Capital Flow Management when Capital Controls Leak

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Motivation

- Central banks in emerging markets have responded to large capital inflows using capital flow management (CFM) policies
- Disagreement about effectiveness of capital controls:
- 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; Lorenzoni 2008
- ...but empirical literature is more skeptical & suggests existence of important leakages in CFM policies (IMF; Forbes; Klein; etc...)

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- ...but empirical literature is more skeptical & suggests existence of important leakages in CFM policies (IMF; Forbes; Klein; etc...)
- Crucial disconnect between theory and empirical literatures

Key Questions

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

This Paper

- Theory of optimal CFM with imperfect regul. enforcement
- Rationale for capital controls due to pecuniary externality
- ...but "shadow sector" can evade capital controls

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- Rationale for capital controls due to pecuniary externality
- ...but "shadow sector" can evade capital controls
- Key trade-off: macroprudential benefits vs. costs of risk-shifting by unregulated agents (allocative inefficiency)

Related Literature

- Theoretical:
  - Capital Controls & Macorpru. 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 & Macorpru 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

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 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):
  - 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' Full Problem

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

$$(BC0) \qquad c_{U0}^{T} \leq b_{U1}$$

$$(BC1) \qquad c_{U1}^{T} + p_1^N c_{U1}^{N} + b_{U2} = (1+r)\, b_{U1} + y_1^T + p_1^N y_1^N$$

$$(BC2) \qquad c_{U2}^{T} + p_2^N c_{U2}^{N} = (1+r)\, b_{U2} + y_2^T + p_2^N y_2^N$$

and credit constraint:

$$b_{U2} \quad \geq \quad -\kappa \left(y_1^T + p_1^N y_1^N \right)$$

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Households

Regulated Agents' Full Problem

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

$$(BC0) \qquad c_{R0}^{T} \leq b_{R1}$$

$$(BC1) \qquad c_{R1}^{T} + p_1^N c_{R1}^{N} + b_{R2} = (1+r)(1+\tau) b_{R1} + y_1^T + p_1^N y_1^N + T$$

$$(BC2) \qquad c_{R2}^{T} + p_2^N c_{R2}^{N} = (1+r) b_{R2} + y_2^T + p_2^N y_2^N$$

and credit constraint:

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Regulated Equilibrium

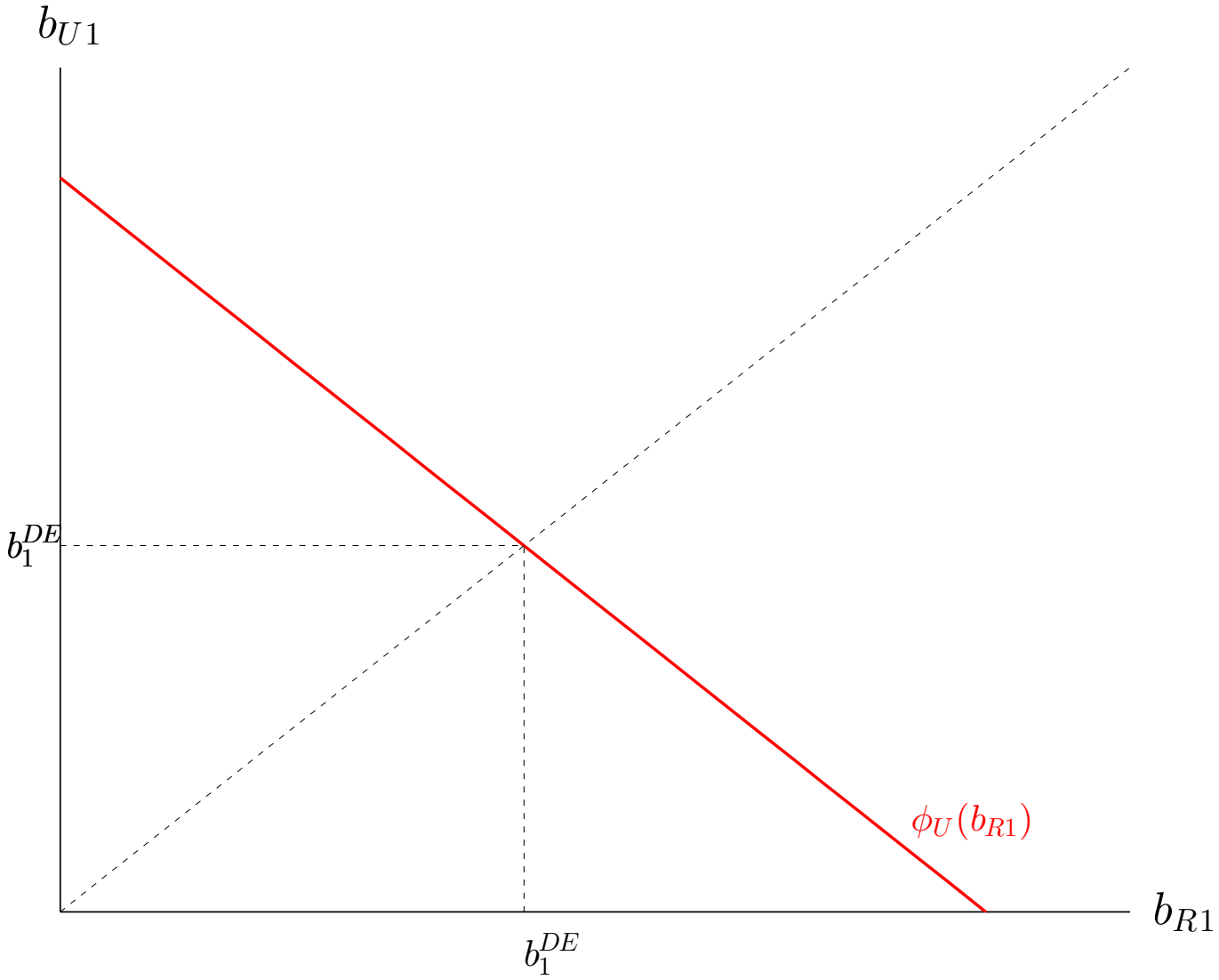
Indexed by τ

- Households choose b', c^T, c^N optimally:
- Market for NT goods clear and gov. budget constraint is satisfied

Model Mechanisms

- 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
- ...but private agents fail to internalize these effects
- Planner seeks to reduce overborrowing via $\tau > 0$ (Bianchi, 2011)
- ...but here τ creates risk-shifting to the unregulated sphere

