

Consumer Debt Moratoria

| | | | |
|--------------------|--------------------|--------------------------|------------------|
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October 11th 2024

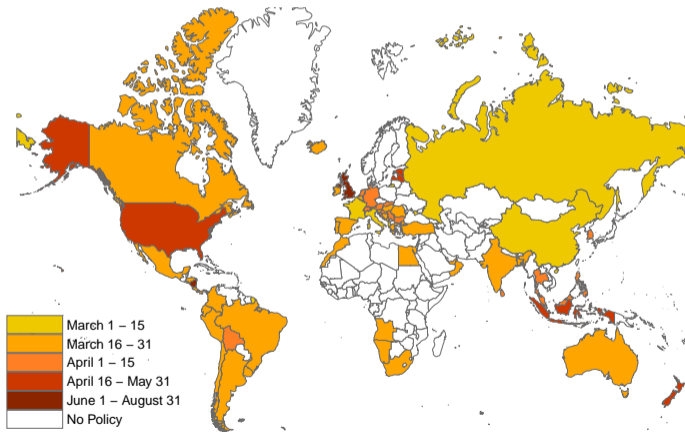
Internal Seminar: Macroeconomics, Policy & Econometrics

Motivation, why is it important?

- **Debt moratorium:** payment suspension of a debt instrument.
- One of the **oldest policy recommendations**, references in Abrahamic religions.
 - *“If it is difficult for someone to repay a debt, **postpone it** until a time of ease.”* –Qur’an 2:280
- A world of **record-high** debt levels, both public and private
 - Navigating such world record of debt levels is now at the **forefront of macroeconomic debates**.
 - Debt moratorium plays a central role in these discussions.

Motivation, why is it important?

- Moratorium policies **gained prominence** in the wake of the **2020 pandemic**.
 - **DEBT MORATORIA** remains **largely unexplored** in both empirical and theoretical contexts.



TWO MAIN CONTRIBUTIONS:

1. **(Empirical)** Investigate causal impact of mortgage moratorium on households. **(new)**
 - Causal evidence use administrative level Colombian data
2. **(Quantitative)** A heterogeneous agent life-cycle incomplete market model. **(new)**
 - Aggregate implications, long run effect, and policy counterfactual comparisons.

What do we find?

1. Moratoria improved economic conditions stressed households
 - ↑ Consumption
 - ↓ Delinquency probability
2. Moratoria mitigates the negative response of the economy to an aggregate productivity shock.
 - Welfare improving for both HHs banks.
 - Payment suspension with interest rates are not accrued is a better alternative.

TODAY'S PRESENTATION

I. EMPIRICAL STRATEGY

- The Colombian Case
- Identification
- Main Results: Consumption and Delinquency

II. QUANTITATIVE MODEL

- Model
- Calibration
- Model Results: Aggregate Effect, Alternative Policies

III. CONCLUSIONS

Empirical Strategy

The Colombian Case

Data

- Colombian credit registry from Q1-2019 to Q4-2021.
 - **Comprise universe of loans** between bank-individual pairs.
 - Borrowing and loan delinquency information at quarterly frequency.
 - We can identify **mortgages treated by moratoria** in 2020.
- We employ 152,000 **existent-mortgages** (i.e. originated by 2019Q4) at the end of 2020:Q1
 - ⇒ 26 private banks & 149,000 individuals.
- Match treatment information to **other household borrowing** during 2019Q4-2021Q4
 - 66,000 credit cards, 24,000 personal (short-term) loans and 4,100 car loans.

The Debt Moratorium Policy

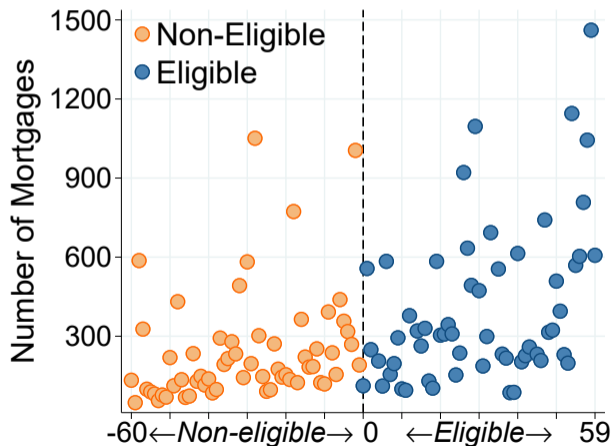
- Enacted in **March 2020** \implies mitigate the effects of the COVID-19 Pandemic
- **Treatment**
 1. Duration \leq 120 days
 2. Grace periods on principal and interest payments
 3. Delinquency days reset
 4. Interest rate accrues \implies **we will have a policy suggestion on this**
 5. Credit rating remain frozen
- **Eligibility:** all loans with \leq 60 days past due as of 29/02/2020
 - First covid case: March 6th **NO ANTICIPATION!!!**
- *Existent Mortgage* \implies **Eligible** + apply for Debt Moratorium Policy \implies **Treated**

Empirical Strategy

Identification

- Household " i " existent mortgage with bank " j " (i.e. originated by 2019Q4)

$$\Rightarrow \text{run}_{ij} = 60 \text{ days} - \text{delinquency days}_{ij}$$



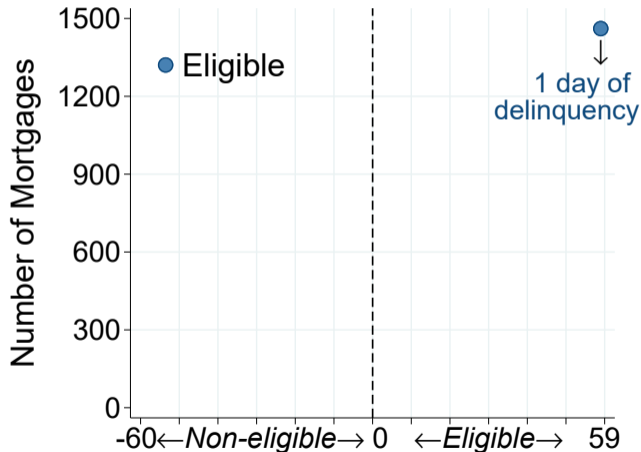
Identification

NElig-Elig.Distrib

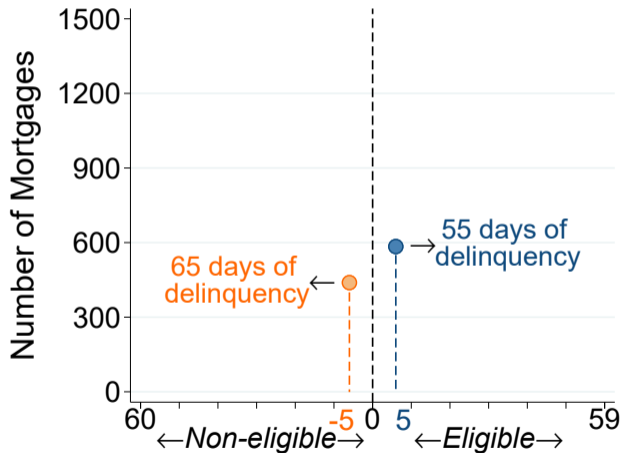
Pre-Treat.Distrib.

Manipulation

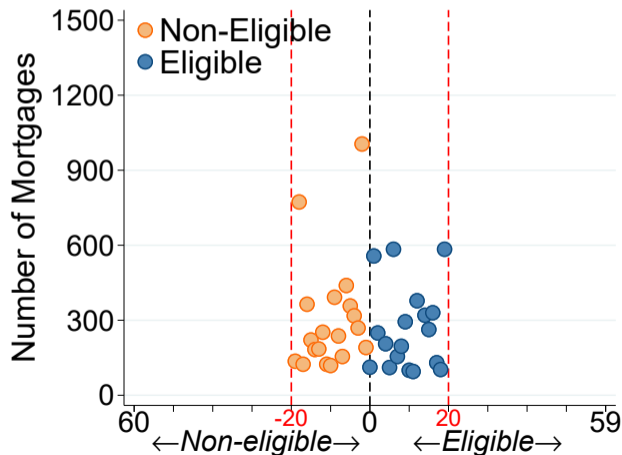
- **Stressed households** \implies at least one day of delinquency on existent mortgage



- Eligible and Ineligible households within 5 days of the threshold.



- **IDENTIFICATION** \implies compare barely eligible and non-eligible households
 \implies Non-parametric Local Polynomials (Calonico, Cattaneo, and Titiunik, 2014)



Empirical Strategy

RD Estimates: Household Consumption

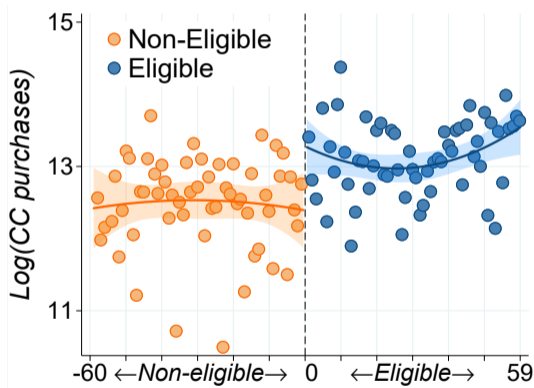
Moratoria and CC Expenditures: RD Plots

new carloans

new mortgages

before policy

- We proxy non-durable consumption by CC purchases.



