Financial Liberalization, Debt Mismatch, Allocative Efficiency and Growth

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Can one make the case for Financial liberalization?

- Our answer: a qualified yes
- Provided regulation imposes limits on the type of issuable liabilities

Financial liberalization may enhance growth and consumption possibilities because it improves allocative efficiency:

- By allowing for new financing instruments and the undertaking of risk, liberalization relaxes financing constraints.
- Sectors more dependent on external finance can invest more and grow faster.
- The rest of the economy benefits from this relaxation of the bottleneck via input–output linkages.

However,

- The use of new financial instruments
  - $\rightarrow$ a riskless economy is transformed into one with systemic-risk
  - $\rightarrow$ $\uparrow$ Incidence of crises
  - $\rightarrow$ Bailout costs
- $\uparrow\downarrow$ Consumption opportunities
- We derive a condition for gains from gowth that we bring to the data

Model

- Combine endogenous growth model with Schneider-Tornell (2004)
- Two-sectors:
  - Input (N) sector
  - Final goods (T) sector
  - T-good is numeraire $\rightarrow$ $p_t = \frac{p_t^n}{p_t^T}$
- N-sector uses its own goods as capital
  - ϕ: share of N-output commanded by the N-sector for investment.
- ϕ determines production efficiency and GDP growth.

Agents:

- Risk-neutral investors, opportunity cost $1 + r$
- Workers (T-sector): supply inelastically $l_t^T = 1$, wage v_t^T
- Entrepreneurs (N-sector): supply inelastically $l_t = 1$, wage v_t
- OLGs, linear preferences over consumption of T-goods $c_t + \frac{1}{1+r} c_{t+1}$

T-sector

- Produce T-goods using N-inputs

$$y_t = d_t^{\alpha}(l_t^T)^{1-\alpha}, \qquad \alpha \in (0,1).$$

- Representative T-firm maximizes profits taking as given the price of N-goods (p_t) and standard labor wage (v_t^T)

$$\max_{d_t, l_t^T} \left[y_t - p_t d_t - v_t^T l_t^T \right]$$

N-sector

- Produce N-goods using entrepreneurial labor (l_t), and capital (k_t).

$$q_t = \Theta_t k_t^{\beta} l_t^{1-\beta}, \qquad \Theta_t =: \theta \overline{k_t}^{1-\beta}, \qquad k_t = I_{t-1}$$

- Budget constraint

$$p_t I_t + s_t \leq w_t + B_t, \qquad w_t = v_t.$$

- Can issue two types of one-period bonds
  - N-bonds promise to repay in N-goods.
  - T-bonds promise to repay in T-goods.
- Profits

$$\pi(p_{t+1}) = p_{t+1} q_{t+1} + (1+r) s_t - v_{t+1} l_{t+1} - (1+\rho_t) b_t - p_{t+1}(1+\rho_t^n) b_t^n.$$

Production Efficiency

- Central Planner allocates supply of inputs (q_t) to final goods production $(d_t = [1-\phi_t]q_t)$ and to input production $(I_t = \phi_t q_t)$.

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

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

Optimality $\to$ maximizes PV of final goods (T-)production $(\sum_{t=0}^{\infty} \delta^t y_t)$

- $\uparrow \phi$ today
  - $\to$ $\downarrow$ today's T-output by $\alpha(1-\phi)^{\alpha-1} q_t^{\alpha} \partial\phi$
  - $\to$ $\uparrow$ tomorrow's N-output by $\theta q_t \partial\phi$
  - $\to$ $\uparrow$ tomorrow's T-output by $\alpha \left[(1-\phi)\theta\phi q_t\right]^{\alpha-1} \theta q_t \partial\phi$
  - $\to$ Intertemporal rate of transformation

$$M = \frac{\alpha \left[(1-\phi)\theta\phi q_t\right]^{\alpha-1} \theta q_t}{\alpha(1-\phi)^{\alpha-1} q_t^{\alpha}} = \theta^{\alpha}\phi^{\alpha-1}.$$

- Set $M = \delta^{-1}$

$$\phi^{cp} = (\theta^{\alpha}\delta)^{\frac{1}{1-\alpha}}, \qquad \text{if } \delta < \theta^{-\alpha}.$$

Imperfections

Contract Enforceability Problems. 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, then a bailout agency pays lenders the outstanding liabilities of each non-diverting firm that defaults.

