Recurrent Bubbles and Economic Growth

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Motivation

- Hysteresis and super hysteresis.
- Renewed attention;
  - Great Stagnation hypothesis (Hansen, Summers),
  - Blanchard, Cerutti, and Summers (2015).
- Bubbles may be important.
  - Japan's lost decades.
  - Jorda, Schularick, and Taylor (2015).
- Construct a model; bring it to the data.

Plan

1. Model
2. Comparative Statics
3. Estimation
4. Conclusion

Model

Model

Otherwise standard model with

1. liquidity constraint (Kiyotaki and Moore 2012),
2. variable capacity utilization (Greenwood et. al. 1998),
3. learning-by-doing (Arrow 1962; Sheshinski 1967; Romer 1986).

Household's Structure

- A continuum of households with measure one.
- Each household has a unit measure of members.
- Some become investors; others become savers.

Household's Problem

- Household's utility

$$E_0\left[\sum_{t=0}^{\infty}\beta^t\left(\pi\log\left[c_t^i\right]+(1-\pi)\log\left[c_t^s\left(1-l_t\right)^{\eta}\right]\right)\right]$$

- c_t^i is investor's consumption; c_t^s saver's.
- Member's roles ex ante unknown.
- Realize after separated.
- Equally divide the assets; give state-contingent plans.

Budget Constraints

- Investor

$$x_t^i + i_t + q_t \underbrace{n_{t+1}^i}_{\text{gross equity purchase}} = q_t i_t + \left[u_t r_t + q_t \left(1 - \delta\left(u_t\right)\right)\right] n_t.$$

- Saver

$$x_t^s + q_t n_{t+1}^s = w_t l_t + \left[u_t r_t + q_t \left(1 - \delta\left(u_t\right)\right)\right] n_t.$$

- Potluck party at night

$$\pi x_t^i + (1 - \pi) x_t^s = \pi c_t^i + (1 - \pi) c_t^s.$$

- Equity holding at night

$$n_{t+1} = \pi n_{t+1}^i + (1 - \pi) n_{t+1}^s.$$

Liquidity Constraints

- Investors face

$$\underbrace{n^{i}_{t+1}}_{\text{gross equity purchase}} \geq (1-\phi)\left[i_t + (1-\delta(u_t))\, n_t\right].$$

- If $\phi = 1$, can sell everything.
- If $\phi = 0$, dividends $(u_t r_t n_t)$ are the sole liquidity.
- Intrinsically useless (liquid) assets may have a positive value.
- Fiat money in KM; bubbles in our model.

Capacity Utilization

- Capital can be intensively used, which means
  - more capital service;

$$\underbrace{KS_t}_{\text{capital service}} = \underbrace{u_t}_{\text{utilization}} \underbrace{K_t}_{\text{capital stock}}$$

  - faster depreciation;

$$K_{t+1} = \underbrace{\pi i_t}_{\text{gross investment}} + \left(1 - \underbrace{\delta\left(u_t\right)}_{\text{depreciation rate}}\right) K_t$$

Learning-By-Doing

- Competitive firms maximize profits.
- Cobb-Douglas production function

$$Y_t = \underbrace{A_t}_{\text{technology level}} (u_t K_t)^\alpha (L_t)^{1-\alpha}.$$

- A_t is endogenous;

$$A_t = \underbrace{\bar{A}}_{\text{scale parameter}} \underbrace{(K_t)^{1-\alpha}}_{\text{externality}}.$$

- Individual firms take A_t as exogenous ("Big K, little k" trick).
- Growth is sustained by externality.

Regimes

- Bubbly and fundamental regimes.
- M units of bubbly assets in bubbly regime.
- No bubbly assets in fundamental regime.
- Helicopter drop of bubbly assets when $f \longrightarrow b$.
- Sudden disappearance when $b \longrightarrow f$.
- Markov switching.

