Liquidity, Business Cycles, and Monetary Policy

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1 Question

How does economy fluctuate with shocks to productivity and liquidity?

$\longrightarrow$ Want to develop a canonical model of monetary economy in which money is essential for smooth running of the economy

What are the roles of monetary policy?

Approach: Real business cycles model + limited commitment

present goods

original lender $\rightleftarrows$ borrower

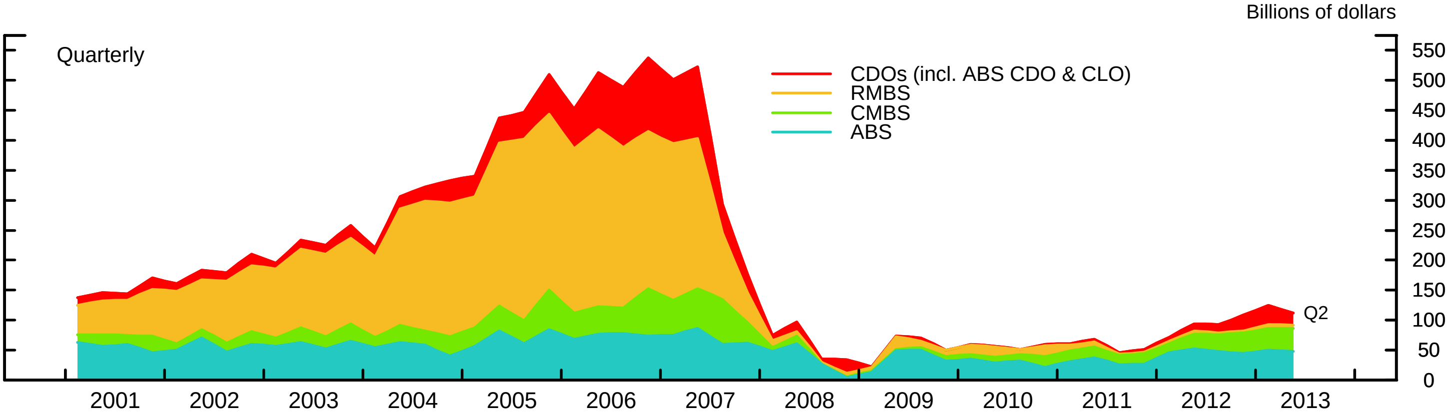
resell $\searrow$claim claim to future goods

new lenders

How much can the original lender enforce the borrower to repay? $\longrightarrow$ borrowing constraint

How much can new lenders enforce the borrower to repay? $\longrightarrow$ resaleability constraint

Chart 13
U.S. Securitization Issuance



Note: CLO refers to all securities backed by loans or bonds issued by businesses. CMBS and RMBS refer respectively to securities backed by commercial and residential mortgages. ABS refers to securities backed by consumer loans.

Source: Asset-backed Alert, Commercial Mortgage Alert from Harrison Scott Publications, Inc. (downloaded May 8, 2013).

2 Model

homogeneous output Y_t, capital K_t and fiat money M_t at each date

agents, measure 1: $\qquad E_t \sum_{s=t}^{\infty} \beta^{s-t} \log c_t$

All agent use their capital to produce goods:

$$\begin{array}{ccc} k_t \text{ capital} & \longrightarrow & \begin{cases} r_t k_t \text{ goods} \\ \lambda k_t \text{ capital} \end{cases} \\ \text{start of date t} & \dashrightarrow & \text{end of date t} \end{array}$$

individually constant returns & decreasing returns in aggregate

$$\begin{aligned} r_t &= a_t K_t^{\alpha-1}, \\ Y_t &= r_t K_t = a_t K_t^{\alpha} \end{aligned}$$

Fraction π of agents can invest in producing new capital:

$$\begin{array}{ccc} i_t \text{ goods} & \longrightarrow & i_t \text{ new capital} \\ \text{start of date t} & \dashrightarrow & \text{end of date t} \end{array}$$

investment opportunities are i.i.d., across people, through time

no insurance market against arrival of investment opportunity

Equity:

capital is specific to the agent who produces it, but he can mortgage future returns by issuing equity

one unit of equity issued at date t promises

$$r_{t+1}, \lambda r_{t+2}, \lambda^2 r_{t+3}, \ldots$$

Borrowing Constraint: an investing agent can mortgage at most θ fraction of the future returns from his new capital production

Resaleability Constraint: at each date, an agent can resell at most ϕ_t fraction of his equity holdings $\longrightarrow$ (a_t, ϕ_t) follows a stationary Markov process

balance sheet at the end of date t	
money: $p_t m_{t+1}$	own equity issued: $q_t^i n_{t+1}^i$
equity of others: $q_t^o n_{t+1}^o$	
own capital stock: $q_t^k k_{t+1}$	net worth

Simplification: at every date, an agent can mortgage up to a fraction ϕ_t of his unmortgaged capital stock

$\longrightarrow$ equity of the others and unmortgaged capital stock become perfect substitutes: $q_t^o = q_t^k = q_t^i = q_t$ & $n_t^o + k_t - n_t^i = n_t$