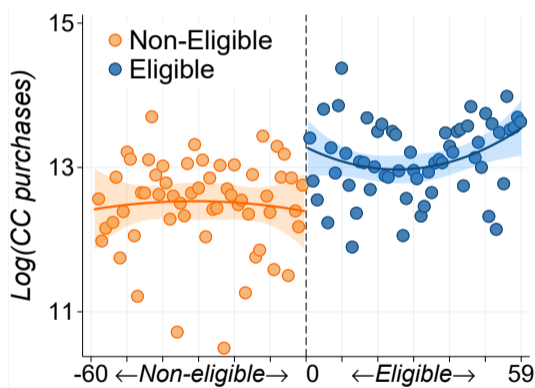
Moratoria and CC Expenditures: RD Plots

new carloans

new mortgages

before policy

- Upward jump CC purchases when moving along the eligibility cutoff



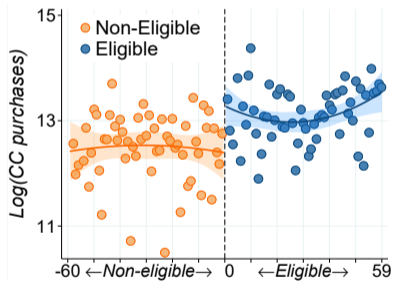
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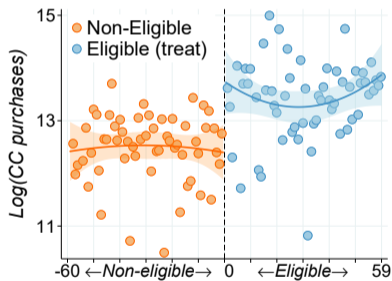
new mortgages

before policy

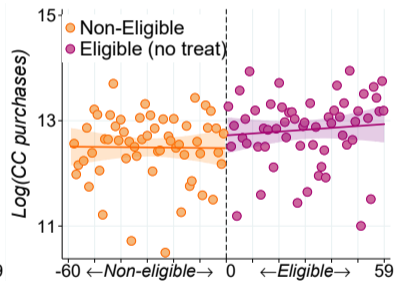
- Upward jump CC purchases when moving along the eligibility cutoff
- ⇒ Explained by Eligible-Treated households



(a) Non-Eligible vs Eligible



(b) Non-Eligible vs Eligible-Treated



(c) Non-Eligible vs Eligible Non-Treated

- Effect of moratoria on CC at **end of the quarter of treatment (2020-Q2)**.

| | CC Expenditure | | Mortgage Payment (COP) |
|---------------------|--------------------|--------------------|---------------------------|
| | (log) | (COP) | |
| Fuzzy-RD | 2.10** (1.06) | 2.39* (1.30) | -3.09*** (0.27) |
| | First Stage | | |
| D_{ij} | 0.27*** (0.041) | 0.27*** (0.035) | 0.18*** (0.010) |
| Observations | 16,504 | 16,504 | 149,867 |
| Bandwidth (in days) | 19.2 | 28.5 | 22.3 |

- Households receiving moratoria **increase CC expenditure** by **2.10 %** relative to non-treated ones.

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- Better interpret magnitude of the effect, we estimate **"MPC out of the moratoria"**
 - Increase CC expenditure: 2.4 mill COP (\approx 625 USD)
 - Drop mortgage payments: 3.1 mill COP (\approx 805 USD)

| | CC Expenditure | | Mortgage Payment |
|---------------------|--------------------|--------------------|--------------------|
| | (log) | (COP) | (COP) |
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- Better interpret magnitude of the effect, we estimate **"MPC out of the moratoria"**

Semi-elasticity from moratoria: $0.77 = \frac{2.4}{3.1}$

Elasticity from moratoria: $0.12 = 0.77 \times 0.16$

| | CC Expenditure | | Mortgage Payment (COP) |
|---------------------|--------------------|--------------------|---------------------------|
| | (log) | (COP) | |
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Empirical Strategy

RD Estimates: Delinquency

- Effect of the moratoria on **existent (old) household debt delinquency**.

$$\text{Delinquent}_{ijt} = \mathbb{1} \{ \text{delinquency days}_{ijt} \geq 30 \}$$

| | Existent Mortgages | Personal Loans | Car Loans |
|---------------------|-----------------------|-------------------|-------------------|
| Fuzzy-RD | -0.98** (0.07) | -0.09** (0.04) | -0.36** (0.18) |
| | First Stage | | |
| D_{ij} | 0.21*** (0.02) | 0.29*** (0.01) | 0.18*** (0.06) |
| Observations | 152,879 | 28,158 | 4,187 |
| Bandwidth (in days) | 8.2 | 28.7 | 22.8 |

- Existent mortgages \implies \downarrow delinquency probability:
 - 0.98 pp. in quarter of treatment \implies result of delinquency days reset.

| | Existent Mortgages | Personal Loans | Car Loans |
|---------------------|-----------------------|-------------------|-------------------|
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- **Cross-loan effect** \implies \downarrow **delinquency probability**
 - **0.09 pp.** and **0.36 pp.** for personal and car loans in quarter of treatment.
 - Moratoria mitigate households liquidity problems \implies **repay debt.**

| | Existent Mortgages | Personal Loans | Car Loans |
|---------------------|-----------------------|--------------------------|--------------------------|
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Why do we need a model?

- Identification of causal effect with Fuzzy RD is plausible. Results show clear causal relationship.
- RD design generally pick up local effects (LATE), external validity is a typical concern.
- The quantitative model capture general equilibrium effects of moratoria on households.
 - Benefits/Costs for financial system.
 - Long run implications.
 - Welfare gains of alternative debt relief policies.

Quantitative Model

Model

Setup

- Benchmark model: **Arslan, Guler, Kuruscu (2023)**
- Five sectors: households, banks, rental companies, firms, and government.
- Household heterogeneity in income, wealth, housing tenure and mortgage debt due to idiosyncratic shocks. But no aggregate uncertainty
- We study the effects moratoria in response to unexpected and persistent shock, but perfect foresight is assumed along transition.

About Households

- All born as young individuals with endogenous inherited wealth, draw their initial labor productivity (z)
- Two idiosyncratic shocks
 - **Age**: determines transition through life-cycle phases (young, middle, and old) according to $\pi_z(j'|j)$. Old individuals die after age shock, net wealth equally distributed among the newborns.
 - **Labor efficiency**: affect productivity before retirement, stochastic component $z_j \sim \text{AR}(1)$.
- Once shocks is observed, households decide **housing tenure, saving and consumption**.

About Households

- All born as young individuals with endogenous inherited wealth, draw their initial labor productivity (z)
- Two idiosyncratic shocks **age** and **labor efficiency**.
- Once shocks is observed, households decide **housing tenure**, **saving** and **consumption**.
 - **House purchase financed with mortgages** (long-term perpetuities with decreasing coupons).
 - If moratoria starts at $t + 1$, unpaid coupon is paid (with interest) when payment suspension is over. Plot

Active renter Problem

- Households start active renters with state $\{a, z, j\}$
- Choices are: (i) stay as renters (V^{rr}) or (i) become homeowners (V^{rh})

$$V^r = \max \{V^{rr}, V^{rh}\}$$

Active renter Problem

- Households start active renters with state $\{a, z, j\} \implies$ if continue renting

$$V^{rr}(a, z, j) = \max_{c, s, a' \geq 0} \{u(c, s) + \beta EV^r(a', z', j')\}$$

subject to

$$c + a' + p_r s = w(1 - \tau)y(j, z) + a(1 + r_k)$$

Active renter Problem

- Households start active renters with state $\{a, z, j\} \implies$ if purchase a house

$$V^{rh}(a, z, j) = \max_{c, d, h, a' \geq 0} \left\{ u(c, h) + \beta EV^h(a', z', j', d, h) \right\}$$

subject to

$$\begin{aligned} c + p_h h + \delta_h p_h h + \varphi_f + a' &= w(1 - \tau)y(j, z) + a(1 + r_k) + d(q^m(a', z, j, d, h) - \varphi_m) \\ d &\leq p_h h(1 - \phi) \end{aligned}$$

- Only mortgage pricing is affected by individual default risk.
 - repayment: $m = d(r_l + \delta_m)$
 - debt next period: $d' = (d - m)(1 + r_l)$

Active renter Problem

- Once a household is a homeowner, then has four options
 1. Stays as a homeowner [Details](#)
 2. Refinance mortgage (subject to mortgage origination cost) [Details](#)
 3. Sell house (subject to transaction cost) [Details](#)
 4. Defaults [Details](#) and becomes inactive renter [Details](#)
- Refinancing or selling the house **requires full prepayment** of mortgage

- Perfectly competitive risk averse banks. They borrow from the international market (r_t) and lend to households (long-term mortgages) and firms (short-term working capital)

$$\max_{L_{t+1}, B_{t+1}} \sum_{t=0}^{\infty} \beta_L^{t-1} \log(d_t^B)$$

subject to

$$\begin{aligned} d_t^B + L_{t+1} &= \omega_t + B_{t+1} \\ \omega_{t+1} &= L_{t+1}(1 + r_{\ell, t+1}) - B_{t+1}(1 + r_{t+1}) \end{aligned}$$

L_t Total lending to firms and households \implies Banks make same return on each loan

- Banks don't face aggregate risk
- Law of large numbers apply for households

- Perfectly competitive risk averse banks.

$$\max_{L_{t+1}, B_{t+1}} \sum_{t=0}^{\infty} \beta_L^{t-1} \log(d_t^B)$$

subject to

$$d_t^B + L_{t+1} = \omega_t + B_{t+1}$$

$$\omega_{t+1} = L_{t+1}(1 + r_{\ell, t+1}) - B_{t+1}(1 + r_{t+1})$$

$$(1 - \phi_{t+1})(1 + r_{\ell, t+1})L_{t+1} \geq (1 + r_{t+1})B_{t+1}$$

Endogenous leverage constraint

- Banks can default and steal fraction of assets (**Gertler and Kiyotaki, 2010**)

$$\phi_t = \xi^{1-\beta_L} \left((1 + r_{t+1}) / (1 + r_{\ell, t+1}) - (1 - \phi_{t+1}) \right)^{\beta_L}$$

Quantitative Model

Model Results

- Model is calibrated to Colombia targeting the averages of 2010 to 2019.

| Statistic | Data | Model |
|---|--------|--------|
| Capital- quarterly GDP ratio | 8 | 8 |
| Homeownership rate–aggregate | 43% | 43% |
| Mortgage debt to quarterly GDP ratio | 112% | 112% |
| Share of housing services in GDP | 15% | 15% |
| House price- quarterly rental price ratio | 30 | 30 |
| loan-to-value ratio | 70% | 70% |
| Bank leverage ratio | 10 | 10 |
| Lending premium | 0.375% | 0.375% |

Equilibrium Response to Moratoria

- Evaluate the impact of an aggregate **productivity shock** with **moratoria** policy in place.
 - (1) Economy starts is in steady state before shock.
 - (2) Productivity shock **replicates output drop** around COVID.
 - (3) Perfect foresight after the shock hits the economy.
 - (4) No mortgage payments for 2 quarters $\implies m = 0$ but interest accrues $\implies d' = d (1 + r_l)$.

