

Recurrent Bubbles, Economic Fluctuations, and 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).

Liquidity Constraint

- ▶ Investors and savers in the economy.
- ▶ Investors borrow money using capital as collateral.
- ▶ Can't finance the total costs due to liquidity constraints.
- ▶ Intrinsically useless (liquid) assets may have a positive value.
- ▶ Fiat money in Kiyotaki and Moore.
- ▶ Bubbles in our model.

Capacity Utilization

- ▶ Capital can be intensively used.
- ▶ More capital service.
- ▶ Faster depreciation.
- ▶ Example: road trip in Hokkaido (recommend!).
 - ▶ pros: fun!
 - ▶ cons: added mileages lower the used-car value

Learning-By-Doing

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

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

- ▶ 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

- ▶ Bubble and fundamental regimes.
- ▶ M units of bubble assets in bubble regime.
- ▶ No bubble assets in fundamental regime.
- ▶ Helicopter drop of bubble assets when $f \rightarrow b$.
- ▶ Sudden disappearance when $b \rightarrow f$.
- ▶ Markov switching.

Regimes

period	0	1	2	3	4	5	6	7	8	9	...
regime	f	f	b	b	b	b	f	f	b	b	...
bubble assets	0	0	M	M	M	M	0	0	M	M	...

Table: example

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 bubble assets (literally).

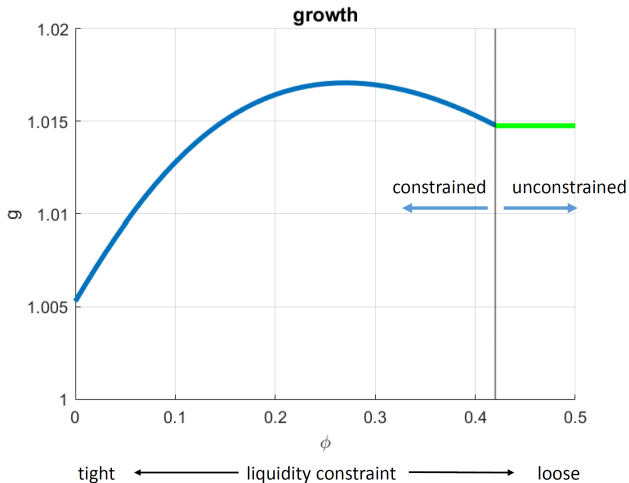
Comparative Statics

Permanent Fundamental

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

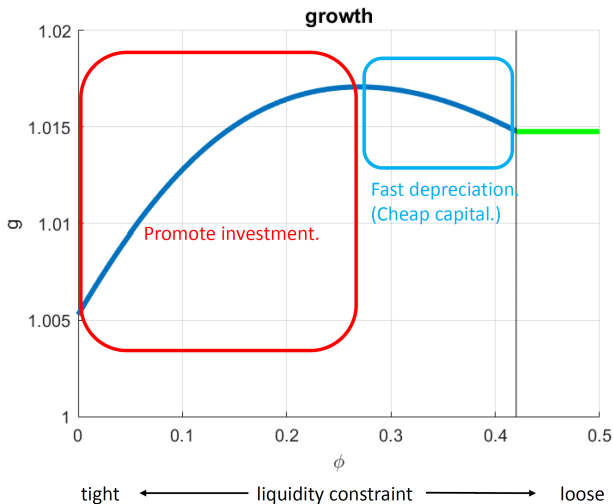
Fundamental Equilibrium

Non-linear relation when liquidity constraint binds.



Fundamental Equilibrium

Competing effects of a marginal change in liquidity constraint.

