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Macro-prudential Policy in a Fisherian Model of Financial Innovation

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[1]The views expressed in this paper are those of the authors and should not be attributed to the International Monetary Fund.

Motivation

- Interaction of financial innovation, imperfect information and credit frictions plays a key role in credit cycles.
- It is widely agreed that macro-prudential policies have to be part the policy toolbox to address credit cycles.
- To-date we don't have models of macro-prudential policies in which this interaction is the key driver of the financial amplification mechanism.

Key Ingredients of the Fisherian Model

- Ingredient 1: Informational frictions
  - Financial innovation due to new products and new laws
  - Learning about the new financial environment
    - No data on default and performance
    - "Layering of risk" created the belief that instruments were risk free.

Key Ingredients of the Fisherian Model

- Ingredient 2: Credit frictions
  - Collateral constraints limit agents' ability to borrow to a fraction of the value of their assets
  - Pecuniary externality: Agents fail to internalize the effect of their borrowing decisions on asset prices.

Analysis

- Positive: decentralized equilibrium (DE) in which learning and credit frictions are present.
- Normative: planner can undo the externality but maybe not the informational friction
  - SP1: Uninformed as private agents and faces the same set of feasible credit positions as DE with learning (same collateral pricing function)

  - SP2: Fully informed but faces the same set of feasible credit positions as DE with learning
  - SP3: Fully informed and faces the same set of feasible credit positions as DE with full information

Learning Scenario

- Agents face a collateral constraint that limits debt not to exceed a fraction κ of the value of their land holdings.
- Financial innovation introduces two regimes: $\kappa^l < \kappa^h$.
- Agents know κ^h & κ^l but not the regime-switching probabilities. They learn by observing regime realizations, and in the long-run beliefs converge to true probs.
- Overborrowing and overpricing followed by sharp reversals occur because learning leads to optimism and pessimism.
- Learning dynamics interact with Fisherian deflation and produce strong amplification effects.

Main Findings: Decentralized Equilibrium (DE)

- After short spell of κ^h agents turn optimistic and believe κ^h is "almost absorbent."
- "Optimistic phase" generates a boom in borrowing and residential land value.
- First κ^l starts "pessimistic phase," triggers credit crunch, land price collapse amplified by Fisherian deflation.

The model at hand is a reasonable laboratory to study policy!

Main Findings: Policy

- Effectiveness of policy depends on SPs information sets and the set of credit positions they can support.
- All SPs choose lower debt than DE during optimistic phase:
  - SP3 reduces the debt buildup to 1/10th of DE
  - SP1 is more effective in reducing overborrowing when priors produce milder optimism and the constraint is less tight.
- Only SP3 can prevent an increase in the price of the asset.
- SP2 chooses lower debt but ends up with similar prices as DE.
- Taxes on debt required to implement SP allocations can be as high as 8-9 percent
  - SP2 and SP3 tax more heavily than SP1.

Model: Private Agents' Problem

Agents maximize

$$E_0^s \left[\sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma}}{1-\sigma} \right]$$

subject to the budget constraint

$$q_t k_{t+1} + c_t + \frac{b_{t+1}}{R_t} = q_t k_t + b_t + \varepsilon_t Y(k_t)$$

and a collateral constraint

$$-\frac{b_{t+1}}{R_t} \leq \kappa_t q_t k_{t+1}.$$

Learning Problem

- Agents learn by observing realizations of κ's.
- They take as given
  - A history of realizations of κ observed over T periods,
  - Initial priors for date $t = 0$
- n_t^{ij}: the number of transitions from state κ^i to κ^j
- Posterior means satisfy:

$$E_t[F_{hh}^s] = \frac{n_t^{hh}}{n_t^{hh} + n_t^{hl}}$$

$$E_t[F_{ll}^s] = \frac{n_t^{ll}}{n_t^{ll} + n_t^{lh}}$$

- Two stage solution:
  - Learning dynamics,
  - Recursive Anticipated Utility optimization problems (AUOP).

