Bond Finance, Bank Credit, and Aggregate Fluctuations in an Open Economy

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Extremely preliminary

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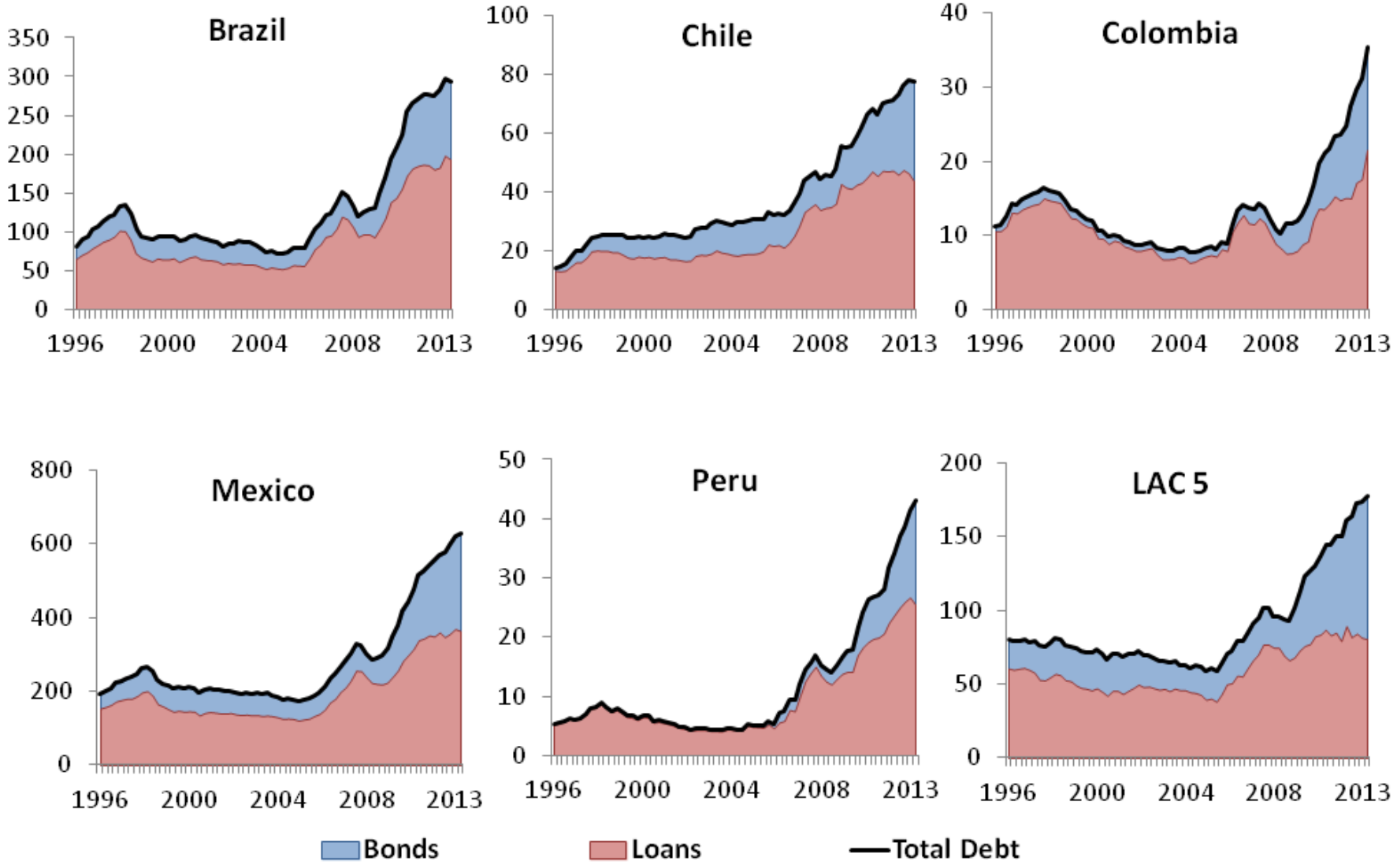
