Bank Capital, Agency Costs, and Monetary Policy

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Motivation

- A large literature quantitatively studies the role of financial factors in business cycle dynamics

  (eg., Bernanke et al., 1999; Carlstrom & Fuerst, 1997, 1998)

- key feature: asymmetric information between banks and firms

- Net worth of firms

  $\Rightarrow$ alleviates the effects of asymmetric information

  $\Rightarrow$ becomes an important element in the propagation of shocks

Question

What about banks themselves? Are they subject to financial market imperfections? If so, do these matter?

Evidence

- Banks face financial frictions in raising funds

  (eg., Calorimis & Wilson 1998; Kashyap & Stein 2000; Schneider 2001)

- Bank capital (bank net worth) has a significant and positive effect on bank lending and economic activity

  (eg., Bernanke & Lown, 1991; Peek & Rosengren, 1997, 2000)

- In US states with low levels of bank capital, output growth is more sensitive to monetary policy

  (eg., Van den Heuvel, 2002)

This paper

- A framework with a double moral hazard problem:
  - ◇ entrepreneurs and bankers
  - ◇ bankers and households
- This framework is embedded into a standard monetary business cycle model
- The model is used to study the links between bank capital, monetary policy, and economic activity

Findings

- The presence of bank capital
  - ◇ lowers the amplification of monetary policy shocks
  - ◇ increases the persistence of monetary policy shocks
- The bank capital-asset ratio is market-generated and is countercyclical as in the data

Literature

- Carlstrom & Fuerst (1997, 1998, 2001); Bernanke et al. (1999)
  - ◇ No bank capital
- Holmstrom & Tirole (1997) and Chen (2001)
  - ◇ No monetary policy
- Van den Heuvel (2002)
  - ◇ Partial-equilibrium
  - ◇ Regulatory capital requirements
  - ◇ Not a monetary model

Rest of the Talk

- Basic Model: economic environment
- Financial contract and intuition for mechanism
- Results: Basic and Extended Model
- Concluding remarks and future work

Economic Environment

- Three types of agents: households, bankers and entrepreneurs
- Final Good: standard CRS technology
- Capital Good: produced by entrepreneurs

$$f(i_t) = \begin{cases} Ri_t, & \text{success,} \\ 0, & \text{failure} \end{cases}$$

Households

- CIA constraint for consumption
- Deposit savings with banks (no direct lending to entrepreneurs)
- Costs of adjusting deposits (limited participation)

Monetary Policy

$$\log(r_t^d/r^d) = \rho_y \log(y_t/y) + \rho_\pi \log(\pi_t/\pi) + \epsilon_t^{mp}$$

Bankers and Entrepreneurs

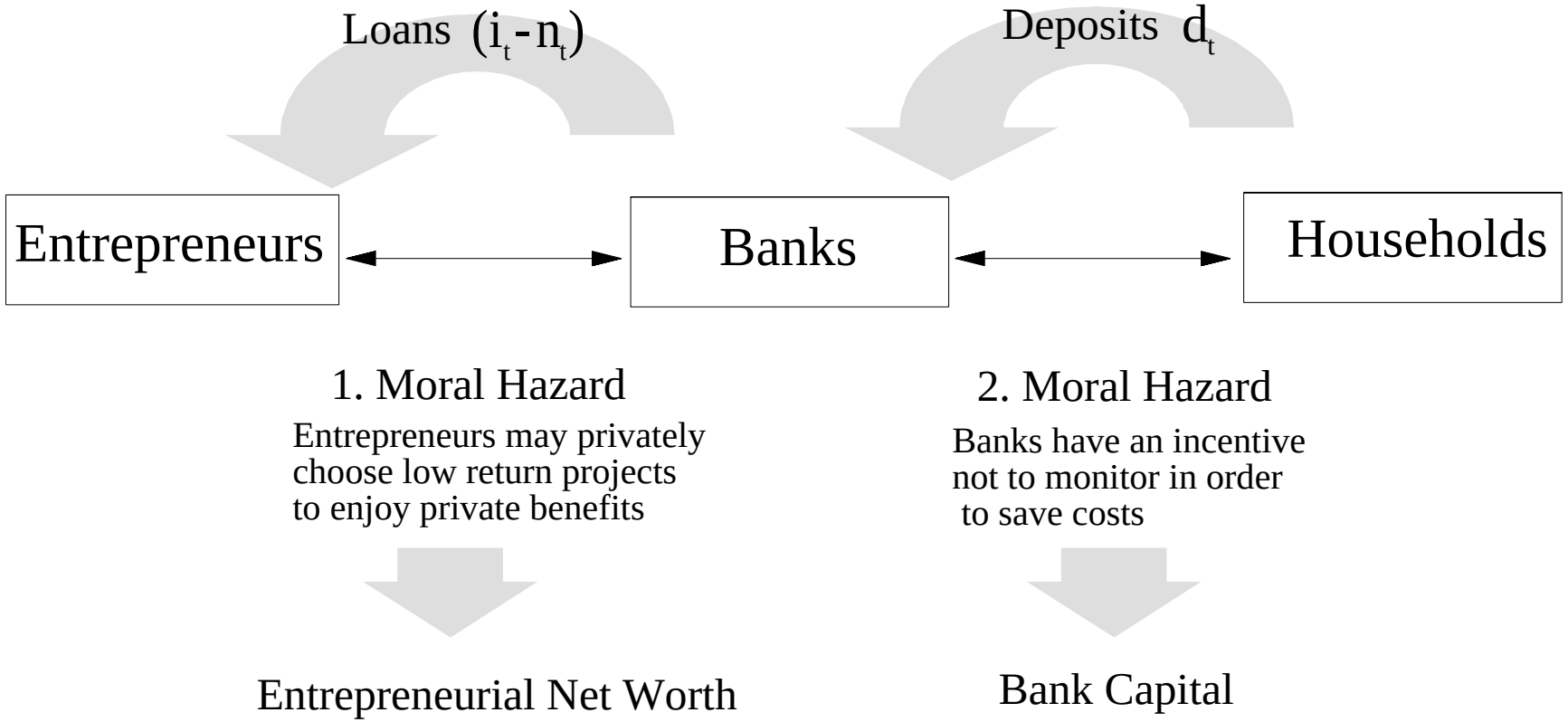
- Bankers and entrepreneurs face a probability of exit; exiting agents are replaced by new ones
- Bank capital and entrepreneurial net worth

