Monetary Policy for a Bubbly World

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We live in a *bubbly world*, which we define to be an environment with:

- low interest rates
- frequent boom-busts in asset prices (Japan, US, Eurozone)

What is the role of monetary policy?

This paper: focus on salient feature of recent crises

- Liquidity traps and expansion of central bank balance sheets
- Markets turned to central banks for stores of value
- Fivefold expansion of monetary base in US and Eurozone

Emphasize role of money as a store of value (as opposed to unit of account)

- Can central banks provide stores of value?
- Should they do so?
- How should they react to bubbles?
The view: ingredients

- Productive and unproductive agents:
  - Entrepreneurs issue assets to invest
  - Savers demand assets as stores of value

- Financial frictions limit supply of “backed” assets
  - i.e., backed by future output (non-bubbly)

- And they open the door for unbacked assets
  - i.e., supported only by the expectation of their future value (bubbly)

- Effects of unbacked assets:
  - Wealth effect: cheap to produce, provide rents to originator
  - Overhang effect: displace capital accumulation
The view: implications

- Two types of unbacked assets:
  - Private: “bubbles”
    - Wealth effect accrues to private sector → fuel investment
    - Value driven by market psychology (unstable)
  - Public: “money”
    - Rent of creation accrues to central bank → how is seigniorage used?
    - Value under control of central bank (stable)
  - Both have overhang effects

- Crucial role of monetary policy: stand ready to supply assets
  - Markets generically fail to supply the right amount of unbacked assets
  - Monetary policy *can* intervene: manage and stabilize total supply
  - Monetary policy *should* intervene: characterize constrained optimal policy

- Crucial role *despite* restrictive assumptions on central bank
  - No fiscal backing, limited use of seigniorage, unable to affect market psychology
Related literature

- Traditional view on rational bubbles and money as store of value
  - Samuelson (1958), Tirole (1985), Wallace (1981)

- New view on rational bubbles and financial frictions
  - Caballero and Krishnamurthy (2006), Farhi and Tirole (2010), Martin and Ventura (2011, 2015, 2016), Galí (2014, 2016), Dong, Miao and Wang (2016)

- Financial accelerator
  - Bernanke and Gertler (1989), Kiyotaki and Moore (1997)

- Liquidity traps
  - Krugman (1998), Eggertson and Woodford (2003), Werning (2011), Eggertson and Mehrotra (2014), Buera and Nicolini (2014), Benigno and Fornaro (2015)
Preferences and Technology

- Two-period OLG structure

- Preferences: continuum of agents that maximize $U^i_t = E^i_t C^i_{t+1}$.

- Technology: $F(K_t, L_t) = K^\alpha_t \cdot (\gamma^t \cdot L_t)^{1-\alpha}$, $(\gamma \geq 1)$
  - Young endowed with one unit of labor; competitive factor markets
  - Capital produced with consumption goods and depreciates fully

- Agent types:
  - Entrepreneurs ($\varepsilon$): invest in capital, sell assets in markets
  - Savers ($1 - \varepsilon - \nu$): do not invest in capital, purchase assets in markets
  - Money holders ($\nu$): do not invest in capital, do not participate in asset markets
Private assets

- Issued by entrepreneurs, purchased by savers

**Backed assets:** debts collateralized by capital, subject to intermediation costs
  - Each unit of credit is backed by \((1 + \phi)^{-1}\) units of capital
  - \(R_{t+1}^K\): marginal product of capital
  - Return: \[\frac{R_{t+1}^K}{1 + \phi}\] (determined by technology, marginal product)

**Unbacked assets:** non-collateralized debts, not subject to intermediation costs
  - \(B_t\): value of old or pre-existing bubbly assets
  - \(N_t\): value of newly created bubbly assets
  - Return: \[\frac{B_{t+1}}{B_t + N_t}\] (determined by expectations, capital gain)
Money

- Issued by central bank and distributed to old, purchased by money holders and savers

- Let $M_t$ and $\mu_t \geq 1$ denote the real value and (gross) growth rate of money
  
  $\frac{M_t}{\mu_t}$: value of old or pre-existing money
  
  $\frac{\mu_t - 1}{\mu_t} \cdot M_t$: value of newly created money (seigniorage), distributed to old

- Return: $\pi_{t+1}^{-1} = \mu_{t+1}^{-1} \cdot \frac{M_{t+1}}{M_t}$

- Why hold money?
  