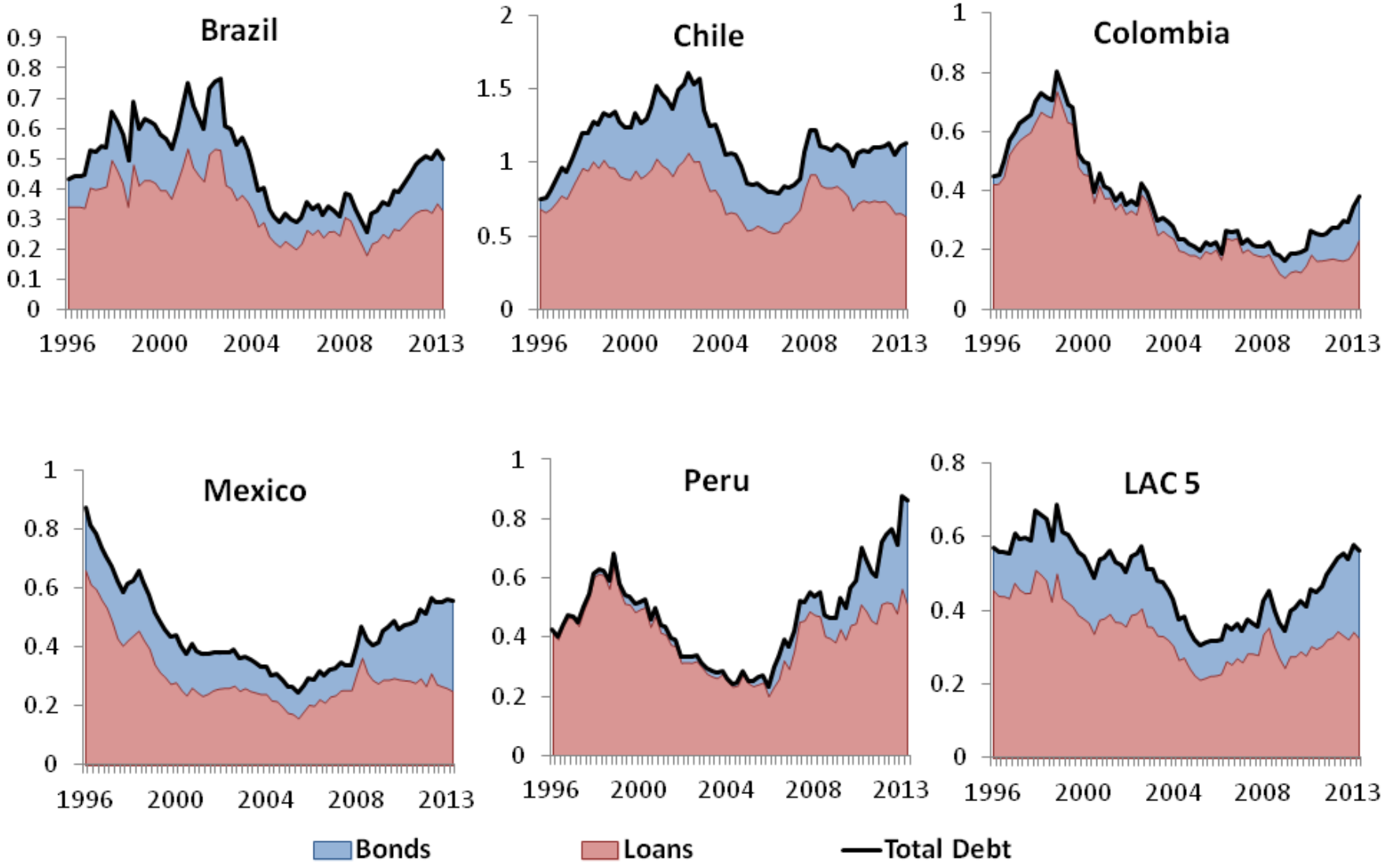
- Shin (2013): new phase in global liquidity, with a broader change in the way private corporations fund themselves, where traditional bank financing is substituted with increased funding through capital markets.

