Bubbles, Money and Liquidity Traps: an Analytical Perspective

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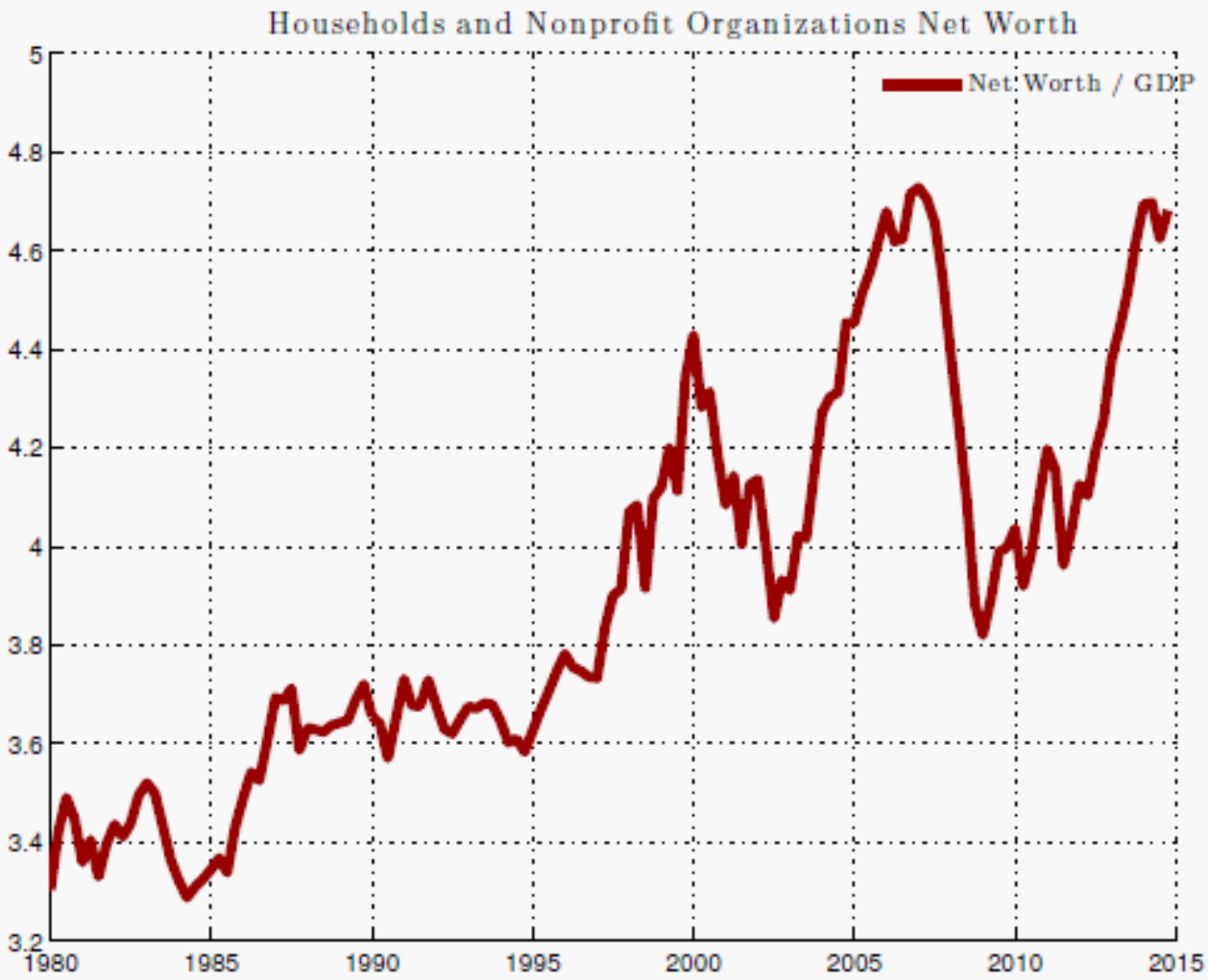
Facts and Questions

