

Central Bank Swap Lines as Bilateral Sovereign Debt

Francisco Roldán
IMF

César Sosa-Padilla
Notre Dame

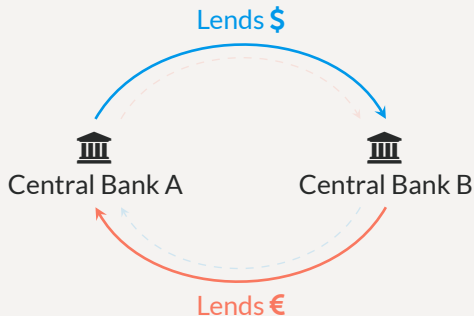
September 2023

The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

What is a Central Bank swap?

Swaps are **symmetric** currency exchanges

- A swap line is a contract between two Central Banks
- When activated, each institution provides an amount of its currency to the counterparty
- At maturity, positions are unwound

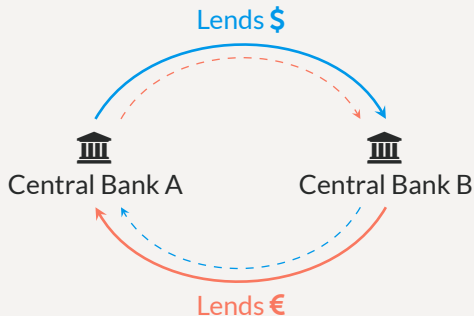


- **Symmetric** swaps (AE-AE) potentially very different from **asymmetric** ones (AE-EM)
... Symmetric swaps better understood, growing number of *asymmetric* ones

What is a Central Bank swap?

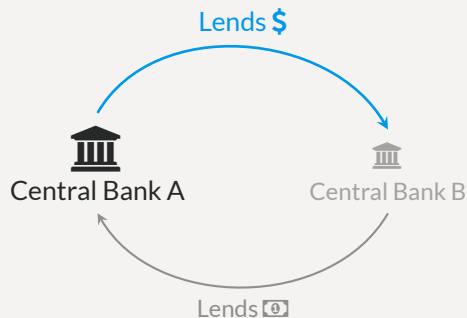
Swaps are **symmetric** currency exchanges

- A swap line is a contract between two Central Banks
- When activated, each institution provides an amount of its currency to the counterparty
- At maturity, positions are unwound



- **Symmetric** swaps (AE-AE) potentially very different from **asymmetric** ones (AE-EM)
... Symmetric swaps better understood, growing number of *asymmetric* ones

What is a Central Bank swap?



which can be **asymmetric**
in practice

- The Fed doesn't really want Mexico's pesos
... treats them more like collateral
- Mexican authorities may need dollars for their BoP
... more similar to borrowed reserves

- **Symmetric** swaps (AE-AE) potentially very different from **asymmetric** ones (AE-EM)
... Symmetric swaps better understood, growing number of *asymmetric* ones

What is a Central Bank swap?

Swaps are **symmetric** currency exchanges

- A swap line is a contract between two Central Banks
- When activated, each institution provides an amount of its currency to the counterparty
- At maturity, positions are unwound

which can be **asymmetric** in practice

- The Fed doesn't really want Mexico's pesos
... treats them more like collateral
- Mexican authorities may need dollars for their BoP
... more similar to borrowed reserves

- **Symmetric** swaps (AE-AE) potentially very different from **asymmetric** ones (AE-EM)
... Symmetric swaps better understood, growing number of *asymmetric* ones

How are Central Bank Swap Lines different from Sovereign Debt?

- We abstract from **currencies**, **collateral**, and focus on the **borrowing**

For an EM using the swap line to **borrow** from an AE

Regular debt (bond markets)

- Defaultable
- Many different lenders
- Interest rate (**spreads**) mainly reflects default risk

Bilateral loan (swap line)

- Non-defaultable (Central Bank)
- No coordination issues
- Can be used to curb default risk
- **Interest rate?**

How are Central Bank Swap Lines different from Sovereign Debt?

- We abstract from currencies, collateral, and focus on the borrowing

For an EM using the swap line to **borrow** from an AE

Regular debt (bond markets)

- Defaultable
- Many different lenders
- Interest rate (**spreads**) mainly reflects default risk

Bilateral loan (swap line)

- Non-defaultable (Central Bank)
- No coordination issues
- Can be used to curb default risk
- **Interest rate?**

How do Central Bank Swap Lines interact with Sovereign Debt?

