

Risk Channel of Monetary Policy

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Federal Reserve Board

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Disclaimer: The views expressed are solely mine and do not necessarily reflect those of the Federal Reserve Board Board of Governors or its staff. All errors are mine alone.

What's to come...

A story,

a model

[Gertler, Kiyotaki, Queralto (2012, JME)] + Monetary Policy,

and some experiments.

Intuition: Monetary policy and investment

Frictionless financial intermediation:

$$E_t \Lambda_{t,t+1} R_{t+1}^K = E_t \Lambda_{t,t+1} R_{t+1}$$

First-order approximation:

$$E_t r_{t+1}^K = r_{t+1}$$

Required return on capital moves 1-for-1 with risk-free rate:

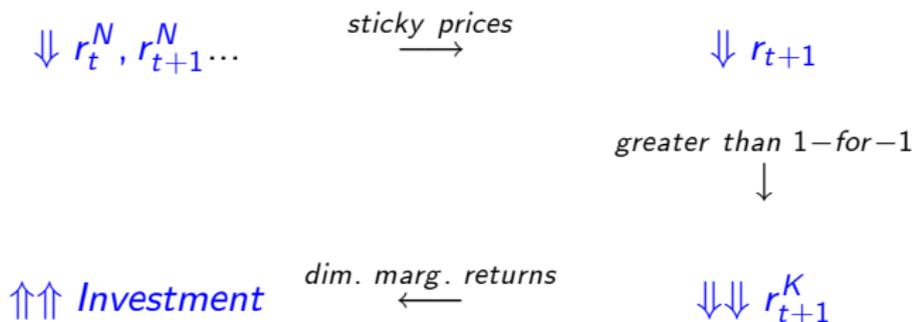


Intuition: Monetary policy, investment and financial frictions

Frictional financial intermediation:

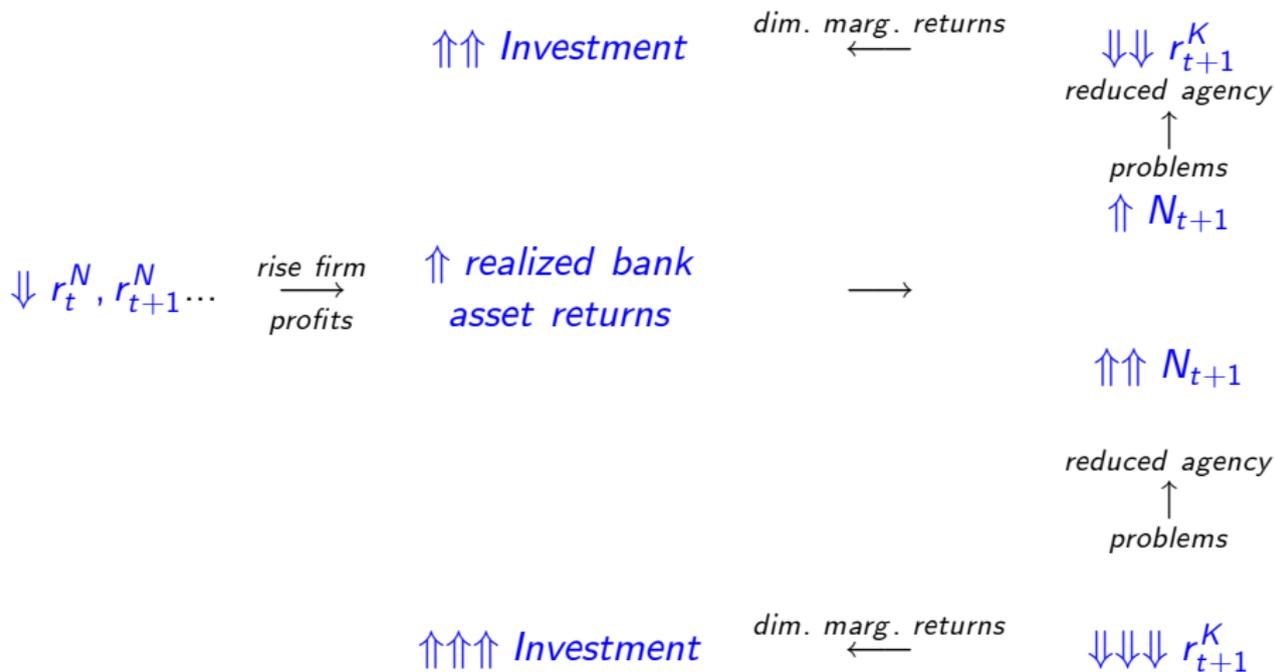
$$E_t r_{t+1}^K \geq r_{t+1}$$

Wedge moves countercyclically:



Intuition: Monetary policy, investment, financial frictions and banks' balance sheets

Outside equity-financed:



Short-term debt-financed:

Intuition: Endogenous bank balance sheets

A		L	
Claims on firm profits		Short-term debt	
		Outside equity	
		Inside equity	

How do banks choose their balance sheet structure?

