Debt Moratorium: Theory and Evidence

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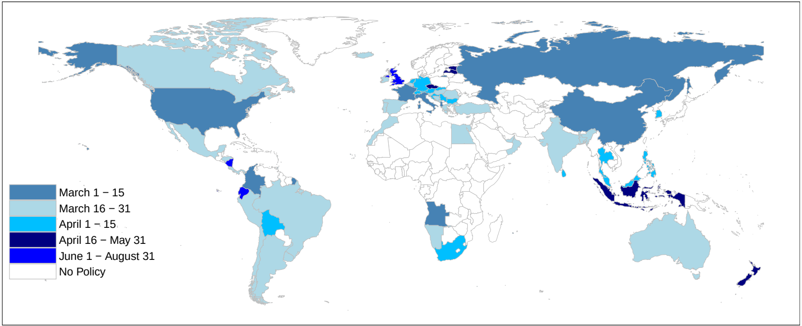
- **Debt moratorium**, refers to stipulating payment suspensions or extending the maturity of debt instruments.
- One of the oldest policy recommendations, references in Abrahamic religions.
  - "If it is difficult for someone to repay a debt, postpone it until a time of ease." –Qur'an 2:280
- A world 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.

Moratorium policies (Covid-19)



What do we do?

Three things:

1. Provide a theoretical explanation with a three period model
2. Investigate the impact of debt moratorium policy
   - Provide causal evidence using highly granular loan level Colombian data (new)
     - Propose an identification strategy (new)
3. A quantitative model, variables that cannot be otherwise studied and extend it for policy analysis.(newish)

Preview of Our Main Findings

1. Theory predicts different effects when accounting default risk as supply elasticities change.
2. A causal link is established for stressed and non-stressed firms.
3. Long-run indebtedness and default rise. Yet, if the policy can be designed to stipulate debt forgiveness (or at least interest rates are not accrued), then larger welfare gains can be attained by reducing default risk.

Simple three-period model

A three-period model environment

1. One-good, closed economy with competitive lenders and firms.
2. Firms have zero endowment in the first period, that is, $y_1 = 0$ and they discount the future at rate $\beta < 1$ while banks discount rate is taken to be unity for simplicity.
3. The utility function for both the bank and the firm is assumed to take the quasi-linear form, that $u(c) = Ac$ for the initial period and $v(c) = Ac - \frac{\phi}{2}c^2$ with $A > \phi > 0$.
4. With a probability π, a liquidity shock ℓ hits. With the policy in place, payments are deferred to the next period.

- The maximization problem of the firm without the debt moratorium policy can be written as

$$\max_{b} \underbrace{u\left(qb\right)}_{t_1} + \beta \underbrace{\left[(1-\pi)v\left(1-\frac{b}{2}\right) + \pi v\left(1-\frac{b}{2}-\ell\right)\right]}_{t_2} \tag{1}$$
$$+\beta \underbrace{\left[(1-\pi)v\left(1-\frac{b}{2}\right) + \pi v\left(1-\frac{b}{2}+\ell\right)\right]}_{t_3}$$

subject to $c \geq 0$.

- FOC, demand curve for firms

$$b(q): \quad 2\frac{A(q-\beta)+\beta\phi}{\beta\phi}. \tag{2}$$

- The maximization problem of the firm with the debt moratorium policy

$$\max_{b^p} \; u(qb^p) + \beta\Big[(1-\pi)v(1-\frac{b^p}{2}) + \overbrace{\pi v(1-\ell)}^{Payments\ deferred}\Big] + \tag{3}$$
$$\beta\Big[(1-\pi)v(1-\frac{b^p}{2}) + \underbrace{\pi v\,(1+\ell-b^p)}_{Deferred\ payments\ are\ paid}\Big]$$

subject to $c \geq 0$.