  (Small) demand by money holders
  
  Savers demand it as store of value if return sufficiently high: liquidity trap!
Law of motion of unbacked assets (as share of wages):

\[ m_t = \max \left\{ \nu, \frac{1 - \alpha}{\alpha} \cdot [1 + \phi \cdot (\varepsilon + n_t) - m_t - b_t] \cdot E_t \left\{ \frac{m_{t+1}}{\mu_{t+1}} \right\} \right\} \]

\[ b_t + n_t = \frac{1 - \alpha}{\alpha} \cdot [1 + \phi \cdot (\varepsilon + n_t) - m_t - b_t] \cdot E_t \left\{ b_{t+1} \right\} \]

- Value of unbacked assets today is tomorrow’s value discounted (capital gain)
- Value of money is bounded below by demand from money holders

Sources of uncertainty: asset price and monetary policy shocks
Equilibrium

- Law of motion of capital stock and consumption (detrended):
  \[ \gamma \cdot k_{t+1} = \frac{1 + \phi \cdot (\varepsilon + n_t) - m_t - b_t}{1 + \phi} \cdot (1 - \alpha) \cdot k_t^\alpha \]
  \[ c_t = [\alpha + (1 - \alpha) \cdot (m_t + b_t)] \cdot k_t^\alpha \]

- Recursive structure:
  - First, for the evolution of unbacked assets \( m_t, b_t, n_t \)
  - Second, solve for the capital stock \( k_t \)
  - Third, solve for consumption \( c_t \)

- From now on: focus on \( \nu \approx 0 \)
Equilibrium: non-bubbly world

If \( \frac{\alpha}{1 - \alpha} \geq \max \left\{ 1 + \phi \cdot \varepsilon, \frac{1}{4} \cdot \frac{1 + \phi}{1 - \varepsilon} \right\} \), world is non-bubbly

- In all competitive equilibria: \( \{ b_t, n_t, m_t \} = \{ 0, 0, 0 \} \) for all \( t \) and \( h^t \).
- Monetary policy irrelevant

Supply of backed assets/interest rate is high: no demand for unbacked assets!
Equilibrium: bubbly world

- If $\frac{\alpha}{1 - \alpha} < \max \left\{ 1 + \phi \cdot \varepsilon, \frac{1}{4} \cdot \frac{1 + \phi}{1 - \varepsilon} \right\}$, world is bubbly
  - Multiple equilibria with different paths of $b_t$, $n_t$ and $m_t$.
  - Monetary policy potentially important

- Supply of backed assets / interest rate is low: demand for unbacked assets!

- We focus throughout on bubbly world
Dealing with multiplicity

- Equilibrium depends on market psychology and monetary policy

- Focus on family of market psychologies:
  - Initial value $b_0$ and sequence of shocks $s_t = \{u_t, n_t\}$ for all $t$ and $h^t$:
    - Bubble-return shocks: $u_{t+1} \equiv \frac{b_{t+1}}{E_t b_{t+1}} - 1$
    - Bubble-creation shocks: $n_t \geq 0$
  - Shocks follow a Markov chain on a finite state space $S$, with constant transition probabilities.

- Procedure:
  - First: select feasible market psychology, i.e., $k_t \geq 0$, $b_t \geq 0$ for all $t$ and $h^t$.
  - Second: select feasible monetary policy, *given* market psychology.
Dealing with multiplicity

Set of equilibria
Dealing with multiplicity

1. Feasible market psychology
2. Feasible monetary policy
What can the central bank do? Laissez-faire

- If central bank does not supply unbacked assets:
  \[ m_t \approx 0 \]

- This requires \( E_t \mu_{t+1}^{-1} \) to be low, so that credit dominates money
  - Thus, the economy is outside the liquidity trap!