Outside equity or short-term debt finance?

Intuition: Banks' balance sheet trade-off

- Agency problem:

Bankers can abscond with banks assets...!

[Incentive compatability limits credit creation]

Abscond with more assets if outside equity financed.

[Calomiris and Kahn (1991, AER)]

- But, outside equity provides a hedge against uncertainty in asset returns.
- Optimal balance sheet trades-off:
 - Volatility in (shadow value of) net worth,
 - Leverage.

Intuition: Bank balance sheet composition and design monetary policy

- (Conventional) monetary policy alters asset return risk banks face.
- (Modelling) problem:
Deterministic steady state independent of monetary policy.

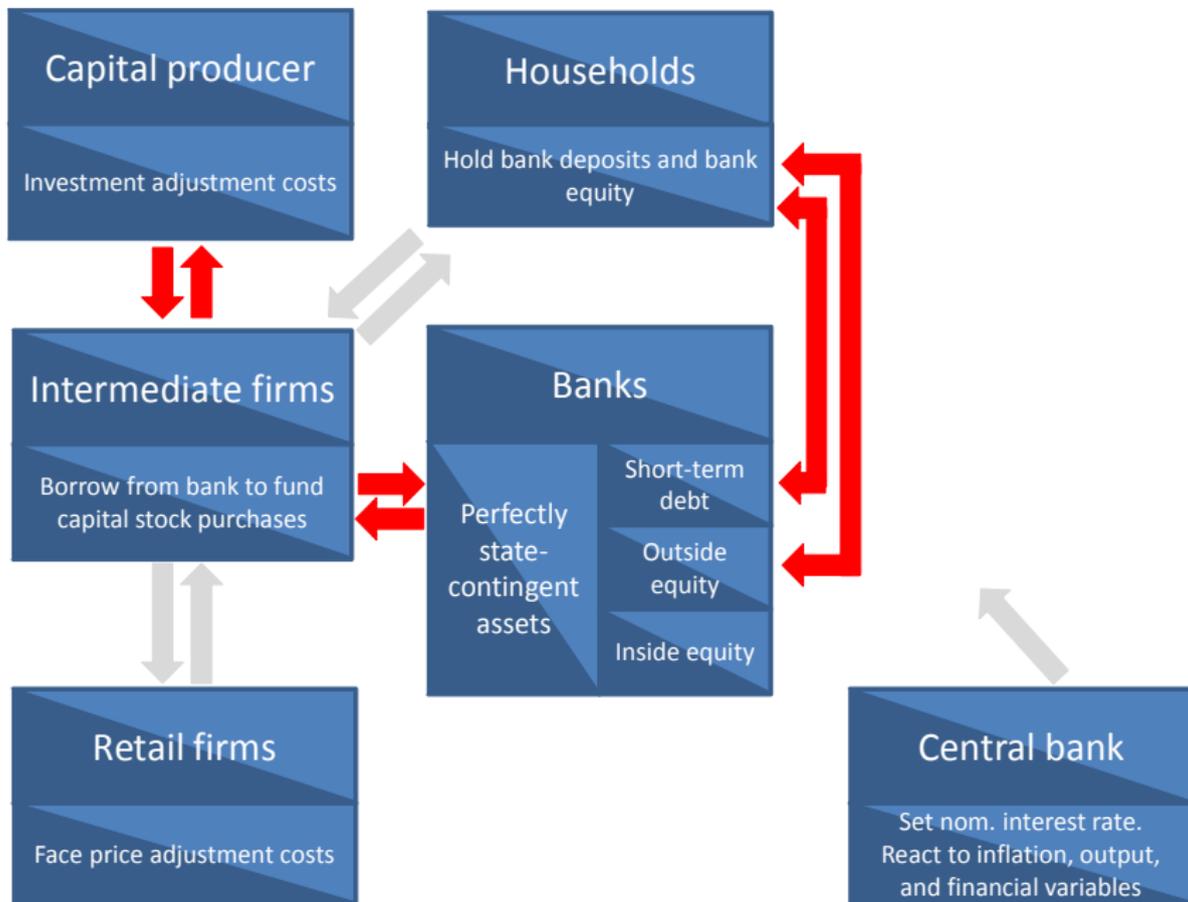
- **Solution:**

Solve model in neighbourhood of *risky steady state*.