Corporate debt in Latin America, bln USD



Corporate debt in Latin America relative to GDP



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- What is the role of net worth (both of firms and of financial intermediaries)?
- How does the observed growing reliance on debt issuance interact with the business cycle?

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- We then use this framework to study the dynamic behavior of both direct and indirect finance when unexpected shocks occur.
- Particularly, a large and persistent drop in world interest rates.

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- As in HT, the net worth of banks can substitute for the net worth of firms, and its evolution is critical for dynamics.

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  - Households
  - Financial intermediaries (banks)
  - Foreigners
  - Holdings of investment good producers

Final Good Producers

- Usual, competitive sector, with production function

$$Y_t = A_t K_t^{\alpha} H_t^{1-\alpha}$$

- Cost minimization:

$$\begin{aligned} \alpha Y_t &= r_t^K K_t \\ (1-\alpha) Y_t &= w_t H_t \end{aligned}$$

Households

- Households own productive factors, including capital
- Capital accumulation is subject to adjustment costs:

$$K_{t+1} = (1-\delta)K_t + X_t - \frac{\varphi}{2}K_t\left(\frac{K_{t+1}}{K_t} - 1\right)^2$$

Households

- Budget constraint:

$$C_t + Q_t X_t + B_{t+1} = w_t H_t + r_t^K K_t + \Psi_t R_t^* B_t$$

where

$$\Psi_t = \Psi - \phi(e^{\bar{B}-B} - 1)$$

- Note that the price of investment goods (new capital), Q_t, is variable

Optimal Labor Supply

- Preferences are GHH
- Labor supply only depends on the wage:

$$w_t = \kappa H_t^{\tau-1}$$

Optimal Savings

- The FOC for savings is standard:

$$\lambda_t^c = \beta^h E_t \left(\lambda_{t+1}^c \Psi_{t+1} R_{t+1}^*\right)$$

with

$$\lambda_t^c = \left(C_t - \kappa \frac{H^\tau}{\tau}\right)^{-\sigma}$$

Optimal capital accumulation

- Capital accumulation is given by the Euler equation

$$
\begin{aligned}
& Q_t \left[1+\varphi\left(\frac{K_{t+1}}{K_t}-1\right)\right] \\
= \quad & \beta^h E_t \frac{\lambda_{t+1}^c}{\lambda_t^c}\left[r_{t+1}^K + Q_{t+1}(1-\delta) + \right. \\
& \left. \varphi\left(\frac{K_{t+2}}{K_{t+1}}-1\right)\frac{K_{t+2}}{K_{t+1}} - \frac{\varphi}{2}\left(\frac{K_{t+2}}{K_{t+1}}-1\right)^2\right]
\end{aligned}
$$

