Bubbles, Banks and Financial Stability

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29 May 2012, CIGS

Introduction

- Bursting bubbles: an important factor in many banking and economic crisis
  - Subprime/Japan/Scandinavia
- But occationally busts can occur without a crisis - 'Dot Com' bubble of 1998-2000
- Aim of the Paper:
  - Build a limited commitment economy with explicit financial intermediation
  - Model's impolications for the interaction of bubbles and bank balance sheets

The Economic Questions

1. Who holds the bubble?
2. How does the real impact of the bubble depend on who holds it?
3. How does the financial safety net affect bubbly equilibria?

Brief Answers

- Question 1 : Who holds the bubble?
  - Answer:
  - No financial safety net: savers
  - Banks hold bubbles if financial safety net exists
- Question 2: Real impact of the bubble
  - Answer: Bubbles held by banks lead to bigger output fluctuations.
- Question 3: financial safety net and bubbly equilibria
  - Answer: (1) bubbles are bigger; (2) more fragile bubbles can exist.

Rational Bubbles: A (very) brief survey

- General economic problem: how to create efficient means of saving
- OLG (no credit constraints)
  - Samuelson (1958)
  - Tirole (1985), Weil (1987)
- Models with credit/resaleability constraints
  - Woodford (1990)
  - Kiyotaki-Moore (2008)
  - Caballero and Krishnamurthy (2006)
  - Martin and Ventura (2011), Farhi and Tirole (2011), Hirano and Yanagawa (2011)

Rational bubbles in a credit constrained economy

- Inside liquidity created from private intermediation
  - debt for borrowers
  - stores of value for lenders
- Limited commitment - too little inside liquidity
  - inefficient stores of value
  - low interest rates
- Bubbles
  - replace inefficient stores of value
  - but: fragile

Our contribution

- Modelling financial intermediaries explicitly
  - Result: multiple asset holders with different economic roles
  - This matters: asset price bubbles have a different real impact depending on who holds them
- Impact of moral hazard on bubbly equilibria

Entrepreneurs

- Utility

$$E_0 \sum_{t=0}^{\infty} \beta^t \ln c_t$$

- Production function

$$y_{t+1} = a h_t, \quad a = a^H, a^L, \quad a^H > a^L$$

- Budget constraint: when becomes a borrower;

$$c_t + \underbrace{w_t h_t}_{\text{investment}} - \underbrace{l_t}_{\text{loan}} + \mu_t m_t^e \leqslant (1 - \tau_t) \left(y_t - R_{t-1}^l l_{t-1} + \mu_t m_{t-1}^e \right)$$

  when becomes a saver;

$$c_t + w_t h_t + \underbrace{d_t}_{\text{deposit}} + \mu_t m_t^e \leqslant (1 - \tau_t) \left(y_t + R_{t-1}^d d_{t-1} + \mu_t m_{t-1}^e \right)$$

- Borrowing constraint

$$R_t^l l_t + E_t Y_{t+1} \leq \theta y_{t+1}, \quad 0 < \theta < 1$$

Entrepreneurs' behavior: low productivity

- In equilibrium, the productives borrow and the unproductives save.
- log utility $\Longrightarrow$ consumption is $(1-\beta)$ share of wealth
- The unproductives allocate savings between deposit, bubbles and own production (if they produce)

$$E_t\left[\frac{1-\tau_{t+1}}{c^L_{t+1}}\frac{\mu_{t+1}}{\mu_t}\right] = E_t\left[\frac{1-\tau_{t+1}}{c^L_{t+1}}\right] R^d_t \geq E_t\left[\frac{1-\tau_{t+1}}{c^L_{t+1}}\frac{a^L}{w_t}\right]$$

where

$$\mu_{t+1} = \begin{array}{ll} \mu_{t+1} & \text{w.p. } \pi \\ 0 & \text{w.p. } 1-\pi \end{array}$$