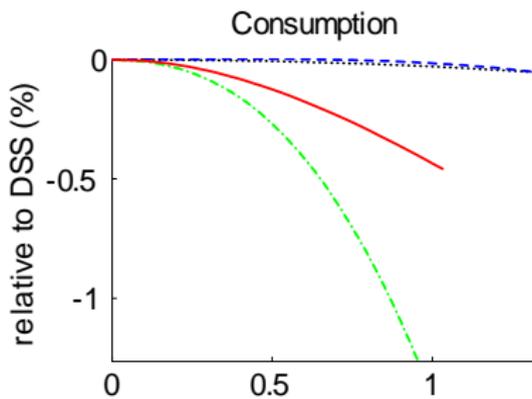
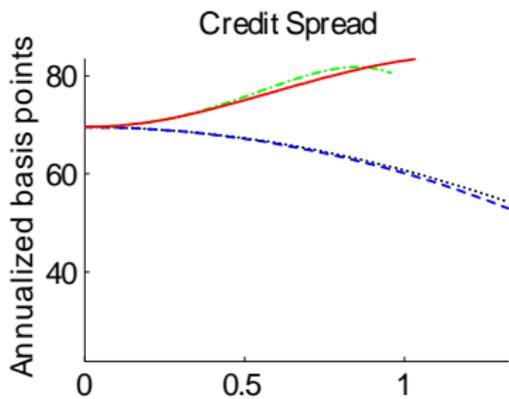
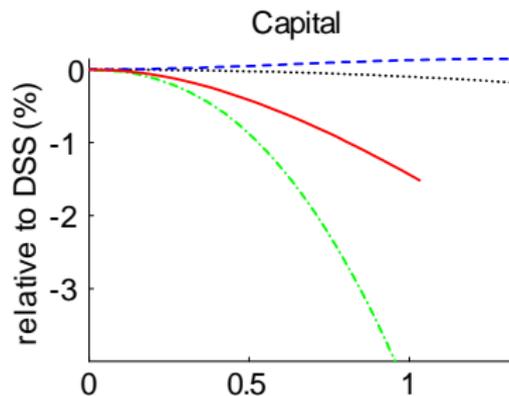
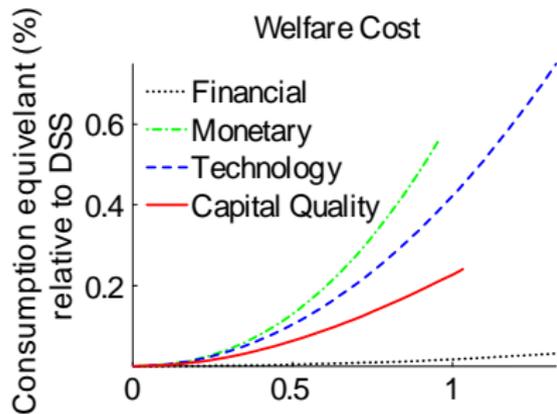
[Coeurdacier, Rey, Winant (2011, AER)]

Δ in monetary policy regime \implies Δ in risks banks face
 Δ in risks \implies Δ in optimal balance sheet composition
 Δ in composition \implies Δ in transmission shocks

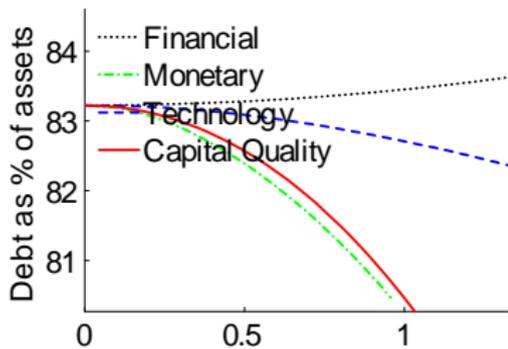
Potential *risk channel of monetary policy*.