Equilibrium Response to Moratoria

Linking the model to RDD

- Evaluate if quantitative model aligns with the empirical estimates. \implies **PE response**
 - Fix wages, lending rate, house prices, rental prices
 - Compute average consumption elasticity at the end of the second quarter relative to economy with no moratoria.

Equilibrium Response to Moratoria

Linking the model to RDD

- Evaluate if quantitative model aligns with the empirical estimates \implies **PE response**
 - Fix wages, lending rate, house prices, rental prices
 - Compute average consumption elasticity at the end of the second quarter relative to economy with no moratoria.
- Consumption elasticity in the model is for **universe of mortgage holders**.
- Model matches a similar consumption elasticity that in data.
 - \implies Average of data estimates for **stressed** and **non-stressed** households.

Equilibrium Response to Moratoria

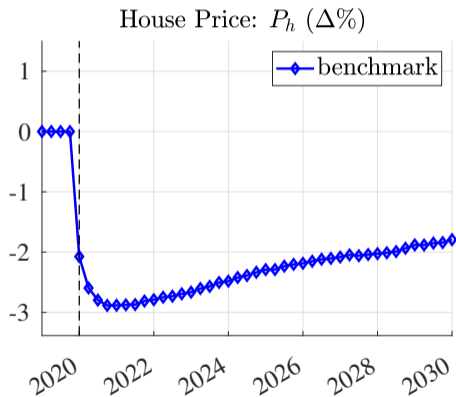
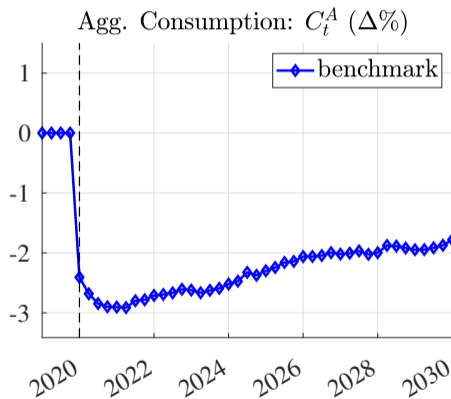
Aggregate impact of debt moratoria

- Turn on **GE effect** on prices to explore the **long-run impacts**.
- Compare economy transition path to same productivity shock in absence of moratoria.

Equilibrium Response to Moratoria

- Aggregate impact without moratoria

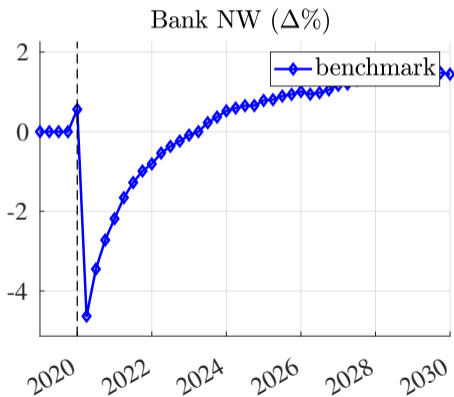
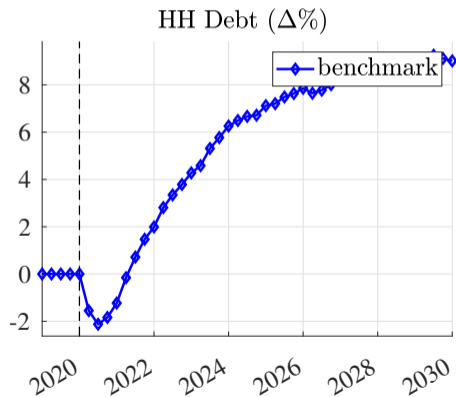
- \downarrow labor income (20% on impact) \implies \downarrow consumption and house prices



Equilibrium Response to Moratoria

- Aggregate impact without moratoria

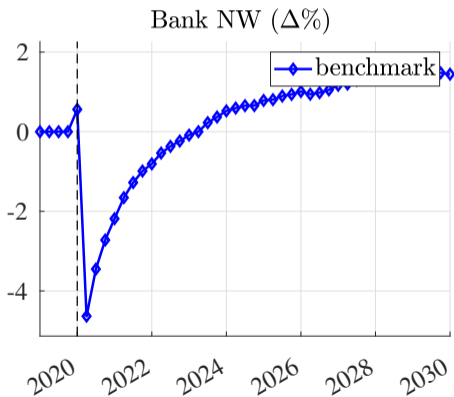
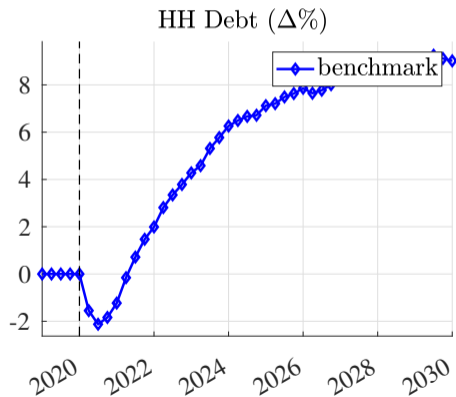
- In short-run: \downarrow house prices \implies \downarrow household debt .
- In the medium-run: house prices and income growth \implies \uparrow household debt



Equilibrium Response to Moratoria

- Aggregate impact without moratoria

- On impact: \downarrow lending \implies \uparrow valuation of existing mortgages \implies \uparrow bank net worth.
- \downarrow assets liquidation value (prepay mortgages) \implies \downarrow bank net worth.



Equilibrium Response to Moratoria

- Aggregate impact with moratoria

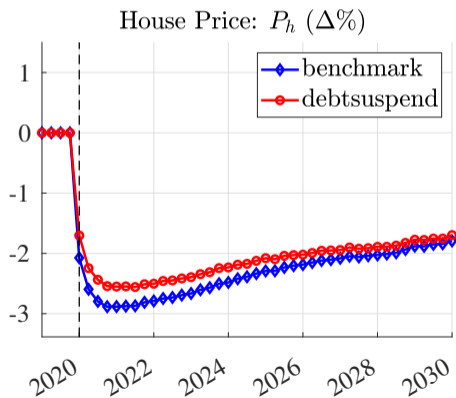
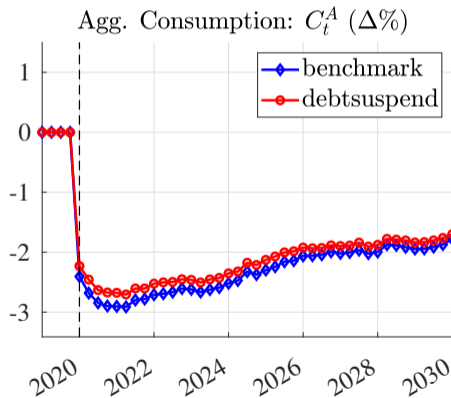
All

Other

Moratoria length

Decomposition

- Consumption and welfare ($\approx 7\%$).
- Housing prices (18%)



Equilibrium Response to Moratoria

- Aggregate impact with moratoria

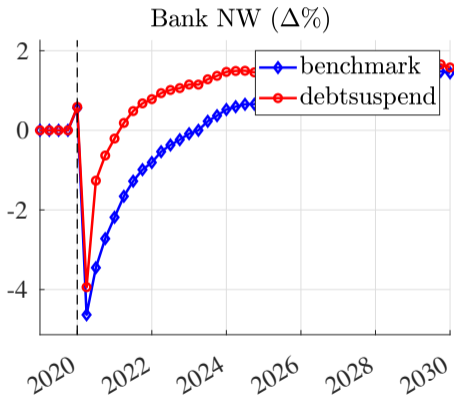
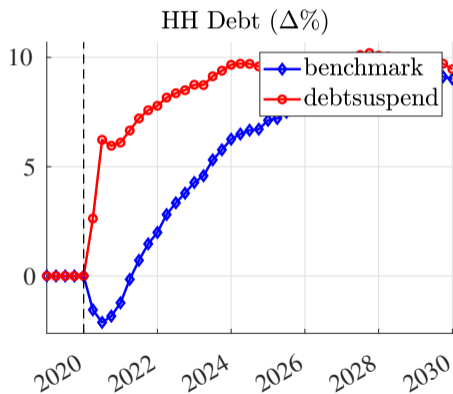
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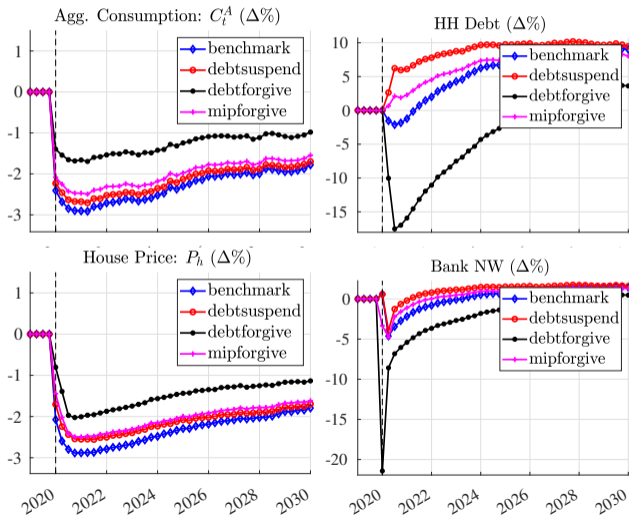
Moratoria length

