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Debt Moratorium: Theory and Evidence

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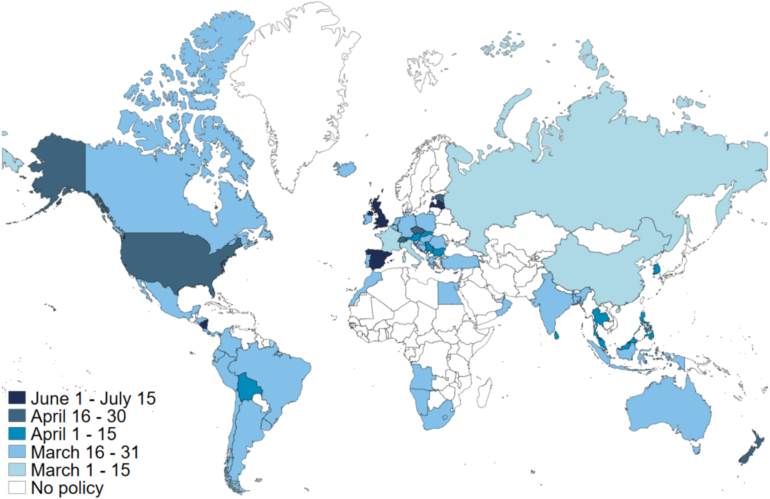
Motivation, why is it important?

A world of record-high debt levels, both public and private

- Shocks to private debt and government alleviation policies are at the center of macroeconomic debates.
    - **Debt moratorium**, which refers to stipulating payment suspensions or extending the maturity of debt instruments plays a central role in these discussions.

Moratorium policies (Covid-19)



Moratorium policies (Covid-19)

Country	Regulation issued date	Eligility Criteria (days past due)	Cutoff date
Panama	March 17	< 90	March 17
Bosnia and Herzegovina	March 20	< 90	March 20
Cabo Verde	April 1	≤ 90	March 28
Cyprus	March 30	< 30	Dec 31, 2019
Hong Kong	May 1	< 30	May 1
Malaysia	April 1	< 90	April 1
Malta	April 14	0	February 29
Montenegro	March 20	≤ 90	Dec 31, 2019
Romania	March 30	0	March 2
Trinidad and Tobago	March 31	< 90	March 31

What we do

Three things:

1. Provide a theoretical explanation with a three period model
2. Empirically evaluate how these measures had an impact on the credit market
    - Debt moratorium policies date back to as early as 1820 for farm foreclosures in NY, USA
    - Provide causal evidence using highly granular loan level Colombian data.
3. A quantitative sovereign default featuring our findings and extend it for policy analysis.

Preview of Our Main Findings

1. Theory predicts different effects when accounting default risk as supply elasticities change.
   - Non-stressed: loan amount depends on elasticity, interest rate $\uparrow$
   - Stressed: loan amount $\uparrow$, interest rate depends on elasticity
2. A causal link is established for stressed and non-stressed firms.
3. Our quantitative default model can account for our findings effects and show that indebtedness and default risk become preferable as the policy eliminates liquidity concerns.

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 $A > \phi$.
4. With a probability π, a liquidity shock ℓ hits. With the policy in place, payments are deferred to the next period.

A three-period model environment

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

$$\max_b \underbrace{u(qb)}_{t_1} + \underbrace{\beta\left[(1-\pi)v(1-\delta b) + \pi v(1-\delta b-\ell)\right]}_{t_2} + \underbrace{\beta v(1-(1-\delta)b+\ell)}_{t_3} \quad \text{subject to } c \geq 0 \quad . \tag{1}$$

- FOC with the fraction of payment in t_2 $\left(\delta = 1/2\right)$

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

With the policy

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

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

subject to $c \geq 0$.

The solution to this problem is

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

Lender's problem

- The maximization problem with and without the policy:

$$\max_{b} \; \underbrace{u\left(1-qb\right)}_{t_1}+\underbrace{v\left(1+\delta b\right)}_{t_2}+\underbrace{v\left(1+\left(1-\delta\right)b\right)}_{t_3} \tag{5}$$

subject to $c \geq 0$.

- With the policy it reads

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

subject to $c \geq 0$.

