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? $\longrightarrow$ limited resaleability

2 Model

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

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

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:

$$i_t \text{ goods} \quad \longrightarrow \quad i_t \text{ new capital}$$

$$\text{start of date t} \dashrightarrow \text{end of date t}$$

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 produce 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: $q_t^i k_{t+1}$	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: $q_t^o = q_t^i = q_t$ & $n_t^o + k_t - n_t^i = n_t$

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 equity holding) and G_t (government net spending/transfers), subject to the budget constraint:

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

Claim *1*: In the neighborhood of the steady state,

$(1-\lambda)\,\theta + \pi\lambda\phi \geq (1-\lambda)(1-\pi) \Leftrightarrow$ unconstrained, first best allocation, no money

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

$(1-\lambda)\,\theta + \pi\lambda\phi < (\beta-\lambda)(1-\pi) \Rightarrow$ liquidity constrained, monetary equilibrium exists

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

$$a_t K_t^\alpha = I_t + G_t +$$

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

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

$$(1-\pi)E_t\left[\frac{(r_{t+1}+\lambda q_{t+1})/q_t - p_{t+1}/p_t}{C^{ss}_{t+1}}\right]$$

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

$$K_{t+1} = \lambda K_t + I_t = N_{t+1} + N^g_{t+1}$$

$$q_t^R \equiv \frac{1-\theta q_t}{1-\theta} < 1$$

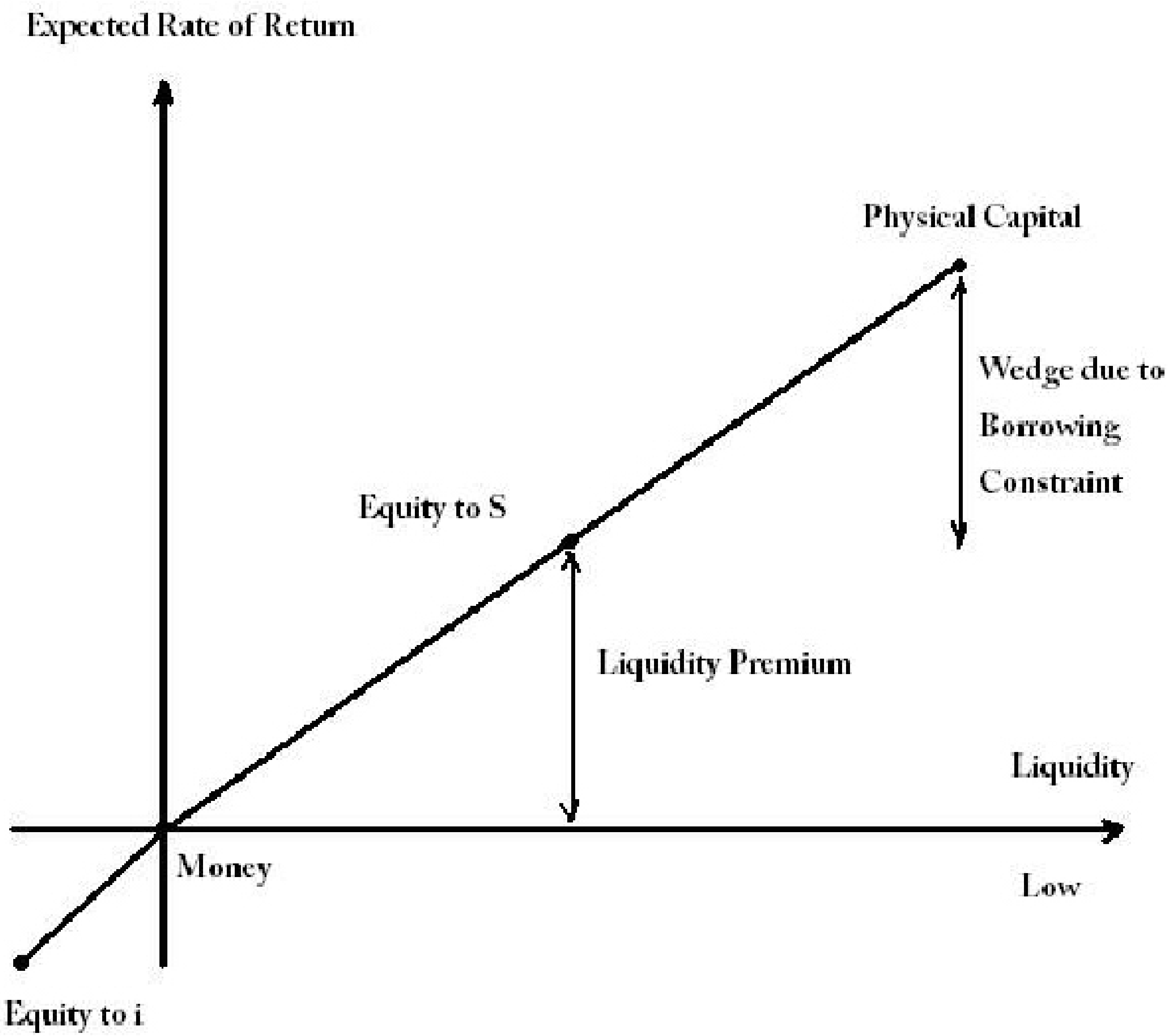

Expected Rate of Return
Physical Capital
Wedge due to
Borrowing
Constraint
Equity to S
Liquidity Premium
Liquidity
Money
Low
Equity to i