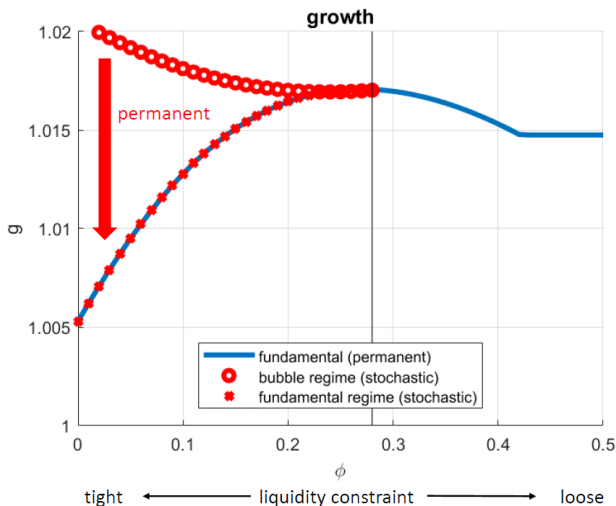


Stochastic Bubble

- ▶ The economy starts with b .
- ▶ Transitions to f with prob. 1% per quarter.
- ▶ Stays in f forever (Weil 1987).

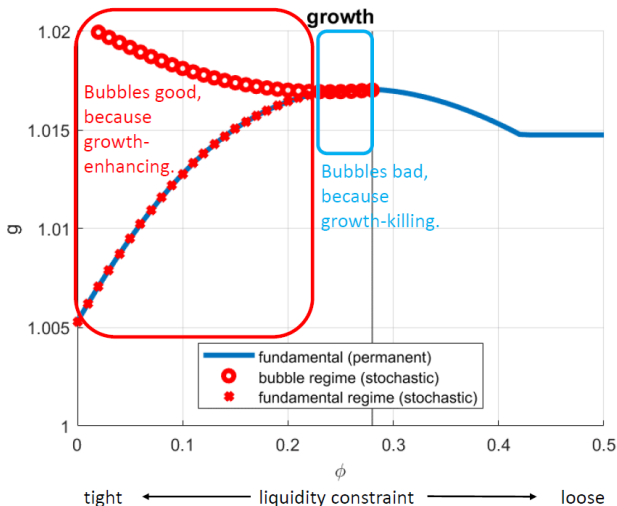
Bubble Equilibrium (Stochastic)

Start from “special.” Back to “normal.”



Bubble Equilibrium (Stochastic)

High growth with bubble? Lucky you!

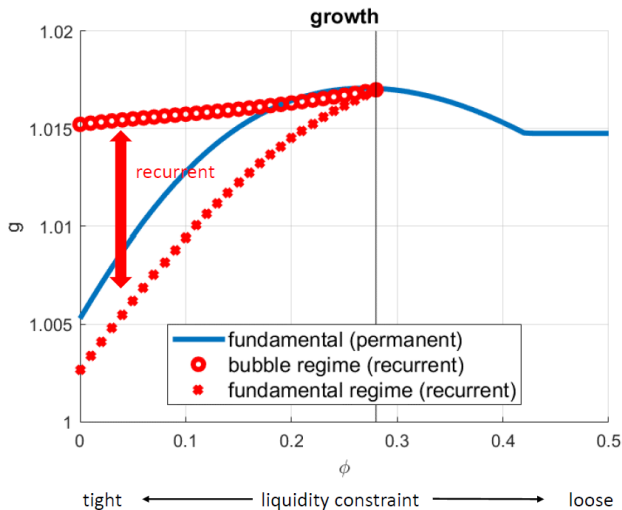


Recurrent Bubble

- ▶ Turn on two-way regime switch.
- ▶ Both $b \rightarrow f$ and $f \rightarrow b$ with prob. 1% quarterly.