Lender's problem

- The solution to these problems are

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

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

Results

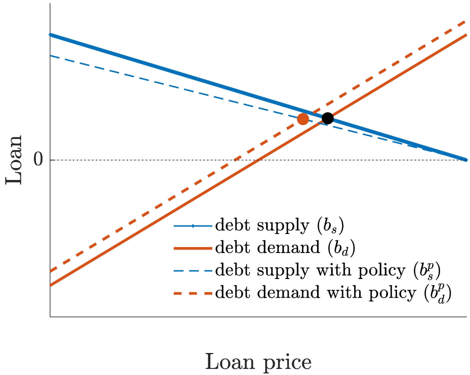


Figure: Demand and supply of loans with and without the policy.

When default risk is accounted

- The solution to firm's problem

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

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

- The solution to lenders' problem

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

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

Results

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

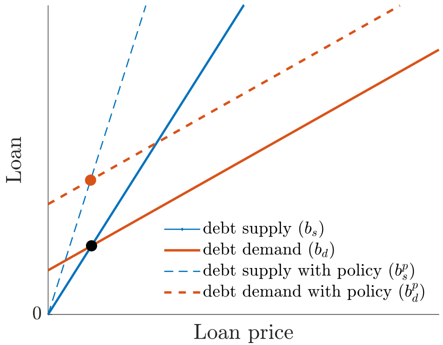


Figure: Demand and supply of loans with and without the policy when default risk is accounted.

Empirical strategy

Data

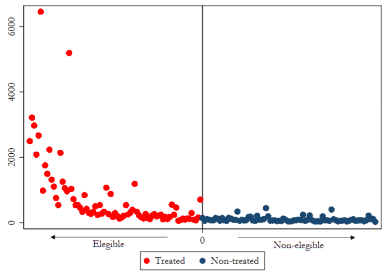
- Colombian credit registry (at the loan level) from Q1-2019 to Q4-2020 (4.4 million observations).
  - Includes information on: interest rates, maturities, amounts, issuance dates, expiration dates, ex-ante credit ratings
- Yearly firm-level balance sheet information (corporate registry, 250.000 observations)
- The database has a total of 37 private banks and 9,000 firms and we match 563,000 loans of which 292,000 correspond to new loans.

Identification

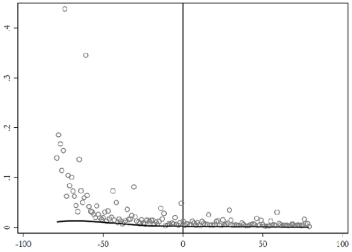
- Regression Discontinuity Design
  1. Eligibility criterion according to how the Colombian regulation was enacted: eligible borrowers could not exceed 60 past due days on their credit as of the 29^{th} of February 2020.
  2. So firms who defaulted before/after January 1st 2020 are expected to be ex-ante to have similar characteristics as they barely meet/miss the criteria.

Descriptives

Figure: Treated and Non treated Loans and McCrary's Test



(a) Treatment Distribution



(b) McCrary's Test

- McCrary test doesn't reject the null hypothesis with a p-value of: 5%

Empirical model

Assignment of treatment:

$$\hat{D}_{ij,t} = \mathbf{1}\left\{X_{ij,t} \geq 0\right\} \tag{13}$$

We estimate:

$$\arg\min_{\theta} \sum_{ij=1}^{I\times J} \sum_{t=0}^{T} \left[Loan_{ij,t+1} - \alpha - \theta\hat{D}_{ij,t} - b\left(X_{ij,t}\right) - \tau\hat{D}_{ij,t}\left(X_{ij,t}\right)\right]^2 K\left(\frac{X_{ij,t}}{h}\right) \tag{14}$$

- $\theta = (\theta_1, ..., \theta_J)'$ are impulse-response coefficients for D_t
- $K(\cdot)$ is a kernel function
- h is the bandwidth (Calonico, 2014)

Main challenges

- In 2007 the Financial Superintendency enacted a provisioning scheme based on the same number of non-performing days as those used to grant the debt moratorium benefit to corporates.
- Hence, to disentangle the effects of the debt moratorium policy, we use pre-pandemic âĂIJplacebo" time periods ($\hat{\theta}^{Pre\_Pandemic}$), in which only the provision effect was active
  - To narrow in on these placebos, i.e. to make them more comparable with θ, we restrict the same firms that had an existing credit line in Q1 of 2020.
  - "RDD Difference-in-Difference": $\hat{\theta} - \hat{\theta}^{Pre\_Pandemic}$

