REQUIRED RESERVES AS A CREDIT POLICY TOOL

(*joint with Enes Sunel and Temel Taşkın*)

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Conference on Reserve Requirements and Other Macroprudential Policies: Experiences in Emerging Economies

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INTRODUCTION

Macroprudential Policies and Financial Stability

- Required reserves ratios (RRR) have been used as a macroprudential policy tool in a number of emerging economies (e.g. Brazil, China, Colombia, Peru, and Turkey).
- In particular, they use reserve requirements to curb excessive credit growth in boom episodes and to ease financial constraints in bad times.
- The main aim is to reduce the procyclicality of financial sector.

Motivating Questions

- How does a time-varying macroprudential RRR policy affect
  - Real and financial cycles of an economy in response to adverse macroeconomic and financial shocks.
  - Welfare implications of moderate and aggressive RRR policies.

- Effectiveness of required reserves policy in different economic structures (ex. highly leveraged financial system).

Building Blocks

- Quantitative monetary DSGE model with banks
  - Households face cash-in-advance (CIA) constraints.
  - Agency problem between households and banks via G&K (2011).
  - Banks are subject to time-varying RRR that countercyclically responds to expected credit growth.
  - Simulate the model economy in the face of productivity and financial shocks under two different RRR policy regimes: time-varying and fixed.
  - Investigate the effectiveness of time-varying RRR policies through impulse response analysis.
  - Compute welfare gains of alternative time-varying RRR policies compared to fixed RRR policy.

Main Results

- Time-varying RRR rule countervails the negative effects of F.A. mechanism triggered by adverse macroeconomic and financial shocks.
- Counter-cyclical RRR rule reduces volatilities of key real and financial variables in response to macro shocks.
- Time-varying RRR policy reduces the intertemporal distortions created by the credit spread at the expense of higher inflation volatility.
- Welfare gain of adopting time-varying RRR policies rather than fixed RRR one ranges from 0.06% to 0.22% in CE welfare terms.
- The effect of time-varying required reserves policy is bigger in high risk economy where loan-deposit spread is higher and the leverage of the banking sector is lower.

Related Literature

- Banking $\longmapsto$ Gertler and Karadi (2011), Mimir (2011).
- Required reserves $\longmapsto$ Glocker and Towbin (2011), Montoro (2011).
- Countercyclical time-varying macro-prudential policy $\longmapsto$ Christensen et al. (2011).
- Contribution
  - Explore the role of RRR policy in response to financial shocks.
  - Focus on the composition of the assets side of the balance sheet rather than size of the balance sheet.

THE MODEL

Framework

- Households — Household's Problem
  - Workers supply labor, h_t and return their wage incomes, $w_t h_t$ to H.H.
  - Households face cash-in-advance (CIA) constraints.
  - Each banker manages an intermediary and transfers earnings back.
  - H.H. owns intermediaries that its bankers manage.
- Financial Intermediaries — Bank's Problem
  - Collect deposits, b_{t+1} from households (HH), combine it with their own net worth, n_t and purchase firms' shares, $q_t s_t$.
  - Agency problem between HH and banks, leading to endogenous capital constraints for banks in obtaining funds from HH.
  - Banks are subject to time-varying RRR, rr_t, that counter-cyclically responds to expected credit growth.
- Non-financial Firms — Firm's Problem
  - finance capital acquisition, K_{t+1} each period via issuing equities, s_t and selling them to banks at the price of capital, q_t.
- Capital Producers — Capital Producer's Problem — Competitive Equilibrium
  - buy depreciated capital from firms to repair and to build new capital.
  - sell new and repaired capital at price q_t.

