Financial Liberalization and Allocative Efficiency

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A Framework to analyze Financial Liberalization and Systemic Risk

Contributions of the paper

- **central question:** Is there a case for financial liberalization in order to foster growth and efficiency, despite the fact that it causes lending booms that are punctuated by severe crises and costly bailouts?
- A Framework able to integrate the key empirical regularities associated with financial liberalization, crises and growth
- Decompose the welfare consequences of financial liberalization between gains from higher production efficiency and losses associated with crisis-induced volatility.
- Emerging Market Countries: From Financial Repression Regime to Financial Liberalization Regime
- **Extension**: US Economy before the 2008 Crisis: Can financial liberalization go too far and break down financial discpline?

Key Features of the Framework.

- Tractable Two-sector endogenous growth model: key to discuss allocative efficiency.
- Contract Enforceability Problems + Systemic Bailout Guarantees.
- Endogenous Crisis Risk (no external shock)
- Analysis of different financial regimes associated with regulation on the type of liabilities that can be issued.
  1. Financial Repression: Standard Debt Contract with No Currency Mismatch
  2. Financial Liberalization: Standard Debt Contract with Currency Mismatch
  3. **Extension:** Example with Catastrophe Bonds-Like Securities (US crisis 2008).

Empirical Regularities on Financial Liberalization in Emerging Market Countries.

- Aggregate Effects: the *dual effects* of financial liberalization in emerging market countries.
  - Financial Liberalization typically leads to higher growth and to more frequent crises (Ranciere, Tornell, Westermann, 2008, Bonfiglioli 2008)
  - Growth effects is measured by an increase in **Aggregate TFP**.
- Sectoral Effects.
  - Sectors more dependent on external finance invest and grow more but become more volatile after financial liberalization (Levchenko, Ranciere, Thoenig, 2009) and suffer more from crises (Dell'Ariccia et al., 2009). **No sector-level TFP effects.**
- How to reconcile Sector-level results and Aggregate TPF Results? **Allocative Efficiency and Input-Output Linkages.**

Empirical Regularities on Systemic Risk and Bailouts.

- Firm-Level Mechanism: risk-taking through currency mismatch.
  - Ranciere,Tornell, Vamvakidis, 2010,2011: Easter European Firms (listed/non listed)
  - Kim, Tesar and Zhang, 2011: Korean firms (listed, non listed)
  - Michaux (2011): Mexican Firms.
- Systemic Bailout Guarantees.
  - Ex-Post evidence: Jeanne-Zettlemeyer (2004); Bailout of Foreign Liabilities.
  - Ex-Ante evidence: Kelly, Lustig and Niewerburgh (2011): The difference in costs of out-of-the-money put options for individual banks, and puts on the financial sector index.
  - Ranciere, Tornell, Vamvakidis (2010): Undepricing of Risk Associated with Currency Mismatch in Eastern Europe.

Preview of Results

- Financial Liberalization: agents coordinate on systemic risk-taking–and by doing so exploit systemic bailout guarantees
  - Safe Economy endogenously transformed in a Risky Economy.
  - Higher leverage, investment and growth
  - Vulnerability to costly financial crises
- Allocative Efficiency
  - Risk-taking reduces misallocation in the economy, raises production efficiency.
  - Key Role of Input-Output Linkages
  - Efficiency Gains vs. Crises Costs (Dynamic vs. Statics)
- The Disciplining Role of Standard Debt with Systemic Bailout Guarantees.
  - Catastrophe Bonds allow "game " systemic bailout.
  - Discpline Breaks Downs and large scale funding of negative NPV projects.

The model

An endogenous OLG growth model of a two-sector small open economy with credit market imperfections.

- Rebelo-type 2 sector AK model.
- Goods
  1. a final consumption good (T/Tradables). T-good is the numeraire
  2. an intermediate good (N/Non-Tradables) good, which is used as an input in the production of both goods. The relative price of N-goods by $p_t = p_t^N / p_t^T$.
- Agents.
  1. Competitive risk neutral international investors whose cost of funds equals the world interest rate r.
  2. Overlapping generations of consumers that live for two periods and have linear preference over consumption. $c_t + c_{t+1/(1+r)}$
  3. Risk-Neutral Consumers are divided into two groups of measure one: workers and entrepreneurs.