- 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

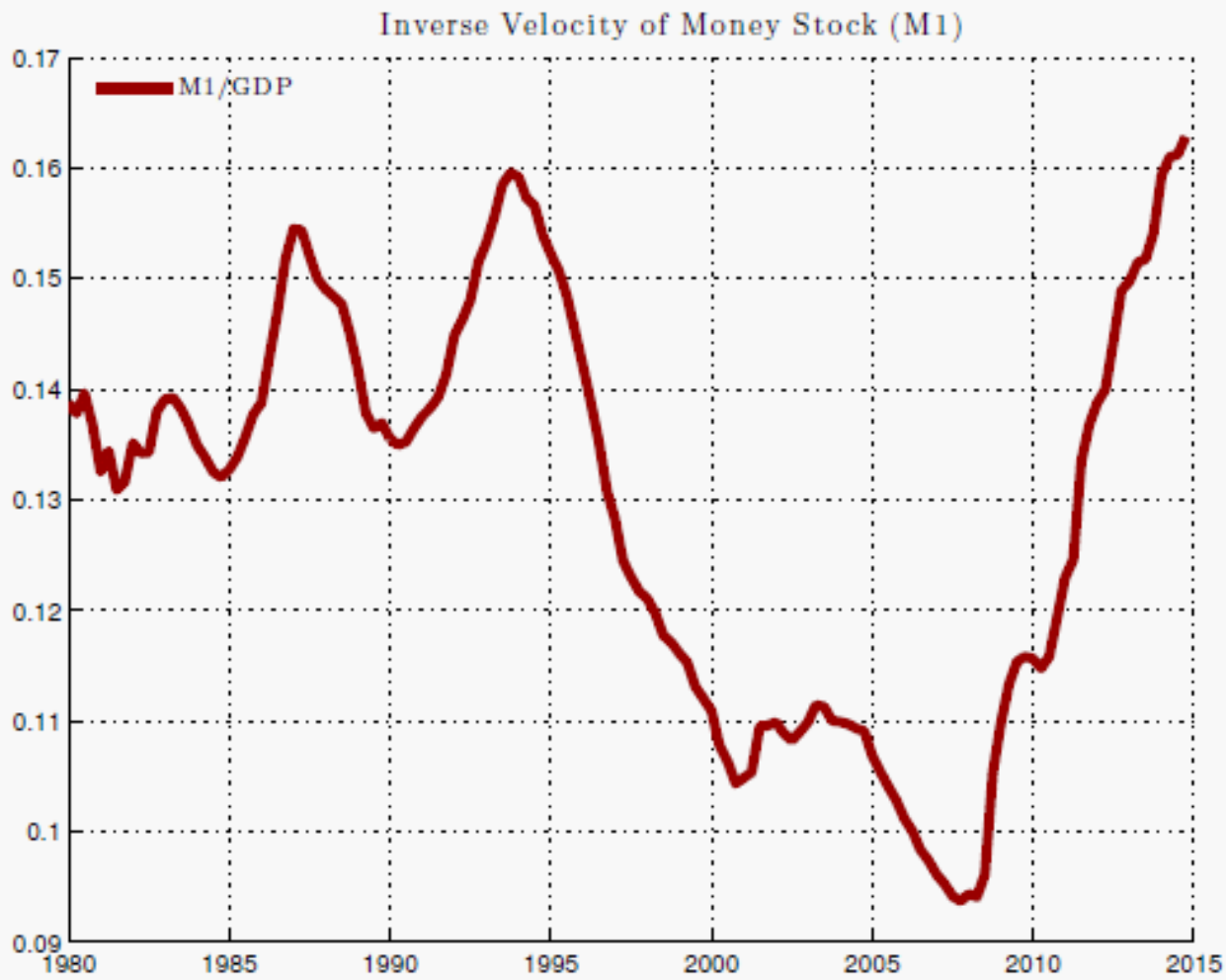
Net Worth, 1980-2015



Source: Board of Governors of the Federal Reserve System

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

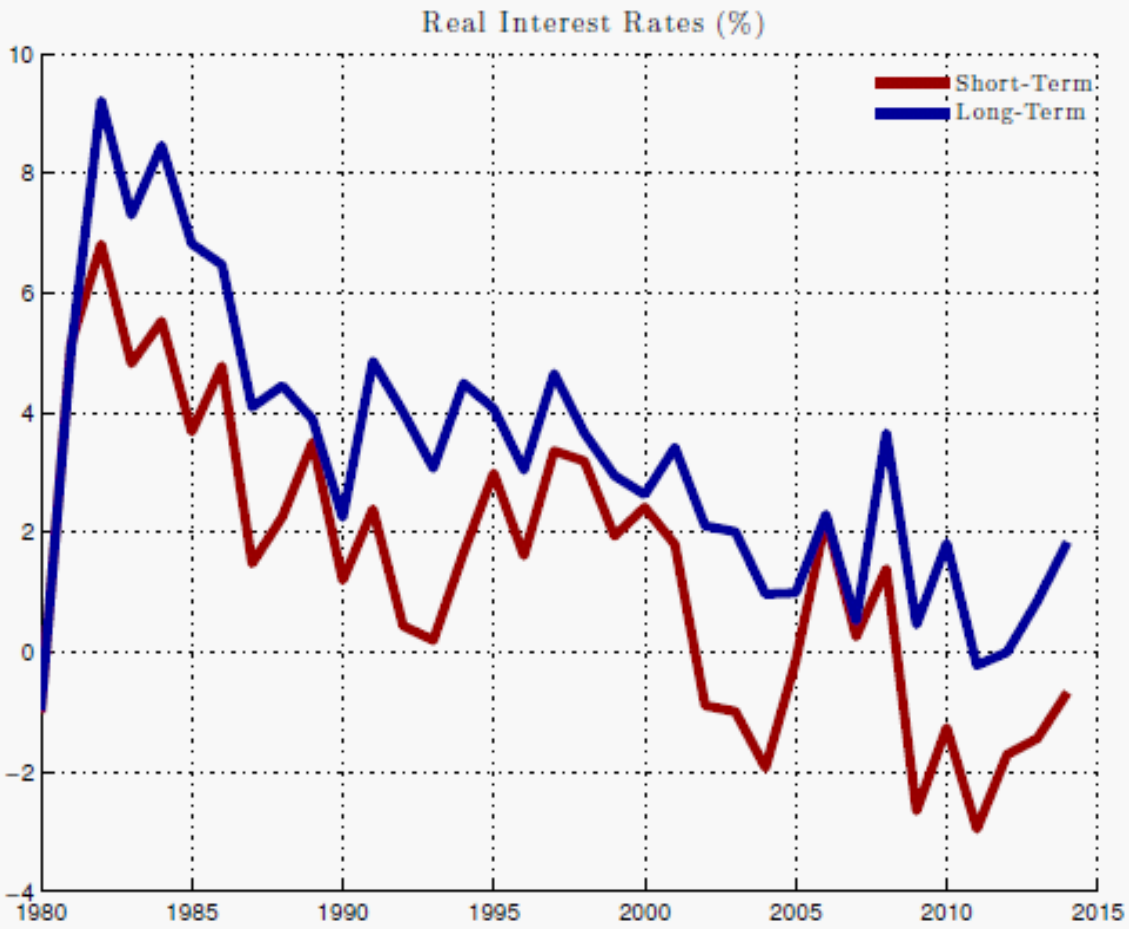
