Two-way Capital Flow Management in Emerging Markets

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Introduction

Motivation

Capital flow management (CFM) policies include foreign exchange interventions and capital controls.

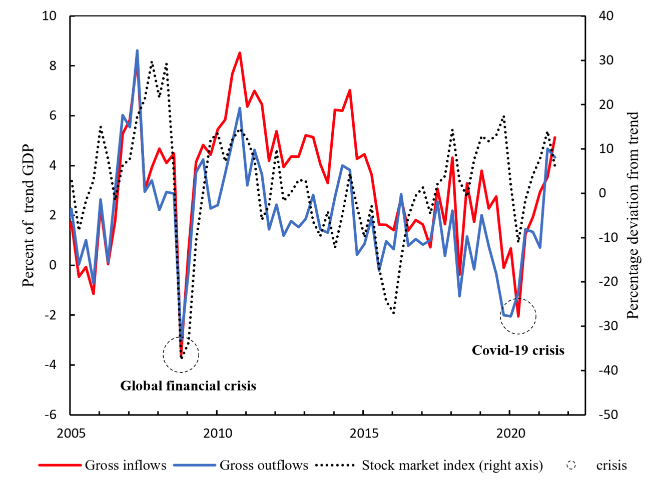
Emerging markets actively use CFM policies to smooth **external financial shocks**.

The ongoing debate about the optimal CFM policies has been mainly focused on **net capital flows**. (Jeanne and Korinek 2010; Bianchi 2011; IMF 2012; OECD 2015; IMF, 2022)

- *Gross inflows:* Net incurrence of external liabilities, e.g., German residents' purchase of Brazil's equity
- *Gross outflows:* Net acquisition of external assets, e.g., Brazilian residents' purchase of US treasuries
- *Net flows:* gross inflows-gross outflows

Net capital flows can mask an economy's real financial vulnerability (Borio and Disyatat 2010).

Motivation (cont.)



Brazil's gross capital flows and stock market index

corr(inflows, outflows)=0.83, corr(inflows, stock index)=0.44, corr(outflows, stock index)=0.40

Objective of This Paper

Focus: Optimal CFM policies involving both **inflows** and **outflows**.

Model Framework:

- Develops a small open economy DSGE model.
- Features:
  - Issuance of long-term debt
  - Accumulation of short-term assets
  - Fluctuating foreign demand for its long-term debt
  - Capital flow events like sudden stops and retrenchments
  - Centralized and decentralized equilibria

Major Findings

Relative to laissez-faire, whether the social planner increases/decreases gross capital flows is **ambiguous**, depend on:

- the legacy long-term debt level

The calibrated model to Brazil shows:

- The social planner decreases gross inflows, gross outflows, and net inflows.
- The social planner increases domestic long-term debt prices.
- Counter-cyclical capital flow taxes can be used to achieve the optimal allocation.
- The welfare gain is equivalent to an increase of 0.2 percent in permanent consumption.

Contribution

Quantitative study of optimal **gross** capital flow management:

- net capital flows: Bianchi (2011), Jeanne and Korinek (2010), Benigno et al. (2013), Farhi and Werning (2016), Schmitt-Grohé and Uribe (2016).
- gross capital flows: Caballero and Simsek (2020), Jeanne and Sandri (2023)

Lenders' friction.

- frictional international lending: Cerutti et al. (2019); IMF Financial Stability Report (2022) ; Chari et al. (2020); Ivashina et al. (2015); Akinci et al. (2022)
- borrower's friction: Bianchi (2011), Benigno et al. (2013), Jeanne and Korinek (2019)

Roadmap

1. Introduction
2. Model
3. A Tractable Case
4. Quantitative Results
5. Conclusion
6. Appendix

Model

Overview

The DSGE model features:

- Small open economy (SOE)
- Single consumption good
- Impatient households
- Short-term assets
- Long-term liabilities
- Foreign financiers with time-varying wealth
- A prudential social planner

Households

Households solve

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma}}{1-\sigma}$$

s.t.

$$\bar{y} + a_t + \delta b_t = c_t + \frac{a_{t+1}}{R_f} + q_t\big(b_{t+1} - (1-\delta) b_t\big)$$

$\bar{y} = 1$: constant endowment income

$a_t > 0$: short-term bonds.

b_t : long-term bonds.

