Monetary Policy for a Bubbly World

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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 $\Longrightarrow$ fuel investment
    - ⋆ Value driven by market psychology (unstable)
  - Public: "money"
    - ⋆ Rent of creation accrues to central bank $\Longrightarrow$ 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 $U_t^i = E_t^i C_{t+1}^i$,
- *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* (ε): invest in capital, sell assets in markets
  - *Savers* $(1 - \varepsilon - v)$: do not invest in capital, purchase assets in markets
  - *Money holders* (v): 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: $\dfrac{R^K_{t+1}}{1+\phi}$ (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: $\dfrac{B_{t+1}}{B_t+N_t}$ (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!

Equilibrium

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

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

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

  - 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 $v \approx 0$

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 comppetitive 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!

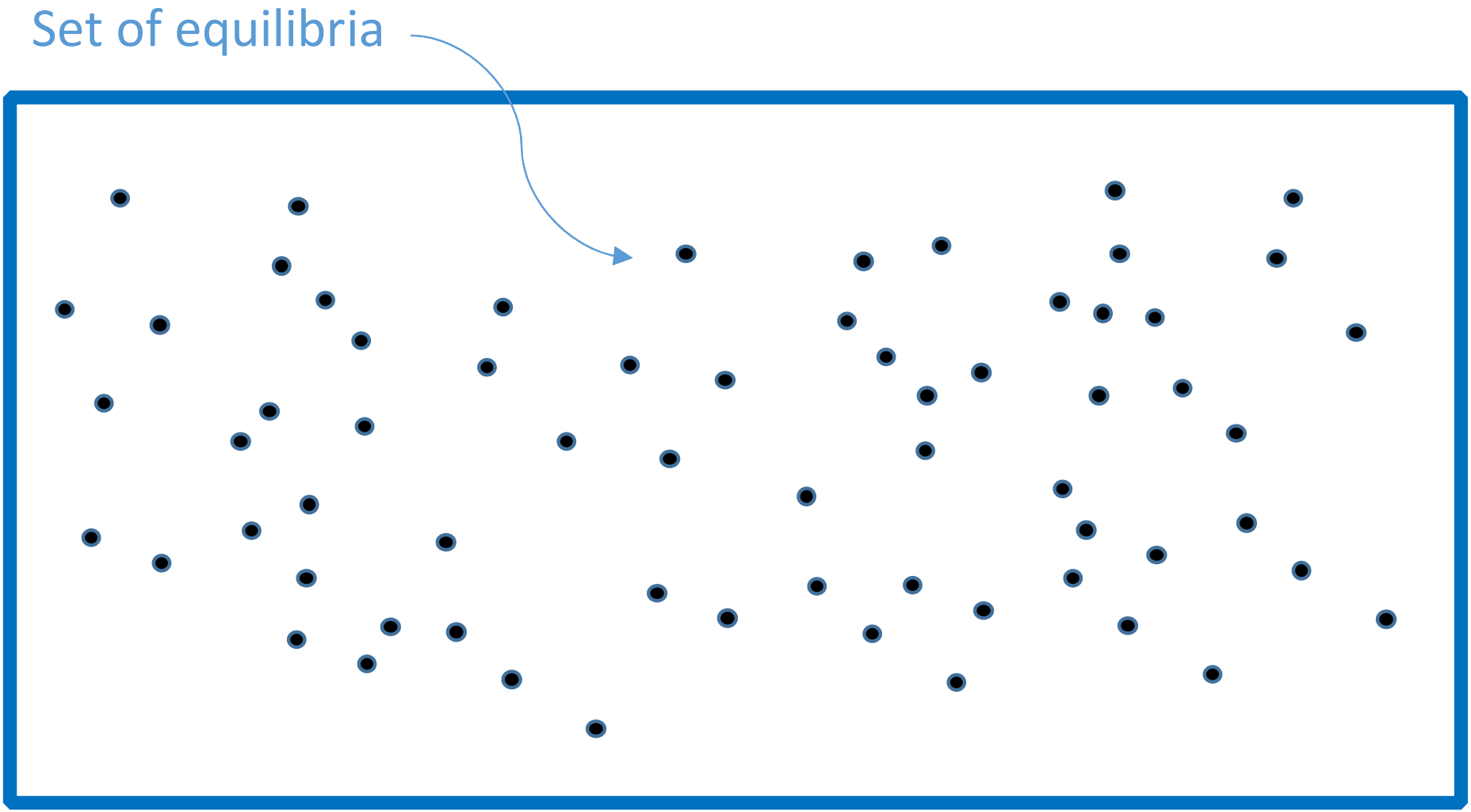
Equilibrium: bubbly world

- 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

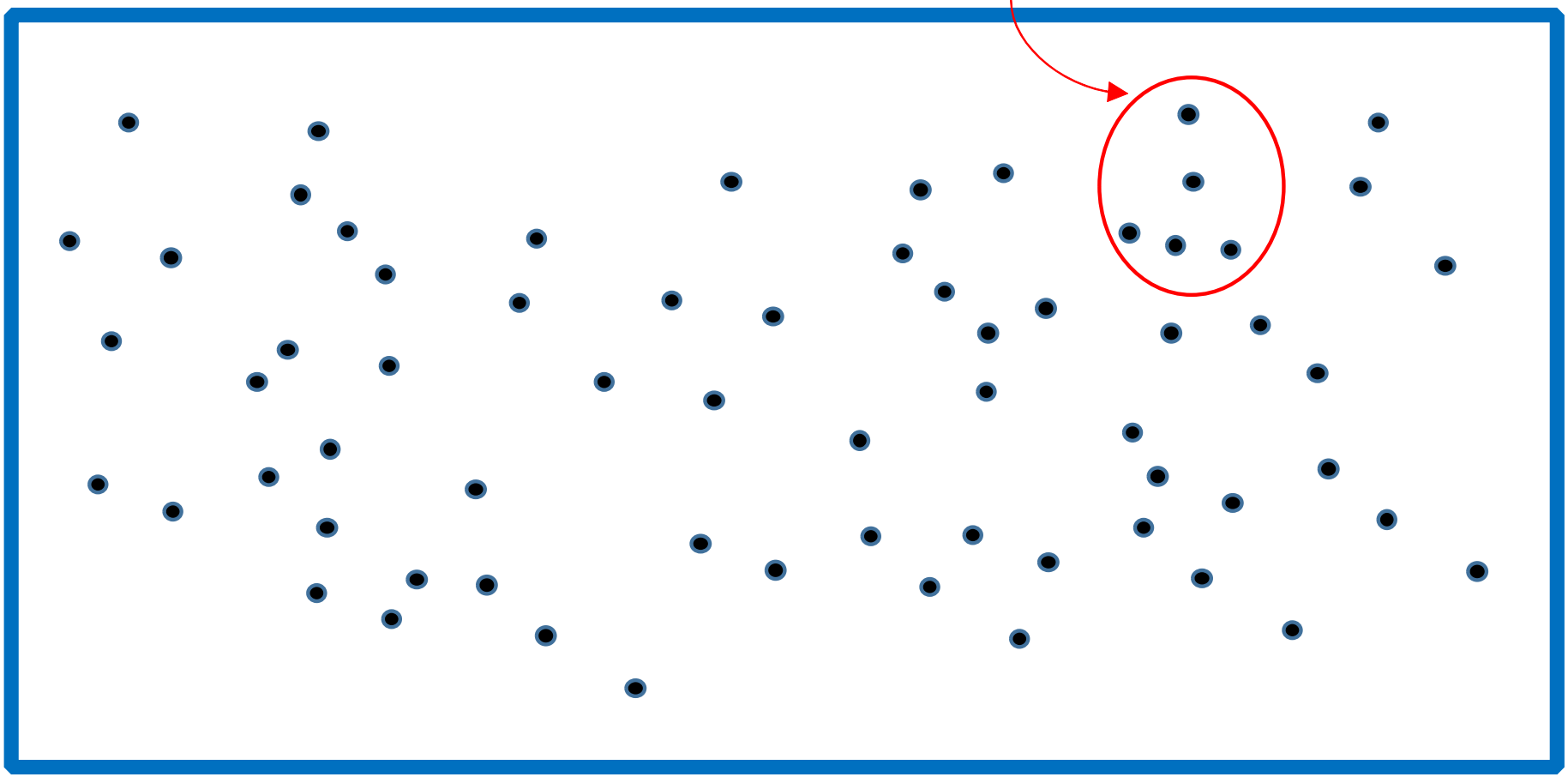
- Equilibrium depends on market psychology and monetary policy
- Focus on family of market psychologies:
  - Initial value b_0 and sequence of shocks $s_t = \{u_t, n_t\}$ for all t and h^t:
    - ★ Bubble-return shocks: $u_{t+1} \equiv \dfrac{b_{t+1}}{E_t b_{t+1}} - 1$
    - ★ Bubble-creation shocks: $n_t \geq 0$
  - 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



