Capital Flow Management when Capital Controls Leak

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Conference on Monetary Policy and Financial Stability
in Emerging Markets, CRBT June 13-14, 2014

Motivation

- Central banks in emerging markets have responded to large capital inflows using capital flow management (CFM) policies
- Wide theoretical support for prudential CFM policies:
  - Bianchi 2011; Bianchi-Mendoza 2011-13; Jeanne-Korinek 2012; Korinek 2011; Schmitt-Grohe-Uribe 2012; Farhi-Werning 2012-13
- ...But empirical literature suggests that there may be important leakages (IMF, 2011)
- Crucial disconnect between theory and empirics

Research Questions

1. To what extent do leakages in regulation undermine the effectiveness of capital controls?
2. How do leakages affect the optimal design of regulation?
3. Are capital controls desirable when they leak?

This Paper

- Theory of optimal CFM with imperfect regul. enforcement
- Rationale for capital controls due to pecuniary externality
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- ...but “shadow sector” can evade capital controls
- Key trade-off: a central bank that raises capital controls trades-off prudential benefits against the costs of higher risk-taking by unregulated agents
- Comparative analysis for different sizes of shadow sector γ

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2. How do leakages affect the design of regulation?

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3. Are capital controls desirable when they leak?

   Yes, but important to consider leakage distortions and redistribution effects

Related Literature on Capital Controls

- Theoretical Literature:
  - Bianchi 2011; Bianchi-Mendoza 2011-13; Jeanne-Korinek 2012; Korinek 2011; Benigno et al. 2013; Schmitt-Grohe-Uribe 2012; Farhi-Werning 2012-13; Bengui 2012; Brunnermeier-Sannikov 2014
- Empirical Literature:
  - Magud, Reinhart and Rogoff 2011; IMF 2011; Cline 2010; Klein 2012; Federico-Vegh-Vuletin 2013, Fernandez-Rebucci-Uribe 2013; Forbes 2007; Forbes-Fratzscher-Straub 2013; Forbes-Klein 2014; Aiyar, Calomiris, and Wieladek; Alfaro-Chari-Kanckuk 2014; Dassatti-Peydro 2013

Key contribution: Optimal capital controls under imperfect enforcement

Roadmap

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

Simple Model

- Three-period small open economy model
- Stochastic endowment economy: Tradable/Non-tradable
- Incomplete markets:
  - Debt in units of tradables
  - Credit constraint linked to current income
- Scope for tax on inflows due to pecuniary externality (Bianchi, 2011; Korinek 2011)

Simple Model

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

Households

Unregulated Agents

Agent maximizes

$$c_{U0}^{T} + \mathbb{E}_0\left[\beta \ln\left(c_{U1}\right) + \beta^2 \ln\left(c_{U2}\right)\right]$$

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

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

Households

Regulated Agents

Agent maximizes

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

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

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

Regulated Equilibrium

- Indexed by τ.
- Households choose b', c^T, c^N optimally

$$p_t^N = \frac{1-\omega}{\omega} C_t^T$$

$$1 = \beta(1+r)(1+\tau)E_0\left[\frac{\omega}{c_{R1}^T}\right]$$

$$\frac{\omega}{c_{R1}^T} = \beta(1+r)\frac{\omega}{c_{R2}^T} + \mu_R$$

- Market clearing: output equals consumption of non-tradables
- Government budget constraint is satisfied

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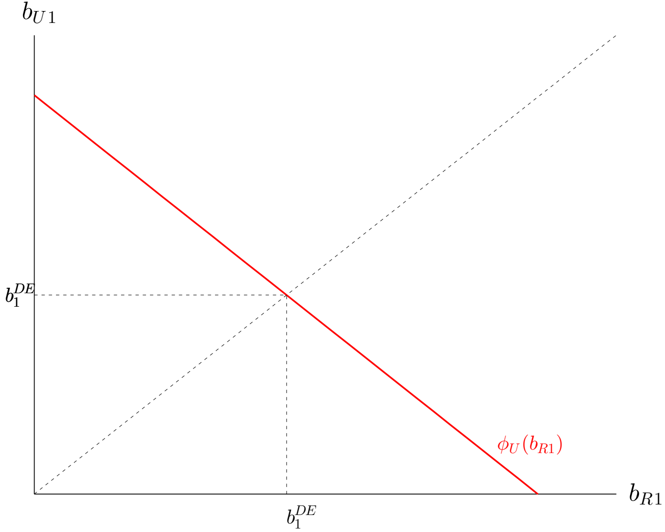
- Market clearing: output equals consumption of non-tradables
- Government budget constraint is satisfied
- Decentralized (unregulated) equilibrium $\tau = 0$