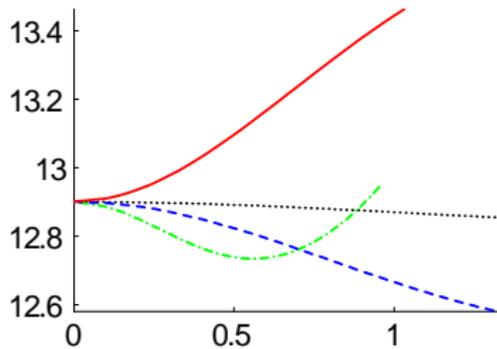
Steady state comparative statics



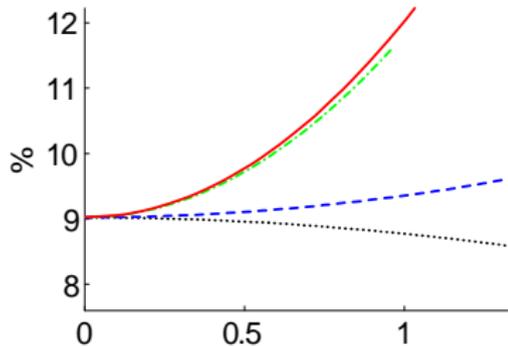
Total Leverage



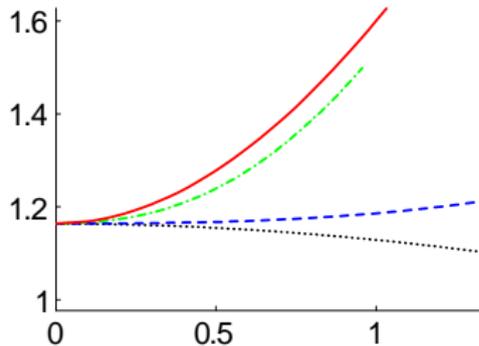
Capital to Net Worth Ratio

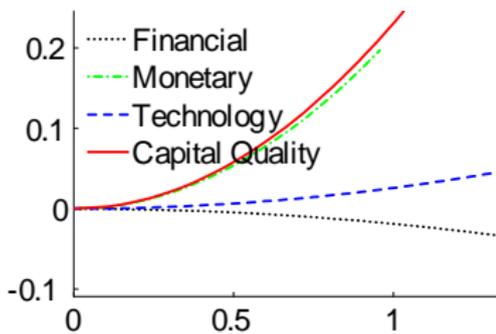
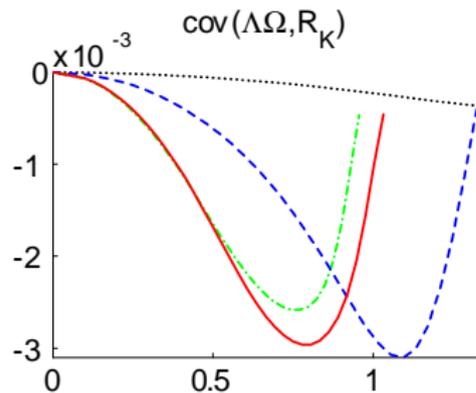
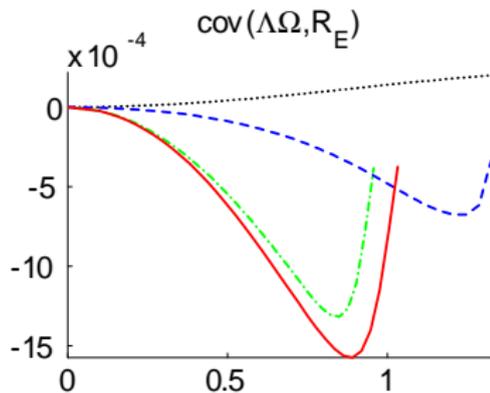
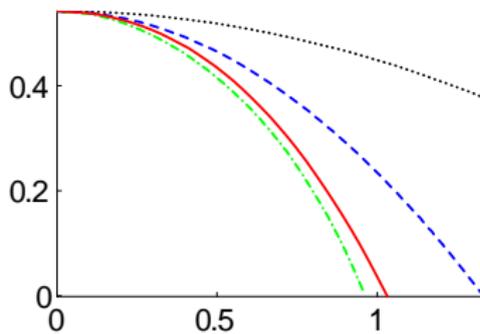