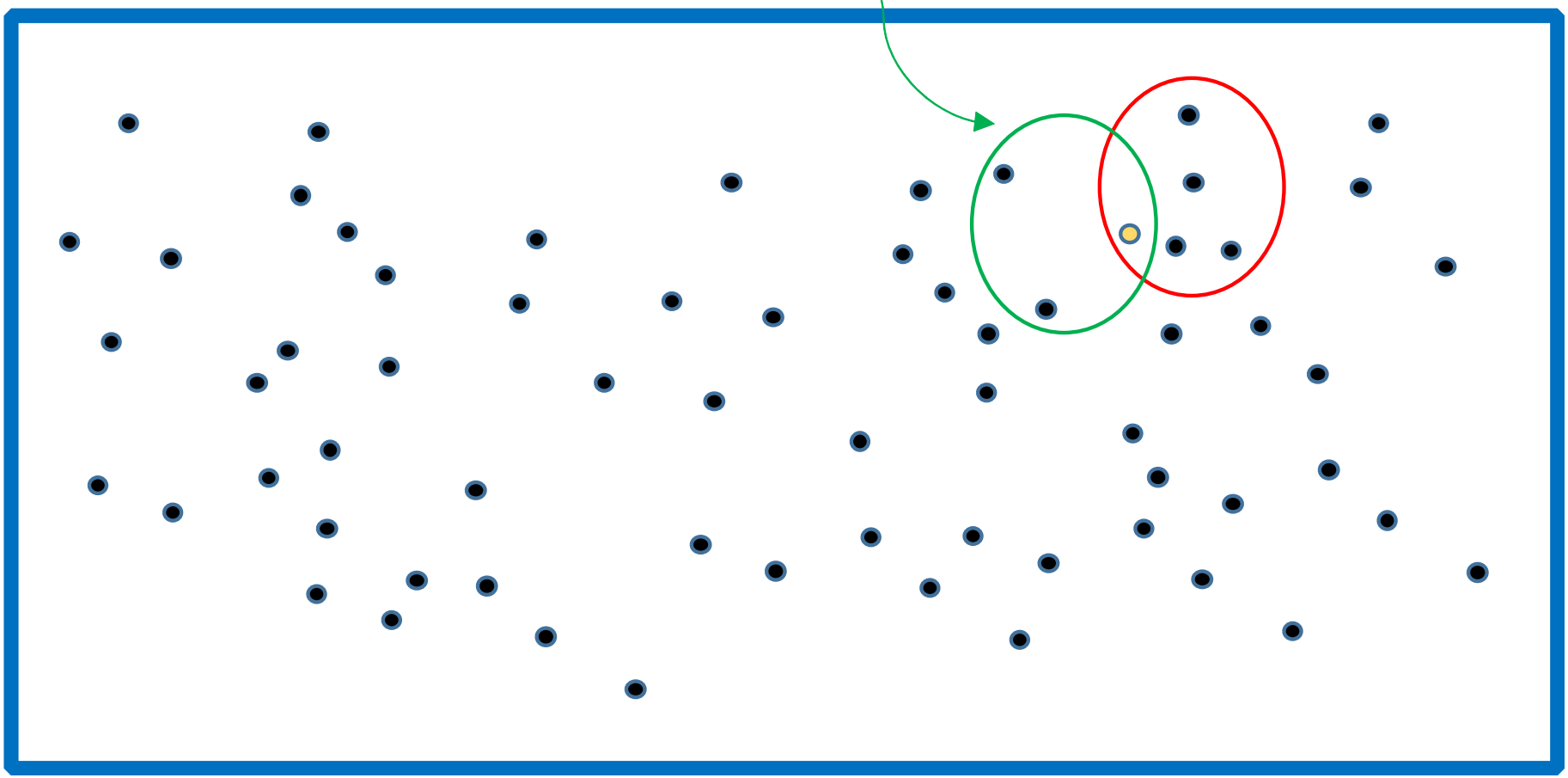
Dealing with multiplicity

1. Feasible market psychology



Dealing with multiplicity