Regimes

period	0	1	2	3	4	5	6	7	8	9	$\cdots$
regime	f	f	b	b	b	b	f	f	b	b	$\cdots$
bubbly assets	0	0	M	M	M	M	0	0	M	M	$\cdots$

Table: example

Bubbly Assets; Pros and Cons

- Intrinsically useless, no dividends (cons)
- May disappear (cons)
- Perfectly liquid (pros)
- Savers may find liquidity service attractive enough.
- Liquidity service depends on the resale value.
- Multiple equilibria.

go

Parameters

Parameter Values

	description	value	target
β	discount rate	0.99	standard
ζ	elasticity of $\delta(\cdot)$	0.33	Comin and Gertler (2006)
α	capital share	0.33	standard
π	fraction of investors	0.06	Shi (2015)
$\delta(0)$	depreciation when idol	0.001	frictionless growth=1.005
$\delta(1)$	depreciation at full capacity	0.005	hand-picked
η	curvature in leisure	2.67	frictionless hours=0.27
$\bar{A}$	scale parameter	0.49	equilibrium condition
σ_b	prob. of $b \longrightarrow f$	0.015	hand-picked
σ_f	prob. of $f \longrightarrow b$	0.015	hand-picked

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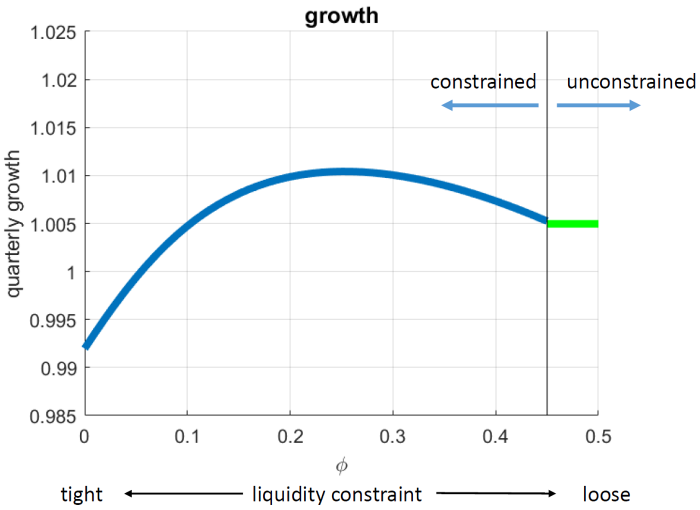
Comparative Statics

Permanent Fundamental

- Turn off the regime switch for a while.
- Always fundamental.

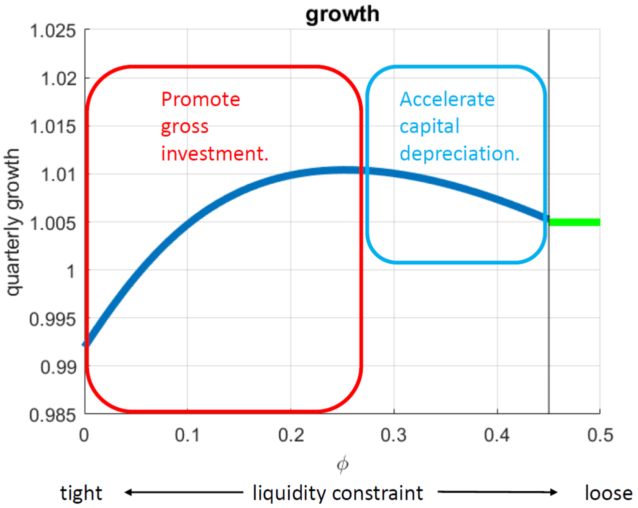
Fundamental Equilibrium

Non-linear relation when liquidity constraint binds.



Fundamental Equilibrium

Competing effects of marginal liquidity provision.



