Overborrowing and Systemic Externalities in the Business Cycle

Javier Bianchi, 2008
Presented by Luis Franjo
Periods of sustained increases in borrowing in an emerging economy are often followed by a devastating disruption in financial markets.
Motivation

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- Natural questions:
  - why the private sector becomes exposed?
  - what the appropriate policy response should be?
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  - welfare-based analysis of how optimal borrowing decisions at the individual level can lead to overborrowing.
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  - welfare-based analysis of how optimal borrowing decisions at the individual level can lead to overborrowing
  - optimal policy response
Related Literature

- Macroeconomic role of financial frictions $\rightarrow$ Bernanke and Gertler (1989), Kiyotaki and Moore (1997)
- Role of pecuniary externalities in generating financial fragility $\rightarrow$ Lorenzoni (2008)
- Optimal policy in a financial crisis $\rightarrow$ Kiyotaki and Moore (2008)

Contribution:
- Study the volatility and the level of amplification of the competitive equilibrium
- Investigate several policy measures
- Quantitative assessment of the macroeconomic, policy and welfare implications of overborrowing
- How an economy can be vulnerable to a financial crisis due to excessive borrowing during normal times
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Analytical Framework

- Representative-agent DSGE-SOE with two sectors
- CRRA utility function

\[ E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) \right\} \]
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- Representative-agent DSGE-SOE with two sectors
- CRRA utility function

\[ E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) \right\} \]

- \( c_t \) is a CES aggregator for tradable \( c^T \) and nontradable goods \( c^N \)

\[ c_t = \left[ \omega(c_t^T)^{-\eta} + (1-\omega)(c_t^N)^{-\eta} \right]^{-\frac{1}{\eta}}, \eta > -1, \omega \in (0, 1) \]
Each period households receive an endowment

\[ y \equiv (y^T, y^N) \in \mathcal{Y} \subseteq \mathbb{R}_{++}^2 \]
Analytical Framework

- Each period households receive an endowment

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- The budget constraint is

\[ b_{t+1} + c_t^T + p_t^N c_t^N = b_t(1 + r) + y_t^T + p_t^N y_t^N \]
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The budget constraint is

\[ b_{t+1} + c_t^T + p_t^N c_t^N = b_t (1 + r) + y_t^T + p_t^N y_t^N \]

Credit constraint

\[ b_{t+1} \geq - \left( \kappa^N p_t^N y_t^N + \kappa^T y_t^T \right) \]
Household’s first order conditions

\[ \lambda_t = u_T(t) \]

\[ p_t^N = \left( \frac{1 - \omega}{\omega} \right) \left( \frac{c_t^T}{c_t^N} \right)^{\eta+1} \]

\[ \lambda_t = \beta E_t \lambda_{t+1} (1 + r) + \mu_t \]

\[ b_{t+1} + \left( \kappa^N p_t^N y_t^N + \kappa^T y_t^T \right) \geq 0 \]
Optimality Conditions
Decentralized Competitive Equilibrium

- Household’s first order conditions
  \[ \lambda_t = u_T(t) \]

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  \[ \lambda_t = \beta E_t \lambda_{t+1} (1 + r) + \mu_t \]

  \[ b_{t+1} + (\kappa^N p_t^N y_t^N + \kappa^T y_t^T) \geq 0 \]

- Market clearing conditions
  \[ c_t^N = y_t^N; \quad c_t^T = y_t^T + b_t (1 + r) - b_{t+1} \]
Benevolent social planner with restricted planning abilities
Benevolent social planner with restricted planning abilities

