NBER

NBER Summer Institute, June 21, 2020

Why Don't Governments Rely More on Property Taxes?

- **Property taxes are an attractive source of revenue for local governments**
  - Tool for redistribution in context where income tax compliance is weak
  - Tax base observable and immobile in short-term
- **Yet property tax revenues in developing countries are low**

Ratio of Tax Revenue to GDP in High vs Low Income Countries



Why Don't Governments Rely More on Property Taxes?

- **Property taxes are an attractive source of revenue for local governments**
  - Tool for redistribution in context where income tax compliance is weak
  - Tax base observable and immobile in short-term
- **Yet property tax revenues in developing countries are low**

Why Don't Governments Rely More on Property Taxes?

- **Property taxes are an attractive source of revenue for local governments**
  - Tool for redistribution in context where income tax compliance is weak
  - Tax base observable and immobile in short-term
- **Yet property tax revenues in developing countries are low**
  - Weak administrative capacity

Why Don't Governments Rely More on Property Taxes?

- **Property taxes are an attractive source of revenue for local governments**
  - Tool for redistribution in context where income tax compliance is weak
  - Tax base observable and immobile in short-term
- **Yet property tax revenues in developing countries are low**
  - Weak administrative capacity
  - Household liquidity and credit constraints

Research Question

How to optimally raise property taxes
in a context of weak capacity and liquidity constraints?

Research Question

How to optimally raise property taxes
in a context of weak capacity and liquidity constraints?

Combine approaches from public finance and development literature

- **Tax systems perspective** (Slemrod and Gillitzer 2013)
- **Economists as plumbers** (Duflo 2017)

This Paper

This Paper

- **Model optimal property taxation** with limited admin capacity and liquidity constraints, based on Keen & Slemrod (2017)

This Paper

- **Model optimal property taxation** with limited admin capacity and liquidity constraints, based on Keen & Slemrod (2017)
- Estimate **revenue** effects of tax rates and enforcement:
  1. **Tax rates:** variation over time and across value bands [RD, DiD]
  2. **Enforcement:** letters to delinquent taxpayers [experiment]

This Paper

- **Model optimal property taxation** with limited admin capacity and liquidity constraints, based on Keen & Slemrod (2017)
- Estimate **revenue** effects of tax rates and enforcement:
  1. **Tax rates:** variation over time and across value bands [RD, DiD]
  2. **Enforcement:** letters to delinquent taxpayers [experiment]
- Examine the role of **liquidity constraints** in shaping taxpayer behavior:
  1. **Tax payment modality** [descriptive regression kink]
  2. **Early bird discounts** & payment timing [bunching, dynamic discrete choice]
  3. **Consumption** response to tax change [IV]

This Paper

- **Model optimal property taxation** with limited admin capacity and liquidity constraints, based on Keen & Slemrod (2017)
- Estimate **revenue** effects of tax rates and enforcement:
  1. **Tax rates:** variation over time and across value bands [RD, DiD]
  2. **Enforcement:** letters to delinquent taxpayers [experiment]
- Examine the role of **liquidity constraints** in shaping taxpayer behavior:
  1. **Tax payment modality** [descriptive regression kink]
  2. **Early bird discounts** & payment timing [bunching, dynamic discrete choice]
  3. **Consumption** response to tax change [IV]
- Analyze **optimal policy**, informed by model and estimates

Empirical Findings

1. **Administrative capacity constraints do not explain under-utilization**
   - Tax rate increases lower compliance but raise revenue
   - Enforcement increases compliance and revenue

2. **Liquidity constraints increase welfare cost of property taxes**
   - Consumption falls when property tax payments increase quasi-exogenously
   - Tax increases lead more taxpayers to pay late or in installments
   - Timing response to discounts imply a high value for liquidity

Policy Implications

1. **Model shows how liquidity constraints impact optimal tax system**
   - Policy instruments: tax rates, enforcement, liquidity provision
   - Sufficient statistics: tax rate, enforcement, consumption elasticities
2. **Liquidity constraints lead to lower tax rates**
   - Gov't can set higher tax rates by easing liquidity constraints
   - Despite liquidity constraints, current tax rates are below optimal
3. **Private costs limit welfare gains from enforcement**
   - Despite 40% delinquency rate, compliance is close to optimal
   - Larger scope for raising welfare through tax increases

Model

Model Setup

- **Households**
  - Live two periods, consume private good from income and save
  - They also consume a government-provided public good
- **Government**
  - Finance public good by taxing property
  - Set level of enforcement to collect taxes

Model Setup

- **Households**
  - Live two periods, consume private good from income and save
  - They also consume a government-provided public good
- **Government**
  - Finance public good by taxing property
  - Set level of enforcement to collect taxes
- **Key Features**
  - **Liquidity-constrained households** would like to borrow but cannot
  - **Delinquency** depends on private cost of enforcement and depreciation of housing value

Optimal Tax Rate

- Welfare impact of increasing t to provide public goods g:

$$MVPF_t = \underbrace{\frac{v'(g)}{u'(c)}}_{\text{Value of Public Goods}} - \underbrace{\frac{1-\gamma\Delta c^{\text{Pay}}}{1+(1-\tilde{z})\varepsilon_t^{\text{Pay}}}}_{\text{Welfare Cost Per Dollar of Revenue}}$$

where :

$\varepsilon_t^{\text{Pay}}$	:	Tax elasticity of compliance
Δc^{Pay}	:	Effect of taxes on consumption
γ	:	Coefficient of relative risk aversion
$\tilde{z}$	:	Tax debt gov't collects in future

- Optimal tax found by setting $MVPF_t = 0$

Optimal Compliance Rate

- Welfare impact of increasing enforcement α to provide public goods g:

$$MVPF_\alpha = \underbrace{\frac{v'(g)}{\frac{\partial m(\alpha)}{\partial \alpha}}}_{\text{Relative Welfare Cost of Enforcement}} - \underbrace{\frac{1 - N^{\text{Pay}}}{(1-\tilde{z})N^{\text{Pay}}\frac{\varepsilon_\alpha^{\text{Pay}} Ht}{\alpha} - 1}}_{\text{Welfare Cost Per Dollar of Revenue}}$$

where :

$\varepsilon_\alpha^{\text{Pay}} \frac{Ht}{\alpha}$	:	Net revenue from enforcement
N^{Pay}	:	Compliance share
$\tilde{z}$	:	Tax debt gov't collects in future
$-\frac{\partial m(\alpha)}{\partial \alpha}$	:	Welfare cost of enforcement

Liquidity

- To decide whether to increase enforcement or taxes, gov't compares $MVPF_\alpha$ and $MVPF_t$
- $MVPF_t$ depends on consumption changes, $MVPF_\alpha$ does not
- Providing liquidity increases $MVPF_t$, increasing welfare and reducing the relative value of enforcement

Liquidity

- To decide whether to increase enforcement or taxes, gov't compares $MVPF_\alpha$ and $MVPF_t$
- $MVPF_t$ depends on consumption changes, $MVPF_\alpha$ does not
- Providing liquidity increases $MVPF_t$, increasing welfare and reducing the relative value of enforcement

Sufficient statistics needed to implement the model: $\varepsilon_t^{\text{Pay}}$, $\varepsilon_\alpha^{\text{Pay}} \frac{Ht}{\alpha}$, Δc^{Pay}

