Sovereign Debt, Currency Composition and Financial Repression

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Introduction

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- Governments choose the currency composition of debt
  - Face a trade-off between LC and FC

This paper studies the relationship between the currency and bondholder composition of sovereign debt in a sovereign default model

What We Do

- We present some empirical facts on currency and bondholder composition of sovereign debt
- Build a 2-period model of sovereign default with two types of investors and two types of bonds
- We establish that the government uses LC bonds as a tool to reduce foreign debt

Preview of Results

Empirical

- We document that in EM, governments issue mostly LC debt
- We find that LC debt is held mostly by Domestic Investors
- Marginal demand of Domestic debt in LC is larger than in FC

Model

- The share of LC in hands of domestics is higher than the share of FC
- Foreign debt is inefficiently high
- Government issues LC in equilibrium
- With no-cost Financial Repression, the government does not issue LC

Taxonomy of Sovereign Debt

	Domestic lenders	Foreign lenders
Local currency debt	62 %	12 %
Foreign currency debt	6 %	20 %

Notes: Arslanalp and Tsuda (2014) database, updated in April 2024.

▸ Total LC ▸ Literature Review

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Marginal Demand of Domestic Investors

Following Broner et al. (2022)

$$\triangle B_{it}^{D} = \gamma_1 + \gamma_2 \triangle B_{it} + \gamma_3 X_{it-1}^{D} + \gamma_4 X_{it-1}^{D} \triangle B_t + \nu_t \qquad \forall i \in LC, FC$$

- $\triangle B_{it}^{D} = B_{it}^{D} - B_{it-1}^{D}$ denotes the change in domestic debt in LC or FC
- $\triangle B_{it} = B_{it} - B_{it-1}$ denotes the change in total debt in LC or FC
- $X_{it-1}^{D} = B_{it-1}^{D} / B_{it-1}$ denotes the average domestic share of LC or FC

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$$Marginal\ Effect_i = \gamma_2 + \gamma_4 X_{it-1}^{D}$$

Marginal Demand of Domestic Investors

	$\triangle$ Domestic LC	$\triangle$ Domestic FC
$\triangle$ Total debt$_{it}$	0.599***	0.753***
	(0.053)	(0.146)
$Share^{D}_{it-1}$	-0.007	-0.097
	(0.090)	(0.064)
$\triangle$ Total debt$_{it}$$*$Share$^{D}_{it-1}$	0.403***	-7.406***
	(0.055)	(1.415)
Time dummies	Yes	Yes
Country fixed effects	Yes	Yes
Observations	705	619

Notes: Domestic Debt in LC (FC) and Total Debt in LC (FC) are measured in real terms with fixed exchange rate in percent of GDP. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

- Domestic marginal demand in LC is higher than in FC

Domestic Debt

Notes: Arslanalp and Tsuda (2014), updated on April 30th 2024.

Two Period Model: Environment

- **Domestic Investors**
  * Time-separable preferences over tradable consumption and leisure
  * Pay distortionary taxes τ_t on labor income
  * Save using only government bonds

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- **Exogenous processes**
  * Nominal exchange rate and default cost ($s = \{e_1, \phi\}$)

Stochastic Structure

- Cost of default $\phi \in [\underline{\phi}, \overline{\phi}]$ has a p.d.f f_ϕ independent of debt
- Nominal exchange rate:
  * In first period $e_0^{-1} = 1$
  * In second period e_1^{-1} is stochastic and $\mathbb{E}\left[e_1^{-1}\right] = 1$
- The shocks are not correlated: $cov(e_1^{-1}, \phi) = 0$

Domestic Investors

$$U = u(c_0 + v(1 - n_0)) + \beta \mathbb{E}[u(c_1(s) + v(1 - n_1(s))) - d(s)\phi]$$

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$$c_0 + qb_D + q^\star b_D^\star = (1 - \tau_0)n_0$$
$$b_D, b_D^\star \geq 0$$

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$$b_D, b_D^\star \geq 0$$

In $t = 1$ at state s, the budget constraint of domestic investors becomes:

$$c_1(s) = (1 - \tau_1(s))n_1(s) + (1 - d(s))\left(\frac{b_D}{e_1} + b_D^\star\right) \quad \forall s$$

Where $d \in \{0, 1\}$ takes the value of 1 if the government defaults or zero otherwise