Main findings

- One type of debt affects borrowing conditions for the other
 - Borrowing from the market serves as threat in swap negotiations
 - Swap can be used when spreads on the market are high
- Lending around or in default maximizes surplus for bilateral loans
 - Availability of swaps in default:
 - ... raises the value of default
 - ... which increases the default frequency
 - ... and worsens borrowing terms in bond markets
 - Without restricting swaps in default, **welfare losses** for the government
- Swap lines worsen the **debt dilution** problem


- Central Bank swaps among advanced economies
 - ... Bahaj and Reis (2021); Cesa-Bianchi, Eguren-Martin, and Ferrero (2022)
- Data on Central Bank swaps
 - ... Perks, Rao, Shin, and Tokuoka (2021); Horn, Parks, Reinhart, and Trebesch (2023)
- Sovereign debt/default with non-defaultable debt
 - ... Hatchondo, Martinez, and Onder (2014)

Model with Swaps only

Environment

The government of a small open economy borrows from a monopolist


- Income $y(z_t)$ follows an AR(1) process in logs
 - ... Only one good, representative risk-averse household, expected utility
- **Renegotiate** the swap m each period
 - ... Involves a transfer x and a new loan size m'
 - ... Swap is non-defaultable \implies Repaying m is the natural threat point
- Should expect
 - ... Implicit interest rate r to vary over time
 - ... Interest rate to reflect **market power**
 - ... Interest rate to reflect **outside options**


$$x = \frac{1}{1+r} m' - m$$

Environment

The government of a small open economy borrows from a monopolist

- Income $y(z_t)$ follows an AR(1) process in logs
 - ... Only one good, representative risk-averse household, expected utility
- **Renegotiate** the swap m each period
 - ... Involves a transfer x and a new loan size m'
 - ... Swap is non-defaultable \implies Repaying m is the natural threat point
- Should expect
 - ... Implicit interest rate r to vary over time
 - ... Interest rate to reflect **market power**
 - ... Interest rate to reflect **outside options**


$$x = \frac{1}{1+r} m' - m$$

Bargaining stage with monopolist

- At income state z and loan m , solve

$$\max_{x, m'} \mathcal{L}(x, m, m', z)^\theta \times \mathcal{B}(x, m, m', z)^{1-\theta}$$

Government surplus

Lender surplus

- Government (borrower) surplus

$$\mathcal{B}(x, m, m', z) = \underbrace{u(y(z) + x) + \beta \mathbb{E}[v(m', z') | z]}_{\text{agreement: receive } x, \text{ owe } m'} - \underbrace{(u(y(z) - m) + \beta \mathbb{E}[v(0, z') | z])}_{\text{threat point: repay } m, \text{ clean slate}}$$

- Lender surplus

$$\mathcal{L}(x, m, m', z) = \underbrace{a - x + \beta_L \mathbb{E}[h(m', z') | z]}_{\text{agreement}} - \underbrace{(a + m + \beta_L \mathbb{E}[h(0, z') | z])}_{\text{threat point}}$$

- Value functions $v(m, z)$ and $h(m, z)$ encode expected outcomes of future rounds

Bargaining stage with monopolist

- At income state z and loan m , solve

$$\max_{x, m'} \mathcal{L}(x, m, m', z)^\theta \times \mathcal{B}(x, m, m', z)^{1-\theta}$$

- Government (borrower) surplus

$$\mathcal{B}(x, m, m', z) = \underbrace{u(y(z) + x) + \beta \mathbb{E}[v(m', z') | z]}_{\text{agreement: receive } x, \text{ owe } m'} - \underbrace{(u(y(z) - m) + \beta \mathbb{E}[v(0, z') | z])}_{\text{threat point: repay } m, \text{ clean slate}}$$

- Lender surplus

$$\mathcal{L}(x, m, m', z) = \underbrace{a - x + \beta_L \mathbb{E}[h(m', z') | z]}_{\text{agreement}} - \underbrace{(a + m + \beta_L \mathbb{E}[h(0, z') | z])}_{\text{threat point}}$$

- Value functions $v(m, z)$ and $h(m, z)$ encode expected outcomes of future rounds

Bargaining stage with monopolist

- At income state z and loan m , solve

$$\max_{x, m'} \mathcal{L}(x, m, m', z)^\theta \times \mathcal{B}(x, m, m', z)^{1-\theta}$$

- Government (borrower) surplus

$$\mathcal{B}(x, m, m', z) = \underbrace{u(y(z) + x) + \beta \mathbb{E}[v(m', z') | z]}_{\text{agreement: receive } x, \text{ owe } m'} - \underbrace{(u(y(z) - m) + \beta \mathbb{E}[v(0, z') | z])}_{\text{threat point: repay } m, \text{ clean slate}}$$

- Lender surplus

$$\mathcal{L}(x, m, m', z) = \underbrace{a - x + \beta_L \mathbb{E}[h(m', z') | z]}_{\text{agreement}} - \underbrace{(a + m + \beta_L \mathbb{E}[h(0, z') | z])}_{\text{threat point}}$$

- Value functions $v(m, z)$ and $h(m, z)$ encode expected outcomes of future rounds

Bargaining stage with monopolist

- At income state z and loan m , solve

$$\max_{x, m'} \mathcal{L}(x, m, m', z)^\theta \times \mathcal{B}(x, m, m', z)^{1-\theta}$$

