Monetary Policy for a Bubbly World

Vladimir Asriyan, Luca Fornaro, Alberto Martin, Jaume Ventura

CREI, CREI, ECB and CREI, CREI

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Introduction

- 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 \(\Rightarrow\) fuel investment
    - Value driven by market psychology (unstable)
  - Public: “money”
    - Rent of creation accrues to central bank \(\Rightarrow\) 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

- New view on rational bubbles and financial frictions

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

- Liquidity traps
Preferences and Technology

- Two-period OLG structure

- **Preferences**: continuum of agents that maximize $U_t^i = E_t^i C_{t+1}^i$.

- **Technology**: $F(K_t, L_t) = K_t^\alpha \cdot (\gamma^t \cdot L_t)^{1-\alpha}$, $(\gamma \geq 1)$
  
  - 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
  - $R^K_{t+1}$: marginal product of capital
  - Return: $\frac{R^K_{t+1}}{1 + \phi}$ (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: $\frac{B^t_{t+1}}{B_t + N_t}$ (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!
Equilibrium

- Law of motion of unbacked assets (as share of wages):

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

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

- 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 $\frac{\alpha}{1-\alpha} \geq \max \left\{ 1 + \phi \cdot \epsilon, \frac{1}{4} \cdot \frac{1 + \phi}{1 - \epsilon} \right\}$, 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 $\alpha < \max \left\{ 1 + \phi \cdot \varepsilon, \frac{1}{4} \cdot \frac{1 + \phi}{1 - \varepsilon} \right\}$, 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: $u_{t+1} = \frac{b_{t+1}}{E_t b_{t+1}} - 1$
    - 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
Dealing with multiplicity

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
- Output
- Unbacked assets
- 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 $\{n_t, x_t\}$:

    \[
    \gamma \cdot k_{t+1} = \frac{1 + \phi \cdot (\epsilon + n_t) - x_t}{1 + \phi} \cdot (1 - \alpha) \cdot k^\alpha_t
    \]

    \[
    c_t = [\alpha + (1 - \alpha) \cdot x_t] \cdot k^\alpha_t
    \]

  
  - **Answer:** yes! Central bank can fully stabilize $x$!
Running example 1: bubble return shocks

Bubble-return shock

Unbacked assets

Output

Consumption

with policy
w/o policy
Running example 2: bubble creation shocks

**Bubble-creation shock**

**Output**

**Unbacked assets**

**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

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

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

\[ x_t+1 \]

\[ x_t \]

\[ \Omega(x_t, n_H) \]

\[ \Omega(x_t, n_L) \]

\[ x_t+1 \]

\[ x_t \]
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