Entrepreneurs' behavior: high productivity

- When borrowing constraints bind ($a^H / w_t > R_t^l$), the productives borrow up to the limit. Leveraged rate of return is

$$\frac{a^H(1-\tilde{\theta}_t)}{w_t - \tilde{\theta}_t a^H / R_t^l} > \frac{a^H}{w_t} > R_t^l$$

  where

$$\tilde{\theta}_t = \frac{\theta - E_t \tau_{t+1}}{1 - E_t \tau_{t+1}} \leq \theta$$

- The productives do not buy bubbles

Banks

- Risk neutral, exit with probability $1-\gamma$
- Budget constraints and state evolution

$$c_t^B + l_t + \underbrace{\mu_t m_t}_{\text{bubble purchase}} = \underbrace{n_t}_{\text{net worth}} + d_t$$

$$n_{t+1} = R_t^l l_t + \mu_{t+1} m_t - R_t^d d_t$$

- Borrowing constraint

$$\underbrace{(1-\lambda) d_t}_{\text{diversion value}} \leqslant \underbrace{V(n_t)}_{\text{continuation value of the bank}}, \quad 0 < \lambda < 1$$

Constraint binds when $R_t^l > R_t^d$. $V(n_t)$ given by

$$V(n_t) = \beta E_t \left[\gamma V(n_{t+1}) + (1-\gamma) n_{t+1} \right]$$

Banks' behaviour

- Risk neutrality implies that

$$V(n_t) = \phi_t n_t$$

$$\phi_t = \frac{\beta\left[(1-\gamma) + \gamma E_t \phi_{t+1}\right] R_t^l}{1 - \beta\left[(1-\gamma) + \gamma E_t \phi_{t+1}\right] \frac{R_t^l - R_t^d}{1-\lambda}} > 1.$$

- Expectation of high future leverage allows the bank to borrow more (i.e. high leverage today)
- Deposits (under a binding collateral constraint on banks)

$$D_t = \underbrace{\frac{\phi_t}{(1-\lambda)}\gamma}_{\approx \text{leverage}} N_t$$

Banks' behabiour (cont)

- Banks' portfolio choice between bubbles and loans

$$E_t\left[(1-\gamma+\gamma\phi_{t+1})\frac{\tilde{\mu}_{t+1}}{\mu_t}\right] \leq E_t\left[(1-\gamma+\gamma\phi_{t+1})\right]R_t^l$$

where

$$\tilde{\mu}_{t+1} = \begin{array}{c} \mu_{t+1}^b \text{with prob. } \pi \\ \rho_{t+1}\mu_t \text{with prob. } 1-\pi \end{array}$$

- ρ captures the financial safety net

Workers: (passive role)

- Utility

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left(c_t^w - \frac{h_t^{1+\eta}}{1+\eta} \right)$$

- No collateralisable assets —> cannot borrow
- Do not save in equilibrium due to low interest rate
- Labour supply

$$h_t^s = w_t^{\eta}$$

Government

- The government only spends money on bailing out banks
- Balanced budget

$$\tau_t Z_t = \rho_t m^b_{t-1} \mu_{t-1}$$

Bubbles and the rates of return

deterministic steady state

- In equilibrium bubbles must be (a) attractive to hold and (b) affordable
- Bank-held bubbles

$$R_t^d < \text{bubble return} = R_t^l \leqslant 1$$

- Saver-held bubbles

$$R_t^d = \text{bubble return} \leqslant 1$$

- Banks choose not to buy bubbles when $R_t^l > R_t^d = \text{bubble return}$

Who holds the bubble: stochastic steady state

- Base line case: $\rho = 0$

% of bubbles held by banks

$\pi = 0.965$	$\pi = 0.975$	$\pi = 0.985$	$\pi = 0.995$
0	0	0.016	0

Introducing the government financial safety net

- Consider $\rho > 0$
- What effect does it have
  - on bank's bubble holdings?
  - on bubble size?
  - on bubble amplification?