- Government (borrower) surplus

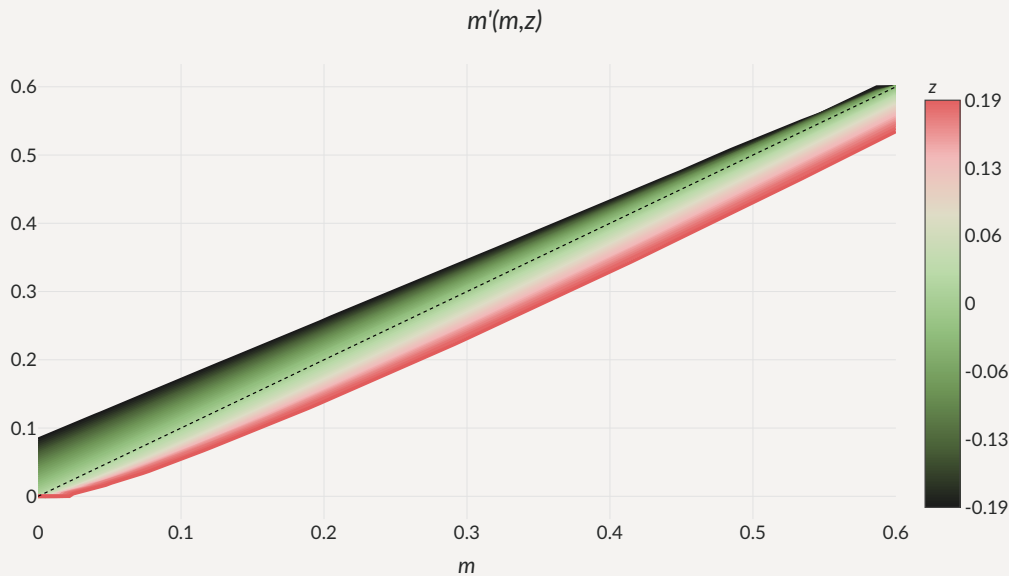
$$\mathcal{B}(x, m, m', z) = \underbrace{u(y(z) + x) + \beta \mathbb{E}[v(m', z') | z]}_{\text{agreement: receive } x, \text{ owe } m'} - \underbrace{(u(y(z) - m) + \beta \mathbb{E}[v(0, z') | z])}_{\text{threat point: repay } m, \text{ clean slate}}$$

- Lender surplus

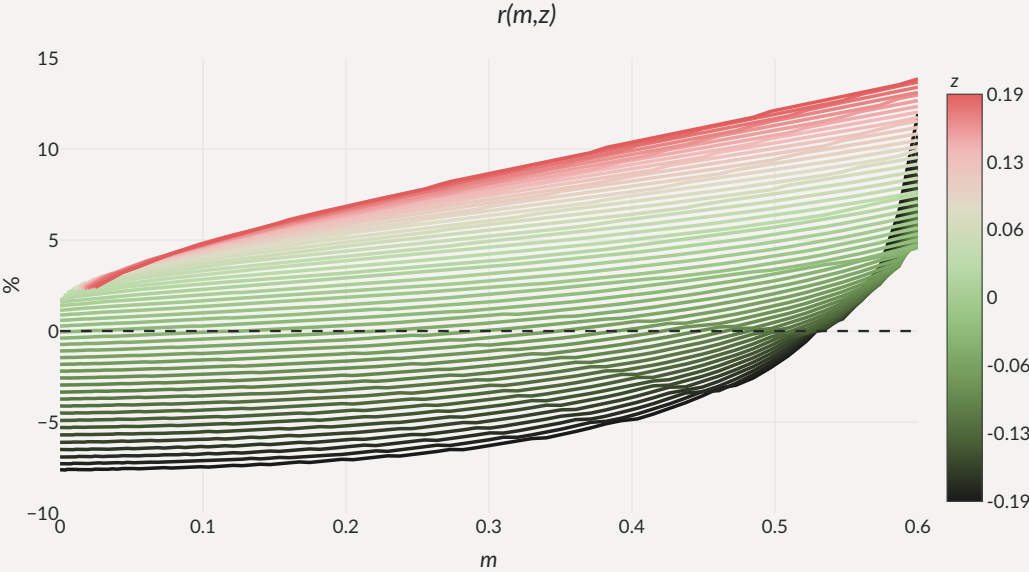
$$\mathcal{L}(x, m, m', z) = \underbrace{a - x + \beta_L \mathbb{E}[h(m', z') | z]}_{\text{agreement}} - \underbrace{(a + m + \beta_L \mathbb{E}[h(0, z') | z])}_{\text{threat point}}$$

- Value functions $v(m, z)$ and $h(m, z)$ encode expected outcomes of future rounds