Money, 1980-2015



Source: Federal Reserve Bank of St. Louis

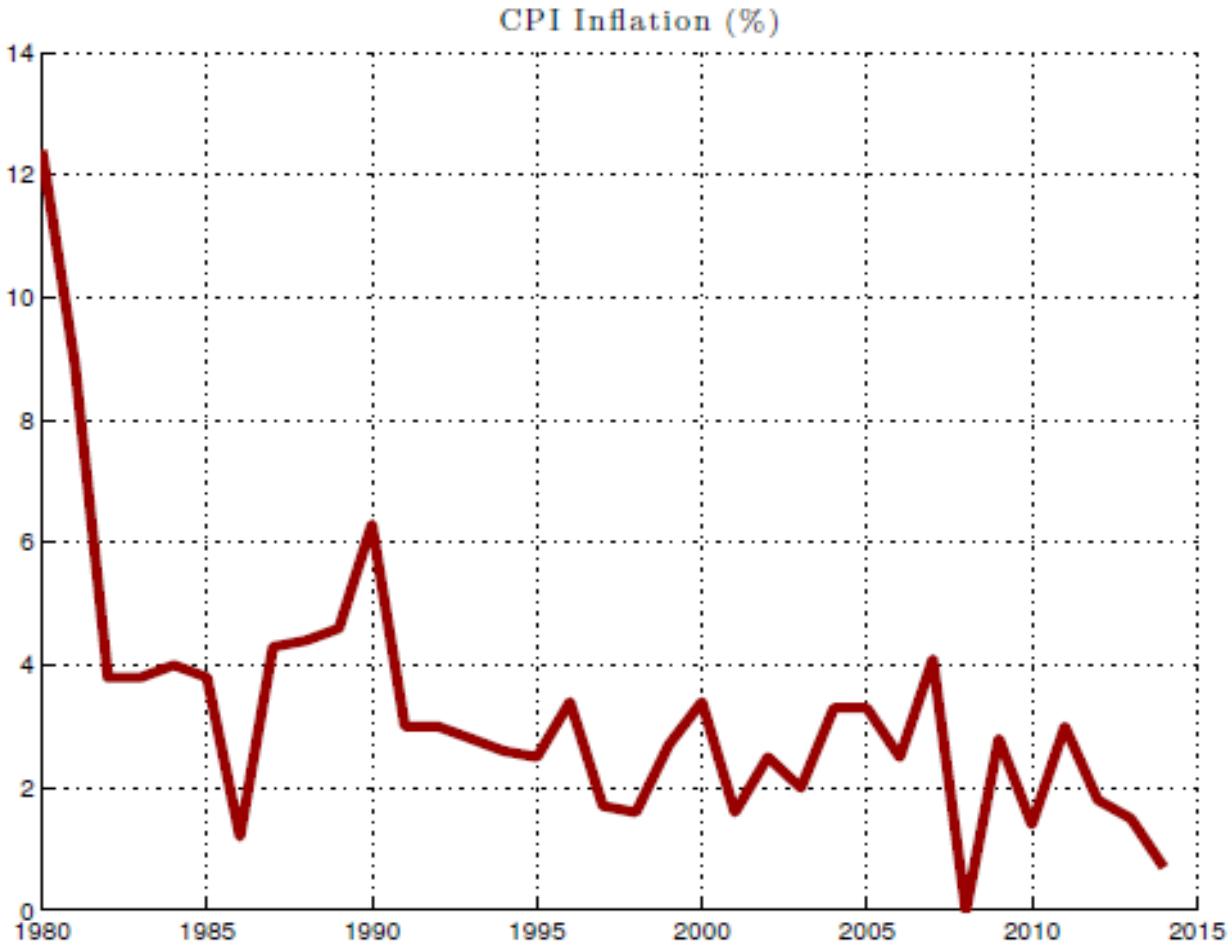
Figure 2 : Ratio of the money stock M1 to nominal GDP

Real Interest Rates, 1980-2015



Source: Board of Governors of the Federal Reserve System (authors' calculation)