- Two effects of bubbles:
  - Overhang effect: old bubbles divert resources away from investment
  - Wealth effect: new bubbles lower costs of intermediation
Running example 1: bubble return shocks

Bubble-return shock

Unbacked assets

Output

Consumption
Running example 2: bubble creation shocks

**Bubble-creation shock**

**Unbacked assets**

**Output**

**Consumption**
What can the central bank do? Intervention

- Are there feasible policies that manage the supply of stores of value?
  - \( n_t = \) intragenerational transfers
  - \( x_t \equiv b_t + m_t = \) intergenerational transfers
  - \( \{k_t, c_t\} \) depend on \( \{n_t, x_t\} \):
    \[
    \gamma \cdot k_{t+1} = \frac{1 + \phi \cdot (\varepsilon + n_t) - x_t}{1 + \phi} \cdot (1 - \alpha) \cdot k_t^\alpha
    \]
    \[
    c_t = [\alpha + (1 - \alpha) \cdot x_t] \cdot k_t^\alpha
    \]
  - Answer: yes! Central bank can fully stabilize \( x_t \)!
Running example 1: bubble return shocks

Bubble-return shock

Unbacked assets

Output

Consumption
Running example 2: bubble creation shocks

Bubble-creation shock

Unbacked assets

Output

Consumption
What should the central bank do?

Objective:

- We construct a boundary function $\Omega : (x_t, n_t) \mapsto \mathbb{R}$ such that:
  - Allocations are Pareto efficient if $x_t \geq \Omega(x_t, n_t)$ for all $h^t$ and $t \geq t_0$
  - Allocations are Pareto inefficient if $x_t < \Omega(x_t, n_t)$ for all $h^t$ and $t \geq t_0$

Intuition:

- As usual: stores of value eliminate inefficient investment
- Novelty: inefficient investment depends on financial friction ($\phi$) and market psychology ($n$)
Pareto Frontier

\[ x_{t+1} \]

\[ \Omega(x_t, n_t, \phi_H) \]

\[ \Omega(x_t, n_t, \phi_L) \]

\[ x_t \]
Constrained optimal policy

- Define $x^* = \Omega (x^*, \bar{n})$, where $\bar{n} = \max_s n_s$
- Consider constrained optimal policy: central bank sets
  \[
  x_t = \begin{cases} 
  v + b_L & \text{if } x^* < v + b_L \\
  x^* & \text{if } x^* \in [v + b_L, v + b_H] \\
  v + b_H & \text{if } x^* > v + b_H
  \end{cases}
  \]

- This policy stabilizes asset supply at Pareto optimal level, unless it is not feasible.
  - Stabilizes the economy
  - Raises consumption
  - Reduces capital by crowding out inefficient investment
Extensions

- Fiscal backing:
  - Not needed to stabilize $x$, but stabilization may require volatile inflation
    - If inflation volatility costly, fiscal backing may be important
    - If money cannot be inflated away, must be redeemed through taxes (i.e., may require $\mu < 1$)

- Distribution of seigniorage:
  - What if CB could distribute seigniorage to entrepreneurs?
  - Monetary policy, like bubbles, has an expansionary wealth effect: even more powerful!
  - Paradoxically, may lead to multiple equilibria on money: loss of control by monetary policy

- Effect on market psychology:
  - What if central bank moves before market sets its psychology?
  - Possible for monetary policy to rule out certain equilibria
Key takeaways

- Bubbly world: scarcity of backed assets fosters demand for unbacked assets
- Key role for monetary policy: stand ready to supply assets!
  - Emphasis on money as a store of value
- Crucial: *net* provision of assets by central bank
  - Gross provision (i.e., balance sheet expansion) irrelevant *per se*
  - No need for fiscal backing
- Open questions: interaction between money as store of value and unit of account