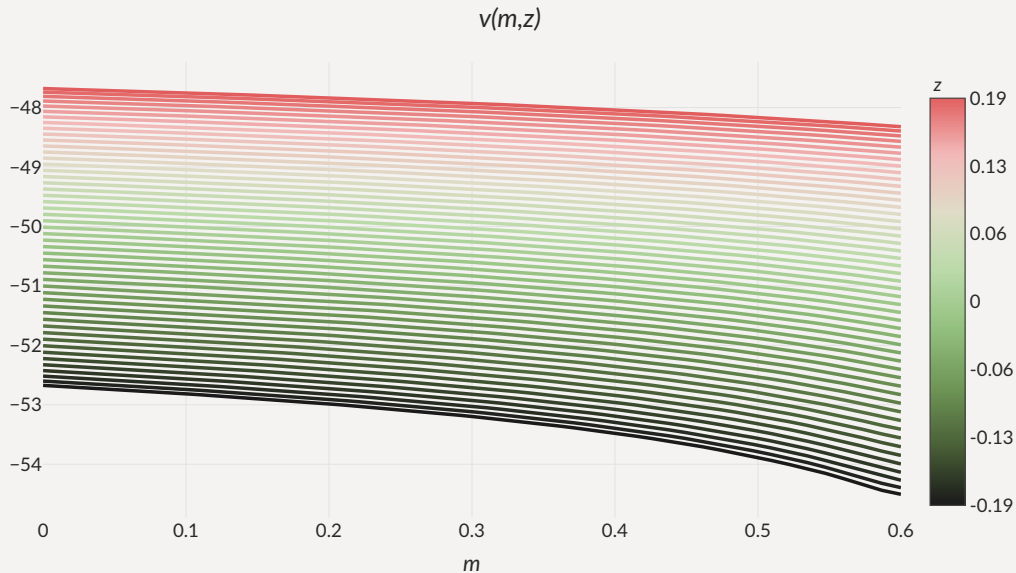
Swap Line Terms: Loan Dynamics



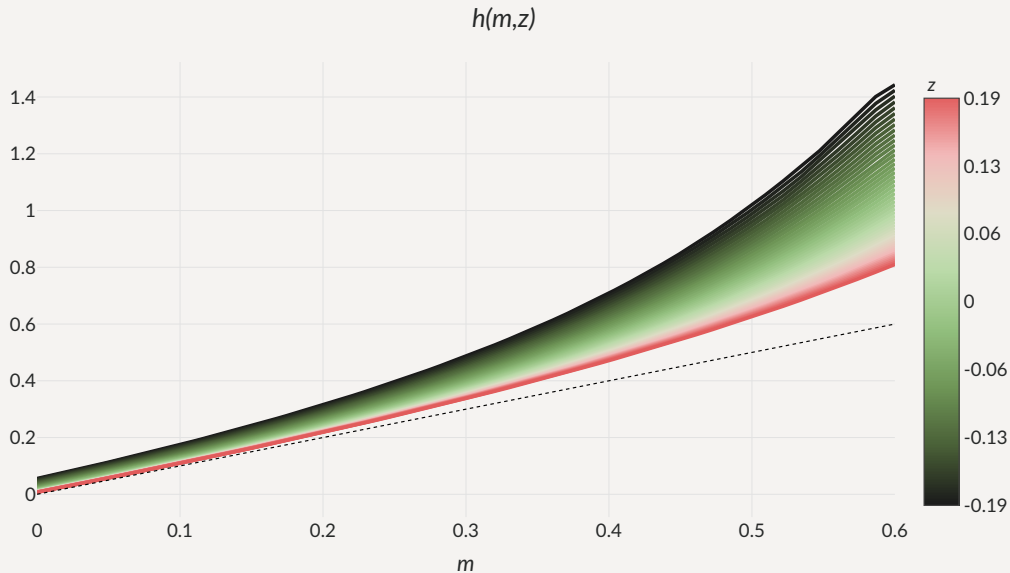
Swap Line Terms: Implicit interest rate



Swap Line Terms: Borrower's value function



Swap Line Terms: Lender's value function



Swap Line Terms: Takeaways

key requirement:

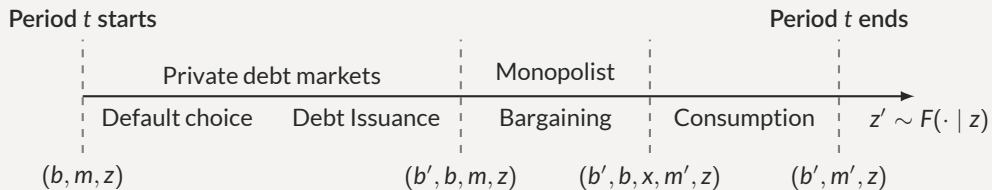
threat point value decreasing in m

The threat point is less 'credible' when m is large

- This creates convexity in the lender's value function
 - ... making the lender act 'as if' **risk-loving**
- The lender initially subsidizes the loan to induce indebtedness and high profits
 - **Gamble for debt overhang**
- Initial subsidy and high rates consistent with B's risk aversion – 'Participation constraint'