New demand curve with the policy:

$$b^p(q): \quad 2\frac{A(q-\beta)+\beta\phi}{\beta\phi} + \beta\frac{\pi(A-\phi)+\pi\phi\ell}{\beta\phi}. \tag{4}$$

- The maximization problem without the policy:

$$\max_b \; u\left(1 - qb\right) + v\left(1 + \frac{b}{2}\right) + v\left(1 + \frac{b}{2}\right) \tag{5}$$

subject to $c \geq 0$.

Lenders' problem

- The maximization problem without the policy:

$$\max_{b} \; u\left(1 - qb\right) + v\left(1 + \frac{b}{2}\right) + v\left(1 + \frac{b}{2}\right) \tag{5}$$

subject to $c \geq 0$.

- With the policy it reads

$$\max_{b^p} \; u(1 - qb^p) + \left[(1-\pi)v(1 + \frac{b^p}{2}) + \overbrace{\pi v(1)}^{receivables\ deferred}\right] + \left[(1-\pi)v(1 + \frac{b^p}{2}) + \underbrace{\pi v\left(1 + b^p\right)}_{deferred\ payments\ received}\right] \tag{6}$$

subject to $c \geq 0$.

- The solution to these problems are supply curves:

$$b(q): \quad 2\frac{A(1-q)-\phi}{\phi}, \tag{7}$$

$$b^p(q): \quad 2\frac{A(1-q)-\phi}{\phi(1+\pi)}. \tag{8}$$

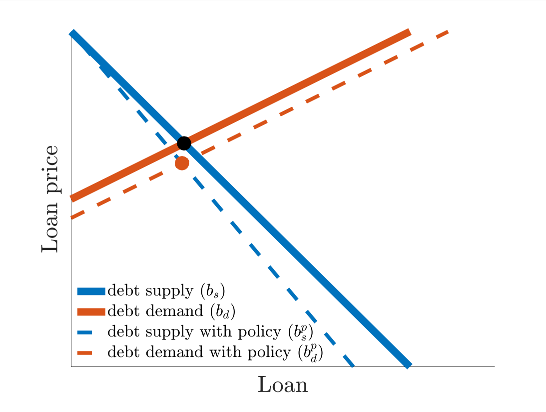


Figure 1: Demand and supply of loans with and without the policy.

- The solution to firm's problem, price is now $q(b)$

$$b(q): \quad 2\frac{A(q-\beta)+\beta\phi}{\beta\phi \underbrace{-2A\frac{\partial q}{\partial b}}_{always \geq 0}}, \tag{9}$$

$$b^p(q): \quad 2\frac{A(q-\beta)+\beta\phi}{\beta\phi - 2A\frac{\partial q}{\partial b}} \underbrace{+\beta\frac{\pi(A-\phi)+\pi\phi\ell}{\beta\phi} - 2A\frac{\partial q}{\partial b}}_{always \geq 0}. \tag{10}$$

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- The solution to lenders' problem

$$b(q): \quad 2\frac{A(1-q)-\phi}{\underbrace{\phi + 2A\frac{\partial q}{\partial b}}}, \tag{11}$$

$$b^p(q): \quad 2\frac{A(1-q)-\phi}{\underbrace{\phi(1+\pi) + 2A\frac{\partial q}{\partial b}}_{depends\ on\ price's\ responsiveness}}. \tag{12}$$

- During crisis times, that is, when price q is highly responsive to the loan amount b, $\frac{\partial q}{\partial b}$

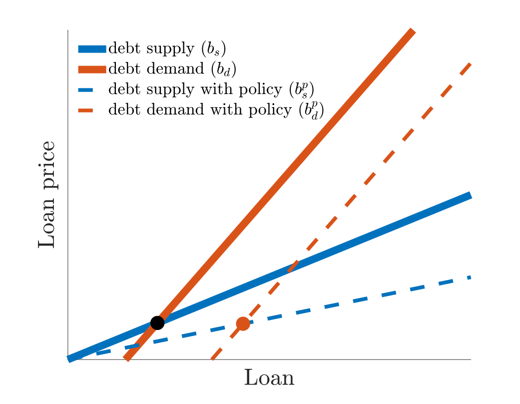


Figure 2: Demand and supply of loans with and without the policy when default risk is accounted.