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Government

- Money supply is assumed to grow at a constant rate $\overline{\mu}$

$$M_{0t+1} = exp(\overline{\mu}) M_{0t}$$

- Required reserves ratio follows a time-varying rule in response to deviations of expected future credit growth.

$$rr_t = \bar{rr} + \phi E_t \Big[\log(q_{t+1} s_{t+1}) - \log(q_t s_t) \Big]$$

where $\phi > 0 \Rightarrow$ relax financial markets when credit is shrinking

- The money market equilibrium necessitates

$$M_{0t+1} = M_{t+1} + P_t rr_t b_{t+1}$$

- Increases in the monetary base are rebated to households through lump-sum transfers

$$T_t = M_{0t+1} - M_{0t}$$

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Shock Process

- Productivity shocks

$$z_{t+1} = \rho_z z_t + \epsilon^z_{t+1} \qquad \epsilon^z_{t+1} \sim N(0, \sigma_z)$$

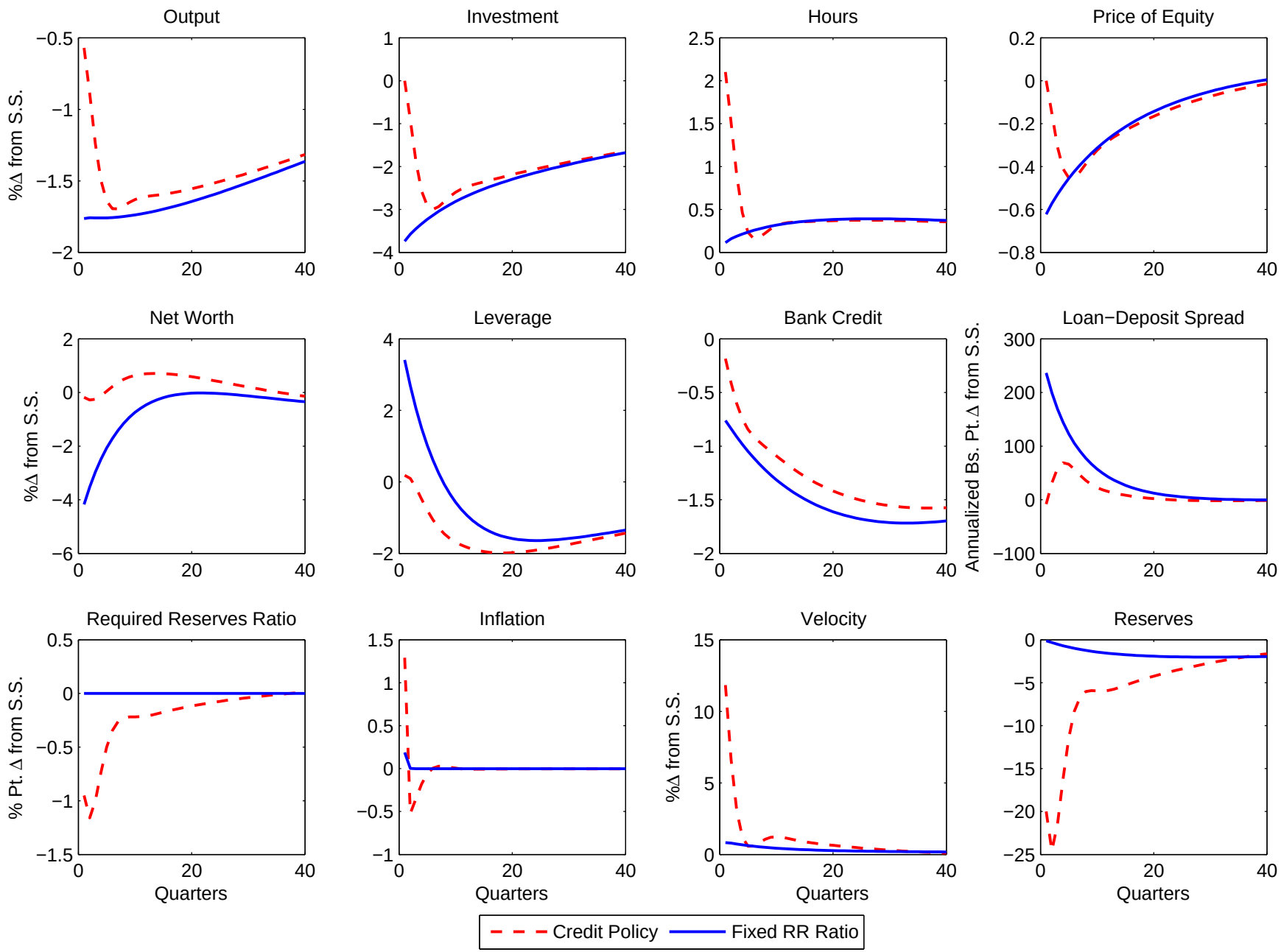
QUANTITATIVE ANALYSIS

Model Parameterization and Calibration

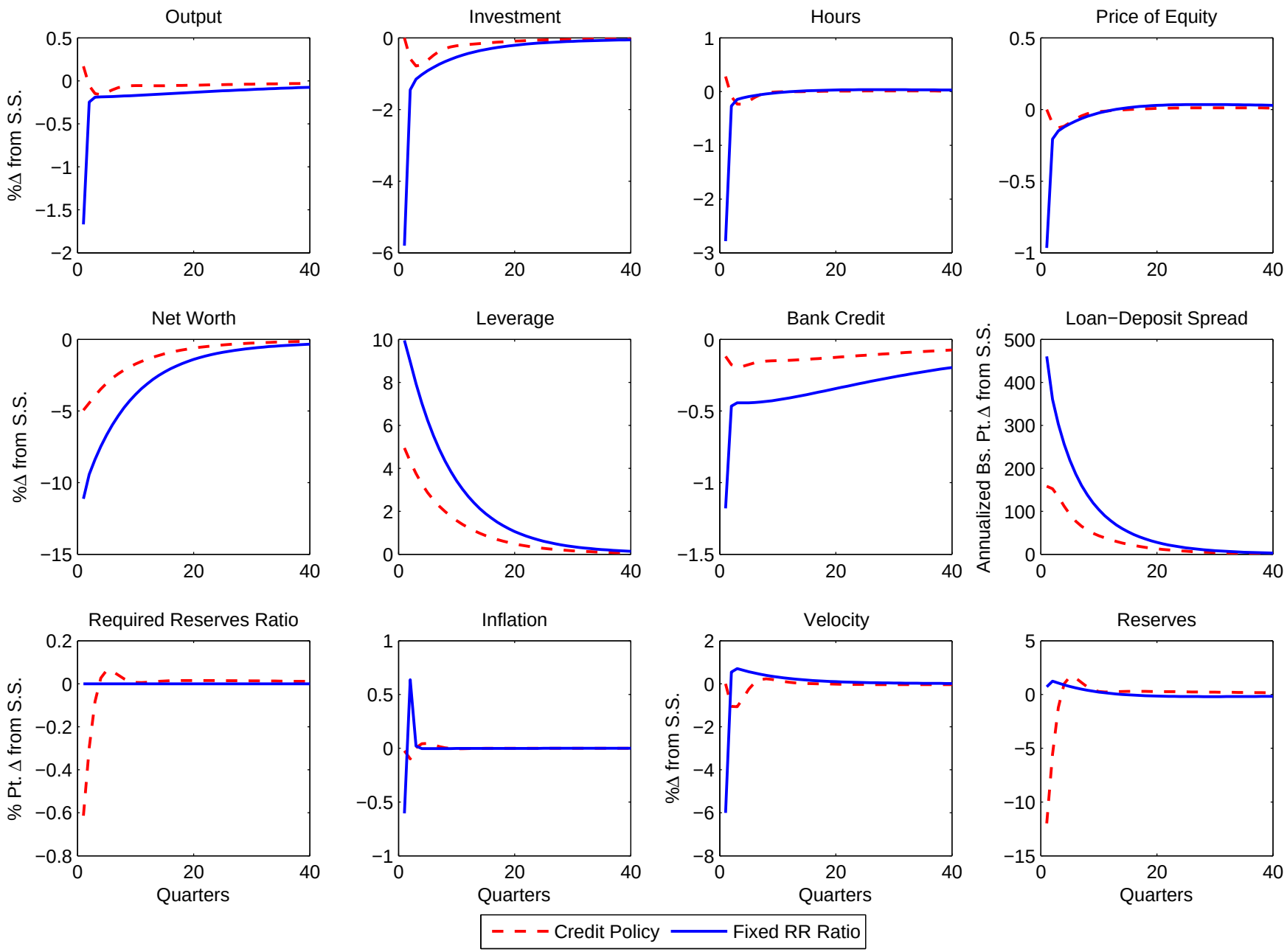
Description	Value	Target
Preferences		
Quarterly discount factor (β)	0.9885	Annualized real deposit rate (4.73%)