Bankruptcy Costs. If a firm is insolvent $(\pi(p_{t+1}) < 0)$ a share $1 - \mu_w$ of its revenues is lost in bankruptcy procedures. The remainder is paid as wages to the young entrepreneurs.

Regulatory Regimes

Financial Repression. Can issue only one-period standard bonds with repayment indexed to the price of N-goods that it produces.

Financial Liberalization. Can issue one-period standard bonds with repayments denominated in N- or T-goods.

Anything Goes. Can also issue option-like catastrophe bonds.

Symmetric Equilibrium

Given prices, N-sector firms and creditors set $(I_t, s_t, b_t, b_t^n, \rho_t, \rho_t^n)$; the T-sector demand for N-input d_t maximizes T-firms' profits; factor markets clear; and the market for intermediate goods clears

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

$$p_{t+1} = \begin{cases} \overline{p}_{t+1} & \text{with probability } \chi_{t+1} \\ \underline{p}_{t+1} & \text{with probability } 1 - \chi_{t+1} \end{cases} \qquad \chi_{t+1} = \begin{cases} 1 \\ u \in (0,1). \end{cases}$$

Allocation under Financial Repression

There exists an SSE if and only if $H \in (0,1)$, $\beta \in (H,1)$ and the input sector productivity $\theta > \underline{\theta}^s \equiv \left(\frac{1}{\beta\delta}\right)^{\frac{1}{\alpha}} \left(\frac{1-\beta}{1-H}\right)^{\frac{1-\alpha}{\alpha}}$.

- Debt is hedged and crises never occur ($\chi_{t+1} = 1$).
- Input sector debt

$$b_t^n = \frac{H}{1-H} w_t$$

- Investment Share

$$I_t = \phi^s q_t, \qquad \phi^s = \frac{1-\beta}{1-H}.$$

Bottleneck:

- Under financial repression the investment share is below the Central Planner's optimum: $\phi^s < \phi^{cp}$
- Why? $\phi^s < \phi^{cp}$ can be rewritten as $\theta > \left(\frac{1}{\delta}\right)^{\frac{1}{\alpha}} (\phi^s)^{\frac{1-\alpha}{\alpha}} \equiv \theta'$,
- An equilibrium exists only if $\theta > \underline{\theta}^s \equiv \left(\frac{1}{\beta}\right)^{\frac{1}{\alpha}} \left(\frac{1}{\delta}\right)^{\frac{1}{\alpha}} (\phi^s)^{\frac{1-\alpha}{\alpha}}$.
- Since $\beta \in (0,1) \rightarrow \underline{\theta}^s > \theta'$.

Allocation under Financial Liberalization

- Systemic risk: a sunspot can induce a sharp fall in the input price that bankrupts all input sector firms and generates a systemic crisis, during which creditors are bailed out.
- There exists an RSE for any crisis' financial distress costs $l^d \in (0,1)$ if and only if

$$H \in (0,1), \quad u \in (H,1), \quad \beta \in \left(\frac{H}{u}, 1\right), \quad \theta \in (\underline{\theta}, \overline{\theta})$$

- Debt is risky: $b_t = \frac{H/u}{1-H/u} w_t$
- Input sector's investment $(I_t = \phi_t q_t)$ (τ_i denotes a crisis time):

$$\chi_{t+1} = \begin{cases} 1-u & \text{if } t \neq \tau_i; \\ 1 & \text{if } t = \tau_i; \end{cases} \qquad \phi_t = \begin{cases} \phi^l \equiv \frac{1-\beta}{1-Hu^{-1}} & \text{if } t \neq \tau_i; \\ \phi^c \equiv \frac{\mu_w}{1-H} & \text{if } t = \tau_i. \end{cases}$$

