Central Bank Swap Lines as Bilateral Sovereign Debt

Francisco Roldán
IMF

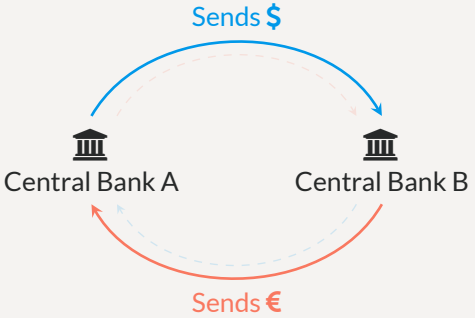
César Sosa-Padilla
Notre Dame

Society for Economic Dynamics
June 2023

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



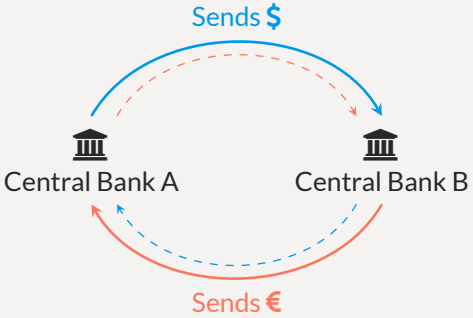
- Symmetric swaps (AE-AE) potentially very different from asymmetric ones (AE-EM)

... Symmetric swaps better understood, growing number of *asymmetric* ones

What is a Central Bank swap?

Swaps are symmetric currency exchanges

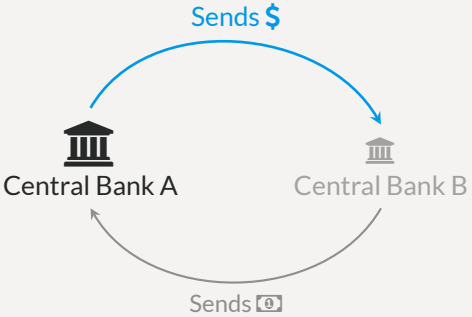
- A swap line is a contract between two Central Banks
- When activated, each institution provides an amount of its currency to the counterparty
- At maturity, positions are unwound



- 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?

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-defaulteable (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
  - Without restricting swaps in default, welfare losses for government
- Swaps worsen the debt dilution problem

Literature

- 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)

Roadmap

Model with Swaps only

Model with Swaps and Debt

Quantitative Effects of Swap Lines

Concluding remarks

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
- Renegotiate the swap m each period
  - … Involves a transfer x and a new loan size m'
- The swap is non-defaultable
  - … Repaying the whole amount is a 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
- Renegotiate the swap m each period
  - ... Involves a transfer x and a new loan size m'
- The swap is non-defaultable
  - ... Repaying the whole amount is a 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 (borrower) surplus

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

- Lender surplus

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

- 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

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

- Lender surplus

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

- 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

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

- Lender surplus

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

- 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

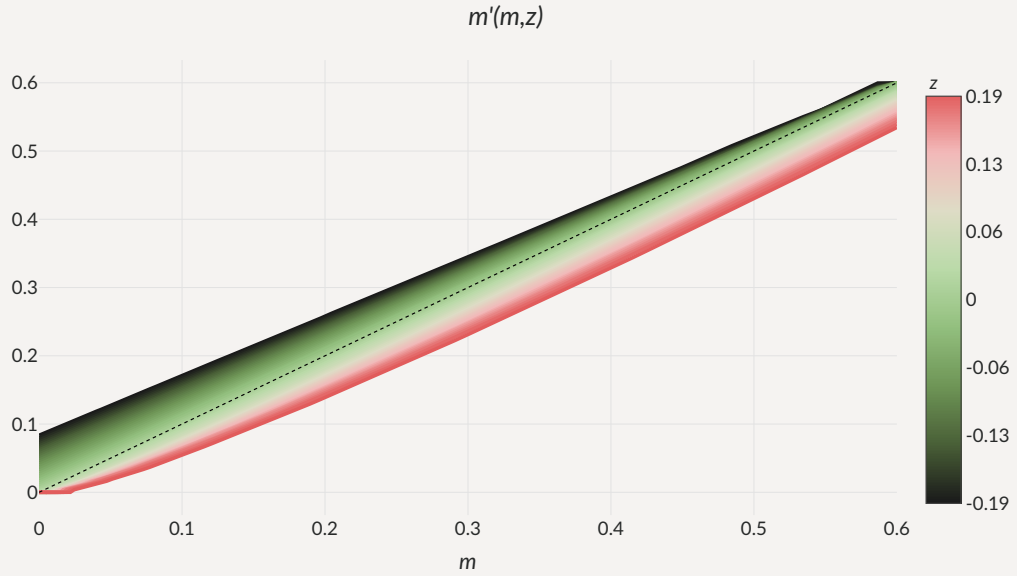
$$\mathcal{B}(x, m, m', z) = \underbrace{u(y(z) + x) + \beta \mathbb{E}\left[v(m', z') \mid z\right]}_{\text{agreement: receive } x\text{, owe } m'} - \underbrace{\left(u(y(z) - m) + \beta \mathbb{E}\left[v(0, z') \mid z\right]\right)}_{\text{threat point: repay } m\text{, clean slate}}$$