Equilibrium Responses: b_1 Strategic Substitutes



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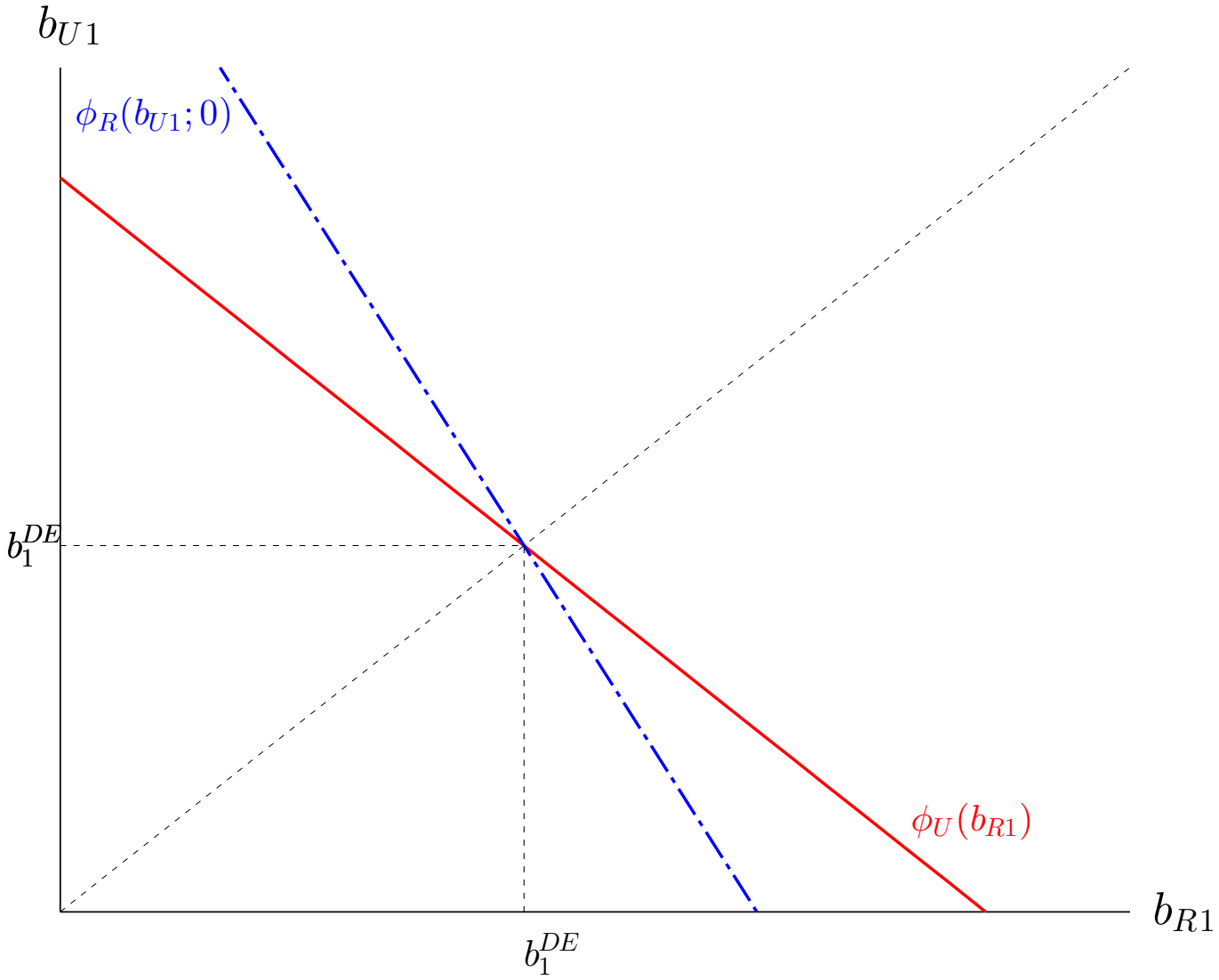
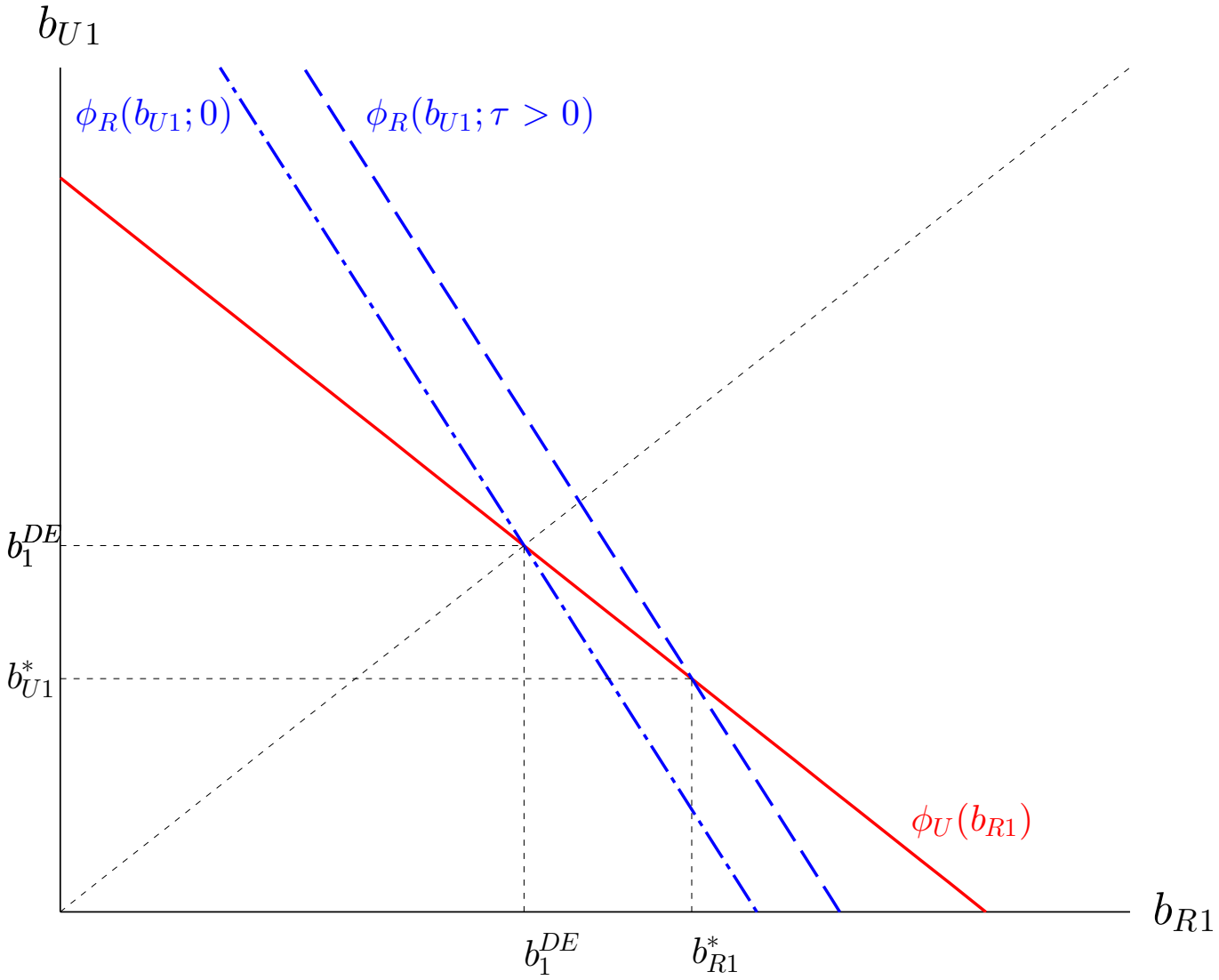
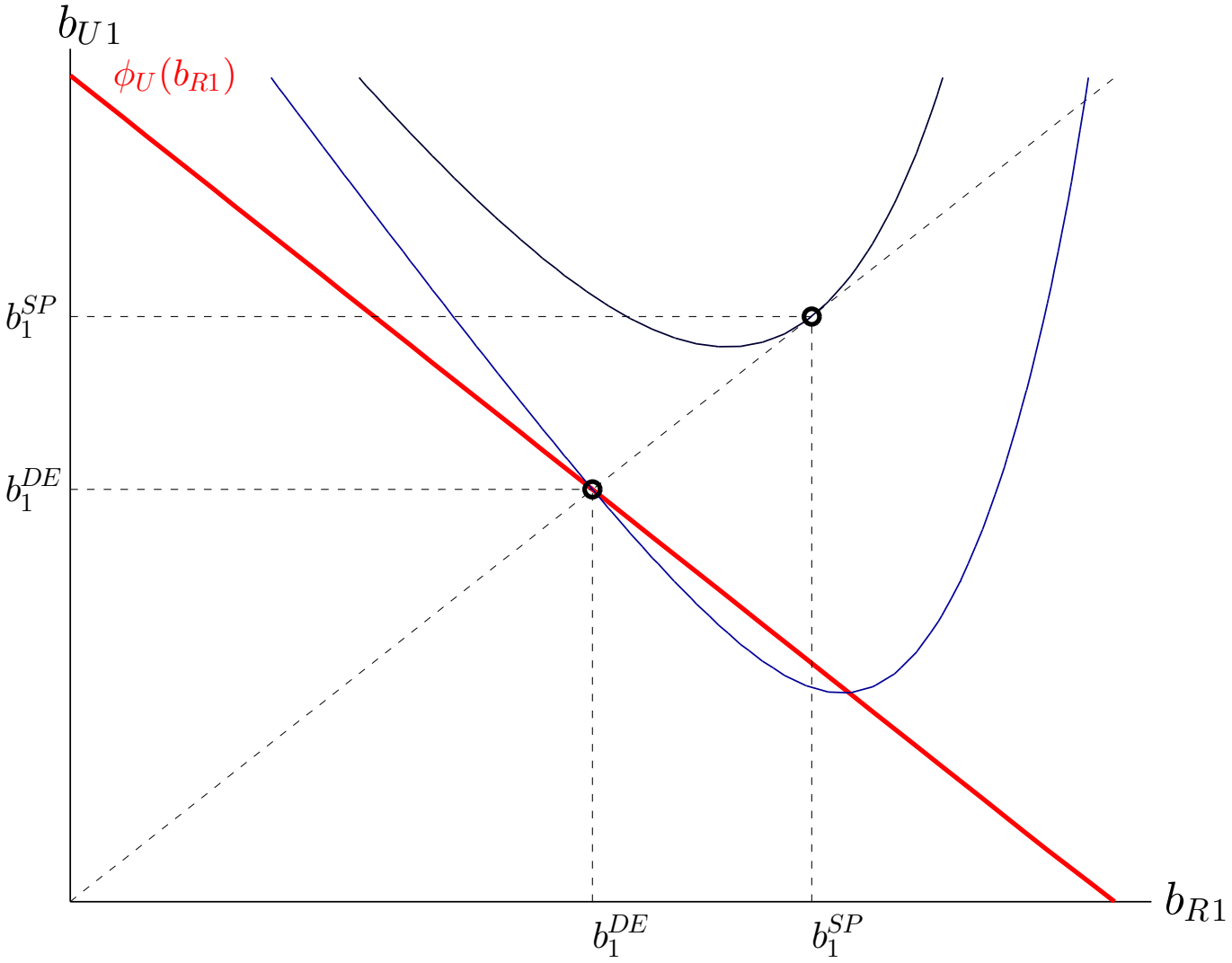