Figure 1: Deterministic Productivity Shifts

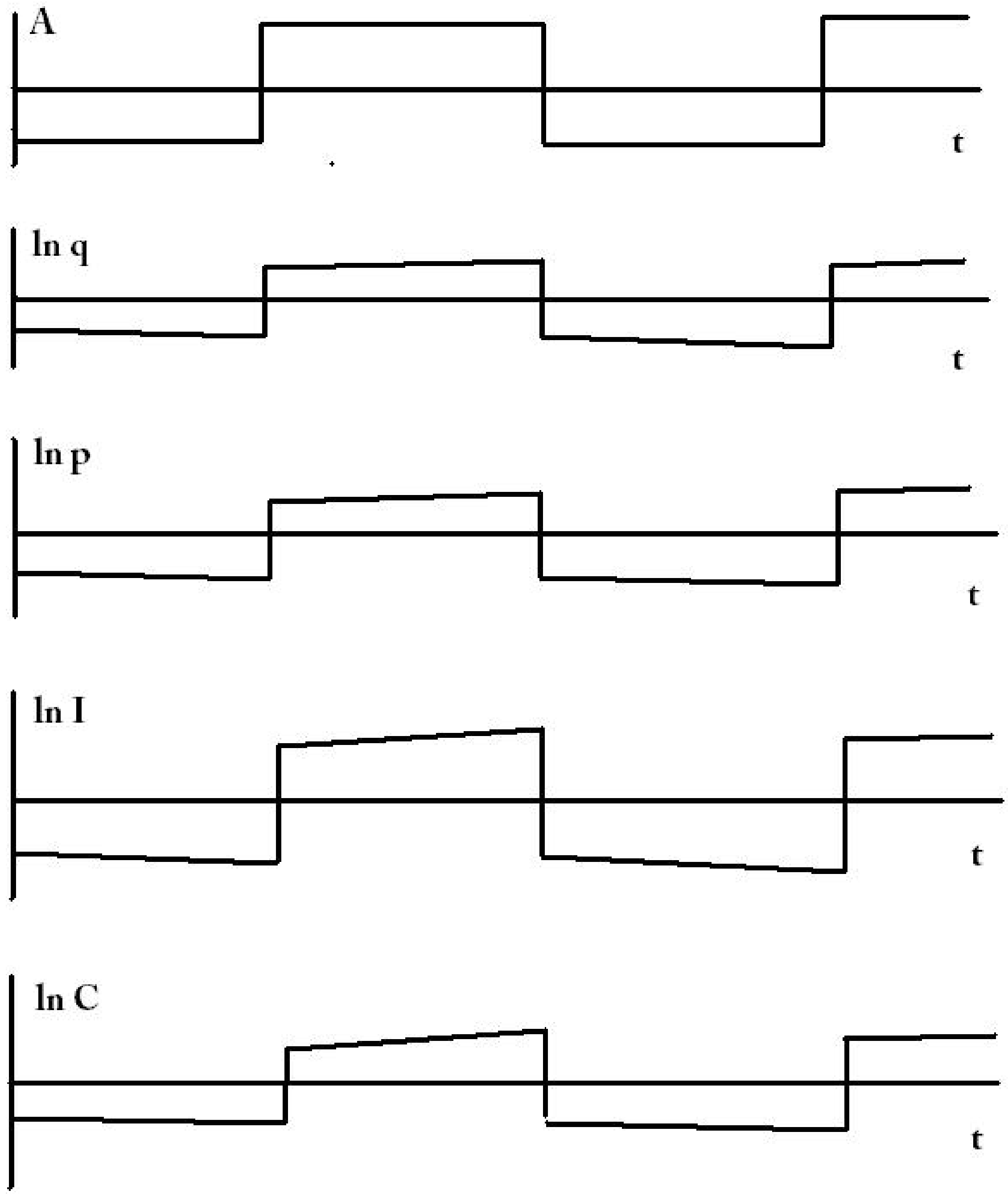
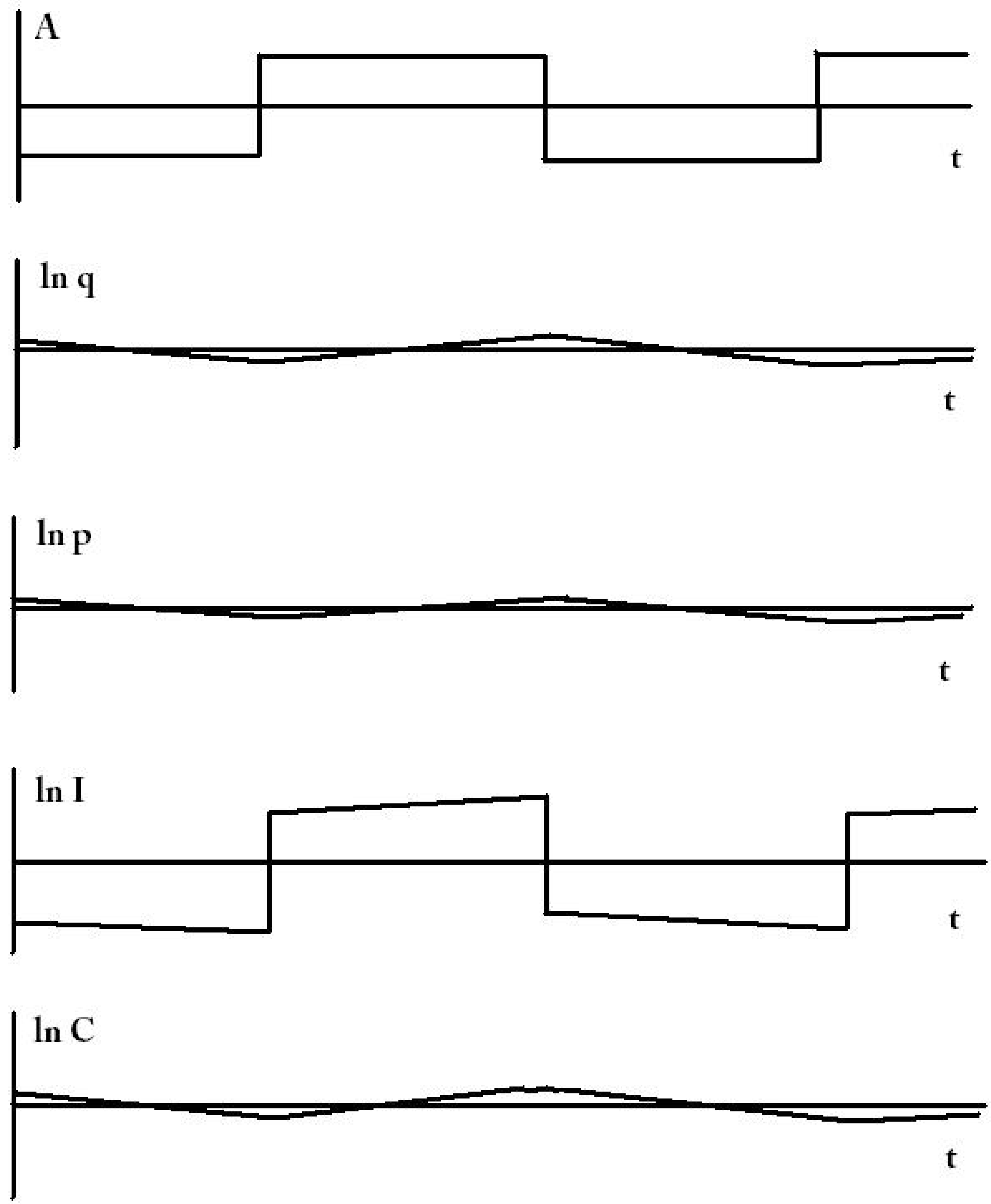