2. Feasible monetary policy



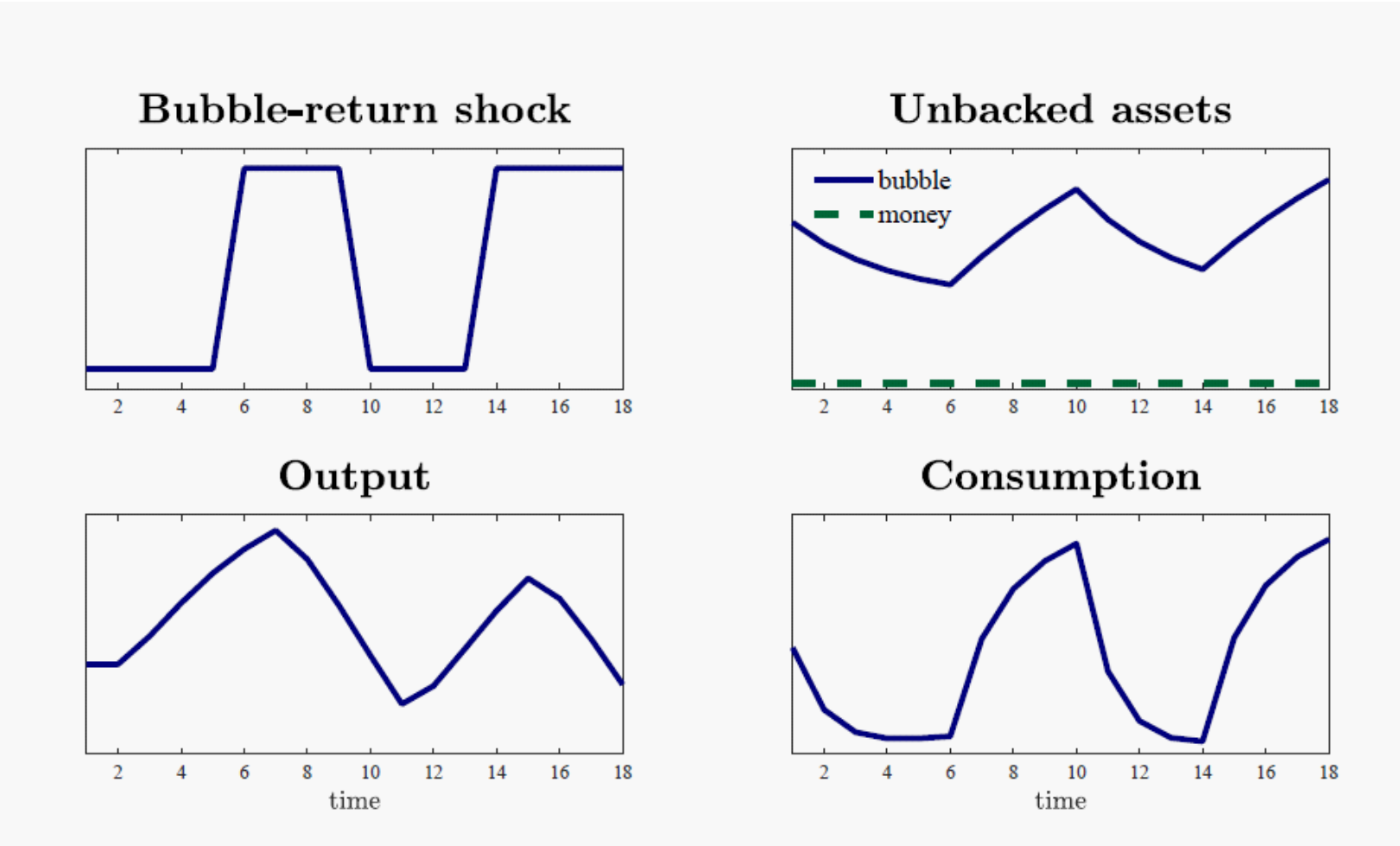
What can the central bank do? Laissez-faire