Impact of the safety net

Banks' bubble holdings as % of total

	$\pi = 0.965$	$\pi = 0.975$	$\pi = 0.985$	$\pi = 0.995$
$\rho = 0.00$	-	0.000	0.016	0.000
$\rho = 0.25$	-	0.000	0.068	0.000
$\rho = 0.50$	1.000	0.312	0.183	0.000
$\rho = 0.75$	1.000	1.000	0.660	0.016

- $\rho = 0$: banks hold few bubbles at intermediate values of π (risk-sharing)
- $\rho >> 0$: banks' bubble holding grows at low values of π (risk-shifting)

Impact of the safety net

bubble size as % of GDP

	$\pi = 0.965$	$\pi = 0.975$	$\pi = 0.985$	$\pi = 0.995$
$\rho = 0.00$	-	0.118	0.463	0.674
$\rho = 0.25$	-	0.118	0.467	0.674
$\rho = 0.50$	0.008	0.245	0.475	0.674
$\rho = 0.75$	0.361	0.411	0.511	0.676

- High π: ρ has little effect on bubble size
- $\rho \uparrow \Rightarrow$ bubble size $\uparrow$ dramatically at low values of π

Effects of bubble holdings on banks

	$\rho = 0.00$	$\rho = 0.25$	$\rho = 0.50$	$\rho = 0.75$
% of bubbles held by banks	0.000	0.081	0.237	0.881
Bubble to GDP ratio	0.296	0.348	0.396	0.442
E(Bubble Return|bank) - R^l	-0.002	0.005	0.009	0.009
E(Bubble Return|saver) - R^d	0.010	0.010	0.009	0.001
Bank NW/GDP (pre-crash)	0.055	0.063	0.074	0.116
Bank Loss/GDP	0.000	0.021	0.047	0.097
% fall in bank NW	0.000	0.337	0.630	0.842

- The percentage fall in bank net worth is computed after the receipt of government assistance.
- Lage increase in net worth before crash and loss after crash

How do bubbles affect the economy?

- Decomposition of output

$$Y = a^L H_t^L + a^H H_t^H \tag{1}$$

$$= \frac{1}{w_t}\left[a^L\left(\beta Z_t + \gamma N_t\right) - a^L \mu_t + \left(a^H - a^L\right)\left(\beta s_t Z_t + L_t\right)\right] \tag{2}$$

- w: production cost
- 1st term: liquidity effect
- 2nd term: crowding out
- 3rd term: reallocation
  - share of productives
  - credit supply

Effects of bubbles on the economy[1]

	$\rho = 0$	$\rho = 1/3$	$\rho = 2/3$
Bank bubble holdings (% of total)	0.00	0.11	1.00
Total $Y \uparrow$ relative to 'no bubble' SS	1.03	1.32	3.11
(1) Liquidity effect	19.64	20.01	21.78
(2) Bubble 'crowding out' effect	- 19.54	- 19.67	- 19.99
(3) Investment composition effect	0.95	1.04	1.65
...of which			
(3.1.) Productive net worth	0.31	0.34	0.54
(3.2.) Bank lending	0.64	0.70	1.11
(4) Labour costs	- 0.02	- 0.06	- 0.32

- Output larger when banks hold bubbles
- high contribution of liquidity effect and increase in bank lending

[1] Percentage point contributions of each channel to total increase in output relative to bubbleless SS

Costs of funds and bubble holding[2]

	$\rho = 0$	$\rho = 1/3$	$\rho = 2/3$
Bank net worth (% increase)	14.43	25.03	113.7
Bank lending	13.03	14.35	22.69
Lending-Deposit spread	0.02	- 0.01	- 0.22

- Increase in net worth due to bubble risk premium
- This results in increase in credit supply...
- and decline in spread