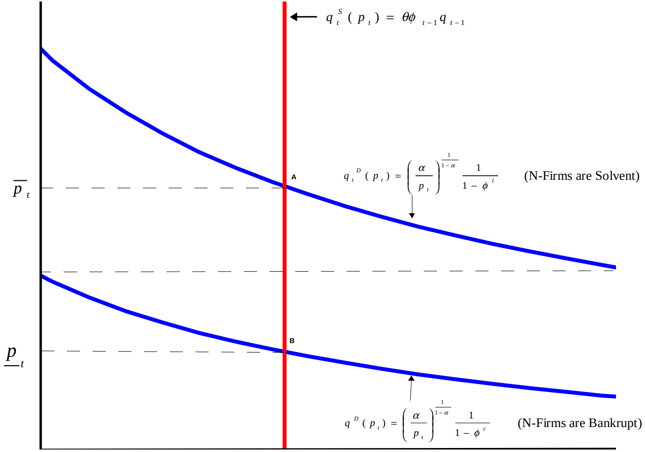

Figure: Market Equilibrium for Input

Bottleneck II:

- Under financial Liberalization the investment share is below the Central Planner's optimum
- $\phi^l < \phi^{cp} \Leftrightarrow \theta > \left(\frac{1}{\delta}\right)^{\frac{1}{\alpha}} \left(\phi^l\right)^{\frac{1-\alpha}{\alpha}} \equiv \theta^{''}$.
- A risky equilibrium exists only if $\theta > \underline{\theta}$.
- Can show that $\underline{\theta} > \theta''$ for all (H, u, β, δ) for which an RSE exists.

GDP Growth

$$gdp_t = p_t I_t + y_t$$

Equilibrium N-sector investment, T-output, and prices:

$$I_t = \phi_t q_t, \quad y_t = \left[(1-\phi_t)q_t\right]^{\alpha}, \qquad p_t = \alpha\left[(1-\phi_t)q_t\right]^{\alpha-1}.$$

Substituting

$$gdp_t = q_t^{\alpha} Z(\phi_t), \qquad\qquad Z(\phi_t) \equiv \frac{1-(1-\alpha)\phi_t}{(1-\phi_t)^{1-\alpha}}.$$

- Repressed Economy

$$1+\gamma^s \equiv \frac{gdp_t}{gdp_{t-1}} = \left(\theta\,\tfrac{1-\beta}{1-H}\right)^{\alpha} = \left(\theta\phi^s\right)^{\alpha}.$$

Liberalized economy

- Tranquil times

$$1+\gamma^l \equiv \frac{gdp_t}{gdp_{t-1}} = \left(\theta \frac{1-\beta}{1-Hu^{-1}}\right)^{\alpha} = \left(\theta\phi^l\right)^{\alpha}.$$

- Crises can occur.
- In equilibrium, 2 crises cannot occur consecutively $\rightarrow$ average growth in crisis episode

$$1+\gamma^{cr} = \left(\left(\theta\phi^l\right)^{\alpha} \frac{Z(\phi^c)}{Z(\phi^l)}\right)^{1/2} \left(\left(\theta\phi^c\right)^{\alpha} \frac{Z(\phi^l)}{Z(\phi^c)}\right)^{1/2} = \left(\theta(\phi^l\phi^c)^{1/2}\right)^{\alpha}.$$

- Loss in GDP growth stems only from the fall in the N-sector's average investment share $(\phi^l\phi^c)^{1/2}$.

- $\log(gdp_t) - \log(gdp_{t-1})$ follows a 3-state Markov chain:

$$\Gamma = \begin{pmatrix} \log\left((\theta\phi^l)^\alpha\right) \\ \log\left((\theta\phi^l)^\alpha \frac{Z(\phi^c)}{Z(\phi^l)}\right) \\ \log\left((\theta\phi^c)^\alpha \frac{Z(\phi^l)}{Z(\phi^c)}\right) \end{pmatrix}, \qquad T = \begin{pmatrix} u & 1-u & 0 \\ 0 & 0 & 1 \\ u & 1-u & 0 \end{pmatrix}.$$