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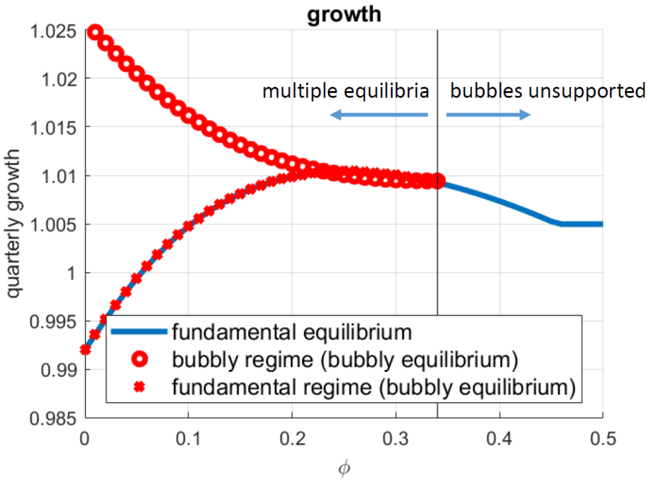
Stochastic Bubble

- The economy starts with b.
- Transitions to f with prob. 1.5% per quarter.
- Stays in f forever (Weil 1987).

Stochastic Bubble

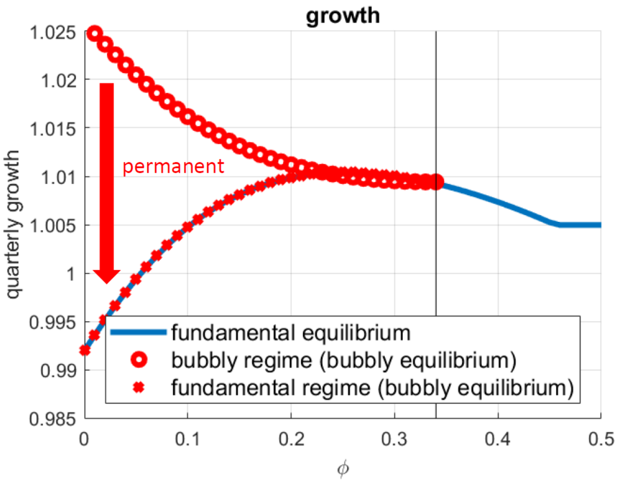
Multiple equilibria when liquidity constraint is tight.



tight ⟵ liquidity constraint ⟶ loose

Stochastic Bubble

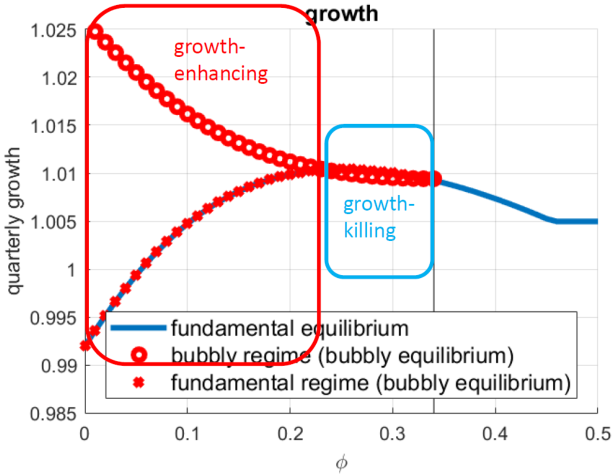
Bubble is "special." Fundamental is "normal."



tight ← liquidity constraint → loose

Stochastic Bubble

High growth with bubble? Lucky you!



tight ⟵ liquidity constraint ⟶ loose

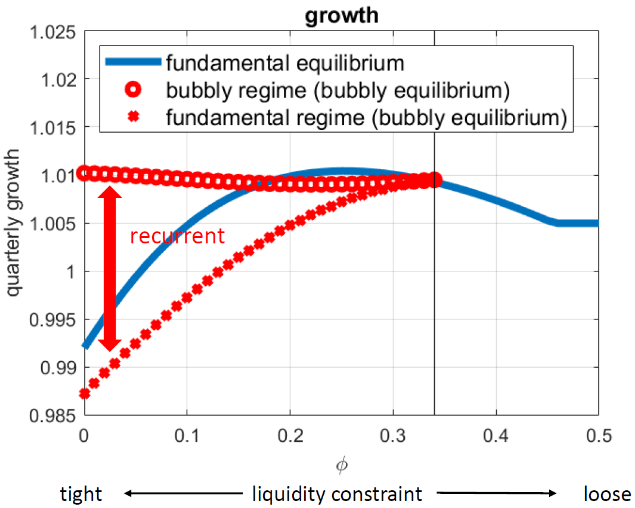
▸ welfare

Recurrent Bubble

- Turn on two-way regime switch.
- Both $b \longrightarrow f$ and $f \longrightarrow b$ with prob. 1.5% quarterly.