Best Responses: b_t Strategic Substitutes



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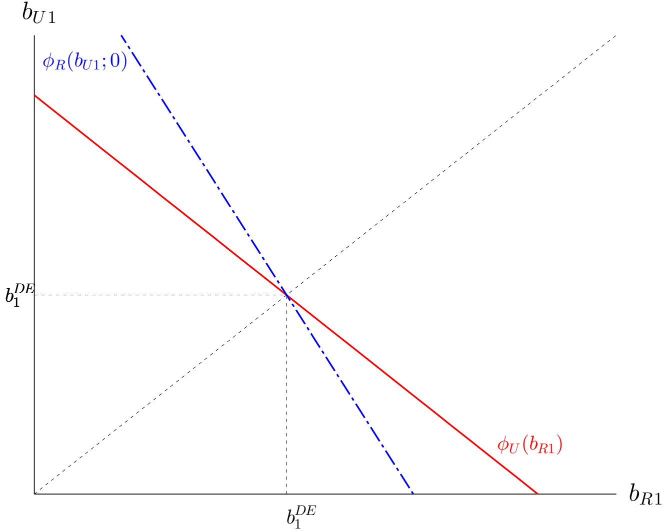
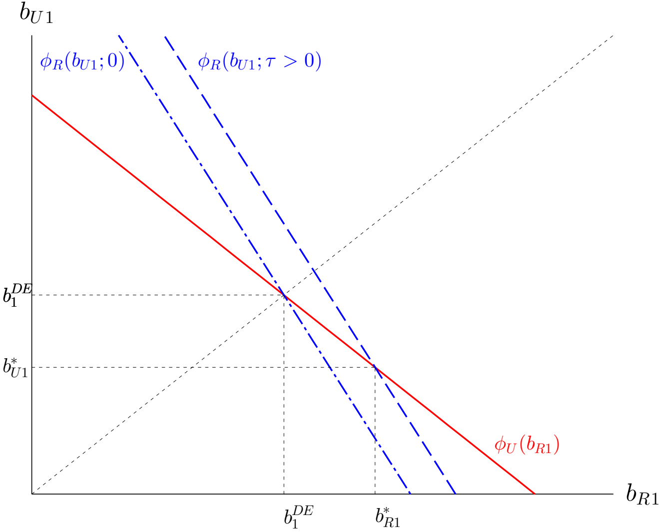
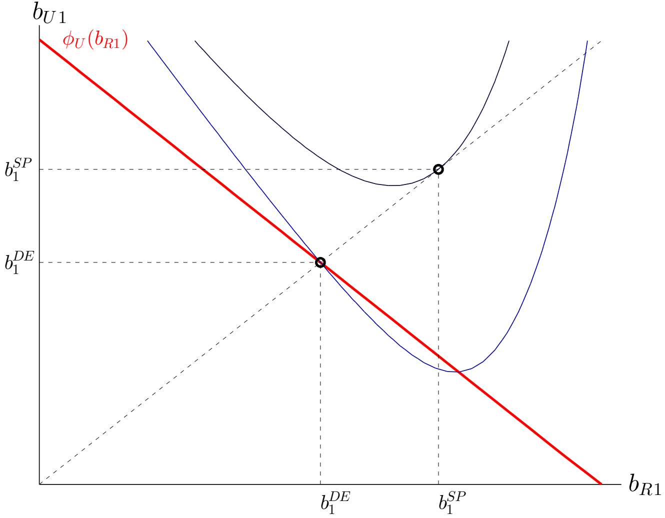