Foreign Lenders

Continuum of identical risk-neutral lenders with initial wealth W

$$\pi = \max_{\{b_F, b_F^\star\}} \mathbb{E}\left[(1 - d(s))\left(\frac{b_F}{e_1} + b_F^\star\right)\right] + (W - qb_F - q^\star b_F^\star)R$$

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Given $q, q^\star$ their demand for government bonds is:

$$b_F^\star = \begin{cases} 0 & \text{if } q^\star > \mathbb{E}\left[\frac{(1-d(s))}{R}\right], \\ [0, W] & \text{if } q^\star = \mathbb{E}\left[\frac{(1-d(s))}{R}\right], \end{cases} \qquad b_F = \begin{cases} 0 & \text{if } q > \mathbb{E}\left[\frac{(1-d(s))}{R}\frac{1}{e_1}\right], \\ [0, W] & \text{if } q = \mathbb{E}\left[\frac{(1-d(s))}{R}\frac{1}{e_1}\right], \end{cases}$$

Government

The fiscal budget for $t = 0$ is:

$$\bar{B}_0 = \tau_0 n_0 + qB_1 + q^\star B_1^\star$$

In $t = 1$, the fiscal budget becomes:

$$(1 - d(s))\left(\frac{B_1}{e_1} + B_1^\star\right) = \tau_1(s) n_1(s) \qquad \forall s$$

▸ CE

Bond Market Equilibrium

Let $\boldsymbol{B} \equiv (B_1^\star, B_1, B_F^*, B_F)$. Define the SDF of the domestic investors as:

$$\Lambda(\boldsymbol{B}, e_1) = \frac{\beta(u'(c_1(s) + v(1 - n_1(s)))}{u'(c_0 + v(1 - n_0))}$$

Price schedules are given by:

$$Q^\star(\boldsymbol{B}) = \begin{cases} \mathbb{E}\left[\frac{(1-d(s))}{R}\right] & \text{if } B_F^\star > 0, \\ \mathbb{E}\left[(1 - d(s))\Lambda(\boldsymbol{B}, e_1)\right] & \text{if } B_F^\star = 0 \end{cases}$$

$$Q(\boldsymbol{B}) = \begin{cases} \mathbb{E}\left[\frac{(1-d(s))}{R}\frac{1}{e_1}\right] & \text{if } B_F > 0, \\ \mathbb{E}\left[(1 - d(s))\frac{1}{e_1}\Lambda(\boldsymbol{B}, e_1)\right] & \text{if } B_F = 0 \end{cases}$$

Optimal Policy: Government in $t = 1$

$$V_1(\boldsymbol{B}, s) = \max_{d \in \{0,1\}} (1 - d) V^R(\boldsymbol{B}, e_1) + d(V^D - \phi)$$

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Where the value of repayments is:

$$V^R(\boldsymbol{B}, e_1) = u\left(N^R(B_1^\star, B_1, e_1) - \frac{B_F}{e_1} - B_F^\star + v\left(1 - N^R(B_1^\star, B_1, e_1)\right)\right)$$

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The value of default is:

$$V^D = u(N^D + v(1 - N^D))$$

Optimal Policy: Government in $t = 1$

We characterized the default decision by defining the following threshold:

$$\hat{V}_1(\boldsymbol{B}, e_1) = V^D - V^R(\boldsymbol{B}, e_1)$$

The government's default decision is the following:

$$D(\boldsymbol{B}, e_1) = \begin{cases} 1 & \text{if} \quad \hat{V}_1(\boldsymbol{B}, e_1) > \phi, \\ 0 & \text{otherwise.} \end{cases}$$

At each e_1 the probability of default is:

$$F(\hat{V}_1(\boldsymbol{B}, e_1)) = \int_{\underline{\phi}}^{\hat{V}_1(\boldsymbol{B}, e_1)} f(\phi) d\phi.$$

Price Functions

The price function becomes:

$$Q^\star(\boldsymbol{B}) = \begin{cases} \mathbb{E}_e\left[\frac{(1-F_\phi(\hat{V}(\boldsymbol{B},e_{\mathbf{1}}))}{R}\right] & \text{if } B_F^\star > 0, \\ \mathbb{E}_e\left[(1-F_\phi(\hat{V}(\boldsymbol{B},e_1))\Lambda(\boldsymbol{B},e_1)\right] & \text{if } B_F^\star = 0 \end{cases}$$

$$Q(\boldsymbol{B}) = \begin{cases} \mathbb{E}_e\left[\frac{(1-F_\phi(\hat{V}(\boldsymbol{B},e_{\mathbf{1}}))}{R}\frac{1}{e_{\mathbf{1}}}\right] & \text{if } B_F > 0, \\ \mathbb{E}_e\left[(1-F_\phi(\hat{V}(\boldsymbol{B},e_1))\frac{1}{e_{\mathbf{1}}}\Lambda(\boldsymbol{B},e_1)\right] & \text{if } B_F = 0 \end{cases}$$