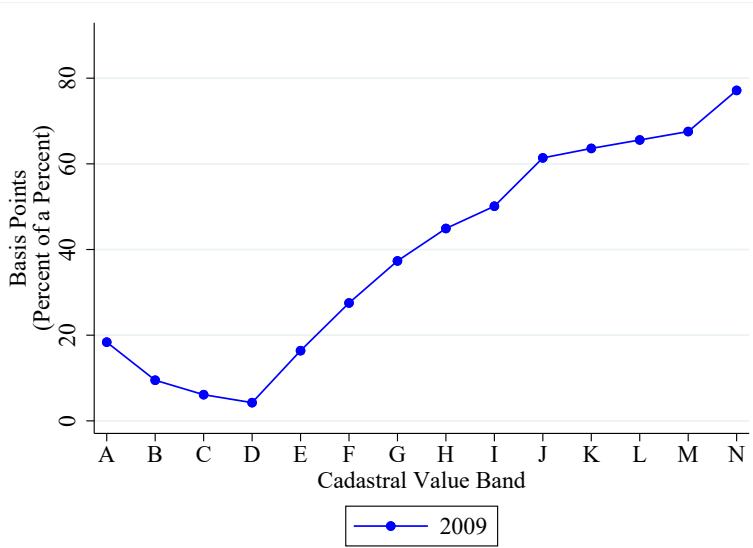
Property Taxation in Mexico City

Property Taxation in Mexico City

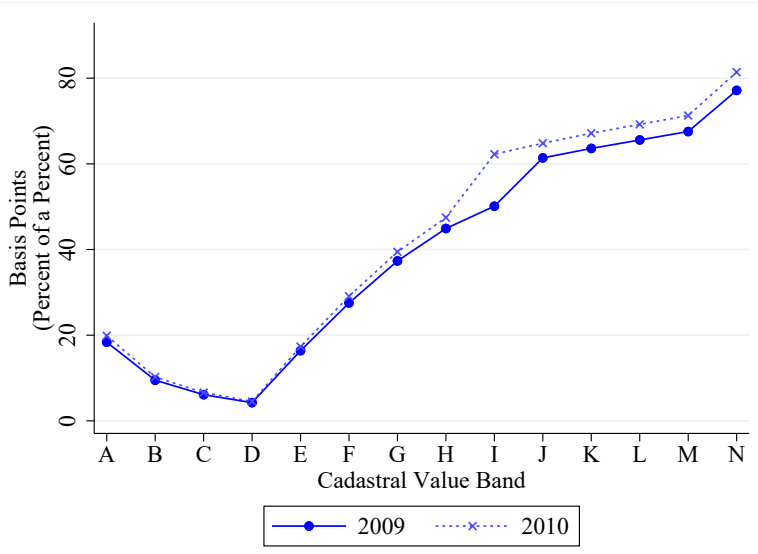
- Mexico City is a useful laboratory:
  - 80% of people do not have a credit card
  - 40% of taxpayers are delinquent
  - Second largest city in the Western Hemisphere
- **Tax base** depends on plot size, property characteristics, (approximated) market values - constant over time! ▸ Property Value Determination
- **Tax rates** change over time

- **Liability** $=$ (lump-sum $+ \tau \cdot$*value*$) \cdot (1 -$ *abatement*$)$

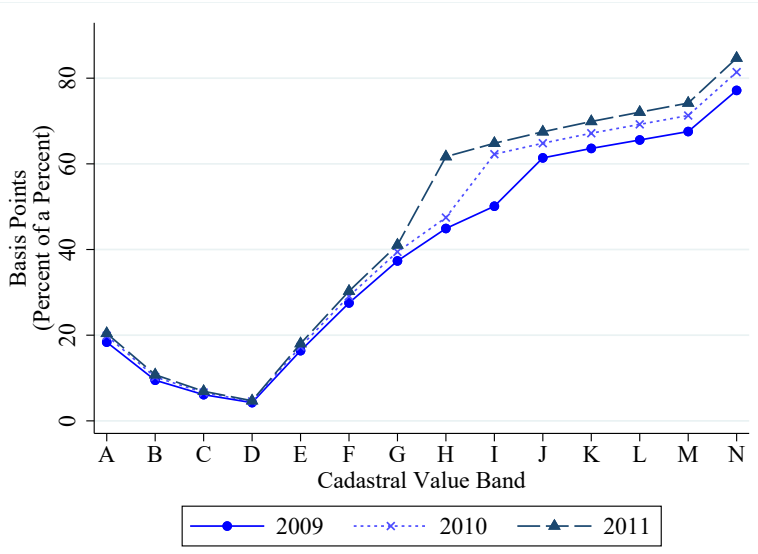
Tax Rates Vary Over Time



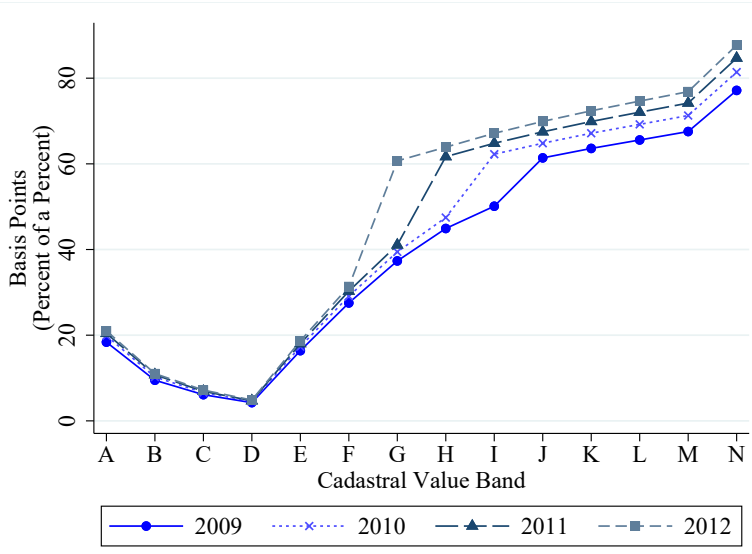
Tax Rates Vary Over Time



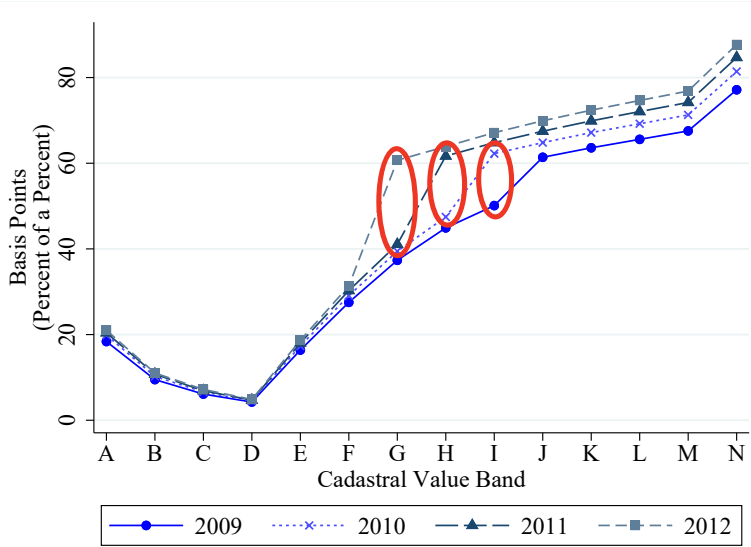
Tax Rates Vary Over Time



Tax Rates Vary Over Time



Tax Rates Vary Over Time



Administrative Tax Data

- Universe of residential properties in CDMX: 2008–2013
  - Tax ID, zip, area, characteristics, value
  - Data on bills (liability, date, due date)
  - Data on payments (amount, date, penalties, adjustments)
- Study a balanced panel of properties and focus on:
  - Payment amount (current MXN $000's)
  - Compliance share = payment / gross liability

▸ Property characteristics ▸ Payment behavior ▸ Compliance behavior ▸ Tax vs income amount

Do Tax Rate Increases Raise Revenue?

