A Simple Quantitative Model of Financial Crises in Open Economies

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Motivation

Stylized facts from financial crises

- external borrowing interest rate rises
- firms under financial distress fire-sale asset: e.g., Schnabel and Shin (2004), Coval and Stafford (2007)
- resource misallocation intensified (MPK dispersion $\uparrow$): e.g., Sandleris and Wright (2011), Oberfield (2013)
    - misallocation accounts for more than half of measured aggregate TFP drop in Argentina 2001

Preview

What we do in the model

- financial crises driven only by external interest rate spike
- firms/banks who have high leverage bind financial constraints and fire-sale asset
- capital misallocation and endogenous output drop

Model - Households

- **Endowment**: W (natural resources e.g., oil)
- **Dividend** d from firms
- **Produce** by employing capital good: $y_h = Bk_h^\alpha$ with $0 < \alpha < 1$
  - interpretation: combination of households, and firms who do not expose to external debt
- **Consumption** given by

$$C = W + d + Bk_h^\alpha + q(k_h - k_h')$$

with q capital good price and use $'$ to denote next period variable

- Lifetime **utility** $\sum_{t=0}^{\infty} \beta^t U(C_t) = \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\sigma}-1}{1-\sigma}$

Model - Firms

- "Firms" capture firms/banks who exposed to foreign debt in reality
- Firms' capital structure: external **debt** and domestic **equity**:

$$V(b, k_b, \tilde{s}) = \max_{b', d, k_b'} d + E[\beta \frac{\Lambda'}{\Lambda} V(b', k_b', \tilde{s}')]$$

  where $\tilde{s}$ denotes aggregate state.

- **Dividend** payment $d = Ak_b^\alpha - b + \frac{b'}{R} - \frac{\xi}{2} b'^2 + q(k_b - k_b')$

Model - Firms

- Dividend **constraint** (equity issuance constraint when $\underline{d} = 0$)

$$d \geq \underline{d} A k_b^{\alpha}$$

  - Brav et al. (2005) managers' desire to **avoid dividend cuts**

- Upon interest rate spike, firms would like to cut dividend or raise equity but can not, so fire-sale to unconstrained sector
  - occasionally binding financial constraint: non-linear dynamics
  - misallocation of capital induces output drop

- Fixed capital supply $K = K_h + K_b$

Private Sector Equilibrium

- Only interest rate shock
- Variables $\{K_h', K_b', C, \Lambda, b', \mu, q, R\}$, where μ is LM of the dividend constraint

$$q = \beta E[\frac{\Lambda'}{\Lambda}(B\alpha K_h'^{\alpha-1} + q')]$$

$$q(1+\mu) = \beta E[\frac{\Lambda'}{\Lambda}[(A\alpha K_b'^{\alpha-1} + q')(1+\mu') - \underline{d}\mu' A\alpha K_b'^{\alpha-1}]]$$

$$K = K_h + K_b$$

$$C = W + AK_b^{\alpha} + BK_h^{\alpha} - b + \frac{b'}{R} - \frac{\xi}{2}b'^2$$

$$(1+\mu)(\frac{1}{R} - \xi b') = \beta E(\frac{\Lambda'}{\Lambda}(1+\mu'))$$

$$\mu(AK_b^{\alpha} - b + \frac{b'}{R} - \frac{\xi}{2}b'^2 + q[K_b - K_b'] - \underline{d}AK_b^{\alpha}) = 0, \mu \geq 0, d \geq \underline{d}AK_b^{\alpha}$$

$$\Lambda = C^{-\sigma}$$

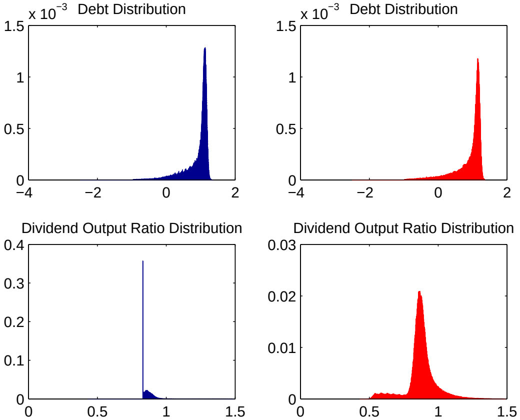
- Interest rate shocks: **Regime 1**, AR(1) process with low mean; **Regime 2**, very high interest rate to capture the "asymmetry" of interest rate process