Flow-of-funds and liquidity constraints:

$$
\begin{aligned}
c_t + i_t + q_t(n_{t+1} - i_t) + p_t m_{t+1} &= (r_t + \lambda q_t) n_t + p_t m_t \\
n_{t+1} &\geq (1 - \theta) i_t + (1 - \phi_t) \lambda n_t \\
m_{t+1} &\geq 0
\end{aligned}
$$

Government chooses M_{t+1} (money supply), N^g_{t+1} (government paper holding) and G_t (government net spending/transfers), subject to the budget constraint:

$$G_t + q_t(N^g_{t+1} - \lambda N^g_t) = r_t N^g_t + p_t(M_{t+1} - M_t)$$

$$\frac{N^g_{t+1}}{K} = \psi_a \frac{a_t - a}{a} + \psi_\phi \frac{\phi_t - \phi}{\phi}$$

Claim 1: $(1-\lambda)\theta + \pi\lambda\phi \geq (1-\lambda)(1-\pi) \leftrightarrow$ unconstrained ($q_t = 1$), first best allocation, no money ($p_t = 0$)

$E_t MPK =$ rate of return on equity $\simeq$ time preference rate

$(1-\lambda)\theta + \pi\lambda\phi < (\beta - \lambda)(1-\pi) \rightarrow$ liquidity constrained ($q_t > 1$), monetary equilibrium exits ($p_t > 0$)

Aggregate Recursive Equilibrium: $(p_t, q_t, I_t, K_{t+1}, N^g_{t+1})$ as functions of aggregate state $(K_t, N^g_t, a_t, \phi_t)$ satisfying:

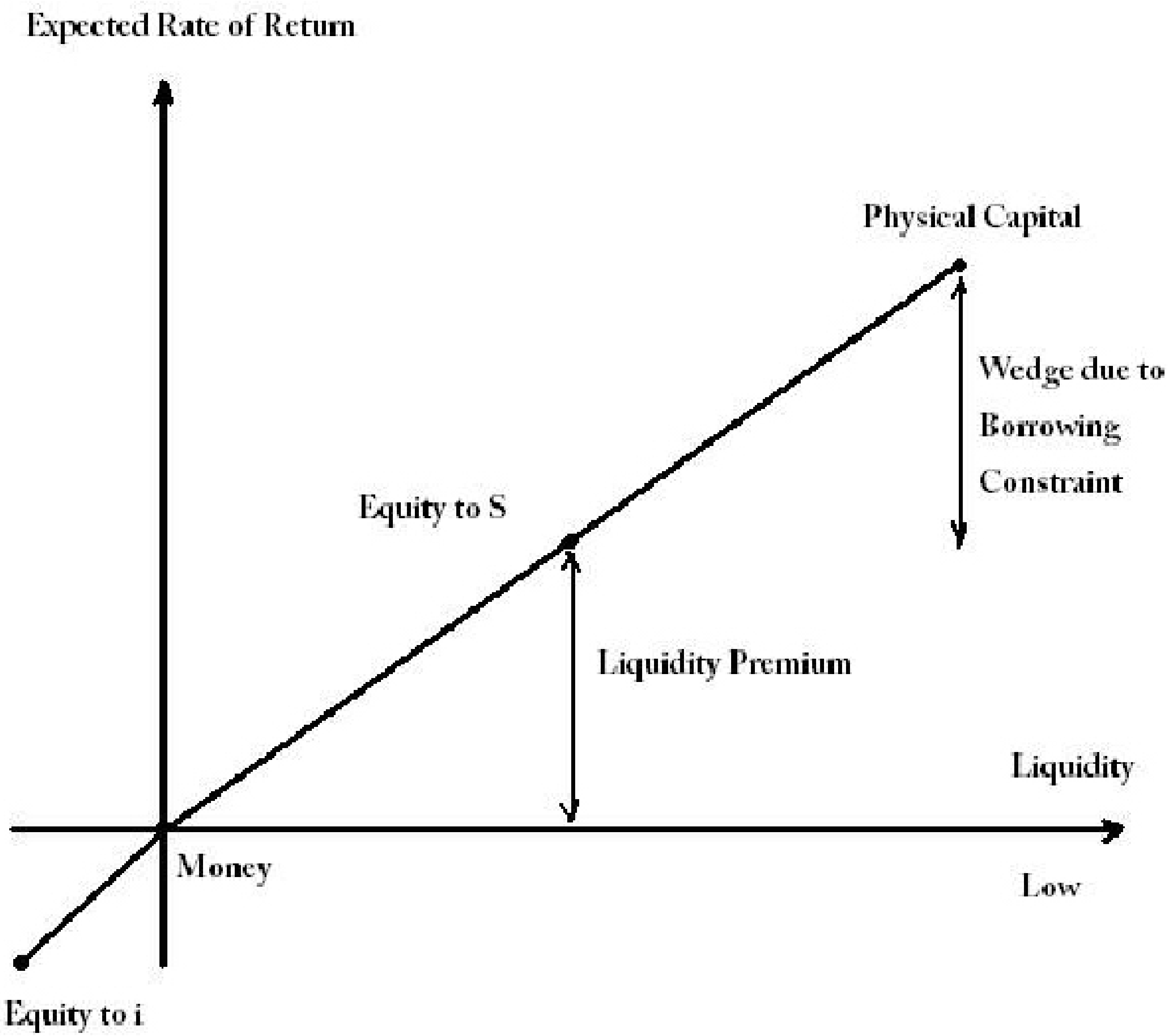
$$a_t K_t^\alpha = I_t + G_t + (1-\beta)\cdot$$