Model with Swaps and Debt

Timeline of events



Borrowing from markets

- Debt is a geometrically-decaying coupon
... get 1, pay $\kappa, (1 - \rho)\kappa, \dots (1 - \rho)^{s-1}\kappa$
- Government enters first stage owing b in debt, m in swaps, income state z

$$v(b, m, z) = \max \{ v_R(b, m, z) + \epsilon_R, v_D(m, z) + \epsilon_D \}$$
$$v_R(b, m, z) = \max_{b'} w_R(b', b, m, z)$$

- Lenders in competitive markets need to anticipate interactions with the monopolist

$$q(b', b, m, z) = \beta_L \mathbb{E} [(1 - 1_{\mathcal{D}}(b', m', z')) (\kappa + (1 - \rho)q(b'', b', m', z')) \mid z]$$
$$m' = m'(b', b, m, z)$$
$$b'' = b'(b', m', z')$$

Borrowing from markets

- Debt is a geometrically-decaying coupon
... get 1, pay $\kappa, (1 - \rho)\kappa, \dots (1 - \rho)^{s-1}\kappa$
- Government enters first stage owing b in debt, m in swaps, income state z

$$v(b, m, z) = \max \{ v_R(b, m, z) + \epsilon_R, v_D(m, z) + \epsilon_D \}$$
$$v_R(b, m, z) = \max_{b'} w_R(b', b, m, z)$$

- Lenders in competitive markets need to anticipate interactions with the monopolist

$$q(b', b, m, z) = \beta_L \mathbb{E} [(1 - 1_{\mathcal{D}}(b', m', z')) (\kappa + (1 - \rho)q(b'', b', m', z')) \mid z]$$
$$m' = m'(b', b, m, z)$$
$$b'' = b'(b', m', z')$$

Borrowing from markets

- Debt is a geometrically-decaying coupon
... get 1, pay $\kappa, (1 - \rho)\kappa, \dots (1 - \rho)^{s-1}\kappa$
- Government enters first stage owing b in debt, m in swaps, income state z

$$v(b, m, z) = \max \{ v_R(b, m, z) + \epsilon_R, v_D(m, z) + \epsilon_D \}$$

$$v_R(b, m, z) = \max_{b'} w_R(b', b, m, z)$$

- Lenders in competitive markets need to anticipate interactions with the monopolist

$$q(b', b, m, z) = \beta_L \mathbb{E} [(1 - 1_D(b', m', z')) (\kappa + (1 - \rho)q(b'', b', m', z')) \mid z]$$

$$m' = m'(b', b, m, z)$$

$$b'' = b'(b', m', z')$$

same sdf as monopolist

- Same as before with extra state variables (b, b')

$$\mathcal{L}_R(b', x, m, m', z) = (a - x + \beta_L \mathbb{E}[h(b', m', z') | z]) - (a + m + \beta_L \mathbb{E}[h(b', 0, z') | z])$$

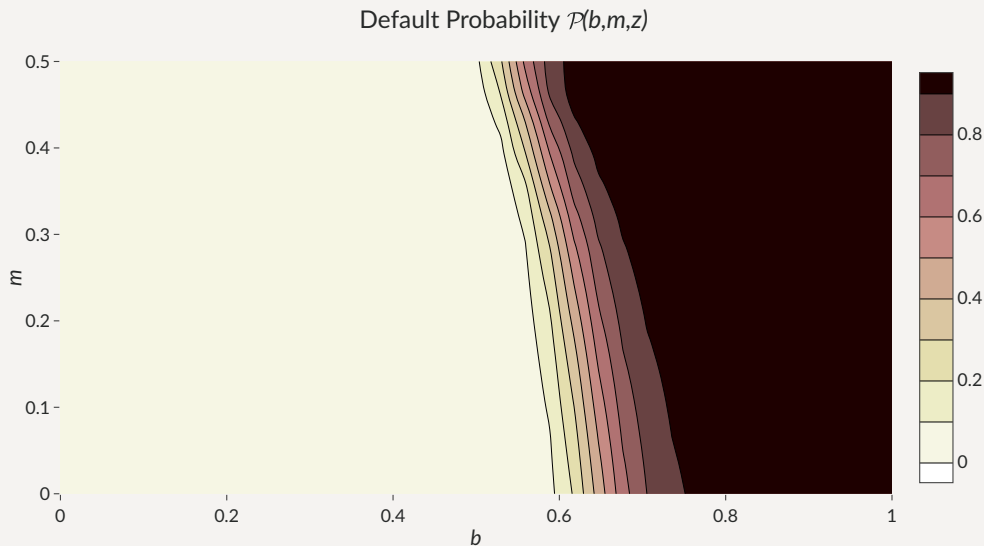
$$\begin{aligned} \mathcal{B}_R(b', b, x, m, m', z) &= u(y(z) + B(b', b, m, z) + x) + \beta \mathbb{E}[v(b', m', z') | z] \\ &\quad - (u(y(z) + B(b', b, m, z) - m) + \beta \mathbb{E}[v(b', 0, z') | z]) \end{aligned}$$