- This would be a standard model if $Q_t \equiv 1$

Modeling the Supply of Capital Goods

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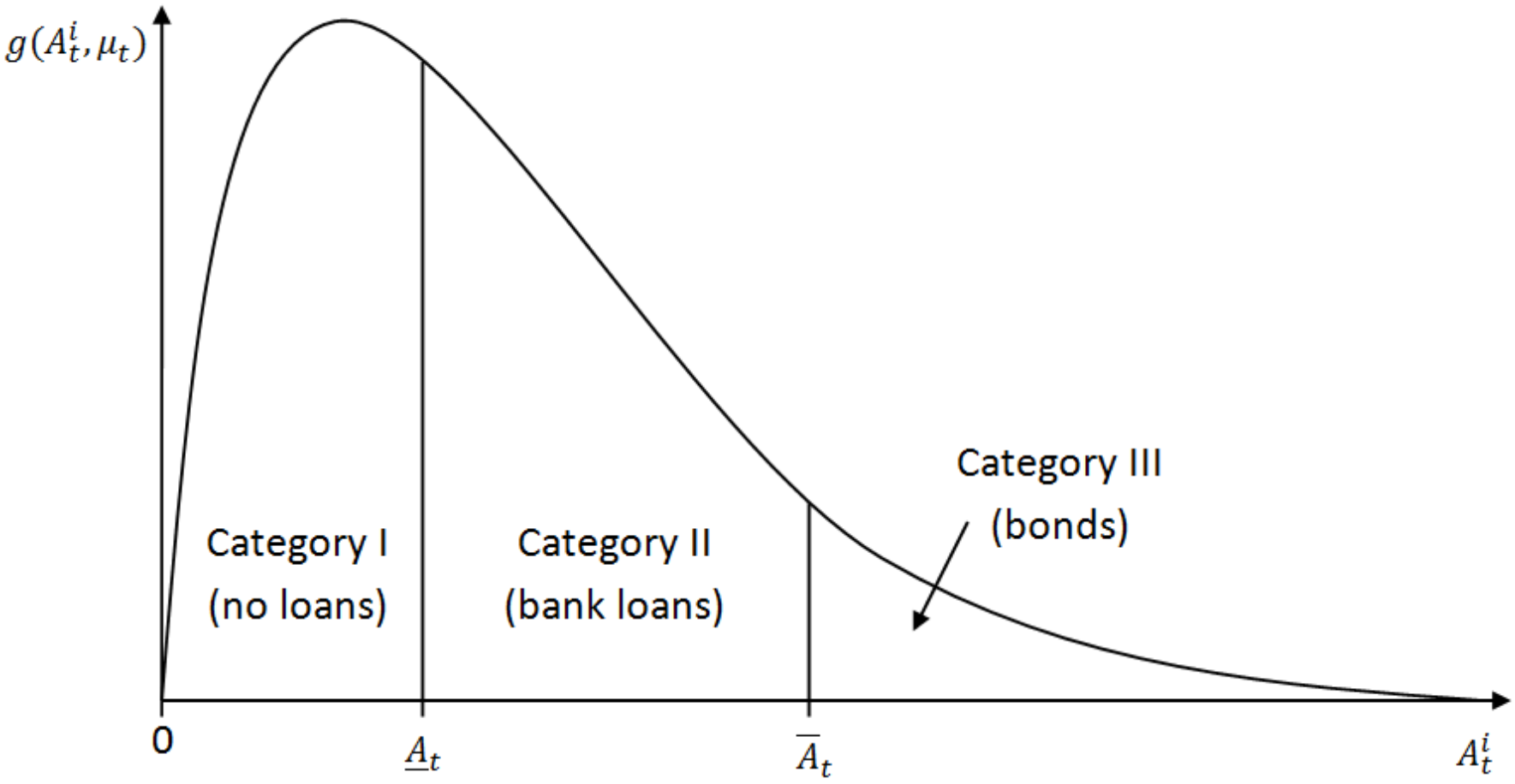
- Each firm i is charged with financing and executing a project, which takes I_t units of the final good as input, and returns a random amount of new capital goods.
- The size of the investment project, I_t, is chosen by the manager of the holding and common to every firm.

Firm distribution



Typical Firms's Problem

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- Follow HT (1997): consider a firm with $A_t^i < I_t$
- Need finance, but there is moral hazard problem
- If project is executed, it returns RI_t with probability p_H and zero otherwise
- But, to gain a private benefit B, the firm can choose a "bad" project that reduces success probability to $p_L < p_H$

Conditions for Direct Finance

- Incentive Compatibility Constraint (ICC):

$$p_H R_t^{f,i} \geq p_L R_t^{f,i} + BI_t$$

or, with $\Delta = p_H - p_L$, $R_t^{f,i} \geq \frac{BI_t}{\Delta}$

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- Combining the two:

$$A_t^i \geq \bar{A}_t = I_t \left[1 - p_H(Q_t R - \frac{B}{\Delta})\right]$$

Intermediated Finance

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- A bank can reduce the private benefit of the bad project to $b < B$ at a cost cl_t

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- ICC for bank:

$$p_H R_t^{m,j} - cl_t \geq p_L R_t^{m,j}$$

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- Outsiders' participation constraint:

$$p_H(Q_t RI_t - R_t^{f,j} - R_t^{m,j}) \geq I_t - I_t^{m,j} - A_t^j$$

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- Bank's participation constraint:

$$p_H R_t^m \geq \beta_t I_t^{m,j}$$

so $I_t^{m,j} \equiv I_t^m$

Conditions for Bank Finance

Combining, firm j will have access to bank finance if it has enough equity: $A_t^j \geq \underline{A}_t$, where

$$\underline{A}_t = I_t \left[1 - p_H \frac{c}{\Delta \beta_t} - p_H \left(Q_t R - \frac{b+c}{\Delta} \right) \right]$$