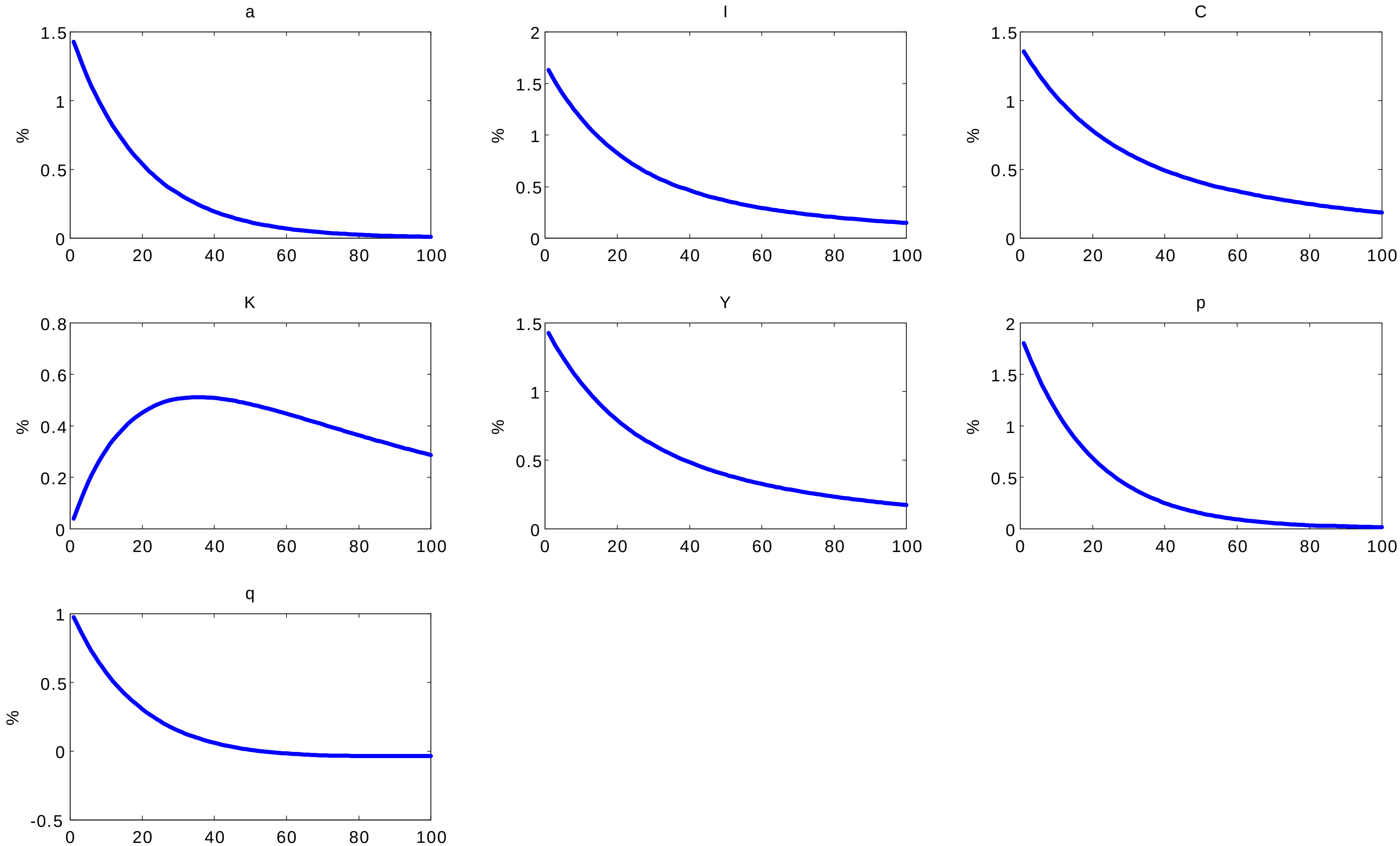
$$\{[r_t + (1-\pi+\pi\phi_t)\lambda q_t + \pi(1-\phi_t)\lambda q^R_t]N_t + p_t M_t\}$$

$$I_t = \pi\frac{\beta[(r_t+\lambda\phi_t q_t)N_t + p_t M_t] - (1-\beta)(1-\phi_t)\lambda q^R_t N_t}{1-\theta q_t}$$