- If central bank does not supply unbacked assets:

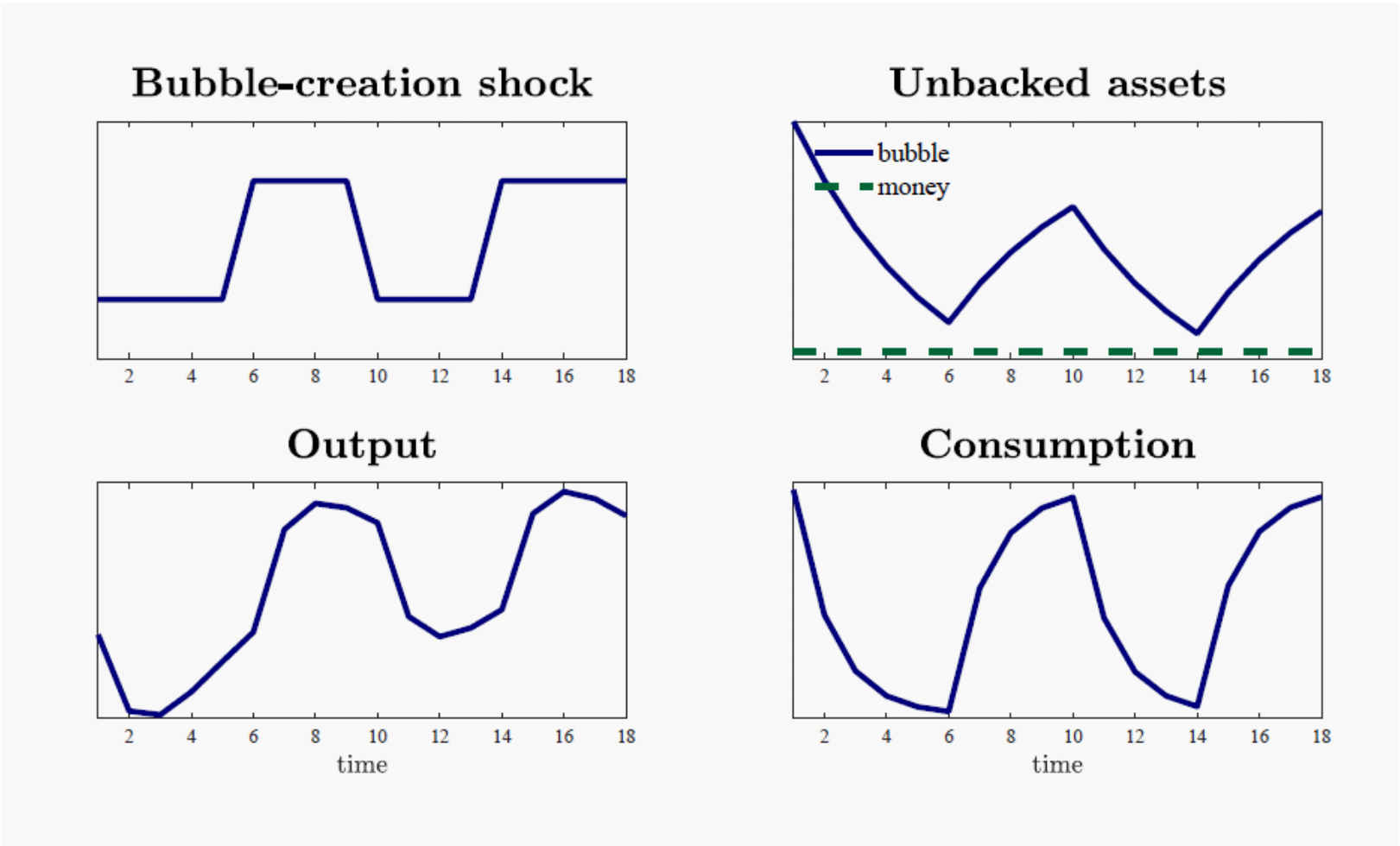
$$m_t \approx 0$$

- 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



Running example 2: bubble creation shocks



What can the central bank do? Intervention

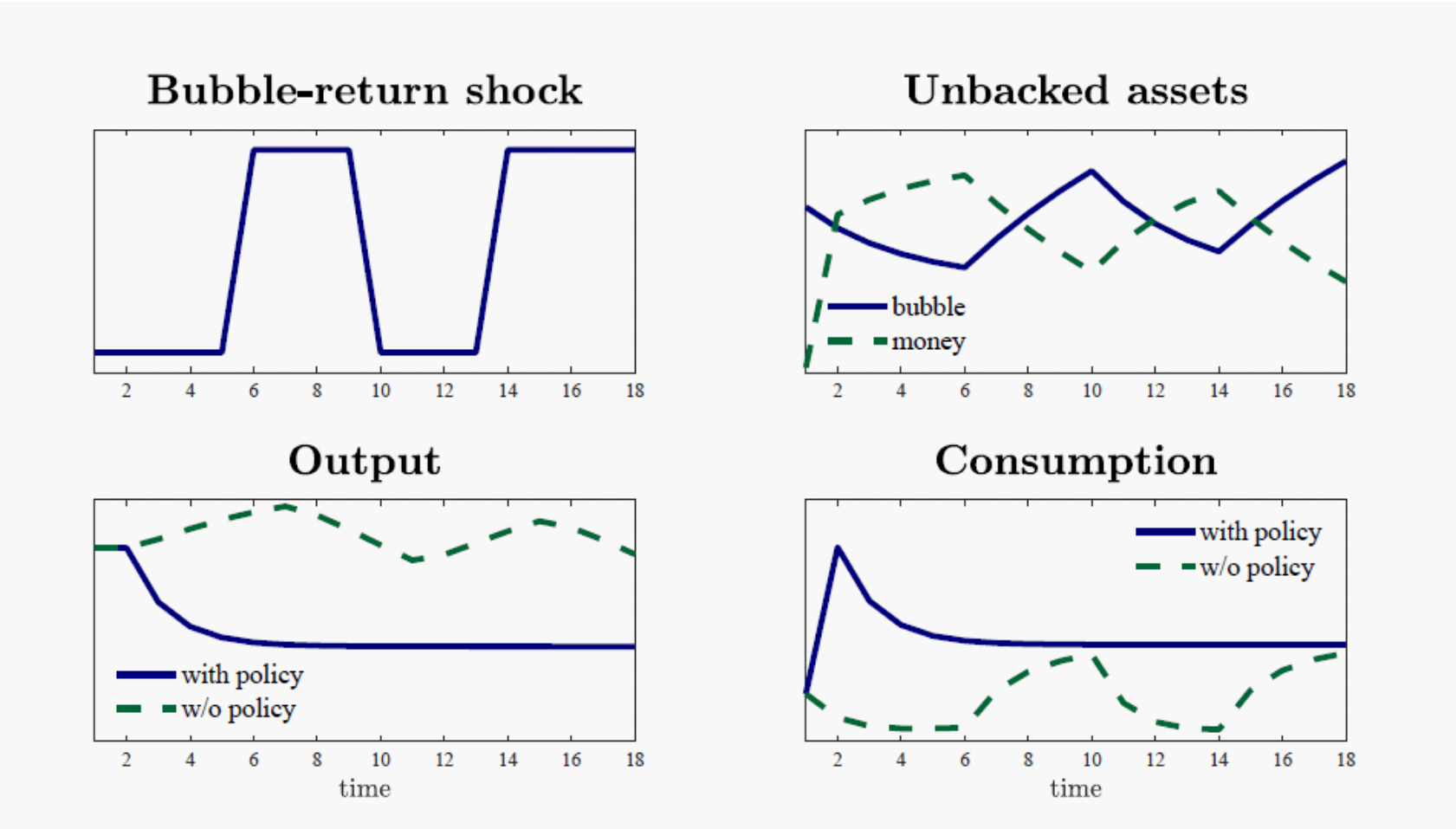
- Are there feasible policies that manage the supply of stores of value?
  - n_t = intragenerational transfers
  - $x_t \equiv b_t + m_t$ = intergenerational transfers
  - $\{k_t, c_t\}$ depend on $\{n_t, x_t\}$:

$$\gamma \cdot k_{t+1} = \frac{1 + \phi \cdot (\varepsilon + n_t) - x_t}{1 + \phi} \cdot (1 - \alpha) \cdot k_t^{\alpha}$$