δ : coupon decaying rate

q_t : ex-coupon long-term bond price

International Financiers

Financiers' Expertise:

- Specialized in investing in the SOE-issued long-term bonds.

Financiers' Lifecycle between Periods t and $t+1$:

- Entry: New financiers enter the market at the beginning of period t.
- Activity: They invest in the SOE bonds during period t.
- Attributes:
  - **exogenous** financial wealth W_t.
  - **exogenous** stochastic discount factor $M_{t,t+1}$.
- Exit: They leave the market by period $t+1$.

The market value of long-term bonds held by financiers cannot exceed W_t.

Long-term Bonds Pricing

$$q_t = \min\left\{E_t\left[M_{t,t+1}\left(\delta + (1-\delta)q_{t+1}\right)\right], \frac{W_t}{b^f_{t+1}}\right\}$$

In equilibrium, $\boldsymbol{b^f_{t+1} + b_{t+1} = 0}$.

International Financiers

Wealth Dynamics: Financiers' wealth oscillates between W_H and W_L ($W_H > W_L$):

$$Pr(W_{t+1}|W_t) \sim \begin{bmatrix} \pi_{HH} & 1-\pi_{HH} \\ 1-\pi_{LL} & \pi_{LL} \end{bmatrix}$$

Note: Under W_H, financiers' wealth constraint is never binding.

SDF Process: The SDF hinges on the current and future financiers' wealth W_t and W_{t+1}. SDF

- $\boldsymbol{E_t M_{t,t+1} = \frac{1}{R_f}}$.
- $R^{\kappa} > 1$ measures financiers' **effective risk-aversion**.

Decentralized Equilibrium

Markov Perfect Equilibrium: Denote the state variable $s \equiv (W, A, B)$. Decision rules $A'_{LF}(s)$, $B'_{LF}(s)$, $C_{LF}(s)$ and the price function $q^{LF}(s)$ must satisfy

- **Budget Constraint:**

$$\bar{y} + A + \delta B = C_{LF}(s) + \frac{A'_{LF}(s)}{R_f} + q^{LF}(s)\big(B'_{LF}(s) - (1-\delta)B\big).$$

- **Portfolio Rules:** Given $q_{LF}(s)$, $A'_{LF}(s)$, $B'_{LF}(s)$ and $C_{LF}(s)$ must solve:

$$\frac{u'(C_{LF}(s))}{R_f} = \beta E_{W'|W} u'(C_{LF}(s')) + \mu_{LF}(s),$$
$$u'(C_{LF}(s))q_{LF}(s) = \beta E_{W'|W} \left[u'(C_{LF}(s'))\left(\delta + (1-\delta)q_{LF}(s')\right)\right]$$

- **Bond Pricing Rule:** Given $A'_{LF}(s)$ and $B'_{LF}(s)$, $q_{LF}(s)$ must satisfy:

$$q_{LF}(s) = \min\left\{E_{W'|W}\left[SDF_{W,W'}\left(\delta + (1-\delta)q_{LF}\left(W', A'_{LF}(s), B'_{LF}(s)\right)\right)\right], -\frac{W}{B'_{LF}(s)}\right\}.$$

Centralized Equilibrium

We assume a social planner who is:

- constrained efficient: faces the same constraint as private households and maximizes social welfare
- discretionary: unable to make commitment to her future actions
- prudential: intervenes only during financial easing periods with high financiers' wealth W_H

when $W = W_H$: $q^{SP}(s)$, $A'_{SP}(s)$, $B'_{SP}(s)$ and $V_{SP}(s)$ must satisfy:

- **Bellman Equation:** Given $q_{SP}(s)$, $A'_{SP}(s)$, $B'_{SP}(s)$ and $V_{SP}(s)$ must solve:

$$V_{SP}(W_H, A, B) \equiv \max_{A'_{SP}\geq 0, B'_{SP}} \left\{ u\left(\bar{y} + A + \delta B - Q\left(W_H, A'_{SP}, B'_{SP}\right)\left(B'_{SP} - (1-\delta)B\right) - \frac{A'_{SP}}{R_f} \right) + \beta E_{W'|W_H} V_{SP}\left(W', A'_{SP}, B'_{SP}\right) \right\}$$

subject to

$$Q\left(W_H, A'_{SP}, B'_{SP}\right) \equiv E_{W'|W_H}\left[SDF_{W_H,W'}\left(\delta + (1-\delta)q^{SP}(W', A'_{SP}, B'_{SP})\right)\right]$$

Centralized Equilibrium (cont.)