Second part: Establishing a causal link

Data

- Colombian credit registry (at the loan level) from Q1-2019 to Q4-2020 (4.4 million observations).
  - Includes information on: interest rates, maturities, amounts, issuance dates, expiration dates, ex-ante credit ratings
  - We center on new and existing loans
- We employ 176,638 loans (36 private banks & 102,386 firms) at the end of 2020:Q2
- We match to 92,214 new loans from bank j to firm i issued in 2020:Q3-2021:Q4

The Colombian Debt Moratorium Policy

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

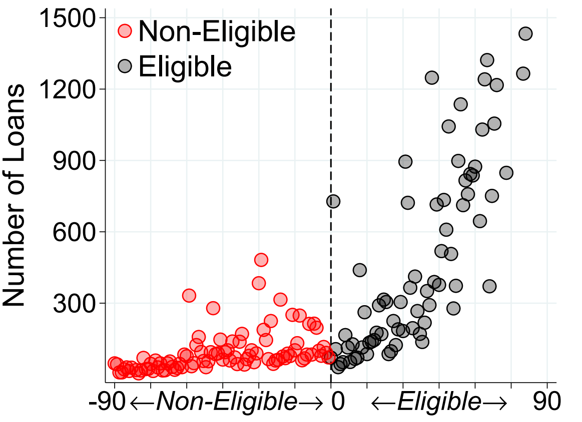
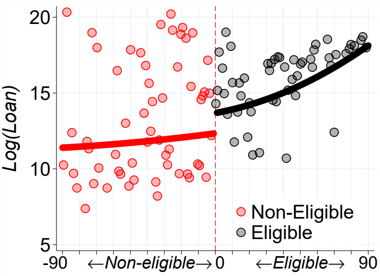
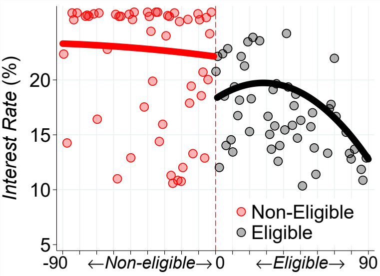


Figure 3: Identification: all loans.



(a) New loan amounts



(b) Interest rate on new loans

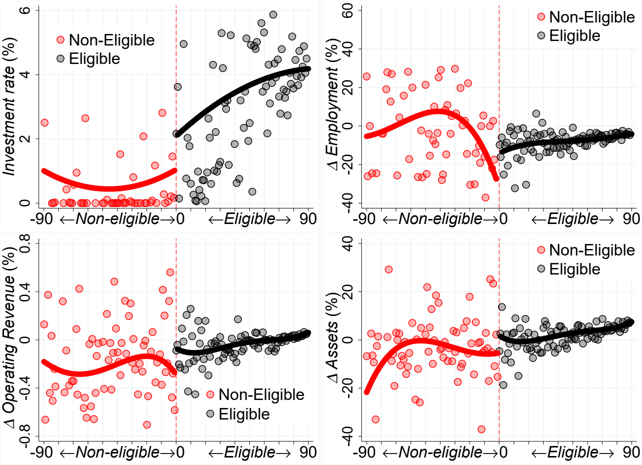
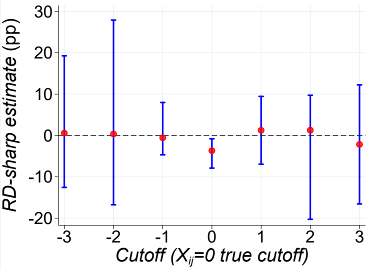
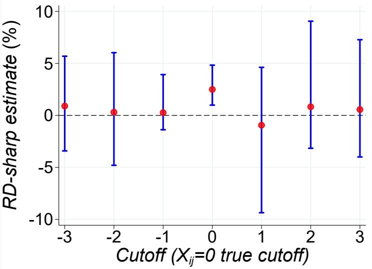

