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)

<table>
<thead>
<tr>
<th>Country</th>
<th>Regulation issued date</th>
<th>Eligibility Criteria (days past due)</th>
<th>Cutoff date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panama</td>
<td>March 17</td>
<td>&lt; 90</td>
<td>March 17</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>March 20</td>
<td>&lt; 90</td>
<td>March 20</td>
</tr>
<tr>
<td>Cabo Verde</td>
<td>April 1</td>
<td>≤ 90</td>
<td>March 28</td>
</tr>
<tr>
<td>Cyprus</td>
<td>March 30</td>
<td>&lt; 30</td>
<td>Dec 31, 2019</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>May 1</td>
<td>&lt; 30</td>
<td>May 1</td>
</tr>
<tr>
<td>Malaysia</td>
<td>April 1</td>
<td>&lt; 90</td>
<td>April 1</td>
</tr>
<tr>
<td>Malta</td>
<td>April 14</td>
<td>0</td>
<td>February 29</td>
</tr>
<tr>
<td>Montenegro</td>
<td>March 20</td>
<td>≤ 90</td>
<td>Dec 31, 2019</td>
</tr>
<tr>
<td>Romania</td>
<td>March 30</td>
<td>0</td>
<td>March 2</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>March 31</td>
<td>&lt; 90</td>
<td>March 31</td>
</tr>
</tbody>
</table>
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 ↑
   - Stressed: loan amount ↑, 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 $\pi$, a liquidity shock $\ell$ 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

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

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

\[
b(q) : 2 \frac{A(q - \beta) + \beta \phi}{\beta \phi}.
\] (2)
With the policy

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

\[
\max_{b^P} u(qb^P) + \beta \left[ (1 - \pi) v (1 - \delta b^P) + \pi v (1 - \ell) \right] + (3)
\]

\[
\beta \left[ (1 - \pi) v (1 - (1 - \delta) b^P) + \pi v (1 + \ell - b^P) \right]
\]

Deferred payments are done

subject to \( c \geq 0 \).

The solution to this problem is

\[
b^P(q) : \quad 2 \frac{A(q - \beta)}{\beta \phi} + \beta \frac{\pi (A - \phi) + \pi \phi \ell}{\beta \phi}.
\]
Lender’s problem

- The maximization problem with and without the policy:

\[
\max_b \quad u(1 - qb) + v(1 + \delta b) + v(1 + (1 - \delta)b) \\
\text{subject to } c \geq 0.
\] (5)

- With the policy it reads

\[
\max_{b^p} \quad u(1 - q b^p) + \left[ (1 - \pi) v(1 + \delta b^p) + \pi v(1) \right] + \left[ (1 - \pi) v(1 + (1 + \delta)b^p) + \pi v (1 + b^p) \right] \\
\text{subject to } c \geq 0.
\] (6)
The solution to these problems are

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

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

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

- The solution to firm’s problem

\[
\begin{align*}
b(q) & : \ 2 \frac{A(q - \beta) + \beta \phi}{\beta \phi - 2A \frac{\partial q}{\partial b}} , \\
& \quad \text{always} \geq 0
\end{align*}
\]

\[
\begin{align*}
b^p(q) & : \ 2 \frac{A(q - \beta) + \beta \phi + \beta \pi(A - \phi) + \pi \phi \ell}{\beta \phi - 2A \frac{\partial q}{\partial b}} - 2A \frac{\partial q}{\partial b} , \\
& \quad \text{always} \geq 0
\end{align*}
\]

- The solution to lenders’ problem

\[
\begin{align*}
b(q) & : \ 2 \frac{A(1 - q) - \phi}{\phi + 2A \frac{\partial q}{\partial b}} , \\
& \quad \text{depends on price’s responsiveness}
\end{align*}
\]

\[
\begin{align*}
b^p(q) & : \ 2 \frac{A(1 - q) - \phi}{\phi(1 + \pi) + 2A \frac{\partial q}{\partial b}} .
\end{align*}
\]
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 29th 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:

\[ \hat{D}_{ij,t} = 1 \{ X_{ij,t} \geq 0 \} \]  

We estimate:

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

(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 “placebo” 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 $\theta$, 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)

