Financial Integration & the Bubbly Savings Glut

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Motivation

- Stylized facts:
  - **Global imbalances & savings glut**: large amount of capital has been flowing from "South" (developing economies) to "North" (developed economies) since the S became more **financially integrated** in 1980s (most notably from China to U.S.)
  - **Boom-bust in asset prices**, most notably the housing bubble preceding U.S. financial crisis
- Many scholars and policymakers argued these phenomena are intimately linked (Bernanke 2005, Rajan 2009, Yellen 2009, Greenspan 2010, etc.)

This paper

- Presents a positive theory of financial integration & asset bubble
  - Simplicity: endowment economy, focus on steady state analysis
- Main finding: Financial integration facilitates **risky** bubbles that come with **default**
  - Northern borrowers leverage to buy bubbly asset
  - Equilibrium default (crisis) in the North when bubble bursts

Related literature

- Theories of bubbles, esp. rational bubbles
  - Samuelson (1958), Diamond (1965), Tirole (1985), Weil (1987)
  - Caballero Krishnamurthy (2006), Kocherlakota (2009), Hirano Yanagawa (2011), Miao Wang (2011), Farhi Tirole (2012), Martin Ventura (2012), Gali (2014), Graczyk Phan (2016), ...
  - Open economy: Basco (2013), Ikeda Phan (2015a), Martin Ventura (2016)
  - Risk-shifting: Allen-Gorton (1993), Allen-Gale (2000), Barlevy (2014), Ikeda Phan (2015b)
  - **Most related: Bengui Phan (2016), closed economy**
- Other
  - Financial frictions in macro: Bernanke-Gertler (1989), Kiyotaki-Moore (1997), Aiyagari-Gertler (1999), ...
  - General equilibrium with incomplete markets: Geanakoplos (1997), Geanakoplos-Zame (2002), ...

Outline

1. Environment
2. Benchmark 1: No bubble
3. Benchmark 2: Bubbles in closed economies
4. Main results
5. Additional result: effect on capital flows

Environment

Basics: 2 country OLG model

- $t = 0, 1, 2, \ldots$ Single consumption good, no capital
- North & South. Identical, except for financial frictions
- Overlapping generations, each lives for two periods: young and old
  - Constant population one in each country
  - Utility: $u(c_{y,t}) + \beta E_t [c_{o,t+1}]$

Bubble asset

- Tirole (1985): fixed, divisible, unit supply, no dividend
- Can be traded anywhere, N or S
- Bubble is *risky* (Weil, 1987): exogenously collapses permanently with iid prob $p_{burst} \in [0,1)$.
  - Price: $\xi_t P_t$, where $\xi_t = 0$ is bursting dummy:

$$\begin{aligned} \Pr(\xi_{t+1} = 0 | \xi_t = 1) &= p_{burst} \\ \Pr(\xi_{t+1} = 0 | \xi_t = 0) &= 1 \end{aligned}$$

Heterogeneous endowments

- Heterogeneity in young age endowment:

$$y^B < y^L$$

  - fraction θ are **Lenders**,
  - remaining $1 - \theta$ are **Borrowers**
- Homogeneous endowment T when old.
- Heterogeneous endowment paths –> natural motive for borrowing/lending.

Credit market frictions

- Assume standard (non-contingent) debt contract, subject to enforcement friction
- Households in country j
  - borrow $q_{t,j}d_{t,j}$ when young to consume or purchase bubble
  - repay $d_{t,j}$ or default when old
  - take as given bond price
- Enforcement friction: if old defaults in $t+1$, lenders can seize
  - fundamental collateral $D_j \in (0, T]$ from endowment, $j \in \{N, S\}$
  - fraction $\phi_j \in [0, 1]$ of debtor's asset b_t
  - seized collateral is divided equally among lenders
- **Asymmetry:** $D_S < D_N$, $\phi_S < \phi_N$ (N is more financially developed)
  - For tractability, assume $\phi_S = 0$ and $\phi_N = 1$.