- Lender surplus

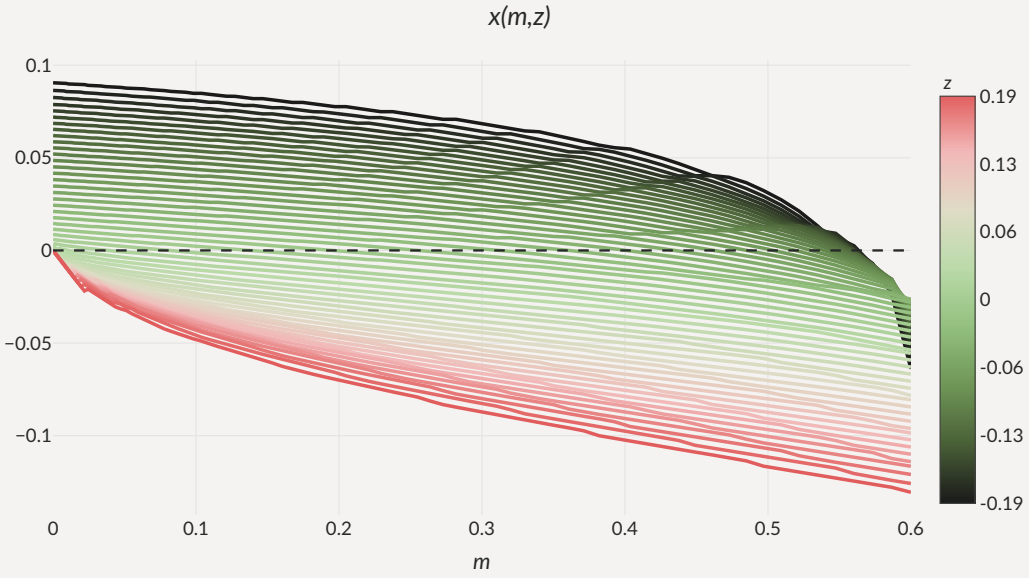
$$\mathcal{L}(x, m, m', z) = \underbrace{a - x + \beta_L \mathbb{E}\left[h(m', z') \mid z\right]}_{\text{agreement}} - \underbrace{\left(a + m + \beta_L \mathbb{E}\left[h(0, z') \mid z\right]\right)}_{\text{threat point}}$$