Government's Problem in $t = 0$

$$V_0 = \max_{B_1, B_1^\star} u(c_0 + v(1 - N_0(\boldsymbol{B}))) + \beta \mathbb{E}[V_1(\boldsymbol{B}, s)]$$

subject to

$$c_0 + \bar{B}_0 = N_0(\boldsymbol{B}) + Q(\boldsymbol{B}) B_F + Q^\star(\boldsymbol{B}) B_F^\star$$

$$Q^\star(\boldsymbol{B}), \quad Q(\boldsymbol{B})$$

$$B_F = \mathcal{B}_F^\star(B_1, B_1^\star), \quad B_F^\star = \mathcal{B}_F(B_1, B_1^\star)$$

‣ Markov Equilibrium

Domestic Demand for Government Bonds

Proposition 1

Assume $\text{Cov}(e_1^{-1}, \phi) = 0$. Also, let $B_1^{\star} > 0$, $B_1 \geq 0$. Then $B_D^{\star} > 0$ if and only if $B_D = B_1$.

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Two key ingredients

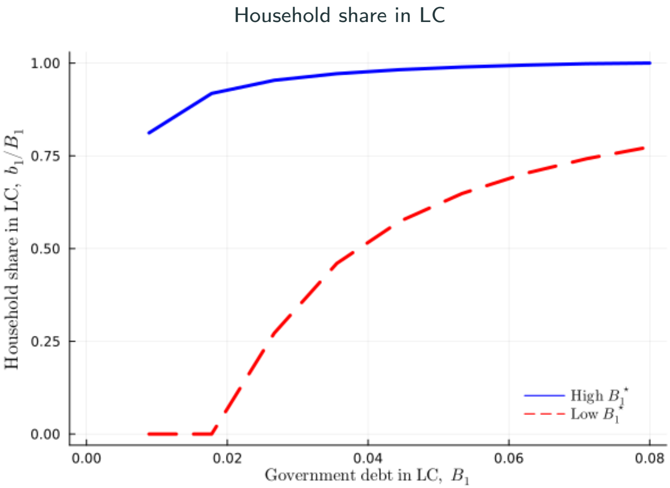
- Domestic investors' budget constraint in $t = 1$:

$$c_1(s) = (1 - \tau_1(s))n_1(s) + (1 - d(s))\left(\frac{b_D}{e_1} + b_D^\star\right) \quad \forall s$$

- Government's fiscal budget in $t = 1$:

$$(1 - d(s))\left(\frac{B_1}{e_1} + B_1^\star\right) = \tau_1(s)n_1(s) \qquad \forall s$$

Model Results



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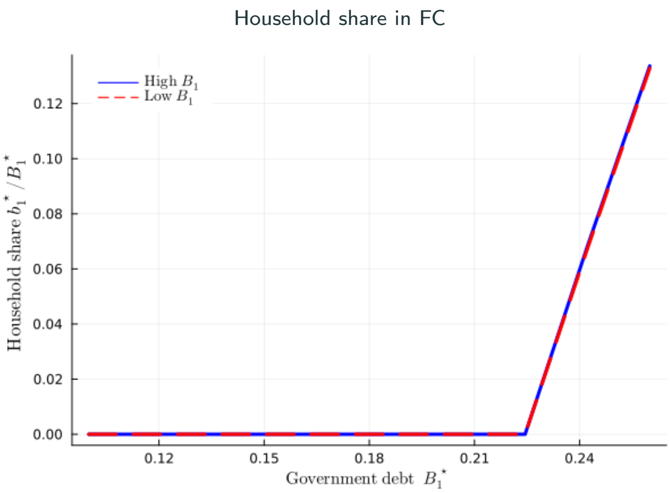