Constrained Planners' Problems

Planners maximize

$$E_0^i\left[\sum_{t=0}^{\infty}\beta^t\frac{c_t^{1-\sigma}}{1-\sigma}\right] \qquad \text{for} \quad i = SP1, SP2, SP3$$

subject to

$$c_t + \frac{b_{t+1}}{R_t} = b_t + \varepsilon_t Y(1)$$

and

$$-\frac{b_{t+1}}{R_t} \leq \kappa_t q_t^i.$$

- SP1: $E^i = E^s$ and $q_t^i = q_t^{DEL}$
- SP2: $E^i = E^a$ and $q_t^i = q_t^{DEL}$
- SP3: $E^i = E^a$ and $q_t^i = q_t^{DEF}$

Externality, Information and Interaction

Euler Equation:

$$u'\left(c_t(b,\varepsilon,\kappa)\right) - \mu_t(b,\varepsilon,\kappa) =$$

$$\beta R E_t^i \left[u'(c_t(b',\varepsilon',\kappa')) \qquad\qquad\qquad \right]$$

Externality, Information and Interaction

Euler Equation:

$$u'\left(c_t(b,\varepsilon,\kappa)\right)-\mu_t(b,\varepsilon,\kappa)=$$
$$\beta R E_t^i\left[u'(c_t(b',\varepsilon',\kappa'))+\kappa'\mu_t(b',\varepsilon',\kappa')\frac{\partial q_t^i(.)}{\partial b'}\right]$$

Externality, Information and Interaction

Euler Equation:

$$u'\left(c_t(b,\varepsilon,\kappa)\right) - \mu_t(b,\varepsilon,\kappa) =$$

$$\beta R E_t^i\left[u'(c_t(b',\varepsilon',\kappa')) + \kappa'\mu_t(b',\varepsilon',\kappa')\frac{\partial q_t^i(.)}{\partial b'}\right]$$

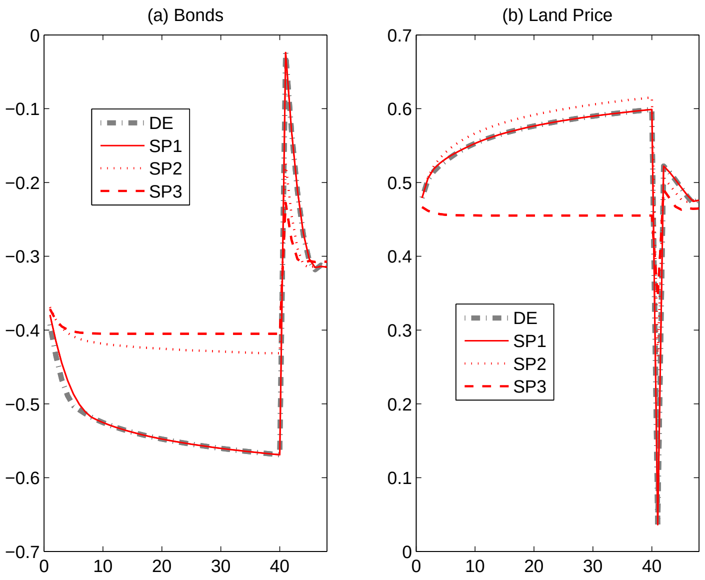
Quantitative Analysis: Financial Innovation Experiment

- Pre-financial innovation: Before 1997, regime with constant κ^l but stochastic TFP
- Financial Innovation: 1997Q1, introduction of regime with two possible values of κ and first realization of κ^h
  - First publicly available securitization of CRA loans.
  - Net credit assets-GDP ratio started to fall in 1997.
- Financial crisis: 2007Q1, first realization of κ^l. Early stages of the subprime mortgage crisis in Fall 2006.
- Learning period of $T = 48$ quarters, first 40 with κ^h and remaining 8 with κ^l.