Regression Discontinuity in Differences

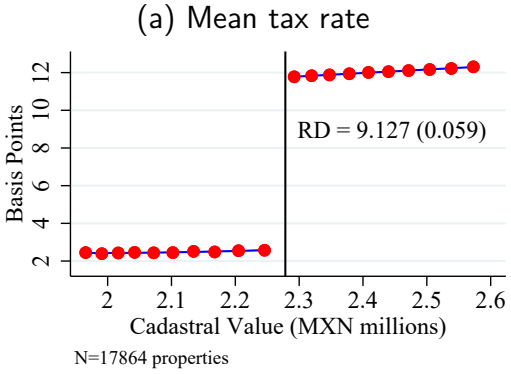
- Estimate year-on-year changes in tax compliance outcomes as:

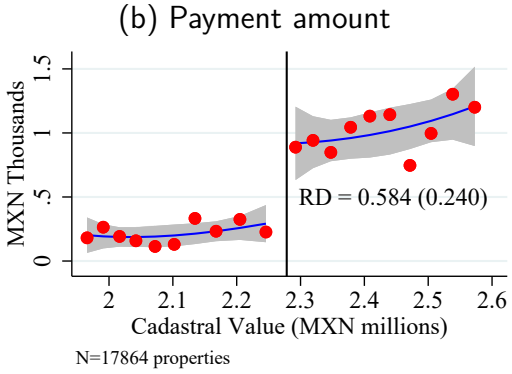
$$\Delta Y_{i,t} = \alpha + \beta T_i + f(\hat{V}_i) + g(\hat{V}_i) T_i + \epsilon_{i,t},$$

where:

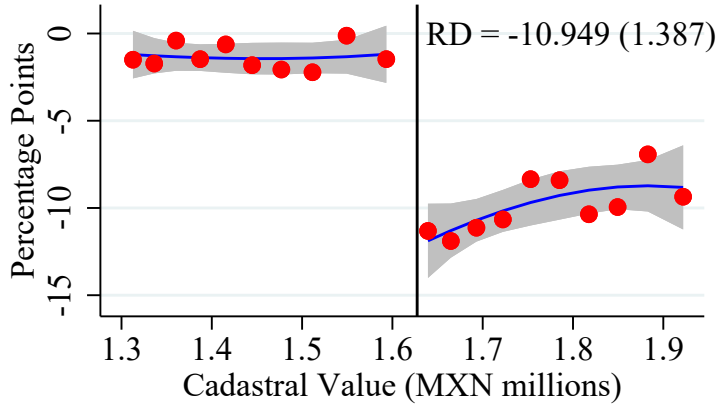
- $\hat{V}_i = V_i - V_-$:distance in value to lower limit of the treated band
- $T_{i,t}$: dummy indicating property is in the treated band
- f and g are continuously differentiable functions

Tax Increases Raise Revenue in Short-Term



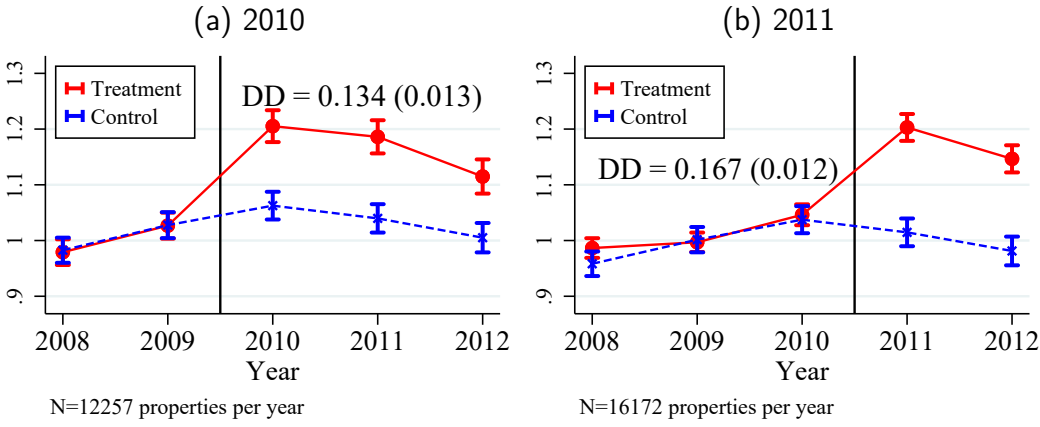


Revenue Increases Despite Fall in Compliance



- Robust to using local-linear regression, optimal bandwidth, diff-in-disc
- ▸ McCrary Test ▸ No Discontinuity in Other Vars

Medium-Term Responses to Taxes: Difference-in-Differences

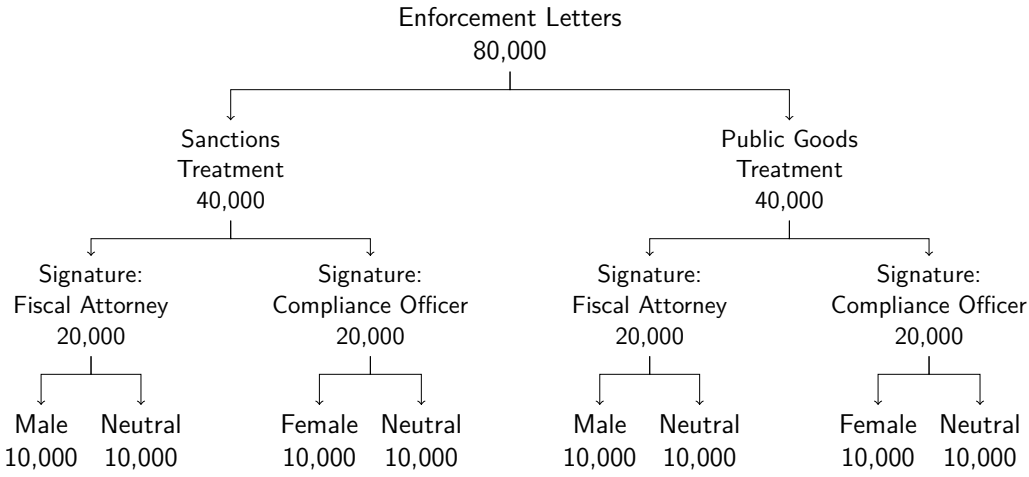


Notes: Outcomes are normalized to their pre-treatment mean.

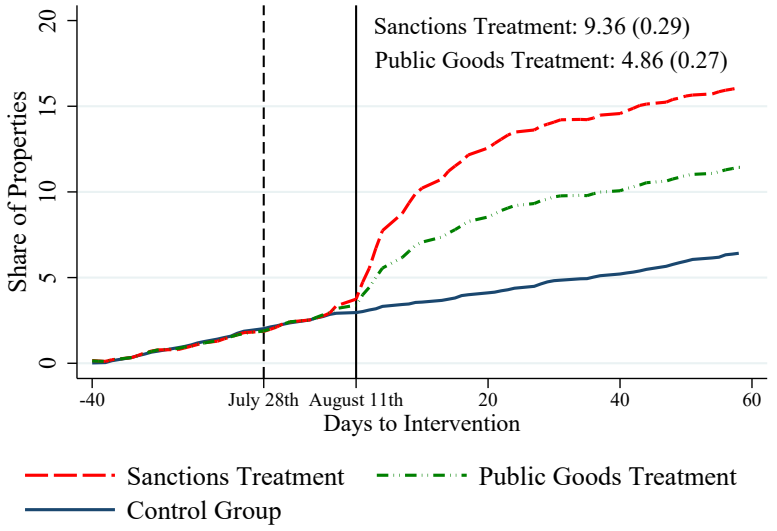
- Revenue effects persist, current tax rates <<< Laffer rate (▸ No Real Response)

Does Enforcement Raise Revenue?