- The mean long-run GDP growth rate

$$E(1+\gamma^r) = (1+\gamma^l)^{\frac{u}{2-u}}(1+\gamma^{cr})^{1-\frac{u}{2-u}} \;=\; \theta^\alpha(\phi^l)^{\frac{1}{2-u}\alpha}(\phi^c)^{\frac{1-u}{2-u}\alpha}$$

Growth Enhancing Liberalization

$$E(\gamma^r) > \gamma^s \;\Leftrightarrow\; \log(\phi^l) - \log(\phi^s) \;>\; [1-u]\,[\log(1-\beta) - \log(\mu_w)]$$

where $\phi^c \equiv \frac{\mu_w}{1-H} = \frac{\mu_w}{1-\beta}\phi^s$.

- Liberalization Enhances Long-run mean GDP growth iff
  - Benefits of higher leverage and investment in tranquil times $(\phi^l > \phi^s)$ compensate for the
  - Shortfall in credit and investment in crisis times $(\mu_w < 1-\beta) \times$ frequency of crisis $(1-u)$.

Let $u \uparrow 1 \rightarrow$ gains for all admissible $1-u$

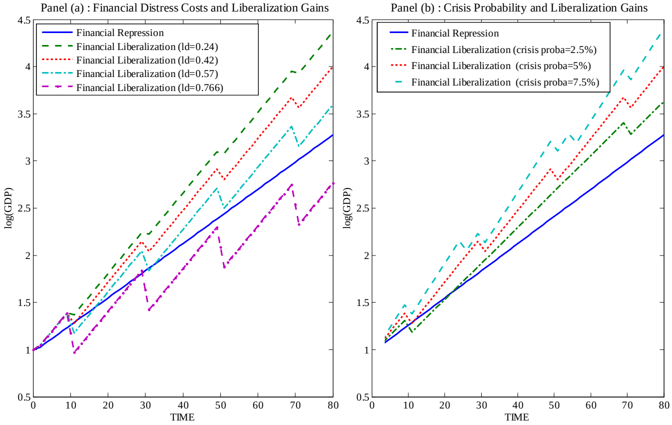

Figure: Growth Gains from Liberalization

Proposition (Liberalization and Growth)

If financial liberalization generates systemic risk and makes the economy vulnerable to self-fulfilling crises and the financial distress costs of crises $l^d \equiv 1 - \frac{\mu_w}{1-\beta}$ *are lower than a threshold*

$$l^d \; < \; \overline{l^d} \equiv 1 - e^{-\frac{H}{1-H}}, \qquad \textit{then:} \tag{1}$$

1. *Liberalization increases long-run mean GDP growth.*
2. *Liberalization increases the long-run mean N-investment share bringing it nearer to—but still below—the central planner's optimal level, i.e.,* $\phi^s < E(\phi^r) < \phi^{cp}$.
3. *The gains from liberalization are increasing in the crisis probability, within the admissible region* $(i.e., \, 1-u \in (0, 1-H))$.

- Replacing ϕ^l by $\frac{1-\beta}{1-Hu^{-1}}$ and ϕ^s by $\frac{1-\beta}{1-H}$,
- $E(\gamma^r) > \gamma^s$ becomes equivalent to $l^d < 1 - \left(\frac{1-Hu^{-1}}{1-H}\right)^{\frac{1}{1-u}}$.
- Then $lim_{u\uparrow 1} \left(\frac{1-Hu^{-1}}{1-H}\right)^{\frac{1}{1-u}} = e^{-\frac{H}{1-H}}$.

What does the data say: $l^d < \overline{l^d} \equiv 1 - e^{-\frac{H}{1-H}}$?