Responses to Capital Controls



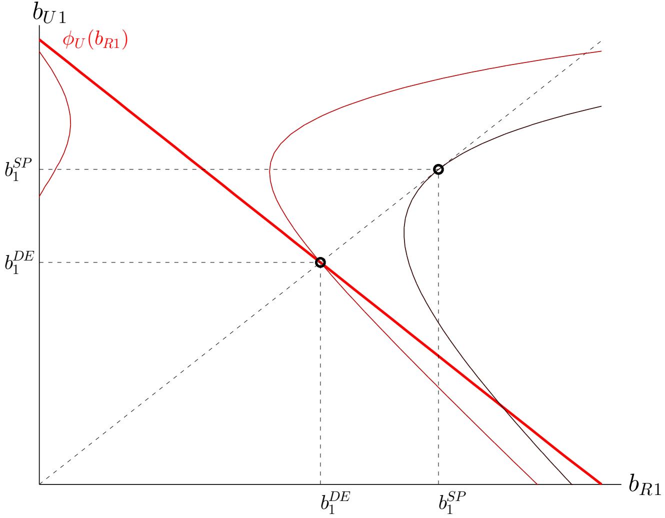
Welfare Effects of Capital Controls

Regulated agents' iso-utility curves



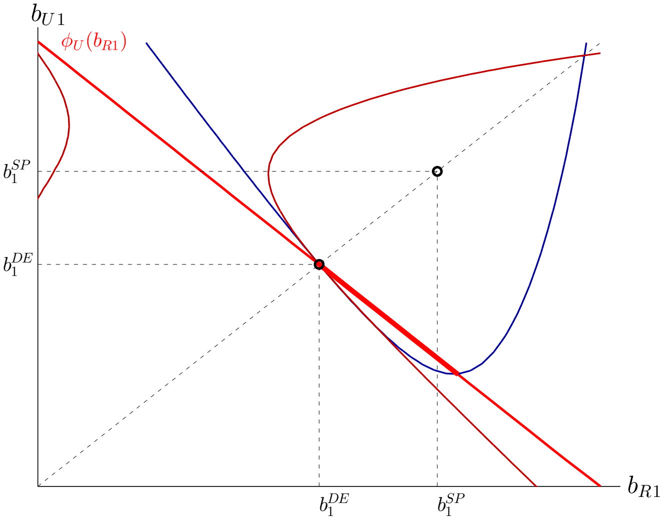
Welfare Effects of Capital Controls

Unregulated agents' iso-utility curves



Welfare Effects of Capital Controls

Pareto improvements



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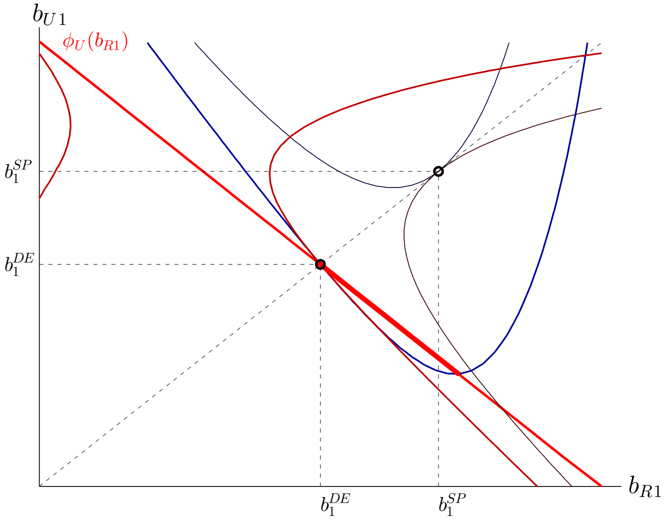

Optimal Capital Controls without Leakages

$$\tau = \frac{\beta\kappa\mathbb{E}_0\left[\left(\mu_{R1} \qquad\qquad\right)\left(\overset{+}{\frac{\partial p_t^N}{\partial b_{R1}}} \qquad\qquad\qquad\right)\right]}{\mathbb{E}_0\left[\frac{\omega}{c_{R1}^T}\right]}$$

Optimal Capital Controls

$$\tau = \frac{\beta\kappa\mathbb{E}_0\left[\left(\mu_{R1} + \frac{\gamma}{1-\gamma}\mu_{U1}\right)\left(\overset{+}{\frac{\partial p_t^N}{\partial b_{R1}}} + \overset{+}{\frac{\partial p_t^N}{\partial b_{U1}}}\overset{-}{\frac{\partial b_{U1}}{\partial b_{R1}}}\right)\right]}{\mathbb{E}_0\left[\frac{\omega}{c_{R1}^T}\right]}$$