Decomposition

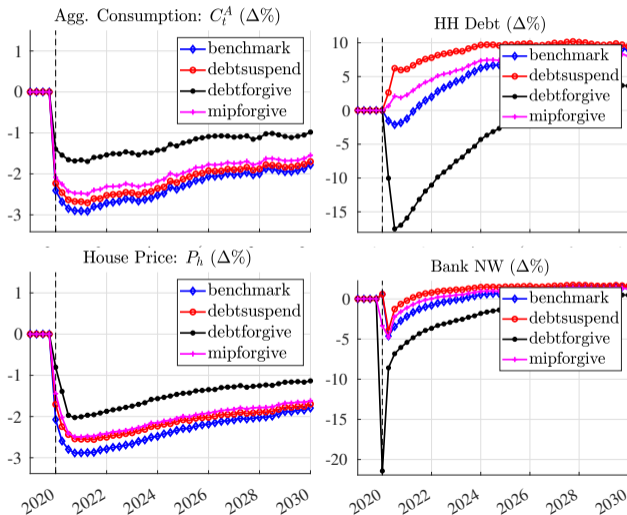
- liquidation value and \uparrow mortgage debt \implies \uparrow banks profitability in the long run.



- Compare alternative debt relief policies



- **Moratoria + no interests accrued** \implies welfare improving and beneficial for banks.



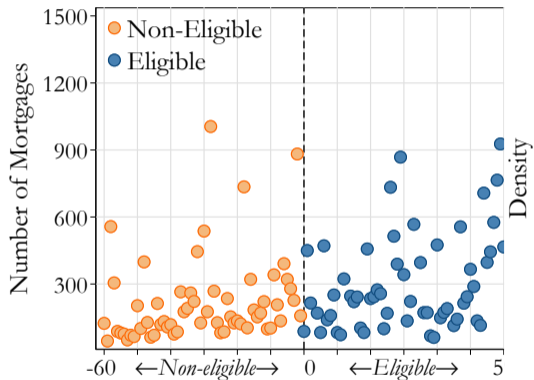
Conclusions

- This paper study implications of temporary payment debt suspension for households.
- **Empirical strategy** \implies LATE on **stressed households**
 - Exploit discontinuity in eligibility for Colombia debt moratoria policy.
 - Higher consumption \implies credit card purchases.
 - Drop in delinquency rates on existent mortgages and other household debt.
- **Quantative model** \implies PE consumption response replicate empirical estimates.
 - Moratoria mitigates the negative response of the economy to an aggregate productivity shock.
 - Long-term effects of the policy is beneficial for banks.
 - Larger welfare gains if policy stipulate debt forgiveness or moratoria with interest rate not accrued.

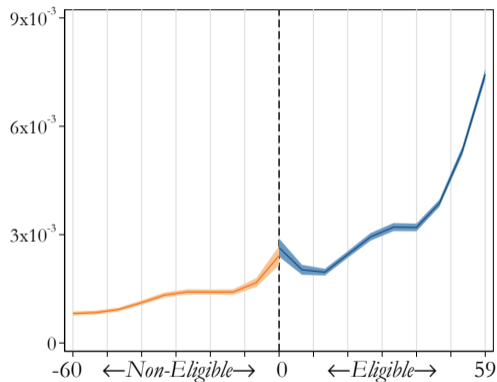
- **Impact of debt relief on financial distress on households**
 - Dobbie and Song (2015) (**consumer bankruptcy protection**), Campbell et al.(2021) (**mortgage design and maturity extension**), Ganong and Noel (2020) (**mortgage modifications**), Dinerstein et al. (2024) (**student loan moratoria**)
- **Quantitative models with long-term debt and default**
 - Hatchondo et al. (2022) (**contingent convertible bonds and sovereign default**), Önder et al. (2023) (**corporate debt moratoria**)

Testing Manipulation [back](#)

- Reject manipulation of the running variable (p -value=0.25)



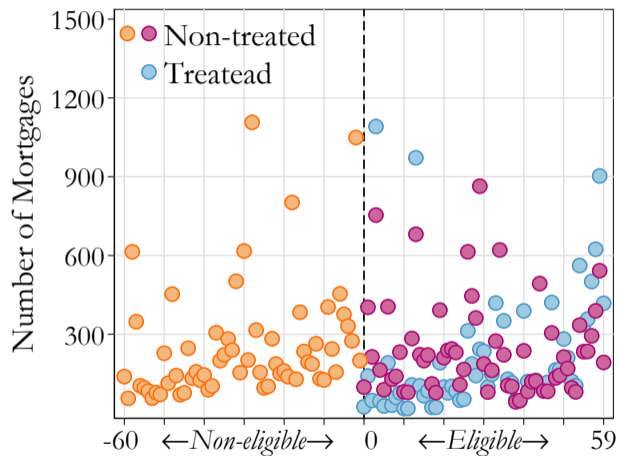
(a) Treatment Distribution



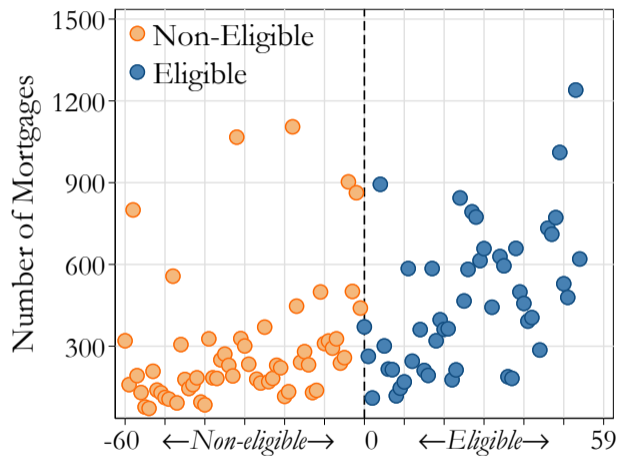
(b) McCrary's Test

Treated and non-Treated Mortgages

back



Pre-treatment distribution of loans [back](#)



Treatment Biting: Existing Mortgages 2020q2

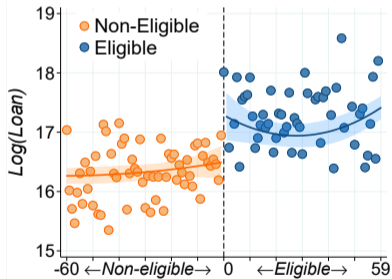
| | During quarter of treatment | | | One quarter after treatment | | |
|---------------|-----------------------------|--------------------|----------------------|-----------------------------|--------------------|----------------------|
| | Log(payment) | Delinq. (days) | Maturity (months) | Log(payment) | Delinq. (days) | Maturity (months) |
| Sharp-RD | -40.20*** (2.0) | -55.50*** (3.2) | 0.76 (0.5) | 6.69 (8.0) | -17.04*** (5.1) | 1.51*** (0.3) |
| Observations | 138,150 | 109,445 | 122,786 | 108,446 | 108,446 | 108,446 |
| BW loc. poly. | 9.5 | 17.0 | 30.0 | 21.9 | 24.2 | 46.4 |

Moratoria and New Mortgages

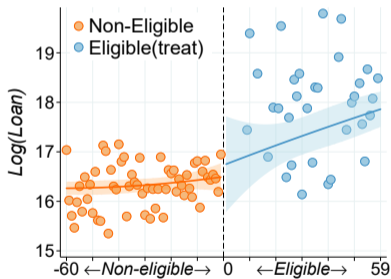
[back](#)

- $\text{Log}(\text{new mortgage}_{ijt})$

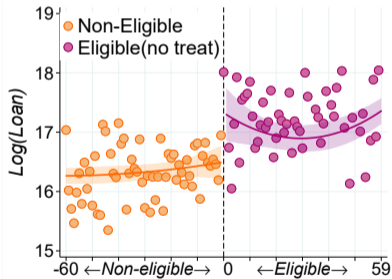
$\text{new mortgage}_{ijt}$ = value of loan_{ij} at quarter of origination t_0



(a) Non-Eligible vs Eligible



(b) Non-Eligible vs Eligible-Treated



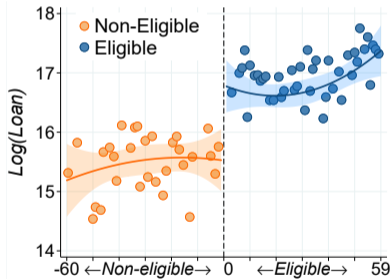
(c) Non-Eligible vs Eligible Non-Treated

Moratoria and New Car Loans

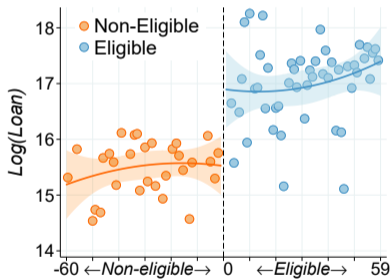
[back](#)

• $\text{Log}(\text{new car loan}_{ijt})$

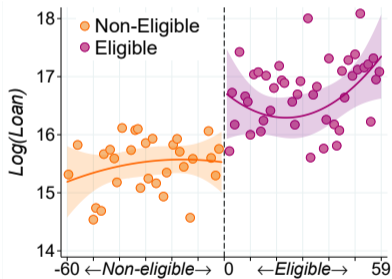
$\text{new car loan}_{ijt}$ = value of loan_{ij} at quarter of origination t_0