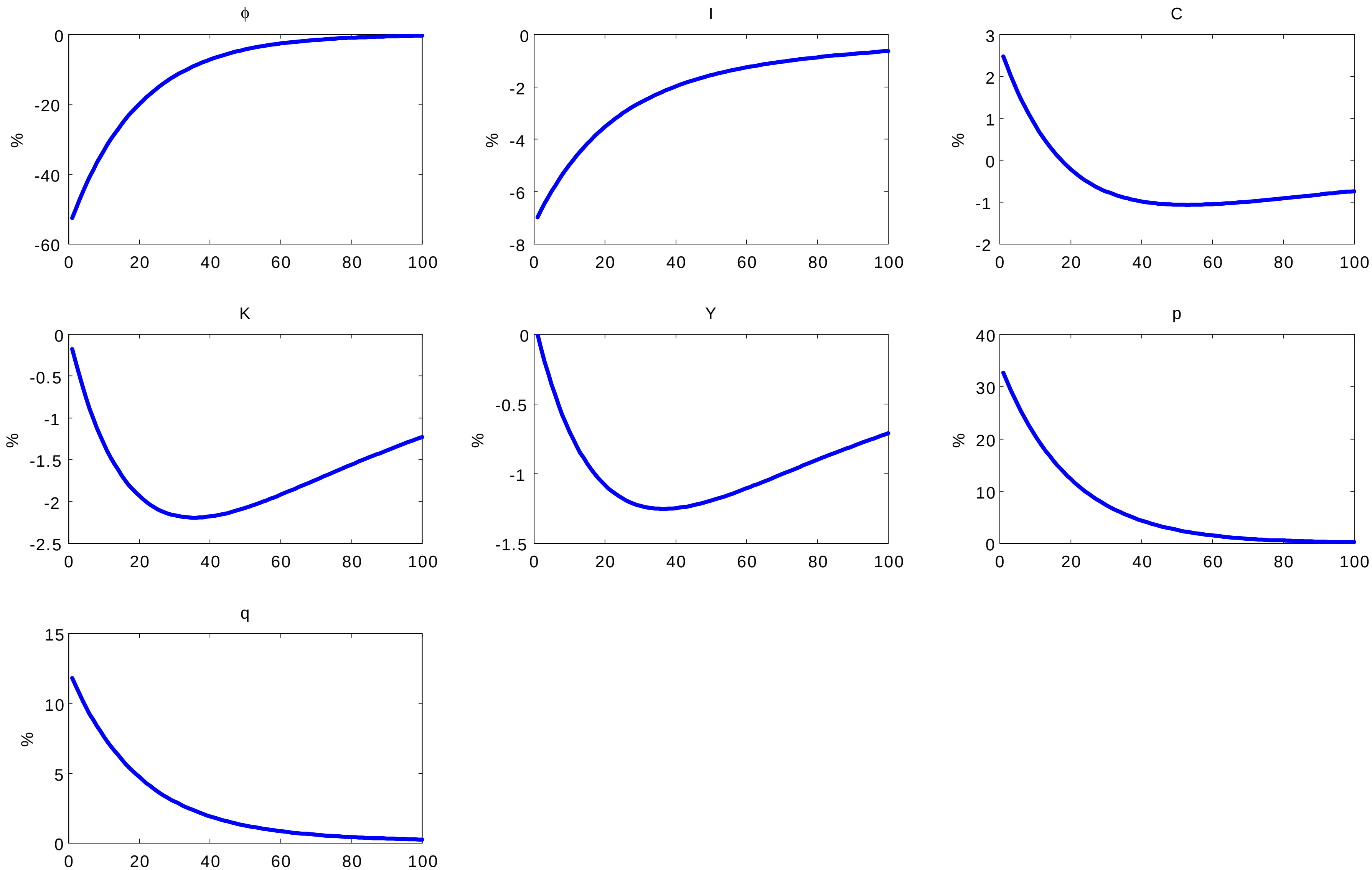
$$\begin{aligned}
&(1-\pi)E_t\left[\frac{(r_{t+1}+\lambda q_{t+1})/q_t - p_{t+1}/p_t}{C^{ss}_{t+1}}\right] \\
= \ &\pi E_t\left[\frac{p_{t+1}/p_t - [r_{t+1}+\lambda\phi_{t+1}q_{t+1} + \lambda(1-\phi_{t+1})q^R_{t+1}]/q_t}{C^{si}_{t+1}}\right]
\end{aligned}$$