Investment rate (%)
Non-Eligible
Eligible
-90 ←Non-eligible→0 ←Eligible→ 90
Δ Employment (%)
Non-Eligible
Eligible
-90 ←Non-eligible→0 ←Eligible→ 90
Δ Operating Revenue (%)
Non-Eligible
Eligible
-90 ←Non-eligible→0 ←Eligible→ 90
Δ Assets (%)
Non-Eligible
Eligible
-90 ←Non-eligible→0 ←Eligible→ 90

Table 1: RD Benchmark results: new loans

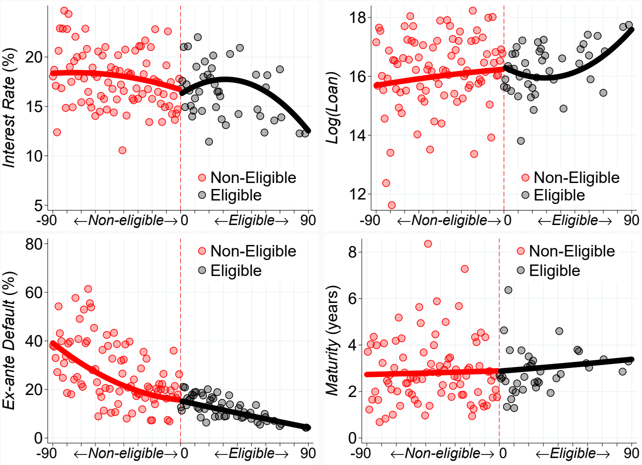
	Log(Loan)	Interest	Maturity	Collateral	Rating	Default Prob. Ex-ante	Default Prob. Ex-post
Fuzzy-RD	15.76**	-25.56*	8.78**	1.30**	3.43***	-1.51***	-1.45***
	(6.8)	(15.3)	(3.8)	(0.6)	(1.3)	(0.4)	(0.5)
Observations	29,947	29,947	29,947	29,947	29,152	57,461	57,461
BW loc. poly.	16.3	18.9	19.9	29.0	25.3	27.7	18.3

Robust Bias-corrected standard errors in parentheses, *, **, ***, indicate significance at the 10% 5% and 1% respectively


RD-sharp estimate (pp)
30
20
10
0
-10
-20
-3
-2
-1
0
1
2
3
Cutoff (X_{ij}=0 true cutoff)


RD-sharp estimate (%)
10
5
0
-5
-10
-3
-2
-1
0
1
2
3
Cutoff (X_{ij}=0 true cutoff)

Testing for Pre-existing differences with respect to the quarter/year before policy



Testing for Pre-existing differences-Firms variables

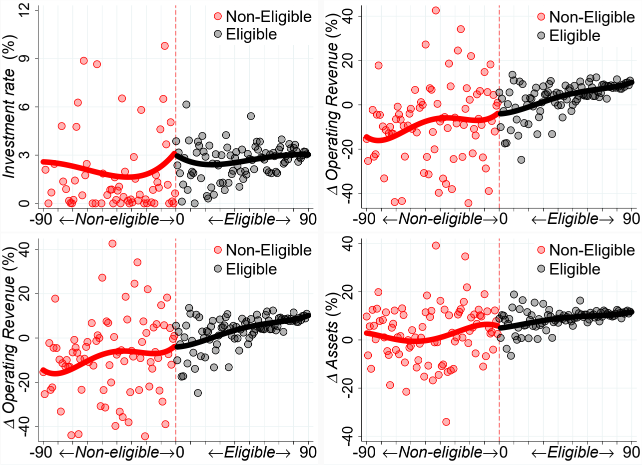


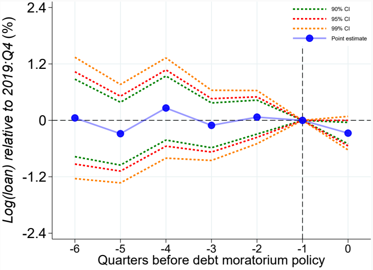
Table 2: RD benchmark results: Firm level outcomes