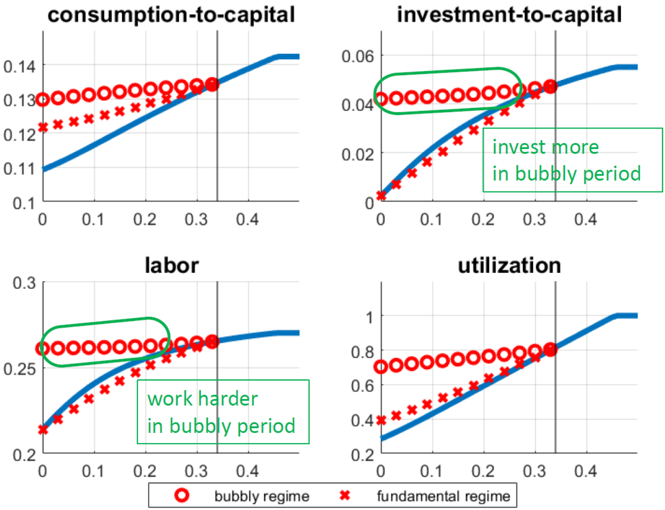
Recurrent Bubble

High growth in bubbly period; low in the other.



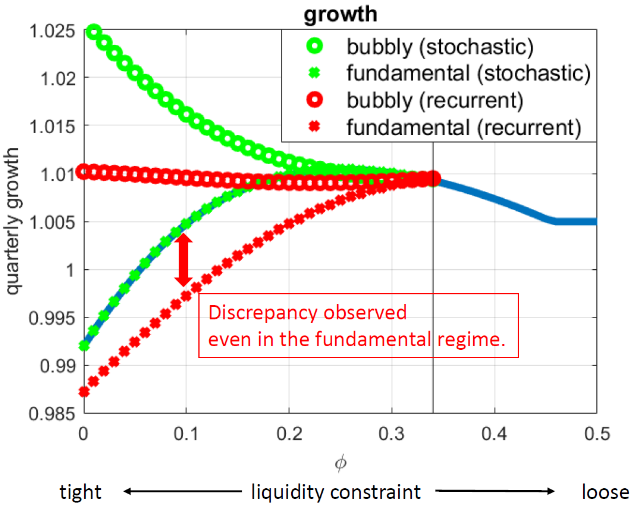
Recurrent Bubble

Inter-temporal (inter-regime) substitution at work.



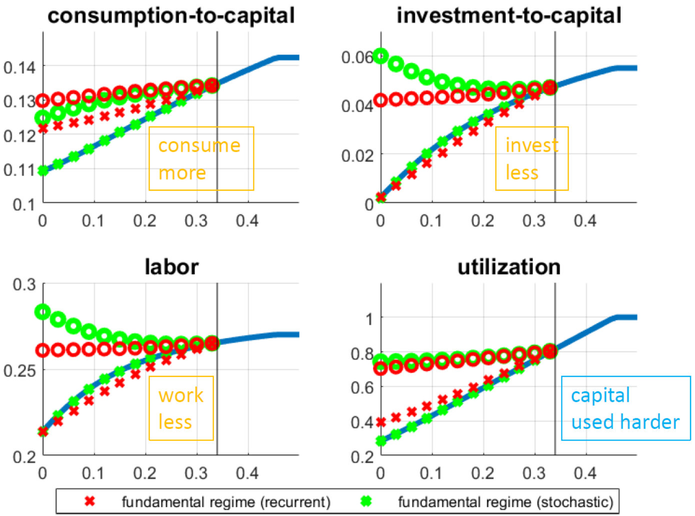
Recurrent v.s. Stochastic

Discrepancy in fundamental regime.