Responses to Capital Controls



Welfare Effects of Capital Controls

Regulated agents' iso-utility curves



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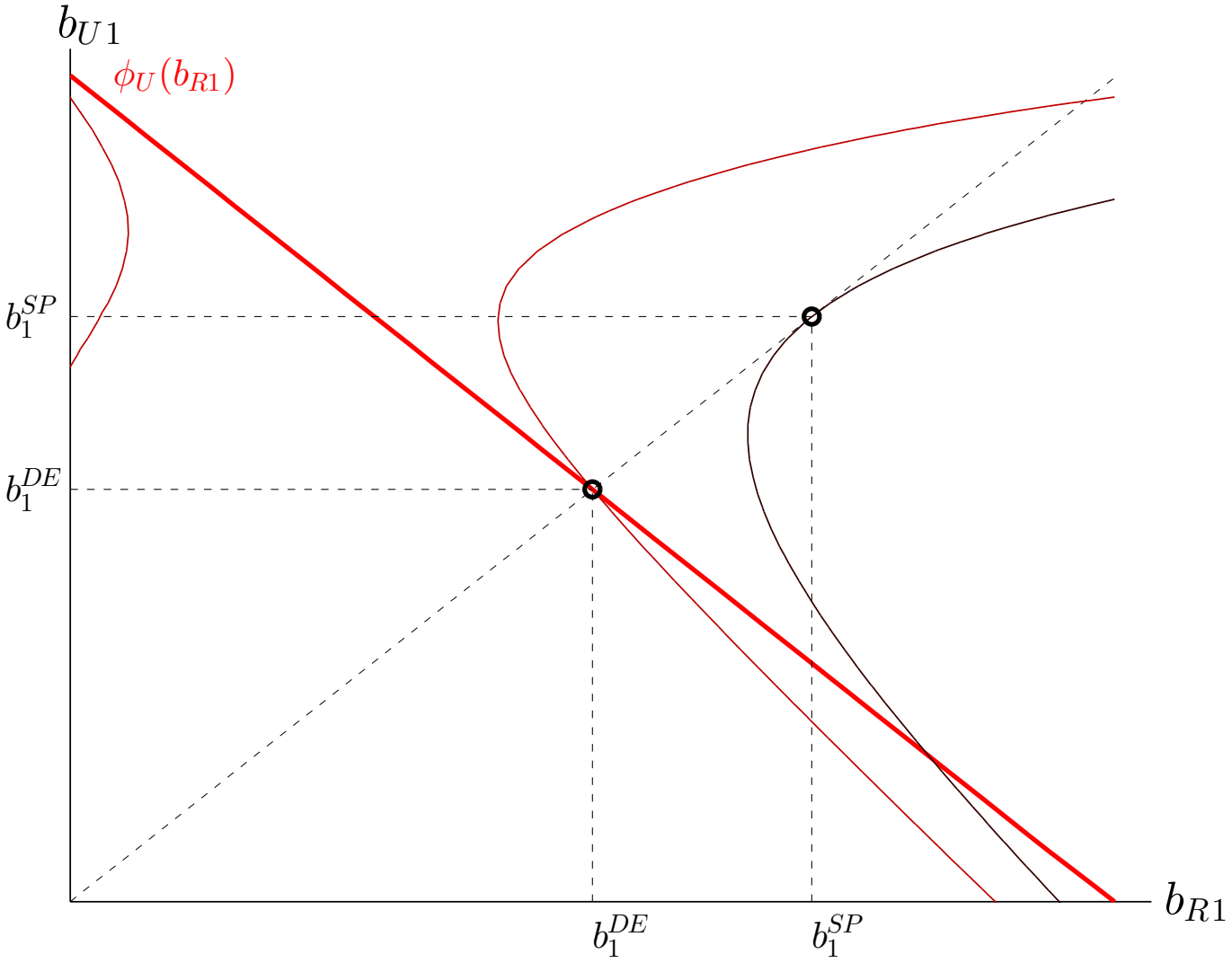
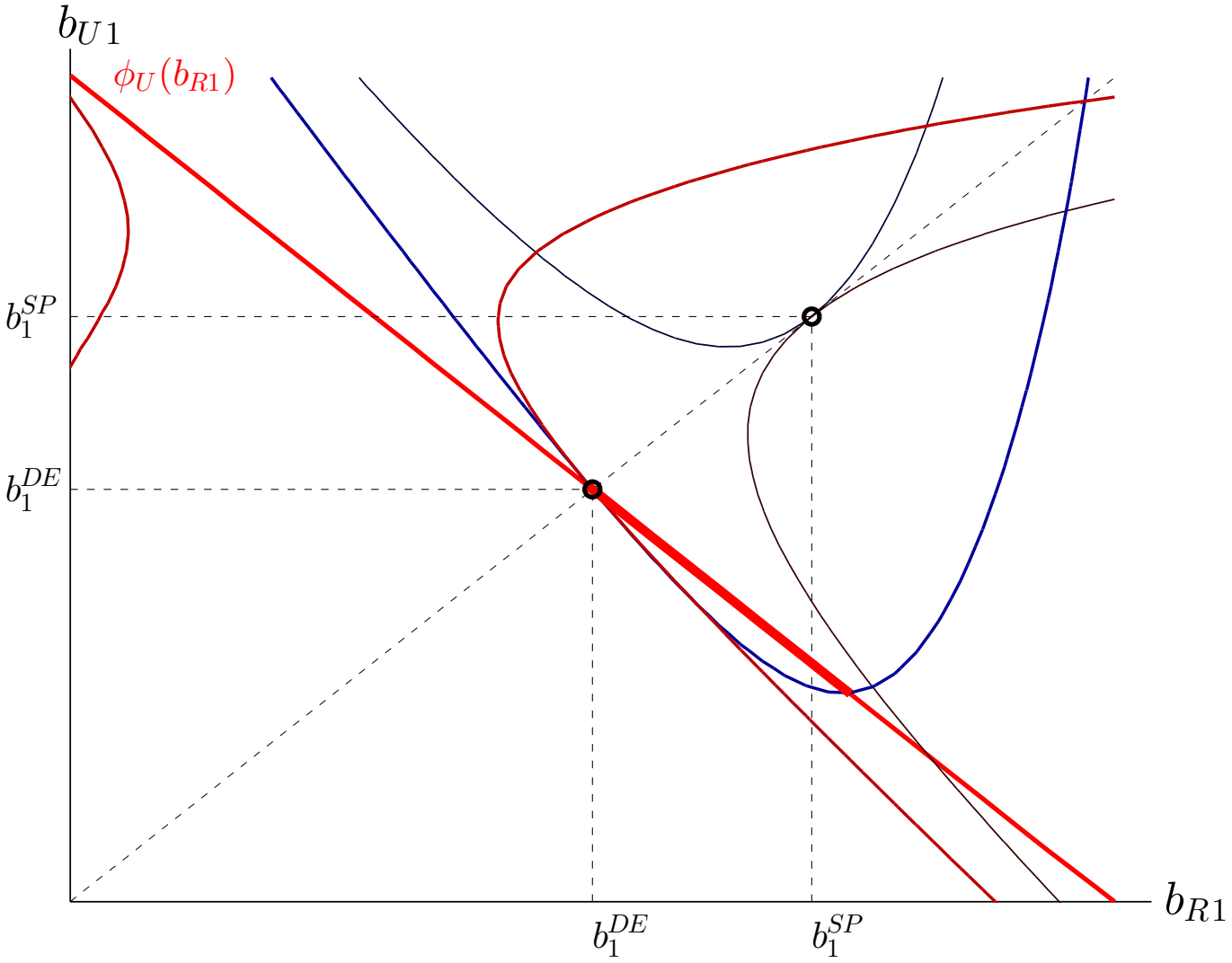


Welfare Effects of Capital Controls

Pareto improvements



Optimal Capital Controls Without Leakages

Planner's optimal bond choice on behalf of regulated agents

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

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

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

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

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

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

Insights from 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

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- 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 $X = \left(b_U, b_R, y^T\right)$
- Full non-linear solution
- Baseline Calibration for Brazil (preliminary)
- Today will show $\gamma \in [0, 1]$

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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Planner's problem with leakages

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

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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

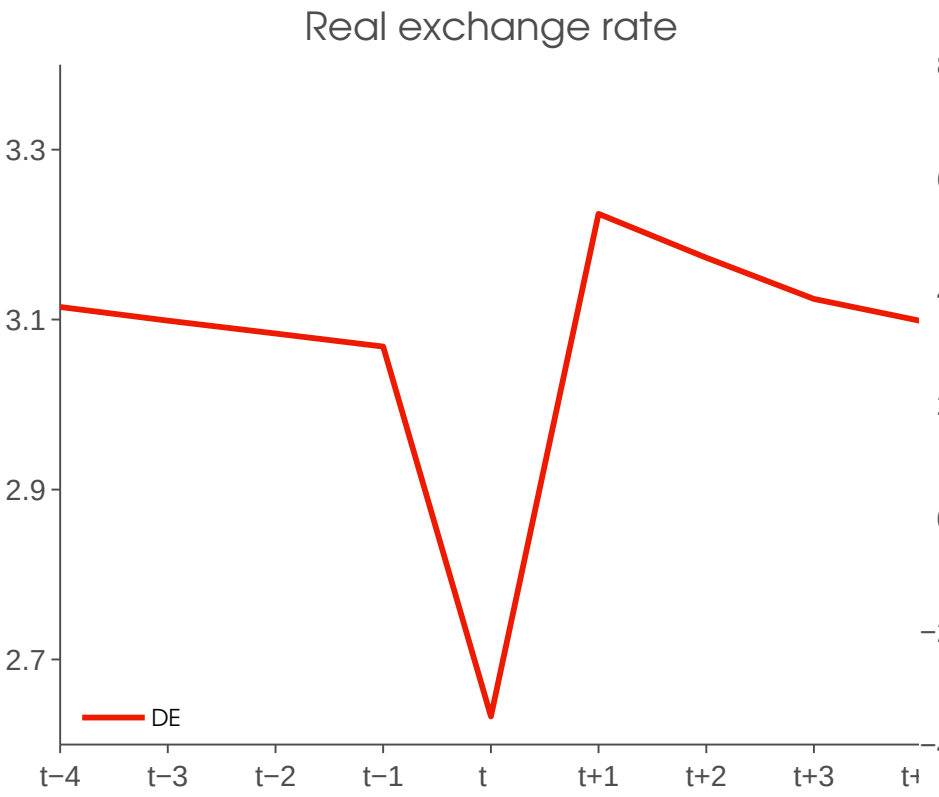
▸ Calibration

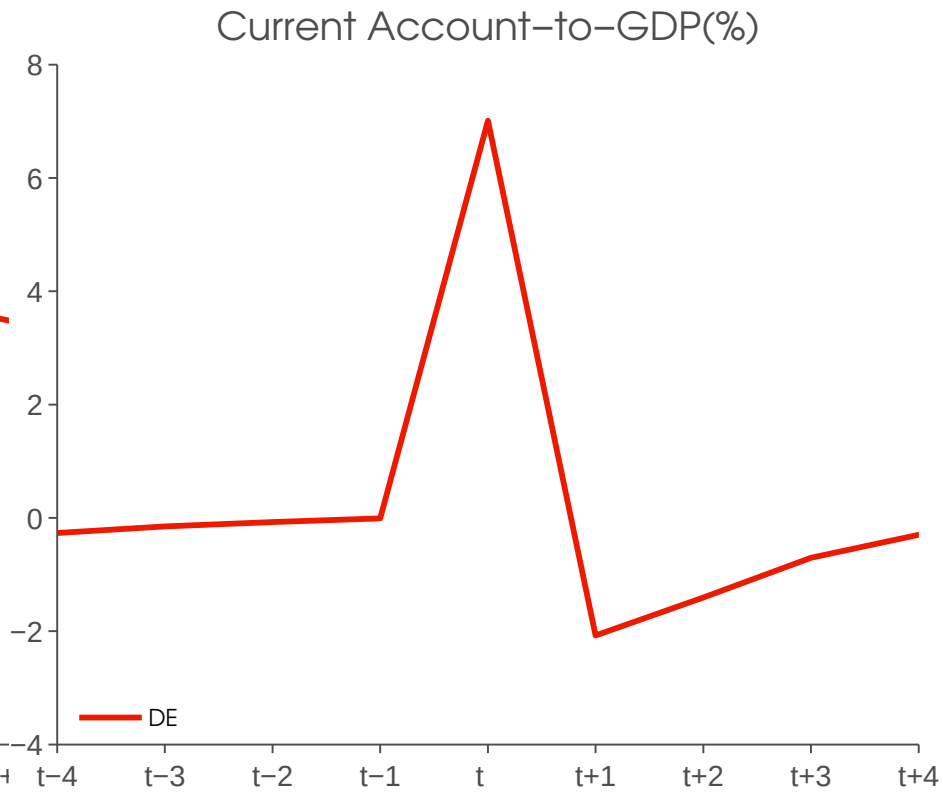
Comparative statics w.r.t. size of shadow sector γ

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

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

Severity of Sudden Stops





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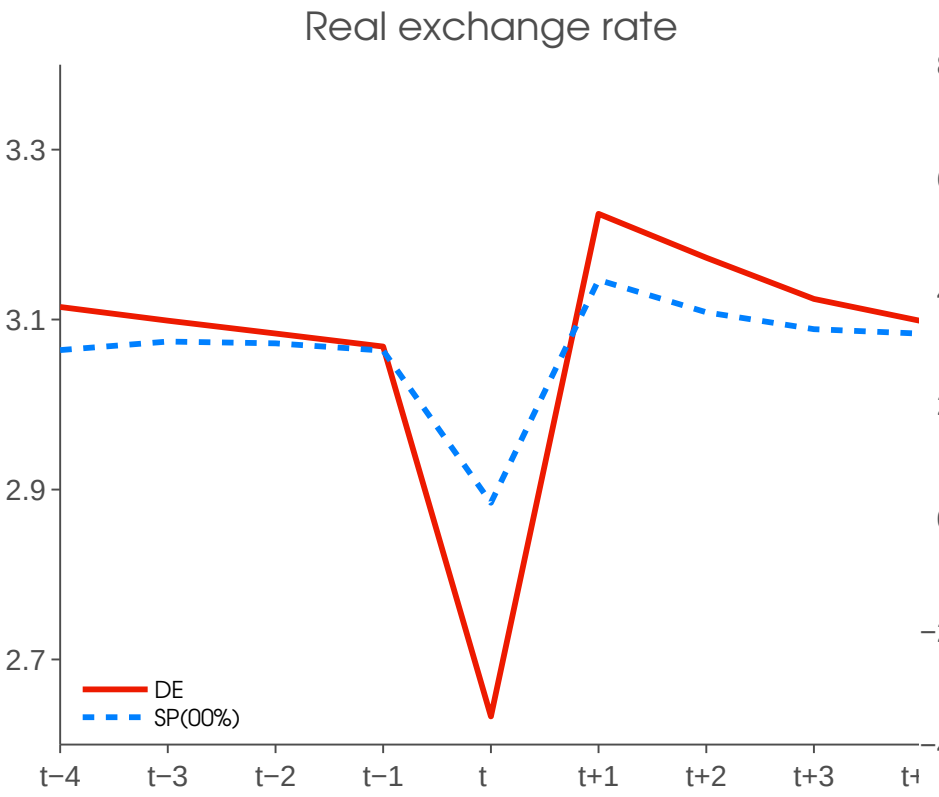