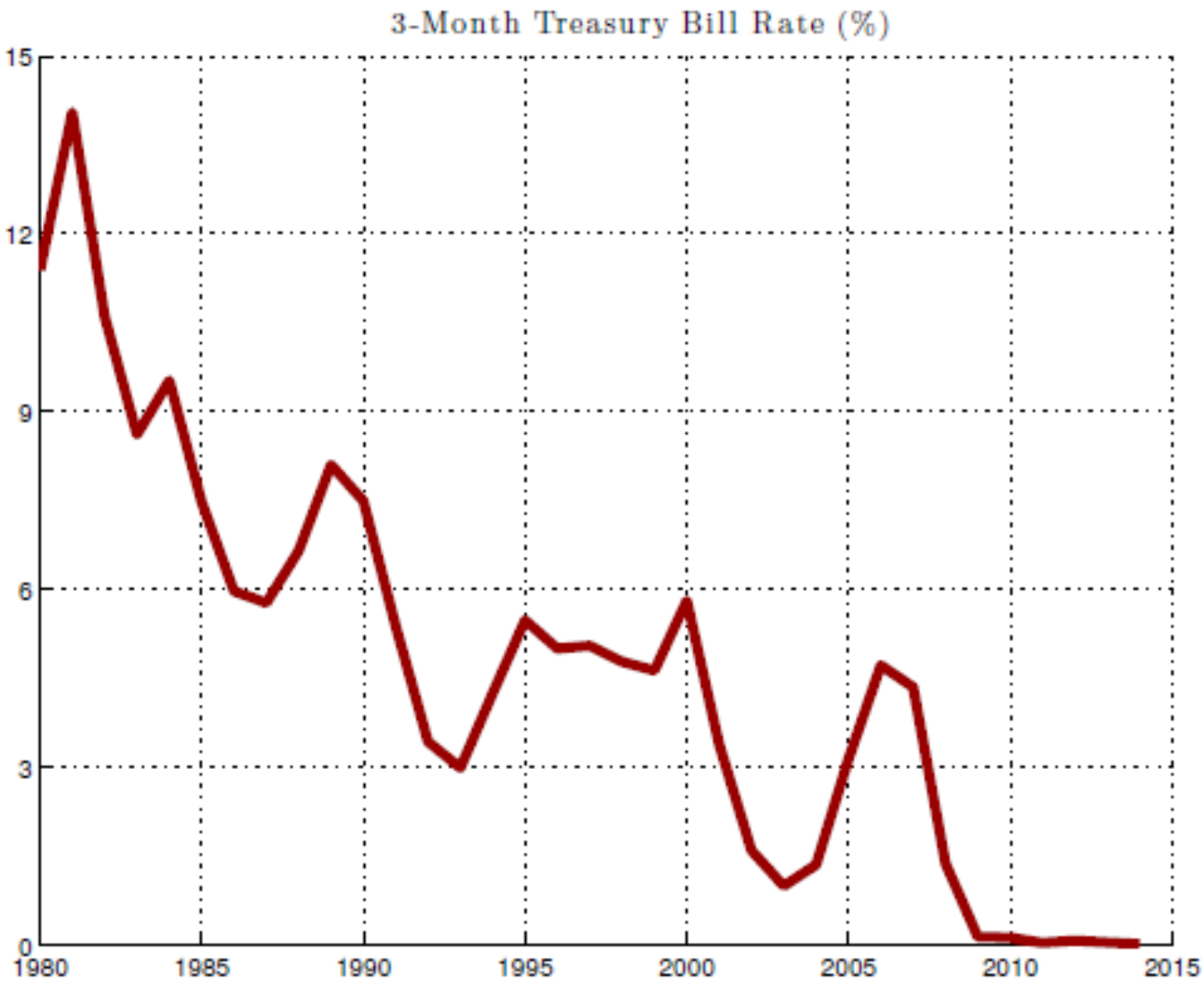
Inflation Rate, 1980-2015



Source: US. Bureau of Labor Statistics

Figure 4

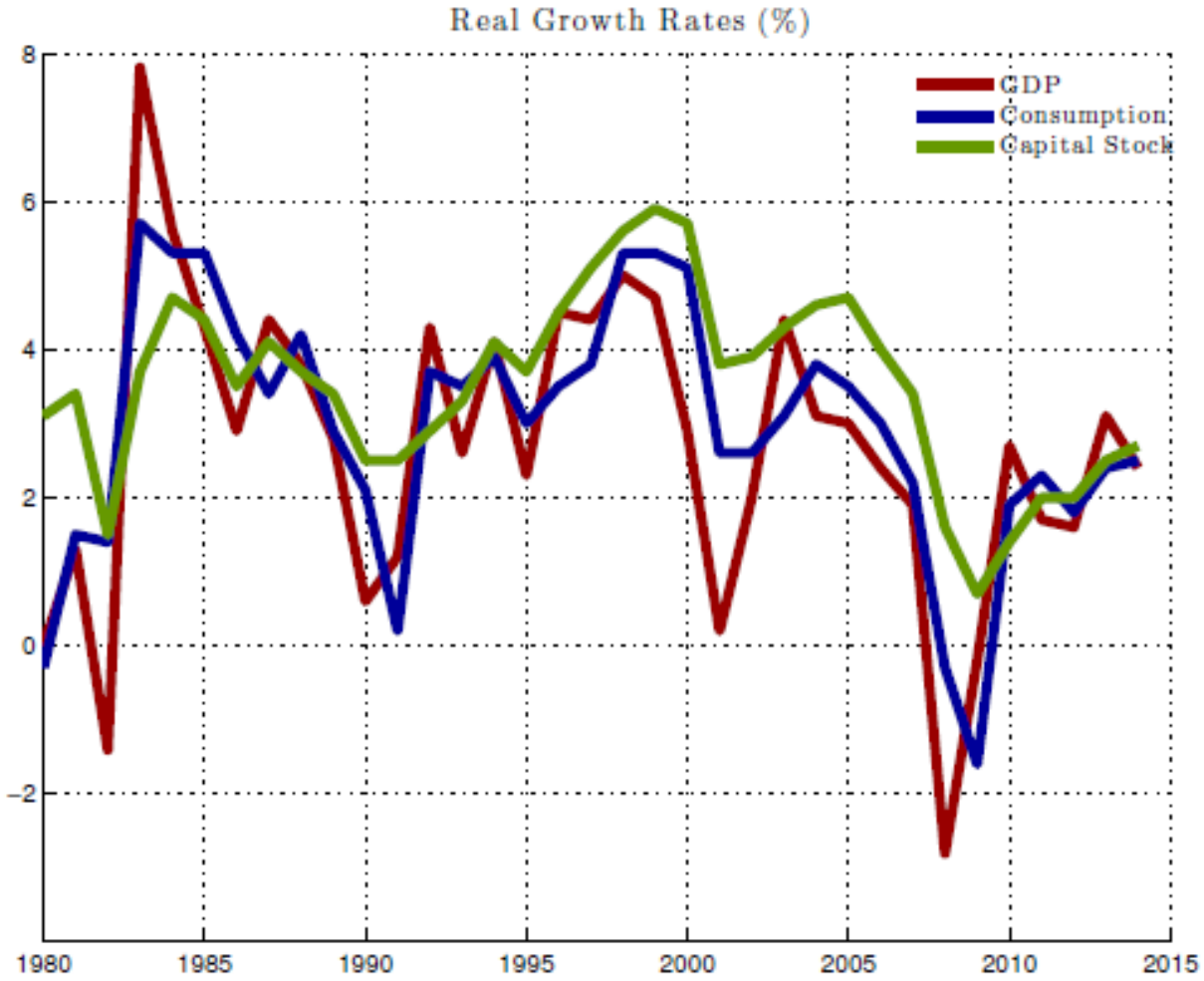
Nominal Interest Rates, 1980-2015



Source: Board of Governors of the Federal Reserve System

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

Macro aggregates, 1980-2015



Source: Bureau of Economic Analysis (authors' calculation)

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- 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
- 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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- 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
  - Caballero and Krishnamurthy (2006), Farhi and Tirole (2010), Miao and Wang (2011), Aoki and Nikolov (2011), Kraay and Ventura (2007), Kocherlakota (2010), Martin and Ventura (2011, 2012, forthcoming), Ventura (2011)
- Liquidity traps
  - Krugman (1998), Eggertson and Woodford (2003), Werning (2011), Eggertson and Mehrotra (2014), Buera and Nicolini (2014), Benigno and Fornaro (2015)

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 leding 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

$$M_{t+1} = \mu \cdot M_t \quad \text{and} \quad T_{t+1} = \frac{M_{t+1} - M_t}{p_{t+1}}$$