CRRA parameter in the utility (γ)	2	Literature
Power parameter of labor (ν)	2	Frisch Elasticity of Labor Supply (0.5)
Scale parameter for disutility of labor (ψ)	15.2	Hours worked (0.3348)
Production Technology		
Share of capital in output (α)	0.40	Capital elasticity of output
Capital adjustment cost parameter (φ)	2.75	Relative volatility of investment $\approx$ 2.25
Depreciation rate of capital (δ)	0.037	Long-run value of i/K
Government		
Steady-state value of RRR ($\bar{rr}$)	0.05	Pre macro-prudential policy period
Adjustment parameter in the RRR rule (ϕ)	5.15	Std. Dev. of diff. in RRR for 2009:Q4 - 2012:Q2 (1.73%)
Financial Intermediaries		
Fraction of diverted loans (λ)	0.5	Annual commercial & industrial loan spread (1.96%)
Proportional transfer to the entering bankers (ϵ)	0.001	2.63% of aggregate net worth
Survival probability of the bankers (θ)	0.962	Capital adequacy of 16% for commercial banks
Shock Processes		
Persistence of TFP process (ρ_z)	0.9821	Estimated from detrended log $TFP_t = \rho_z \log TFP_{t-1} + \epsilon_{zt}$
Std. deviation of productivity shocks (σ_z)	0.0183	