	ΔEmp.	Inv. rate	ΔOp. Rev.	ΔLiab.	Δ Assets	ΔProfits	ΔEquity
Fuzzy-RD	1.59**	0.08***	7.15***	0.19**	0.93***	0.83*	0.68*
	(0.7)	(0.0)	(2.2)	(0.1)	(0.3)	(0.4)	(0.4)
Observations	15,379	11,386	31,799	30,864	30,626	28,490	30,900
BW loc. poly.	28.9	10.7	11.5	12.8	6.6	16.5	16.7

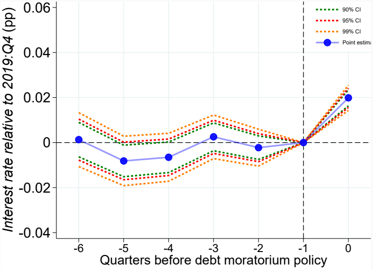
- Acknowledge that the causal link is not as clean as the RDD.
- It is confounded by selection
- We aim to bring theory (and later on the model) closer to the data.
- Use DID, firm and bank-time fixed, $T_t = \mathbf{1}\{2020Q1\}$

$$Loan_{ij,t+1} = \alpha_{i,jt} + \gamma D_{ij} + \sum_{\tau=0}^{m} \beta_\tau D_{ij} T_{t-\tau} + \sum_{\tau=1}^{q} \beta_{-\tau} D_{ij} T_{t+\tau} + \epsilon_{ij,t+1} \tag{13}$$

Figure 4: Parallel trends assumption for non-stressed firms



(a) Log(Loan)



(b) Interest Rate

Table 3: DID benchmark results: firm level outcomes

	ΔEmp.	Inv. rate	ΔOp. Rev.	ΔLiab.	Δ Assets	ΔProfit	ΔEquity
DID	0.001	0.01	0.02	-0.015***	-0.025***	-0.007	0.71
	(0.01)	(0.03)	(0.01)	(0.004)	(0.008)	(0.01)	(1.2)
Observations	120,759	35,193	200,720	145,852	138,597	210,535	146,807
$\bar{R}^2$	15.4	1.2	1.2	2.6	1.4	0.7	-1.0

Robust Bias-corrected standard errors in parentheses, *, **, *** indicate significance at the 10% 5% and 1% respectively

Results - Recap

Theory

	Loan amount	Interest rate
Stressed	$\uparrow$	?
Non-stressed	?	$\uparrow$

Empirical

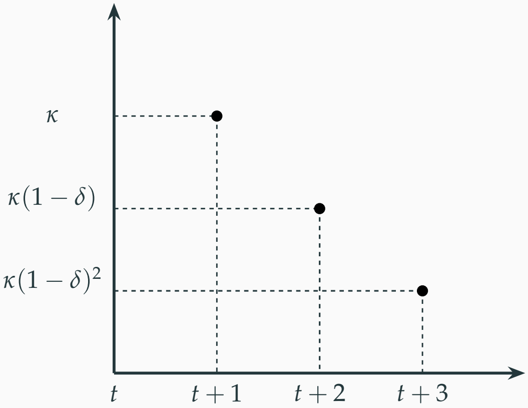
	Loan amount	Interest rate
Stressed	$\uparrow$	$\downarrow$
Non-stressed	$\downarrow$	$\uparrow$