$$\begin{aligned} a_t &= \left[r_t^k + q_t(1-\delta)\right] k_t^b \\ n_t &= \left[r_t^k + q_t(1-\delta)\right] k_t^e \end{aligned}$$

- Next period capital holdings of successful surviving agents

$$\begin{aligned} k_{t+1}^b &= R_t^b i_t \\ k_{t+1}^e &= R_t^e i_t \end{aligned}$$

Two Sources of Moral Hazard



- Three types of projects available to the entrepreneur:

Project	Good	Low Priv. Ben.	High Priv. Ben.
Private benefits	0	bi_t	Bi_t
Prob. of success	α^g	α^b	α^b

  - ◇ Good project is socially desirable
  - ◇ Bank monitoring eliminates the high-private benefit project at cost μi_t

- The projects financed by an individual bank are perfectly correlated

Bank Capital

Bank capital

$\Rightarrow$ increases the incentives to monitor

$\Rightarrow$ reduces the moral hazard problem between depositors and banks

$\Rightarrow$ increases the ability of the bank to attract deposits

$\Rightarrow$ increases bank lending

$\Rightarrow$ increases aggregate investment and output

Financial Contract

- Consider one-period contracts that lead entrepreneurs to choose the good project

- One optimal contract will have the following structure:
  - the entrepreneur invests all his net worth
  - if success, R is distributed among the entrepreneur, the banker and the households: $R = R_t^e + R_t^b + R_t^h$
  - if failure, neither party is paid anything

Financial Contract, cont.

- Choose project size and payment shares
- Maximize expected payoff to entrepreneurs
- Incentive constraints of bankers and entrepreneurs
- Participation constraints of bankers and households
- Resource constraint: $a_t + d_t + n_t = (1 + \mu)\, i_t$

Upshot of the contract

- Shares:

$$R_t^e = \frac{b}{\Delta\alpha};\ \ R_t^b = \frac{\mu}{q_t\Delta\alpha};\ \ R_t^h = R - \frac{b}{\Delta\alpha} - \frac{\mu}{q_t\Delta\alpha}$$

- Participation constraint of depositors:

$$q_t\alpha^g R_t^h i_t = r_t^d d_t, \qquad d_t = [(1+\mu)i_t - a_t - n_t]$$

Upshot of the contract, cont.

- Solve for i_t:

$$i_t = \underbrace{(1/G_t)}_{\text{'aggregate leverage'}} \cdot \underbrace{a_t + n_t}_{\text{internal funds}}$$

$$G_t \equiv 1 + \mu - \frac{q_t \alpha^g}{r_t^d} \left[R - \frac{b}{\Delta\alpha} - \frac{\mu}{q_t \Delta\alpha} \right]$$