Results (Stressed firms)

	Loan Amount	Provision	Credit Rating	Days past due	Interest rate	Maturity	Collateral
All Firms							
	0.114**	0.048*	0.020	-49.220***	-6.018***	0.639	0.084**
	(0.0475)	(0.0268)	(0.107)	(7.247)	(0.573)	(0.593)	(0.0345)
w/bank & firm-sector FE	0.078**	0.037***	0.019	-33.82***	-3.976***	0.020	0.051
	(0.0401)	(0.0152)	(0.0570)	(11.24)	(0.125)	(0.480)	(0.0506)
Obs	587,843	573,888	587,843	575,413	533,781	451,273	585,997
Restricted Firms							
	0.102***	0.044*	-0.034	-34.790***	-4.745***	0.755	0.078**
	(0.0303)	(0.0239)	(0.0980)	(8.340)	(1.046)	(0.613)	(0.0348)
w/bank & firm-sector FE	0.073***	0.036	0.018	-26.15***	-3.366***	0.252	0.052**
	(0.0275)	(0.0310)	(0.0906)	(8.242)	(0.632)	(0.444)	(0.0236)
Obs	391,074	378,510	391,074	383,768	348,753	391,074	389,302

Results for Non-stressed firms

- Acknowledge that the causal link is not as clean as the RDD.
- Potential selection bias.
- We aim to bring theory closer to the data.

	Loan Amount	Provision	Credit rating	Days past due	Interest rate	Maturity	Collateral	Obs
All firms	-0.036***	0.007***	-0.026*	0.636	2.012***	0.068	0.036***	1,194,333
	(0.009)	(0.002)	(0.015)	(0.707)	(0.206)	(0.108)	(0.008)	

Results

Theory

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

Empirical

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

Real sector effects

$$y_i = \alpha_{sector} + \alpha_{firm\_size} + \beta D_i + \epsilon_i$$

- We control for firm-sector and firm-size fixed effects.
- Employment data are not complete yet. Will update once it is complete.

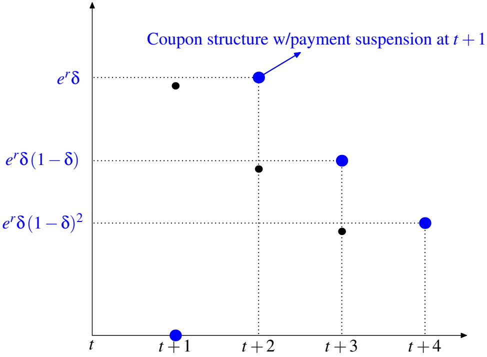
	Δ Op. Income	Δ Profit	Δ Assets	Δ Liabilities	Δ Equity	Δ Investment	Δ Debt
Only stressed firms							
Treatment	0.078***	0.125***	0.029***	0.046***	-0.009	0.029*	0.133***
	(0.0188)	(0.0398)	(0.00761)	(0.00922)	(0.00979)	(0.0174)	(0.0338)
Obs	16,209	15,255	17,183	16,648	16,141	8,121	4,933
Only non-stressed firms							
Treatment	0.016	0.027	0.015***	0.048***	-0.009	0.003	0.150***
	(0.0115)	(0.0226)	(0.00495)	(0.00726)	(0.00614)	(0.0124)	(0.0329)
Obs	32,755	30,806	34,433	33,613	33,051	15,015	8,030

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
- Each period, the government
  1. observes aggregate income and **liquidity shocks**,
  2. chooses whether to default,
  3. borrows using **non-contingent bonds and contingent debt**

Debt moratorium asset

- 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 $s \equiv (A, p)$ denote the vector of exogenous states

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

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

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

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

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

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

r_m is suspension rate.