**Definition**

**Constrained Efficiency** Let \( \{ c_T^t, c_N^t, b_{t+1} \}_{t \geq 0} \) be the allocations of the competitive equilibrium yielding utility \( \hat{V} \). The competitive equilibrium is constrained efficient if a social planner that chooses directly \( \{ b_{t+1} \}_{t \geq 0} \) subject to the credit constraint, but let the goods markets clear competitively, can not improve the welfare of households above \( \hat{V} \).
Efficiency
Social Planner’s optimization problem

\[
\max_{\{b_{t+1}, c_t^T\}} E \left\{ \sum_{t=0}^{\infty} u(c(c_t^T, c_t^N)) \right\}
\]

subject to

\[
c_t^T = y_t^T + b_t(1 + r) - b_{t+1}
\]

\[
b_{t+1} \geq - (\kappa^N \left( \frac{1 - \omega}{\omega} \right) \left( \frac{c_t^T}{y_t^N} \right)^{\eta + 1} y_t^N + \kappa^T y_t^T)
\]
Efficiency
Social Planner’s first order conditions

\[ \lambda_{sp}^t = u_T(t) + \mu_{sp}^t \Psi_t \]

\[ \lambda_{sp}^t = \beta E_t \lambda_{t+1}^{sp}(1 + r) + \mu_{sp}^t \]

\[ b_{t+1} + (\kappa^N \left( \frac{1 - \omega}{\omega} \right) \left( \frac{c_t^T}{y_t^N} \right)^{\eta+1} y_t^N + \kappa^T y_t^T) \geq 0 \]

where \( \Psi_t \equiv \kappa^N (p_t^N c_t^N) / (c_t^T)(1 + \eta) > 0 \)
Efficiency

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\[ \lambda_{t}^{sp} = u_T(t) + \mu_{t}^{sp} \Psi_t \]

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where \( \Psi_t \equiv \kappa^N (p_t^N c_t^N) / (c_t^T)(1 + \eta) > 0 \)

- When the credit constraint binds, private agents undervalue wealth
Decentralized Economy vs. Social Planner

Overborrowing

- Decentralized Economy

\[ u_T(t) = \beta E_t u_T(t + 1)(1 + r) \]
Decentralized Economy vs. Social Planner

Overborrowing

- **Decentralized Economy**

  \[ u_T(t) = \beta E_t u_T(t + 1) (1 + r) \]

- **Social Planner**

  \[ u_T(t) = \beta E_t [u_T(t + 1) + \mu_{t+1}^{sp} \Psi_{t+1}] (1 + r) \]
Decentralized Economy vs. Social Planner

Overborrowing

- **Decentralized Economy**
  \[
  u_T(t) = \beta E_t u_T(t + 1)(1 + r)
  \]

- **Social Planner**
  \[
  u_T(t) = \beta E_t \left[ u_T(t + 1) + \mu_{t+1}^{sp} \Psi_{t+1} \right] (1 + r)
  \]

**Proposition**

**Constrained Inefficiency** The decentralized equilibrium is not, in general, constrained efficient.
Let $\tau_t$ be the tax charged on debt issued at time $t$

$$\lambda_t = (1 + \tau_t) \beta E_t \lambda_{t+1} (1 + r) + \mu_t$$
Decentralization
Financial Policies

- Let $\tau_t$ be the tax charged on debt issued at time $t$

\[ \lambda_t = (1 + \tau_t)\beta E_t \lambda_{t+1}(1 + r) + \mu_t \]

Proposition

**Optimal tax on debt** The constrained-efficient allocations can be implemented with an appropriate tax on debt, with tax revenue rebated as a lump sum transfer.
Decentralization
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**Proposition**

**Optimal tax on debt** The constrained-efficient allocations can be implemented with an appropriate tax on debt, with tax revenue rebated as a lump sum transfer.

