Capital Flow Management when Capital Controls Leak

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IMF ARC Conference, November 14, 2014

Motivation

- How desirable is macroprudential policy when it cannot be enforced on all agents?
- Relevance of policy enforcement problem for macroprudential capital flow management (CFM)?
- Recent research supports use of CFM policies as second-best tools on grounds of financial stability, macro stabilization or ToT management.
- One general criticism of CFM policy opponents is problem of policy enforcement

Motivation

- How desirable is macroprudential policy when it cannot be enforced on all agents?
- Relevance of policy enforcement problem for macroprudential capital flow management (CFM)?
- Recent research supports use of CFM policies as second-best tools on grounds of financial stability, macro stabilization or ToT management.
- One general criticism of CFM policy opponents is problem of policy enforcement
- This paper: evaluate role of policy enforcement for effectiveness, design and desirability of macroprudential CFM policy

Key Questions

1. To what extent do leakages in regulation undermine the **effectiveness** of macropru CFM?
2. How do leakages affect the **optimal design** of macropru CFM?
3. Is macropru CFM still **desirable** when it leaks?

What we do

- Set up a model of macropru CFM with imperfect policy enforcement
  - Emerging market crises model with occasionally binding credit constraint (Mendoza 2002)
  - Credit constraint depends on market price, causing pecuniary externality and overborrowing
  - Tax on borrowing can restore constrained efficiency
  - ... but "shadow sector" can evade the tax
  - Key trade-off of CFM: macroprudential benefits vs. costs of risk-shifting by "shadow sector"

Related Literature

- Theoretical:
  - Capital Controls & Macropru Policies:
    - Caballero-Krishnamurthy 2004; Bianchi 2011; Bianchi-Mendoza 2011-13; Korinek 2011; Jeanne-Korinek 2012; Benigno et al. 2013; Schmitt-Grohe-Uribe 2012; Farhi-Werning 2012-13; Brunnermeier-Sannikov 2014
    - Allen-Gale 2000; Lorenzoni 2008; Farhi-Golosov-Tsyvinsky 2009; Korinek 2011; Bengui 2012
- Empirical:
  - Capital Controls & Macropru Policies:
    - Magud, Reinhart and Rogoff 2011; IMF 2011; Klein 2012; Fernandez-Rebucci-Uribe 2013; Forbes 2007; Forbes-Fratzscher-Straub 2013; Forbes-Klein 2014; Alfaro-Chari-Kanckuk 2014
    - Aiyar, Calomiris, and Wieladek 2014; Dassatti-Peydro 2013
- **Key contribution:** Optimal macroprudential capital controls under imperfect enforcement

Preview of results

- Controls encourage more borrowing by unregulated sphere
- Some controls are in general still desirable
- Optimal controls are more pre-emptive when they leak
- Effectiveness of controls seriously compromised when relative size of unregulated sphere reaches 0.4
- Welfare gains from controls accrue disproportionately to unregulated agents

Roadmap

1. Illustration of Mechanisms in 3-period Model
2. Quantitative Results from Calibrated Model

Simple 3-period Model

- 3-period small open economy model
- Endowment economy: Tradable/Non-tradable goods
- Shock to date 1 tradable endowment only
- Incomplete markets:
  - Debt in units of tradables
  - Credit constraint linked to current income

Simple 3-period Model

- Simple form of heterogeneity
- Two types of agents (exogenously given):
  - Regulated R subject to tax τ on date 0 borrowing (measure $1-\gamma$)
  - Unregulated U (measure γ)
- Parsimonious way to capture:
  - Shadow banking sector
  - Differences in access to sources of funding
  - Differences in ability to exploit loopholes

Households

Type $i \in \{U, R\}$ Agents' Problem

Agent maximizes

$$c_{i0}^T + \mathbb{E}_0 \left[\beta \ln (c_{i1}) + \beta^2 \ln (c_{i2}) \right]$$

with $c_{it} = \left(c_{it}^T\right)^\omega \left(c_{it}^N\right)^{1-\omega}$ subject to (BC0), (BC1) and (BC2) and date 1 credit constraint:

$$b_{i2} \geq -\kappa \left(y_1^T + p_1^N y_1^N \right)$$

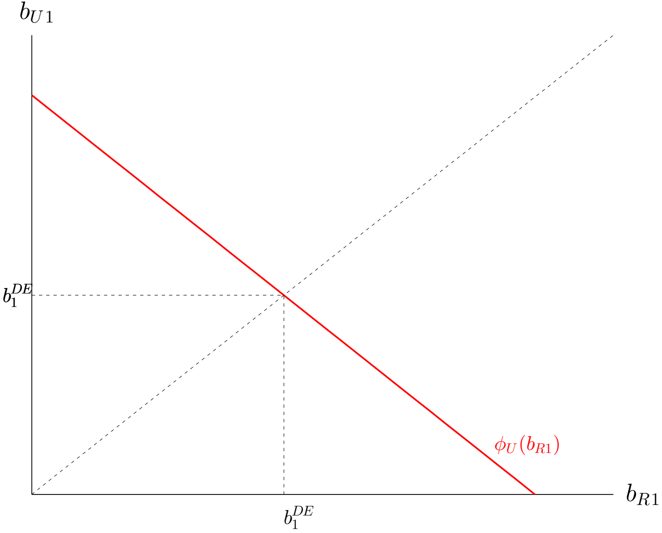
y_1^T is only stochastic variable

▸ U Agent's Full Problem ▸ R Agent's Full Problem

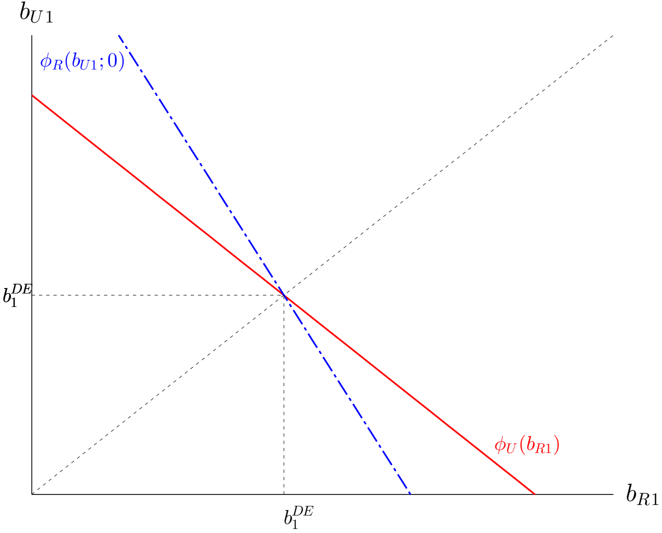
Model Mechanics

- Binding credit constraint $b_2 \geq -\kappa\left(y_1^T + p_1^N y_1^N\right)$ at $t = 1$ triggers decrease in demand for consumption and p^N, which tightens further the constraint, creating pecuniary externality
- ...but private agents fail to internalize these effects, leading to overborrowing (Bianchi (2011), Korinek (2010))
- Planner seeks to reduce overborrowing via $\tau > 0$
- ...but here τ creates risk-shifting to the unregulated sphere

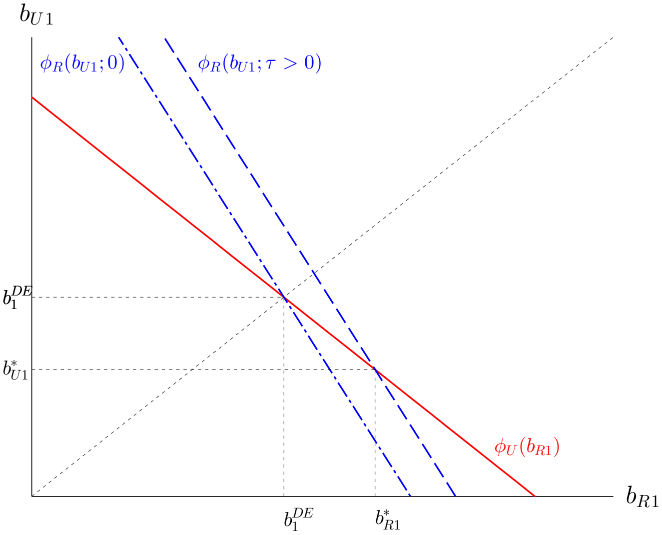
Equilibrium Responses: b_1 Strategic Substitutes



Equilibrium Responses: b_1 Strategic Substitutes

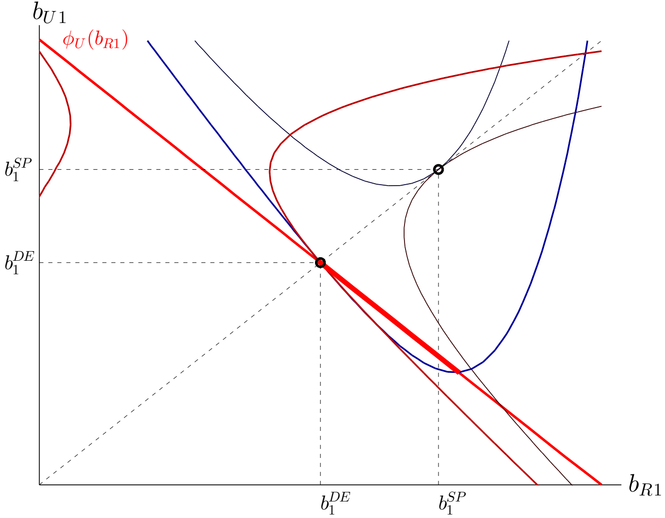


Responses to Capital Controls



Welfare Effects of Capital Controls

Positive controls lead to Pareto improvements



Optimal Capital Controls Without Leakages

Planner's optimal bond choice on behalf of regulated agents

$$1 = \beta(1+r)\mathbb{E}_0\left[\frac{\omega}{c_{R1}^T}\right] + \underbrace{\beta\mathbb{E}_0\left[\left(\overset{+}{\mu}_{R1}\right)\kappa\left(\frac{\partial \overset{+}{p}{}_t^N}{\partial b_{R1}}\right)\right]}_{\text{credit constraint relaxation}}$$

Optimal Capital Controls

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$$1 = \beta(1+r)\mathbb{E}_0\left[\frac{\omega}{c^T_{R1}}\right] + \underbrace{\beta\mathbb{E}_0\left[\left(\overset{+}{\mu}_{R1} + \frac{\gamma}{1-\gamma}\overset{+}{\mu}_{U1}\right)\kappa\left(\frac{\overset{+}{\partial p^N_t}}{\partial b_{R1}} + \frac{\overset{+}{\partial p^N_t}}{\partial b_{U1}}\frac{\overset{-}{\partial b_{U1}}}{\partial b_{R1}}\right)\right]}_{\text{credit constraint relaxation}}$$