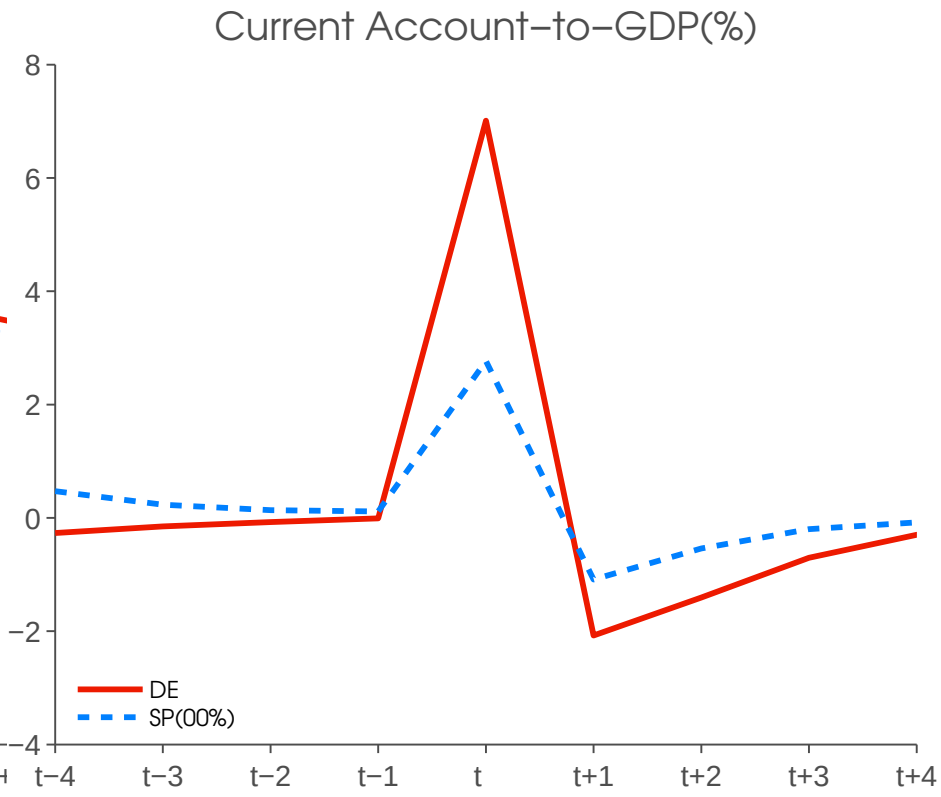

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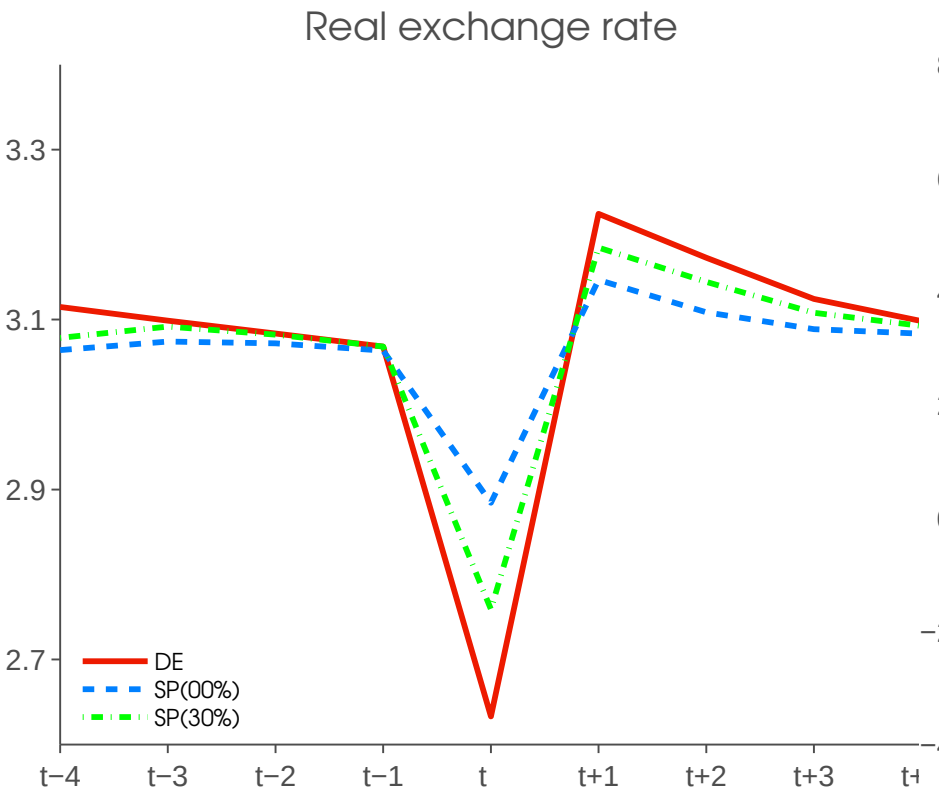

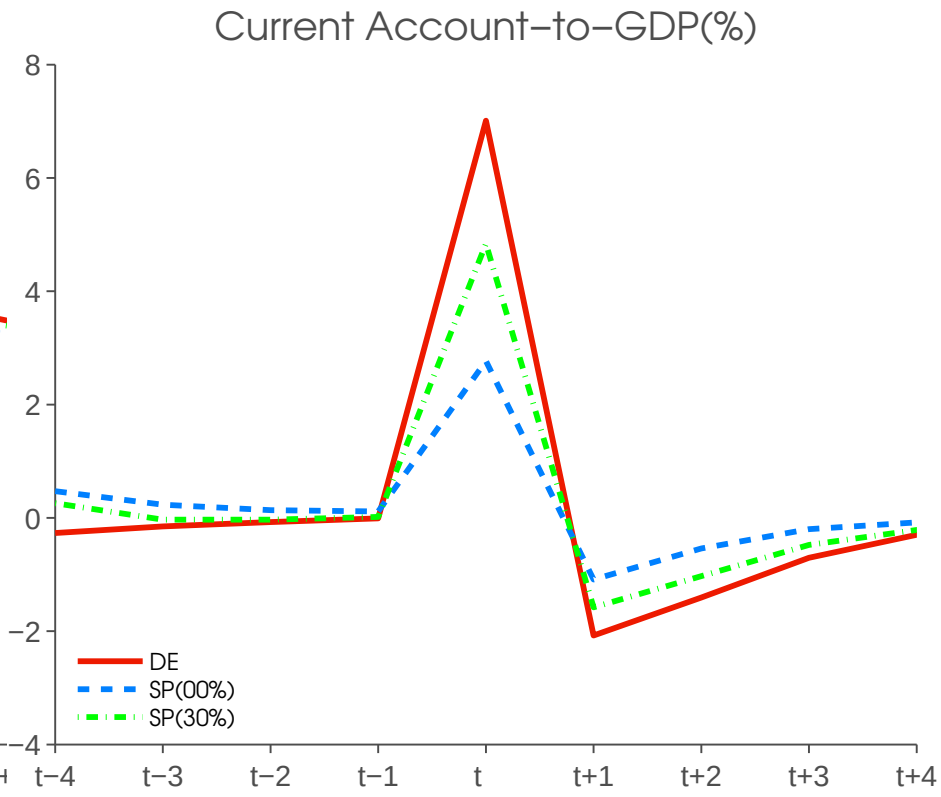

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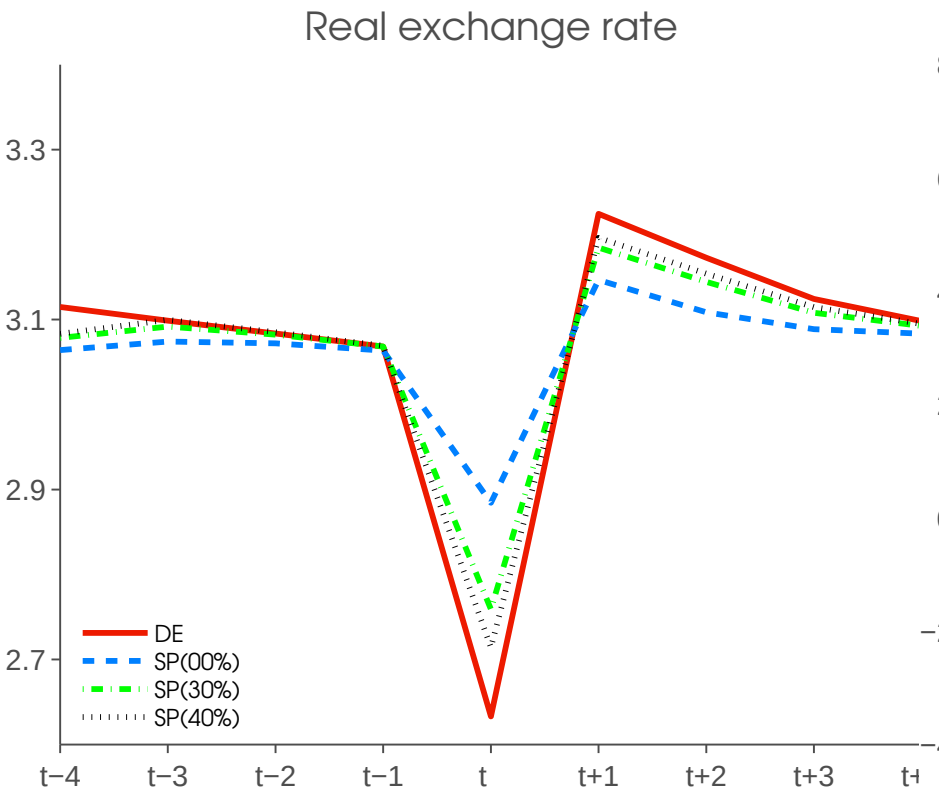