- **Bond Pricing Rule:** Given $A'_{SP}(W_H, A, B)$ and $B'_{SP}(W_H, A, B)$, $q^{SP}(W_H, A, B)$ must satisfy:

$$q^{SP}(W_H, A, B) = Q\big(W_H, A'(W_H, A, B), B'(W_H, A, B)\big)$$

The optimization condition wrt A'_{SP}:

$$\frac{u'(C_{SP}(s))}{R_f} + \underbrace{\beta(1-\pi_{HH})u'\big(C_{SP}(W_L, A', B')\big)\frac{\partial q^{SP}(W_L, A', B')}{\partial A'}(B'' - (1-\delta)B')}_{\text{additional marginal loss in constrained efficiency by increasing } A'} =$$

$$\beta E_{W'|W_H} u'(C_{SP}(s')) + \mu_{SP}(s) \quad \underbrace{-u'(C_{SP}(s))\frac{\partial Q(W_H, A', B')}{\partial A'}(B' - (1-\delta)B)}_{\text{additional marginal gain in constrained efficiency by increasing } A'}$$

Centralized Equilibrium (cont.)

The optimization condition wrt B'_{SP}:

$$u'(C_{SP}(s))q^{SP}(s) + \underbrace{\beta(1-\pi_{HH})u'\big(C_{SP}(W_L, A', B')\big)\frac{\partial q(W_L, A', B')}{\partial B'}(B'' - (1-\delta)B')}_{\text{additional marginal loss in constrained efficiency by increasing } B'} =$$

$$\beta E_{W'|W_H}[u'(C_{SP}(s')) * (\delta + (1-\delta)q^{SP}(s'))] \underbrace{-u'(C_{SP}(s))\frac{\partial Q(W_H, A', B')}{\partial B'}(B' - (1-\delta)B)}_{\text{additional marginal gain constrained efficiency by increasing } B'}$$

A Tractable Case

Additional Assumptions

- Linear utility function: $u(c_t) = c_t$
- $\beta R_f = 1$
- One-shot financial tightening:

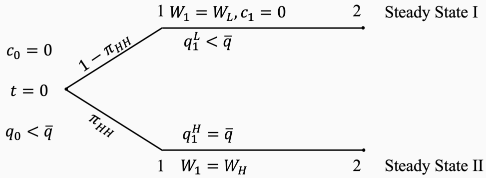
$$
\begin{aligned}
W_0 &= W_H \\
Pr(W_1 = W_L) = 1 - \pi_{HH}, Pr(W_1 = W_H) &= \pi_{HH} \\
W_t = W_H, \forall t &\geq 2
\end{aligned}
$$

Equilibrium Conditions

- Period 0: Positive inflows and outflows with $b_1 < (1-\delta)b_0$ and $a_1 > 0$.
- Period 1 (W_L): Negative inflows and outflows with $b_2 > (1-\delta)b_1$ and $a_2 = 0$.
- $c_0 = 0$: an increase in inflows must be associated with an increase in outflows.

An Important Property

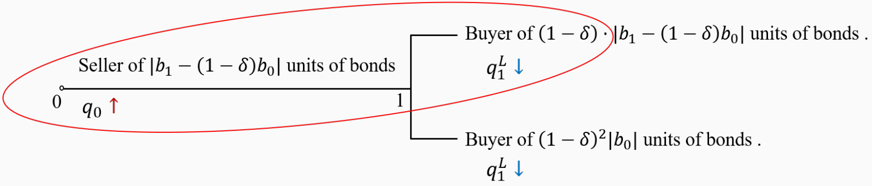
- The firesale price q_1^L **increases** with the volume of long-term bonds issued in period 0: $\frac{\partial q_1^L}{\partial(-b_1)} > 0$.
- Central insight from Jeanne and Sandri (2023) and Caballero and Simsek (2020): **Debt-financed liquidity** can **elevate** the firesale price during financial tightenings.



Social Planner's Problem

Planner's Tradeoff: Relative to the laissez-faire prices, social planner wishes to

- increase the period-0 price q_0
- decrease the period-1 price q_1^L
- However, q_0 and q_1^L are positively connected.