$$B(b', b, m, z) = q(b', b, m, z)(b' - (1 - \rho)b) - \kappa b$$

Quantitative Effects of Swap Lines

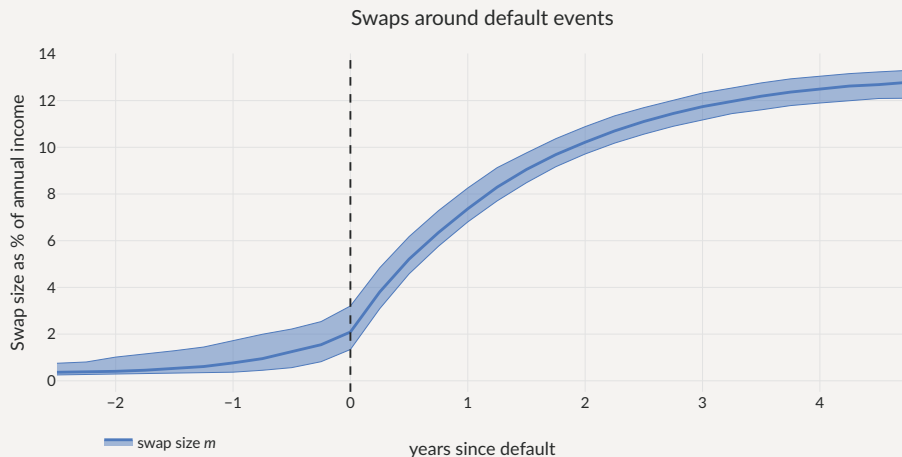
Default probability

Both types of debt are clearly **substitutes**



When is the Swap Used?

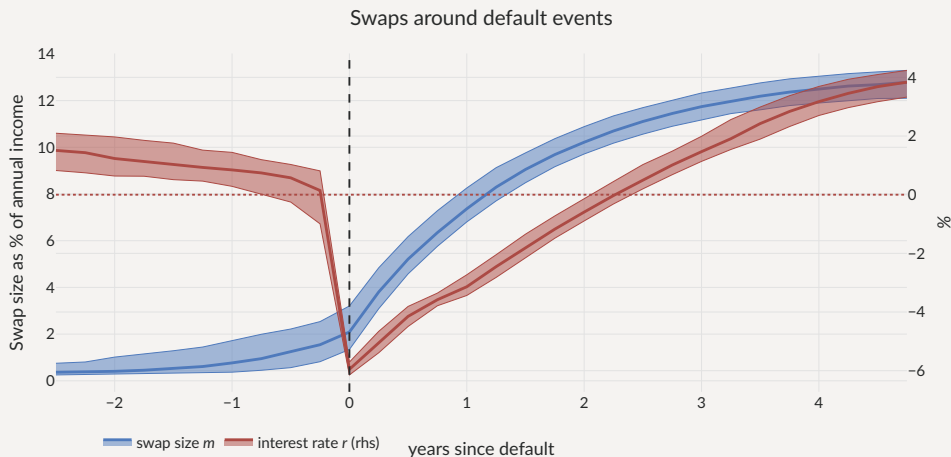
- In repayment, average swap = 0.42% of GDP with s.d. 0.71%
- In default,



- Also consider Limited version: $m' \leq m$ while in default

When is the Swap Used?

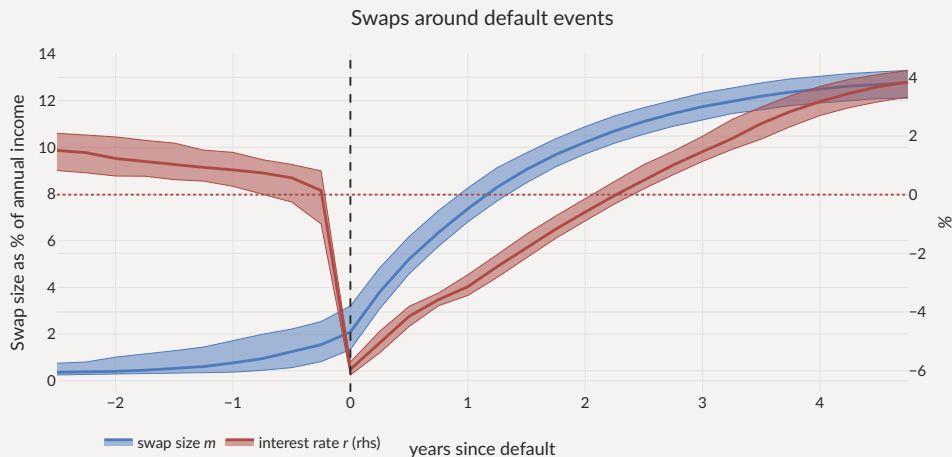
- In repayment, average swap = 0.42% of GDP with s.d. 0.71%
- In default,



- Also consider Limited version: $m' \leq m$ while in default

When is the Swap Used?