Experiment Design



Enforcement Letters Increase Compliance



Low Administrative Capacity Does Not Explain Under-Utilization

- Both tax rates and enforcement raise revenue
  - Reforms are substantial and follow enforcement practices
- Lack of administrative capacity cannot explain under-utilization
- But liquidity constraints can increase welfare cost of property taxes

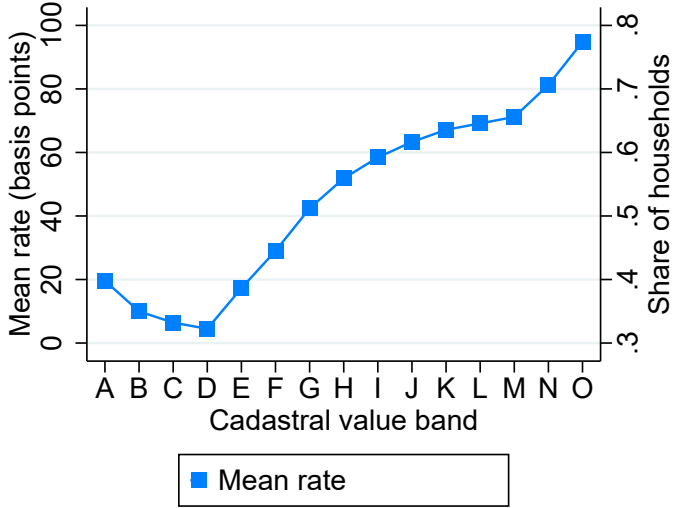
Do Liquidity Constraints Affect Tax Compliance?

Three Pieces of Evidence for Liquidity Constraints

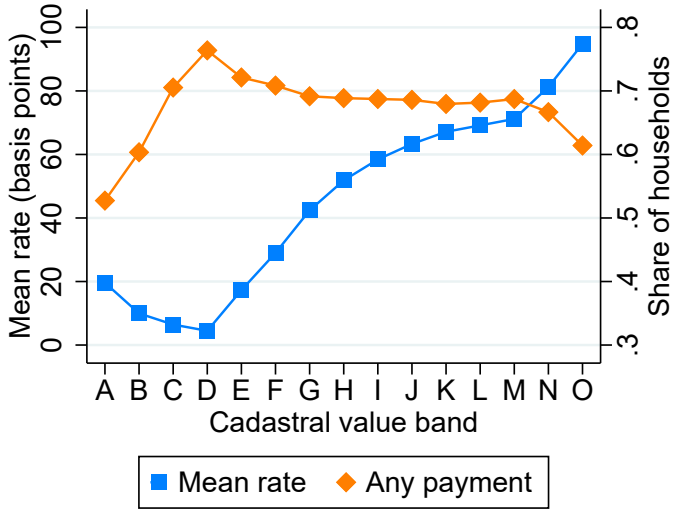
1. **Payment modality** responds to tax rates ▸ Regression Kink ▸ DiD
2. **Payment timing** responds to early-bird discounts ▸ Bunching
3. **Consumption** responds to tax payment shocks ▸ IV