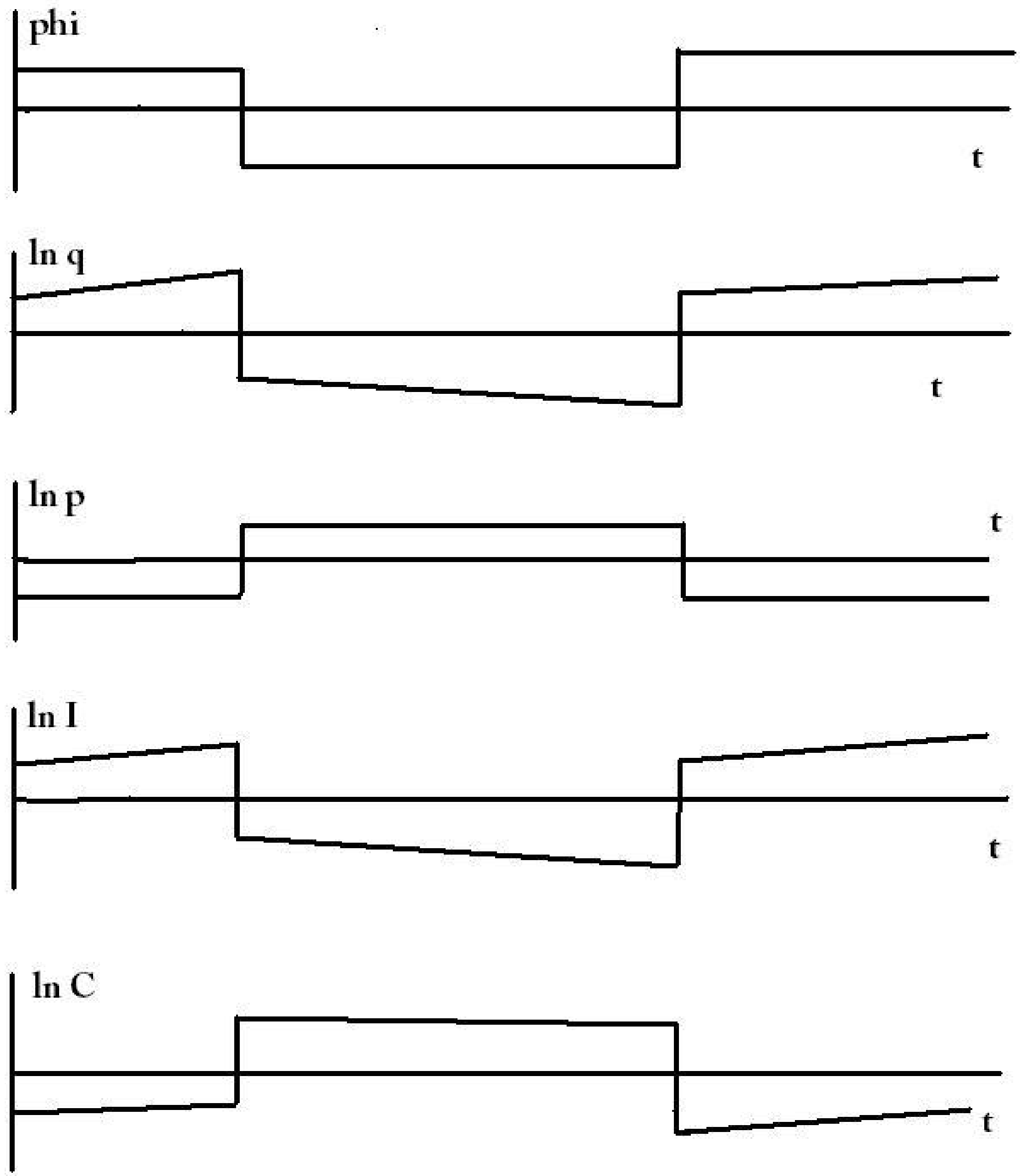