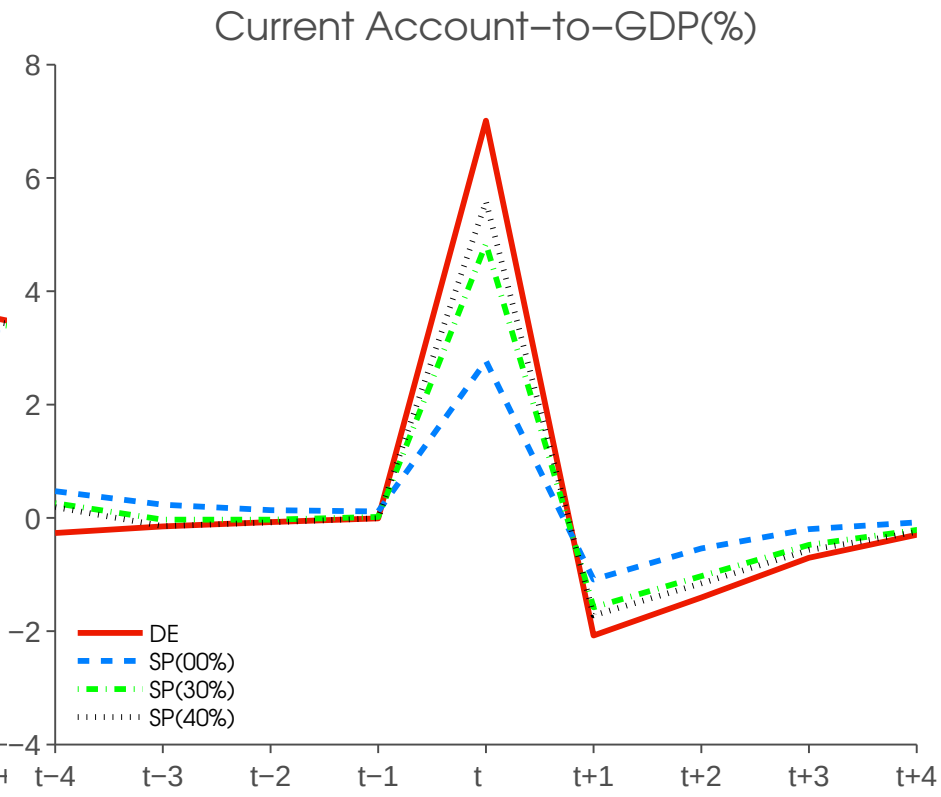

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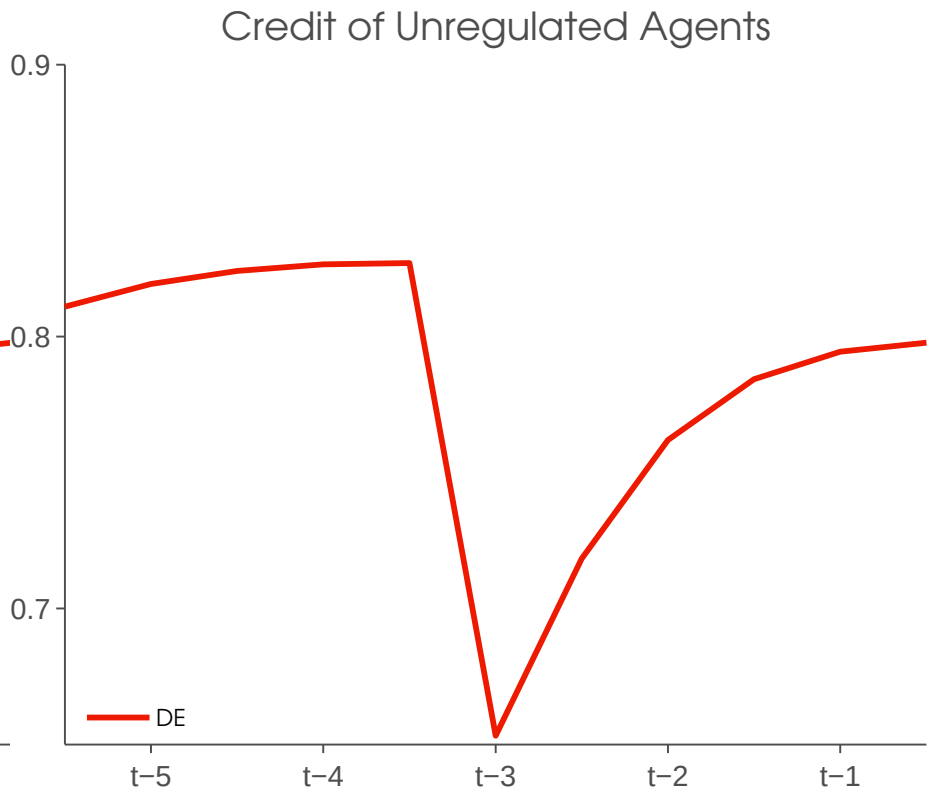

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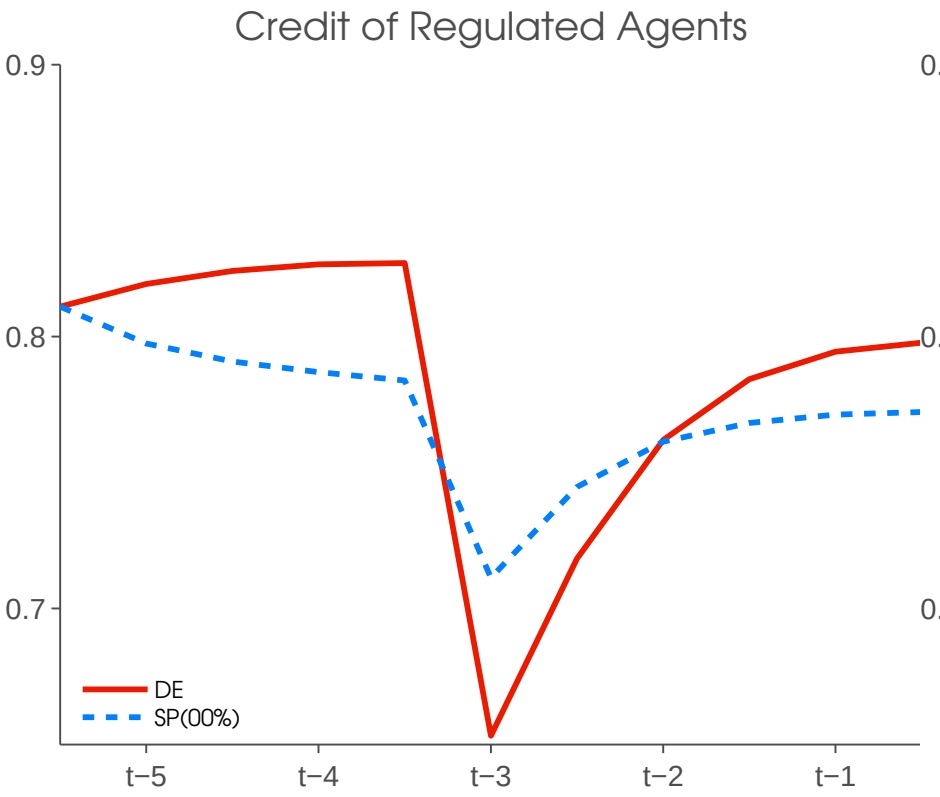

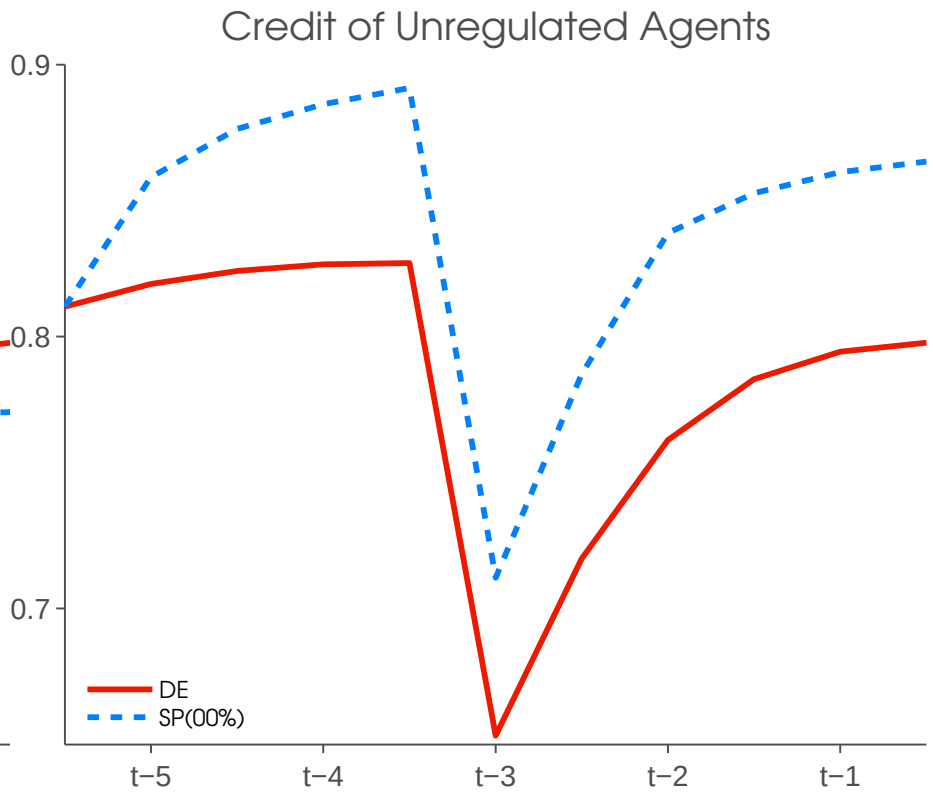

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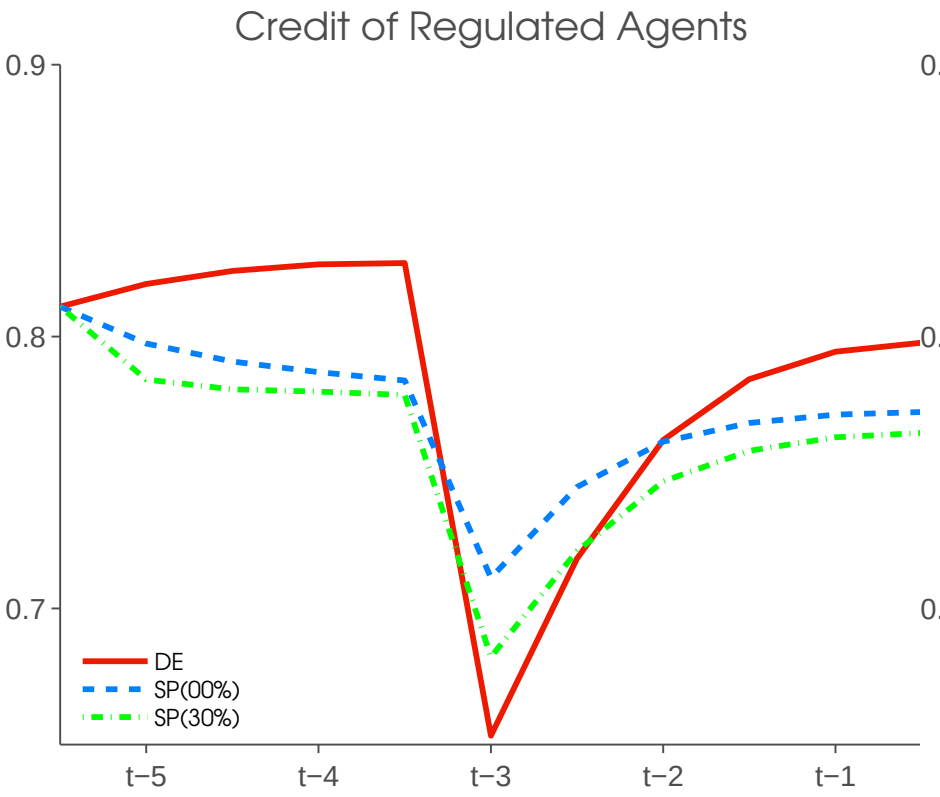