▸ PA

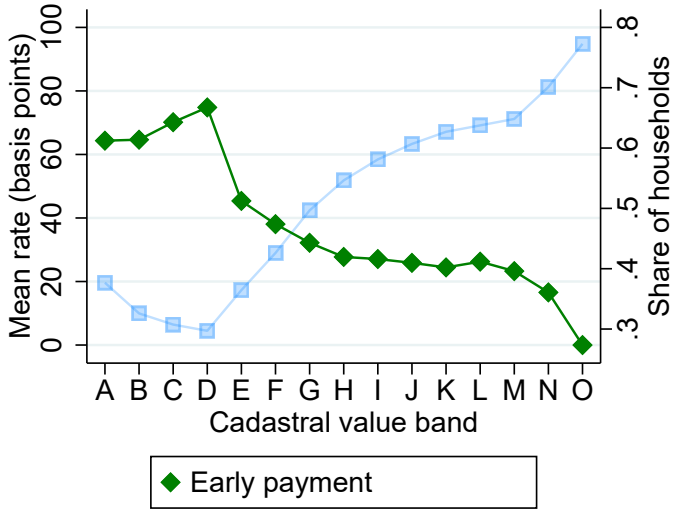
Tax Rate Schedule



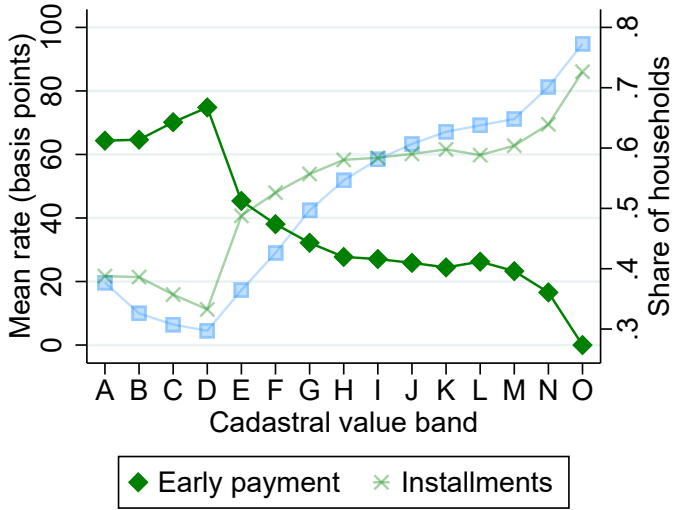
Tax Rates and Payment



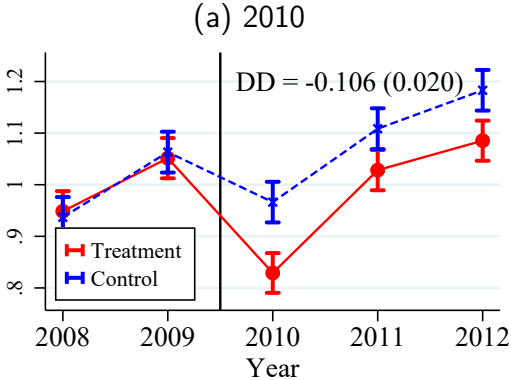
Tax Rates and Payment Modality



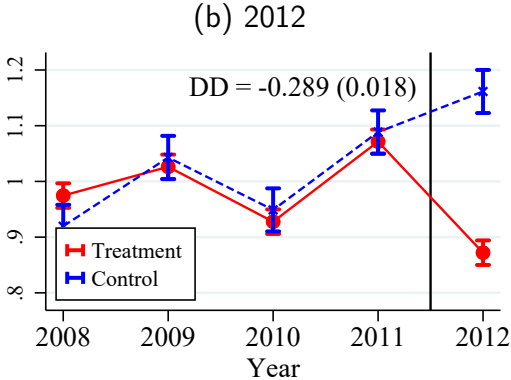
Tax Rates and Payment Modality



Tax Rate Effect on Early Payment: Difference-in-Differences



N=5345 properties per year

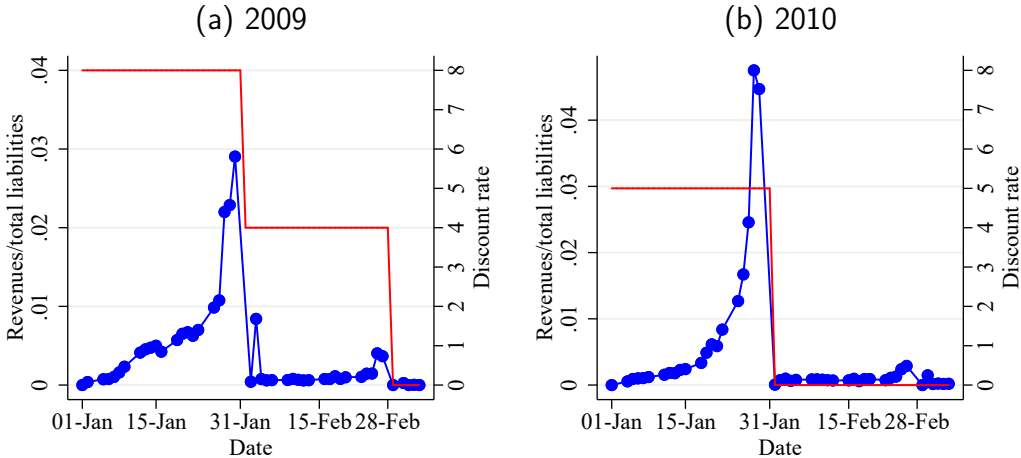


N=9393 properties per year

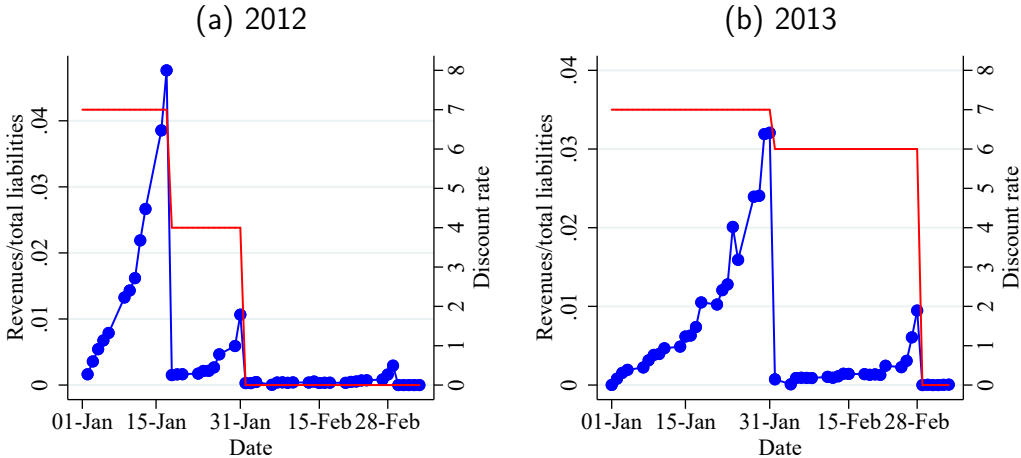
Back

Payment Timing

Bunching Responses to Time Notches



Bunching Responses to Time Notches



Dynamic Model of Payment Timing

Taxpayers trade off liquidity with risk of missing discount:

$$\text{Pay later: } i = 1 \qquad u(t, 1, \theta, y) = \theta_2 \text{Interest Rate}_y$$

$$\text{Pay today: } i = 0 \qquad u(t, 0, \theta, y) = \underbrace{\theta_t + \theta_d + u_{ty}}_{\text{Net Hassle Cost}} - \theta_1 \underbrace{\text{Tax}(t, y)}_{\text{1-Discount}}$$

Dynamic Model of Payment Timing

Taxpayers trade off liquidity with risk of missing discount:

$$\text{Pay later: } i = 1 \qquad u(t, 1, \theta, y) = \theta_2 \text{Interest Rate}_y$$

$$\text{Pay today: } i = 0 \qquad u(t, 0, \theta, y) = \underbrace{\theta_t + \theta_d + u_{ty}}_{\text{Net Hassle Cost}} - \theta_1 \underbrace{\text{Tax}(t, y)}_{\text{1-Discount}}$$

Value from delaying: $u(t, 1, \theta, y) + \underbrace{\varepsilon_{ity}}_{\text{Time Shock}} + \beta \underbrace{\mathbb{E}[V(t+1, \theta, y)]}_{\text{Value of Delaying}}$

where $\varepsilon_{ity} \sim$ logit implies:

$$\mathbb{E}[V(t+1, 1, \theta, y)] = u(t+1, 0, \theta, y) + \gamma - \underbrace{\ln P_0(t+1, y)}_{\text{Conditional Choice Probability}}$$

Estimating the Dynamic Model

Model relates CCPs and discount rates/deadlines:

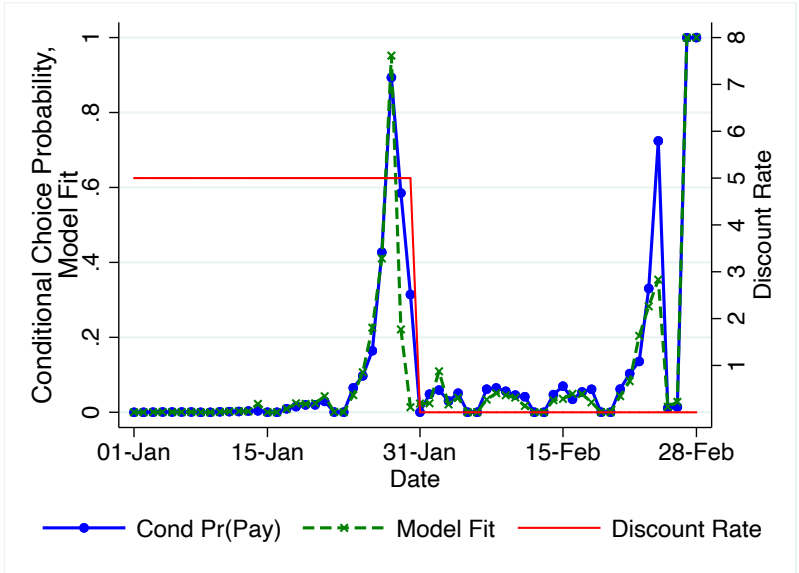
$$\begin{aligned}\ln\left(\frac{P_0(t,y)}{1-P_0(t,y)}\right) &= -\theta_1\{\text{Tax}(t,y) - \beta\text{Tax}(t+1,y)\} - \theta_2\text{Interest}_y \\ &- \beta\ln P_0(t+1,y) + \underbrace{\tilde{\theta}_t + \tilde{\theta}_d}_{\text{Fixed Effects}} + u_{ty}\end{aligned}$$

Estimate $\beta, \theta_1, \theta_2$ **via non-linear-least squares**

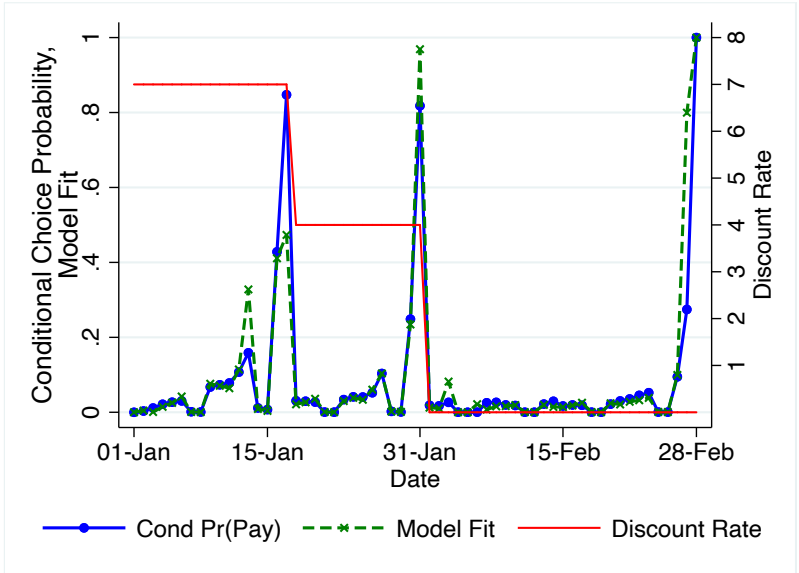
Variation in $\text{Tax}(t,y)$ and Interest_y identifies these parameters

Fixed Effects for day of year and day of week capture hassle costs

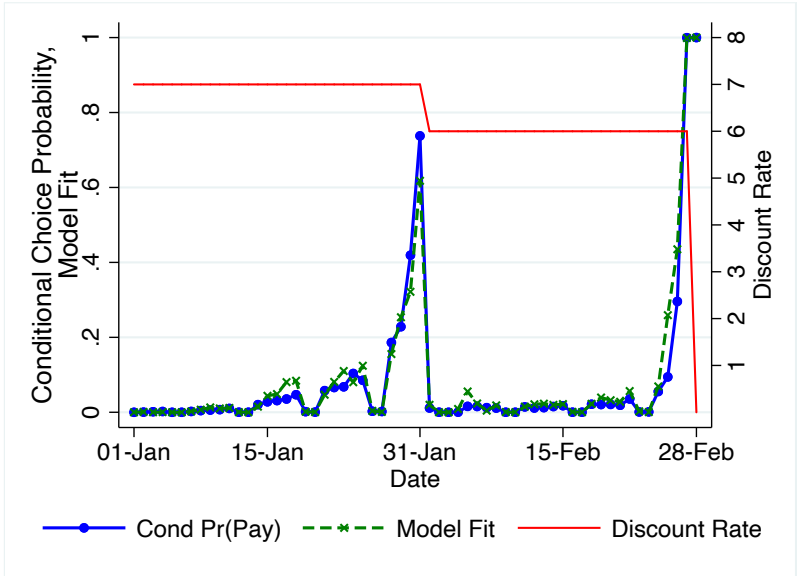
Conditional Choice Probability (Prediction), 2010