Project Size

The holding's manager chooses I_t to maximize profits:

$$\begin{aligned}\Pi_t^f &= p_H Q_t R I_t \left[1 - G_t(\underline{A}_t)\right] + \int_0^{\underline{A}_t} A_t^i \mathrm{d}G_t\left(A_t^i\right) \\ &\quad - \int_{\bar{A}_t}^{\infty} \left(I_t - A_t^i\right) \mathrm{d}G\left(A_t^i\right) - \int_{\underline{A}_t}^{\bar{A}_t} \left(I_t - p_H \frac{cI_t}{\Delta\beta_t} - A_t^i\right) \mathrm{d}G\left(A_t^i\right) \\ &\quad - p_H \frac{cI_t}{\Delta}\left[G(\bar{A}_t) - G(\underline{A}_t)\right]\end{aligned}$$

Distribution

We have assumed that $G_t(A) = G(A; \mu_t)$ for some parameter μ_t. In particular, if

$$A_t^i = K_t^f z_t^i$$

where z_t^i is i.i.d. across agents and time, with cdf $F(z)$, mean one, and some variance

$$G_t(A) = \Pr\left\{A_t^i \leq A\right\} = \Pr\left\{K_t^f z_t^i \leq A\right\} = F\left(\frac{A}{K_t^f}\right) \equiv G(A; \mu_t)$$

For $G_t(.)$ to be lognormal with mean μ_t and variance σ_G^2,

$$\mu_t = \log K_t^f - \frac{\sigma_G^2}{2}$$

Holding's optimality conditions

The FOC's are:

$$(p_H Q_t R - 1)\left[1 - G_t\left(\underline{A}_t\right)\right] - p_H \frac{c}{\Delta\beta_t}(\beta_t - 1)[G(\bar{A}_t) - G(\underline{A}_t)]$$

$$= \lambda_t^1 \left[1 - p_H(Q_t R - \frac{B}{\Delta})\right] + \lambda_t^2 \left[1 - p_H \frac{c}{\Delta\beta_t} - p_H\left(Q_t R - \frac{b+c}{\Delta}\right)\right]$$

with

$$\lambda_t^1 = g_t(\bar{A}_t) I_t p_H \frac{c}{\Delta\beta_t}(\beta_t - 1)$$

$$\lambda_t^2 = g_t(\underline{A}_t) I_t \left[p_H Q_t R - 1 - p_H \frac{c}{\Delta\beta_t}(\beta_t - 1)\right]$$

Temporary Equilibrium

- β_t adjusts to equate demand for bank equity to its supply:

$$K_t^m = p_H \frac{cl_t}{\Delta\beta_t} \left[G(\bar{A}_t; \mu_t) - G(\underline{A}_t; \mu_t) \right]$$

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- The price of new capital, Q_t, adjusts to clear the new capital market:

$$X_t = p_H R I_t \left[1 - G(\underline{A}_t; \mu_t) \right]$$

Dynamics of Equity

- Banks' equity:

$$K_{t+1}^{m} = \theta^{m} p_{H} \frac{cl_t}{\Delta} \left[G(\bar{A}_t; \mu_t) - G(\underline{A}_t; \mu_t) \right]$$

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$$K^m_{t+1} = \theta^m p_H \frac{cI_t}{\Delta} \left[G(\bar{A}_t; \mu_t) - G(\underline{A}_t; \mu_t) \right]$$

- Holding's (capital producers') equity:

$$\begin{aligned} K^f_{t+1} &= \theta^f \Pi^f_t \\ &= \theta^f \{ K^f_t + (p_H Q_t R - 1) I_t \left[1 - G(\underline{A}_t; \mu_t) \right] \\ &\quad - p_H \frac{cI_t}{\Delta \beta_t} (\beta_t - 1) \left[G(\bar{A}_t; \mu_t) - G(\underline{A}_t; \mu_t) \right] \} \end{aligned}$$