- Get estimates of H.
  - $b = \left(\frac{1}{1-H} - 1\right) w \;\rightarrow\; H = \frac{b}{b+w} \cdot u$
  - Estimate $\frac{b}{b+w}$ from firm-level balance sheet info for 23 emerging markets 1990-2013, Thomson Worldscope data set.
  - u use estimates in literature
- Compare $\bar{l}^d$ with data on crisis GDP losses

Estimates of Crisis Probability $1 - u$

- Schularick-Taylor (2012): 14 countries over 1870-2008
- Gourinchas-Obstfeld (2012): 57 emerging countries over 1973-2010.
- Unconditional crisis probability: GO: 3%, ST: 5%
- Conditional Probabilities (logit): ST, five lags of credit growth; GO credit-to-GDP.
- Distribution of Predicted crisis probabilities by percentile of country-years:

Percentile of country-years	5%	25%	50%	75%	95%
Schularick-Taylor, 2012	1.47%	2.54%	3.48%	4.82%	8.55%
Gounrinchas-Obstfled, 2012					
—Full specification	0.37%	1.47%	2.96%	5.70%	17.74%
—Credit/GDP only	1.8%	2.91%	3.57%	4.44%	7.76%

Estimation of Upper Threshold for Financial Distress Costs ($\overline{l^d} = 1 - e^{-\frac{H}{1-H}}$)

- Use Thomson Worldscope data set.
- We bias downwards $\widehat{H}$ by assuming all countries are in a risky equilibrium.
- $\widehat{\frac{debt}{assets}} = 0.542$, s.e.$= 0.0049$

Crisis Probability $(1-u)$	0.05	0.1	0.2
$\widehat{H} = u \cdot \left(\widehat{\frac{debt}{assets}}\right)$	0.515	0.488	0.434
$\widehat{\overline{l^d}} \equiv 1 - e^{-\frac{\widehat{H}}{1-\widehat{H}}}$	0.654	0.614	0.535

Upper Bound on GDP Losses During Crises.

- Financial distress costs do not have a direct counterpart in the data.
- In equilibrium they are closely linked to GDP losses during a crisis (data exists):

$$\mathcal{S} \equiv \frac{GPD^{trend} - GDP^{crisis}}{GPD^{trend}} = 1 - \frac{\left(1+\gamma^{cr}\right)^2}{\left(1+\gamma^{l}\right)^2} = 1 - \left(\frac{\phi^c}{\phi^l}\right)^{\alpha}$$

- Substituting the upper bound $\overline{l^d}$ for l^d, the largest crisis GDP loss consistent with liberalization gains is

$$\overline{\mathcal{S}} = 1 - \left(\frac{1 - Hu^{-1}}{1-H} \cdot e^{-\frac{H}{1-H}}\right)^{\alpha}$$

- Setting $\alpha{=}0.34$, its average for 7 countries in Emerging Asia:

Crisis Probability $(1-u)$	0.05	0.1	0.2
$\widehat{H}$	0.515	0.488	0.434
$\widehat{\overline{\mathcal{S}}}$ (Upper Bound GDP Losses)	31.6%	28.9%	24%

- Laeven and Valencia (2012): 31 crises episodes in emerging countries over 1970-2012.
  - Annualized crisis GDP losses average 10.68%
  - 90th percentile crisis annualized GDP losses is 23.1%
  - Only two crises exhibit losses greater than 30%.
- $\widehat{\bar{\mathcal{S}}} > 10.68\% \rightarrow$ financial distress costs are below the growth enhancing threshold $\bar{l}^d$
- $\Rightarrow$ Across emerging markets over the period 1970-2012, the direct positive effect of financial liberalization—due to a relaxation of borrowing constraints—dominates the indirect negative effect due to a greater incidence of crises.

Consumption Possibilities

- FL $\rightarrow$ Systemic Risk $\rightarrow$ $\begin{array}{lcl} \text{Relax BC} & \rightarrow & \uparrow \text{Investment} \\ \text{Crises} & \rightarrow & \text{Bailouts} \end{array}$
- Expected discounted value of consumption

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

- In repressed economy

$$W^s = \sum_{t=0}^{\infty} \delta^t y_t^s = \frac{1}{1-\delta(\theta\phi^s)^\alpha} y_o^s = \frac{1}{1-\delta\left(\theta\phi^s\right)^\alpha}(1-\phi^s)^\alpha q_o^\alpha .$$