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$$+\frac{\sum_{t=1}^{2}\beta^t\mathbb{E}_0\left[\left(\frac{\omega}{c_{Rt}^T} - \frac{\omega}{c_{Ut}^T}\right)\left(\bar{y}^N - c_{Rt}^N\right)\left(\overset{+}{\frac{\partial p_t^N}{\partial b_{R1}}} + \overset{+}{\frac{\partial p_t^N}{\partial b_{U1}}}\overset{-}{\frac{\partial b_{U1}}{\partial b_{R1}}}\right)\right]}{\mathbb{E}_0\left[\frac{\omega}{c_{R1}^T}\right]}$$

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- Increase γ (shadow sector). Two opposite forces:

Optimal Capital Controls

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  - Controls less effective: $(\frac{\partial p_t^N}{\partial b_{R1}} + \frac{\partial p_t^N}{\partial b_{U1}}\frac{\partial b_{U1}}{\partial b_{R1}}) \downarrow$

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  - Controls more desirable: $\mu_R \uparrow$

Insights from Three-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 $\uparrow$

Insights from Three-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, based on Bianchi (AER, 2011)
- Leakages create time-inconsistency problem as future planner's decisions affect current unregulated borrowing decisions
- Ramsey-Markov problem without commitment (utilitarian welfare measure)

Planner's problem without 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

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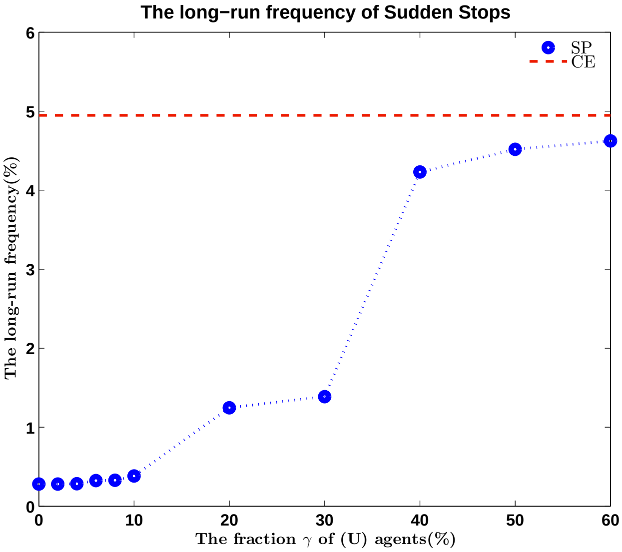
p^N &= \left(\frac{1-\omega}{\omega}\right)\left(\frac{c_R^T}{c_R^N}\right)^{\eta+1} \qquad \text{for} \quad i \in \{U,R\} \\
u_T\left(c_U^T, c_U^N\right) &\geq \beta(1+r)\mathbb{E}u_T\left(\mathcal{C}_U^T(X'), \mathcal{C}_U^N(X')\right)
\end{aligned}$$

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

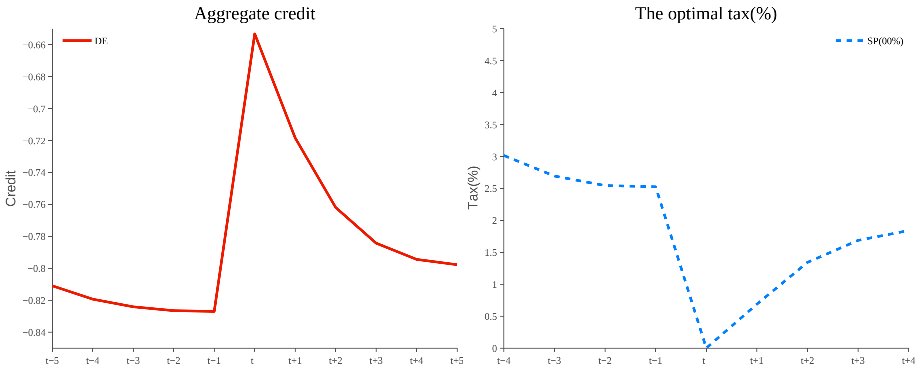
Time consistency: $\mathcal{B}_i(\mathbf{b},\mathbf{y}) = b_i'(\mathbf{b},\mathbf{y}), \mathcal{C}_i^T(\mathbf{b},\mathbf{y}) = c_i^T(\mathbf{b},\mathbf{y}), \mathcal{C}_i^N(\mathbf{b},\mathbf{y}) = c_i^N(\mathbf{b},\mathbf{y})$