Conditional Choice Probability (Prediction), 2012



Conditional Choice Probability (Prediction), 2013



Estimation Results

A. Model Estimates

	(1) Tax Coefficient θ_1	(2) Interest Coefficient θ_2	(3) Discount Factor β
Estimate	0.936	0.096	0.924
	(0.180)	(0.064)	(0.041)

- Model captures data pattern: people risk missing out on the discount by waiting until the day before the deadline
- Discount rate implies a daily interest rate of 8%
- Very high but consistent with interest rates from payday loans
- $\frac{\theta_2}{\theta_1} \approx 10\%$; without liquidity constraints, should be closer to 0

Estimation Results

B. Welfare Estimates

(1) Year	(2) Consumer Surplus From Discounts	(3) Discount Deadlines	(4) Fiscal Cost	(5) Relative Value of Discounts
2009	10.35	Jan 31, Feb 28	7.80	1.33
2010	3.92	Jan 31	4.95	0.79
2011	3.26	Jan 10, 17, 31	6.53	0.50
2012	5.23	Jan 17, 31	6.84	0.77
2013	7.76	Jan 31, Feb 28	6.95	1.12

- Model allows us to quantify consumer surplus
- CS increases in discount and with later deadlines
- CS $>>>$ Fiscal Cost when later deadlines provide liquidity

Back

Consumption

Do Tax Payments Reduce Consumption? An IV Approach

Estimate tax-shock on consumption:

$$\ln C_{it} = \alpha + \beta_1 \ln P_{it} + \delta_1 \ln I_{it} + \gamma_1 X_{it} + \varepsilon_{it}$$

$$\beta_1 < 0 \implies \text{liquidity constraints but income shocks may bias } \beta \uparrow$$

Do Tax Payments Reduce Consumption? An IV Approach

Estimate tax-shock on consumption:

$$\begin{aligned} \ln C_{it} &= \alpha + \beta_1 \ln P_{it} + \delta_1 \ln I_{it} + \gamma_1 X_{it} + \varepsilon_{it} \\ \beta_1 < 0 &\implies \text{liquidity constraints but income shocks may bias } \beta \uparrow \end{aligned}$$

Measure consumption from ENIGH HH survey

Instrument for P_{it} with reform-driven increases in tax liability

- Split-sample IV using property characteristics in admin/survey data
- Allow β_1 to vary by Income/Access to Credit

Do Tax Payments Reduce Consumption? An IV Approach

	(1)	(2)	(3)	(4)
log(Pay)	-.006	-.024	.002	-.012
	(.052)	(.055)	(.051)	(.053)
log(Pay) × log(pc income)		.066 ***		.046 **
		(.024)		(.023)
log(Pay) × Lack of credit			-.041 ***	-.035 ***
			(.007)	(.006)
log(pc income)	.815 ***	.435 ***	.782 ***	.52 ***
	(.035)	(.13)	(.032)	(.129)

N=2,649. Regressions include delegación and year FE. Bootstrap SE based on 1,000 replicas in parentheses. Outcome is log(pc consumption).

Do Tax Payments Reduce Consumption? An IV Approach

	(1)	(2)	(3)	(4)
log(Pay)	-.006	-.024	.002	-.012
	(.052)	(.055)	(.051)	(.053)
log(Pay) × log(pc income)		.066 ***		.046 **
		(.024)		(.023)
log(Pay) × Lack of credit			-.041 ***	-.035 ***
			(.007)	(.006)
log(pc income)	.815 ***	.435 ***	.782 ***	.52 ***
	(.035)	(.13)	(.032)	(.129)

N=2,649. Regressions include delegación and year FE. Bootstrap SE based on 1,000 replicas in parentheses. Outcome is log(pc consumption).

Do Tax Payments Reduce Consumption? An IV Approach

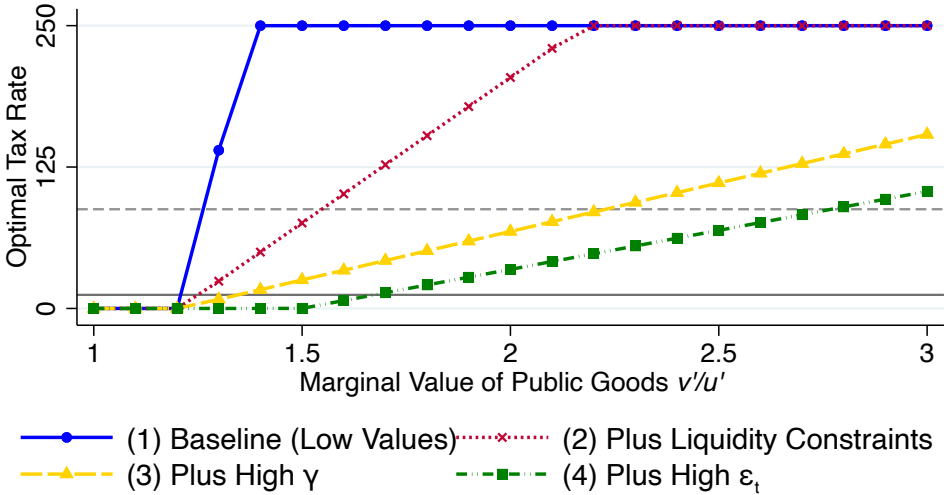
	(1)	(2)	(3)	(4)
log(Pay)	-.006	-.024	.002	-.012
	(.052)	(.055)	(.051)	(.053)
log(Pay) × log(pc income)		.066 ***		.046 **
		(.024)		(.023)
log(Pay) × Lack of credit			-.041 ***	-.035 ***
			(.007)	(.006)
log(pc income)	.815 ***	.435 ***	.782 ***	.52 ***
	(.035)	(.13)	(.032)	(.129)

N=2,649. Regressions include delegación and year FE. Bootstrap SE based on 1,000 replicas in parentheses. Outcome is log(pc consumption).

- For HH in 25th income percentile & credit constrained, doubling property tax reduces consumption by 7.3%

Policy Analysis

Optimal Taxes



Takeaway

1. **Evaluated possible reasons for under-utilization of property taxes**
   - **Administrative capacity**: Government can raise revenue through tax rate and enforcement
   - **Liquidity constraints**: affect compliance behavior and increase welfare cost of taxation
2. **Optimal tax and compliance model shows**
   - Limited or no welfare gains from enforcement
   - Tax rate increases can raise welfare, even with liquidity constraints
   - Providing liquidity is a key aspect of property tax administration

Takeaway

1. **Evaluated possible reasons for under-utilization of property taxes**
   - **Administrative capacity**: Government can raise revenue through tax rate and enforcement
   - **Liquidity constraints**: affect compliance behavior and increase welfare cost of taxation
2. **Optimal tax and compliance model shows**
   - Limited or no welfare gains from enforcement
   - Tax rate increases can raise welfare, even with liquidity constraints
   - Providing liquidity is a key aspect of property tax administration

Thank you!