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Two opposite forces of shadow sector ($\gamma > 0$):

Capital controls **less effective** but **more desirable**

Optimal Capital Controls

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$$\underbrace{+\gamma\sum_{t=1}^{2}\beta^t\mathbb{E}_0\left[\left(\frac{\omega}{c^T_{Ut}} \overset{+}{-} \frac{\omega}{c^T_{Rt}}\right)\left(c^N_{Rt} \overset{+}{-} c^N_{Ut}\right)\left(\frac{\overset{+}{\partial p^N_t}}{\partial b_{R1}} + \frac{\overset{+}{\partial p^N_t}}{\partial b_{U1}}\frac{\overset{-}{\partial b_{U1}}}{\partial b_{R1}}\right)\right]}_{\text{wealth redistribution}}$$

Two opposite forces of shadow sector ($\gamma > 0$):

Capital controls **less effective** but **more desirable**

Insights from 3-Period Model

- Controls increase borrowing by unregulated sphere
- Controls are still desirable (Pareto improvements)
- Size of optimal controls depends on two forces
  1. leakages make controls less effective $\downarrow$
  2. leakages make controls more desirable $\uparrow$
- Next, a quantitative model to explore these magnitudes

Quantitative Model of Emerging Markets Crises

- Infinite horizon extension of 3 period model with CRRA utility function and CES aggregator of T-NT goods, (Bianchi, 2011)
- Focus on optimal time consistent policy
  - Policies are a function of $X = \left(b_U, b_R, y^T\right)$
- Global (non-linear) solution
- Preliminary calibration
- Today will show $\gamma \in [0, 1]$

Planner's problem with leakages

$$\mathcal{V}(X) = \max_{\{c_i^T, c_i^N, b_i'\}_{i\in\{U,R\}}, p^N} \gamma u\left(c\left(c_U^T, c_U^N\right)\right) + (1-\gamma)u\left(c\left(c_R^T, c_R^N\right)\right) + \beta\mathbb{E}\mathcal{V}(X')$$

subject to

$$\begin{aligned}
c_i^T + p^N c_i^N + b_i' &= b_i(1+r) + y^T + p^N y^N \qquad \text{for} \quad i \in \{U,R\} \\
b_i' &\geq -\left(\kappa^N p^N y^N + \kappa^T y^T\right) \text{ for} \quad i \in \{U,R\} \\
y^N &= \gamma c_U^N + (1-\gamma) c_R^N \\
p^N &= \left(\frac{1-\omega}{\omega}\right)\left(\frac{c_R^T}{c_R^N}\right)^{\eta+1} \qquad \text{for} \quad i \in \{U,R\} \\
u_T\left(c_U^T, c_U^N\right) &\geq \beta(1+r)\mathbb{E}u_T\left(\mathcal{C}_U^T(X'), \mathcal{C}_U^N(X')\right)
\end{aligned}$$

$$\left[b_U' + \left(\kappa^N p^N y^N + \kappa^T y^T\right)\right] \times \left[\beta(1+r)\mathbb{E}u_T\left(\mathcal{C}_U^T(X'), \mathcal{C}_U^N(X')\right) - u_T\left(c_U^T, c_U^N\right)\right] = 0$$

Markov Perf. Eq.: $\mathcal{B}_i(X) = b_i'(X), \mathcal{C}_i^T(X) = c_i^T(X), \mathcal{C}_i^N(X) = c_i^N(X)$

Quantitative Results

▸ Calibration

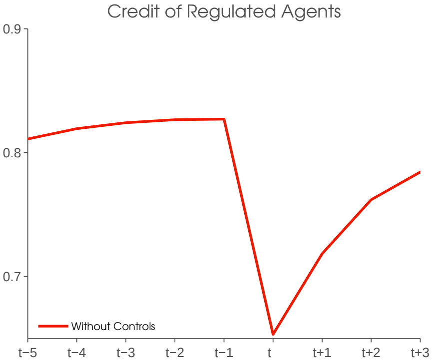
Comparative statics w.r.t. size of shadow sector γ

- Severity of crises (i.e. sudden stops defined as $CA > std(CA)$)
- Frequency of crises
- Welfare effects of macroprudential controls

▸ U agents' borrowing ▸ R agents' borrowing ▸ Optimal taxes

Severity of Crises

Credit dynamics



Severity of Crises

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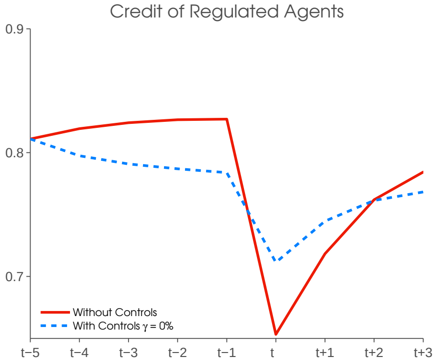