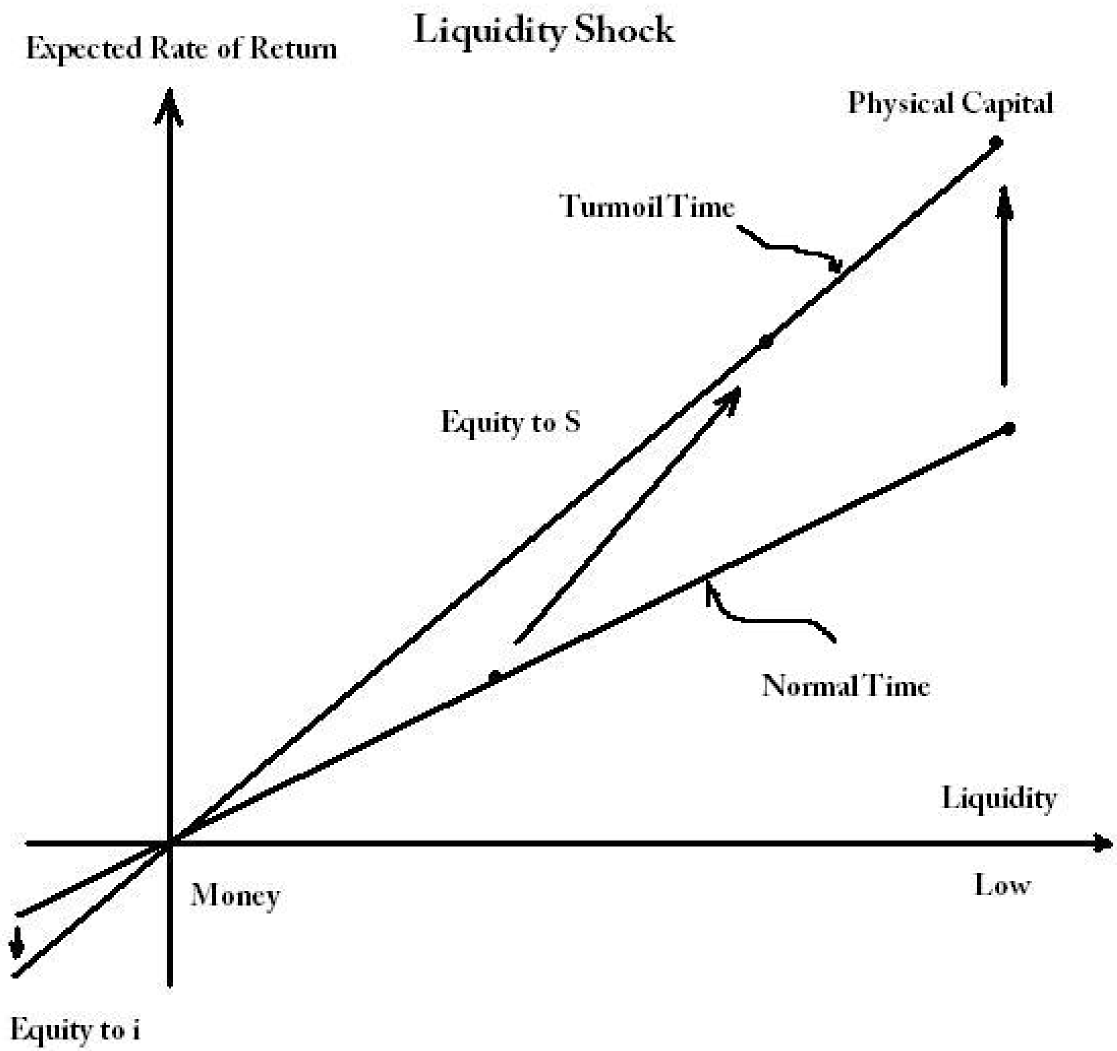
$$\begin{aligned}
K_{t+1} \ &= \ \lambda K_t + I_t = N_{t+1} + N^g_{t+1} \\
q^R_t \ &= \ \frac{1-\theta q_t}{1-\theta}
\end{aligned}$$