Default decision & collateral constraint

- Borrowers default if privately optimal to do so
- Default dummy of borrowers in country j:

$$\delta_{t+1,j} \equiv 1\{ \underbrace{d_{t,j}}_{\text{face value}} > \underbrace{D_j + \phi_j \xi_{t+1} P_{t+1} b^B_{t,j}}_{\text{loss from default}} \}.$$

$\Rightarrow$ If $d_{t,j} > D_j + \phi_j P_{t+1} b_{t,j}$, borrowers always default, even in the best state when $\xi_{t+1} = 1$.

- Thus impose collateral constraint on borrowers in country j:

$$d_{t,j} \leq \underbrace{D_j}_{\text{fundamental collateral}} + \underbrace{\phi_j P_{t+1} b^B_{t,j}}_{\text{bubbly collateral}} \qquad \text{(CC)}$$

Problem of borrowers in country j

$$\max_{b^B_{t,j}, d^B_{t,j}} u\left(c^B_{y,t,j}\right) + \beta E_t\left[c^B_{o,t+1,j}\right]$$

subject to

$$\begin{aligned}
c^B_{y,t,j} + P_t b^B_{t,j} &= y^B + q_{t,j} d^B_{t,j} \\
c^B_{o,t+1,j} &= T + \xi_{t+1} P_{t+1} b^B_{t,j} \\
&\quad - \underbrace{\left(1 - \delta_{t+1,j}\right) d^B_{t,j}}_{\text{repay}} - \underbrace{\delta_{t+1,j}\left(D_j + \phi_j \xi_{t+1} P_{t+1} b^B_{t,j}\right)}_{\text{default}} \\
b^B_{t,j} &\geq 0 \\
d^B_{t,j} &\leq D_j + \phi_j P_{t+1} b^B_{t,j} \qquad \text{(CC)}
\end{aligned}$$

Problem of lenders in country j

$$\max_{b^L_{t,j}, d^L_{t,j}, d^{L*}_{t,j}} u\left(c^L_{y,t,j}\right) + \beta E_t \left[c^L_{o,t+1,j}\right]$$

subject to

$$\begin{aligned} c^L_{y,t,j} + P_t b^L_{t,j} &= y^L + \underbrace{q_{t,j} d^L_{t,j}}_{\text{lend at home}} + \underbrace{q_{t,-j} d^{L*}_{t,j}}_{\text{lend abroad}} \\ c^L_{o,t+1,j} &= T + \xi_{t+1} P_{t+1} b^L_{t,j} - (1 - h_{t+1,j})\, d^L_{t,j} - (1 - h_{t+1,-j})\, d^{L*}_{t,j} \\ b^L_{t,j} &\geq 0 \end{aligned}$$

Haircut & interest rates

- Haircut:

$$h_{t+1,j} \equiv \begin{cases} 0 & \text{if } \delta_{t+1,j} = 0 \text{ (no default)} \\ 1 - \frac{(1-\theta)\left(D_j + \phi_j \xi_{t+1} P_{t+1} b^B_{t,j}\right)}{\theta(-d^L_{t,j} - d^{L*}_{t,j})} & \text{if } \delta_{t+1,j} = 1 \end{cases}$$

- Interest rates:

$$R_{t,j} \equiv \frac{1}{q_{t,j}}$$

FOCs

- (Unconstrained) lenders in j:

$$\mu^L_{b,t,j} \overset{b}{=} \underbrace{P_t u'\left(c^L_{y,t,j}\right)}_{\text{marginal cost}} - \beta \underbrace{P_{t+1} E_t\left[\xi_{t+1}\right]}_{\text{E marginal resale value}}$$

$$u'\left(c^L_{y,t,j}\right) \overset{d}{=} \beta E_t\left[1-h_{t+1,j}\right]/q_{t,j} = \beta E_t\left[1-h_{t+1,-j}\right]/q_{t,-j}$$