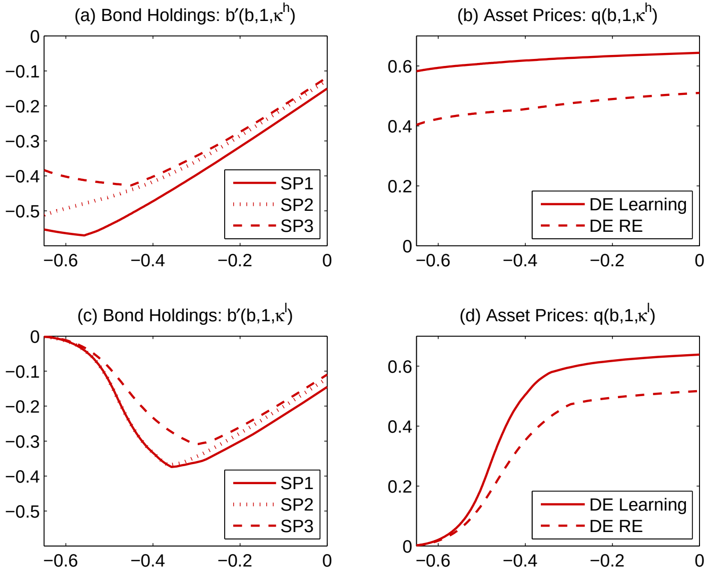
Calibration

		Base. 1	Base. 2
F^a_{hh}	True persistence of κ^h	0.964	0.968
F^a_{ll}	True persistence of κ^l	0.964	0.900
n_0^{hh}	Counter, high-to-high	0.0205	12.10
n_0^{hl}	Counter, high-to-low	0.0205	0.40
n_0^{lh}	Counter, low-to-high	0.0205	0.18
n_0^{ll}	Counter, low-to-low	0.0205	0.02

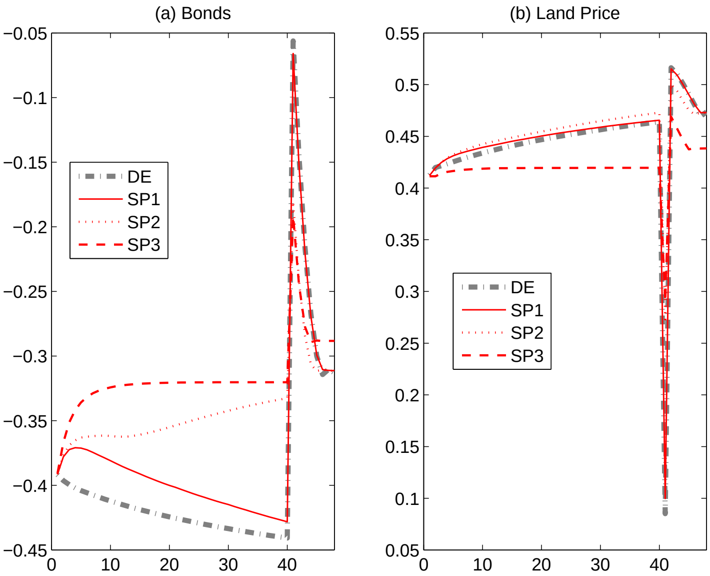
Time Series Simulations: Baseline 1



Bond Holdings and Asset Prices at date-40: Baseline 1



Time Series Simulations: Baseline 2



Decentralization of Planners' Allocations

- SPs use taxes on debt ($\tau^i_{b,t}$) and land dividends ($\tau^i_{l,t}$) to implement constrained efficient allocations