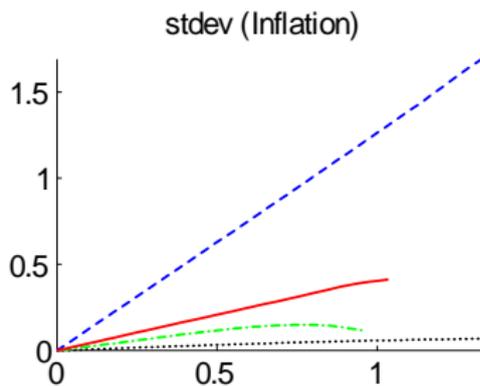
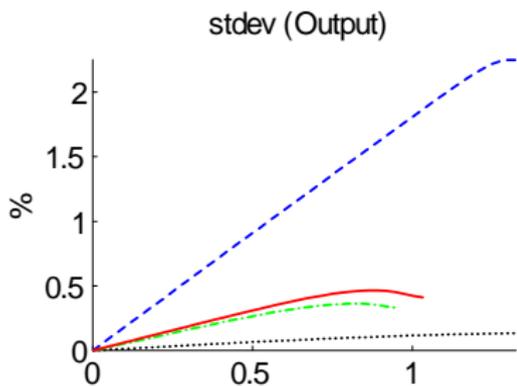
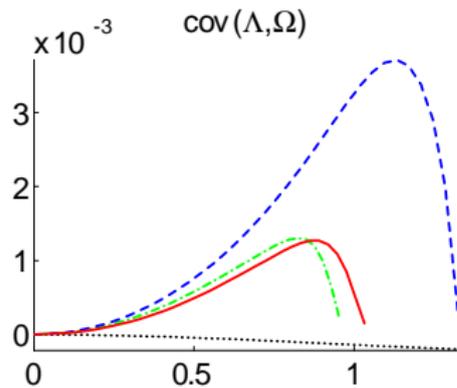
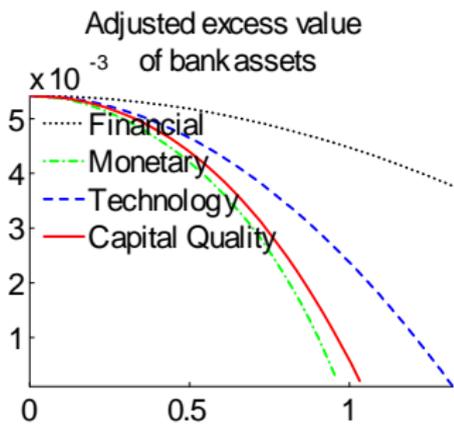
Outside Equity to Capital Ratio



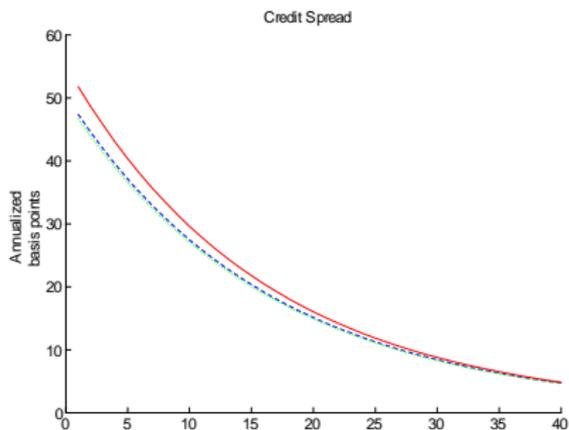
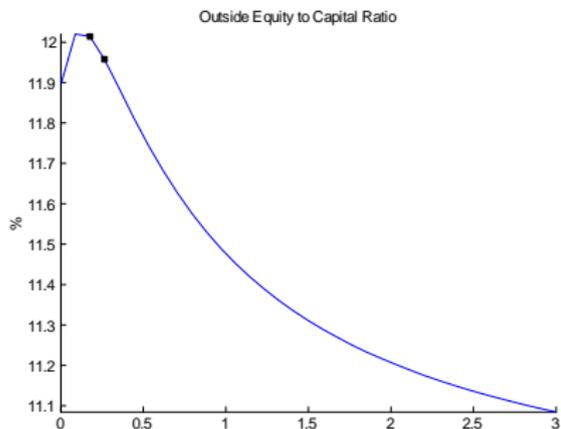
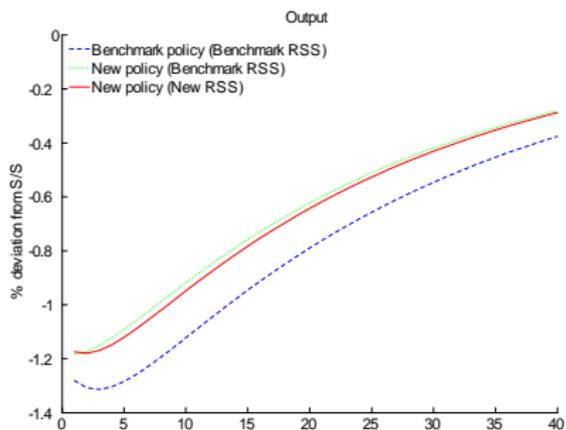
Outside to Inside Equity Ratio