  seignorage rebated lump-sum

- Savers subject to cash-in-advance constraint

$$M_t \geq \frac{1}{\nu} \cdot p_{t+1} \cdot C^S_{t+1}$$

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 π_{t+1} denotes the inflation rate

- **Credit market clears:**

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

  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 $m_t \geq 0$

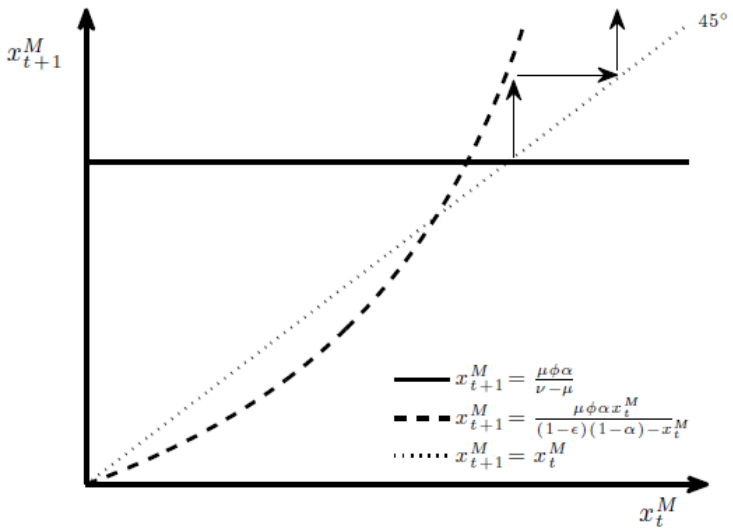
Case 1: Bubbleless Economy

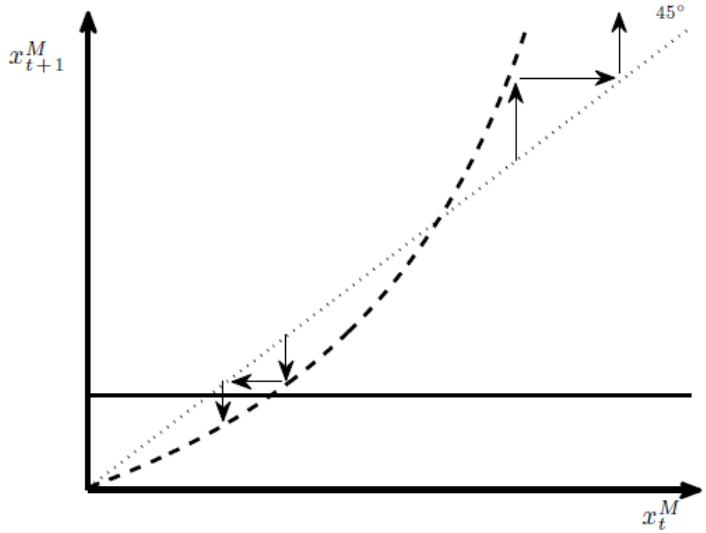
- If $b_t = 0$ for all t,

$$m_t = \max\left\{\underbrace{\frac{\mu\cdot\phi\cdot\alpha}{\nu-\mu}}_{\text{CIA Regime}}, \underbrace{(1-\varepsilon)\cdot(1-\alpha)-\mu\cdot\phi\cdot\alpha}_{\text{Liquidity Trap}}\right\}\cdot k_t^{\alpha}$$

- The economy is in a liquidity trap if:
  - Transaction needs are low: high ν
  - Credit supply is high relative to credit demand: low ε and ϕ
  - Inflation tax is low and return on money is high: low μ

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

$$m = \max \left\{ \underbrace{\frac{\mu \cdot \left(\phi \cdot \alpha + x^B\right)}{\nu - \mu}}_{\text{CIA Regime}}, \underbrace{(1-\varepsilon) \cdot (1-\alpha) - \mu \cdot \left(\phi \cdot \alpha + x^B\right)}_{\text{Liquidity Trap}} \right\} \cdot k^{\alpha}$$

where $b = x^B \cdot k^{\alpha}$.