- In liberalized economy

$$W^r = E_0 \sum_{t=0}^{\infty} \delta^t \kappa_t y_t, \qquad \kappa_t = \begin{cases} \kappa^c \equiv 1 - \frac{\alpha}{1-\phi^c}[1-\mu_w] & \text{if } t = \tau_i, \\ 1 & \text{otherwise;} \end{cases}$$

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

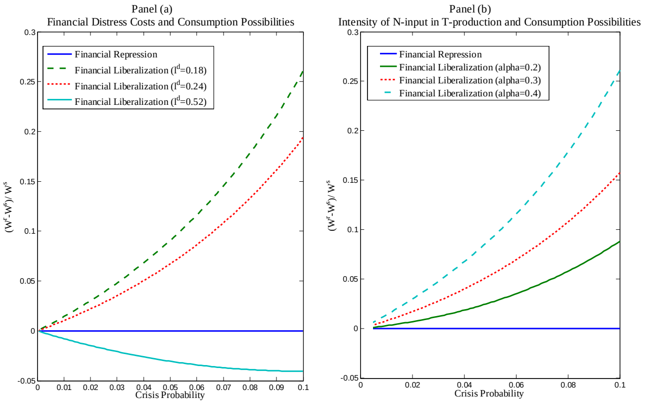

Figure: Consumption Gains from Liberalization

Example: Anything Goes Regulatory Regime

- Alternative (inferior) technology for producing final T-goods using only T-goods

$$\begin{aligned} y_{t+1} &= \varepsilon_{t+1} I_t^{\varepsilon}, \quad \text{where } \varepsilon_{t+1} = \begin{cases} \overline{\varepsilon} & \text{with probability} \quad \lambda, \\ 0 & \text{with probability} \quad 1-\lambda \end{cases} \\ \overline{\varepsilon} &\leq 1+r. \end{aligned}$$

- Catastrophe bonds w/no collateral are allowed:

$$L_{t+1}^c = \begin{cases} 0 & \text{if } \varepsilon_{t+1} = \overline{\varepsilon}, \\ \left(1+\rho_t^c\right) b_t^c & \text{if } \varepsilon_{t+1} = 0. \end{cases}$$

- Bailout up to an amount Γ_t is granted to lenders of a defaulting borrower if majority of borrowers defaults.

- The negative NPV ε-technology may be funded
- Catastrophe bonds $\rightarrow$ all repayments shifted to the default state
- Borrowing determined by expected bailout rather than by equity ($b_t^c = [1-\lambda]\delta\Gamma_{t+1}$).
- Average growth may be higher than under F. repression, but losses during crises more than offset private profits.

This example helps rationalize contrasting experiences:

- Emerging markets' booms have featured mainly standard debt
  - Systemic risk taking has been, on average, associated with higher long-run growth.
- Recent US boom featured a proliferation of uncollateralized option-like liabilities
  - Supported funding of negative net present value projects.

Conclusions

- Liberalization has led to more crisis-induced volatility
- $\not\Rightarrow$ Liberalization per-se is bad for either growth or production efficiency.
- Policies intended to eliminate financial fragility might block the forces that spur growth and allocative efficiency.
- At the other extreme, the gains can be overturned in a regime with unfettered liberalization where option-like securities can be issued without collateral.

Parameters	*Baseline Value*	*Range of Variation*	*Target / Sources*
Probability of crisis	$1 - u = 0.05$	$[0, 0.1]$	Schularick-Taylor (2012), Gourinchas-Obstbeld (2012)
Intensity of N-inputs in T-production	$\alpha = 0.34$	$[0.2, 0.4]$	Input-Output Tables for Emerging Asia Source: ADB (2012)
Financial distress costs	$l^d = 24\%$	$[18\%, 76.6\%]$	Laeven and Valencia (2013)
Contract enforceability	$H = 0.515$		Debt-to-Assets in Emerging Countries Source: Thompson Worldscope
N-sector Internal Funds	$1 - \beta = 0.33$		
N-sector Productivity	$\theta = 1.6$		

The discount factor is set to $\delta = 0.85$ to satisfy $\delta < \theta^{-\alpha}$, so that $\phi^{cp} < 1$.