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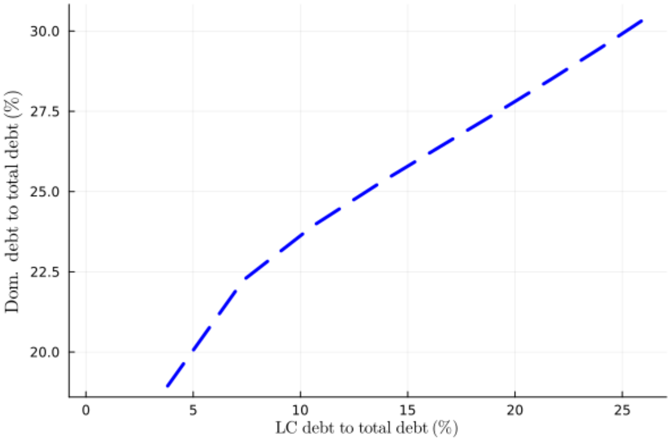
Model Results

Domestic debt to total debt ratio



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Foreign Debt is Inefficiently High

Lemma 1

Let $B_1^\star > 0$. Then foreign demand for government bonds is inefficiently high

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Key drivers

1. $B_F^\star = B_1^\star - B_D^\star$
2. $V^R(\boldsymbol{B}, e_1) = u\left(N^R(B_1^\star, B_1, e_1) - \frac{B_F}{e_1} - B_F^\star + v\left(1 - N^R(B_1^\star, B_1, e_1)\right)\right)$
3. $D(\boldsymbol{B}, e_1)$
4. $Q^\star(\boldsymbol{B})$

Government FOC

Government Issues LC in Equilibrium

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Let $\text{Cov}(e_1^{-1}, \phi) = 0$ and $B_1^\star > 0$. Then, $B_1 = 0$ cannot be part of the Markov Equilibrium.

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Two conditions:

1. Domestic investors demand all LC debt (*Proposition 1*)
2. Foreign Debt is Inefficiently High (*Lemma 1*)

Regulated Economy

Government can impose a minimum requirement on $b_D^\star$ by using *Financial Repression* (Chari et al. (2020)) without any cost

$$b_D^\star \geq \Theta B_1^\star$$

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Proposition 3

Assume $\text{Cov}(e_1^{-1}, \phi) = 0$. Let $B_1^\star > 0$. Then, $B_1 = 0$ is part of the Markov Equilibrium in a regulated economy.

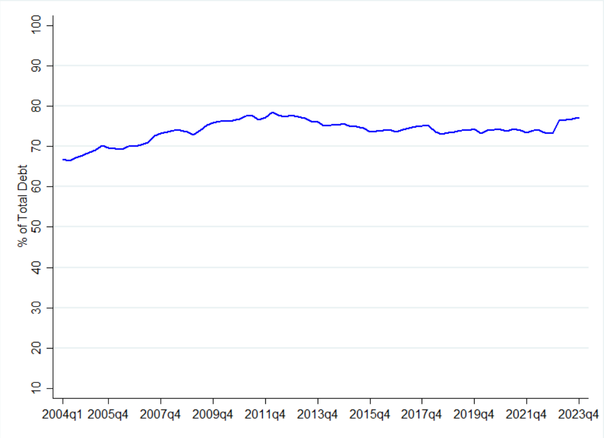
▸ Regulated CE

Conclusion

- In EM, governments issue mostly LC debt
- LC debt is held mostly by Domestic Investors
- Government uses LC debt to reduce foreign debt
- If government can choose the domestic demand in FC at no-cost, then issues only FC debt

EM issue mostly in LC

Share of Total Public Debt in Local Currency



Notes: Arslanalp and Tsuda (2014), updated on April 30th 2024.

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Literature Review

- Sovereign default models
  Eaton and Gersovitz (1981), Aguiar and Gopinath (2006), Arellano (2008)
- Currency composition and the hedging benefits of LC debt
  Eichengreen and Hausmann (1999), Ottonello and Perez (2019), Du et al. (2020), Lee (2021)
- Bondholder composition and domestic default
  Bolivar (2023), D Erasmo and Mendoza (2021), Sunder-Plassmann (2020)
- Financial repression as a tool to change the composition of bondholders
  Chari et al. (2020), Mallucci (2022)
- Empirical work on currency and bondholder composition of sovereign debt
  Hausmann and Panizza (2003), Arslanalp and Tsuda (2014)

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Marginal Demand of Domestic Investors

	$\triangle$ Domestic LC	$\triangle$ Domestic FC
$\triangle$ Total debt$_{it}$	0.599***	0.753***
	(0.053)	(0.146)
$Share^{D}_{it-1}$	-0.007	-0.097
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Time dummies	Yes	Yes
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Observations	705	619