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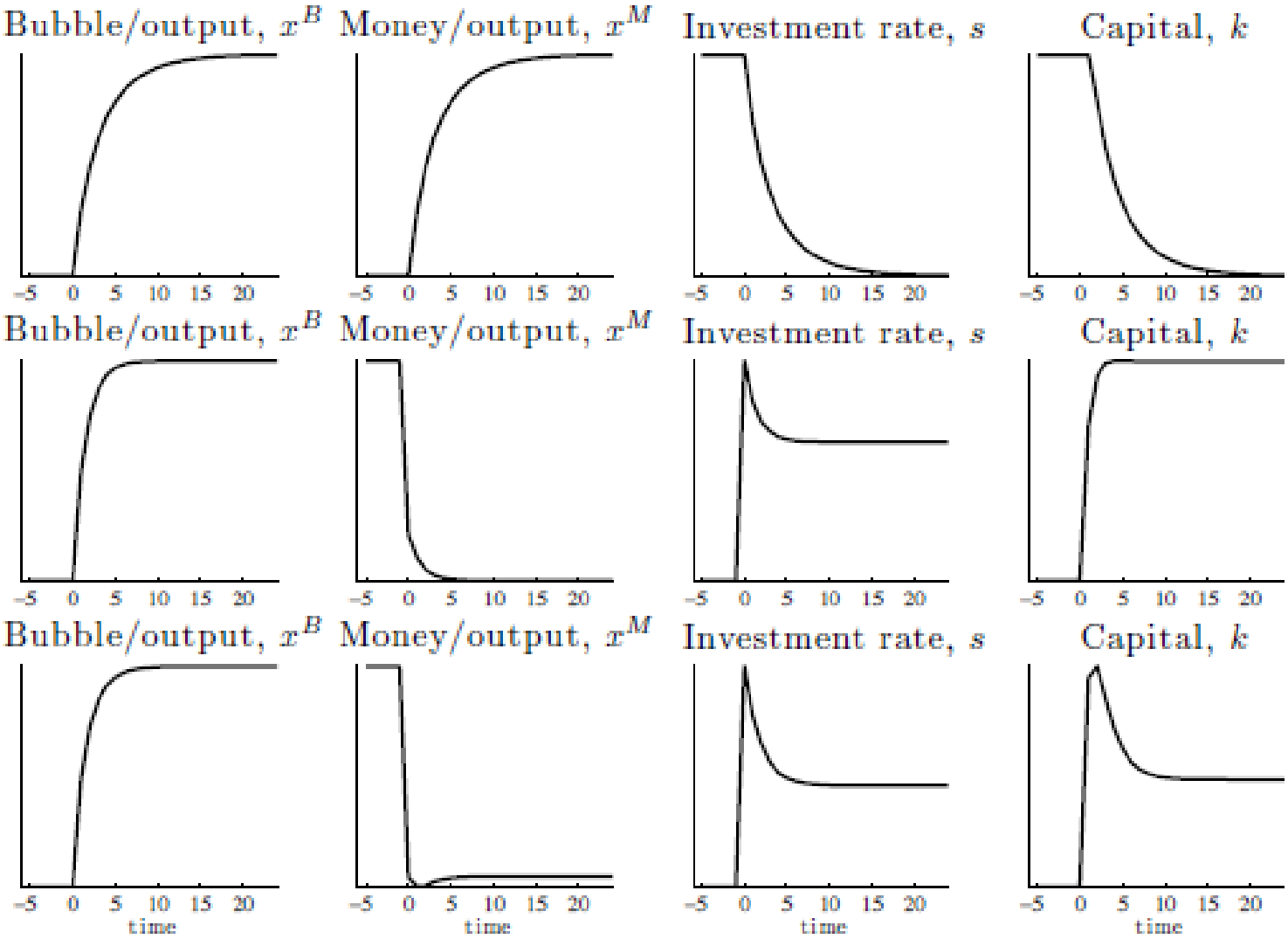

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General narrative

- Declining real and nominal interest rates:
  - financial globalization (increase in $1-\varepsilon$)
  - improvement in transactions technology (increase in ν)
  - decline of inflation (fall in μ)
- Conditions for liquidity traps, but also for bubbles, to arise