▸ F.A. Effects (TFP Shocks)

Adverse TFP Shocks



Adverse Financial Shocks



Effect of Credit Policy on Volatilities

Variable	$\phi = 0$* Fixed Reserves	$\phi = 5.925$* ($\bar{\kappa} = 6.25$) ($\overline{R_k - R} = 48$ bs. pt.) Credit Policy	$\phi = 1$ Credit Policy	$\phi = 10$ Credit Policy
Real Variables				
Output	2.77	1.66	2.22	1.50
Consumption	1.21	1.09	1.21	1.06
Investment	7.76	3.83	5.49	3.40
Hours	2.79	2.36	2.50	2.42
Financial Variables				
Credit	1.24	0.72	0.91	0.66
Deposits	1.53	1.57	1.10	2.07
Net Worth	12.30	6.42	6.25	6.46
Leverage	11.38	6.30	6.00	6.38
Credit Spread	0.45	0.26	0.33	0.25
Asset Prices	0.80	0.39	0.57	0.35
Monetary Variables				
Inflation	0.19	0.27	0.18	0.34

Sensitivity: High Risk vs. Low Risk Economies

	$\lambda = 0.25$	$\lambda = 0.25$	$\lambda = 0.75$	$\lambda = 0.75$
	($\bar{\kappa} = 12.51$)		($\bar{\kappa} = 4.17$)	
	($\overline{R_k - R} = 27$ bs. pt.)		($\overline{R_k - R} = 69$ bs. pt.)	
Variable	Fixed Reserves	Credit Policy	Fixed Reserves	Credit Policy
Real Variables				
Output	2.37	1.59	3.25	1.73
Consumption	1.23	1.13	1.22	1.07
Investment	5.63	3.30	10.01	4.37
Hours	1.48	2.29	3.99	2.41
Financial Variables				
Credit	0.94	0.63	1.54	0.83
Deposits	0.94	1.36	2.39	1.92
Net Worth	13.33	6.09	11.88	6.66
Leverage	12.76	6.13	10.65	6.41
Credit Spread	0.73	0.34	0.33	0.22
Asset Prices	0.58	0.34	1.03	0.45
Monetary Variables				
Inflation	0.10	0.27	0.27	0.27