Whether the social planner increases/decreases the firesale price q_1^L as opposed to laissez-faire depends on which force dominates.

Social Planner's Problem

- In period 0, the social planner aims to increase q_1^L for her net bond issuance (the red encircled area) (Jeanne and Sandri 2023)
- In period 0, the social planner seeks to decrease q_1^L for the remaining legacy debt.
- The optimal firesale price q_1^L strikes a balance between two targets:
  - $\bar{q}$ (for the net bond issuance at period 0)
  - 0 (for the remaining legacy debt)
- The legacy debt level b_0 is a critical factor for the social planner to adjust q_1^L.
  - There exists a threshhold denoted by b_0^*: for $b_0 < b_0^*$ ($b_0 > b_0^*$), the social planner decreases (increases) gross capital flows so as to decrease (increase) the firesale price q_1^L.

Policy Implication

The optimal capital flow management is a quantitative question!

Quantitative Results

Calibration

We calibrate our model to Brazil's case (2002 Q1 to 2022 Q4).

Parameters

Parameter	Value	Determination	Description
R_f	1.0017	Calibrated	International risk-free rate
δ	0.0174	Calibrated	Depreciation rate of long-term bonds
σ	4.0	Calibrated	Relative risk-aversion
β	0.9859	Estimated	Subjective discount factor for households
R^{κ}	1.3627	Estimated	Risk-aversion measure for financiers
W_L	1.1101	Estimated	Lower bound of financiers' wealth
π_{UU}	0.9664	Estimated	Continuation probability in high wealth W_H
π_{CC}	0.5366	Estimated	Continuation probability in low wealth W_L

Model Fit

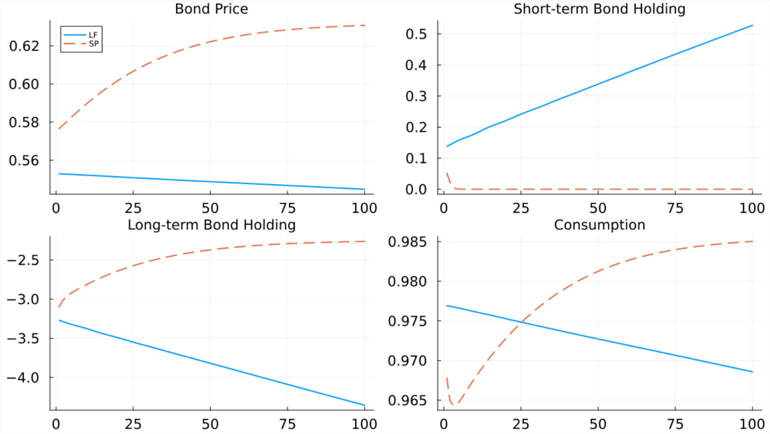
Comparison between data moments and model moments

Moment	Theoretical Moments	Empirical Moments	Targeted
std(inflows)	0.0263	0.0235	Yes
std(outflows)	0.0170	0.0191	Yes
std(excess return)	0.0730	0.0798	Yes
std(NFA)	0.1395	0.2194	No
ρ(inflows, outflows)	0.8278	0.7740	Yes
ρ(inflows, excess return)	0.4148	0.1939	Yes
ρ(outflows, excess return)	0.2554	0.4191	Yes
ρ(inflows, NFA)	-0.6393	-0.6806	No
ρ(outflows, NFA)	-0.2709	-0.2918	No
E(excess return)	0.0151	0.0107	Yes
E(liability-GDP-ratio)	1.5785	1.5585	Yes
E(inflow-GDP-ratio)	0.0289	0.0277	No
E(asset-GDP-ratio)	0.0340	0.7984	No

Note: E[X], std[X], and ρ[X, Y] denote the mean of variable X, the standard deviation of variable X, and the correlation between variables X and Y, respectively.

Main Findings

The social planner **shrinks** the external balance sheet by decreasing gross inflows and outflows.



Transition from decentralized equilibrium to centralized equilibrium. Initial points $(A_0, B_0) = (0.13, -3.26)$ represent ergodic means in decentralized equilibrium where $A'_{LF} > 0$.

- In the short run:

$$E_{LF}[(A'_{LF}(W_H, A, B) - A'_{SP}(W_H, A, B)] = 0.024$$
$$E_{LF}[(B'_{LF}(W_H, A, B) - B'_{SP}(W_H, A, B)] = -0.066$$

E_{LF}: the ergodic distribution of (A, B) in decentralized equilibrium.