Additional Slides

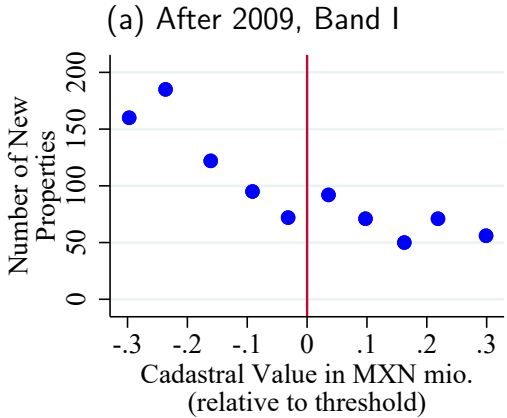
Property Tax Elasticities from Diff-in-Diffs

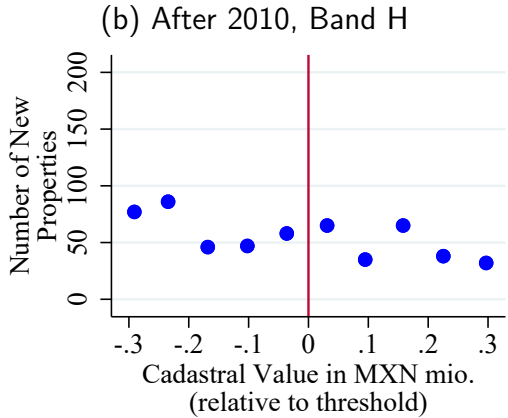
Treatment year	Payment amount	Payment in full	Compliance share
	(1)	(2)	(3)
2010	.696	-.531	-.186
	(.067)	(.095)	(.06)
2011	.612	-.556	-.23
	(.044)	(.059)	(.038)
2012	.333	-.649	-.366
	(.028)	(.035)	(.023)

Notes: Elasticities are calculated using the elasticity formula $\epsilon_{y,t} = \frac{dy}{dt}\frac{t}{y}$, where both $\frac{dy}{y}$ and $\frac{t}{dt}$ are taken directly from the differences-in-differences estimates.

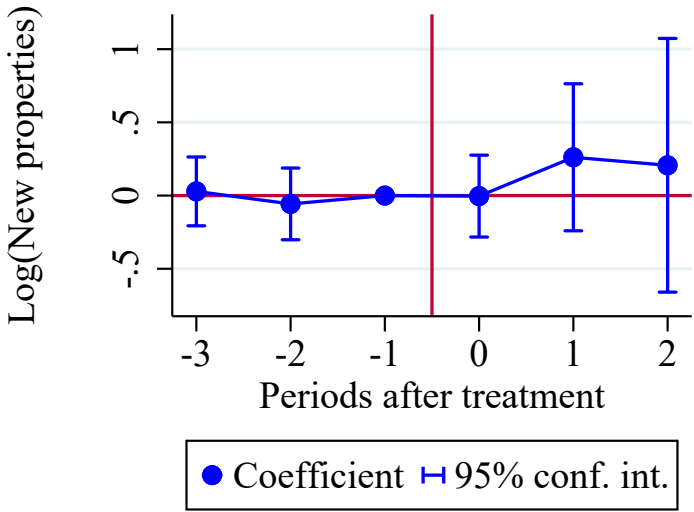
▸ Real Effects

No Real Response to Tax Rate Increases: Descriptive Evidence





No Real Response to Tax Rate Increases: DiD



Back

Distribution of Property Characteristics by Value Band

	2008	2012
	(1)	(2)
Property count	1,420,259	1,420,259
Property value (MXN)	585,320	605,346
	(1,121,680)	(1,169,283)
Yearly liability (MXN)	1,457	1,788
	(10,097)	(11,985)
Mean tax rate $\times$ 100	.1112	.1323
	(.1243)	(.1532)

Back

Payment Characteristics by Year

	2008	2012
	(1)	(2)
Payment (current MXN)	1,014	867
	(5,957)	(5,535)
Compliance share	.773	.524
	(1.007)	(.713)
Payment type		
Zero payment	.201	.414
	(.401)	(.493)
Partial payment	.092	.083
	(.289)	(.276)
Full payment	.707	.503
	(.455)	(.5)

Notes: N= 1,420,259 residential properties.

Back

Property Value Determination

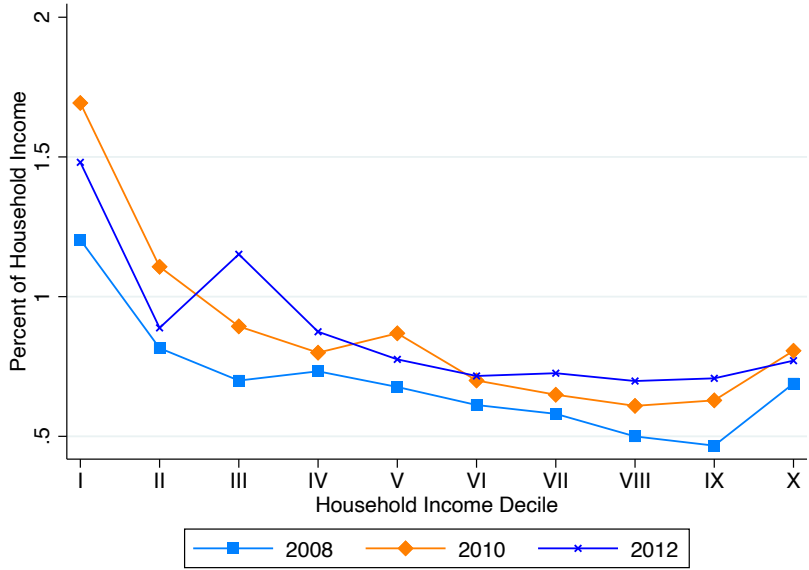
$$V_{it} = (A_{it}L_{it} + U_{it}M_{it})[1 - D_t \cdot (\mathbb{1}_{\{t-t_0 \leq 40\}}(t - t_0) + \mathbb{1}_{\{t-t_0 > 40\}}40)]$$

- A_{it}: unit value of land in the neighborhood (last updated in 2009)
- U_{it}: unit value of construction (last updated in 2009)
- L_{it}: land area of the property
- M_{it}: construction area of the property
- $D_t = 0.01$: reduction applied per each year of antiquity
- t_0: year of the construction of the property

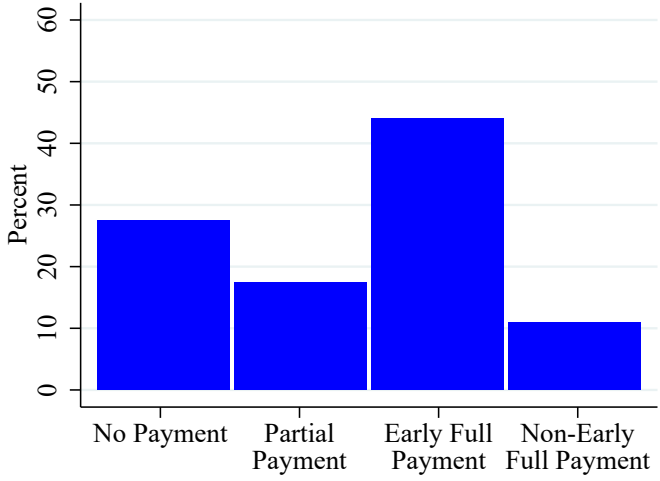
Back

Property Tax Bill

Tax Payment as a Share of Household Income

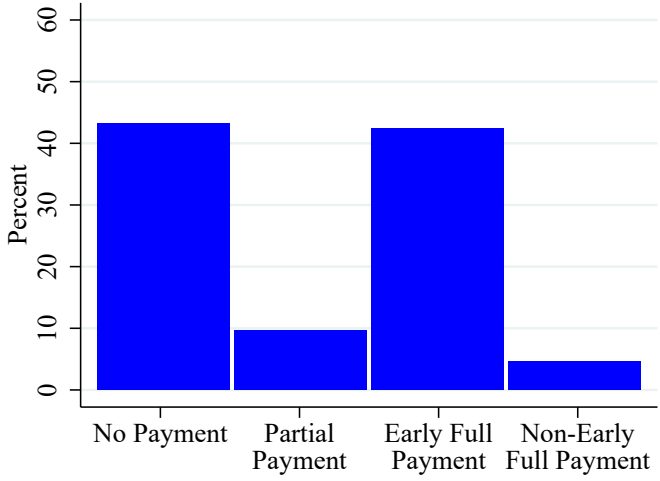


Distribution of Tax Compliance Behavior (2009)