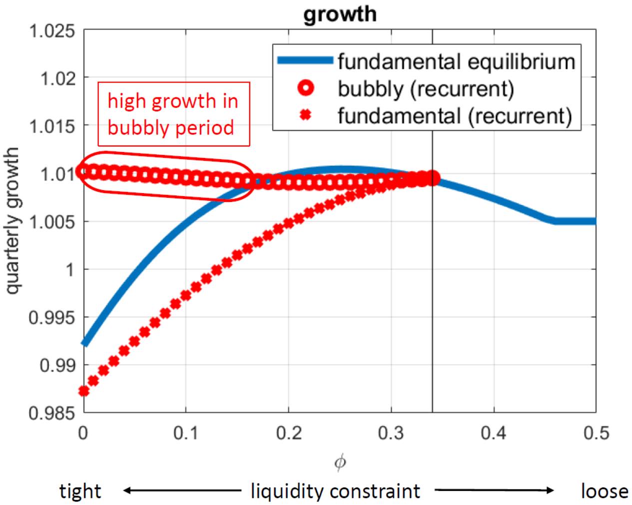
Recurrent v.s. Stochastic

Both wealth effect and price effect at work.



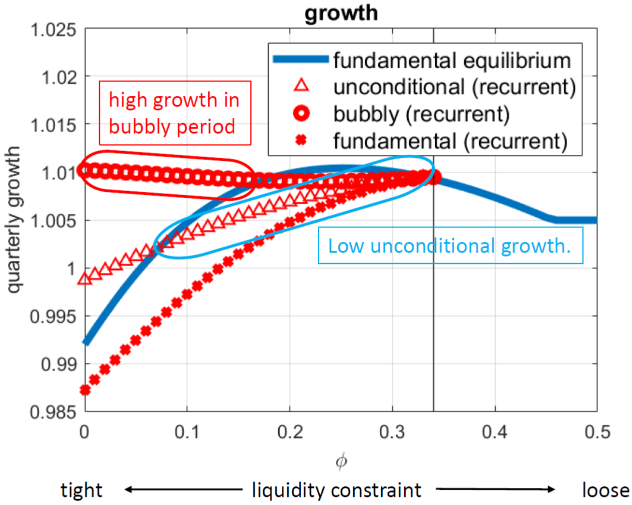
Takeaways

The economy may grow fast in the bubbly period.



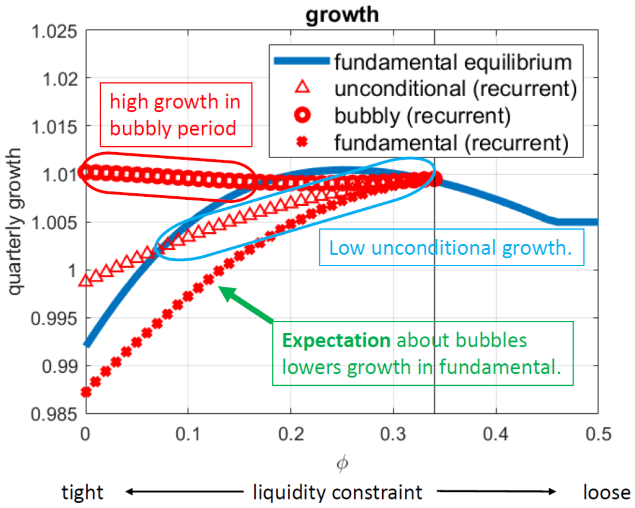
Takeaways

Not necessarily means unconditionally high growth.