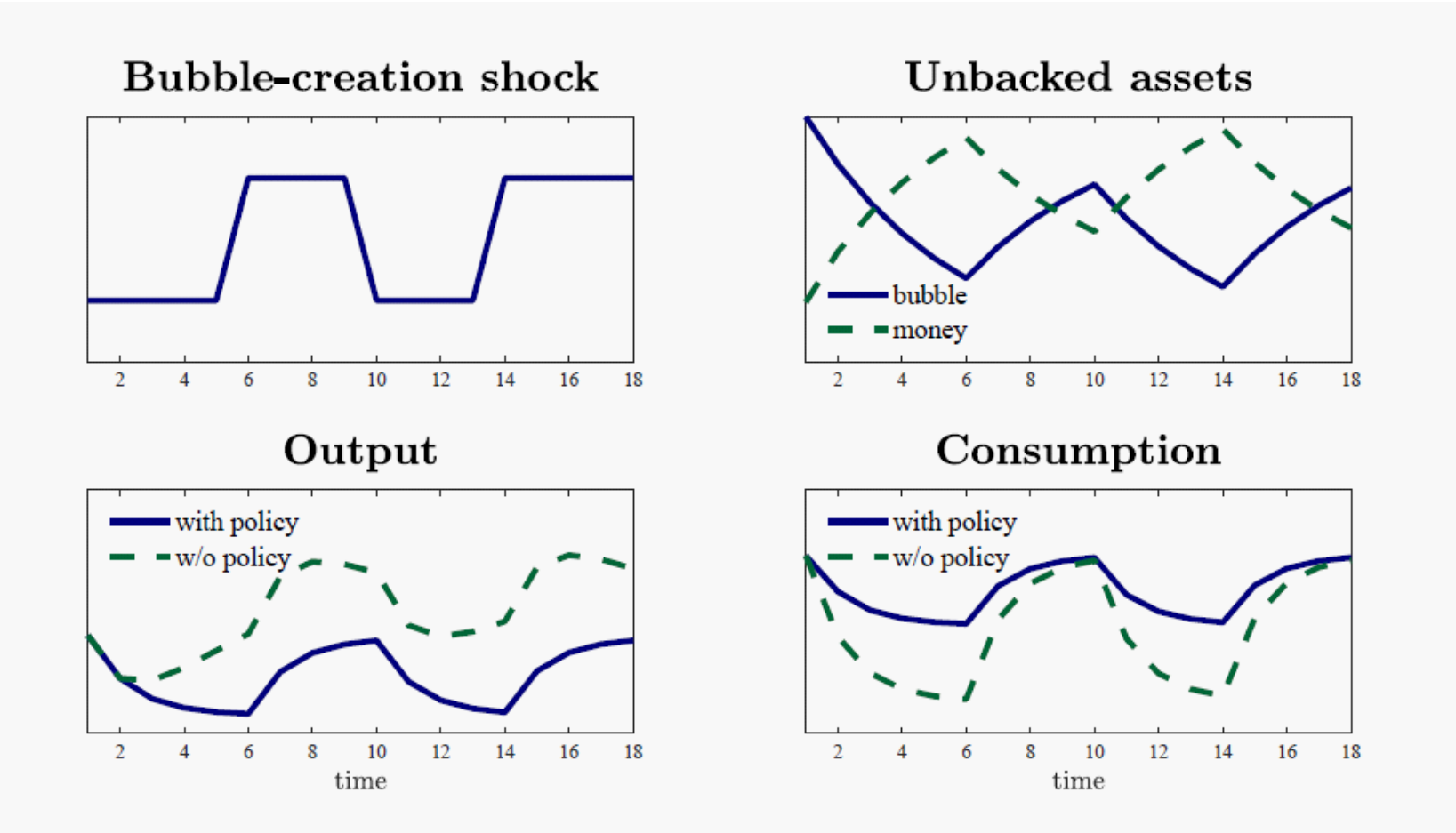
$$c_t = [\alpha + (1 - \alpha) \cdot x_t] \cdot k_t^{\alpha}$$

  - *Answer:* yes! Central bank can fully stabilize x!