- Borrowers in country j:

$$\mu^B_{b,t,j} \overset{b}{=} \underbrace{P_t u'\left(c^B_{y,t,j}\right)}_{\text{marginal cost}} - \beta \underbrace{P_{t+1} E_t\left[\left(1-\phi_j \delta_{t+1,j}\right)\xi_{t+1}\right]}_{\text{E marginal resale value}} - \underbrace{\phi_j P_{t+1} \mu^B_{d,t,j}}_{\text{"collateral value"}}$$

$$\mu^B_{d,t,j} \overset{d}{=} \underbrace{q_{t,j} u'\left(c^B_{y,t,j}\right)}_{\text{marginal gain}} - \beta \underbrace{E_t\left[1-\delta_{t+1,j}\right]}_{\text{E marginal cost of debt service}}$$

Equilibrium definition

- Definition: Given $P_0 \geq 0$, $\{\xi_t\}_{t=0}^{\infty}$, equilibrium consists of {portfolio choices, default decision, haircuts, prices} satisfying optimality & market clearing.
- Market clearings in **autarky**:

$$\theta\, b_{t,j}^{L} + (1-\theta)\, b_{t,j}^{B} = 1 \text{ if } P_t > 0$$

$$\theta\, d_{t,j}^{L} + (1-\theta)\, d_{t,j}^{B} = 0,\ \forall j$$

- Market clearings under **financial integration**:

$$\theta\, b_{t,N}^{L} + (1-\theta)\, b_{t,N}^{B} + \theta\, b_{t,S}^{L} + (1-\theta)\, b_{t,S}^{B} = 1$$

$$\theta\, d_{t,j}^{L} + \theta\, d_{t,-j}^{L*} + (1-\theta)\, d_{t,j}^{B} = 0,\ \forall j$$

- Bubble-less: $P_t = 0$, $\forall t$. Asymptotic bubble: $\lim_{t\to\infty} P_t > 0$.

Assumptions

- First best: no credit frictions, then

$$c^L_{y,t} = c^B_{y,t} = y^{ave} \equiv \theta y^L + (1-\theta)\, y^B$$

$$R^{fb} = \beta^{-1} u'\left(y^{ave}\right)$$

- Assumptions:

$$R^{fb} \geq 1 \tag{A1}$$

$$D_j < \underbrace{\beta^{-1} u'\left(y^{ave}\right)}_{R^{fb}} \underbrace{\theta\left(y^r - y^p\right)}_{d^{p,fb}}, \forall j \tag{A2}$$

  - A1 $\Rightarrow$ Bubbles are impossible in frictionless economy.
  - A2 $\Rightarrow$ With frictions, credit constraint binds

- For talk, set $\theta = 1/2$ and $\beta = 1$.

Benchmarks

1. Bubble-less
   1. Closed
   2. Open
2. Bubbles in autarky
   1. South
   2. North

1a. Bubble-less $P \equiv 0$ + Autarky

- Lenders over-consume, borrowers under-consume: $c_j^{B,nb} < y^{ave} < c_j^{L,nb}$
- Interest rate depressed:

$$\underbrace{u'\left(y^L - \frac{1}{\bar{R}_j^{nb}} D_j\right)}_{\bar{R}_j^{nb}} < \underbrace{u'(y^{ave})}_{R^{fb}}$$

  - $\bar{R}_j^{nb} \uparrow$ in D_j

1b. Bubble-less $P \equiv 0$ + **Financial integration**

- A single interest rate R^{nb}, solving

$$R^{nb} = u'\left(y^L - \frac{1}{R^{nb}}\frac{D_S + D_N}{2}\right)$$

  - Recall: $\bar{R}_j^{nb} = u'\left(y^L - \frac{1}{\bar{R}_j^{nb}} D_j\right)$

$\Rightarrow$ Integration $\uparrow$ interest rate for S, $\downarrow$ for N:

$$\bar{R}_S^{nb} < R^{nb} < \bar{R}_N^{nb}$$

$\Rightarrow$ "Savings glut:" N is net debtor to S

$$D_N > 0 > D_S$$

  - Capital flows from S to N in the period t following financial integration ($CA_{N,t} < 0 < CA_{S,t}$)