Simulation - Parameter Values

- **Regime 1**: $\log R' - \mu_R = \rho(\log R - \mu_R) + \sigma_R \epsilon$, **Regime 2**: $\log R = \mu_R^H$. **Regime switching**: prob. p_{12} and p_{21}

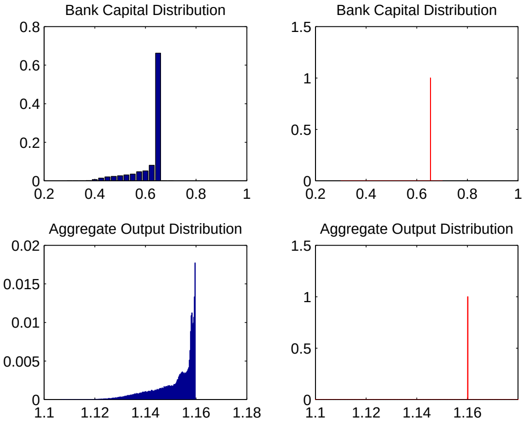
Parameter	Value
σ	2
β	0.88
ξ	0.03
W	0.5
A	1
B	0.8
α	0.65
K	1
Grids for b	$[-2.5, 1.35]$
Grids for k_b	$[0.3, 0.7]$
μ_R	0.08
ρ	0.7
σ_R	0.01
μ_R^H	0.2
p_{12}	0.03
p_{21}	0.2

Simulation -Compare $\underline{d} = 0.83$ (Left) and $\underline{d} = -\infty$ (Right)



- **precautionary** debt position under financial friction: mean debt 0.9561 v.s. 0.9711

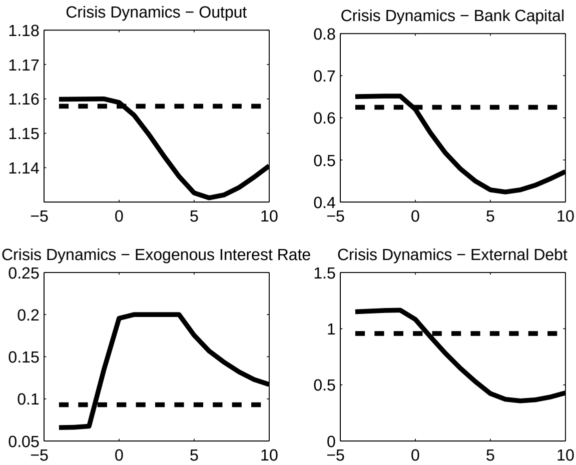
Simulation -Compare $\underline{d} = 0.83$ (Left) and $\underline{d} = -\infty$ (Right)



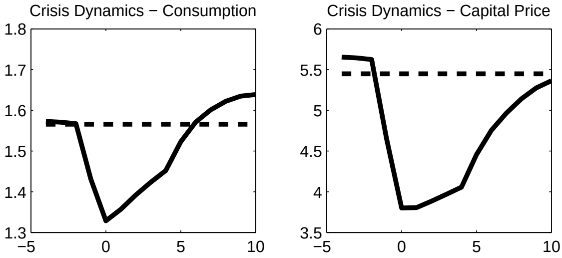
- **misallocation** and endogenous output drop

Simulation -Crisis Dynamics with $\underline{d} = 0.83$

- **Crisis Definition**: period t output is above or equal to mean of output, while $t + 5$, output is 2% below mean. Average windows $t - 4$ to $t + 10$



Simulation -Crisis Dynamics with $\underline{d} = 0.83$



- here closed economy will not generate output loss as immune from external interest rate shock

- pecuniary externality through capital price q: scope for capital control or external leverage regulation

$$AK_b^\alpha - b + \frac{b'}{R} - \frac{\xi}{2}b'^2 + \mathbf{q}(K_b - K_b') \geq \underline{d}AK_b^\alpha$$

Conclusion

- Build up a simple model of financial crises in open economies
- Asset fire-sale of firms under high debt, upon interest rate spike
- Capital misallocation and endogenous output drop
- Future work: add collateral constraint to amplify misallocation; study government asset purchase policy, leverage regulation policy and dividend tax policy etc.