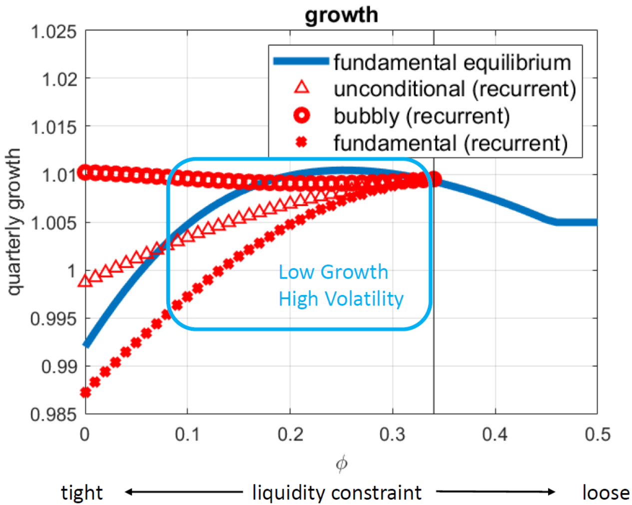
Takeaways

Bubbleless growth is slow just because people **expect** bubbles.



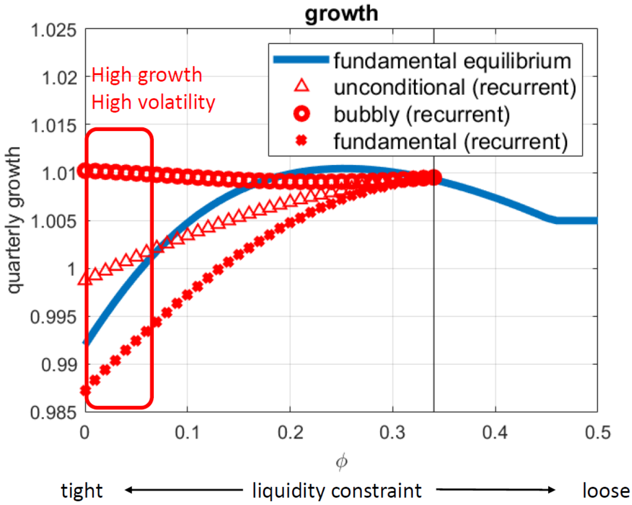
Takeaways (Growth and Volatility)

Bubbles will be unpopular in the advanced economy.



Takeaways (Growth and Volatility)

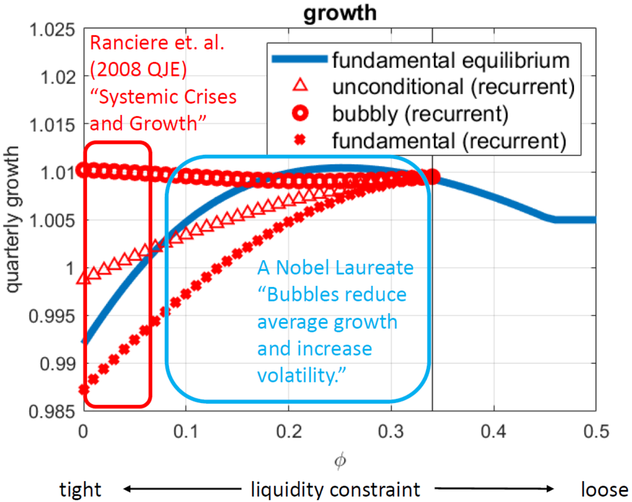
Bubbles may be welcomed in the developing economy.



welfare

Takeaways (Growth and Volatility)

Seemingly puzzling views not so puzzling in our model.



welfare

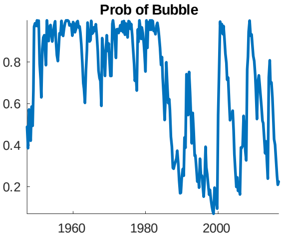
Estimation

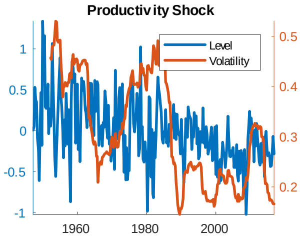
Estimation (Method)

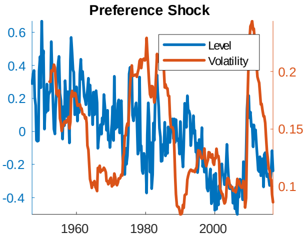
- Structural estimation detecting bubbles.
- Data: GDP growth and consumption-investment ratio.
- In a first pass;
  - estimate bubble and fundamental regimes,
  - estimate persistence and volatility of shocks (added),
  - retain rest of parameters.
- Absence of endogenous states facilitates estimation.