Equilibrium bond prices

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

$$q(b', b'_m, s) = \mathbb{E}_{s'|s}\left[M(\varepsilon', p)\left[d'\alpha q\left(\alpha b', \alpha b'_m, s'\right)(1-d')\left[\delta + (1-\delta)q\left(b'', b''_m, s'\right)\right]\right]\right], \quad (15)$$

$$\begin{aligned} q_m(b', b'_m, s) \quad &= \quad \mathbb{E}_{s'|s}\left[M(\varepsilon', p)\left[d'\alpha q_m\left(\alpha b', \alpha b'_m, s'\right)\right.\right. \\ &+ \quad (1-d')\left[\left[1-\mathcal{I}(p', g')\right]\left[\delta_m + (1-\delta_m)q_m\left(b'', b''_m, s'\right)\right]\right. \\ &+ \quad \left.\left.\left.\mathcal{I}(p', g')e^{r_m}q_m\left(b'', b''_m, s'\right)\right]\right]\right], \end{aligned} \quad (16)$$

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 200 basis points higher with p_H
  - With negative correlation between shocks to global risk premia and domestic income shocks

$$Pr(p' = 1 \mid p = 0) = Min\left\{\pi_{lh} e^{-\lambda log(y') - 0.5\sigma^2_{log(y)}\lambda^2}, 1\right\}$$

- Parameter λ determines correlation between global premium shocks and domestic endowment.

Long-run Simulation results

	Data	Benchmark	With Moratorium Debt
Mean debt/y (%)	38.3	36.3	2.9
Mean moratorium debt/y (%)	*n.a.*	*n.a.*	42.0
Mean r_s (%)	2.1	2.1	2.1
Mean moratorium r_s (%)	*n.a.*	*n.a.*	2.7
Defaults per 100 years	2	2.1	2.8
Duration	5.0	5.0	5.8
Duration moratorium	*n.a.*	*n.a.*	6.0
Probability high-risk-premium starts (%)	15.0	15.0	15.0
Lower income during high-risk-premium (%)	4.0	4.1	4.4
Δ r_s with high-risk-premium shock	2.0	2.1	3.1
Δ r_s moratorium with high-risk-premium shock	*n.a.*	*n.a.*	2.7
Fraction of defaults triggered by liquidity (%)		3.2	0.0

Welfare gains

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

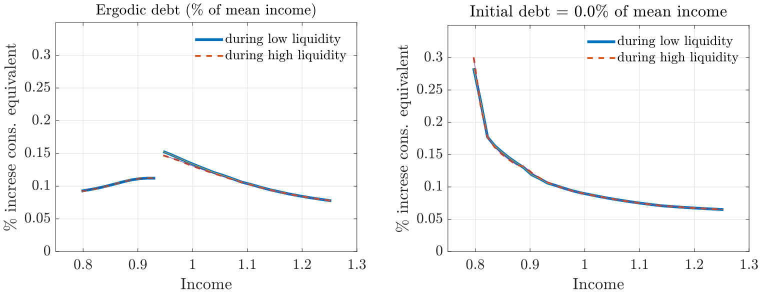


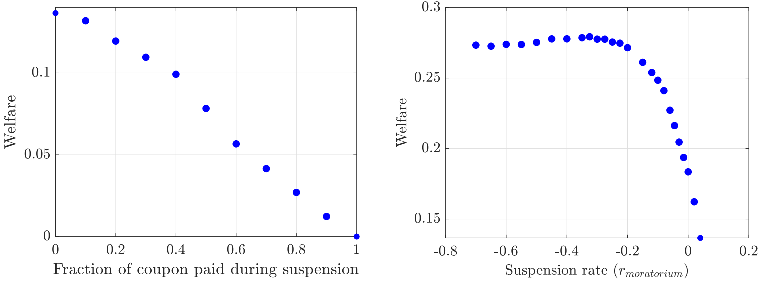
Figure: Welfare gains from switching to debt moratorium economy

Tightening the link between empiric and model

- Policy increases the investment for distressed firms as interest rate declines
- Policy eliminates liquidity related delinquencies (but may generate higher delinquencies in the future if not addressed)
- For non-stressed firms, interest rates are higher.

Ways to improve the contract design
Welfare gains

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



Conclusions

- Non-stressed firms: loan amount $\downarrow$, interest rate $\uparrow$
- Stressed firms: loan amount $\uparrow$, interest rate $\downarrow$
- The stressed firms that receive the treatment improve compared with those that don't.

Thank you!