Sensitivity: Financial Accelerator

	$\varphi = 0.275$	$\varphi = 0.275$	$\varphi = 13.75$	$\varphi = 13.75$
		$(\bar{\kappa} = 6.25)$ $(\overline{R_k - R} = 48$ bs. pt.)		
	Fixed Reserves	Credit Policy	Fixed Reserves	Credit Policy
Real Variables				
Output	2.86	1.94	2.53	1.27
Consumption	1.13	1.06	1.57	1.19
Investment	8.48	5.02	5.69	1.97
Hours	2.90	2.16	2.49	2.58
Financial Variables				
Credit	0.88	0.67	3.10	1.09
Deposits	1.28	1.34	2.39	2.31
Net Worth	7.79	6.23	26.46	6.72
Leverage	7.36	6.17	23.72	6.40
Credit Spread	0.30	0.28	0.87	0.24
Asset Prices	0.09	0.05	2.93	1.01
Monetary Variables				
Inflation	0.20	0.23	0.16	0.34

Welfare Evaluation

$$V_0^{trp} = E_0 \sum_{t=0}^{\infty} \beta^t U(c_t^{trp}, l_t^{trp}) \qquad V_0^{frp} = E_0 \sum_{t=0}^{\infty} \beta^t U(c_t^{frp}, l_t^{frp})$$

$$V_0^{trp} = E_0 \sum_{t=0}^{\infty} \beta^t U\left((1+\lambda^c)c_t^{frp}, l_t^{frp}\right)$$

- λ^c : proportional increase of regime *frp*'s consumption plan that a household must demand to be as well off as under policy regime *trp*.
- Moderate time-varying RRR policy ($\phi = 5$) $=>$ $\lambda^c = 0.06\%$.
- Aggressive time-varying RRR policy ($\phi = 10$) $=>$ $\lambda^c = 0.22\%$.

Conclusion

- RRR policies that are meant to stabilize credit growth work as a macro-prudential tool under the existence of TFP and financial shocks.
- However, reduced volatilities of real and financial variables come at the expense of higher inflation volatility.
- For further work, small open economy features and optimal monetary policy considerations shall be introduced in order to reconcile the analysis more with the experience of emerging economies.

THANK YOU

CHAPTER 2: THE MODEL

Workers

$$\max_{c_t, l_t, b_{t+1}, M_{t+1}} E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, l_t)$$

$$\text{s.t.} \qquad c_t + b_{t+1} + \frac{M_{t+1}}{P_t} = w_t(1 - l_t) + R_t b_t + \frac{M_t}{P_t} + \frac{\Pi_t}{P_t} + \frac{T_t}{P_t}$$

$$\text{and} \qquad c_t \leq \frac{M_t}{P_t} + \frac{T_t}{P_t} + R_t b_t - b_{t+1}$$

$$\Rightarrow \qquad u_c(t) = \beta E_t \left\{ R_{t+1} u_c(t+1) \right\}$$

$$\frac{u_l(t)}{P_t w_t} = \beta E_t \left\{ \frac{u_c(t+1)}{P_{t+1}} \right\}$$

Back

Bankers

- Banker j collects deposits from worker $i \neq j$, lend to a large number of identical firms, and hold required "reserves"

$$q_t s_{jt} = (1 - rr_t) b_{jt+1} + n_{jt}$$

- Net worth accumulation into the next period,

$$n_{jt+1} = R_{kt+1} q_t s_{jt} - R_{t+1} b_{jt+1} + rr_t b_{jt+1} \quad \Rightarrow$$

$$n_{jt+1} = \underbrace{\left[R_{kt+1} - \left(\frac{R_{t+1} - rr_t}{1 - rr_t} \right) \right]}_{ESP_{t+1}} q_t s_{jt} + \underbrace{\left(\frac{R_{t+1} - rr_t}{1 - rr_t} \right)}_{RR_{t+1}} n_{jt}$$