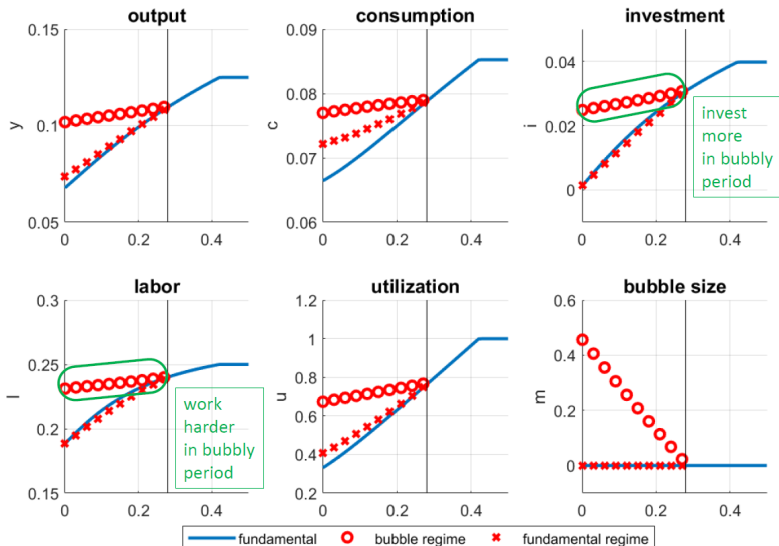
Bubble Equilibrium (Recurrent)

High growth in bubble; low in the other.



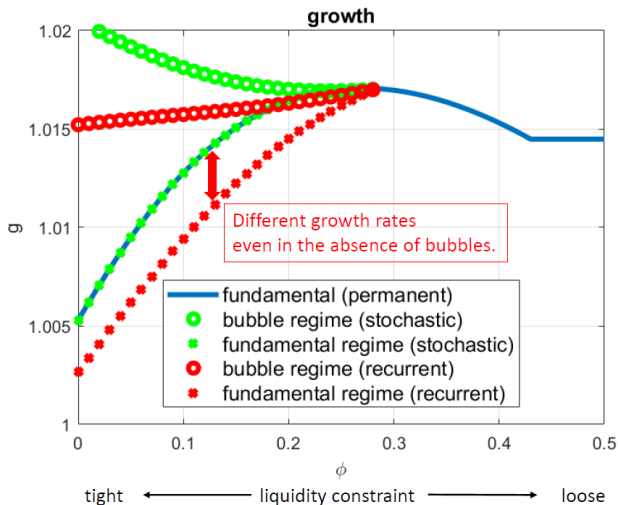
Bubble Equilibrium (Recurrent)

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



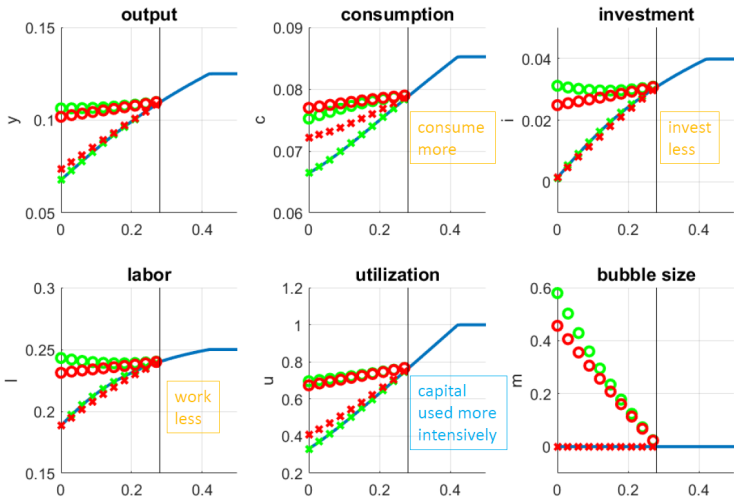
Recurrent v.s. Stochastic

Discrepancy in fundamental too.



Recurrent v.s. Stochastic

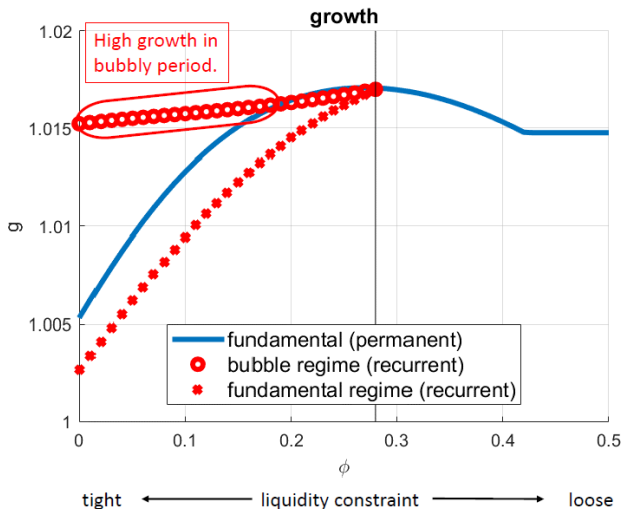
Both **wealth effect** and **price effect** at work.