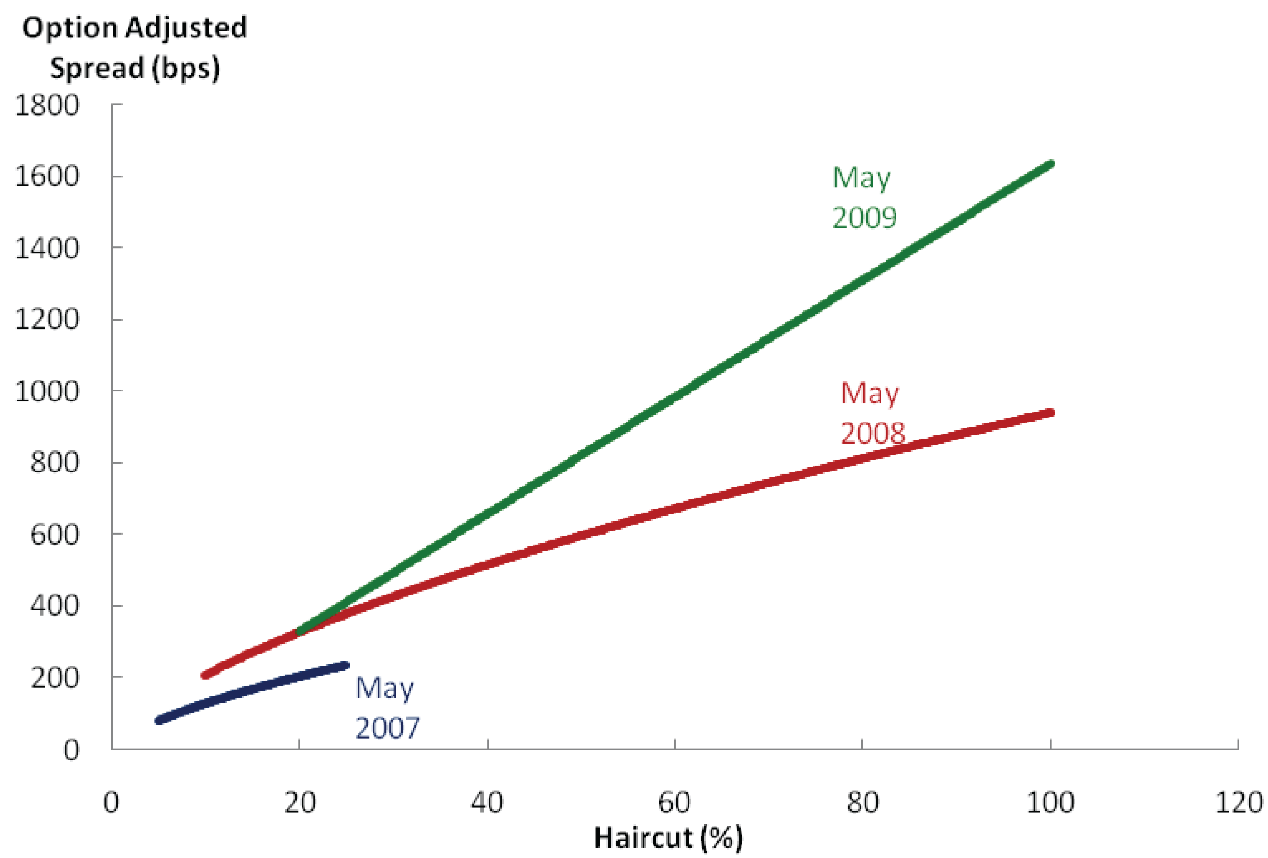

Expected Rate of Return
Physical Capital
Wedge due to
Borrowing
Constraint
Equity to S
Liquidity Premium
Liquidity
Money
Low
Equity to i