- When $r_t^d \uparrow$, leverage $\downarrow$

Aggregation

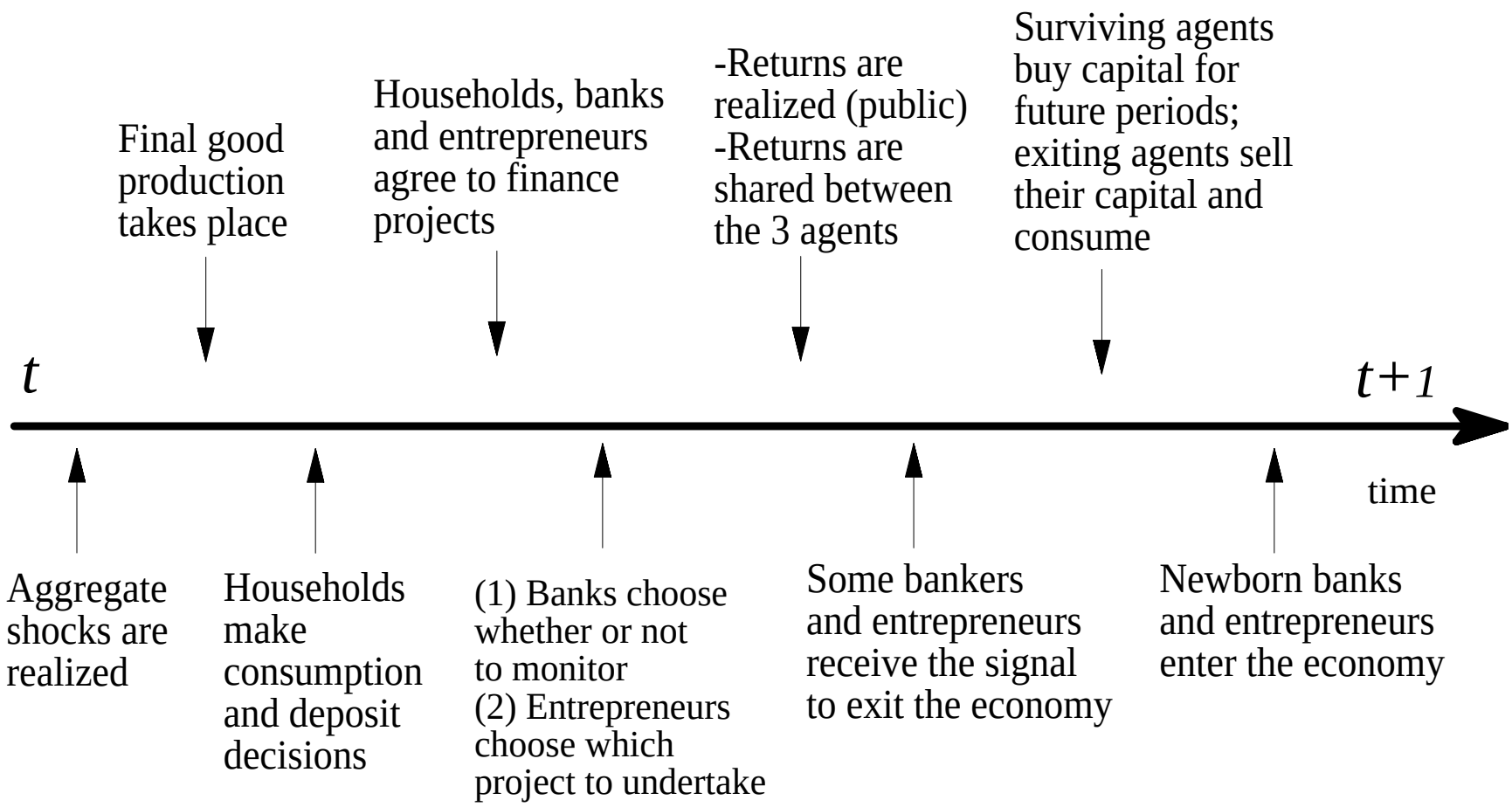
- Linearity simplifies aggregation
- Aggregate investment:

$$I_t = \frac{A_t + N_t}{G_t}$$

- Aggregate bank capital and entrepreneurial net worth:

$$A_t = \left[r_t^k + q_t(1-\delta)\right] K_t^b \left(I_{t-1}\right)$$

$$N_t = \left[r_t^k + q_t(1-\delta)\right] K_t^e \left(I_{t-1}\right)$$


Final good production takes place
Households, banks and entrepreneurs agree to finance projects
-Returns are realized (public)
-Returns are shared between the 3 agents
Surviving agents buy capital for future periods; exiting agents sell their capital and consume
t
t+1
time
Aggregate shocks are realized
Households make consumption and deposit decisions
(1) Banks choose whether or not to monitor
(2) Entrepreneurs choose which project to undertake
Some bankers and entrepreneurs receive the signal to exit the economy
Newborn banks and entrepreneurs enter the economy

Market Clearing Conditions

- labor markets:

$$H_t \quad = \quad \eta^h h_t$$

- Final goods market:

$$Y_t \quad = \quad C_t^h + C_t^e + C_t^b + (1+\mu) I_t$$

- Capital goods market:

$$K_{t+1} \quad = \quad (1-\delta)\, K_t + \alpha^g R I_t$$

- Deposits markets:

$$\frac{q_t \alpha^g R_t^h I_t}{r_t^d} = \frac{\overline{M_t} - M_t^c + X_t}{P_t}$$