— fundamental ○ bubble (stochastic) * fundamental (stochastic) ○ bubble (recurrent) * fundamental (recurrent)

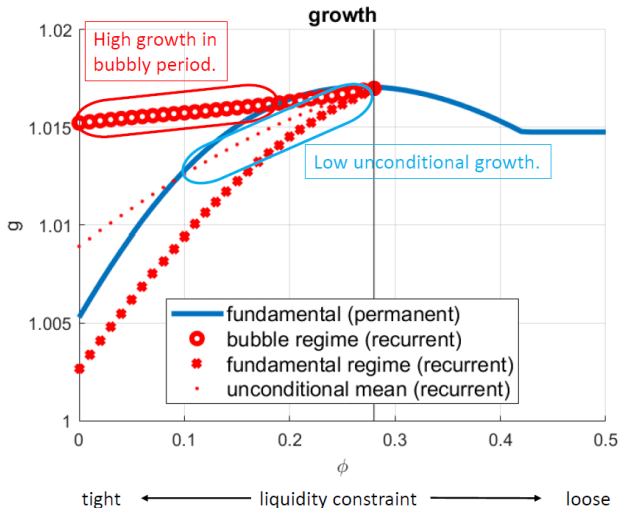
Takeaways (Growth)

The economy may grow fast in the presence of bubble.



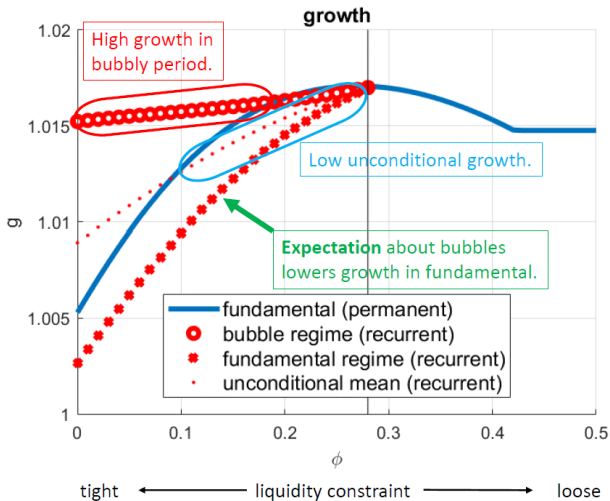
Takeaways (Growth)

Not necessarily means unconditionally high growth.



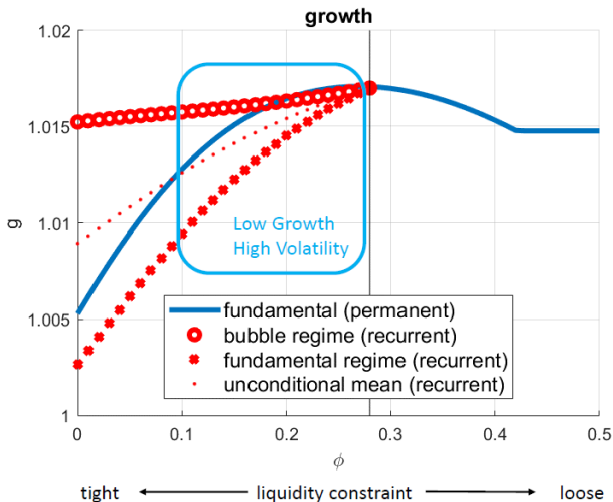
Takeaways (Growth)