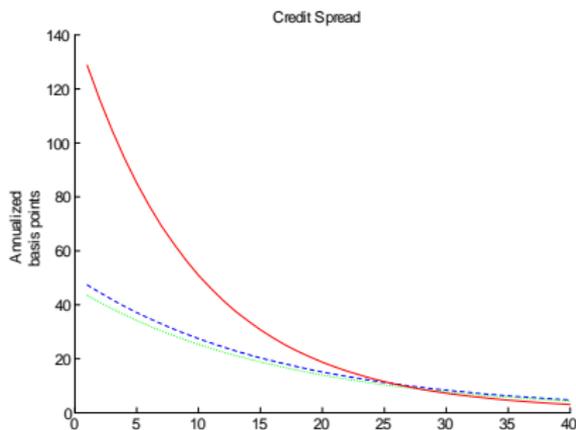
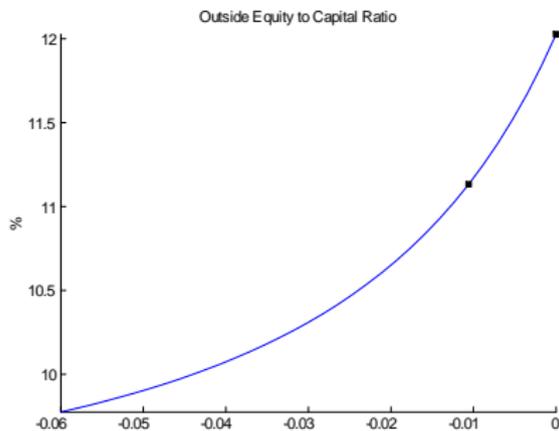
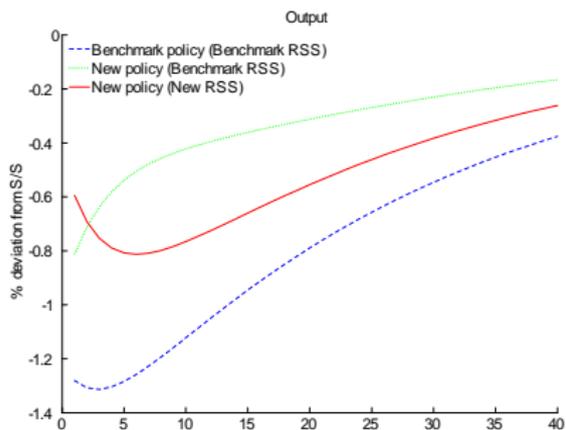
Excess value of substituting
outside equity for debtExcess value of assets
over debt