(a) Non-Eligible vs Eligible



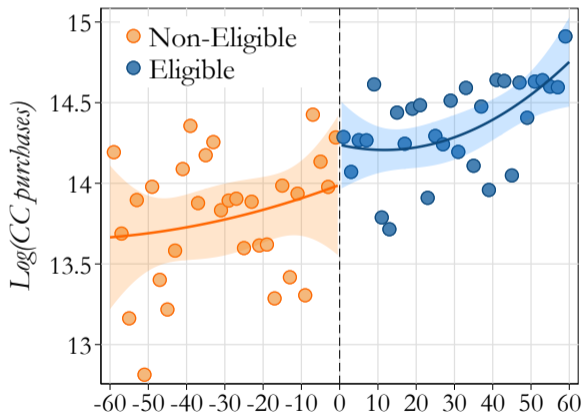
(b) Non-Eligible vs Eligible-Treated



(c) Non-Eligible vs Eligible Non-Treated

Pre-existing differences in Household Consumption back

- One quarter before the implementation of the policy (i.e., 2019Q4)
⇒ Observed jump in CC purchases around cutoff disappears



Moratoria and Durable Consumption [back](#)

- **Durable Consumption:** $\text{Log}(\text{new mortgage}_{ijt})$, $\text{Log}(\text{new car loan}_{ijt})$

$\text{new mortgage}_{ijt}$ ($\text{new car loan}_{ijt}$) = value of loan_{ij} at quarter of origination t_0

| | New Cars | New Mortgages |
|---------------------|------------------|------------------|
| Fuzzy-RD | 6.67** (0.6) | 3.78* (2.2) |
| | First Stage | |
| D_{ij} | 0.14** (0.05) | 0.05** (0.02) |
| Observations | 4,407 | 8,846 |
| Bandwidth (in days) | 22.8 | 17.0 |

Summary Statistics: Treated Households [back](#)

| | Mean | SD | P25 | P50 | P75 | N_{obs} |
|---------------------------|------|-------|-------|------|------|-----------|
| CC Purchases | 2.0 | 4.1 | 0.2 | 0.7 | 2.0 | 10,379 |
| CC purchases growth | 4.8 | 101.2 | -40.2 | 16.9 | 67.9 | 7,534 |
| <i>Existent Mortgages</i> | | | | | | |
| Repayment | 0.8 | 1.1 | 0.0 | 0.5 | 1.2 | 76,343 |
| Delinquency probability | 4.9 | 21.6 | 0.0 | 0.0 | 0.0 | 79,228 |
| Outstanding debt | 51.7 | 49.0 | 20.6 | 38.2 | 64.2 | 76,629 |
| Interest rate | 10.5 | 2.7 | 9.0 | 10.7 | 12.5 | 77,895 |
| Maturity | 10.7 | 5.9 | 6.1 | 10.2 | 14.7 | 79,158 |
| LTV | 37.2 | 18.1 | 22.8 | 37.1 | 51.4 | 79,228 |
| Rating | 4.9 | 0.4 | 5.0 | 5.0 | 5.0 | 79,183 |
| <i>Personal Loans</i> | | | | | | |
| Delinquency probability | 5.0 | 21.8 | 0.0 | 0.0 | 0.0 | 17,001 |
| Outstanding debt | 5.0 | 7.4 | 1.0 | 2.4 | 5.4 | 16,126 |
| Interest rate | 22.9 | 7.9 | 23.7 | 27.1 | 27.2 | 16,797 |
| Maturity | 7.2 | 8.9 | 2.9 | 4.3 | 5.0 | 16,853 |
| Rating | 4.7 | 0.9 | 5.0 | 5.0 | 5.0 | 17,001 |
| <i>Car Loans</i> | | | | | | |
| Delinquency probability | 17.7 | 38.2 | 0.0 | 0.0 | 0.0 | 2,082 |
| Outstanding debt | 28.6 | 26.1 | 11.1 | 22.1 | 37.2 | 2,048 |
| Interest rate | 12.3 | 6.4 | 10.3 | 13.0 | 15.9 | 1,990 |
| Maturity | 3.2 | 1.8 | 1.7 | 3.3 | 4.5 | 2,053 |
| Rating | 4.3 | 1.3 | 5.0 | 5.0 | 5.0 | 2,082 |

Summary Statistics: Eligible Non-Treated Households

[back](#)

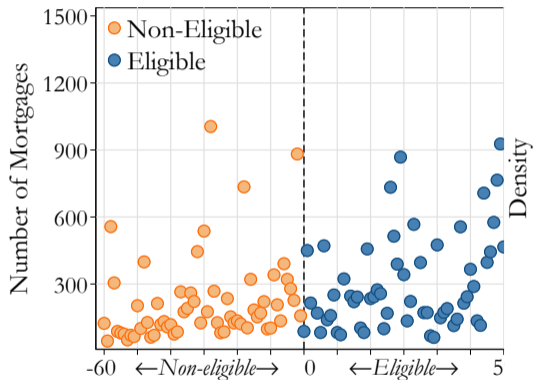
| | Mean | SD | P25 | P50 | P75 | N_{obs} |
|---------------------------|------|-------|-------|------|-------|-----------|
| CC Purchases | 2.3 | 4.3 | 0.2 | 0.8 | 2.4 | 4,035 |
| CC purchases growth | -1.4 | 195.0 | -36.1 | 26.1 | 77.3 | 3,043 |
| <i>Existent Mortgages</i> | | | | | | |
| Repayment | 1.4 | 1.6 | 0.5 | 1.0 | 1.8 | 27,597 |
| Delinquency probability | 43.9 | 49.6 | 0.0 | 0.0 | 100.0 | 32,606 |
| Outstanding debt | 50.4 | 54.8 | 16.6 | 33.9 | 62.6 | 32,052 |
| Interest rate | 10.8 | 2.7 | 9.5 | 10.7 | 12.7 | 31,823 |
| Maturity | 9.3 | 5.7 | 4.8 | 8.7 | 13.1 | 32,334 |
| LTV | 32.5 | 18.5 | 17.5 | 31.9 | 46.5 | 32,605 |
| Rating | 4.4 | 0.9 | 4.0 | 5.0 | 5.0 | 32,536 |
| <i>Personal Loans</i> | | | | | | |
| Delinquency probability | 8.7 | 28.2 | 0.0 | 0.0 | 0.0 | 7,174 |
| Outstanding debt | 5.0 | 7.4 | 1.1 | 2.4 | 5.4 | 6,414 |
| Interest rate | 23.3 | 7.6 | 24.3 | 27.1 | 27.2 | 7,040 |
| Maturity | 7.1 | 9.1 | 2.7 | 4.2 | 5.0 | 7,097 |
| Rating | 4.6 | 1.1 | 5.0 | 5.0 | 5.0 | 7,174 |
| <i>Car Loans</i> | | | | | | |
| Delinquency probability | 31.8 | 46.6 | 0.0 | 0.0 | 100.0 | 1,484 |
| Outstanding debt | 25.6 | 27.1 | 5.9 | 18.3 | 35.2 | 1,448 |
| Interest rate | 12.7 | 5.7 | 10.7 | 13.2 | 15.7 | 1,231 |
| Maturity | 2.7 | 1.8 | 1.0 | 2.6 | 4.2 | 1,447 |
| Rating | 3.6 | 1.8 | 2.0 | 5.0 | 5.0 | 1,484 |

Summary Statistics: Non-Eligible Households [back](#)

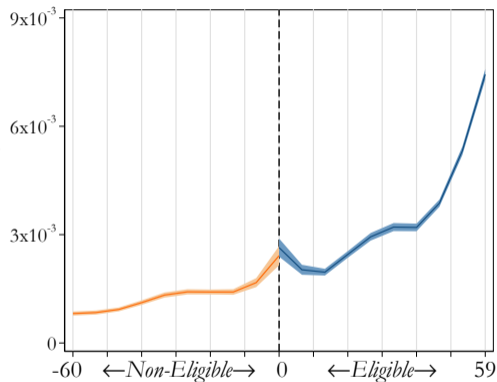
| | Mean | SD | P25 | P50 | P75 | N_{obs} |
|---------------------------|-------|-------|-------|-------|-------|-----------|
| CC Purchases | 1.3 | 3.1 | 0.1 | 0.4 | 1.2 | 1,992 |
| CC purchases growth | -63.7 | 245.3 | -96.3 | -25.3 | 34.1 | 1,522 |
| <i>Existent Mortgages</i> | | | | | | |
| Repayment | 1.6 | 2.4 | 0.3 | 0.9 | 1.9 | 19,982 |
| Delinquency probability | 94.8 | 22.2 | 100.0 | 100.0 | 100.0 | 41,045 |
| Outstanding debt | 53.1 | 58.0 | 18.3 | 35.2 | 64.1 | 40,702 |
| Interest rate | 11.1 | 3.1 | 9.5 | 11.1 | 13.0 | 40,831 |
| Maturity | 9.7 | 5.8 | 5.2 | 8.9 | 13.8 | 40,621 |
| LTV | 35.3 | 17.1 | 21.6 | 35.8 | 48.5 | 41,045 |
| Rating | 3.4 | 1.0 | 3.0 | 3.0 | 4.0 | 12,150 |
| <i>Personal Loans</i> | | | | | | |
| Delinquency probability | 27.9 | 44.9 | 0.0 | 0.0 | 100.0 | 3,983 |
| Outstanding debt | 4.7 | 7.0 | 1.1 | 2.3 | 5.0 | 3,766 |
| Interest rate | 24.7 | 6.4 | 25.9 | 27.2 | 27.2 | 3,870 |
| Maturity | 9.1 | 11.3 | 2.1 | 3.9 | 5.6 | 3,903 |
| Rating | 3.5 | 1.8 | 1.0 | 5.0 | 5.0 | 3,983 |
| <i>Car Loans</i> | | | | | | |
| Delinquency probability | 81.6 | 38.7 | 100.0 | 100.0 | 100.0 | 621 |
| Outstanding debt | 22.5 | 24.2 | 4.3 | 16.0 | 30.4 | 609 |
| Interest rate | 15.1 | 6.1 | 11.8 | 14.6 | 18.1 | 459 |
| Maturity | 2.4 | 1.8 | 0.9 | 2.0 | 3.6 | 594 |
| Rating | 1.7 | 1.1 | 1.0 | 1.0 | 2.0 | 621 |