Factors that have put downward pressure on interest rates

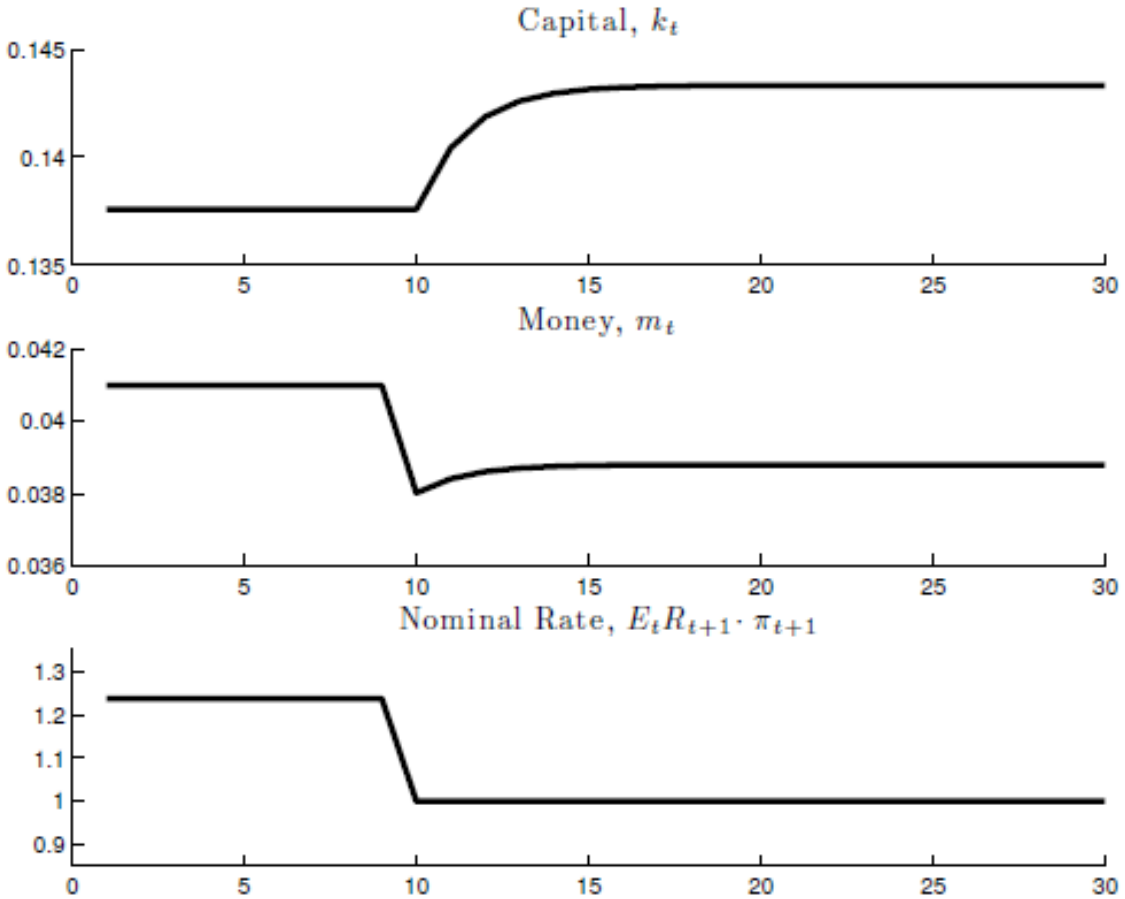

Figure 11 : Transition from CIA to LT with no bubbles

Dot.com, housing bubbles hid these pressures

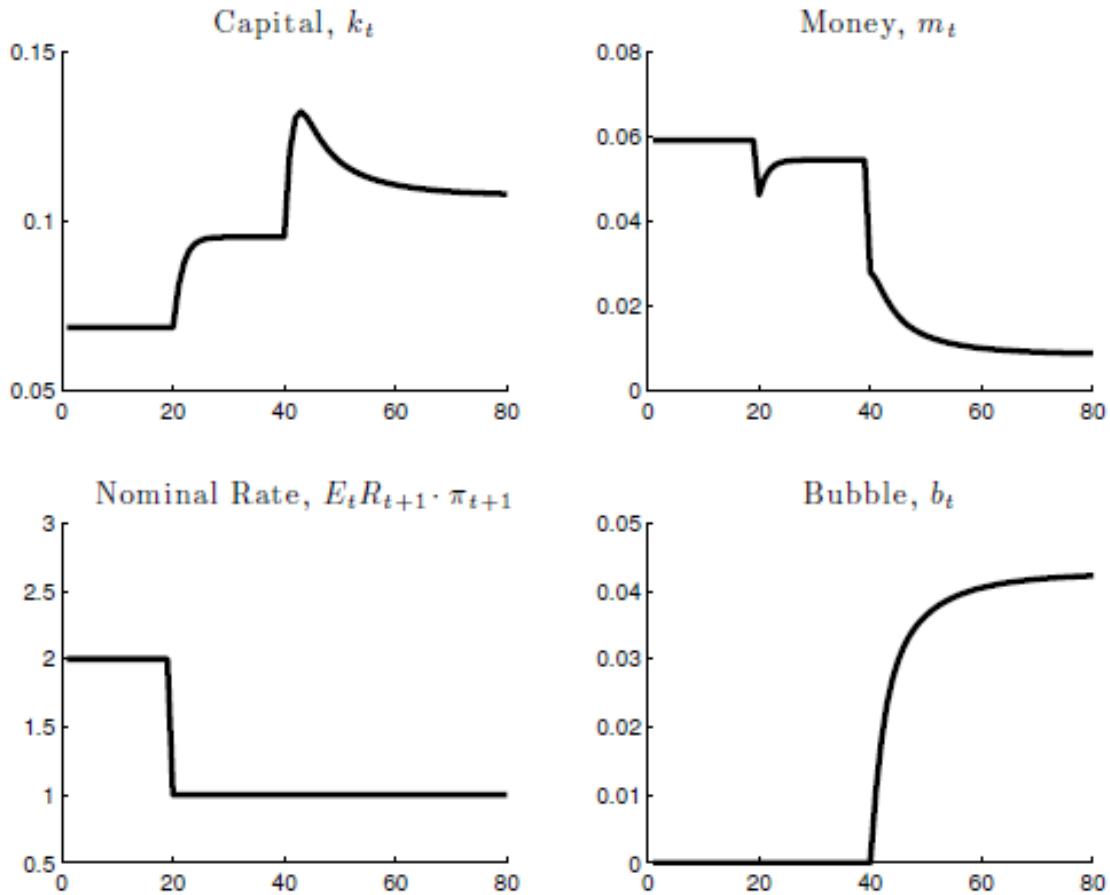

Figure 12 : Transition from CIA to LT with bubbles

When bubble bursts, economy enters liquidity trap

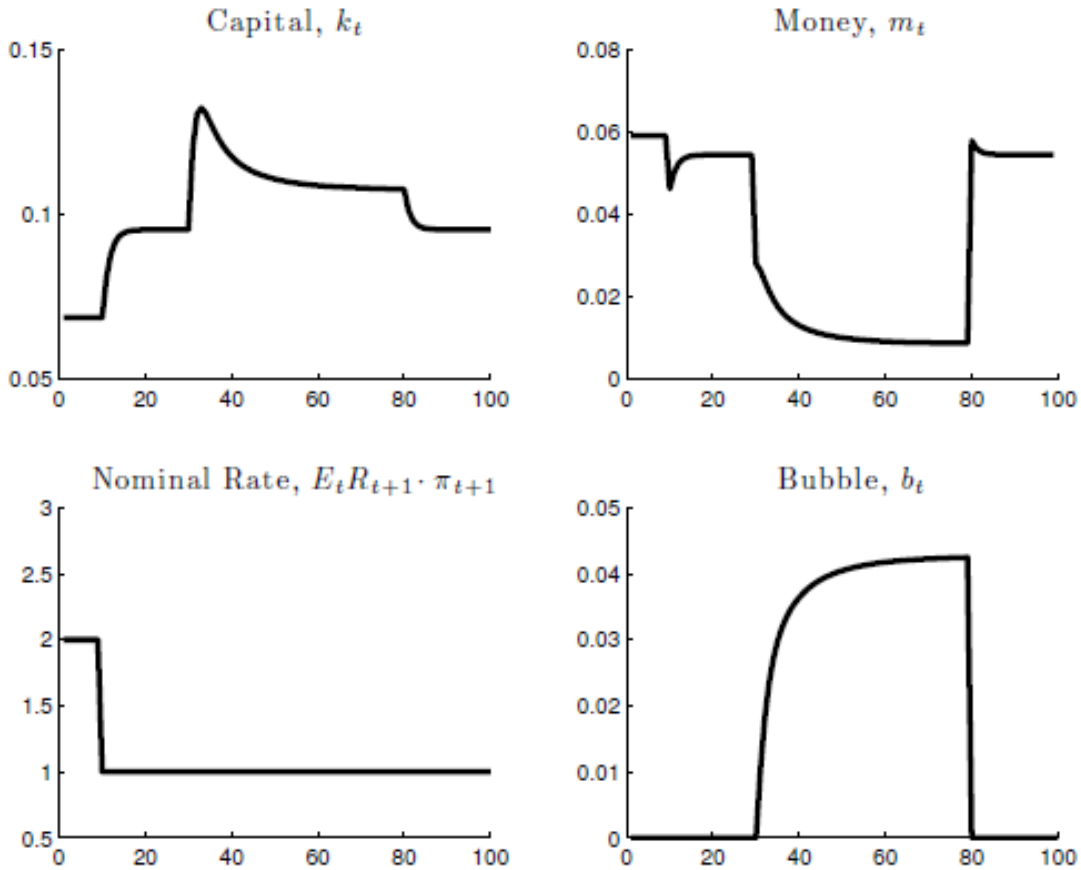