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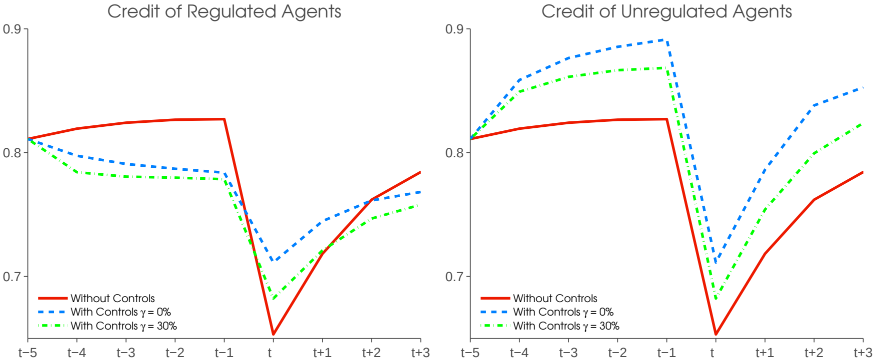

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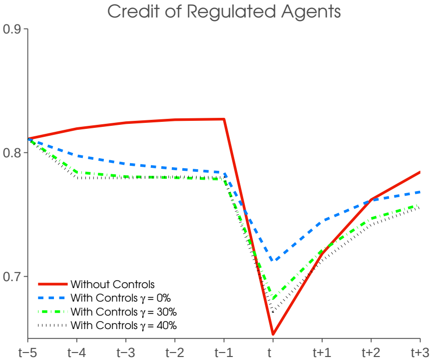
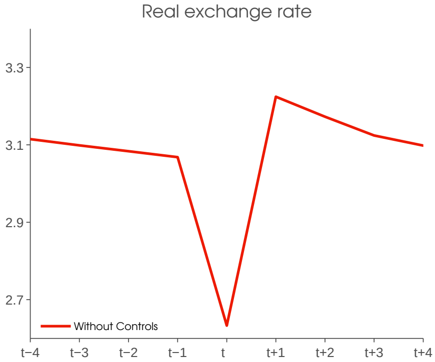
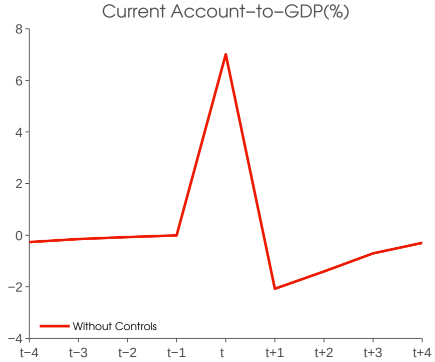


Severity of Crises

Exchange rate depreciation and Current account reversal





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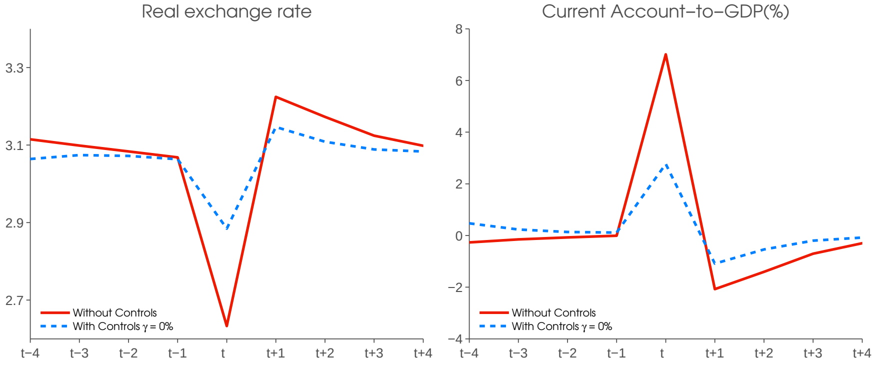

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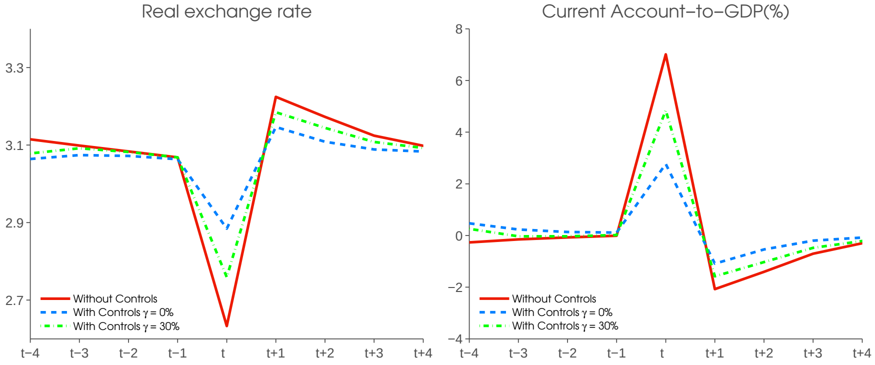