Testing Manipulation [back](#)

- Reject manipulation of the running variable (p -value=0.25)



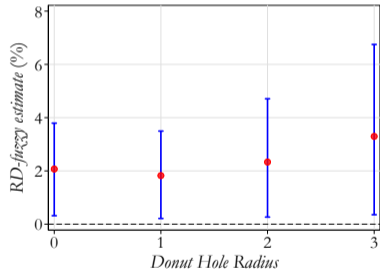
(a) Treatment Distribution



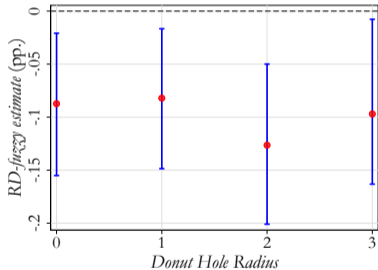
(b) McCrary's Test

Donut-hole Test [back](#)

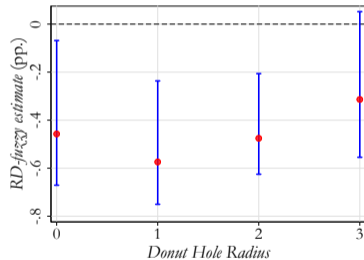
- Test checks for additional “bunching” of observations around the cutoff
- Most estimates are robust to excluding 1, 2, and 3 days before/after the cutoff



(a) Log(CC Expenditure)



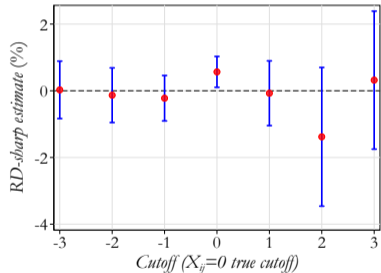
(b) Delinquency Personal Loans



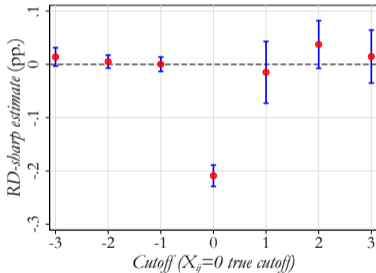
(c) Delinquency Car Loans

Placebo Cutoffs [back](#)

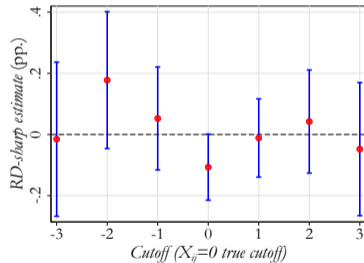
- What if **move the cutoff** for delinquency days?
- **no effects on placebo cutoffs**



(a) Log(CC expenditure)



(b) Delinquency Personal loans



(c) Delinquency Car loans

Testing for Pre-Policy Differences I [back](#)

| Variable | RD Estimator | Robust Inference | | Bandwidth (in days) | Observations |
|---------------------------|--------------|------------------|-----------------|---------------------|--------------|
| | | p-value | 95% Conf. Int. | | |
| <i>Credit Cards</i> | | | | | |
| Log(Expenditure) | -0.68 | 0.71 | [-3.70, 2.35] | 49.56 | 17,252 |
| Delinquency Prob. | -0.05 | 0.11 | [-0.11, 0.00] | 20.71 | 58,303 |
| Log(Outstanding Debt) | -0.14 | 0.68 | [-0.67, 0.40] | 32.91 | 53,469 |
| Interest Rate | 0.04 | 0.85 | [-0.29, 0.37] | 18.33 | 66,581 |
| <i>Existing Mortgages</i> | | | | | |
| Repayment | -0.06 | 0.71 | [-0.32, 0.20] | 30.84 | 149,556 |
| Delinquency Prob. | -0.05 | 0.52 | [-0.19, 0.08] | 14.81 | 119,817 |
| Log(Outstanding Debt) | -0.17 | 0.28 | [-0.44, 0.09] | 24.57 | 152,734 |
| Interest Rate | -0.30 | 0.52 | [-1.07, 0.47] | 48.99 | 155,970 |
| Maturity | -0.98 | 0.29 | [-2.49, 0.53] | 52.19 | 155,551 |
| LTV | -1.45 | 0.64 | [-6.52, 3.62] | 24.28 | 155,985 |
| Rating | 0.20 | 0.17 | [-0.04, 0.44] | 8.83 | 119,802 |

Testing for Pre-Policy Differences II [back](#)

| Variable | RD Estimator | Robust Inference | | Bandwidth (in days) | Observations |
|-----------------------|--------------|------------------|-------------------|---------------------|--------------|
| | | p-value | 95% Conf. Int. | | |
| <i>Personal Loans</i> | | | | | |
| Delinquency Prob. | -0.02 | 0.50 | [-0.08, 0.03] | 30.34 | 27,158 |
| Log(Outstanding Debt) | 0.05 | 0.83 | [-0.36, 0.47] | 27.87 | 24,971 |
| Interest Rate | 0.08 | 0.92 | [-1.33, 1.49] | 19.02 | 26,830 |
| Maturity | -0.36 | 0.35 | [-0.99, 0.27] | 35.76 | 26,522 |
| Rating | 0.24 | 0.26 | [-0.11, 0.59] | 40.45 | 27,158 |
| <i>Car Loans</i> | | | | | |
| Delinquency Prob. | -0.11 | 0.63 | [-0.49, 0.27] | 38.28 | 5,489 |
| Log(Outstanding Debt) | -1.57 | 0.19 | [-3.52, 0.38] | 27.07 | 5,362 |
| Interest Rate | 0.55 | 0.65 | [-1.44, 2.53] | 33.36 | 4,878 |
| Maturity | -0.22 | 0.80 | [-1.63, 1.20] | 35.12 | 5,379 |
| LTV | 5.15 | 0.58 | [-10.19, 20.49] | 33.94 | 5,489 |
| Rating | 0.52 | 0.09 | [0.02, 1.02] | 30.50 | 5,489 |

(Un)-Predictability of Treatment [back](#)

- Check which mortgage characteristics **explain treatment status**
- **Only running variable** explain treatment choice consistently.

| | Entire sample | BW=40 | BW=30 | BW=25 | BW=15 |
|------------------|-------------------------|------------------------|-----------------------|----------------------|----------------------|
| Running | 0.0021*** (0.0001) | 0.0090*** (0.00005) | 0.0087*** (0.0001) | 0.011*** (0.0001) | 0.012*** (0.0004) |
| Oustanding Debt | 0.41*** (0.041) | 0.15*** (0.042) | 0.21*** (0.071) | 0.19 (0.123) | 0.13 (0.108) |
| Expected Payment | -1.14e-08*** (0.000) | 0.0012*** (0.0002) | 0.00015 (0.0003) | 0.00023 (0.0003) | 0.00072 (0.0006) |
| Maturity | -0.0001 (0.0002) | -0.00006 (0.0003) | 0.0004 (0.0004) | 0.0004 (0.0005) | 0.0004 (0.0005) |
| LTV | -1.9e-12*** (0.000) | -8.83e-07 (0.000) | 1.05e-06 (0.000) | 4.2e-06 (0.000) | 7.9e-06 (0.000) |
| Observations | 822,876 | 28,513 | 20,289 | 14,916 | 10,348 |
| R-squared | 0.21 | 0.38 | 0.26 | 0.29 | 0.34 |

Dynamic Estimates: CC Expenditure [back](#)

- T \implies contemporaneous effect.
- $T + \tau$ \implies effect τ quarters after receiving debt moratoria.
- $T + 2$ \implies pre-policy differences.

| | T-2 | T | T+1 | T+2 | T+3 |
|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Fuzzy-RD | -1.07 (1.90) | 2.10** (1.06) | 4.24* (2.47) | 0.66 (1.66) | -0.49 (2.63) |
| First Stage | | | | | |
| D_{ij} | 0.26*** (0.029) | 0.27*** (0.041) | 0.29*** (0.042) | 0.25*** (0.037) | 0.28*** (0.033) |
| All Observations | 17,344 | 16,504 | 17,954 | 19,696 | 20,630 |
| Bandwidth (in days) | 36.2 | 19.2 | 15.9 | 24.7 | 27.9 |

Dynamic Estimates: CC Expenditure [back](#)

- No differences in CC purchases before policy implementation.

| | T-2 | T | T+1 | T+2 | T+3 |
|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Fuzzy-RD | -1.07 (1.90) | 2.10** (1.06) | 4.24* (2.47) | 0.66 (1.66) | -0.49 (2.63) |
| | First Stage | | | | |
| D_{ij} | 0.26*** (0.029) | 0.27*** (0.041) | 0.29*** (0.042) | 0.25*** (0.037) | 0.28*** (0.033) |
| All Observations | 17,344 | 16,504 | 17,954 | 19,696 | 20,630 |
| Bandwidth (in days) | 36.2 | 19.2 | 15.9 | 24.7 | 27.9 |

Dynamic Estimates: CC Expenditure back

- Effect of moratorium on consumption disappears after two quarters.