Benchmarks

- Bubble-less
  - Closed
  - Open
- **Bubbles in autarky**
  - **South**
  - North

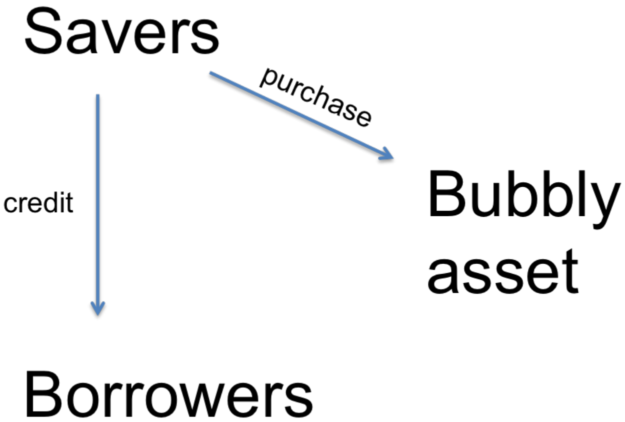
Financially underdeveloped S

- Recall $\phi_S = 0$. Hence:

$$R_t d_t \leq D_S. \tag{CC}$$

- Lemma: only lenders buy bubble in equilibrium.
  - Intuition: bubble does not provide any value for credit-constrained borrowers
  - Hence, S bubble is **unleveraged** (lenders self-finance bubble investment)

Bubble in the S



Existence of unleveraged S bubble

Proposition

$\exists$ *asymptotic bubbly equilibrium in South iff*

$$\underbrace{\bar{R}_S^{nb}}_{\text{no bubble interest rate}} < \underbrace{R_S^b = 1 - p_{burst}}_{\text{unlev. bubble interest rate}} .$$

- Similar to bubble existence condition in Tirole (1985)
- Bubble equilibrium exists iff
  - sufficient credit friction (leading to low R^{nb})
  - bubble not too risky (low p_{burst})

Benchmarks

- Bubble-less
  - Closed
  - Open
- Bubbles in autarky
  - South
  - **North**

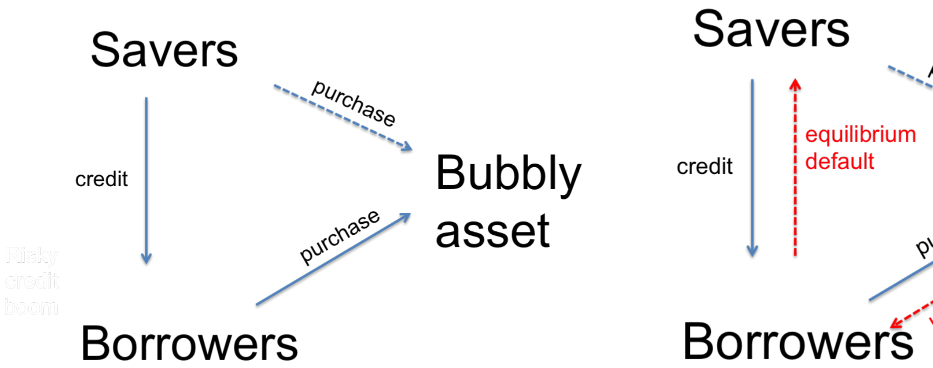
Financially developed N

- Recall $\phi_N = 1$. So:

$$R_t d_t \leq D_N + P_{t+1} b_t \tag{CC}$$

- Lemmas: In bubbly steady state,
  - Borrowers use bubbly collateral: $Rd^B > D$.
  - Only borrowers buy bubble.
- Intuition:
  - Bubble provides collateral value to borrowers, but not to lenders
  - Borrowers shift bubble risk thanks to defaultable debt
  - $\Rightarrow$ When ϕ so high, only borrowers buy bubble
  - Bubble investment is **leveraged** (financed by credit)