- The tax is set to

$$\tau_t^* = \frac{(E_t \mu_{t+1}^{sp} \Psi_{t+1})}{E_t u_T(t + 1)}$$
Data from Argentina

Endowment shocks as first-order bivariate autoregressive process

\[ y_t = \rho y_{t-1} + \epsilon_t \] where \( y = \begin{bmatrix} y^T & y^N \end{bmatrix}' \) with

\[ \rho = \begin{bmatrix} 0.901 & 0.495 \\ -0.453 & 0.225 \end{bmatrix}; \quad \text{Cov}(\epsilon_t) = \begin{bmatrix} 0.00219 & 0.00162 \\ 0.00162 & 0.00167 \end{bmatrix} \]
### Table 1: Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source/Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate</td>
<td>$r = 0.04$</td>
<td>Standard value DSGE-SOE</td>
</tr>
<tr>
<td>Risk aversion</td>
<td>$\sigma = 2$</td>
<td>Standard value DSGE-SOE</td>
</tr>
<tr>
<td>Elasticity of substitution</td>
<td>$1/(1 + \eta) = 0.83$</td>
<td>Conservative value</td>
</tr>
<tr>
<td>Stochastic structure</td>
<td>See text</td>
<td>Argentina’s economy</td>
</tr>
<tr>
<td>Relative credit coefficients</td>
<td>$\kappa^N / \kappa^T = 1$</td>
<td>Baseline Value</td>
</tr>
<tr>
<td>Weight on tradables in CES</td>
<td>$\omega = 0.31$</td>
<td>Share of tradable output = 32%</td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\beta = 0.91$</td>
<td>Average NFA-GDP ratio = -29%</td>
</tr>
<tr>
<td>Credit coefficient</td>
<td>$\kappa^T = 0.32$</td>
<td>Frequency of crisis = 5.5%</td>
</tr>
</tbody>
</table>
Figure 1: Bond decision rules for negative one-standard-deviation shocks
Figure 2: Ergodic Distribution of Bond Holdings
Policy Instruments

**Figure 3:** Policy Instruments for negative one-standard-deviation shocks
Figure 4: Conditional distribution of impact effect of financial crises on consumption
## Financial Crises: Incidence and Severity

**Table 2: Severity of Financial Crises**

<table>
<thead>
<tr>
<th></th>
<th>Decentralized Equilibrium</th>
<th>Social Planner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>-16.7</td>
<td>-10.1</td>
</tr>
<tr>
<td>Current Account-GDP</td>
<td>7.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>19.2</td>
<td>1.1</td>
</tr>
</tbody>
</table>
### Table 3: Second Moments

<table>
<thead>
<tr>
<th>Standard Deviations</th>
<th>Decentralized Equilibrium</th>
<th>Social Planner</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>8.4</td>
<td>5.8</td>
<td>12.2</td>
</tr>
<tr>
<td>Consumption</td>
<td>5.9</td>
<td>5.3</td>
<td>6.2</td>
</tr>
<tr>
<td>Consumption in units of Tradable</td>
<td>10.1</td>
<td>6.0</td>
<td>15.5</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>7.5</td>
<td>3.4</td>
<td>13.8</td>
</tr>
<tr>
<td>Current Account-GDP</td>
<td>2.8</td>
<td>0.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Trade Balance-GDP</td>
<td>2.9</td>
<td>0.7</td>
<td>2.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Correlation with GDP</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption in units of Tradable</td>
<td>0.99</td>
<td>0.84</td>
<td>0.84</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>0.79</td>
<td>0.43</td>
<td>0.47</td>
</tr>
<tr>
<td>Current Account-GDP</td>
<td>-0.76</td>
<td>-0.05</td>
<td>-0.46</td>
</tr>
<tr>
<td>Trade Balance-GDP</td>
<td>-0.77</td>
<td>-0.22</td>
<td>-0.77</td>
</tr>
</tbody>
</table>

Note: GDP is measured in units of tradables. Data is annual from WDI and IFS for Argentina from 1965-2007.
Conclusions

- By reducing the amount of debt ex-ante, a social planner mitigates the downward spiral in the borrowing capacity during a crisis improving social welfare.
- There is much to gain from introducing macroprudential regulation → Long-run probability of a financial crisis from 5.5 percent to 0.4 percent.
- Several regulatory measures commonly used to maintain financial stability can achieve the constrained-efficient allocations.