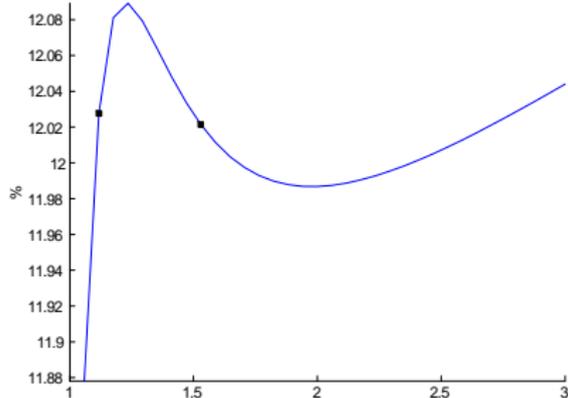
Monetary policy rule: Output



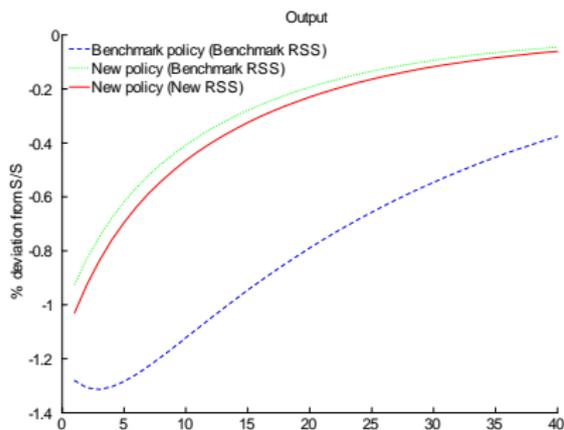
Monetary policy rule: Leverage



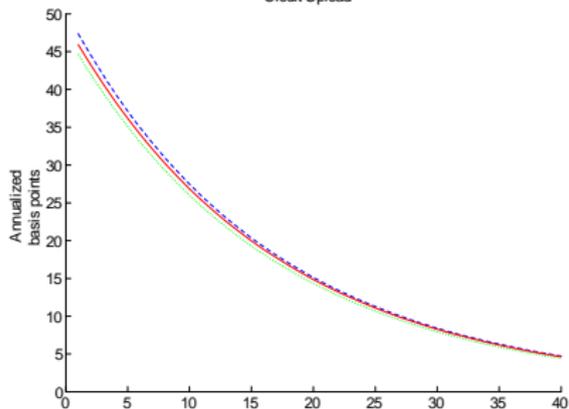
Outside Equity to Capital Ratio

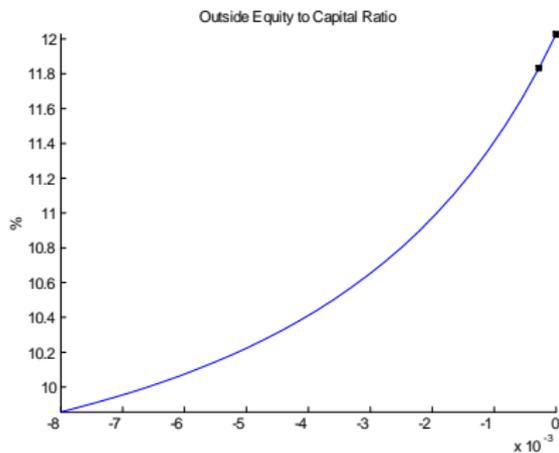


Monetary policy rule: Inflation

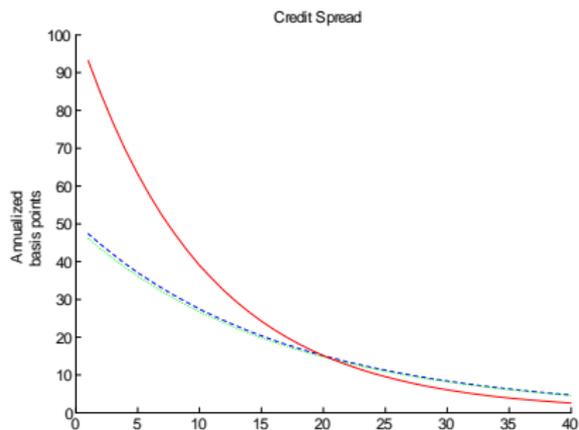
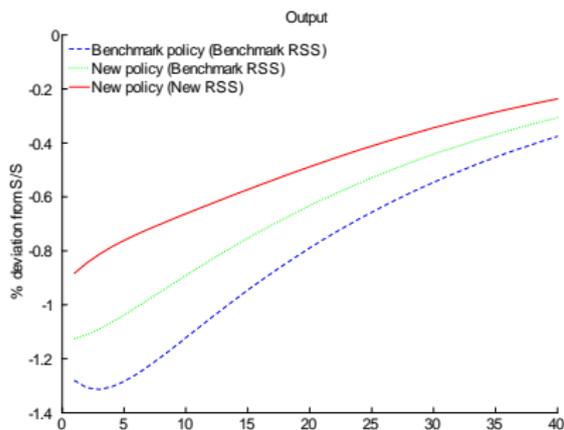


Credit Spread





Monetary policy rule: Credit spread



Conclusion

- Banks' balance sheets affect the transmission of shocks.
- Banks choose (privately) optimal balance sheets.
- Banks' choice depends on the risks they face.
- Monetary policy can alter the risks banks face.

Further work:

- Quantify / estimate risk taking channel.
- Optimal policies may not be time consistent.

The model

- Households:

$$\max_{\{C_t, L_t, D_{t+1}, \Xi_{t+1}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t \frac{[C_t (1 - L_t)^\gamma]^{(1-\eta)} - 1}{(1 - \eta)}$$

$$\text{s.t. } C_t = W_t L_t + Y_t + R_t D_t + Q_{E,t-1} R_{E,t} \Xi_t - D_{t+1} - Q_{E,t} \Xi_{t+1}$$

- Intermediate firms:

$$Y_t = \zeta_{A,t} (\zeta_{K,t} K_t)^\alpha L_t^{1-\alpha} \quad , \quad K_{t+1} = (1 - \delta) \zeta_{K,t} K_t + I_t$$