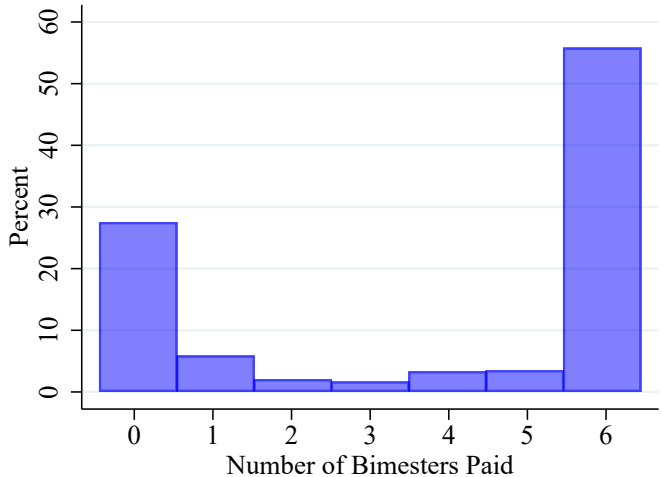
Back

Distribution of Tax Compliance Behavior (2012)

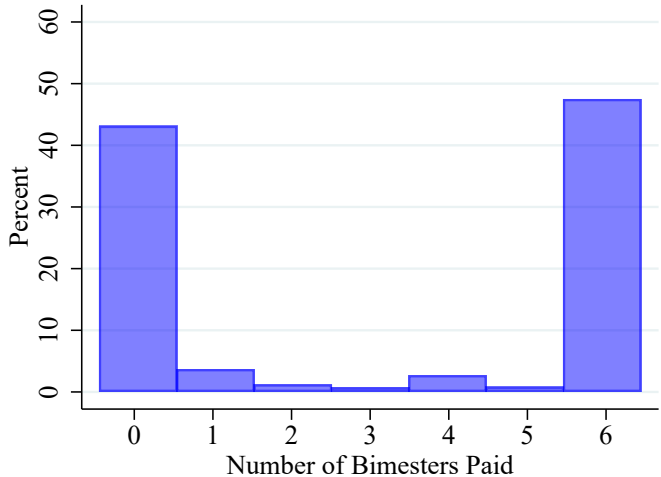


Back

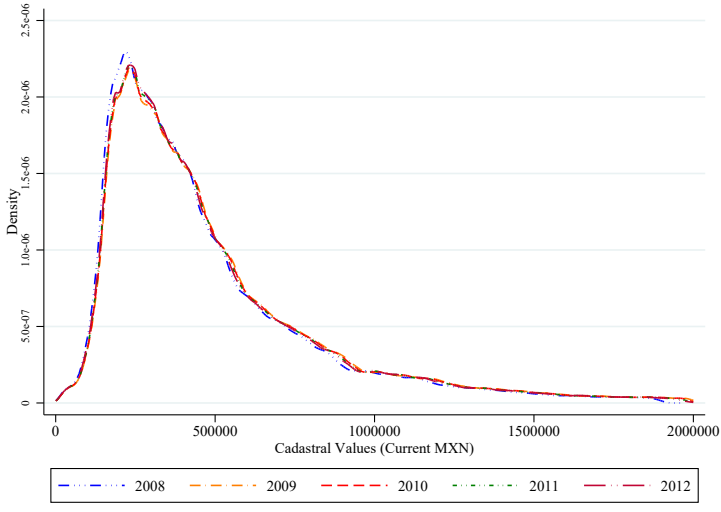
Distribution of Compliance Over Time (2009)



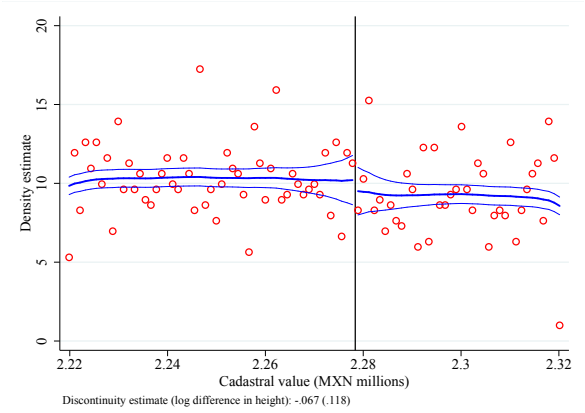
Distribution of Compliance Over Time (2012)



Cadastral Value Distributions by Year, 2008–2012

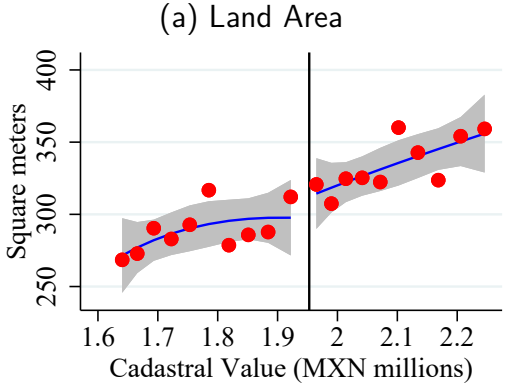


No Manipulation of the Running Variable (McCrary 2008)

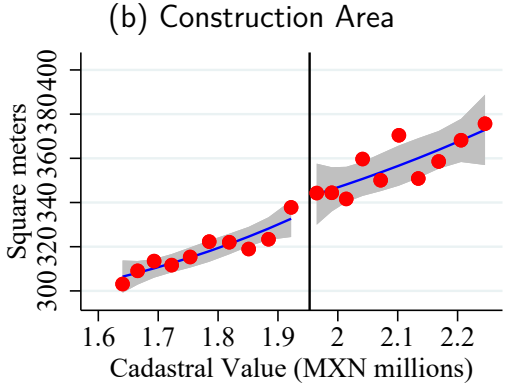


Back

No Discontinuity in Property Characteristics



RD = 10.241 (19.452), N=28094 properties

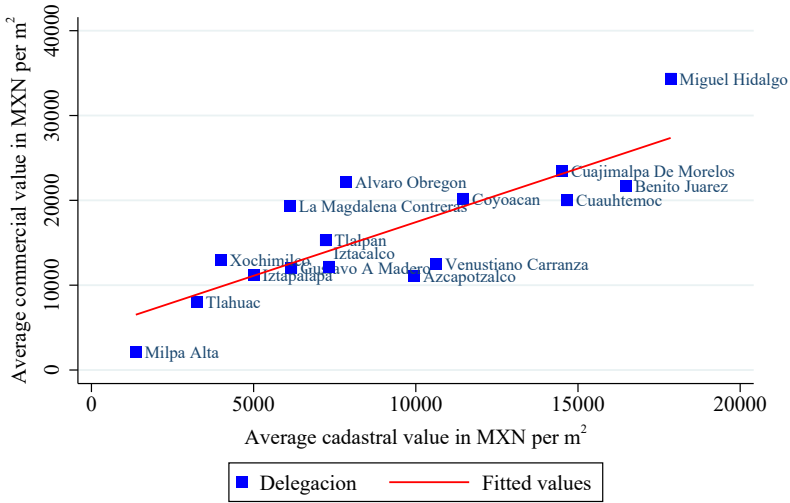


RD = 5.858 (7.970), N=28094 properties

Back

Property Tax Revenue in Mexico City 2006-2013

Cadastral Values and Commercial Property Prices



Commercial = Cadastral * 1.264 (0.238) , R^2=0.669