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



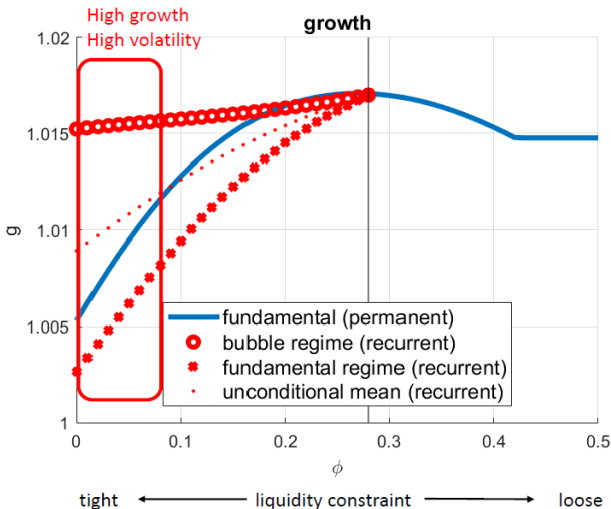
Takeaways (Growth and Volatility)

Bubbles likely to be undesirable if financial system is dependable.



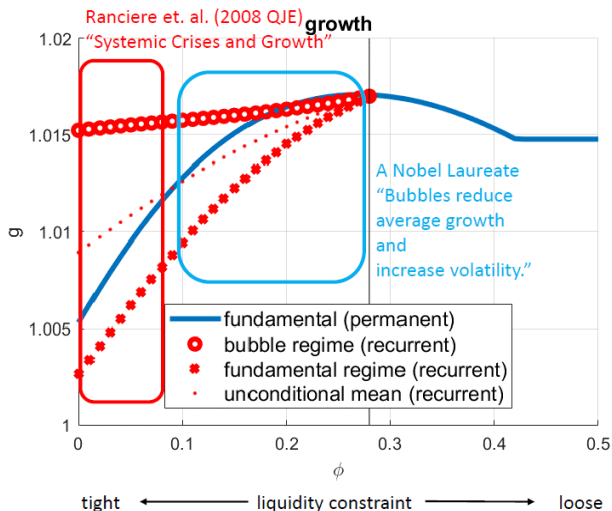
Takeaways (Growth and Volatility)

Bubbles can be desirable if financial system is weak.



Takeaways (Growth and Volatility)

Seemingly puzzling views not a puzzle in our model.



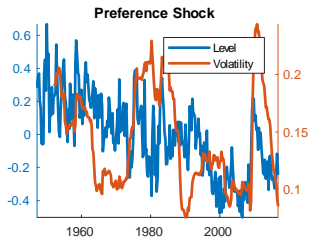
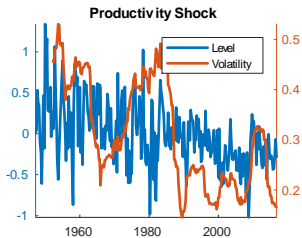
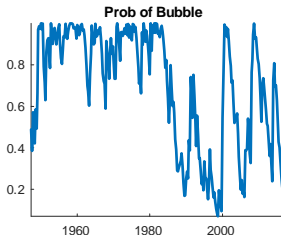
Estimation

Estimation (Method)

- ▶ 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.
- ▶ Identification: according to our model,
 - ▶ bubble: high growth and high volatility,
 - ▶ fundamental: low growth and low volatility.

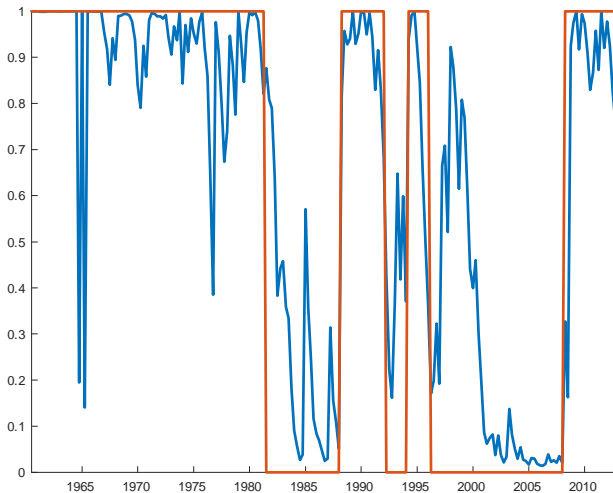
Estimation (U.S.)