If bubble has high pledgeability



Existence of leveraged bubble

Proposition

$\exists$ *asymptotic bubbly equilibrium in closed North iff*

$$\underbrace{\bar{R}_N^{nb}}_{no\ bubble\ interest\ rate} < \underbrace{R^{lb} = 1}_{lev.\ bubble\ interest\ rate} .$$

- Again, similar to existence condition in Tirole (1985)
- Bubble equilibrium exists iff
  - sufficient inequality and/or financial frictions (leading to low R^{nb})
- But this time bubble risk p_{burst} **plays no role**
  - consequence of risk-shifting, as in Ikeda-Phan (2015)

Bubbly Effects of Financial Integration

Plan

- Will show: integration facilitates existence of risky asset bubbles
- To show this in the clearest possible way, we set parameters so that risky bubble *cannot* exist in closed economy.
- Recall:
  - $D_S < D_S \Rightarrow \bar{R}_S^{nb} < \bar{R}_N^{nb}$.
  - Bubble exists in closed S iff $\bar{R}_S^{nb} < R^{ub} \equiv 1 - p_{burst}$.
  - Bubble exists in closed N iff $\bar{R}_N^{nb} < R^{lb} \equiv 1$.
- Assume p_{burst}, D_N, D_S such that:

$$1 - p_{burst} \leq \bar{R}_S^{nb} \quad \text{(A3)}$$

$$1 \leq \bar{R}_N^{nb} \quad \text{(A4)}$$

  - Then bubble cannot exist in closed economies

Unleveraged bubble

- Assume integration. Can unleveraged bubble exist?
- Lemma: $\nexists$ any bubble s.s. where a lender buys the bubble asset.
  - Intuitively, if $\exists$ such a s.s., then interest rate is $R^{ub} \equiv 1 - p_{burst}$ (as lender internalizes bubble risk).
  - Existence of bubble requires bubble-less interest rate to be low: $R^{nb} < 1 - p_{burst}$.
  - Integration raises R for S ($\bar{R}_S^{nb} < R^{nb}$).
  - So $\bar{R}_S^{nb} < 1 - p_{burst}$.
  - But this violates (A3), that $\nexists$ bubble in closed S.

Leveraged bubble

- Can a leveraged bubble exist?
- Yes. Focus on the case where:
  - Only N borrowers buy the bubble ($b_N^B > 0$, $b_N^L = b_S^B = b_S^L = 0$), so bubble is "purely" leveraged
  - Credit constraints bind
- Recall characteristics of leveraged bubble:
  - When bubble investment is financed with credit, the collapse leads to default
  - Risk shifting $\Rightarrow$ steady state interest rate: $R^{lb} = 1$.

Proposition

$\exists$ a bubble s.s. in integrated economies iff $R^{nb} < 1$.

Main result

Theorem

Assume

A3 . *Bubbles are sufficiently risky:* $1 - p_{burst} \leq \bar{R}_S^{nb}$

A4 . *N sufficiently financially developed:* $1 \leq \bar{R}_N^{nb}$.

Then:

1. $\nexists$ *bubble s.s. in closed economies*
2. $\exists$ *bubble s.s. in open economies if integration lowers R sufficiently (from N's perspective):*

$$R^{nb} < 1.$$

- More generally, model implies financial integration facilitates existence of bubbles that are:
  - risky
  - leveraged (financed by credit, associated with default risk)

Conclusion

A positive theory of how financial integration facilitates risky leveraged bubbles