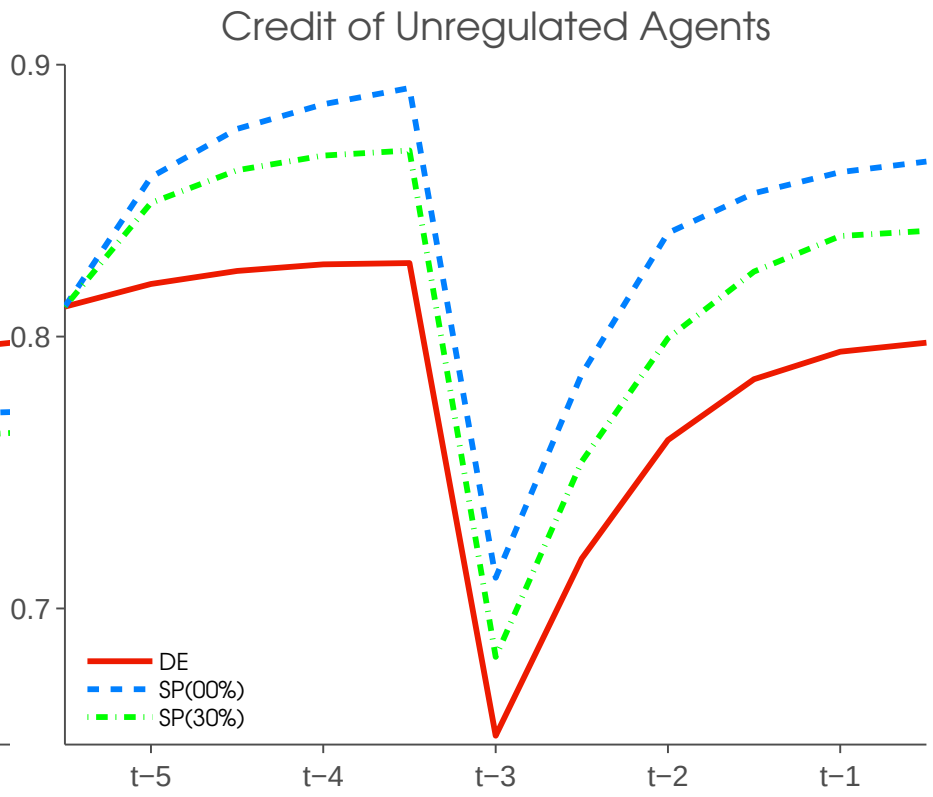

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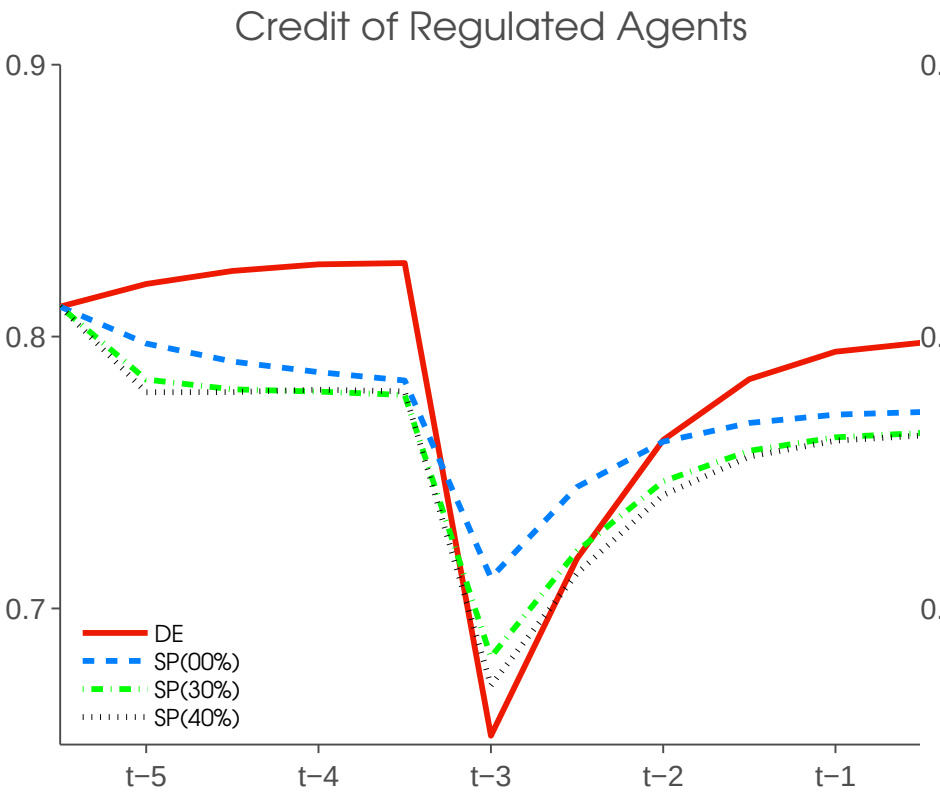
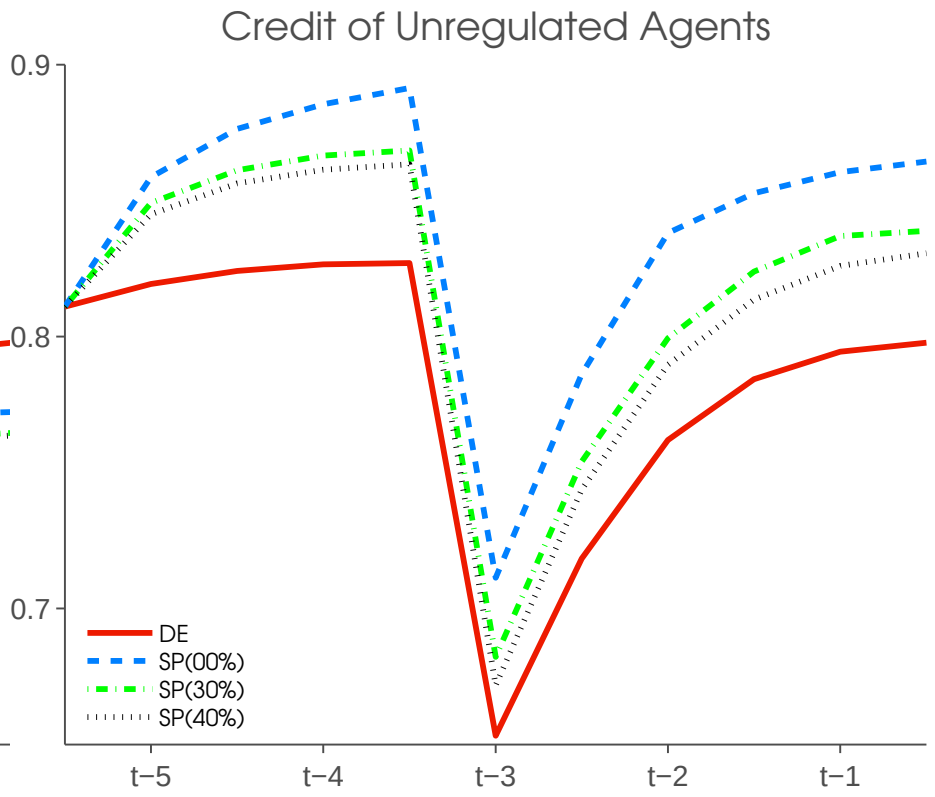
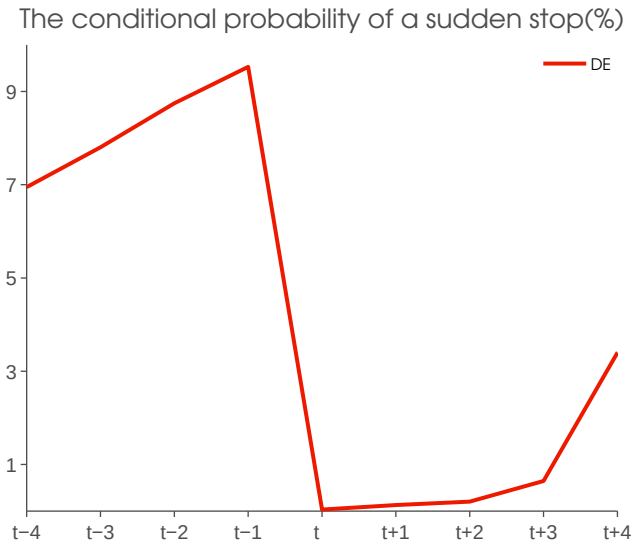
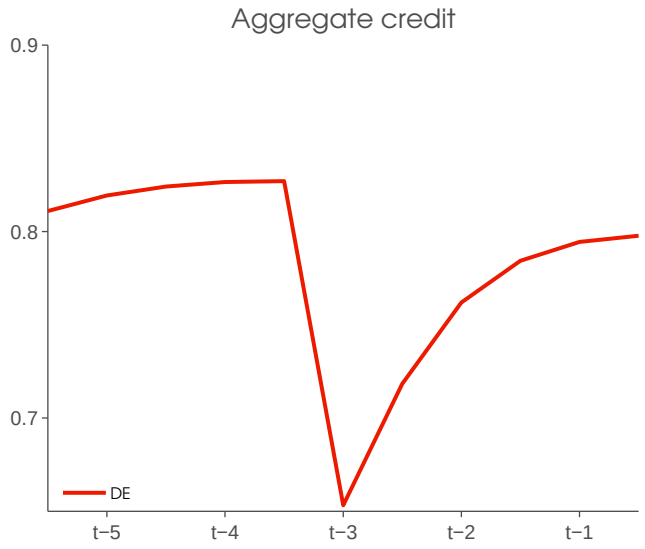




