Bubbles, Money and Liquidity Traps: an Analytical Perspective

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Facts and Questions

Key features of the last two decades:

- large fluctuations in net worth
- large fluctuations in money holdings
- low nominal and real interest rates: liquidity trap
- macro aggregates correlated with net worth
Net Worth, 1980-2015

Figure 1: Net worth of US households and nonprofit organizations divided by GDP

Source: Board of Governors of the Federal Reserve System
Money, 1980-2015

Source: Federal Reserve Bank of St. Louis

Figure 2: Ratio of the money stock M1 to nominal GDP
Real Interest Rates, 1980-2015

Source: Board of Governors of the Federal Reserve System (authors' calculation)
Inflation Rate, 1980-2015

Source: US. Bureau of Labor Statistics

Figure 4
Nominal Interest Rates, 1980-2015

Figure 5: Nominal 3-month treasury bill rate (secondary market)

Source: Board of Governors of the Federal Reserve System
Macro aggregates, 1980-2015

![Real Growth Rates (%)](image)

Source: Bureau of Economic Analysis (authors’ calculation)
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Key questions

- why have fluctuations in net worth and money holdings become so large?
- how are they connected to low interest rates?
- what are their effects on output, consumption and investment?
This paper

- Model of bubbles, money and investment

- Theoretical framework with the following features:
  - liquidity traps appear when there is a shortage of stores of value
  - money holdings expand at the expense of investment in capital
  - bubbles raise collateral, crowd out money and crowd in investment
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- Theoretical framework with the following features:
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- Application to recent events:
  - several factors have put downward pressure on interest rates
  - dot.com and housing bubbles temporarily alleviated these pressures
  - after their collapse the economy entered into a liquidity trap
Related literature

- **Rational bubbles**
  - Samuelson (1958), Tirole (1985)

- **Bubbles and financial frictions**

- **Liquidity traps**
Model

- Two-period OLG structure

- All individuals maximize:  $U_t^i = E_t C_{t,t+1}^i$

- Savers:
  - Supply one unit of labor when young and receive wage $W_t$
  - Save by lending to entrepreneurs $F_t$ and by holding money $M_t$

- Entrepreneurs (or bankers?):
  - Supply one unit of labor when young and receive wage $W_t$
  - Construct portfolios of capital and bubbles, $K_t$ and $B_t$
  - Finance their activities by selling credit contracts, $F_t$
Capital and bubbles

- **Capital:**
  - Investment by entrepreneurs, full depreciation
  - Production: \( F(K_t, N_t) = K_t^\alpha \cdot (\gamma^t \cdot N_t)^{1-\alpha} \), where \( \gamma \geq 1 \)

- **Bubbles:**
  - Intrinsically useless assets only held for resale
  - Initiated and traded by entrepreneurs
  - Law of motion: \( B_{t+1} = g_{t+1} \cdot B_t + N_{t+1} \)
    * \( g_{t+1} \) is growth in the value of old bubbles
    * \( N_{t+1} \) value of new bubbles
Money

- Used to facilitate transactions and as store of value
- Rate of money growth set by government

\[ M_{t+1} = \mu \cdot M_t \quad \text{and} \quad T_{t+1} = \frac{M_{t+1} - M_t}{\rho_{t+1}} \]

seignorage rebated lump-sum

- Savers subject to cash-in-advance constraint

\[ M_t \geq \frac{1}{\nu} \cdot \rho_{t+1} \cdot C^S_{t+1} \]
Credit

- Entrepreneurs sell credit contracts to savers
  - Promise a contingent gross return $R_{t+1}$
  - $E_t R_{t+1}$ is the real interest rate
- Credit contracts need to be collateralized:
  \[ R_{t+1} \cdot F_t \leq \phi \cdot r_{t+1} \cdot K_{t+1} + B_{t+1} \]
  where $r_{t+1}$ denotes the rental price of capital
- One constraint for each possible future
Market equilibria

- **Factor markets:** \( w_t = (1 - \alpha) \cdot k_t^\alpha \) and \( r_t = \alpha \cdot k_t^{\alpha - 1} \)

- **Market for bubbles:** \( E_t g_{t+1} = E_t R_{t+1} \)

- **Money market clears:**

\[
\frac{1}{\pi_{t+1}} \geq R_{t+1} \cdot \frac{(1 - \varepsilon) \cdot (1 - \alpha) \cdot k_t^\alpha - m_t}{(\nu - \mu) \cdot m_t} \quad \text{and} \quad E_t \left\{ \frac{1}{\pi_{t+1}} \right\} \leq E_t R_{t+1}
\]

where \( \pi_{t+1} \) denotes the inflation rate

- **Credit market clears:**

\[
R_{t+1} = \frac{\gamma \cdot [\phi \cdot \alpha \cdot k_{t+1}^\alpha + b_{t+1}]}{(1 - \varepsilon) \cdot (1 - \alpha) \cdot k_t^\alpha - m_t}
\]

where the borrowing constraint binds
Equilibrium dynamics

- From aggregate resource constraint:

\[ \gamma \cdot k_{t+1} = (1 - \alpha) \cdot k_t^\alpha - m_t - b_t \]

- Existence of bubbles requires low interest rates: possible sources
  - Inefficient investment (traditional view)
  - Financial frictions (this paper)
    - here, low rates can also give rise to liquidity traps

- Finding equilibria:
  - Propose process \( \{g_t, n_t, \pi_t\} \) such that \( E_t g_{t+1} = E_t R_{t+1} \) and \( n_t \geq 0 \)
  - Determine all possible sequences for state variables \( \{k_t, b_t, m_t\} \)
  - Check that all sequences satisfy \( k_t \geq 0, b_t \geq 0 \) and \( m_t \geq 0 \)
Case 1: Bubbleless Economy

- If \( b_t = 0 \) for all \( t \),

\[
    m_t = \max \left\{ \frac{\mu \cdot \phi \cdot \alpha}{\nu - \mu}, (1 - \varepsilon) \cdot (1 - \alpha) - \mu \cdot \phi \cdot \alpha \right\} \cdot k_t
\]

The economy is in a liquidity trap if:
- Transaction needs are low: high \( \nu \)
- Credit supply is high relative to credit demand: low \( \varepsilon \) and \( \phi \)
- Inflation tax is low and return on money is high: low \( \mu \)
Case 1: Bubbleless Economy
Case 2: Bubbly Economy

- If \( b_0 = 0 \) and \( n_t = x \cdot k_t^\alpha \) for all \( t \), then the bubble grows and the economy transitions to a steady state \( \{ b, m \} \), where

\[
m = \max \left\{ \frac{\mu \cdot (\phi \cdot \alpha + x^B)}{v - \mu}, (1 - \varepsilon) \cdot (1 - \alpha) - \mu \cdot (\phi \cdot \alpha + x^B) \right\} \cdot k^\alpha
\]

where \( b = x^B \cdot k^\alpha \).
Case 2: Bubbly Economy

Bubble/output, $x^B$  Money/output, $x^M$  Investment rate, $s$  Capital, $k$

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General narrative

- Declining real and nominal interest rates:
  - financial globalization (increase in $1 - \varepsilon$)
  - improvement in transactions technology (increase in $\nu$)
  - decline of inflation (fall in $\mu$)

- Conditions for liquidity traps, but also for bubbles, to arise
Factors that have put downward pressure on interest rates

Figure 11: Transition from CIA to LT with no bubbles
Dot.com, housing bubbles hid these pressures

**Figure 12**: Transition from CIA to LT with bubbles
When bubble bursts, economy enters liquidity trap

Figure 13: Transition from CIA to LT with a bubble that crashes
Conclusions

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