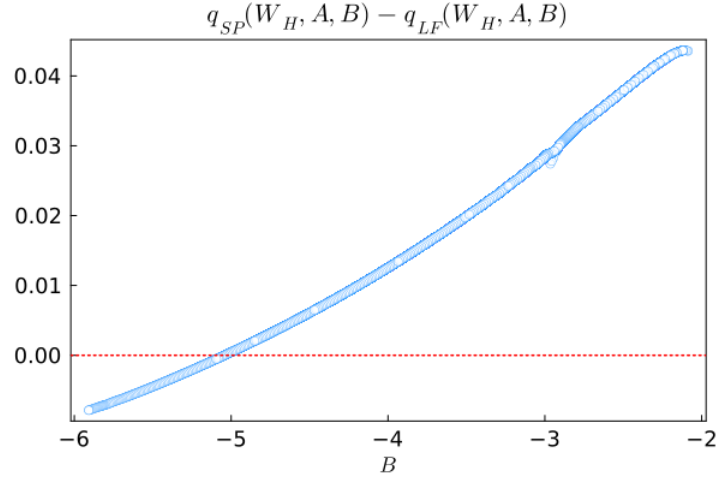
- In the long run:

$$E_{LF}[A'_{LF}(W_H, A, B)] - E_{SP}[A'_{SP}(W_H, A, B)] = 0.036$$
$$E_{LF}[B'_{LF}(W_H, A, B)] - E_{SP}[B'_{SP}(W_H, A, B)] = -0.695$$

E_{SP}: the ergodic distribution of (A, B) in centralized equilibrium.

Similarities to the Tractable Case

- The social planner **increases** the long-term bond price in the lower range of legacy debt.

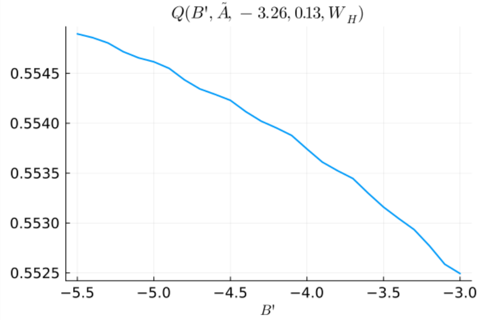


Similarities to the Tractable Case

- A prudential social planner can augment the bond price by increasing gross capital flows if she only intervenes once.
- Use the budget constraint

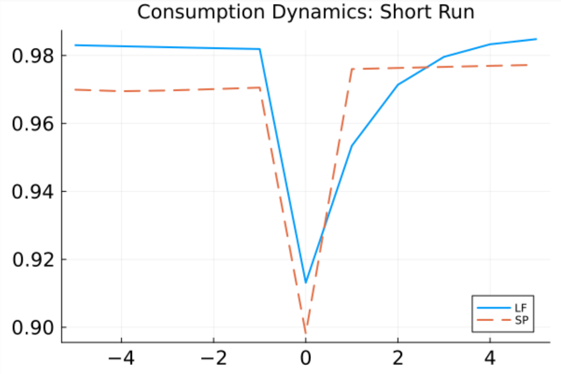
$$C_{Lf}(W_H, A, B) = y + \delta B + A - \frac{A'}{R_f} - Q(B', \tilde{A}, B, A, W_H)(B' - (1-\delta)B)$$

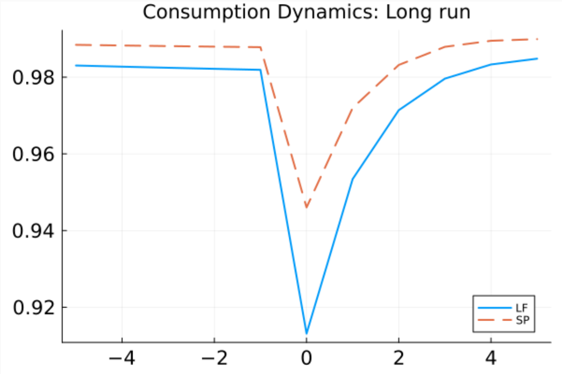
to construct $Q(B', \tilde{A}, B, A, W_H)$ such that $\tilde{A}$ is adjusted in response to B' to ensure the consumption fixed at the laissez-faire level $C_{Lf}(W_H, A, B)$.