Quantitative Results

Frequency of Sudden Stops



Aggregate credit and the optimal tax(%)



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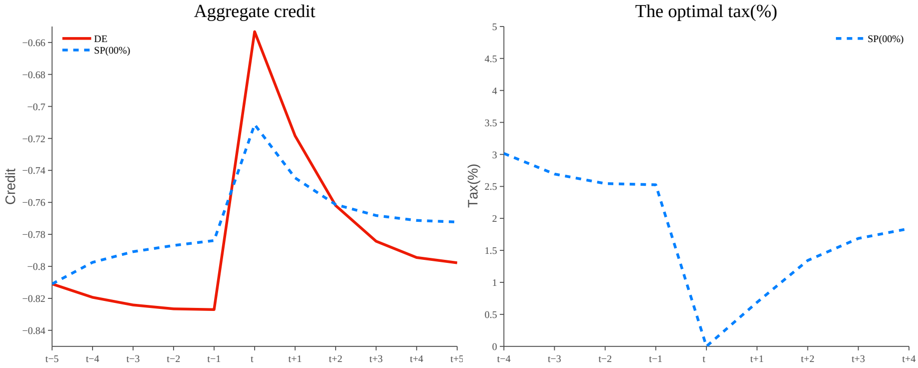

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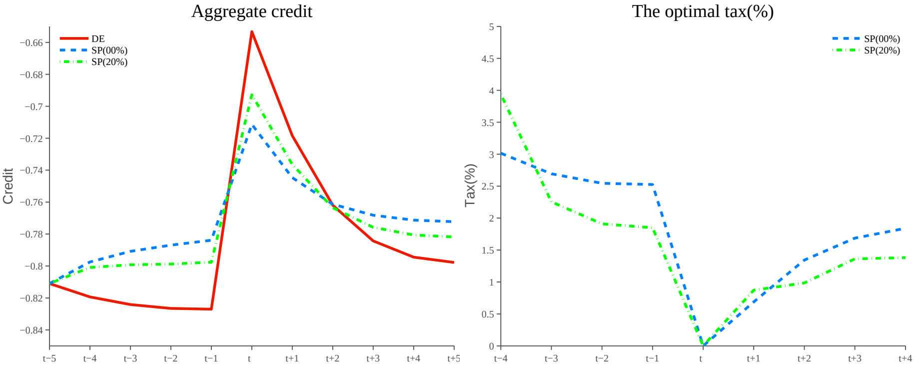

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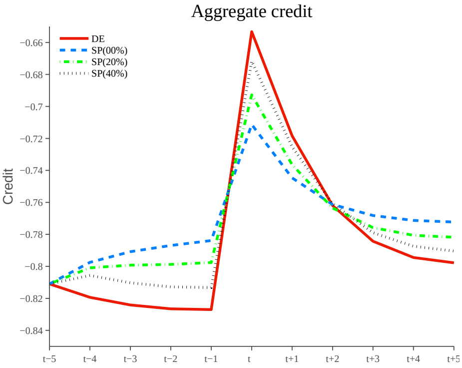
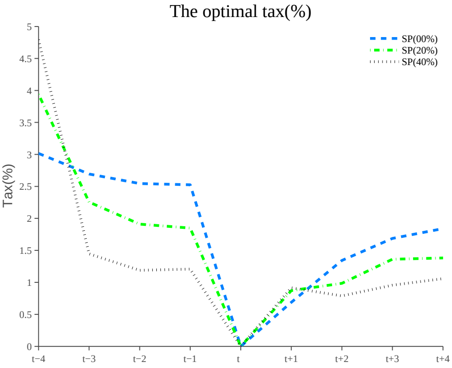
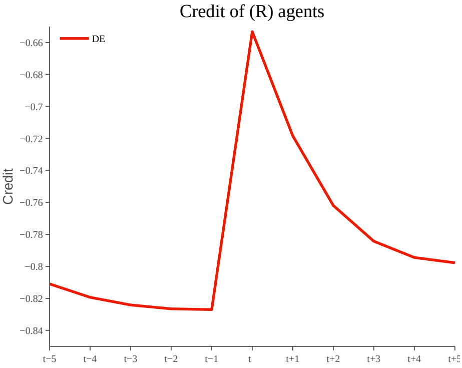
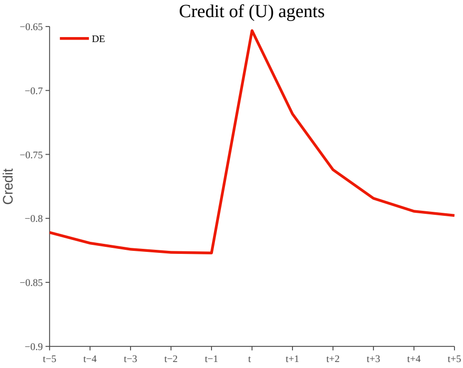