Figure 3: Open Market Operation against Productivity Shifts



Liquidity Shock under Laissez-Faire



Liquidity Shock

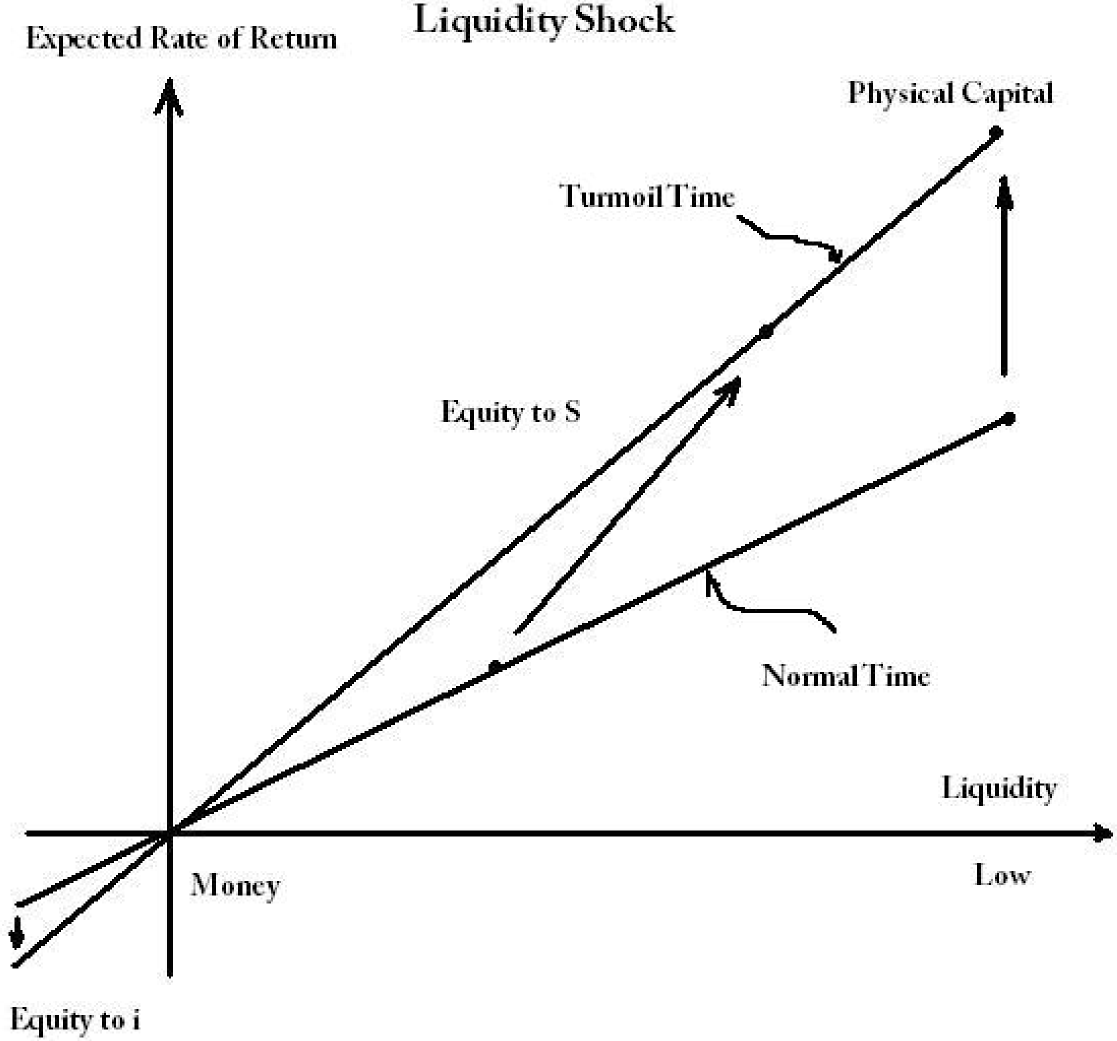