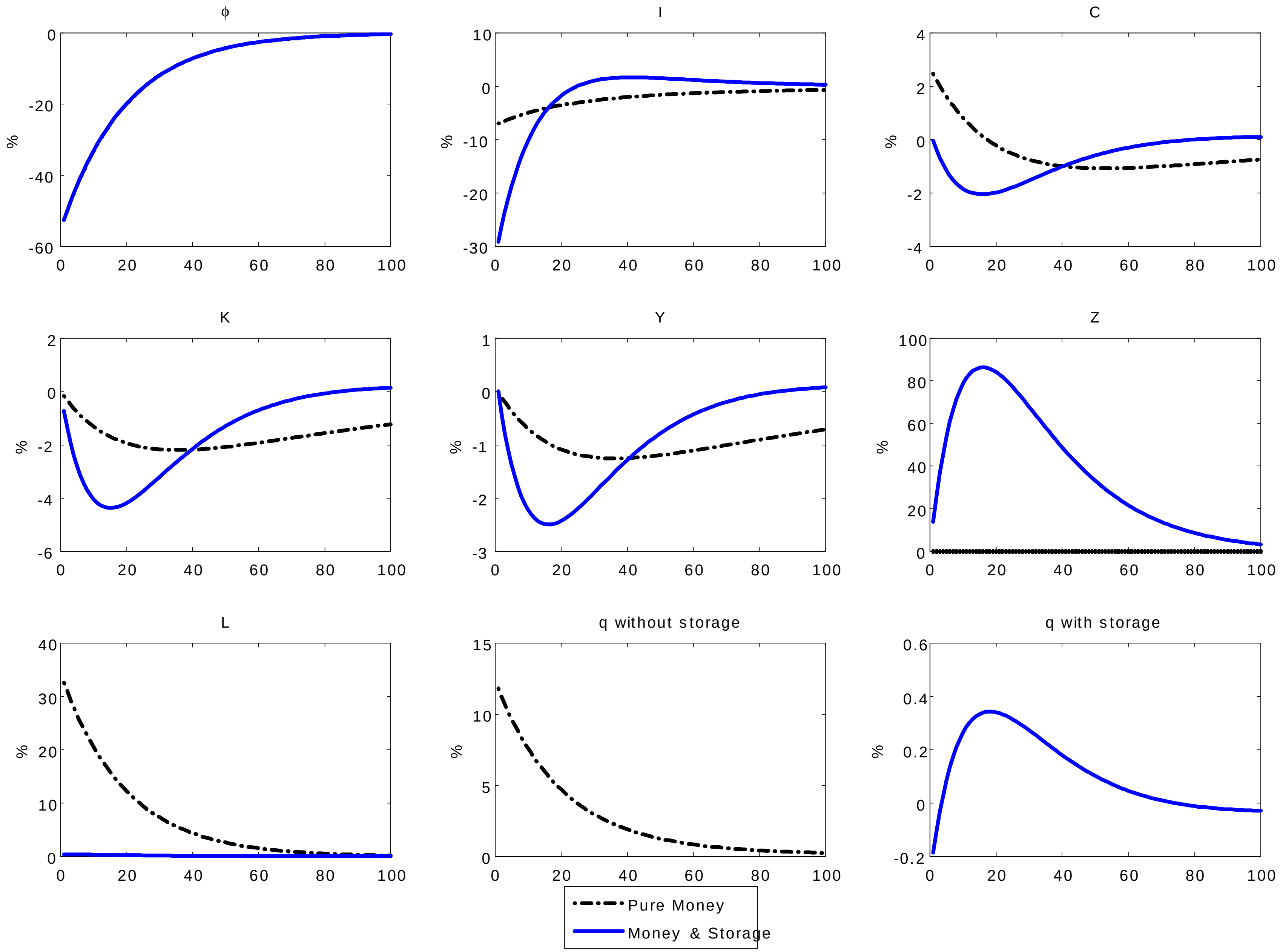
a
I
C
K
Y
p
q
%


ϕ
%
0
-20
-40
-60
I
%
0
-2
-4
-6
-8
C
%
3
2
1
0
-1
-2
K
%
0
-0.5
-1
-1.5
-2
-2.5
Y
%
0
-0.5
-1
-1.5
p
%
40
30
20
10
0
q
%
15
10
5
0
0
20
40
60
80
100

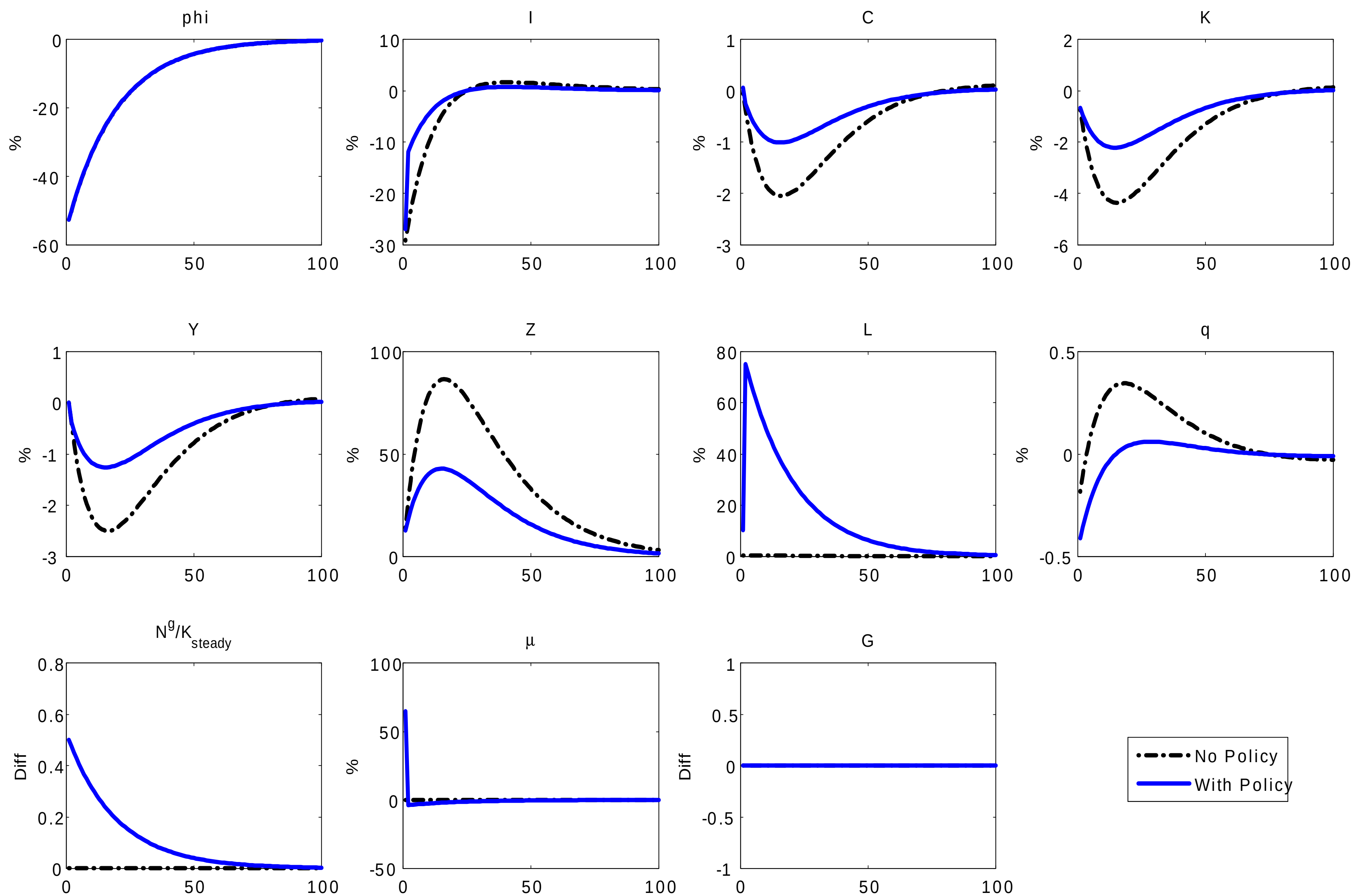

Liquidity Shock
Expected Rate of Return
Physical Capital
Turmoil Time
Equity to S
Normal Time
Liquidity
Money
Low
Equity to i