Figure 13 : Transition from CIA to LT with a bubble that crashes

Conclusions

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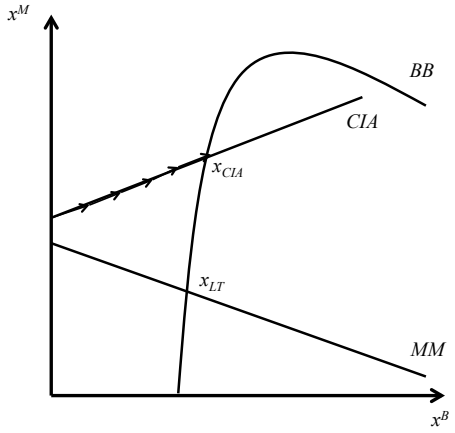
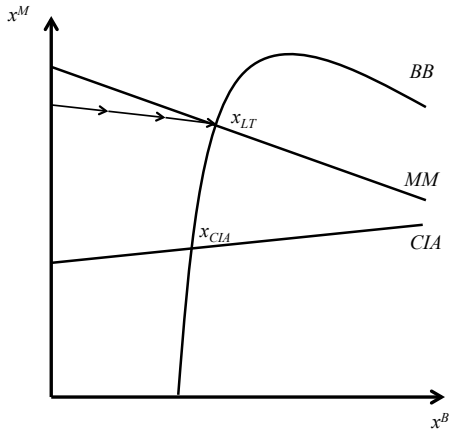

x^M
BB
CIA
x_{CIA}
x_{LT}
MM
x^B


x^M
BB
x_{LT}
MM
x_{CIA}
CIA
x^B

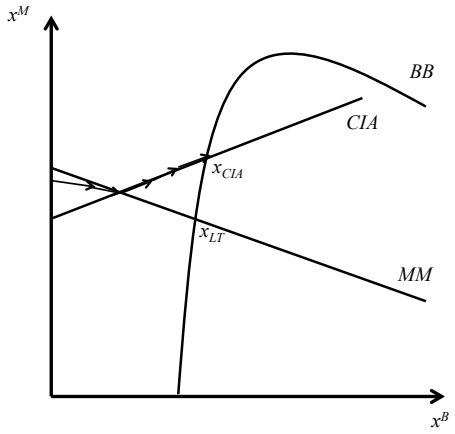

x^M
BB
CIA
x_{CIA}
x_{LT}
MM
x^B

Figure 9