Third part: Quantitative part

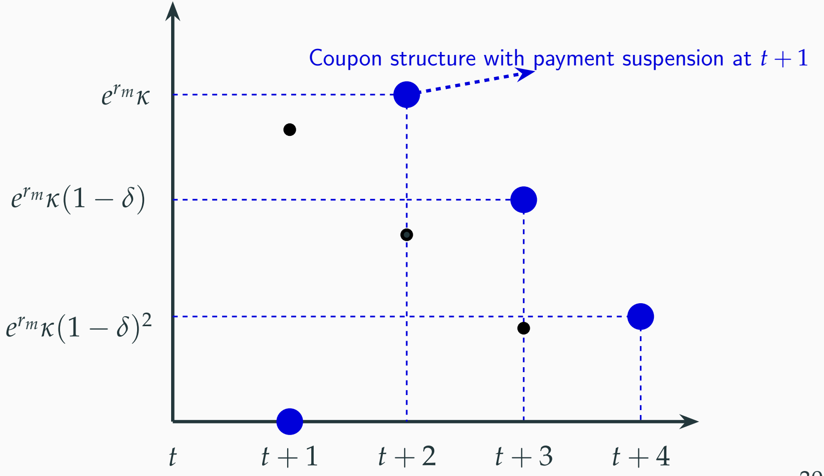
Model outline

- Benchmark model: Eaton and Gersovitz (1981); Aguiar and Gopinath (2006), Arellano (2008), Hatcondo and Martinez and Önder and Roch (2022)
- Add **liquidity shocks** in the form of lenders' increased risk aversion.
- Introduce production economy as in Mendoza and Yue (2012)
- Nash-bargaining between borrowers and lenders after default
- Households own firms and borrow on behalf of them
- Each period, the household
  1. observes aggregate income and **liquidity shocks**,
  2. chooses whether to default,
  3. borrows using **non-contingent bonds and contingent debt**

- **Perpetuities with geometrical decreasing coupons** (Arellano and Ramanarayanan, 2012; Chatterjee and Eyigungor, 2012; Hatchondo and Martinez, 2009).
- Coupon structure of a **non-contingent bond** issued at t:



- Automatic payment suspension with adverse "liquidity" shock.
- If payment suspension clause activates at $t+1$, unpaid coupon is paid (with interest) when liquidity shock is over.



Recursive formulation (Standard)

Let $s \equiv (\epsilon, p)$ denote the vector of exogenous states

$$V(b_m, b, s) = \max \left\{ V^R(b_m, b, s), V^D(b_m, b, s) \right\},$$

$$c = \epsilon f(K, L) - I^f P^f(r^*) - \delta b - [1 - \mathcal{I}(p)]\, \delta_m b_m + q(b', b'_m, s) i + q_m(b', b'_m, s) i_m,$$

$$i = b' - b(1 - \delta),$$

$$i_m = b'_m - [1 - \mathcal{I}(p)]\, b_m (1 - \delta_m) - \mathcal{I}(p) b_m e^{r_m},$$

$$q(b', b'_m, s) \geq \underline{q}\; \forall\, b' > b(1 - \delta),$$

$$q_m(b', b'_m, s) \geq \underline{q}\; \forall\, b'_m > [1 - \mathcal{I}(p)]\, b_m (1 - \delta_m) + \mathcal{I}(p) b_m e^{r_m},$$

r_m is suspension rate.