$$u'(t) = \beta R(1 + \tau^i_{b,t})E^s_t \left[u'(t+1)\right] + \mu_t$$

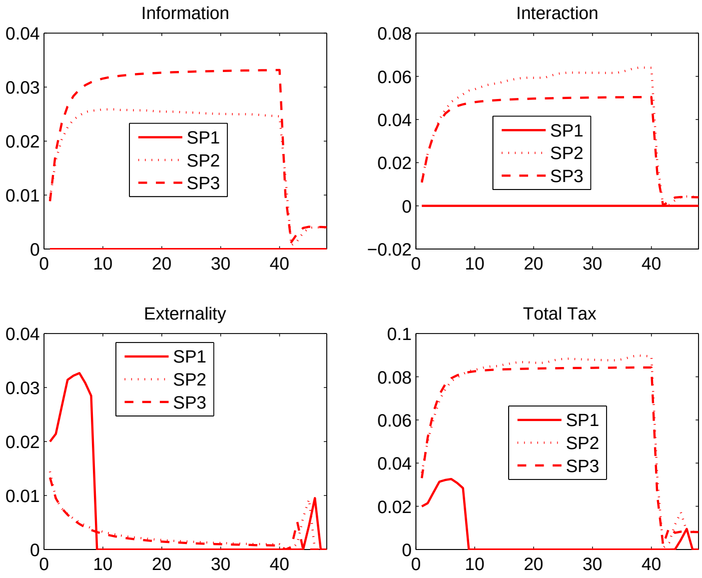
$$q_t(u'(t) - \mu_t \kappa) = \beta E^s_t \left[u'(t+1)\left(\varepsilon_{t+1} Y_k(k_{t+1})(1 - \tau^i_{l,t}) + q_{t+1}\right)\right].$$

Decentralization of Planners' Allocations

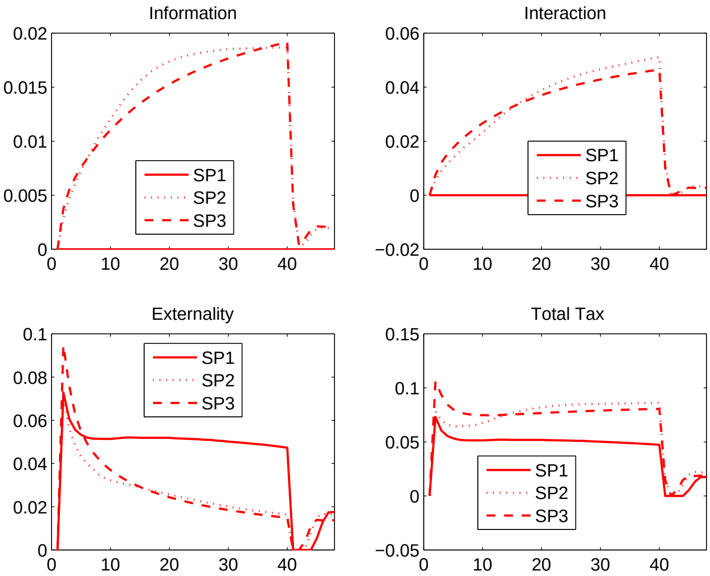
$$\tau^i_{b,t} = \underbrace{\frac{E^i_t[u'(t+1)]}{E^s_t[u'(t+1)]} - 1}_{\text{information}} + \underbrace{\frac{E^i_t\left[\kappa'\mu(t+1)\frac{\partial q^i_t(.)}{\partial b'}\right] - E^s_t\left[\kappa'\mu(t+1)\frac{\partial q^i_t(.)}{\partial b'}\right]}{E^s_t[u'(t+1)]}}_{\text{interaction}}$$

$$+ \underbrace{\frac{E^s_t\left[\kappa'\mu(t+1)\frac{\partial q^i_t(.)}{\partial b'}\right]}{E^s_t[u'(t+1)]}}_{\text{externality}}$$

Taxes on Debt: Baseline 1



Taxes on Debt: Baseline 2



Conclusion

- In a credit boom episode, macro-prudential policies are effective when regulators
  - Have better information than private agents and
  - Can implement feasible sets of credit positions consistent with this information set.
- If regulators operate with the same incomplete information as private agents, the effects of these policies may be more limited depending on the degree of optimism after financial innovation.
- Conversely, poorly informed regulators can make matters worse.