Treated households \uparrow CC purchases:

- 2.10% in quarter moratoria started.
- 4.24% one quarter after. \implies liquidity mitigation + treatment timing and duration.

| | T-2 | T | T+1 | T+2 | T+3 |
|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Fuzzy-RD | -1.07 (1.90) | 2.10** (1.06) | 4.24* (2.47) | 0.66 (1.66) | -0.49 (2.63) |
| | First Stage | | | | |
| D_{ij} | 0.26*** (0.029) | 0.27*** (0.041) | 0.29*** (0.042) | 0.25*** (0.037) | 0.28*** (0.033) |
| All Observations | 17,344 | 16,504 | 17,954 | 19,696 | 20,630 |
| Bandwidth (in days) | 36.2 | 19.2 | 15.9 | 24.7 | 27.9 |

Moratoria and Mortgage Delinquency Dynamics [back](#)

- ↓ **Delinquency** over next four quarters after treatment.

| | T-1 (1) | T (2) | T+1 (3) | T+2 (4) | T+3 (5) | T+4 (6) |
|---------------------|-------------------|---------------------------|--------------------------|---------------------------|---------------------------|---------------------------|
| Fuzzy-RD | -0.05 (0.08) | -0.98*** (0.07) | -0.67*** (0.1) | -0.70*** (0.04) | -0.31*** (0.05) | -0.26*** (0.06) |
| | First Stage | | | | | |
| D_{ij} | 0.24*** (0.02) | 0.21*** (0.02) | 0.23*** (0.02) | 0.22*** (0.01) | 0.24*** (0.02) | 0.25*** (0.02) |
| Observations | 119,981 | 152,879 | 147,628 | 143,105 | 138,268 | 102,596 |
| Bandwidth (in days) | 14.8 | 8.2 | 8.5 | 20.13 | 14.6 | 13.8 |

Moratoria and Delinquency Dynamics on Other Debt [back](#)

- Only short term ↓ delinquency probability for other household debt.

| | T-1 (1) | T (2) | T+1 (3) | T+2 (4) | T+3 (5) | T+4 (6) |
|---------------------------|-----------------|--------------------------|---------------------------|-----------------|----------------|-----------------|
| (A) Personal Loans | | | | | | |
| Fuzzy-RD | -0.02 (0.03) | -0.09** (0.04) | -0.16*** (0.06) | -0.09 (0.06) | 0.03 (0.05) | -0.09 (0.06) |
| Observations | 27,158 | 28,158 | 29,348 | 31,134 | 32,823 | 34,783 |
| (B) Car Loans | | | | | | |
| Fuzzy-RD | -0.11 (0.23) | -0.36** (0.18) | 0.13 (0.26) | 0.24 (0.18) | 0.21 (0.19) | 0.27 (0.51) |
| Observations | 5,489 | 4,187 | 4,110 | 4,237 | 4,335 | 4,702 |

Moratoria and Mortgage Debt Dynamics [back](#)

- Existent Mortgage debt \implies **Log (Outstanding Balance_{it})**
 - Financial burden doesn't increase in quarter of treatment.
 - \downarrow Mortgage debt four quarters after treatment (due to \downarrow delinquency)

| | T-1 | T | T+1 | T+2 | T+3 | T+4 |
|---------------------|-------------------|------------------------|-------------------|-------------------|-------------------|--------------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Fuzzy-RD | -0.17 (0.16) | -0.16 (0.16) | -0.19 (0.16) | -0.17 (0.13) | -0.15 (0.14) | -0.22** (0.11) |
| | First Stage | | | | | |
| $D_{i,j}$ | 0.21*** (0.01) | 0.21*** (0.01) | 0.21*** (0.01) | 0.21*** (0.01) | 0.21*** (0.01) | 0.24*** (0.02) |
| Observations | 152,734 | 149,383 | 144,872 | 140,284 | 135,606 | 100,420 |
| Bandwidth (in days) | 24.6 | 23.7 | 22.6 | 20.8 | 20.4 | 18.6 |

Moratoria and Dynamics on Other Debt [back](#)

- Household debt on personal loans and car loans \implies **Log (Outstanding Balance_{it})**

| | T-1 (1) | T+1 (2) | T+1 (3) | T+2 (4) | T+3 (5) | T+4 (6) |
|---------------------------|-----------------|------------------|-------------------|-----------------|-----------------|-----------------|
| (A) Personal Loans | | | | | | |
| Fuzzy-RD | 0.06 (0.25) | -0.52* (0.29) | -0.58** (0.27) | -0.09 (0.34) | -0.06 (0.39) | -0.35 (0.31) |
| Observations | 24,971 | 25,897 | 26,306 | 26,964 | 27,557 | 28,278 |
| (B) Car Loans | | | | | | |
| Fuzzy-RD | -1.60 (0.77) | -2.7** (1.22) | -2.4*** (0.91) | -0.77 (0.86) | 0.94 (1.10) | 0.92 (1.12) |
| Observations | 5,362 | 4,105 | 4,006 | 4,141 | 4,235 | 1,837 |

Moratoria and Dynamics on Other Debt [back](#)

- ↓ **Outstanding debt** on personal loans and car loans:
 - Quarter of treatment: **0.52%** and **2.7%**.
 - One quarter after treatment: **0.58%** and **2.4%**.

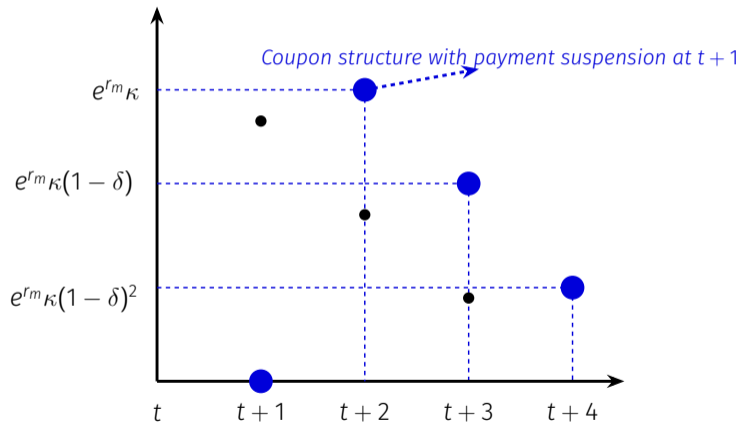
| | T-1 (1) | T (2) | T+1 (3) | T+2 (4) | T+3 (5) | T+4 (6) |
|---------------------------|-----------------|-------------------------|--------------------------|-----------------|-----------------|-----------------|
| (A) Personal Loans | | | | | | |
| Fuzzy-RD | 0.06 (0.25) | -0.52* (0.29) | -0.58** (0.27) | -0.09 (0.34) | -0.06 (0.39) | -0.35 (0.31) |
| Observations | 24,971 | 25,897 | 26,306 | 26,964 | 27,557 | 28,278 |
| (B) Car Loans | | | | | | |
| Fuzzy-RD | -1.60 (0.77) | -2.7** (1.22) | -2.4*** (0.91) | -0.77 (0.86) | 0.94 (1.10) | 0.92 (1.12) |
| Observations | 5,362 | 4,105 | 4,006 | 4,141 | 4,235 | 1,837 |

Exposure to Debt Moratoria and Bank Response [back](#)

| | Δ Profit | Δ Equity | Δ Assets | Δ Liab. |
|----------------------------|--------------------|--------------------|--------------------|--------------------|
| Bartik-IV | 0.46** (0.038) | 0.21*** (0.18) | 0.37*** (0.021) | 0.06 (0.16) |
| | First Stage | | | |
| B_{jt} | 0.98*** (0.192) | 0.98*** (0.192) | 0.98*** (0.192) | 0.98*** (0.192) |
| F-first stage | 26.06 | 26.06 | 26.06 | 26.06 |
| Observations | 200 | 200 | 200 | 200 |
| Bank fixed effects | ✓ | ✓ | ✓ | ✓ |
| Time-quarter fixed effects | ✓ | ✓ | ✓ | ✓ |

Mortgages with moratoria [back](#)

- Coupon structure of a **non-contingent bond** issued at t :



- If remains homeowner

$$V^{hh}(a, h, d, z, j) = \max_{c, a' \geq 0} \left\{ u(c, h) + \beta EV^h(a', z', j', h, d) \right\}$$

subject to

$$\begin{aligned} c + \delta_h p_h h + a' + m &= w(1 - \tau)y(j, z) + a(1 + r_k) \\ d' &= (d - m)(1 + r_l), \end{aligned}$$

- If decide to refinance \implies pay balance and get a new mortgage

$$V^{hf}(a, h, d, z, j) = \max_{c, d', a'} \left\{ u(c, h) + \beta EV^h(a', z', j', h, d'') \right\}$$

subject to

$$\begin{aligned} c + d + p_h h + \delta_h p_h h + \varphi_f + a' &= w(1 - \tau)y(j, z) + a(1 + r_k) + d'(q^m(a', z, j, d, h) - \varphi_m) \\ d' &\leq p_h h(1 - \phi) \end{aligned}$$

- If sell house (rent or buy new house) \implies identical to a renter's problem

$$V^{hr}(a, h, d, z, j) = V^{rr}(a + p_h h(1 - \varphi_s) - d, z, j)$$

- If default

$$V^{he}(a, d, z, j) = \max_{c, s, a' \geq 0} \left\{ u(c, s) + \beta_i E \left[\pi V^r(a', z', j') + (1 - \pi) V^i(a', z', j') \right] \right\} \quad (1)$$

subject to

$$c + a' + p_r s = a(1 + r_k) + w(1 - \tau)y(j, z) + \max\{(1 - \varphi_e)p_h h - d, 0\}.$$

$$V^i(a, z, j) = \max_{c, s, a'} \left\{ u(c, s) + \beta \left[\pi EV^r(a', z', j') + (1 - \pi)EV^i(a', z', j') \right] \right\}$$

subject to

$$c + a' + p_r s = w(1 - \tau)y(j, z) + a(1 + r_k)$$

- Perfectly competitive firm produces final output

$$\max_{K_t, N_t, u_t} \mathbb{Z}_t K_t^\alpha (N_t u_t)^{1-\alpha} - (r_{k,t} + \delta_k) K_t - (1 + \zeta r_{l,t+1}) w_t N_t$$