Welfare Improvement

- The optimal allocation can be achieved via capital flow taxes on both short-term and long-term bond purchases.
- The welfare gain is equivalent to 0.2 percent of permanent consumption in laissez-faire.





Conclusion

Conclusion

- We study optimal two-way capital flow management within a quantitative framework.
- We find that the implications of optimal CFM policies are ambiguous.
- Legacy long-term liabilities play a crucial role in shaping the optimal CFM policies
- The calibrated model suggests that Brazil should decrease gross capital flows to improve welfare.

Appendix

The SDF Secification

$$M_{t,t+1} = \begin{cases} \dfrac{1}{R_f + (1-\pi_{HH})(R^{\kappa}-1)R_f}, & \text{if } W_t = W_H \,\&\, W_{t+1} = W_H, \\ \dfrac{R^{\kappa}}{R_f + (1-\pi_{HH})(R^{\kappa}-1)R_f}, & \text{if } W_t = W_H \,\&\, W_{t+1} = W_L, \\ \dfrac{1}{R_f + \pi_{LL}(R^{\kappa}-1)R_f}, & \text{if } W_t = W_L \,\&\, W_{t+1} = W_H, \\ \dfrac{R^{\kappa}}{R_f + \pi_{LL}(R^{\kappa}-1)R_f}, & \text{if } W_t = W_L \,\&\, W_{t+1} = W_L. \end{cases}$$

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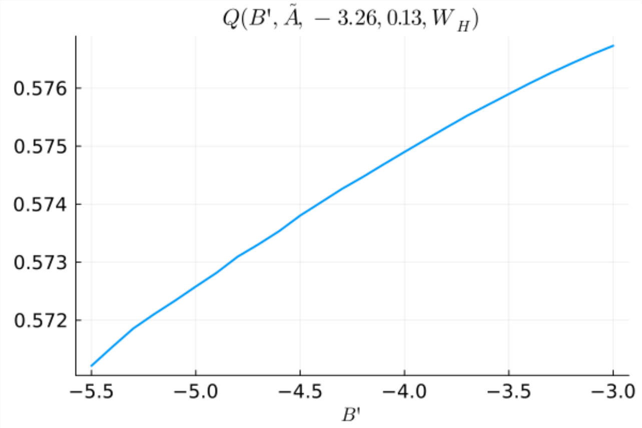
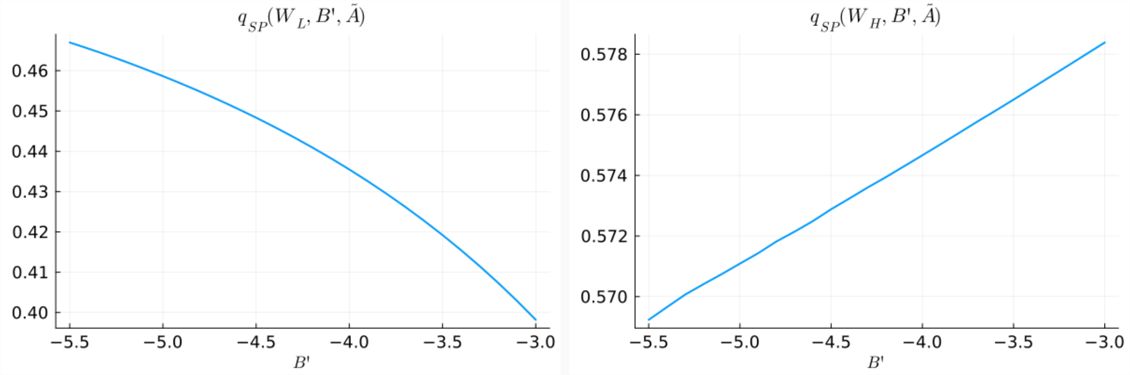
Dissimilarities to the Tractable Case

A prudential social planner cannot improve the bond price by increasing inflows and outflows if she intervenes permanently.



Dissimilarities to the Tractable Case

By increasing gross capital flows, the permanent prudential social planner **increases the firesale price** $q(B', \tilde{A}, W_L)$ but **decreases the normal price** $q(B', \tilde{A}, W_H)$ in the next period.



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