- In repayment, average swap = 0.42% of GDP with s.d. 0.71%
- In default,

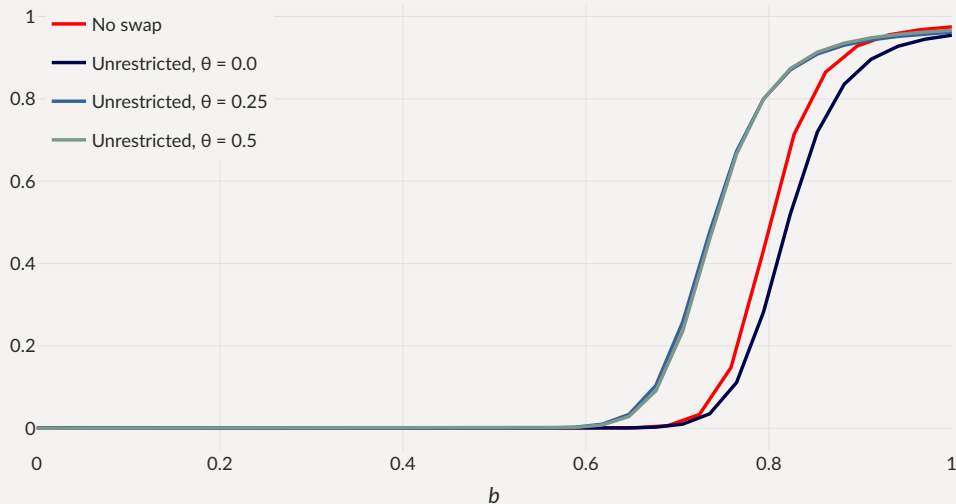


- Also consider Limited version: $m' \leq m$ while in default

Debt Tolerance with Swaps

Repay less often when swaps present (except when $\theta = 0$). More often with Limited

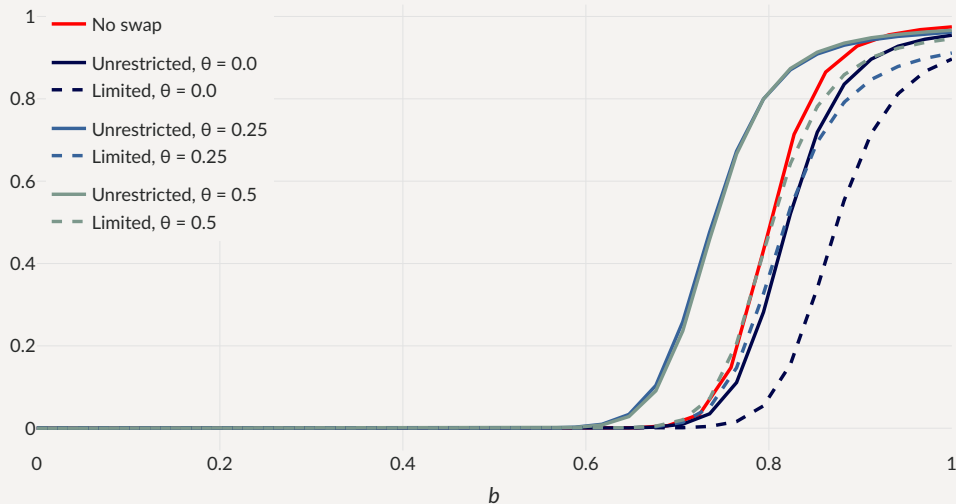
Default Probability $\mathcal{P}(b, m, z)$



Debt Tolerance with Swaps

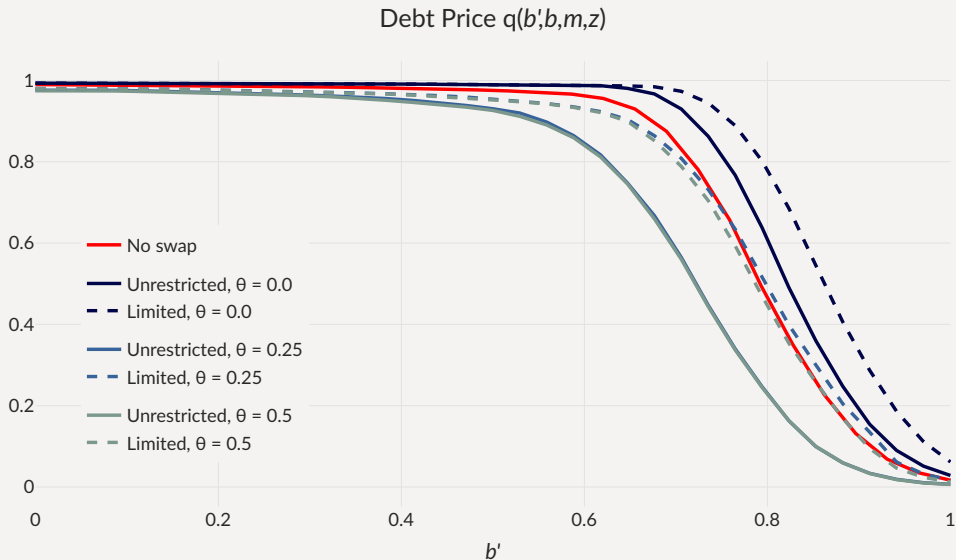
Repay less often when swaps present. More often with **Limited**