$$d' = \text{ next-period default decision } = \hat{d}\,(b', b'_m, s'),$$
$$b'' = \text{ next-period non-contingent debt decision } = \hat{b}\,(b', b'_m, s'),$$
$$b''_m = \text{ next-period debt moratorium decision } = \hat{b}_m\,(b', b'_m, s').$$

$$q(b', b'_m, s) \quad = \quad \mathbb{E}_{s'|s}\left[M(\varepsilon', p)\left[d'\alpha q\left(\alpha b', \alpha b'_m, s'\right)(1-d')\left[\delta + (1-\delta) q\left(b'', b''_m, s'\right)\right]\right]\right], \tag{14}$$

$$\begin{aligned} q_m(b', b'_m, s) \quad &= \quad \mathbb{E}_{s'|s}\left[M(\varepsilon', p)\left[d'\alpha q_m\left(\alpha b', \alpha b'_m, s'\right)\right.\right. \\ &+ \quad (1-d')\left[\left[1-\mathcal{I}(p', g')\right]\left[\delta_m + (1-\delta_m) q_m\left(b'', b''_m, s'\right)\right]\right. \\ &+ \quad \left.\left.\left.\mathcal{I}(p', g') e^{r_m} q_m\left(b'', b''_m, s'\right)\right]\right]\right], \end{aligned} \tag{15}$$

Parameterization

- Follow Hacthondo et al. (2022) for global liquidity shock:
  - Three 1.25-year p_H episodes every 20 years, o.w. $p_L = 0$
  - Spread is on average 300 basis points higher with p_H
  - With negative correlation between shocks to global risk premia and TFP

Long-run Simulation results

	Data	Benchmark	Moratoria
Mean standard loan/income (%)	15.7	15.5	4.0
Mean moratorium loan/income (%)	*n.a.*	*n.a.*	14.2
Mean r_s (%)	5.7	5.7	6.5
Mean moratorium r_s (%)	*n.a.*	*n.a.*	7.6
Share of NPL	3.5	3.7	3.9
Recovery rate (%)	33	31.2	29.2
Duration	5.0	5.0	4.8
Duration moratorium	*n.a.*	*n.a.*	5.2
σ_{r_s}	2.2	2.4	2.82
σ_{r_s} moratorium	*n.a.*	*n.a.*	2.9
Labor decline during defaults (%)		14.4	14.3
Labor decline during high-risk-premium		2.8	3.2
Probability high-risk-premium starts (%)	15.0	15.0	15.0
Lower income during high-risk-premium (%)	4.0	4	4.5
Δ r_s with high-risk-premium shock	3	3	3.8
Fraction of defaults triggered by liquidity (%)		10.1	0.8
$\sigma(c)/\sigma(y)$		0.95	0.93
$\rho(c, y)$		0.99	0.99

- Equivalent % increase in consumption.
- Initial debt = mean debt in the simulations.

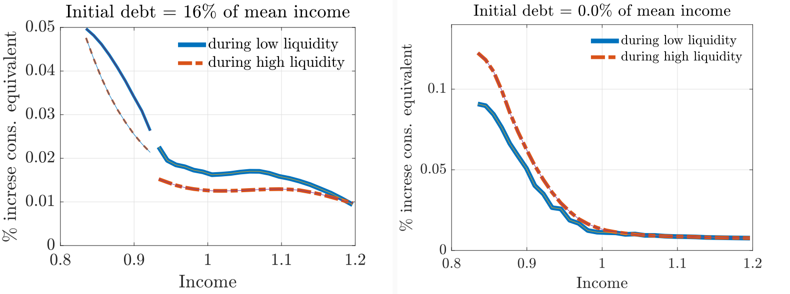
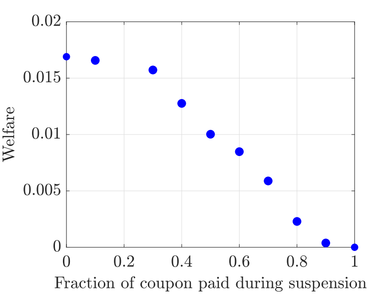
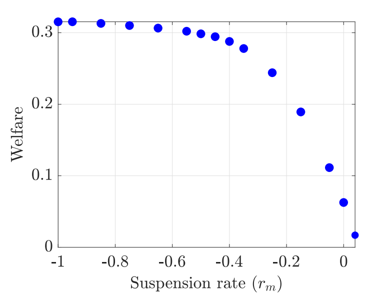


Figure 5: Welfare gains from switching to debt moratorium economy

Welfare gains

- Equivalent % increase in consumption.
- Initial debt = mean debt in the simulations.