Equilibrium rate of return on bank capital:

$$r_t^a = \frac{\alpha^g \mu \left(1 + N_t / A_t\right)}{G_t \Delta \alpha}$$

Results

- Basic model
  - monetary policy shock
- The extended model
  - wealth shock
  - monetary policy shock
  - cyclical properties of bank capital-asset ratio

Table 1

Parameter Calibration

Household Preferences

χ	γ	ϕ	β
2.75	1.5	5.0	0.99

Final Good Production

δ	θ_k	θ_h	θ_e	θ_b	ρ_z
0.02	0.36	0.6399	$5 \cdot 10^{-5}$	$5 \cdot 10^{-5}$	0.95

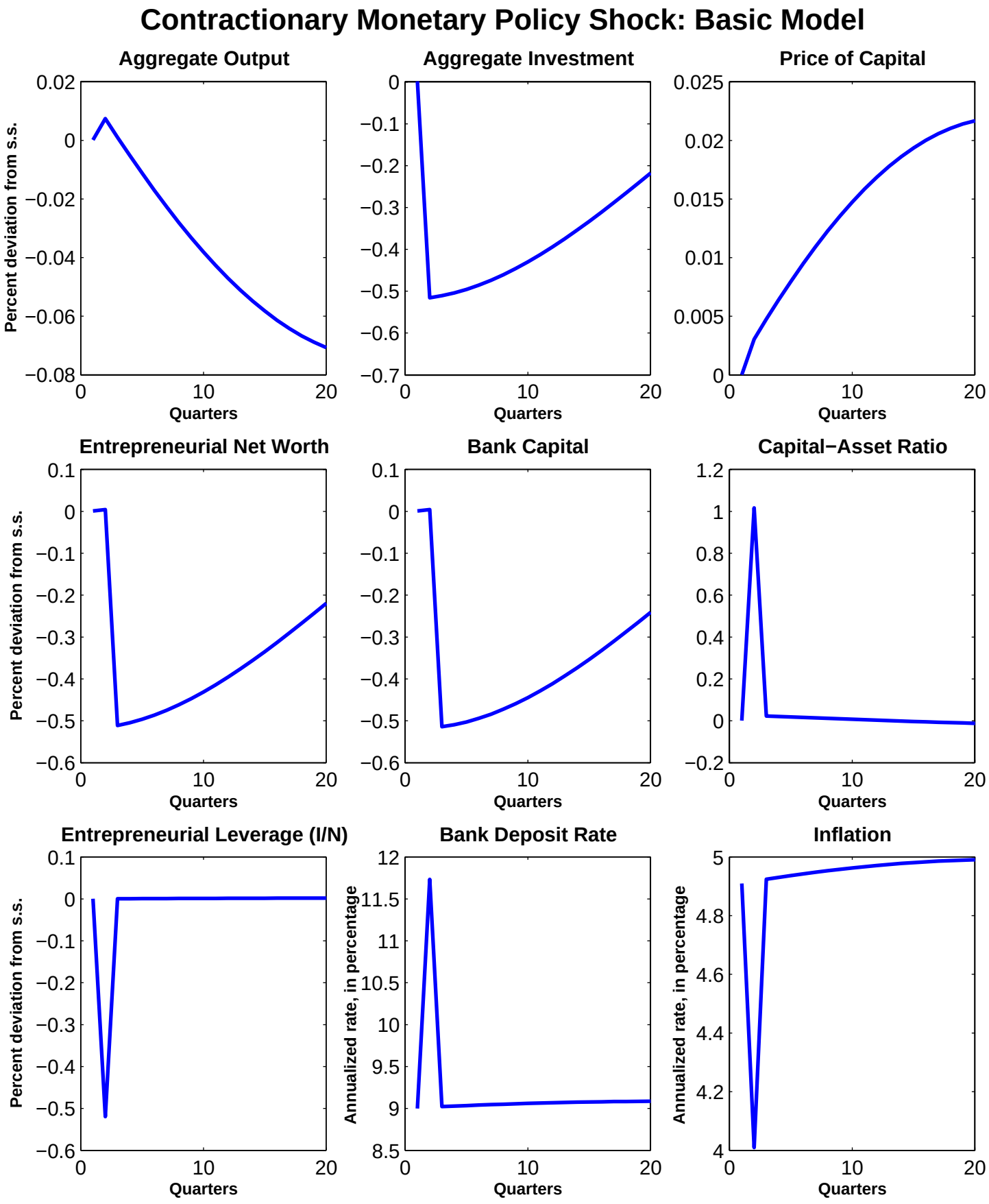
Capital Good Production with Asymetric Infomation

	μ	α^g	α^b	R	b
Baseline	0.025	0.97	0.67	0.5	0.09
More Severe Friction	0.05	0.97	0.67	0.5	0.06
Less Severe Friction	0.001	0.97	0.67	0.5	0.06

Resulting Steady-State Characteristics

	CA	I/N	BOC	ROE
Baseline	15%	2.0	5%	15%
More Severe Friction	31%	1.91	11%	15%
Less Severe Friction	6%	2.06	2%	15%