Production Technologies in two sectors

N-sector:

- N-Firms run by entrepreneurs that produce N-goods using entrepreneurial labor $(l_t^e = 1)$, and capital (k_t). Capital consists of N-goods invested during the previous period (I_{t-1}),which fully depreciates after one period.

$$\begin{aligned} q_t &= \Theta_t k_t^{\beta} {I_t}^{1-\beta}, \quad \Theta_t =: \theta \overline{k_t}^{1-\beta} \\ q_t &= \theta I_{t-1} \end{aligned}$$

- N-sector: source of endogenous growth.

T-sector:

- There is a continuum, of measure one, of competitive firms that produce the T-good combining standard labor $(l_t = 1)$ and the N-good (d_t) using a Cobb-Douglas technology: $y_t = a d_t^{\alpha} (l_t)^{1-\alpha}$.
- $q_t = \phi_t \theta q_{t-1}; y_t = [a(1-\phi_t) d_t]^{\alpha}$
- Key equation for production efficiency and growth:$\phi_t = \phi$(agency problems, financial regime, bailout expectations)

Firm Financing

- Investable funds of a firm consist of its internal funds w_t plus the liabilities B_t it issues.
- N-firms investment consist in buying N-goods $(p_t I_t)$,
- Cash flow of the firm equals the young entrepreneur's wage (w_t)
- Time t budget constraint : $p_t I_t = w_t + B_t$
- Time $t+1$ profits :$p_{t+1} q_{t+1} - v^e_{t+1} I_{t+1} - L_{t+1}$.
- Standard bonds: N-bond and T-bond have to repay in all states

$$L_{t+1} = (1+\rho_{t+1}) b_t \ + \ p_{t+1}(1+\rho^n_{t+1}) b^n_t. \tag{1}$$

  If at $t+1$ the firm does not repay, then it must default.
- T-bond leads to mismatch and credit risk.

Credit Market Imperfections

Contract Enforceability Problems. Entrepreneurs cannot commit to repay their liabilities: if at time t the entrepreneur incurs a non-pecuniary cost $h[w_t + B_t]$, then at $t+1$ she will be able to divert all the returns provided the firm is solvent (i.e., $\pi(p_{t+1}) \geq 0$).

Systemic Bailout Guarantees. If a majority of firms become insolvent, a bailout agency pays lenders the outstanding liabilities of each defaulting firm. The guarantee applies to any type of financial liabilities.

Banrkuptcy Costs When a firm defaults, a share $1 - \mu - \mu_w$ of the insolvent firms' revenues is lost in bankruptcy procedures. In this case, the bailout agency can recoup only $\mu p_t q_t$, and the workers receive a wage of only $\mu_w p_t q_t$.

- **Fiscal Solvency:** Domestically Financed Bailouts via Lump Sum Taxes.

Risk and Equilibrium.

- Endogenous price risk: in an equilibrium p_{t+1} may equal $\overline{p}_{t+1}$ with probability u_{t+1} or $\underline{p}_{t+1}$ with probability $1 - u_{t+1}$. The probability u_{t+1} may equal either 1 or u, and this is known at t
- Crises are self-fulfilling outcome of multiple equilibrium ($1 - u$ crisis probability/ sunspot uncertainty).
- Credit Market Game: N-entrepreneurs choose a financing plan and a diversion strategy to maximize profits.
- T-entrepreneur choose inputs to maximize profits
- The market for non-tradeable input clears:

$$d_t(p_t) + I_t(p_t, \underline{p}_{t+1}, \overline{p}_{t+1}, u_{t+1}) = q_t(I_{t-1}) \tag{2}$$

Credit Market Game Equilibrium

- Step1: p_t, $\bar{p}_{t+1}$, $\underline{p}_{t+1}$, u_{t+1} taken as given. Determine Borrowing ammount (B_t), Borrowing Denomination (N or T), and interest rate.
- Step 2: Solve for p_t, $\bar{p}_{t+1}$, $\underline{p}_{t+1}$, u_{t+1}.
- Key Equations
  - No-diversion constraint: Incentive Compatibility Constraint (ICC)

$$E_t(L_{t+1}) \leq h(w_t + B_t)$$

  - Lender's Break-Even: Participation Constraint (PC):

$$E_t(L_{t+1}) \geq (1 + r)B_t$$

Leverage.

