

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
 - a riskless economy is transformed into one with systemic-risk
 - ↑ Incidence of crises
 - Bailout costs
- ▶ $\uparrow\downarrow$ Consumption opportunities
- ▶ We derive a condition for gains from growth 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 $\rightarrow p_t = \frac{p_t^n}{p_t}$
- ▶ 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

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

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

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

N-sector

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

$$q_t = \Theta_t k_t^\beta l_t^{1-\beta}, \quad \Theta_t =: \theta \bar{k}_t^{1-\beta}, \quad k_t = I_{t-1}$$

- ▶ Budget constraint

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

- ▶ 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 ($I_t = \phi_t q_t$).

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

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

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

▶ ↑ ϕ today

→ ↓ today's T-output by $\alpha(1 - \phi)^{\alpha-1} q_t^\alpha \partial\phi$

→ ↑ tomorrow's N-output by $\theta q_t \partial\phi$

→ ↑ tomorrow's T-output by $\alpha [(1 - \phi)\theta\phi q_t]^{\alpha-1} \theta q_t \partial\phi$

→ Intertemporal rate of transformation

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

▶ Set $M = \delta^{-1}$

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

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

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

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

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

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

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

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

- ▶ 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):

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

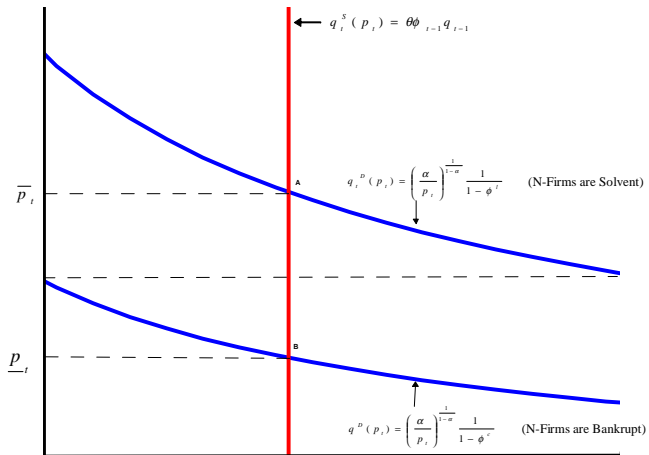


Figure: Market Equilibrium for Input

Bottleneck II:

- ▶ Under financial Liberalization the investment share is below the Central Planner's optimum
- ▶ $\phi^l < \phi^{cp} \Leftrightarrow \theta > \left(\frac{1}{\delta}\right)^{\frac{1}{\alpha}} (\phi^l)^{\frac{1-\alpha}{\alpha}} \equiv \theta''$.
- ▶ 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:

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

Substituting

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

► Repressed Economy

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

Liberalized economy

- ▶ Tranquil times

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

- ▶ Crises can occur.
- ▶ In equilibrium, 2 crises cannot occur consecutively → average growth in crisis episode

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

- ▶ 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:

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

- ▶ 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 $1 - u$

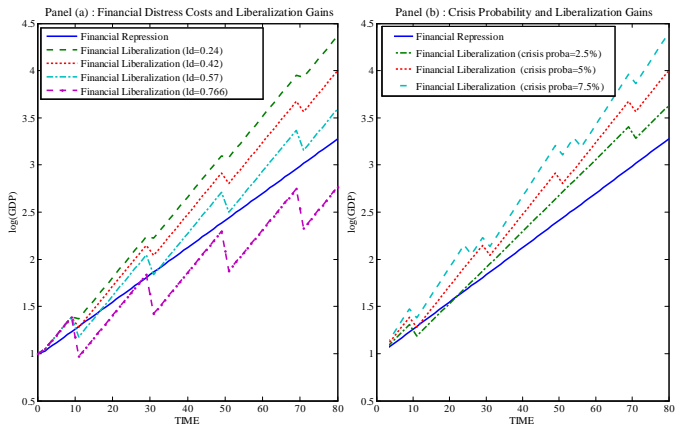


Figure: Growth Gains from Liberalization

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

$$l^d < \bar{l}^d \equiv 1 - e^{-\frac{H}{1-H}}, \quad \text{then:} \quad (1)$$

- 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: $l^d < \bar{l}^d \equiv 1 - e^{-\frac{H}{1-H}}$?

- ▶ 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

$$(\widehat{l}^d = 1 - e^{-\frac{\widehat{H}}{1-\widehat{H}}})$$

- ▶ 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
$\widehat{l}^d \equiv 1 - e^{-\frac{\widehat{H}}{1-\widehat{H}}}$	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):

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

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

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

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

Crisis Probability ($1 - u$)	0.05	0.1	0.2
\hat{H}	0.515	0.488	0.434
\hat{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%.
- ▶ $\widehat{S} > 10.68\% \rightarrow$ 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 Relax BC \rightarrow \uparrow Investment
Crises \rightarrow Bailouts
- ▶ 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

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

- ▶ In liberalized economy

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

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

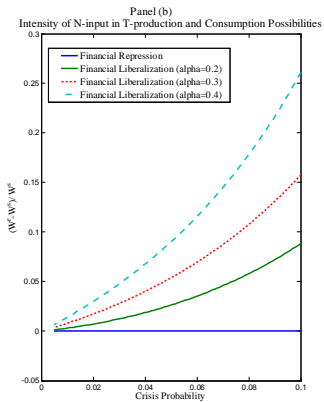
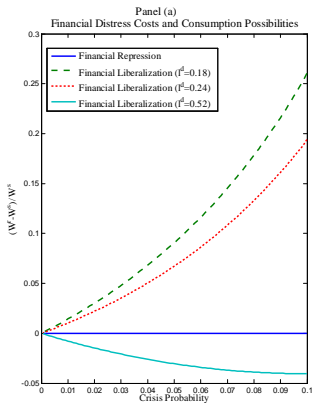


Figure: Consumption Gains from Liberalization

Example: Anything Goes Regulatory Regime

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

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

- ▶ Catastrophe bonds w/no collateral are allowed:

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

- ▶ 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
- ▶ \nRightarrow 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.

<i>Parameters</i>	<i>Baseline Value</i>	<i>Range of Variation</i>	<i>Target / Sources</i>
Probability of crisis	$1 - u = 0.05$	[0, 0.1]	Schularick-Taylor (2012), Gourinchas-Obstfeld (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 $\phi^{cP} < 1$.