Regime switches from bubble→fundamental→bubble.



Estimation (Japan)

Bubbles in the late 80s, the mid 90s, and very recent years.



Conclusion

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

Appendix

Literature

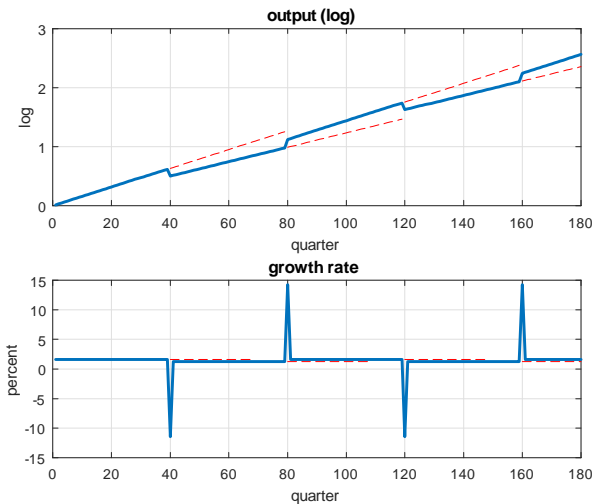
- ▶ **Bubbles:** Tirole (1982), Kocherlakota (1992), Martin and Ventura (2011), Gali (2015, 2017), Hirano and Yanagawa (2017), Dong, Miao, and Wang (2017)
- ▶ **Financial Frictions:** Jermann and Quadrini (2012), Kiyotaki and Moore (2012), Shi (2015)
- ▶ **Endogenous Productivity:** Romer (1990), Comin and Gertler (2006), Guerron and Jinnai (2017)
- ▶ **Solution/Estimation Markov-Switching DSGE Models:** Farmer, Waggoner, and Zha (2009), Hamilton (2016), Bianchi (2014), Kim and Nelson (1999)

Parameter Values

Parameter	Value	Calibration Target
β	0.99	Exogenously Chosen
α	0.4	Capital Share=0.4
fraction of investors	0.05	Exogenously Chosen
IES	1	Exogenously Chosen
elasticity of $\delta' (u_t)$	0.33	Exogenously Chosen
$\delta (1)$	0.025	Annual Depreciation=0.10
η	2.78	Labor Supply=0.25
\bar{A}	0.30	Rental Rate of Capital=0.05

Effects of Regime Switches

Super hysteresis after regime changes.



Impulse Responses (Productivity Shock)

- ▶ Effects amplified in the bubble regime.

Supply Shock ($\Delta a_t = 1\%$, $\text{Corr}(a_t, a_{t-1}) = 0.95$)

Change in Period t in	Bubble Regime	Fundamental Regime
capital growth	0.033%	0.019%
output	1.24%	1.09%
consumption	1.08%	1.04%
investment	1.69%	1.28%
labor	0.12%	0.04%
utilization	0.41%	0.16%
price of capital	0.74%	0.96%
bubble size	2.29%	0%

- ▶ Productivity shock increases bubbles for strong demand.

Impulse Responses (Preference Shock)

- ▶ Effects amplified in the bubble regime.

Demand Shock ($\Delta b_t = 1\%$, $\text{Corr}(b_t, b_{t-1}) = 0.8$)

Change in Period t in	Bubble Regime	Fundamental Regime
capital growth	-0.034%	-0.024%
output	0.03%	0.11%
consumption	0.31%	0.30%
investment	-0.78%	-0.71%
labor	-0.22%	-0.15%
utilization	0.39%	0.49%
price of capital	-0.53%	-0.60%
bubble size	-0.87%	0%

- ▶ Preference shock reduces bubbles by making people impatient.