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Competitive Equilibrium

Definition 1

Given an initial debt B_0 and government policies $\{B_1, B_1^\star, \tau_1, \{\tau_2(s), d(s)\}_s\}$, an equilibrium consists of a sequence of prices $\{q, q^\star\}$, and domestic investor's allocations $\{c_0, n_0, \{c_1(s), n_1(s)\}_s, b_D, b_D^\star\}$ such that

- Given prices and government policies, $\{c_0, n_0, \{c_1(s), n_1(s)\}_s, b_D, b_D^\star\}$ maximizes domestic investors' problem
- Given government policies, foreign demand for government bonds solve the foreign lenders' problem
- Given prices and domestic investor's allocations, $\{B_1, B_1^\star, \tau_0, \{\tau_1(s), d(s)\}_s\}$, is consistent with government budget constraints
- Markets clear: $B_F = B_1 - B_D$, $B_F^\star = B_1^\star - B_D^\star$, $B_D = b_D$ and $B_D^\star = b_D^\star$

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Labor Market Equilibrium

Let $v(1-n_t) = \psi \log(1-n_t)$. Combining optimality conditions of the domestic investors and government:

$$\psi = (1-n_0)\left[1 - \frac{B_0 - qB_1 - q^\star B_1^\star}{n_0}\right]$$

$$\psi = (1-n_1(s))\left[1 - \frac{(1-d(s))\left(\frac{B_1}{e_1} + B_1^\star\right)}{n_1(s)}\right] \qquad \forall s$$

Domestic Investors $t = 0$

Given debt policy $B_1^\star, B_1$, the portfolio $B_D^\star, B_D$ solve the problem of the domestic investors if and only if:

$$0 = \eta_1 \Big(Q(\boldsymbol{B}) - \mathbb{E}_e \left[(1 - F_\phi(\hat{\phi}(\boldsymbol{B}, e_1)) \frac{\Lambda(\boldsymbol{B}, e_1)}{e_1} \right] \Big)$$

$$0 = \eta_2 \Big(Q^\star(\boldsymbol{B}) - \mathbb{E}_e [(1 - F_\phi(\hat{\phi}(\boldsymbol{B}, e_1))\Lambda(\boldsymbol{B}, e_1)] \Big)$$

$$B_D^\star = 0 \quad \textit{if} \quad \eta_1 > 0.$$

$$B_D = 0 \quad \textit{if} \quad \eta_2 > 0.$$

Let $\mathcal{B}_F^\star(B_1, B_1^\star), \mathcal{B}_F(B_1, B_1^\star)$ be the policy functions consistent with the optimality conditions given government policy

Markov Equilibrium

Definition 2

Given initial debt B_0, a Markov equilibrium is a set of value functions $V_0, V_1(\boldsymbol{B}, s)$, price functions $Q(\boldsymbol{B}), Q^{\star}(\boldsymbol{B})$, and policy functions $\mathcal{B}_F^{\star}(B_1, B_1^{\star}), \mathcal{B}_F(B_1, B_1^{\star}), \mathcal{B}, \mathcal{B}^{\star}$ such that:

- given the price, $\{\mathcal{B}_F^{\star}(B_1, B_1^{\star}), \mathcal{B}_F(B_1, B_1^{\star})\}$ solves the domestic investor's problem at every state;
- Price functions $Q(\boldsymbol{B}), Q^{\star}(\boldsymbol{B})$ are consistent with the demand function of foreign investors and the Euler equations of the domestic investors;
- $\mathcal{D}, \mathcal{B}, \mathcal{B}^{\star}$ solves the government problem at every state, and V_0, V_1 attains the maximum

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Regulated Competitive Equilibrium

Definition 1

Given an initial debt level B_0 and government policies $\{B_1, B_1^\star, \tau_1, \{\tau_2(s), d(s)\}_s, \Theta\}$, an equilibrium consists of a sequence of prices $\{q, q^\star\}$, and domestic investors' allocations $\{c_0, n_0\{c_1(s), n_1(s)\}_s, b_D, b_D^\star\}$ such that

- Given prices and government policies, $\{c_0, n_0\{c_1(s), n_1(s)\}_s, b_D, b_D^\star\}$ maximizes domestic investors' problem;
- Given government policies, foreign demand for government bonds solve the foreign lenders' problem;
- Given prices and domestic investors' allocations, $\{B_1, B_1^\star, \tau_1, \{\tau_2(s), d(s)\}_s\}$, is consistent with government budget constraints;
- Markets clear: $B_F = B_1 - B_D$, $B_F^\star = B_1^\star - B_D^\star$, $B_D = b_D$ and $B_D^\star = b_D^\star$.