Severity of crises

Capital controls can be more pre-emptive when they leak





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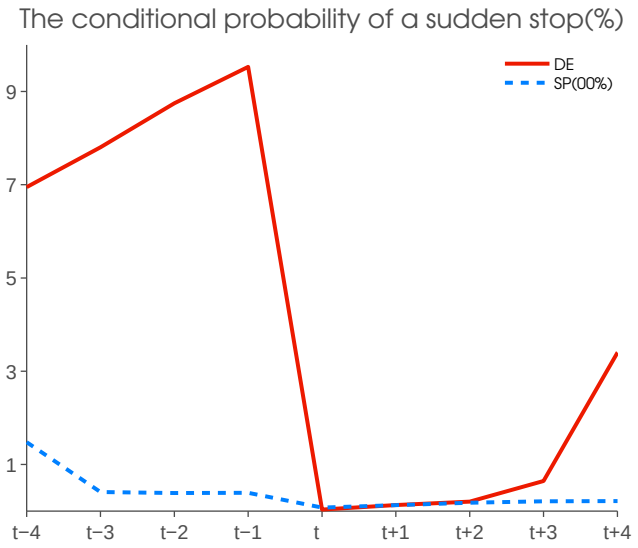

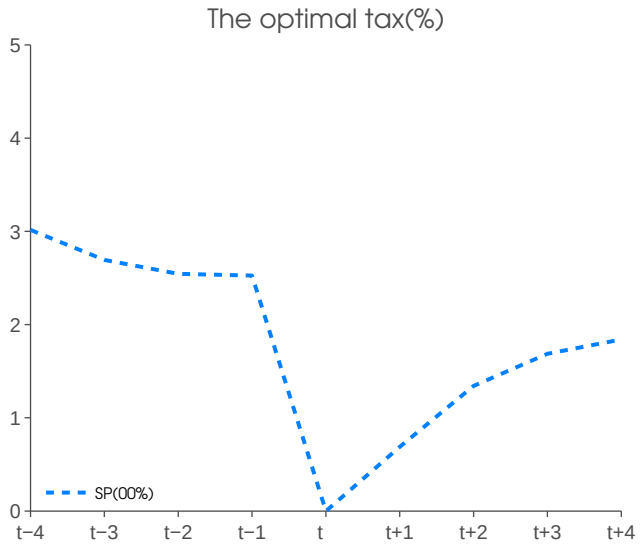

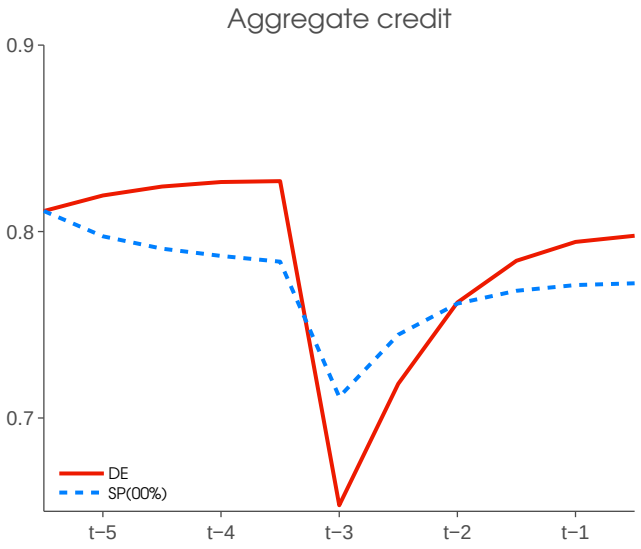

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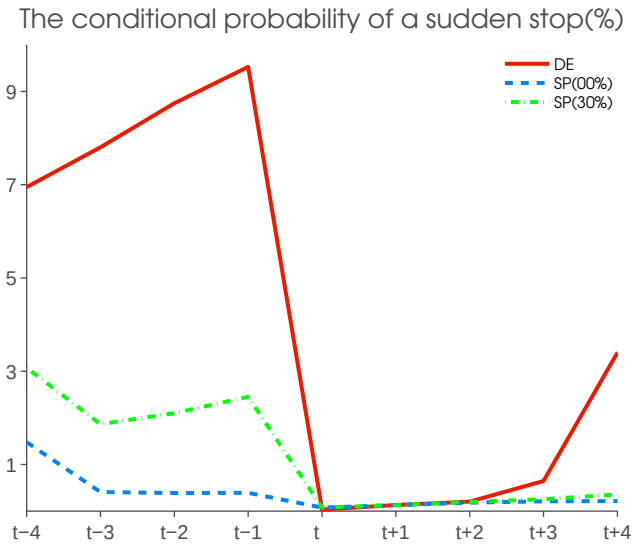

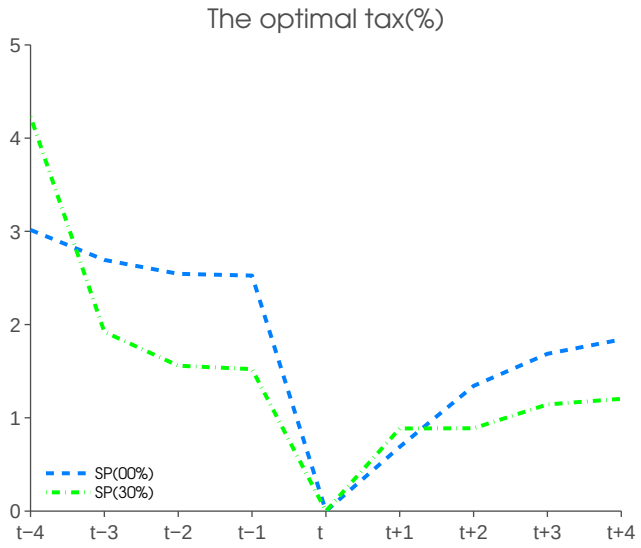

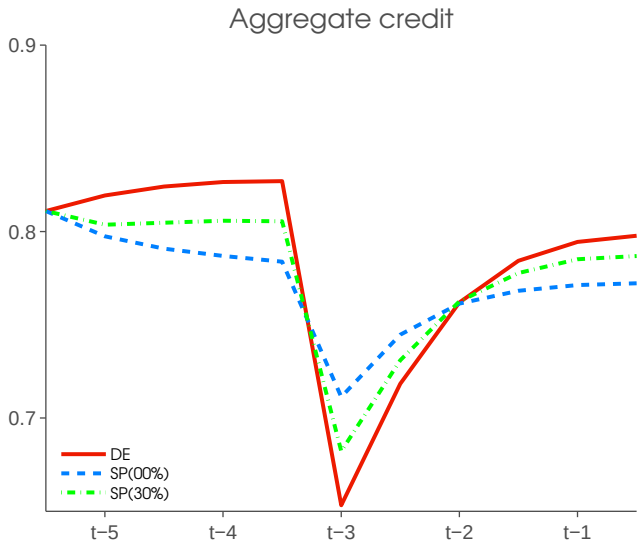

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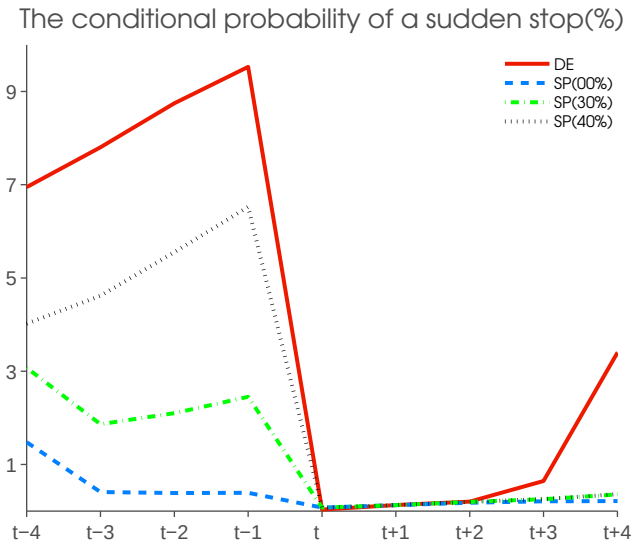
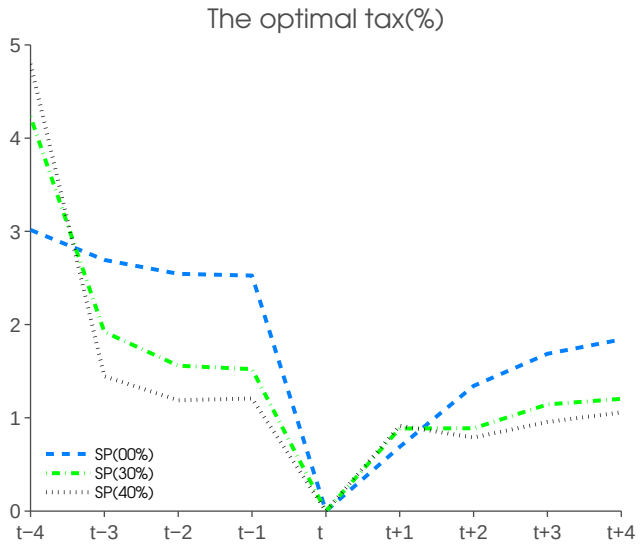
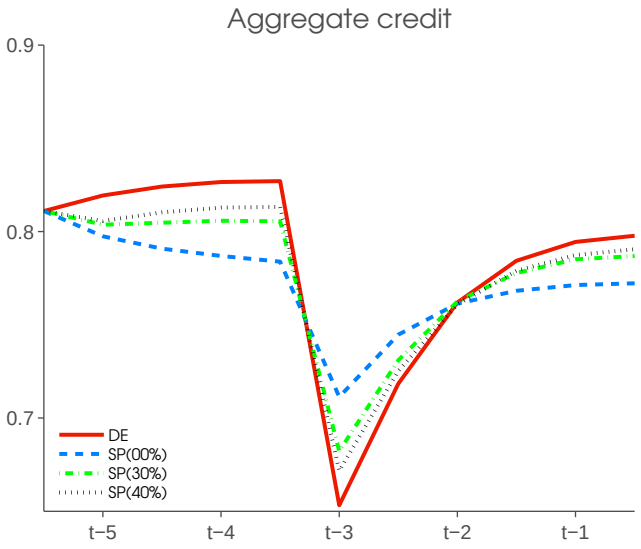
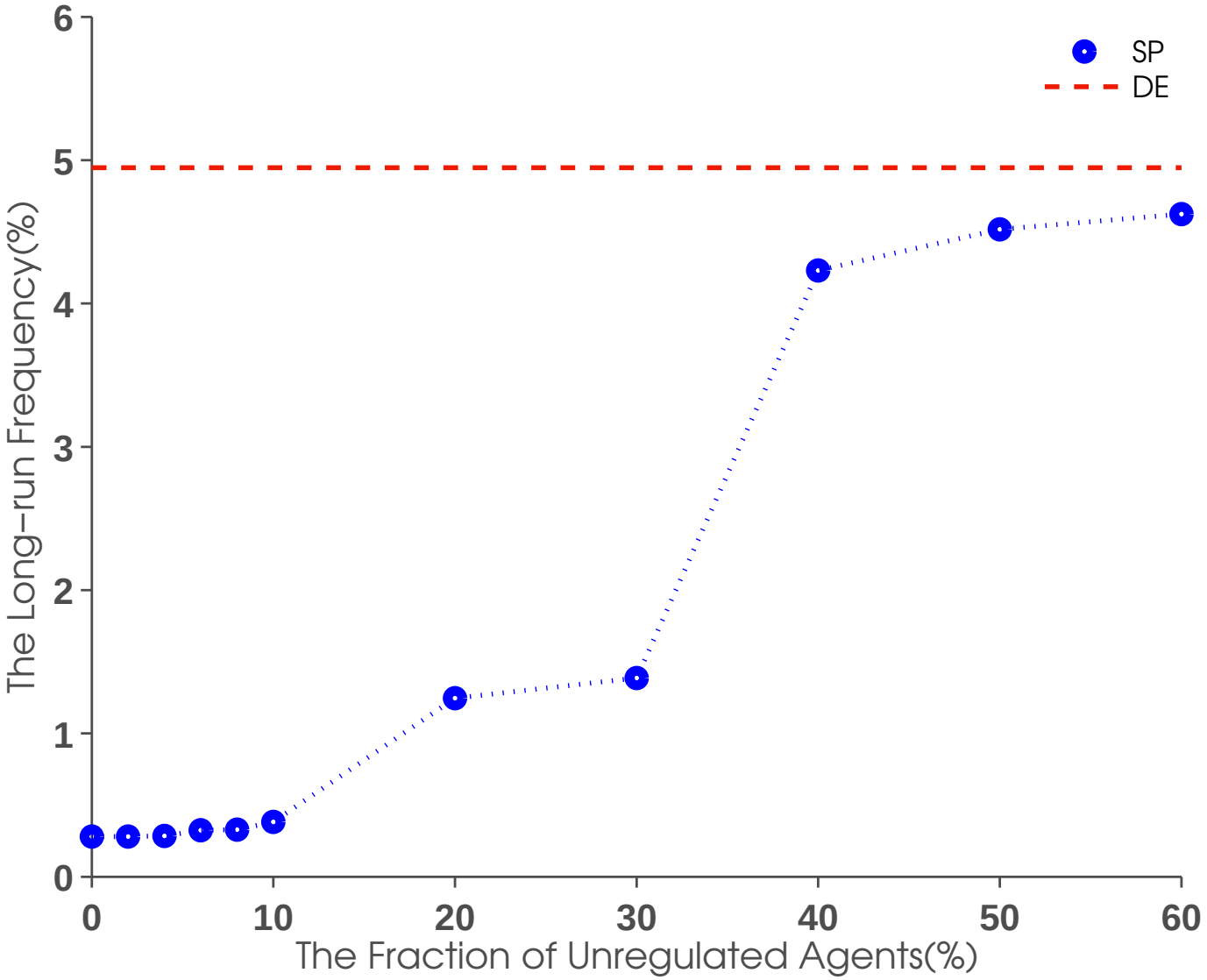