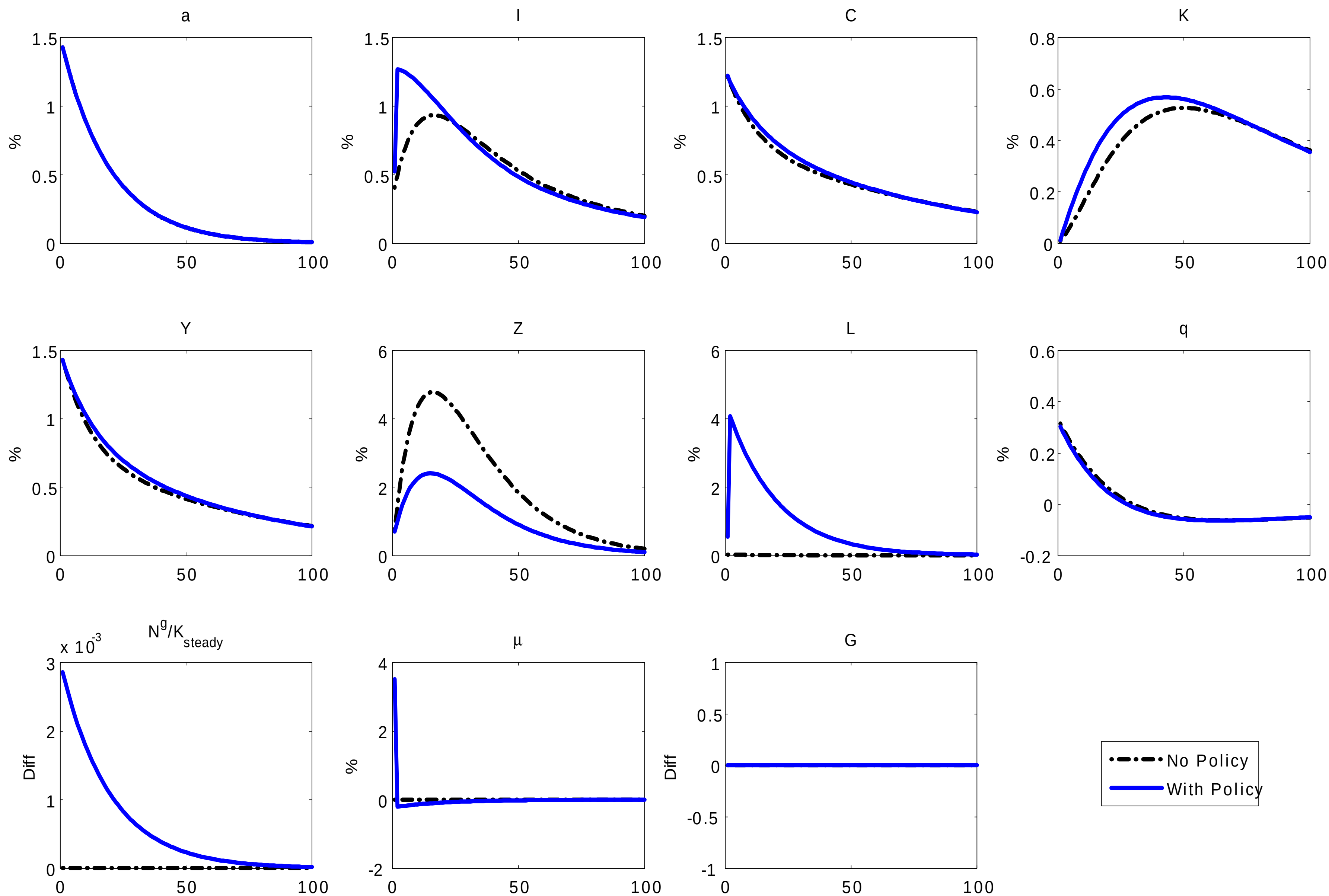
Option Adjusted
Spread (bps)
1800
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120
Haircut (%)
May
2009
May
2008
May
2007



ϕ
I
C
K
Y
Z
L
q without storage
q with storage
%
Pure Money
Money & Storage



phi
I
C
K
Y
Z
L
q
N^g/K_{steady}
μ
G
%
Diff
No Policy
With Policy



a
I
C
K
Y
Z
L
q
N^g/K_{steady}
μ
G
%
Diff
x 10^{-3}
No Policy
With Policy

Normal features of "monetary economy"

· interest rates spread between assets with different liquidity

rate of return on money $<$ rate of return on equity $<$ time preference rate $<$ expected marginal product of capital

· quantities and asset prices react to liquidity shock

Policy: Can use open market operation to accommodate productivity shock and to offset shocks to liquidity (resaleability)

Needs to buy (or lend against) partially resaleable assets which has liquidity premium