Calibration

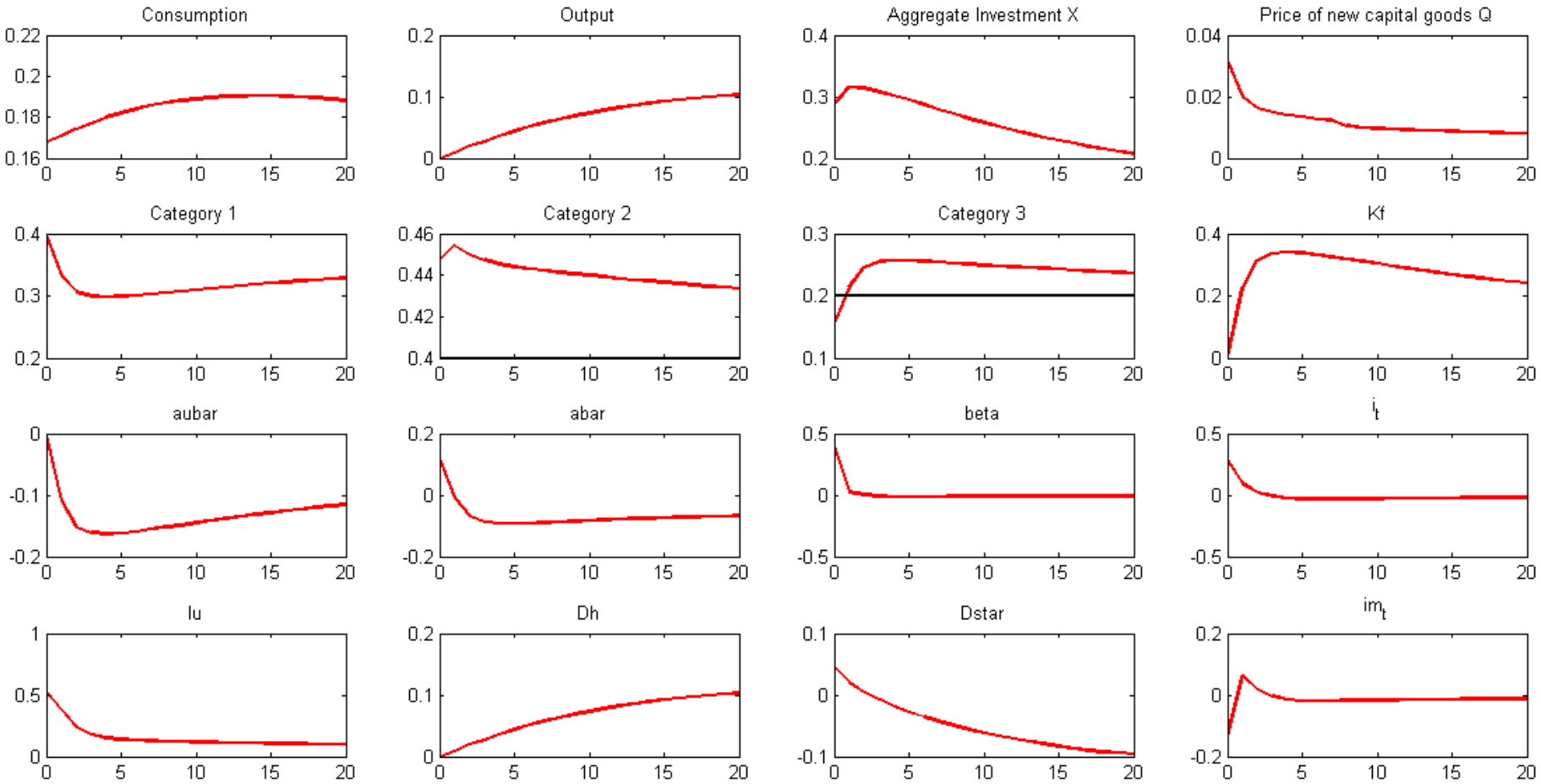
- An important aspect of the parameterization concerns the distribution of equity supply which is assumed to be

$$
\begin{aligned}
G(\underline{A};\mu) &= 0.4 \\
G(\bar{A};\mu) &= 0.8
\end{aligned}
$$