Conclusion

Conclusions

- Debt moratorium has different effects depending if firm is stressed or not. Do it **If** stressed
- Haircuts on the suspension rate may reduce defaults and improve welfare even further. At least do not accrue interest during the suspension.

$$\max_{b}\ u\left(qb\right)+\beta(1-\pi)\left(\underbrace{\int_{y^{\star}} v\left(y-\frac{b}{2}\right)}_{repayment}+\underbrace{\int^{y^{\star}} v\left(y-C\left(y\right)\right)}_{default}\right)dF(y) \quad (16)$$

$$+\beta\pi\left(\underbrace{\int_{y^{\star}} v\left(y-\frac{b}{2}-\ell\right)}_{repayment}+\underbrace{\int^{y^{\star}} v\left(y-C\left(y\right)\right)}_{default}\right)dF(y)$$

$$+\beta(1-\pi)\left(\underbrace{\int_{y^{\star}} v\left(y-\frac{b}{2}\right)}_{repayment}+\underbrace{\int^{y^{\star}} v\left(y-C\left(y\right)\right)}_{default}\right)dF(y)$$

$$+\beta\pi\left(\underbrace{\int_{y^{\star}} v\left(y-\frac{b}{2}+\ell\right)}_{repayment}+\underbrace{\int^{y^{\star}} v\left(y-C\left(y\right)\right)}_{default}\right)dF(y)$$

subject to $c\geq 0$.

and the lender's problem who takes the default threshold y^* given as

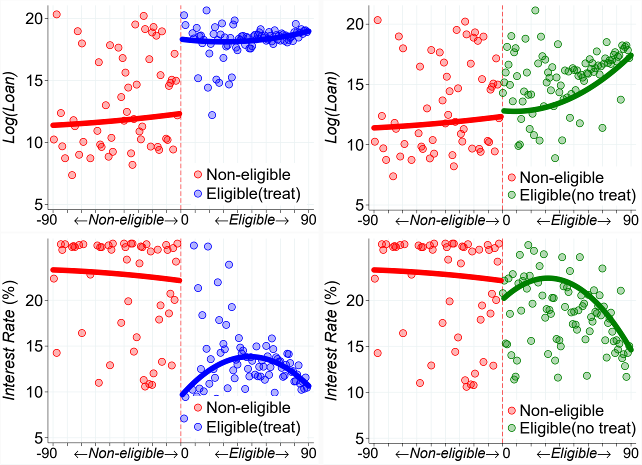
$$\max_b \; u\left(1-qb\right) + (1-\pi)\left(\underbrace{\int_{y^\star} v\left(y+\frac{b}{2}\right)}_{repaid} + \underbrace{\int^{y^\star} v\left(y\right)}_{defaulted}\right) dF(y) \tag{17}$$

$$+\pi\left(\underbrace{\int_{y^\star} v\left(y+\frac{b}{2}\right)}_{repaid} + \underbrace{\int^{y^\star} v\left(y\right)}_{defaulted}\right) dF(y)$$

$$+(1-\pi)\left(\underbrace{\int_{y^\star} v\left(y+\frac{b}{2}\right)}_{repaid} + \underbrace{\int^{y^\star} v\left(y\right)}_{defaulted}\right) dF(y)$$

$$+\pi\left(\underbrace{\int_{y^\star} v\left(y+\frac{b}{2}\right)}_{repaid} + \underbrace{\int^{y^\star} v\left(y\right)}_{defaulted}\right) dF(y)$$

subject to $c \geq 0$.



Log(Loan)
Interest Rate (%)
Non-eligible
Eligible(treat)
Eligible(no treat)
-90
←Non-eligible→
0
←Eligible→
90
20
15
10
5