Figure 2


Contractionary Monetary Policy Shock: Basic Model
Aggregate Output
Aggregate Investment
Price of Capital
Entrepreneurial Net Worth
Bank Capital
Capital−Asset Ratio
Entrepreneurial Leverage (I/N)
Bank Deposit Rate
Inflation
Percent deviation from s.s.
Annualized rate, in percentage
Quarters

Extended Model

- Risk-aversion: $U = log(c_t) + \chi log(1 - h_t - V_t)$
- Households insure themselves against idiosyncratic risk

  $\longrightarrow$ collapses to representative agent model
- Final good producers require external financing for wage bill

  $\longrightarrow$ introduce another type of financial intermediary to provide this lending
- Wage income and purchases of physical capital now part of the household's CIA constraint

Negative Wealth Shock on Banking Sector: Extended Model

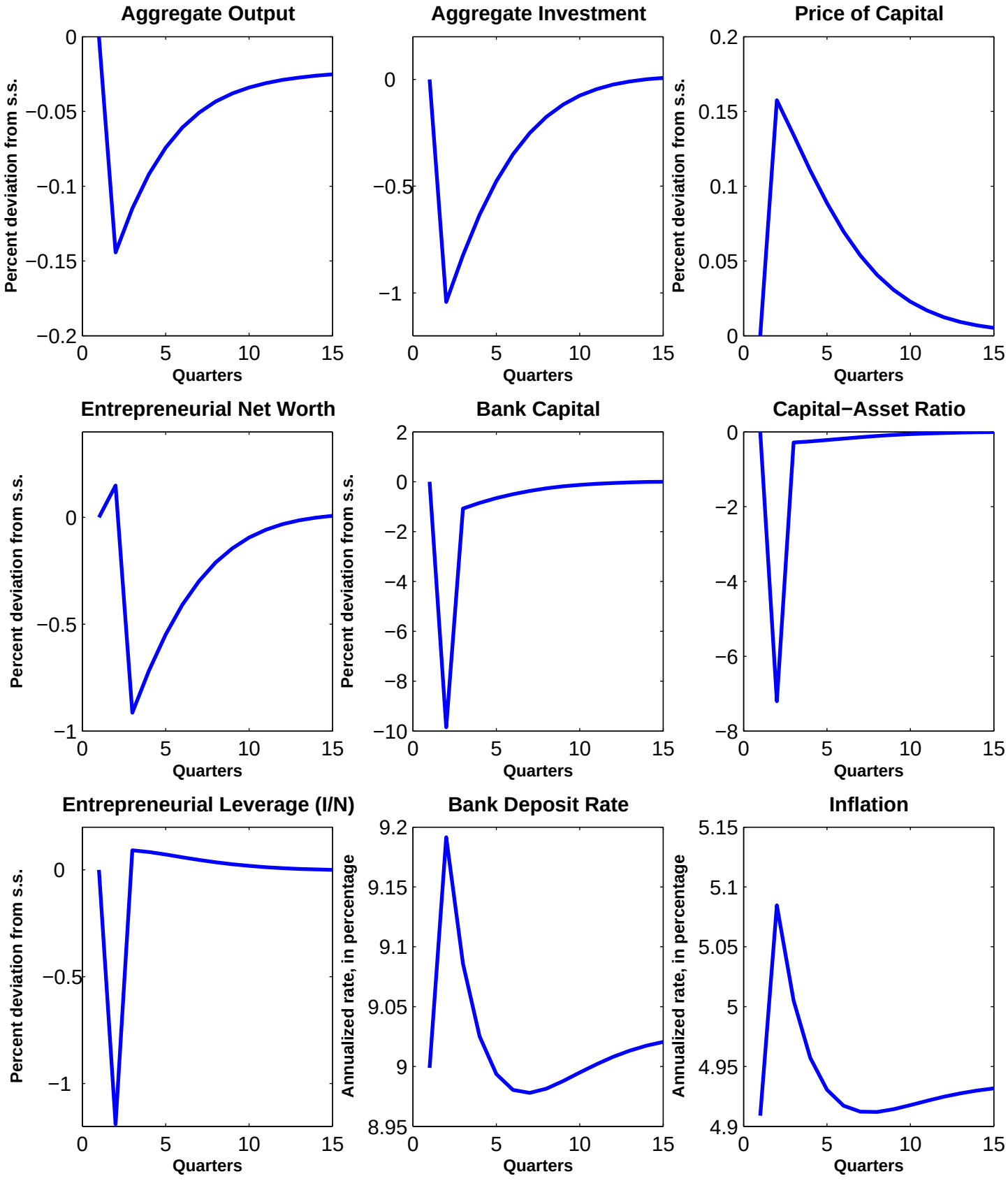
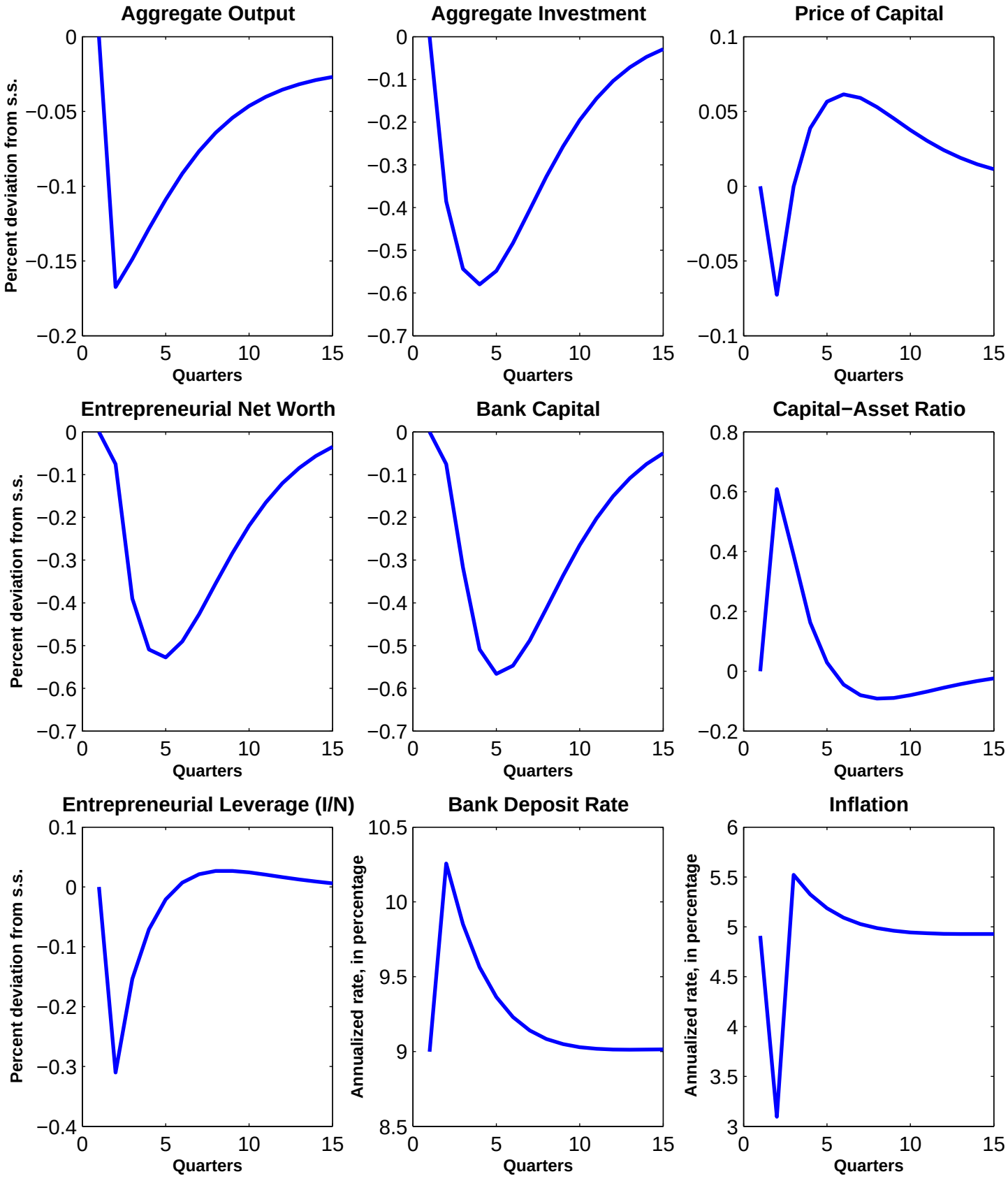