Running example 1: bubble return shocks



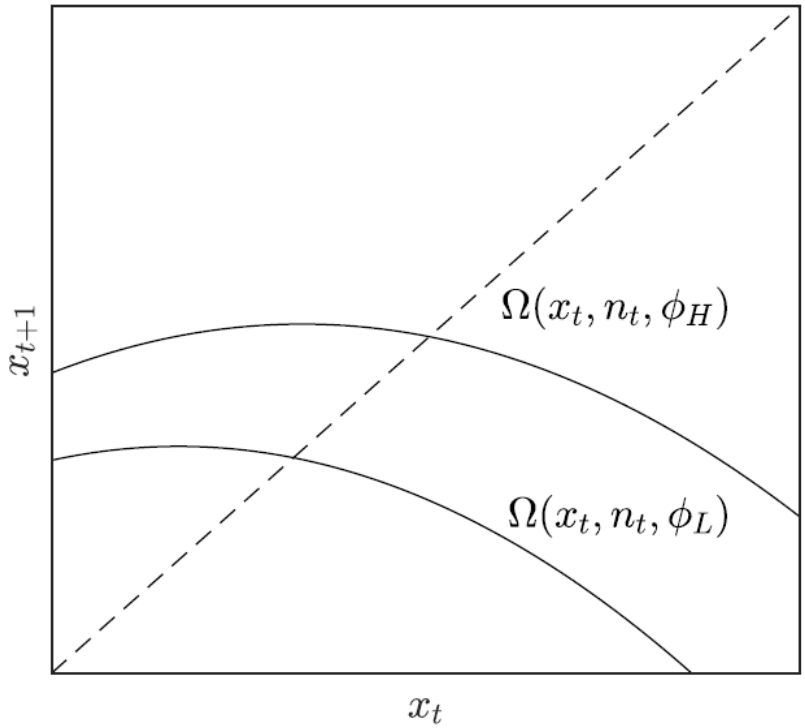
Running example 2: bubble creation shocks

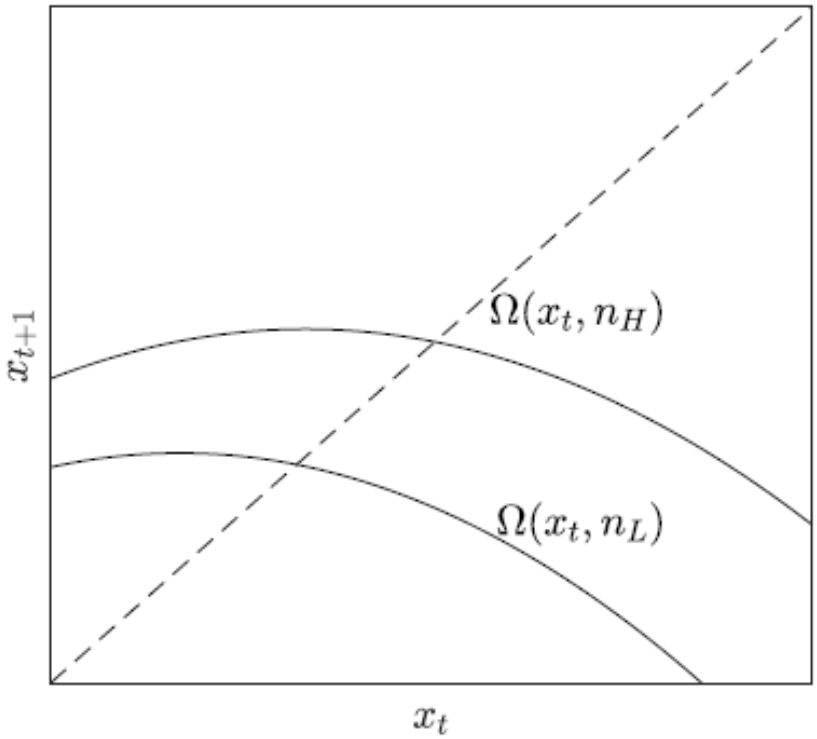


What should the central bank do?

- 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 (ϕ) and market psychology (n)

Pareto Frontier





Constrained optimal policy

- Define $x^* = \Omega\left(x^*, \bar{n}\right)$, 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