- Financially Repressed Economy.
  - N-firm must issued N-debt. No default risk. $L_{t+1} = (1+\rho_t)B_t$
  - Participation Constraint: $1+r = 1+\rho_t$
  - No diversion constraint: $(1+\rho_t)B_t = h(w_t + B_t)$.
  - Credit Multiplier.

$$m^s = \frac{w_t + B_t}{w_t} = \frac{1}{1 - h/(1+r)}$$

- Financially Liberalized Economy.
  - N-firm entrepreneurs can coordinate on risk-taking by issuing T-bonds.
  - Currency Mismatch : N-firms solvency depend on price of N-goods.
  - Default in low state $(1-u)$ and solvent in high state (u)
  - Systemic Bailout: with proba$=(1-u)$: $(1+\rho_t)L_t$
  - PC: $1+\rho_t = 1+r_t$
  - ICC: $u(1+r)B_t = h(w_t + B_t)$.
  - Credit Mutliplier

$$m^r = \frac{w_t + B_t}{w_t} = \frac{1}{1 - h/u(1+r)} > m^s$$

Equilibria

- **Safe Symmetric Equilibrium**. There is no currency mismatch $(b_t = 0)$ and crises never occur $(u_{t+1} = 1)$. The N-sector investment share $(I_t = \phi_t q_t)$ is

$$\phi^s = \frac{1-\beta}{1-h\delta} \tag{3}$$

- **Risky Symmetric Equilibrium.** Currency mismatch is optimal $(b_t^n = 0)$. The probability of a crisis and the N-sector's investment share are:

$$1 - u_{t+1} = \begin{cases} 1-u & \text{if } t \neq \tau_i \\ 0 & \text{if } t = \tau_i \end{cases} \qquad \phi_t = \begin{cases} \phi^l := \frac{1-\beta}{1-h\delta u^{-1}} & \text{if } t \neq \tau_i \\ \phi^c := \frac{\mu_w}{1-h\delta} & \text{if } t = \tau_i \end{cases} \tag{4}$$

  τ_i denotes a crisis time. **Crisis must be rare events.**

- KEY: Crises induce financial distress

$$w^{crisis} = \mu_w < [1-\beta] p_t q_t = w^{no\ \ crisis}$$

$$\phi^{crisis} < \phi^{safe} < \phi^{lucky}$$

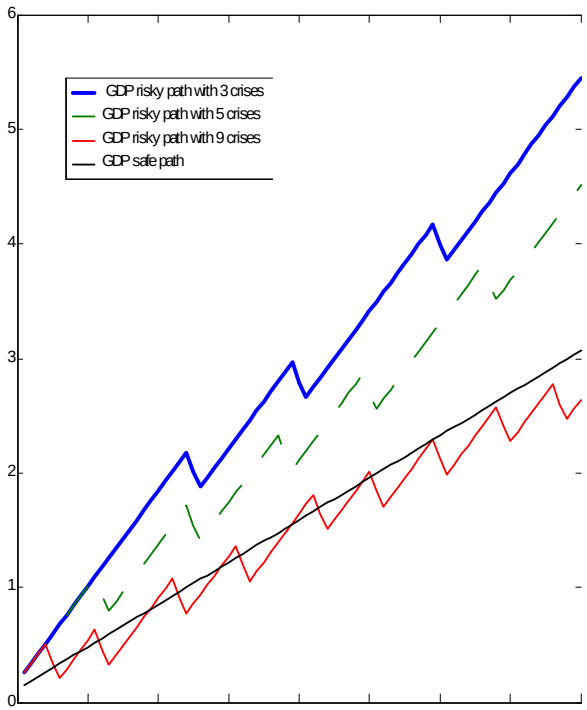
Intuition for Self-fulfilling Crises

- T-bond denomination induces Solvency Risk (currency mismatch). $\pi_t = p_t q_t - (1 + r_t) B_t$
- Price of N-good depends on the demand of N-input by N-firms for investment.
- Investment by N-firms depends on Solvency of N-firms.
- Solvency of N-firms depends on the price of N-good
- Feedback loop: multiple clearing prices on the N-good market.
- High Price: N-firms are solvent
- Low Price: N-firms are in default
- Crisis Probability: $(1 - u)$