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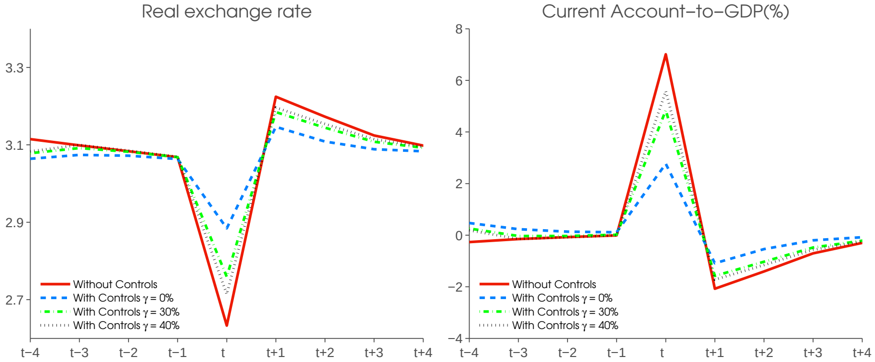
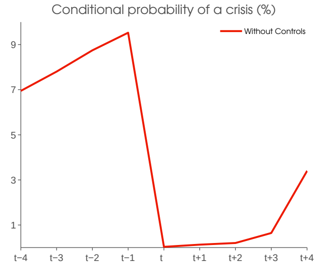
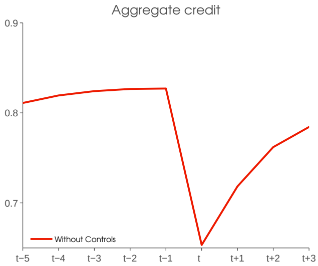


Severity of crises

Probability of crisis and optimal tax

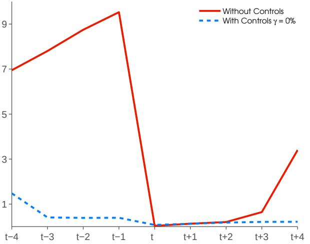




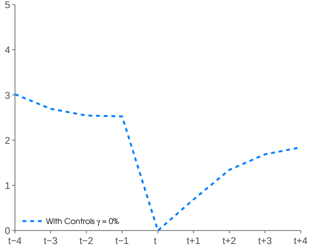
Severity of crises

Probability of crisis and optimal tax

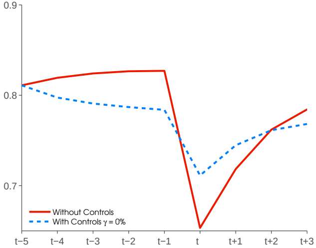
Conditional probability of a crise (%)



Optimal tax (%)

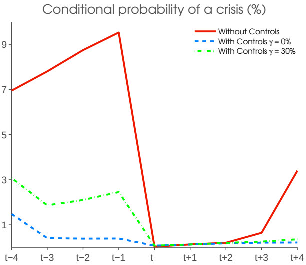


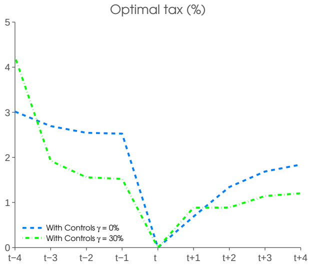
Aggregate credit

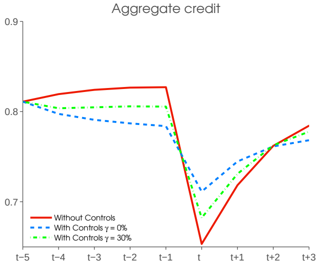


Severity of crises

Probability of crisis and optimal tax







Severity of crises

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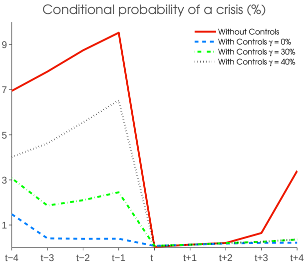
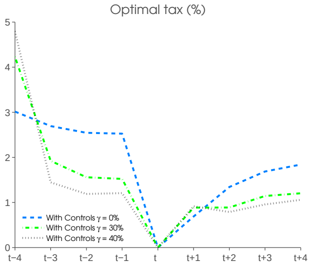
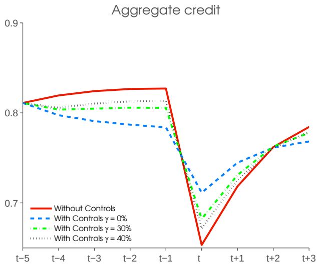
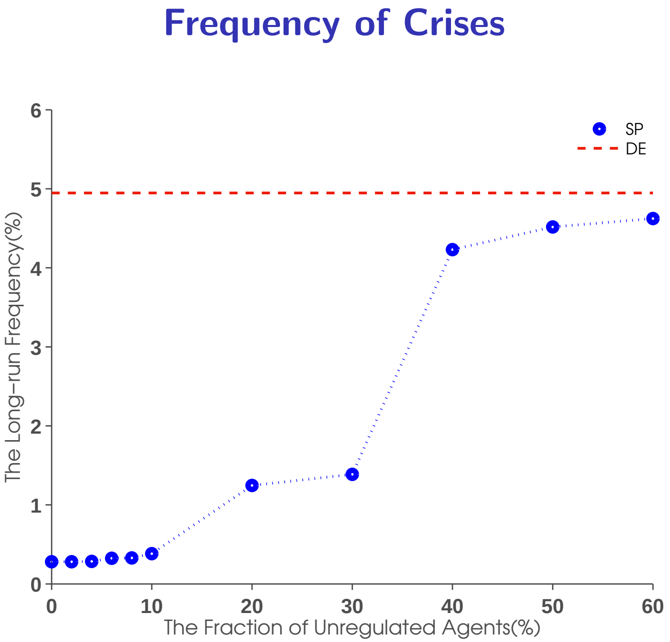
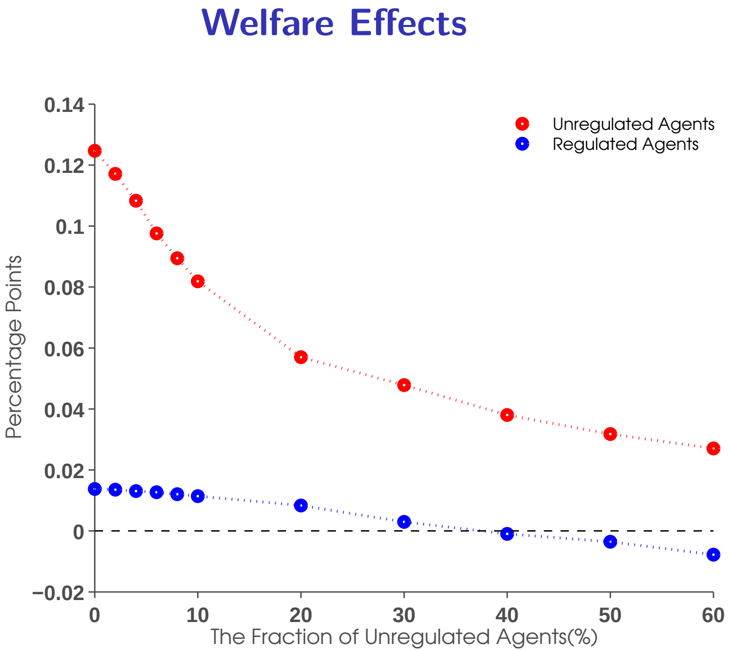