Default Probability $\mathcal{P}(b, m, z)$



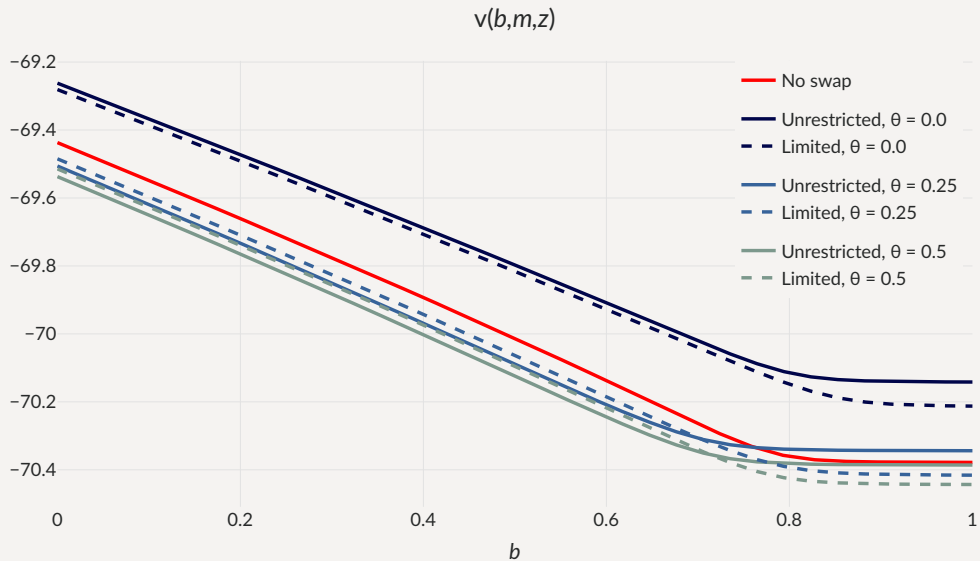
Debt Prices with Swaps

Limited: more likely to repay but lower **prices** → Tell-tale sign of **debt dilution**



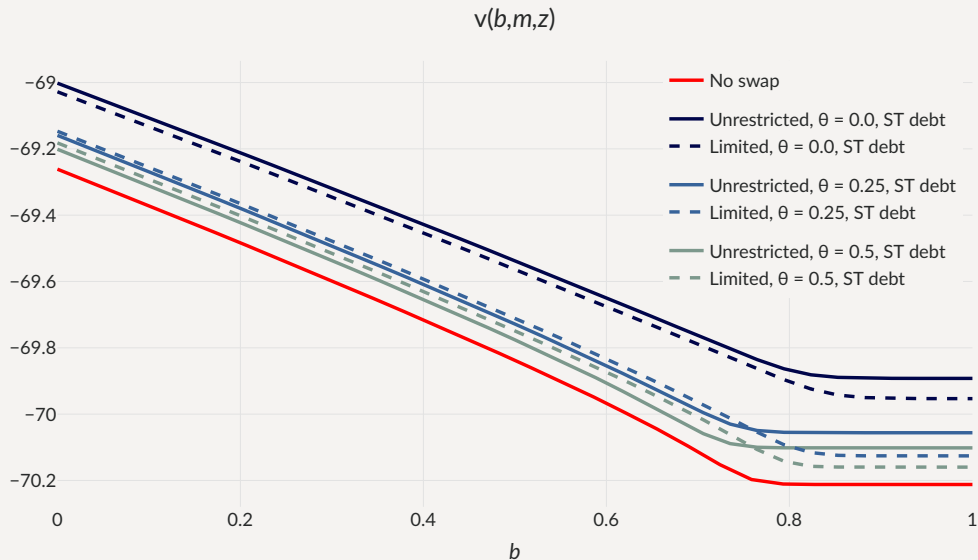
Welfare effects of swap lines

with interior bargaining power, Limited \succcurlyeq Unrestricted, but...



Welfare effects of swap lines – Debt dilution

Solving model with **short-term debt**: gains of swaps



Concluding remarks

Concluding remarks

- Simple model with monopolist/fringe structure
- Strong interaction between two markets for sovereign debt
 - ... even if swaps are not used intensely on the equilibrium path
- Market power crucial in model
 - ... how to discipline in model?
 - ... how to affect in reality?
- Large welfare effects, policy challenges
 - How to limit their use during defaults?
 - Strengthened debt dilution – more gains from fiscal rules, state-contingent debt?

When is the Swap Used?

- Further conditioning on default events lasting exactly two years