[2] percentage point deviation from bubbleless steady state

Dynamics

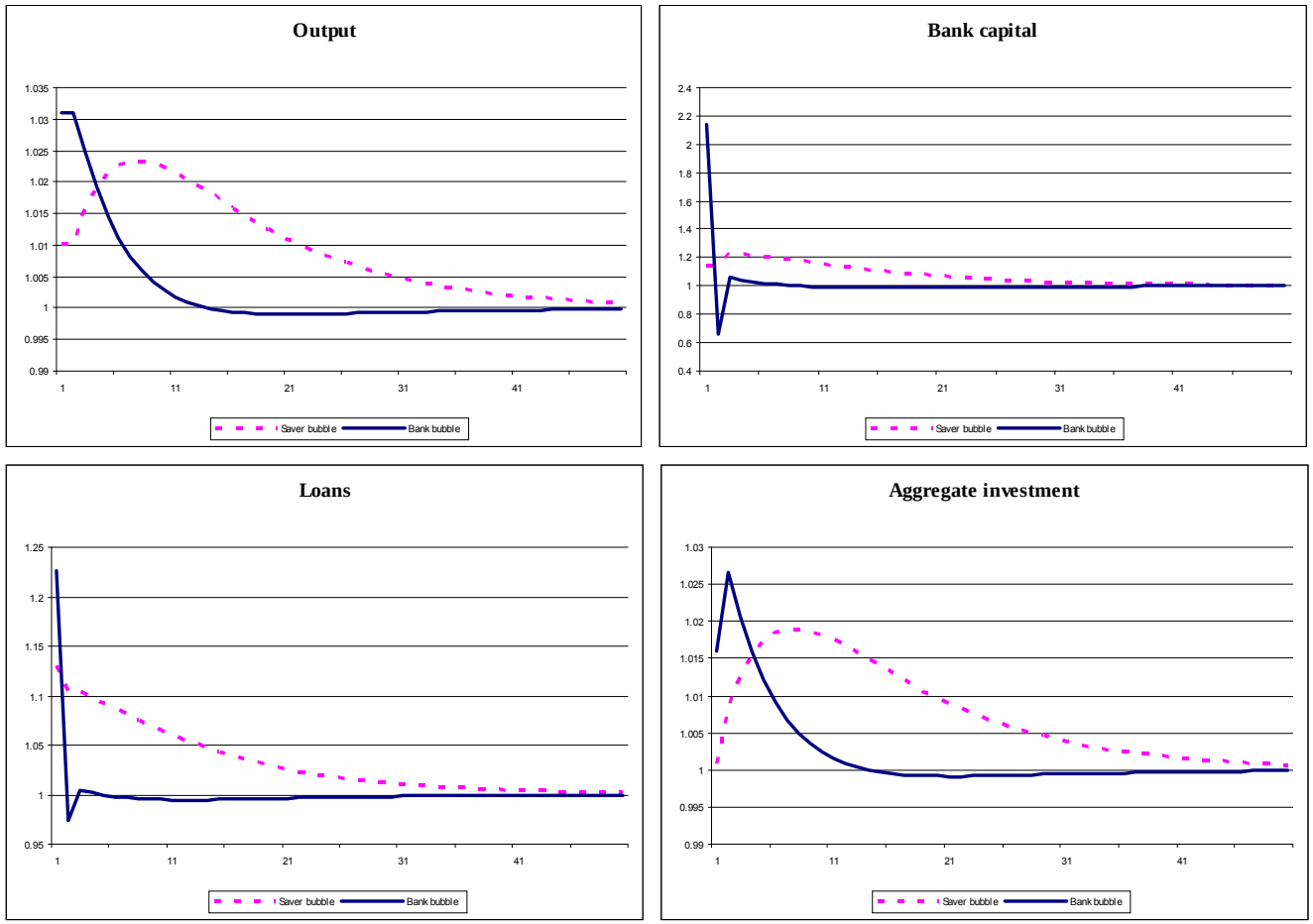

Figure 3: Comparing a bank-held (solid line) and a saver-held (dashed line) bubble

- Large expansion and severe contraction under bank bubble

Conclusions

- Bubbles held by banks have a more amplified impact on the economy
  - while they survive
  - when they burst
- Banks invest in bubbles
  - when their risk is underwritten by the government