Frequency of Crises
SP
DE
The Long-run Frequency(%)
6
5
4
3
2
1
0
0
10
20
30
40
50
60
The Fraction of Unregulated Agents(%)


Welfare Effects
Unregulated Agents
Regulated Agents
Percentage Points
The Fraction of Unregulated Agents(%)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
−0.02
0
10
20
30
40
50
60

Conclusion

- Theory of macropru CFM under imperfect policy enforcement
- Unregulated agents respond to macropru CFM by taking more risk, undermining policy effectiveness
- Capital controls appear to be effective despite large leakages
- Capital controls should be even more preemptive
- Potentially relevant for other areas of macropru policies

Households

Unregulated Agents' Full Problem

Agent maximizes

$$c_{U0}^{T} + \mathbb{E}_0 \left[\beta \ln \left(c_{U1} \right) + \beta^2 \ln \left(c_{i2} \right) \right]$$

with $c_{Ut} = \left(c_{Ut}^{T} \right)^{\omega} \left(c_{Ut}^{N} \right)^{1-\omega}$ subject to

$$\begin{aligned} c_{U0}^{T} &= -b_{U1} \\ c_{U1}^{T} + p_1^N c_{U1}^{N} + b_{U2} &= (1+r)\, b_{U1} + y_1^T + p_1^N y_1^N \\ c_{U2}^{T} + p_2^N c_{U2}^{N} &= (1+r)\, b_{U2} + y_2^T + p_2^N y_2^N \\ b_{U2} &\geq -\kappa \left(y_1^T + p_1^N y_1^N \right) \end{aligned}$$

Back

Households

Regulated Agents' Full Problem

Agent maximizes

$$c_{R0}^T + \mathbb{E}_0 \left[\beta \ln(c_{R1}) + \beta^2 \ln(c_{R2}) \right]$$

with $c_{Rt} = \left(c_{Rt}^T\right)^\omega \left(c_{Rt}^N\right)^{1-\omega}$ subject to

$$\begin{aligned} c_{R0}^T &= -b_{R1} \\ c_{R1}^T + p_1^N c_{R1}^N + b_{R2} &= (1+r)(1+\tau) b_{R1} + y_1^T + p_1^N y_1^N + T \\ c_{R2}^T + p_2^N c_{R2}^N &= (1+r) b_{R2} + y_2^T + p_2^N y_2^N \\ b_{R2} &\geq -\kappa \left(y_1^T + p_1^N y_1^N \right) \end{aligned}$$

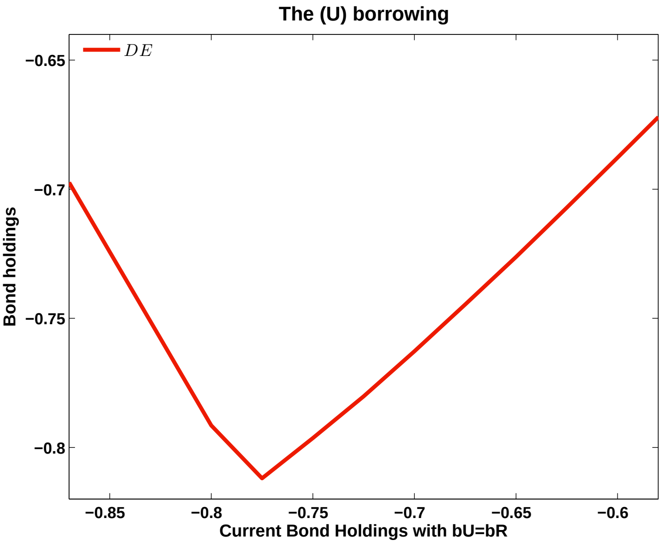
Back

Calibration ▸ Back

	Value	Source
Interest rate	$r = 0.04$	Standard value DSGE-SOE
Risk aversion	$\sigma = 2$	Standard value DSGE-SOE
Elasticity of substitution	1	Otherwise MPE doesn't converge
Calibration	**Value**	**Target**
Weight on tradables in CES	$\omega = 0.31$	Share of tradable output=32%
Discount factor	$\beta = 0.91$	Average NFA-GDP $= -29\%$
Credit coefficient	$\kappa^H = 0.5$	never binds
	$\kappa^L = 0.25$	Prob. of SS $= 5\%$
$P = \begin{bmatrix} 0.1 & 0.9 \\ 0.1 & 0.9 \end{bmatrix}$		mean duration $\kappa^H = 10$ years
		LR prob. of $\kappa^L = 10\%$