Growth in Save vs. Risky Economy

- Calibrated on India vs. Thailand - 1980-2000 (crisis probability: 5%)
- GDP: Investment + Final Good Ouptut.
  $gdp_t = p_t \phi_t q_t + y_t = q_t^{\alpha} Z(\phi_t)$
- TFP depends on ϕ

Figure: Limit Distribution of GDP



Mean Long Run GDP Growth: Proposition

- Mean Growth in Liberalized (Risky) Economy vs. Repressed (Safe) Economy.
- $E(1+\gamma^r) = (1+\gamma^s)^{\alpha} \left(\frac{\phi^l}{\phi^s}\right)^{\frac{1}{2-u}} \left(\frac{\mu_w}{1-\beta}\right)^{\frac{1-u}{2-u}}$
- The *leverage effect* dominates the *crisis effect.*

$$\underbrace{\log(\phi^l) - \log(\phi^s)}_{\text{Leverage Gains}} \geq \underbrace{(1-u)}_{\text{Crisis Risk}} \quad \underbrace{[\log(1-\beta) - \log(\mu_w)]}_{\text{Financial Distress Costs}}$$

- A risky economy outperforms a safe one if the benefits of higher investment in no-crisis times $(\phi^l > \phi^s)$ compensate for the shortfall in internal funds and investment in crisis times $(\mu_w < 1-\beta)$ weighted by the frequency of crisis $(1-u)$.
- Condition is satisfied with an upper bound on financial distress costs.

Production Efficiency

Bottleneck and Allocative Inefficiency

- Central planner maximizes the present discount value of consumption.

$$\max_{\{c_t, c_t^e, \phi_t\}_{t=0}^{\infty}} W^{PO} = \sum_{t=0}^{\infty} \delta^t \left[c_t^e + c_t\right], \quad \text{s.t.} \quad \sum_{t=0}^{\infty} \delta^t \left[c_t + c_t^e - y_t\right] \leq 0$$

$$y_t = \left[1 - \phi_t\right]^{\alpha} q_t^{\alpha}, \qquad q_{t+1} = \theta \phi_t q_t$$

- Pareto optimality implies efficient accumulation of N-inputs.

Proposition (Bottleneck)

N-sector investment in a safe economy is below the Pareto optimal level (i.e., there is a 'bottleneck') if there is low contract enforceability:

$$h < \left(1 - (1-\beta)\theta \left(\theta\delta\right)^{-\frac{1}{1-\alpha}}\right)/\delta.$$

Present Value of Consumption in a Decentralized Economy

- The expected discounted value of workers' consumption and entrepreneurs' consumption in our decentralized economy is equal to:

$$W^d = E_0\left(\sum_{t=0}^{\infty}\delta^t(c_t + c_t^e)\right) = E_0\left(\sum_{t=0}^{\infty}\delta^t[[1-\alpha]y_t + \pi_t - T_t]\right) \tag{5}$$

- Closed Form Solutions:

$$W^s = \frac{(1-\phi^s)^\alpha}{1-\delta(\theta\phi^s)^\alpha}q_o^\alpha \quad W^r = \frac{1+\delta(1-u)\left[\theta\phi^l\frac{1-\phi^c}{1-\phi^l}\right]^\alpha k^c}{1-\left[\theta\phi^l\right]^\alpha\delta u-\left[\theta^2\phi^l\phi^c\right]^\alpha\delta^2(1-u)}\left[(1-\phi^l)q_0\right]^\alpha$$

- Effect of a Marginal Increase in Crisis Risk.

$$\left.\frac{\partial W^r}{\delta u}\right|_{u=1} = \underbrace{\alpha\phi'\left(\left(\frac{\phi^{po}}{\phi}\right)^{1-\alpha}-1\right)}_{\text{Efficiency gains}} + \underbrace{(1-\delta(\theta\phi)^\alpha)(1-k_c(\frac{1-\phi^c}{1-\phi^l})(1-\phi}_{\text{Bankruptcy costs}}$$
$$+ \underbrace{(1-\phi)^\alpha\delta^2(\theta\phi)^\alpha(\theta)^\alpha((\phi)^\alpha-(\phi^c)^\alpha)}_{\text{Financial distress costs}}$$

