Liquidity, Business Cycles, and Monetary Policy

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1 Question

How does economy fluctuate with shocks to productivity and liquidity?

→ 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 $\leftrightarrow$ borrower

resell $\downarrow$ claim $\downarrow$ claim to future goods

new lenders

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

How much can new lenders enforce the borrower to repay? $\rightarrow$ 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:

$k_t$ capital $\rightarrow \begin{cases} r_t k_t \text{ goods} \\ \lambda k_t \text{ capital} \end{cases}$

start of date $t$ $\rightarrow$ end of date $t$

individually constant returns & decreasing returns in aggregate

$$r_t = a_t K_t^{\alpha-1},$$

$$Y_t = r_t K_t = a_t K_t^\alpha$$
Fraction $\pi$ of agents can invest in producing new capital:

$$i_t \text{ goods} \rightarrow i_t \text{ new capital}$$

start of date $t$ $\rightarrow$ 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 $\theta$ fraction of the future returns from his new capital production

Resaleability Constraint: at each date, an agent can resell at most $\phi_t$ fraction of his equity holdings $\rightarrow (a_t, \phi_t)$ follows a stationary Markov process
balance sheet at the end of date $t$

<table>
<thead>
<tr>
<th>money: $ptmt_{t+1}$</th>
<th>own equity issued: $q^i_t n^i_{t+1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>equity of others: $q^o_t n^o_{t+1}$</td>
<td></td>
</tr>
<tr>
<td>own capital stock: $q^i_t k_{t+1}$</td>
<td>net worth</td>
</tr>
</tbody>
</table>

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

$\rightarrow$ equity of the others and unmortgaged capital stock become perfect substitutes: $q^o_t = q^i_t = q_t \& n^o_t + k_t - n^i_t = n_t$

Flow-of-funds and liquidity constraints:

$$c_t + i_t + q_t(n_{t+1} - i_t) + ptmt_{t+1} = (r_t + \lambda q_t)n_t + ptmt$$

$$n_{t+1} \geq (1 - \theta)i_t + (1 - \phi_t)\lambda n_t$$

$$m_{t+1} \geq 0$$
Government chooses $M_{t+1}$ (money supply), $N_{t+1}^g$ (government equity holding) and $G_t$ (government net spending/transfers), subject to the budget constraint:

$$G_t + q_t(N_{t+1}^g - \lambda N_t^g) = r_t N_t^g + p_t(M_{t+1} - M_t)$$

Claim 1: In the neighborhood of the steady state,

$$(1 - \lambda) \theta + \pi \lambda \phi \geq (1 - \lambda)(1 - \pi) \iff \text{unconstrained, first best allocation, no money}$$

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

$$(1 - \lambda) \theta + \pi \lambda \phi < (\beta - \lambda)(1 - \pi) \Rightarrow \text{liquidity constrained, monetary equilibrium exists}$$
Equilibrium: \((p_t, q_t, I_t, K_{t+1}, M_{t+1})\) as functions of aggregate state \((K_t, a_t, \phi_t, G_t, N_{t+1}^g)\) satisfying:

\[
\alpha_t K_t = I_t + G_t + (1 - \beta) \left\{ [r_t + (1 - \pi + \pi \phi_t) \lambda q_t + \pi (1-\phi_t) \lambda q_t^R] N_t + p_t M_t \right\}
\]

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

\[
(1 - \pi) E_t\left[ \frac{(r_{t+1} + \lambda q_{t+1}) / q_t - p_{t+1} / p_t}{C_{t+1}^{ss}} \right] = \pi E_t \left[ \frac{p_{t+1} / p_t - [r_{t+1} + \lambda \phi_{t+1} q_{t+1} + \lambda (1 - \phi_{t+1}) q_{t+1}^R] / q_t}{C_{t+1}^{si}} \right]
\]

\[
K_{t+1} = \lambda K_t + I_t = N_{t+1} + N_{t+1}^g
\]

\[
q_t^R \equiv \frac{1 - \theta q_t}{1 - \theta} < 1
\]
Figure 1: Deterministic Productivity Shifts

A

ln q

ln p

ln I

ln C
Figure 3: Open Market Operation against Productivity Shifts

- A
- $\ln q$
- $\ln p$
- $\ln I$
- $\ln C$
Liquidity Shock under Laissez-Faire
Figure 4: Open Market Operation against Liquidity Shocks

- $\phi_i$
- $\ln q$
- $\ln p$
- $\ln I$
- $\ln C$
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 pro-
ductivity shock and to offset shocks to liquidity (resaleability)

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