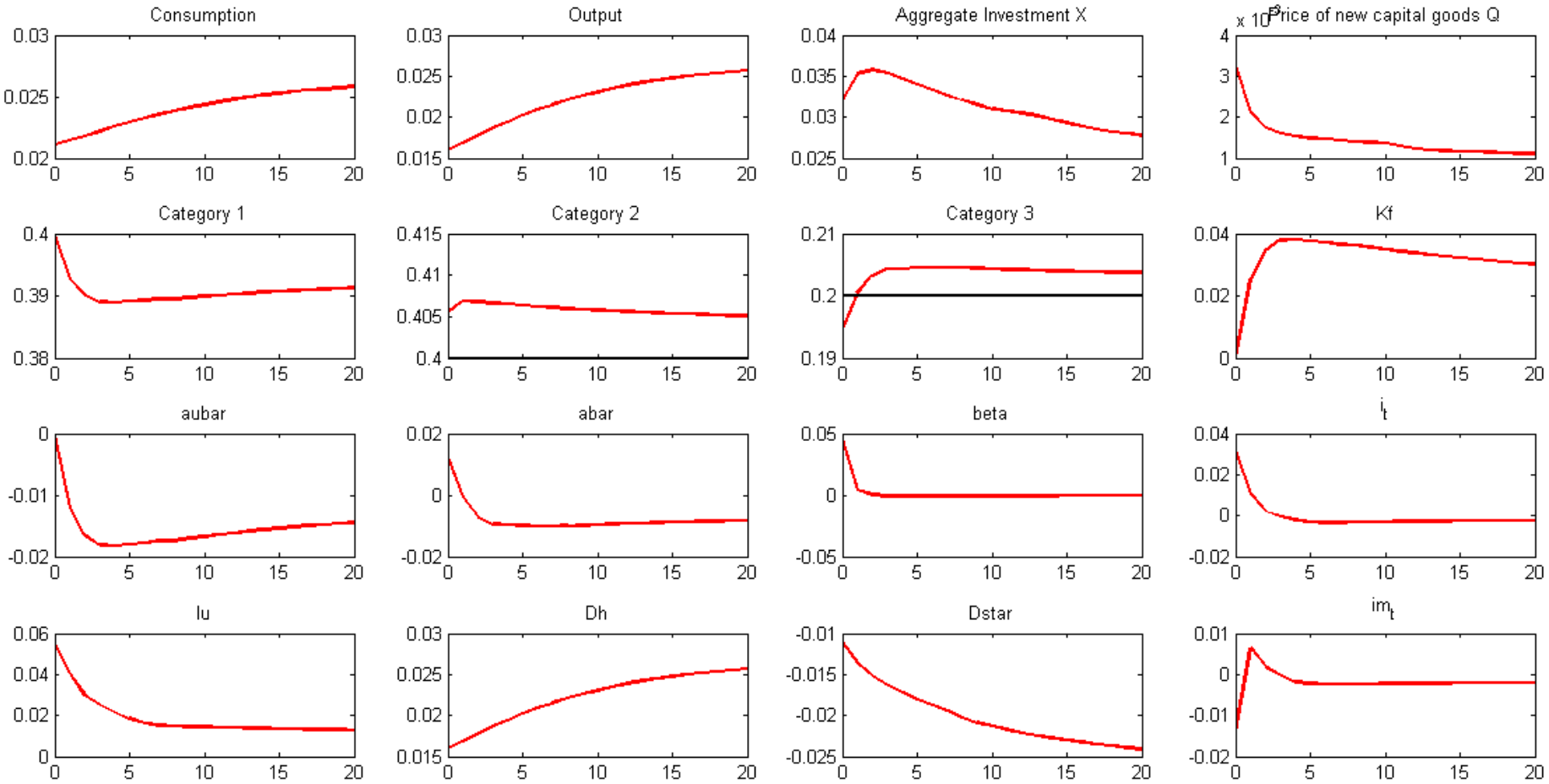
Calibration

Parameter	*Description*	*Value*
φ	Cost of capital adjustment	4.602
$\tilde{\Psi}$	Risk premium elasticity	0.001
β	Rate of return to bank equity	1.042
p_H	High prob. of project success	0.99
p_L	Low prob. of project success	0.96
α	Cobb-Douglas capital share	0.3
K/Y	Capital-to-output ratio	20
β^h	Household's discount factor	0.99
δ	Depreciation rate	0.05
A	TFP	1
H	Hours	0.33
C/Y	Consumption-to-output ratio	0.7
R^*	World interest rate	1.002
τ	Labor disutility	1.6
σ	Relative risk aversion	2

Drop in R^* of 1% on impact, persistence 0.99



Increase in A of 1% on impact, persistence 0.99



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