Figure 4

Contractionary Monetary Policy Shock: Extended Model



Steady State With and Without Bank Capital

Variables	With Bank Capital	Without Bank Capital	% Change
Investment	0.215	0.232	7.9%
Output	1.098	1.128	2.8%
Entrepreneurial Leverage (I/N)	2.0	2.10	5%
Aggregate Leverage $(I/(N+A))$	1.74	2.10	21%

'With Bank Capital': Baseline Calibration of the Double Moral Hazard Model.

'Without Bank Capital': Calibration with moral hazard only between entrepreneurs and bankers (μ 0 .0)

Figure 5

Contractionary Monetary Policy Shock: The Importance of Bank Capital

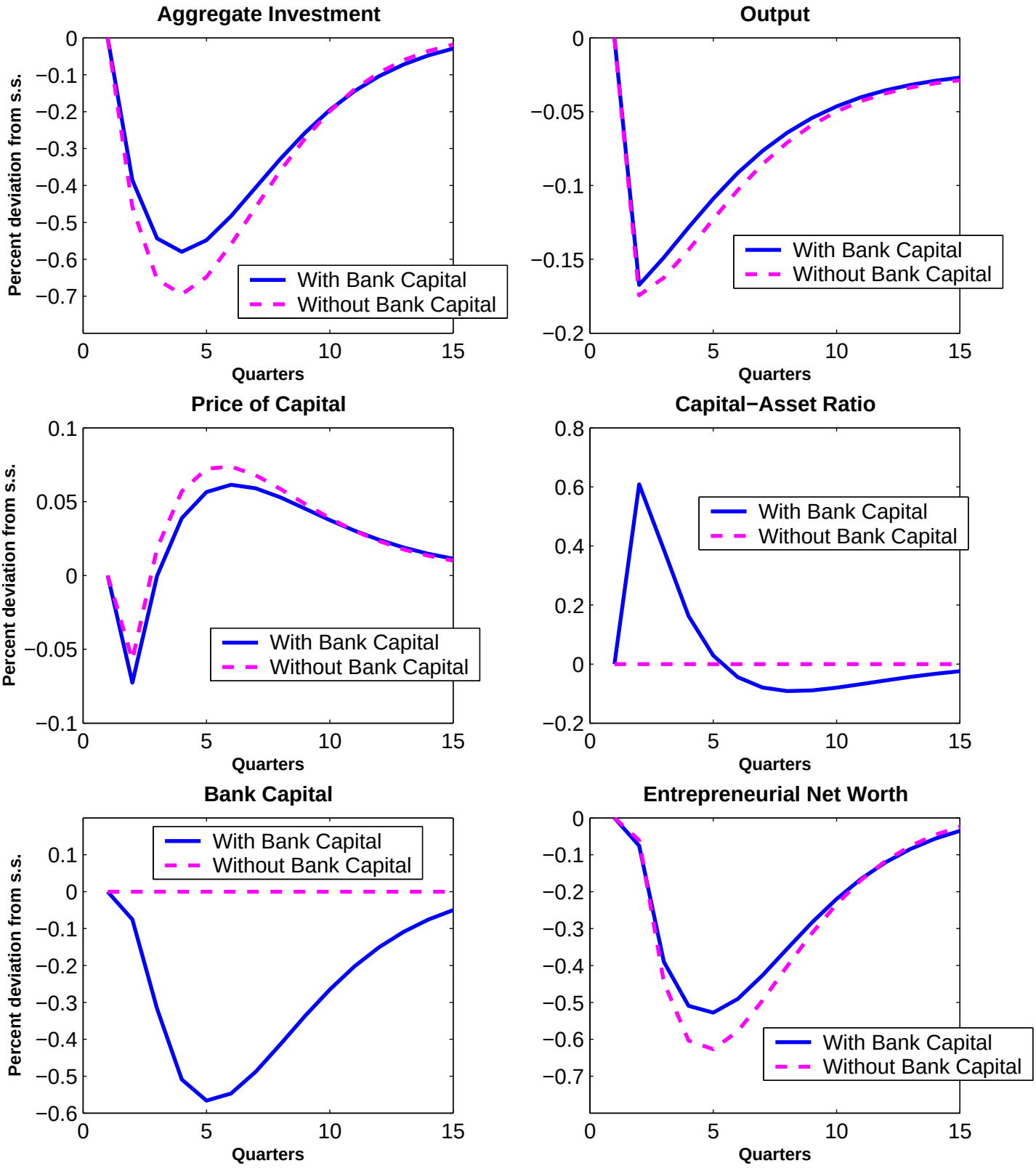


Figure 6

Contractionary Monetary Policy Shock: Sensitivity Analysis

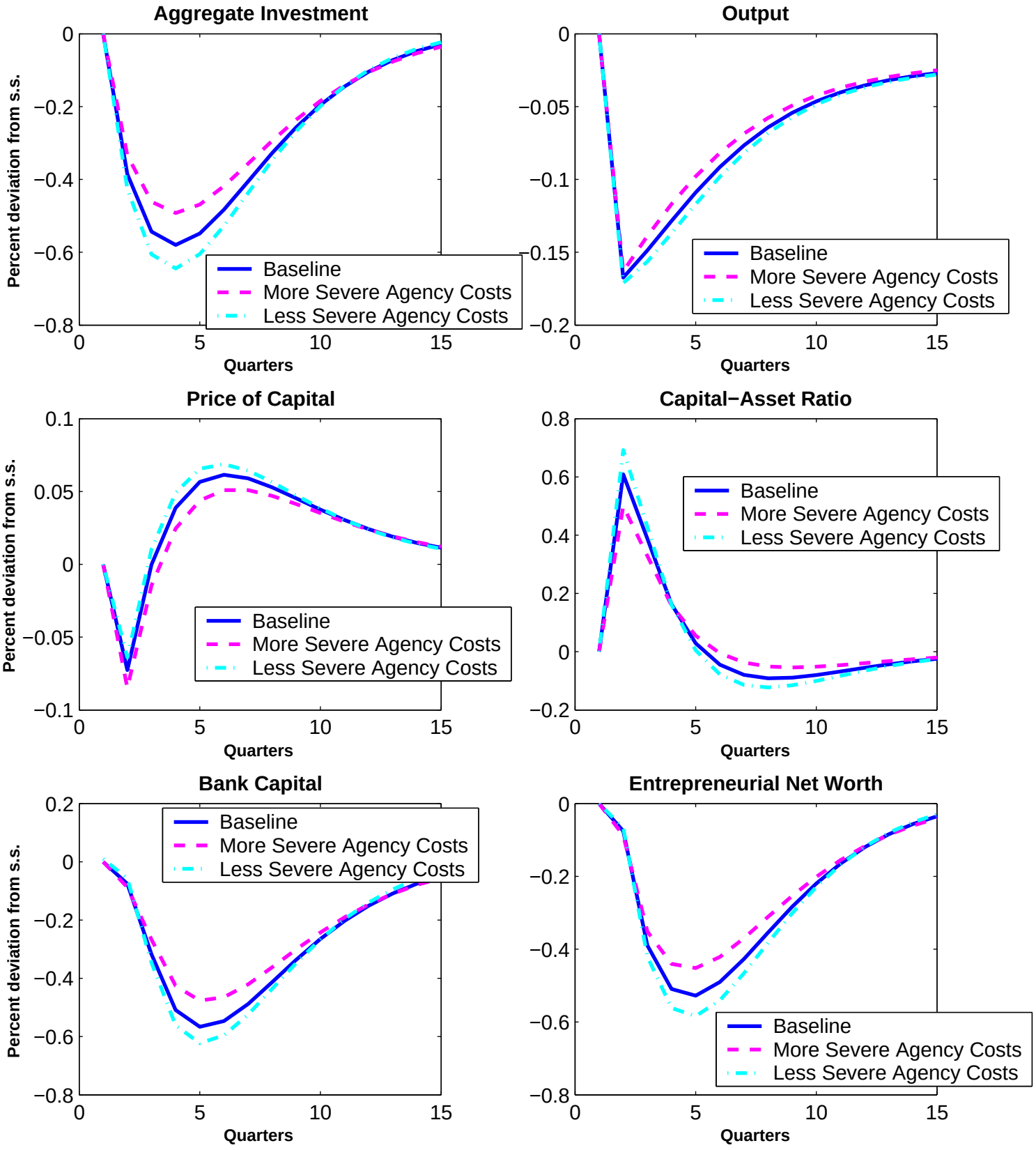


Table 2

Cyclical Properties of the Capital-Asset Ratio: Model and Data

Variable	$\frac{\sigma(X)}{\sigma(GDP)}$	*Cross-Correlation of the Capital-Asset Ratio with:* X_{t-4}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+4}
Panel A: Model Economy								
Capital-Asset Ratio	0.53	0.85	0.94	0.98	1.00	0.98	0.94	0.85
Fixed Non Res. Investment	2.60	−0.07	−0.21	−0.32	−0.44	−0.52	−0.57	−0.60
GDP	1.00	−0.12	−0.25	−0.35	−0.45	−0.47	−0.48	−0.47
Bank Lending	2.70	−0.10	−0.25	−0.37	−0.51	−0.56	−0.59	−0.59
Panel B: US Economy								
Capital-Asset Ratio	0.38	0.47	0.79	0.91	1.00	0.91	0.79	0.47
Fixed Non Res. Investment	4.41	−0.44	−0.48	−0.44	−0.38	−0.28	−0.20	−0.02