<table>
<thead>
<tr>
<th></th>
<th>Loan Amount</th>
<th>Provision</th>
<th>Credit Rating</th>
<th>Days past due</th>
<th>Interest rate</th>
<th>Maturity</th>
<th>Collateral</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Firms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.114**</td>
<td>0.048*</td>
<td>0.020</td>
<td>-49.220***</td>
<td>-6.018***</td>
<td>0.639</td>
<td>0.084**</td>
<td></td>
</tr>
<tr>
<td>(0.0475)</td>
<td>(0.0268)</td>
<td>(0.107)</td>
<td>(7.247)</td>
<td>(0.573)</td>
<td>(0.593)</td>
<td>(0.0345)</td>
<td></td>
</tr>
<tr>
<td>w/bank &amp;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.078**</td>
<td>0.037***</td>
<td>0.019</td>
<td>-33.82***</td>
<td>-3.976***</td>
<td>0.020</td>
<td>0.051</td>
<td></td>
</tr>
<tr>
<td>(0.0401)</td>
<td>(0.0152)</td>
<td>(0.0570)</td>
<td>(11.24)</td>
<td>(0.125)</td>
<td>(0.480)</td>
<td>(0.0506)</td>
<td></td>
</tr>
<tr>
<td><strong>Obs</strong></td>
<td>587,843</td>
<td>573,888</td>
<td>587,843</td>
<td>575,413</td>
<td>533,781</td>
<td>451,273</td>
<td>585,997</td>
</tr>
<tr>
<td><strong>Restricted Firms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.102***</td>
<td>0.044*</td>
<td>-0.034</td>
<td>-34.790***</td>
<td>-4.745***</td>
<td>0.755</td>
<td>0.078**</td>
<td></td>
</tr>
<tr>
<td>(0.0303)</td>
<td>(0.0239)</td>
<td>(0.0980)</td>
<td>(8.340)</td>
<td>(1.046)</td>
<td>(0.613)</td>
<td>(0.0348)</td>
<td></td>
</tr>
<tr>
<td>w/bank &amp;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.073***</td>
<td>0.036</td>
<td>0.018</td>
<td>-26.15***</td>
<td>-3.366***</td>
<td>0.252</td>
<td>0.052**</td>
<td></td>
</tr>
<tr>
<td>(0.0275)</td>
<td>(0.0310)</td>
<td>(0.0906)</td>
<td>(8.242)</td>
<td>(0.632)</td>
<td>(0.444)</td>
<td>(0.0236)</td>
<td></td>
</tr>
<tr>
<td><strong>Obs</strong></td>
<td>391,074</td>
<td>378,510</td>
<td>391,074</td>
<td>383,768</td>
<td>348,753</td>
<td>391,074</td>
<td>389,302</td>
</tr>
</tbody>
</table>
Acknowledge that the causal link is not as clean as the RDD.

Potential selection bias.

We aim to bring theory closer to the data.

<table>
<thead>
<tr>
<th>All firms</th>
<th>Loan Amount</th>
<th>Provision</th>
<th>Credit rating</th>
<th>Days past due</th>
<th>Interest rate</th>
<th>Maturity</th>
<th>Collateral</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.036***</td>
<td>0.007***</td>
<td>-0.026*</td>
<td>0.636</td>
<td>2.012***</td>
<td>0.068</td>
<td>0.036***</td>
<td>1,194,333</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.002)</td>
<td>(0.015)</td>
<td>(0.707)</td>
<td>(0.206)</td>
<td>(0.108)</td>
<td>(0.008)</td>
<td></td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Theory</th>
<th>Loan amount</th>
<th>Interest rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressed</td>
<td>↑</td>
<td>?</td>
</tr>
<tr>
<td>Non-stressed</td>
<td>?</td>
<td>↑</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Empirical</th>
<th>Loan amount</th>
<th>Interest rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressed</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Non-stressed</td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>
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.

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


- 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

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

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

\[
i = b' - b(1 - \delta),
\]

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

\[
q(b', b'_m, s) \geq q \ \forall \ b' > b(1 - \delta),
\]

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

\( r_m \) is suspension rate.
Equilibrium bond prices

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

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

\[ q_m(b', b'_m, s) = \mathbb{E}_{s'|s} \left[ M(\varepsilon', p) \left[ d' \alpha q_m \left( \alpha b', \alpha b'_m, s' \right) \left( 1 - d' \right) \left[ \delta + (1 - \delta)q_m \left( b'', b''_m, s' \right) \right] \right] + \left( 1 - d' \right) \left[ \left[ 1 - \mathcal{I}(p', g') \right] \left[ \delta_m + (1 - \delta_m)q_m \left( b'', b''_m, s' \right) \right] \right] + \mathcal{I}(p', g') e^{r_m} q_m \left( b'', b''_m, s' \right) \right] \]
Parameterization

- Follow Hachtondo 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

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

- Parameter $\lambda$ determines correlation between global premium shocks and domestic endowment.
## Long-run Simulation results

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Benchmark</th>
<th>With Moratorium Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean debt/y (%)</td>
<td>38.3</td>
<td>36.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Mean moratorium debt/y (%)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>42.0</td>
</tr>
<tr>
<td>Mean $r_s$ (%)</td>
<td>2.1</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Mean moratorium $r_s$ (%)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>2.7</td>
</tr>
<tr>
<td>Defaults per 100 years</td>
<td>2</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Duration</td>
<td>5.0</td>
<td>5.0</td>
<td>5.8</td>
</tr>
<tr>
<td>Duration moratorium</td>
<td>n.a.</td>
<td>n.a.</td>
<td>6.0</td>
</tr>
<tr>
<td>Probability high-risk-premium starts (%)</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Lower income during high-risk-premium (%)</td>
<td>4.0</td>
<td>4.1</td>
<td>4.4</td>
</tr>
<tr>
<td>$\Delta r_s$ with high-risk-premium shock</td>
<td>2.0</td>
<td>2.1</td>
<td>3.1</td>
</tr>
<tr>
<td>$\Delta r_s$ moratorium with high-risk-premium shock</td>
<td>n.a.</td>
<td>n.a.</td>
<td>2.7</td>
</tr>
<tr>
<td>Fraction of defaults triggered by liquidity (%)</td>
<td>3.2</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>
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 ↓, interest rate ↑
- Stressed firms: loan amount ↑, interest rate ↓
- The stressed firms that receive the treatment improve compared with those that don’t.
Thank you!