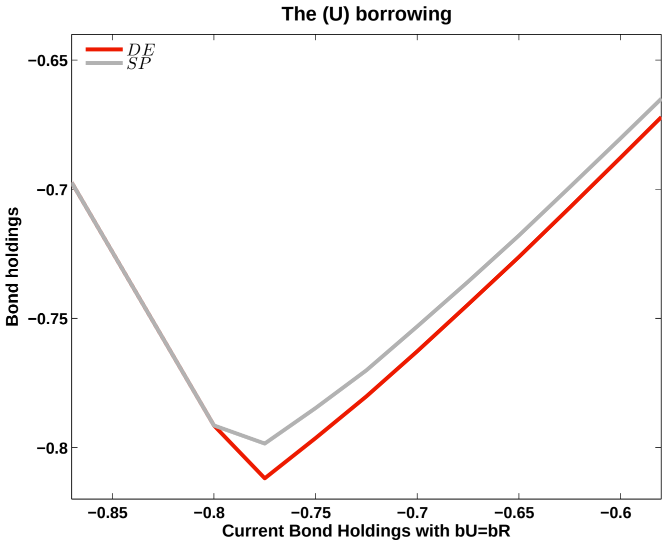
Borrowing decisions ▸ Back

Unregulated agents



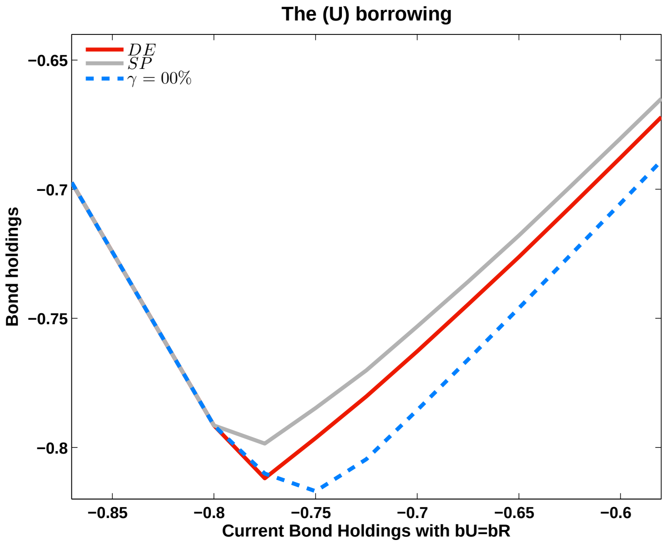
Borrowing decisions ▸ Back

Unregulated agents



Borrowing decisions ▸ Back

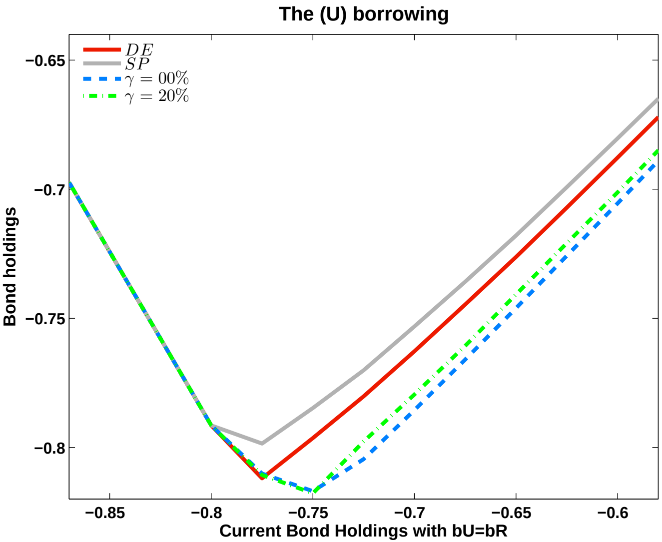
Unregulated agents



Borrowing decisions

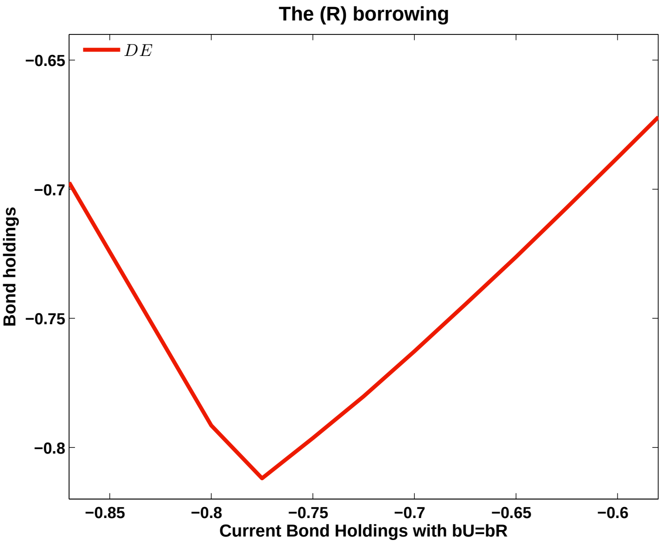
Back

Unregulated agents



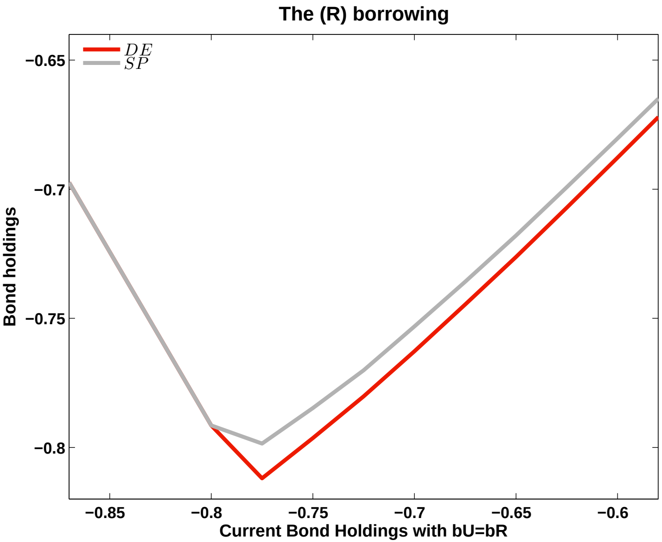
Borrowing decisions ▸ Back

Regulated agents



Borrowing decisions ▸ Back