GDP	1.00	−0.47	−0.40	−0.27	−0.16	−0.00	0.08	0.12
Bank Lending (C & I)	4.67	−0.42	−0.67	−0.75	−0.80	−0.76	−0.69	−0.40

Note: For the US economy, 1990:1-2003:1. Capital-Asset Ratio: *tier1* + *tier2* capital over risk weighted assets (source BIS); Fixed Non Res. Investment: Fixed Investment, Non Residential, in billions of chained 1996 Dollars (source BEA); GDP: Gross Domestic Product, in billions of chained 1996 Dollars (source BEA); Bank Lending: Commercial and Industrial Loans Excluding Loans Sold (source BIS). GDP, Investment, and Bank Lending are expressed as real, per capita quantities. All series are detrended using the HP filter.

Conclusion

- We present a quantitative monetary business cycle model in which bank capital helps mitigate an agency problem between banks and depositors

- Bank capital affects the transmission mechanism of monetary policy:

  ◇ lowers the amplification of monetary policy shocks

  ◇ increases the persistence of monetary policy shocks

- The bank capital-asset ratio is market-generated and is countercyclical as in the data

Future Research

- Heterogeneity in bank size and capital-asset ratio
- Interaction between market and regulatory discipline on banks
- Externality of a bank's action
- Optimal monetary policy when bank capital is present?

  $\longrightarrow$ Should monetary policy respond to bank capital movements?