- Purchase capital using bank funding (a perfectly state contingent security).
- Gross profits per unit of capital:

$$Z_t = X_t \alpha \frac{Y_t}{\zeta_{A,t} K_t}$$

- Capital producers:

$$\max_{\{I_\tau\}_{\tau=t}^{\infty}} E_t \sum_{\tau=t}^{\infty} \Lambda_{t,\tau} \left\{ Q_{K,\tau} I_\tau - \left(1 + \frac{\phi_I}{2} \left(\frac{I_\tau}{I_{\tau-1}} - 1 \right)^2 \right) I_\tau \right\}$$

- Retail firms:

$$\max_{\{P_{r,\tau}\}_{\tau=t}^{\infty}} E_t \sum_{\tau=t}^{\infty} \Lambda_{t,\tau} \left\{ \left(\frac{P_{r,\tau}}{P_t} - X_\tau \frac{P_\tau}{P_t} \right) Y_{r,\tau} - \frac{\phi_\Pi}{2} \left(\frac{P_{r,\tau}}{P_{r,\tau-1}} - 1 \right)^2 Y_\tau \frac{P_\tau}{P_t} \right\}$$

$$\text{s.t. } Y_{r,t} = \left(\frac{P_{r,t}}{P_t} \right)^{-\varepsilon} Y_t$$

- Monetary policy:

$$\left(\frac{R_{N,t}}{R} \right) = \left(\frac{\Pi_t}{\Pi} \right)^{\phi_\Pi} \left(\frac{Y_t}{Y} \right)^{\phi_Y} \underbrace{\left(\frac{\Phi_t}{\Phi} \right)^{\phi_\Phi}}_{\text{Leverage}} \underbrace{\left(\frac{E_t R_{K,t+1} / R_{t+1}}{R_K / R} \right)^{\phi_S}}_{\text{Credit spread}} \zeta_{M,t}$$

● Banks:

- Balance sheet:

$$Q_{K,t}K_{t+1} = N_{t+1} + D_{t+1} + Q_{E,t}E_{t+1}$$

- Evolution of inside equity:

$$N_{t+1} = \theta \left((R_{K,t} - R_t) + (R_t - R_{E,t}) B_{t-1} \right) Q_{K,t-1}K_t + R_t N_t$$

where

$$B_t = \frac{Q_{E,t}E_{t+1}}{Q_{K,t}K_{t+1}}$$

- Banker's problem:

$$\max_{\{K_{\tau+1}, B_{\tau}, N_{\tau+1}\}_{\tau=t}^{\infty}} V_t = E_t \left[\sum_{\tau=t}^{\infty} (1 - \theta) \theta^{\tau-t} \Lambda_{t,\tau} N_{\tau} \right]$$

s.t. incentive compatibility constraint

$$V_t \geq F_t Q_{K,t} K_{t+1}$$

where

$$F_t = \zeta_{F,t} \kappa_0 \left(1 + \kappa_1 B_t + \frac{\kappa_2}{2} B_t^2 \right)$$

Calibration

α	Income share of capital	.33
β	Quarterly subjective discount factor	.99
γ, η	Utility: $\left((C(1-L)^\gamma)^{(1-\eta)} - 1 \right) / (1-\eta)$	3.6, 2
ε	Price elasticity of demand	4.167
δ	Quarterly depreciation rate	.025
$\varphi_{\Pi, I}$	Adjustment cost	64, 1
$\phi_{\Pi, Y, R, \Phi, S}$	Monetary policy	1.5, .0125, .8, 0, 0
θ	Survival probability	.9685
$\kappa_{0,1,2}$	Agency costs: $\kappa_0 \left(1 + \kappa_1 B + \frac{\kappa_2}{2} B^2 \right)$.3, -1.2, 13.4
$\rho_{A,M,K}$	Persistence of shocks	.95, 0, 0
$\sigma_{A,M,K}$	St. dev. of shock innovations	.056, .006, 0

Risky steady state

- System of equilibrium conditions

$$E_t [f(y_{t+1}, y_t, x_{t+1}, x_t, z_{t+1}, z_t)] = 0$$

$$z_{t+1} = \Lambda z_t + \eta \sigma \varepsilon_{t+1}$$

- Decision rules that solve the system

$$y_t = g(x_t, z_t, \sigma) \quad \text{and} \quad x_{t+1} = h(x_t, z_t, \sigma)$$

- Deterministic steady state

$$x^d = h(x^d, 0, 0) \quad \iff \quad f(y^d, y^d, x^d, x^d, 0, 0) = 0$$

- Risky steady state [de Groot (2012, WP)]

$$x^r = h(x^r, 0, \sigma) \quad \iff \quad E f(y_{t+1}, y^r, x^r, x^r, z_{t+1}, 0) = 0$$