Regulated agents



Borrowing decisions

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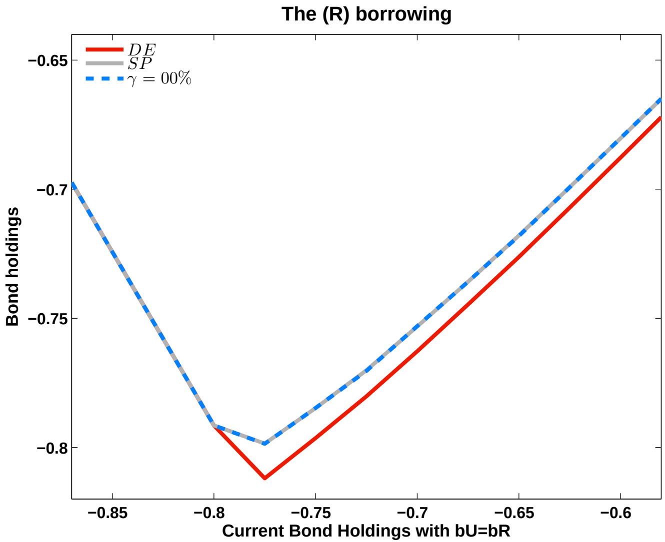

Borrowing decisions

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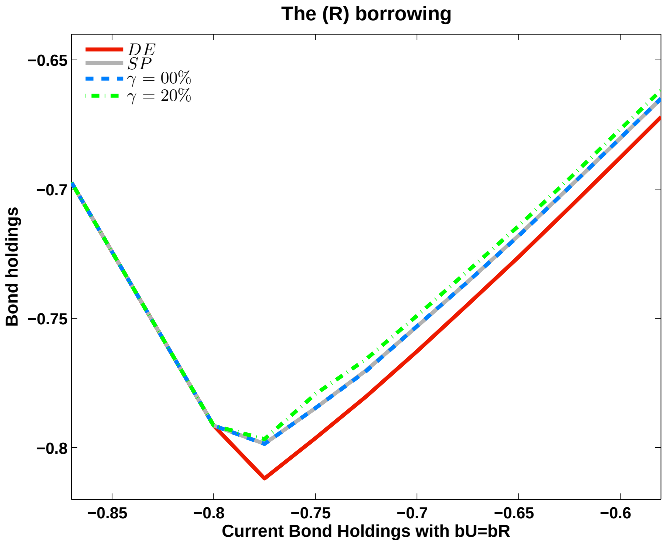
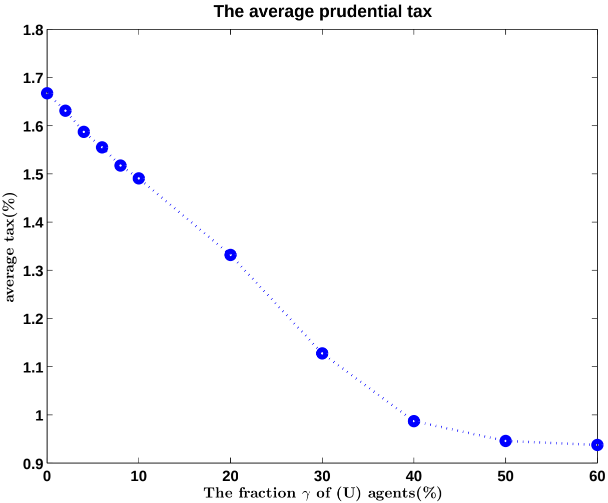
Regulated agents



Optimal tax on borrowing ▸ Back

Average tax



Optimal tax on borrowing

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Example of non-monotonicity w.r.t. γ