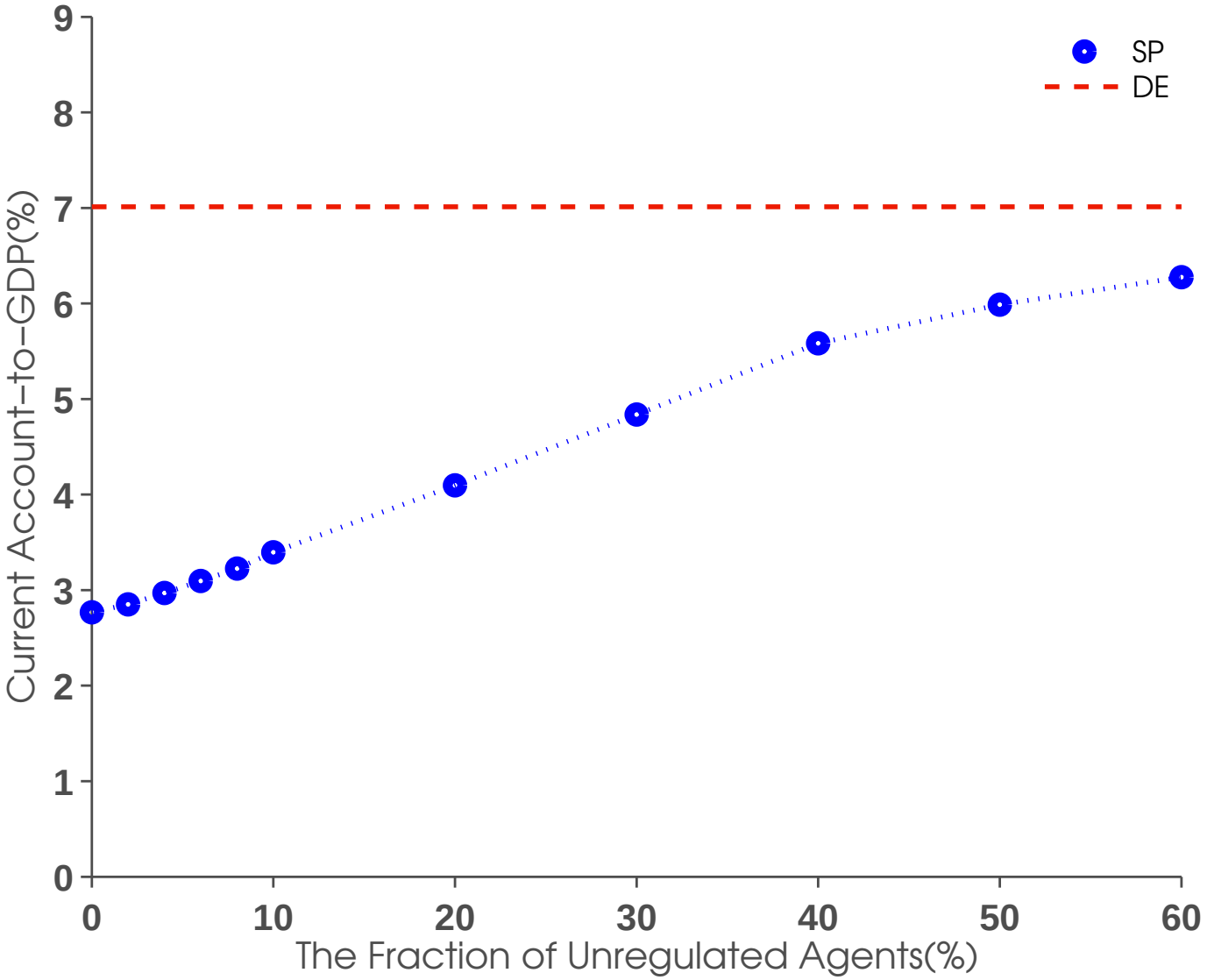




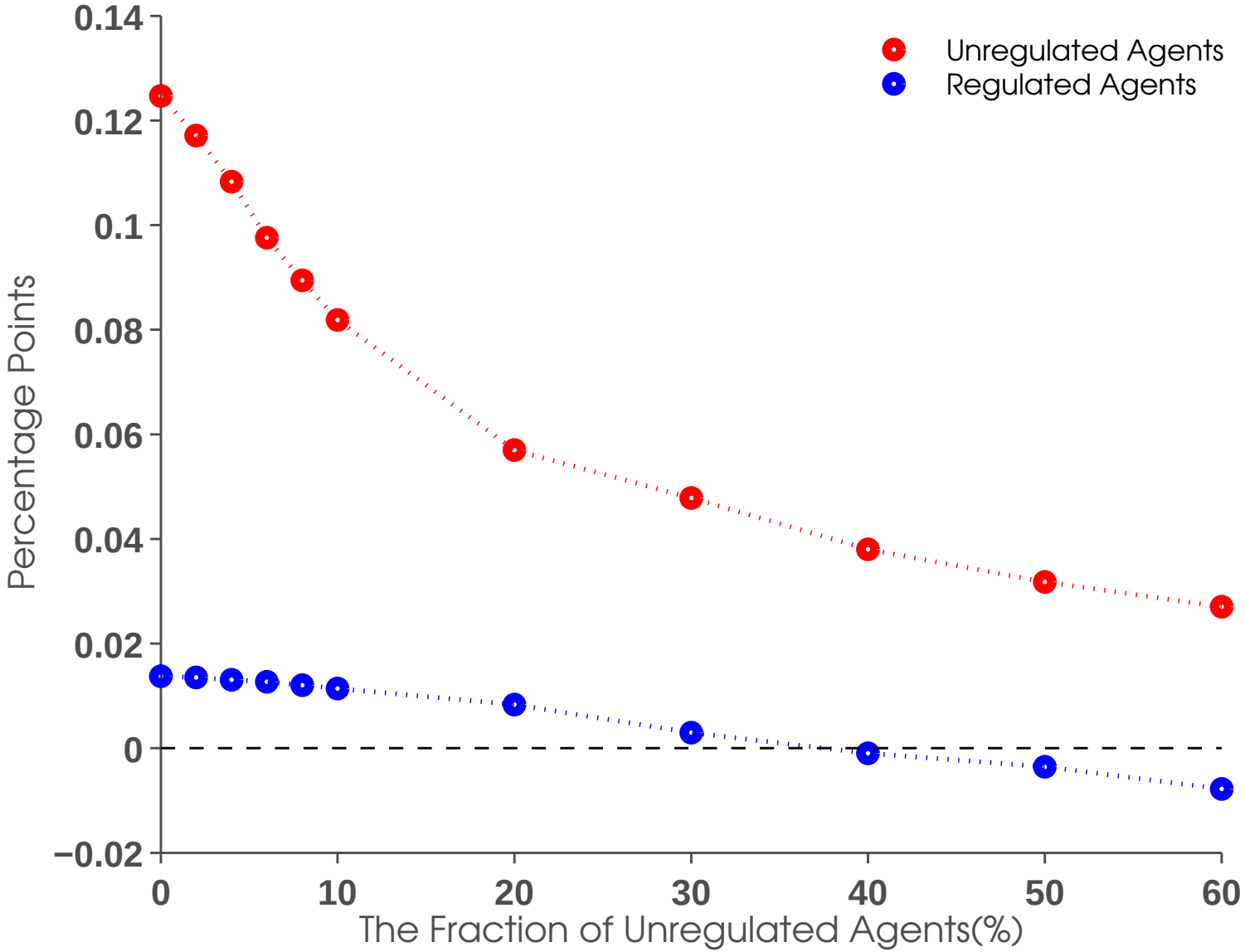
Frequency of Sudden Stops



Current Account-to-GDP Ratio of Sudden Stops



Welfare Effects



Conclusion

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