Credit of (R) agents and (U) agents





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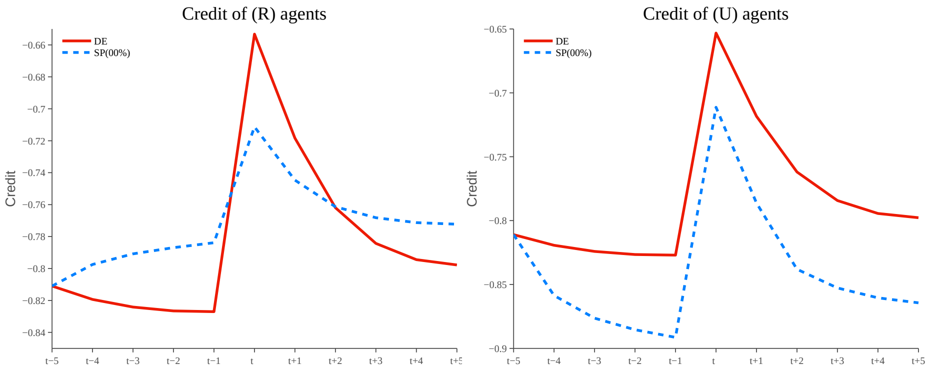

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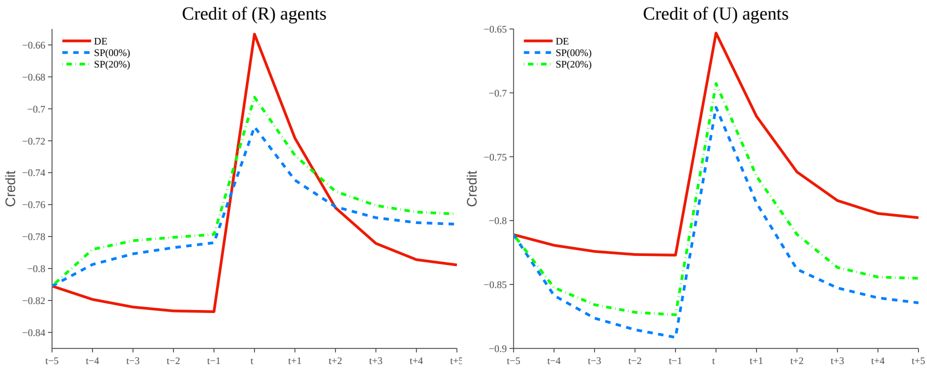