Estimation (U.S.)

Regime switches from bubble→fundamental→bubble.







Conclusion

- Recurrent bubbles.
- Two-way dynamic effects ($b \leftarrow f$ and $f \leftarrow b$).
- Super-hysteresis.
- Structural estimation.

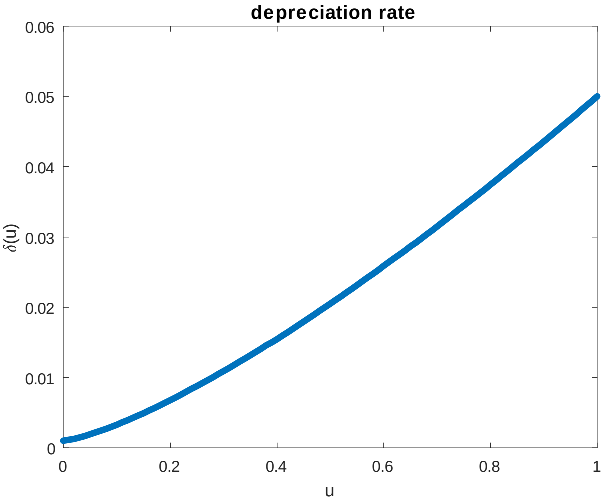
Appendix

If bubbles arise in the future, why not now?

- We exclude it by assumption.
- No bubble markets in the fundamental regime.
- Neither spot nor future.
- No way to purchase bubbly assets (literally).

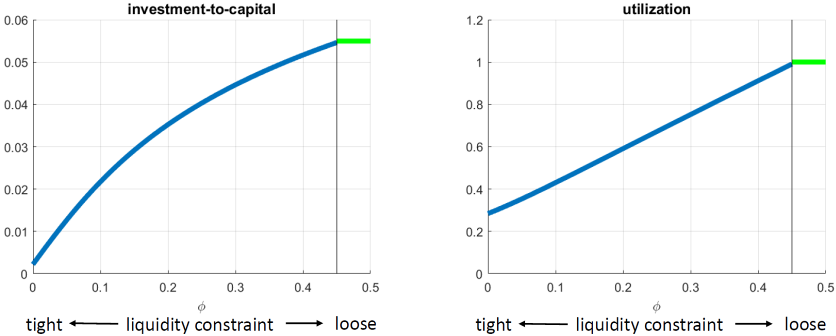
Depreciation Function

$$\delta'(u_t) > 0,\ \delta''(u_t) > 0, \text{ and } u_t\delta''(u_t)/\delta'(u_t) = 0.33.$$



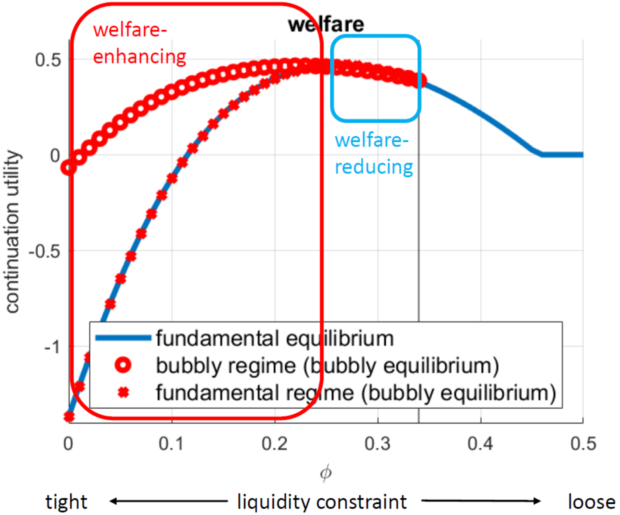
Depreciation Function

Advanced economy both invests and crashes a lot.



Stochastic Bubble

Welfare implication is similar.



Recurrent Bubble

Bubbles are disliked in the advanced economy.