- Wage per efficiency of labor (w_t) is defined as:

$$w_t = \underbrace{\bar{w}_t}_{\text{base rate}} + \underbrace{\vartheta \frac{u_t^{1+\psi}}{1+\psi}}_{\text{convex adjustment cost}}$$

- Own the rental housing units by buying and selling from households and from each other.

$$(1 + r_k) V^{rc}(H_r) = \max_{H'_r} \left\{ (p^r - \kappa - p^h) H'_r + (1 - \delta_h) H_r + \eta \frac{(H_r - H'_r)^2}{2} + V^{rc}(H'_r) \right\}$$

- In equilibrium rate of return equal to the rate of return on capital

$$p_r = \kappa + p_h + \eta p_h (H'_r - H_r) - \frac{(1 - \delta_h + \eta (H''_r - H'_r)) p'_h}{1 + r_k}$$

Externally Set Parameters [back](#)

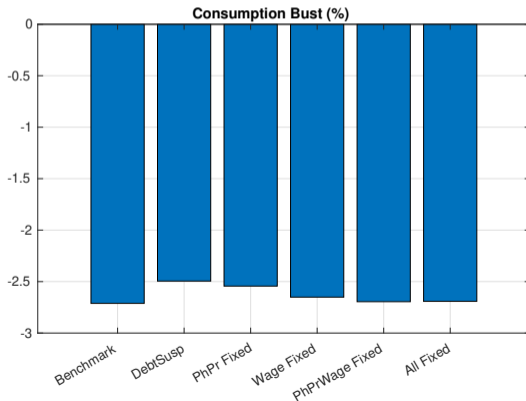
| Parameter | Explanation | Value |
|------------------------|---|-------|
| σ | risk aversion | 2 |
| α | capital share | 0.4 |
| ρ_{ε} | annual persistence of income | 0.96 |
| σ_{ε} | annual std of innovation to AR(1) | 0.19 |
| φ_h | selling cost for a household | 7% |
| φ_e | selling cost for foreclosures | 25% |
| φ_f | fixed cost of mortgage origination | 8% |
| φ_m | variable cost of mortgage origination | 0.75 |
| δ_h | annual housing depreciation rate | 2.5% |
| π | quarterly prob. of being an active renter | 3.6% |
| \bar{H} | housing supply | 1 |
| ψ | wage curvature | 3 |
| ϕ | down payment requirement | 0.3 |
| ζ | share of wage bill financed | 100% |
| δ_R | quarterly capital depreciation rate | 2.5% |
| δ_m | quarterly mortgage depreciation rate | 2.5% |

Internally Calibrated Parameters [back](#)

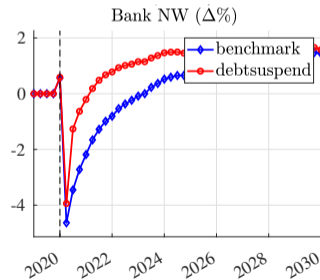
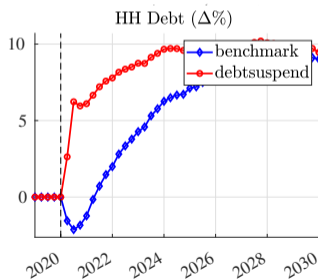
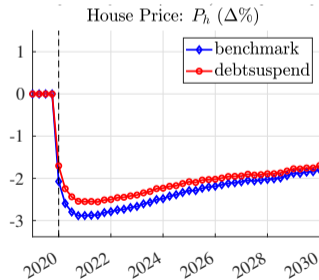
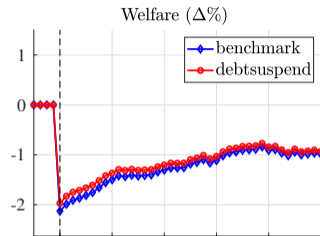
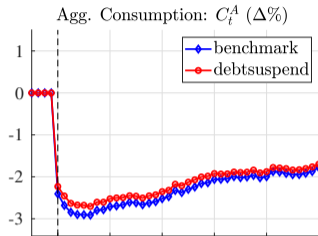
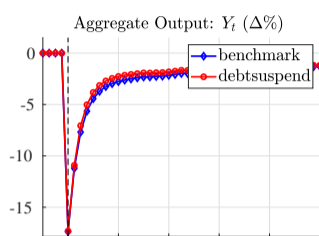
| Parameter | Explanation | Value |
|-----------------|---------------------------------------|-------|
| β | discount factor | 0.96 |
| \underline{h} | minimum house size | 0.89 |
| r | bank borrowing rate | 1.5% |
| γ | weight of housing services in utility | 0.19 |
| κ | rental maintenance cost | 0.06 |
| ϑ | wage parameter | 2.36 |
| ξ | bank seizure rate | 0.2 |
| β_L | bank discount factor | 0.95 |

Decomposition of the Debt Suspension Policy [back](#)

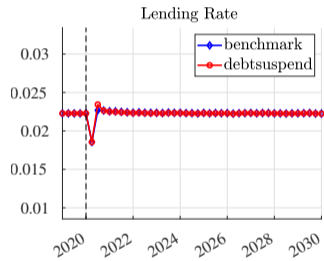
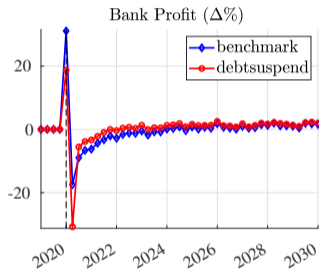
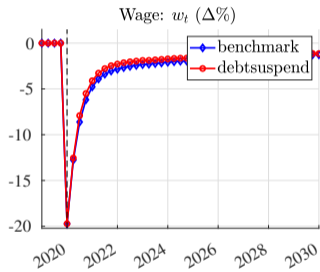
- Decompose change in consumption after two quarters into components.
 - Indirect effect explains most of the consumption response.
 - Direct effect is about 10%



Aggregate Effect: all aggregate variables [back](#)

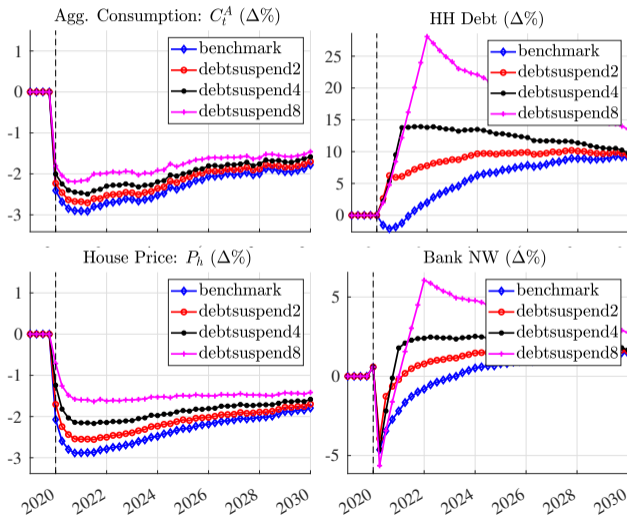


Introducing Moratoria: Other Outcomes [back](#)



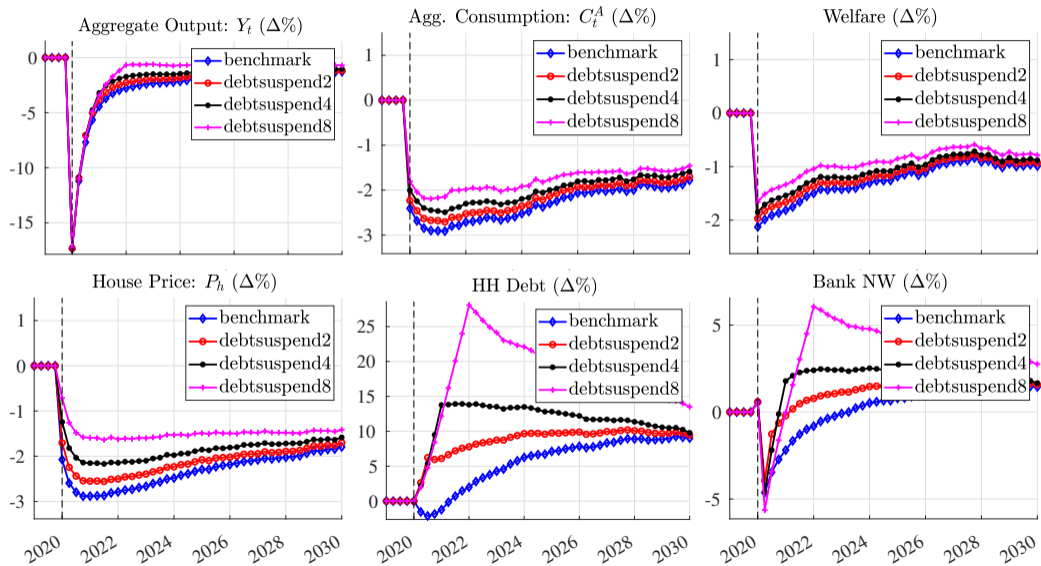
Comparing Length of Moratoria All back

- Gains increase with length of payment suspension to households



Comparing Length of Moratoria

[back](#)



Policy Comparison [back](#)