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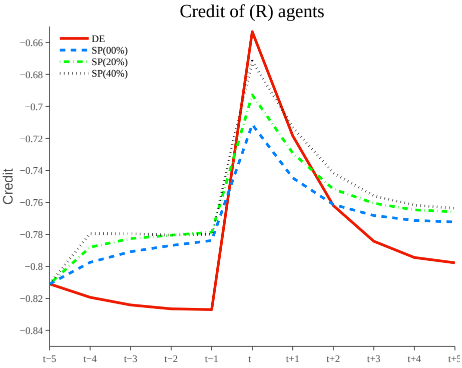
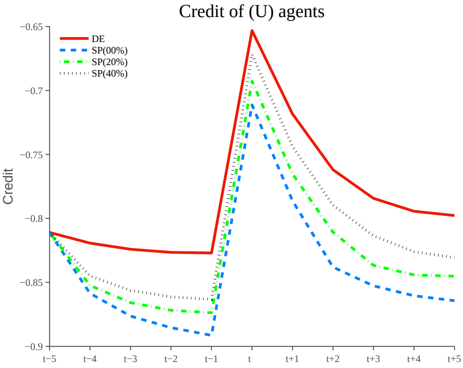
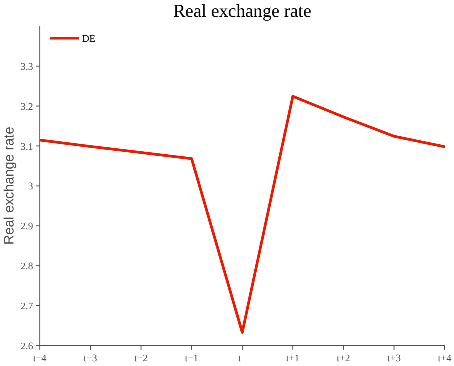
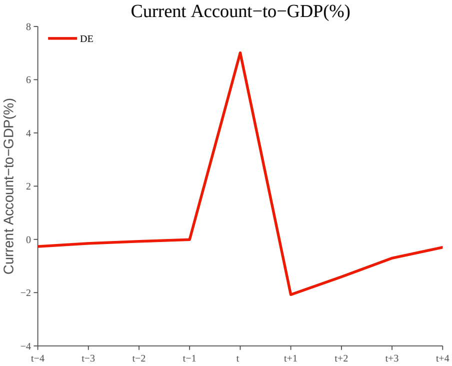




Real exchange rate and CA-to-GDP





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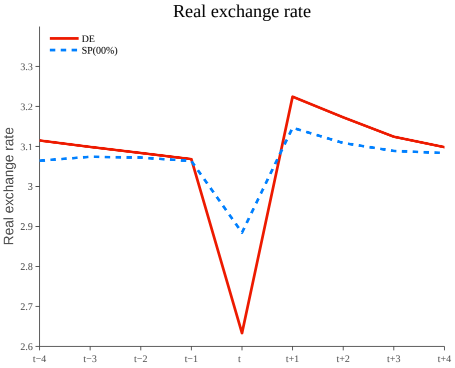

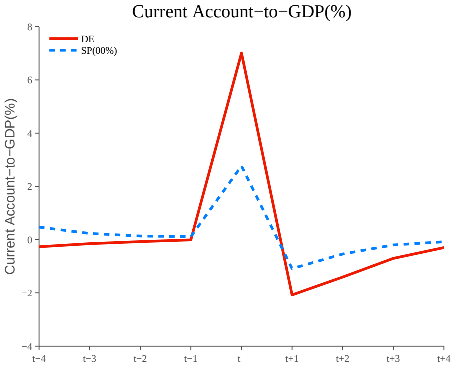

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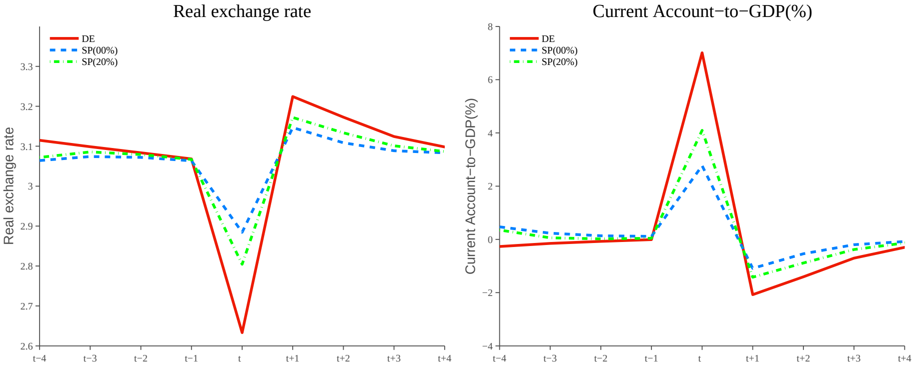