Present Value of Consumption in a Decentralized Economy

Proposition

In an economy where crisis are rare events:

1. *Financial liberalization increases the present value of consumption only if the investment share in a repressed regime (ϕ) is less than the Pareto investment share (ϕ^{po}).*
2. *When $\phi < \phi^{po}$, financial liberalization increases the present value of consumption for any level of bankruptcy costs μ, if financial distress in the wake of crisis is not too high ($\mu_w > \mu_w^*$) and the discount rate δ is not too low.*

Catastrophe Bonds.

- An alternative–inferior–technology to produce T-goods.

$$y_{t+1} = \varepsilon_{t+1} I_t^{\varepsilon}, \qquad \varepsilon_{t+1} = \begin{cases} \bar{\varepsilon} & \text{with probability } \lambda, \\ 0 & \text{with probability } 1-\lambda \end{cases} \qquad \bar{\varepsilon} \leq 1+r, \tag{7}$$

  where I_t^{ε} denotes the input of T-goods.

- Entrepreneurs can issue both standard and catastrophe bonds with the following repayment schedule

$$L_{t+1}^{c} = \begin{cases} 0 & \text{if } \varepsilon_{t+1} = \bar{\varepsilon} \text{ with } \lambda \\ 1+\rho_t^{c} & \text{if } \varepsilon_{t+1} = 0 \text{ with } (1-\lambda) \end{cases}$$

- Consider an situtation in which entrepreneurs with positive NPV play safe.$(\theta - \textit{entrepreneur})$

The Break-down of Financial Discipline.

- **Catastrophe bonds**: borrowers shift all their liability repayments to the default state.
  1. any positive return in the no-default state is enough to ensure positive profits in that state;
  2. the solution to the borrower–lender agency problem: no equity investment: the borrowing limit is determined by the expected generosity of the bailout rather than by internal funds $E(L) = 0 < h(\ B)$
  3. the ε-technology is funded under the anything-goes regime.
- **Standard debt contracts**:
  1. external finance only for projects that return at least the risk-free rate in the no-default state.
  2. borrowing more a multiple of their own equity to eliminate incentives to divert.
  3. Borrowers invest only in projects that have a private return (net of debt repayments) greater than the storage return $1 + r$.
  4. The ε-technology is not funded.

Financial Black Hole Equilibrium

Efficiciency Losses

- Welfare in Anything Goes Regime.

$$W^{agr} = E_0\left(\sum_{t=0}^{\infty}\delta^t(c_t + c_t^e + c_t^{\varepsilon})\right) = E_0\left(\sum_{t=0}^{\infty}\delta^t[[1-\alpha]y_t^t + \pi_t + \pi_t^{\varepsilon}\right. \tag{8}$$

$$W^{agr} = \underbrace{W^s}_{\text{Safe economy's PVC}} + \underbrace{\sum_{t=1}^{\infty}\delta^t b_{t-1}^c(\bar{\varepsilon} - \frac{1+r}{1-\lambda}))}_{\varepsilon\text{-expected PVC} \;-\; \text{Expected bailout}}, \tag{9}$$

- Since the ε-technology has negative net present value (i.e., $(1-\lambda)\bar{\varepsilon} < 1+r$), it follows that $W^{agr} < W^s$.
- The losses it incurs during crisis times more than offset private profits.
- Therefore, a financial black-hole equilibrium generates net consumption losses for the overall economy

Conclusions

- In a world were systemic bailout are part of the environment.
- Financial liberalization can help improve the allocation of resources–by increasing leverage in constrained sectors–but at the same time it can generate new states under which systemic insolvencies occur.
- Despite occurence of crisis, financial liberalization brings benefits to growth and increase allocative efficiency and the present value of consumption.
- However at the other extreme–a lack of financial regulation–might also be harmful.
- In an any-thing-goes regime where borrowers can issue catastrophe-like securities, the presence of systemic bailout guarantees might lead to excessive leverage and a lack of discipline in lending decisions.
- Regulation on the Liability Side.