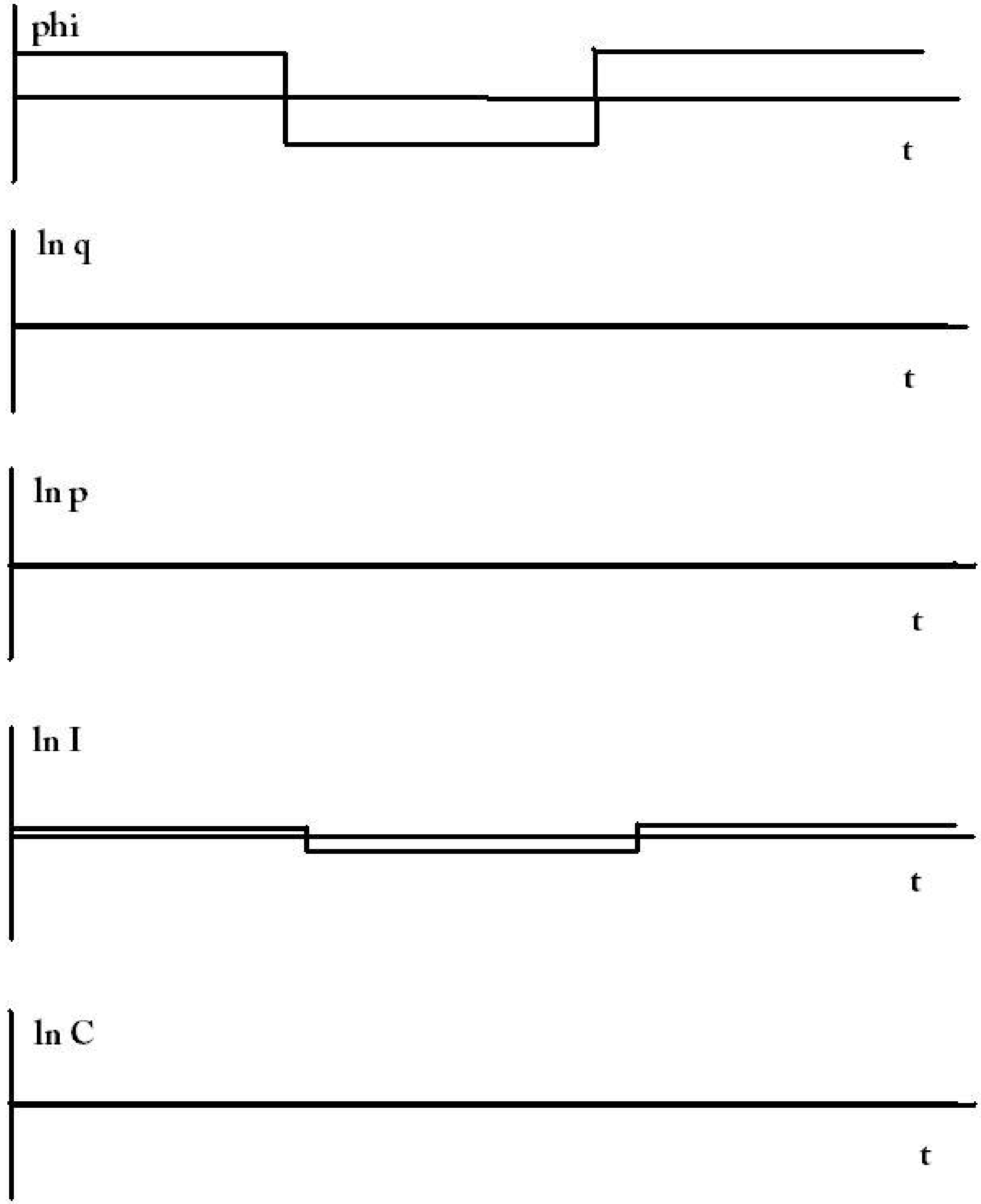


Figure 4: Open Market Operation against Liquidity Shocks



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