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Optimal Policy: Government in $t = 0$

The problem of the government in a regulated economy becomes:

$$V_0^R = \max_{B_{\mathbf{1}}, B_{\mathbf{1}}^\star, B_F^\star} u(c_0 + v(1 - N_0(\boldsymbol{B}))) + \beta \mathbb{E}[V_1(\boldsymbol{B}, s)]$$

subject to

$$c_0 + B_0 = N_0(\boldsymbol{B}) + Q(\boldsymbol{B})B_F + Q^\star(\boldsymbol{B})B_F^\star$$

$$Q^\star(\boldsymbol{B}), \quad Q(\boldsymbol{B})$$

$$\mathcal{B}_F^R(B_1, B_1^\star)$$

Markov Equilibrium of a Regulated Economy

Definition 2

Given initial debt B_0, a Markov equilibrium is a set of value functions $V_0^R, V_1(\boldsymbol{B}, s)$, price functions $Q(\boldsymbol{B}), Q^\star(\boldsymbol{B})$, and policy functions $\mathcal{B}_F^R(B_1, B_1^\star), \mathcal{B}_F^\star, \mathcal{B}, \mathcal{B}^\star$ such that:

- given the price, $\{\mathcal{B}_F^R(B_1, B_1^\star)\}$ solves the domestic investor's problem at every state;
- Price functions $Q(\boldsymbol{B}), Q^\star(\boldsymbol{B})$ are consistent with the demand function of foreign investors and the Euler equations of the domestic investors;
- $\mathcal{B}_F^\star, \mathcal{B}, \mathcal{B}^\star$ solves the government problem at every state, and V_0, V_1 attains the maximum

Foreign Debt is Inefficiently High

From the government FOC

$$Q^{\star}(\boldsymbol{B}) = \mathbb{E}_e[(1 - F_{\phi}(\hat{V}(\boldsymbol{B}, e_1))\Lambda(\boldsymbol{B}, e_1)]$$

$$+ \underbrace{\left(\frac{\partial Q}{\partial B^{\star}} - \frac{\partial Q^{\star}}{\partial B_F^{\star}}\right) \mathcal{B}_F^{\star}(B_1, B_1^{\star}) + \left(\frac{\partial Q}{\partial B^{\star}} - \frac{\partial Q}{\partial B_F^{\star}}\right) \mathcal{B}_F(B_1, B_1^{\star})}_{\mathbf{ext_1}}$$

$$+ \underbrace{\frac{\partial n_0}{\partial B^{\star}} \left[1 - v'(1 - n_0)\right] - \mathbb{E}\left[(1 - F_{\phi}(\hat{V}(\boldsymbol{B}, e_1))\Lambda(\boldsymbol{B}, e_1) \frac{\partial n_1^R}{\partial B^{\star}} \left[1 - v'(1 - n_1)\right]\right]}_{ext_2}$$

▸ Back

Constrained Efficiency

Definition 5

An allocation in the bond market $\hat{\boldsymbol{B}}$ is constrained efficiency in this environment if it is part of Markov equilibrium and there no exist another allocation $\overline{\boldsymbol{B}}$ such that:

- $u(c_0 + v(1 - N_0(\overline{\boldsymbol{B}}))) + \beta\mathbb{E}[V_1(\overline{\boldsymbol{B}}, s)] > u(c_0 + v(1 - N_0(\hat{\boldsymbol{B}}))) + \beta\mathbb{E}[V_1(\hat{\boldsymbol{B}}, s)]$;
- $c_0^T + B_0 \leq N_0(\overline{\boldsymbol{B}}) + Q(\overline{\boldsymbol{B}})B_F + Q^\star(\overline{\boldsymbol{B}})B_F^\star$

Proposition 4

Assume $\mathrm{Cov}(e_1^{-1}, \phi) = 0$. Let $\boldsymbol{B}^{NR}$ and $\boldsymbol{B}^R$ be the optimal allocation in an unregulated and regulated economy, respectively. Then, $\boldsymbol{B}^{NR}$ is not constrained efficient while $\boldsymbol{B}^R$ is constrained efficient.