- Required reserves make net worth financing more preferable

$$\frac{dESP_{t+1}}{drr_t} < 0 \quad \text{and} \quad \frac{dRR_{t+1}}{drr_t} > 0$$

- Banks operate only if $E_t \left\{ \beta^{1+i} \Lambda_{t,t+1+i} ESP_{t+1+i} \right\} \geq 0 \; \forall i$

Back

Bankers cont'd

- Bankers maximize the terminal value of their net worth

$$V_{jt} = \max_{s_{jt}} E_t \sum_{i=0}^{\infty} (1-\theta)\theta^i \beta^{1+i} \Lambda_{t,t+1+i} n_{jt+1+i}$$

- s.t. an agency problem: After borrowing from households, bankers can divert λ fraction of their total assets.

- Incentive compatibility:

$$V_{jt} \geq \lambda q_t s_{jt}$$

Bankers cont'd

- V_{jt} can be written as follows:

$$V_{jt} = \nu_t q_t s_{jt} + \eta_t n_{jt} \geq \lambda q_t s_{jt}$$

- When it binds:

$$q_t s_{jt} = \frac{\eta_t}{\lambda - \nu_t} n_{jt} = \kappa_t n_{jt}$$

- Financial intermediaries may fund non-financial firms only up to an "endogenous multiple" of their net worth

- We aggregate over j and get: $q_t s_t = \kappa_t n_t$

Firms

- Finance capital acquisition each period via issuing equity claims which are purchased by financial intermediaries

$$q_t s_t = q_t K_{t+1}$$

- Produce with a CRS technology by using capital and labor

$$exp(z_t)F(K_t, H_t)$$

- Labor demand satisfies

$$w_t = exp(z_t)F_H(K_t, H_t)$$

- Zero profit condition leads to following condition of return on capital:

$$R_{kt} = \frac{exp(z_t)F_K(K_t, H_t) + q_t(1-\delta)}{q_{t-1}}$$

Back

Capital Producers

- Buy depreciated capital from firms, repair it, and build new capital
- Sell new and repaired capital at the asset price q_t
- Profit maximization

$$\max_{I_t} \Pi^{cp} = q_t K_{t+1} - q_t(1-\delta)K_t - I_t$$

$$s.t. \;\; K_{t+1} = (1-\delta)K_t + \Phi\left(\frac{I_t}{K_t}\right)K_t$$

- "Q" relation for investment

$$q_t = \left[\Phi'\left(\frac{I_t}{K_t}\right)\right]^{-1}$$

Back

Competitive Equilibrium

- Nominal monetary base and prices grow constantly in this model, which renders the equations listed above non-stationary. Therefore, following Cooley and Hansen (1989), we make the model stationary by applying the following normalizations: $\widehat{P_t} = P_t/M_{0t+1}$ and $\hat{m}_t = M_{t+1}/(\widehat{P_t} M_{0t+1})$ and solve the model locally around a deterministic steady state.

- A competitive equilibrium of this model economy is defined by sequences of allocations $\{c_t, k_{t+1}, i_t, l_t, h_t, s_t, n_t, n_{et}, n_{nt}, b_{t+1}, \Lambda_{t,t+1}, \nu_t, \eta_t, \kappa_t, \rho_{t,t+1}, \chi_{t,t+1}, \hat{m}_{t+1}, \pi_t\}_{t=0}^{\infty}$, prices $\{q_t, R_{kt+1}, R_{t+1}, w_t, \widehat{P_t}\}_{t=0}^{\infty}$, shock processes $\{z_t\}_{t=0}^{\infty}$ and the government policy $\{rr_t\}_{t=0}^{\infty}$ such that