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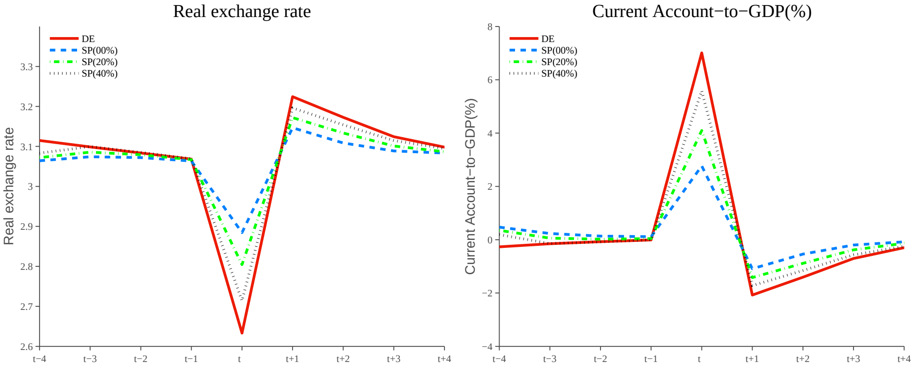
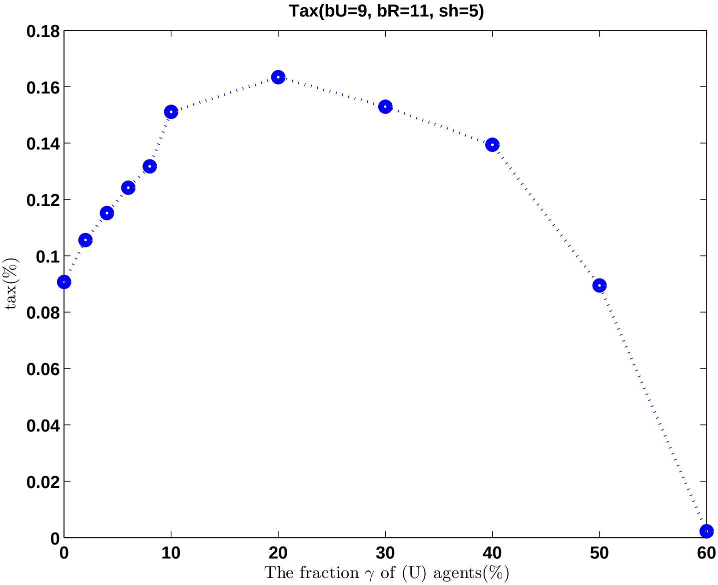
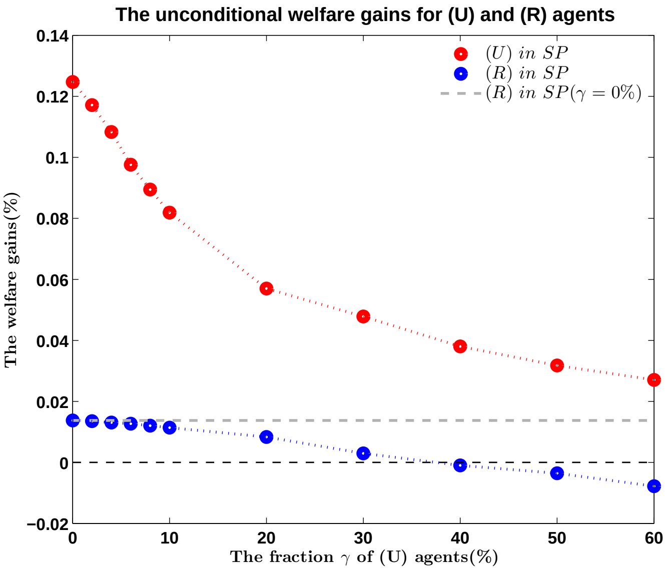


Non-monotonic Tax



Welfare Effects



Conclusion

- We provided a theory of CFM under imperfect enforcement
- Unregulated agents respond to capital controls by taking more risk, undermining their effectiveness
- Possibly, a non-monotonic relationship between size of optimal capital control and shadow sector
- Capital controls appear to be effective despite large leakages