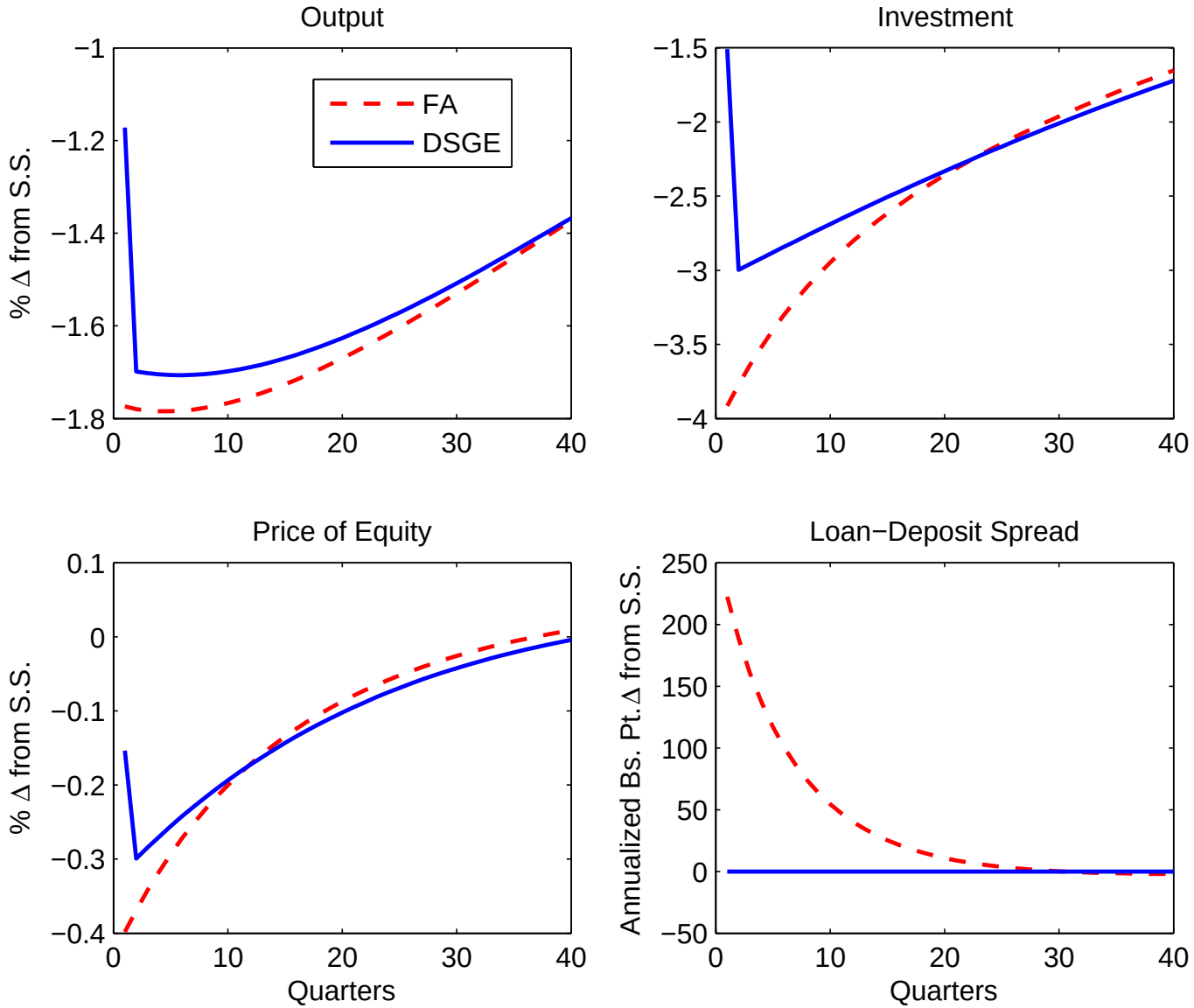
  (i) allocations solve household's, financial intermediary's, firm's, and capital producer's problems at the equilibrium prices.

  (ii) markets for factor inputs clear.

  (iii) aggregate resource constraint is satisfied.

Back

Financial Accelerator (TFP ↓)



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