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

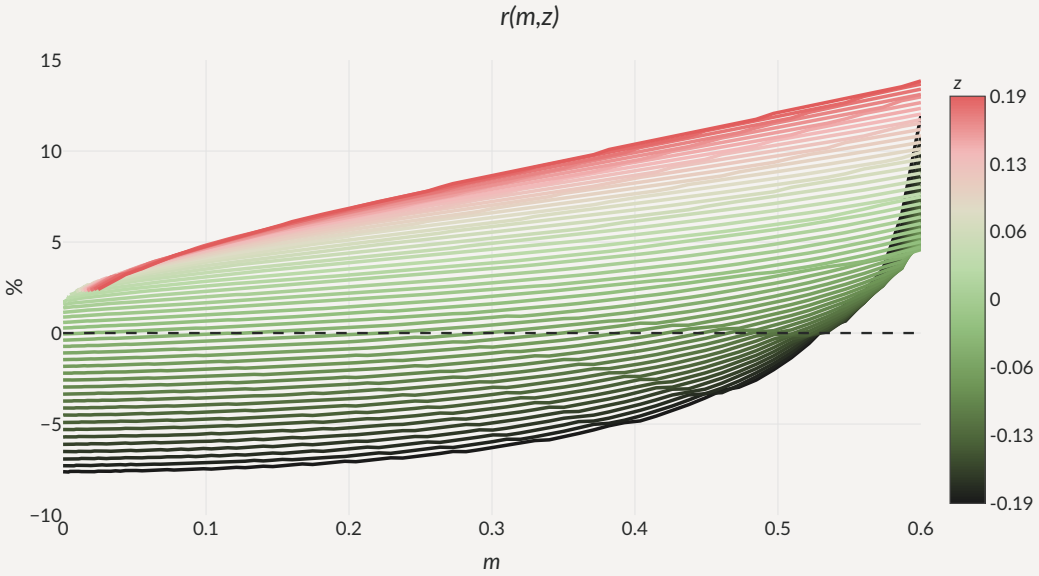
Swap Line Terms: Loan Dynamics



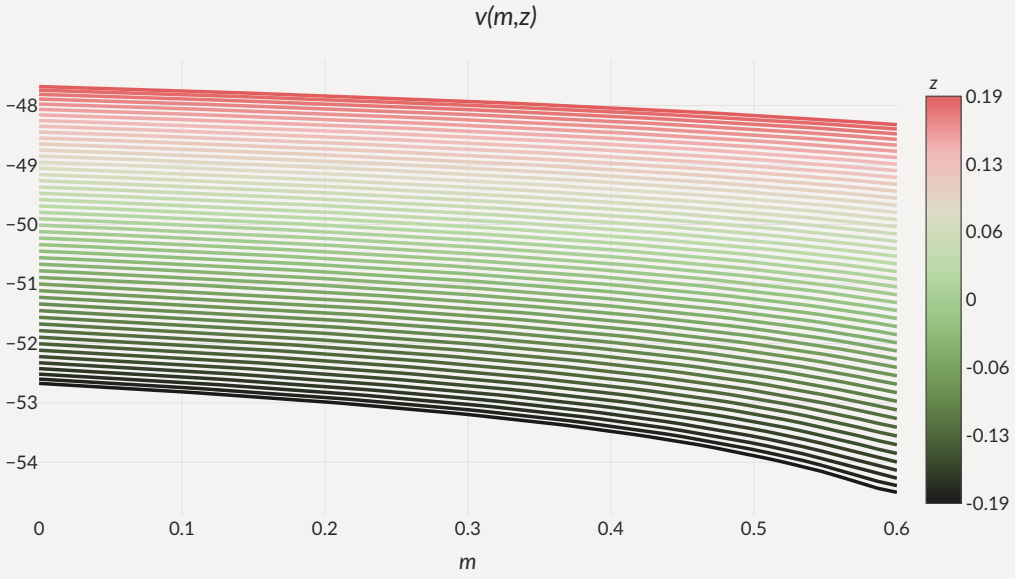
Swap Line Terms: Transfers



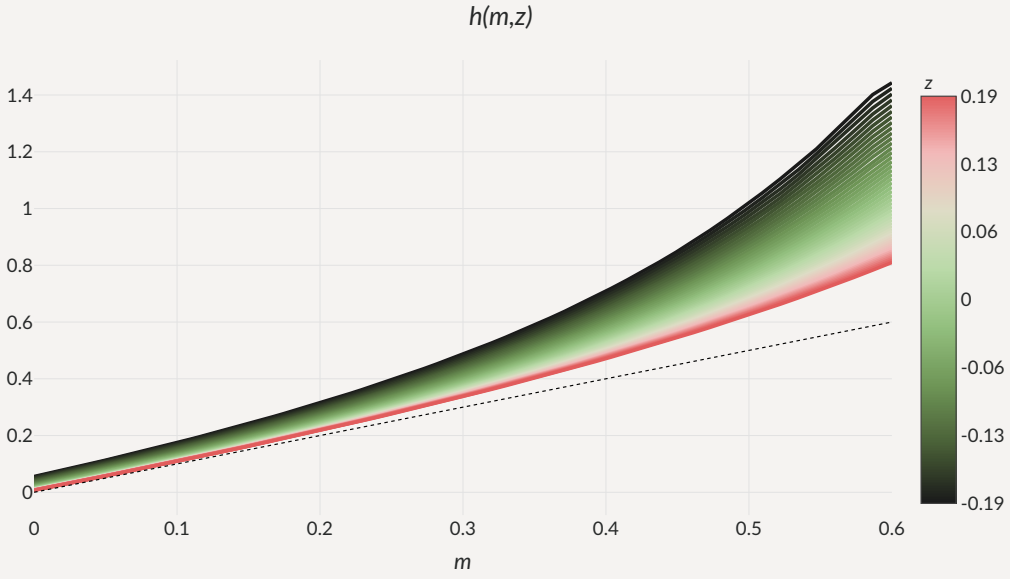
Swap Line Terms: Interest rate



Swap Line Terms: Borrower's value function



Swap Line Terms: Lender's value function



Swap Line Terms: Takeaways

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

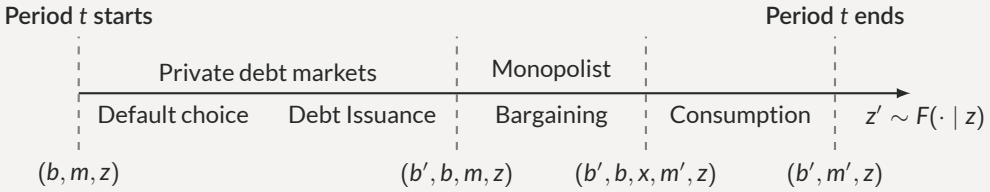
- This creates convexity in the lender's value function
  … making the lender act 'as if' risk-loving

- 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 $\kappa, (1-\rho)\kappa, \ldots (1-\rho)^{s-1}\kappa$

- Government enters first stage owing b in debt, m in swaps, income state z

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

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

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

Borrowing from markets

- Debt is a geometrically-decaying coupon

  ... get 1, pay $\kappa, (1-\rho)\kappa, \ldots (1-\rho)^{s-1}\kappa$

- Government enters first stage owing b in debt, m in swaps, income state z

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

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

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

Bargaining stage

- Similar to the case with swaps only with extra state variables (b, b')

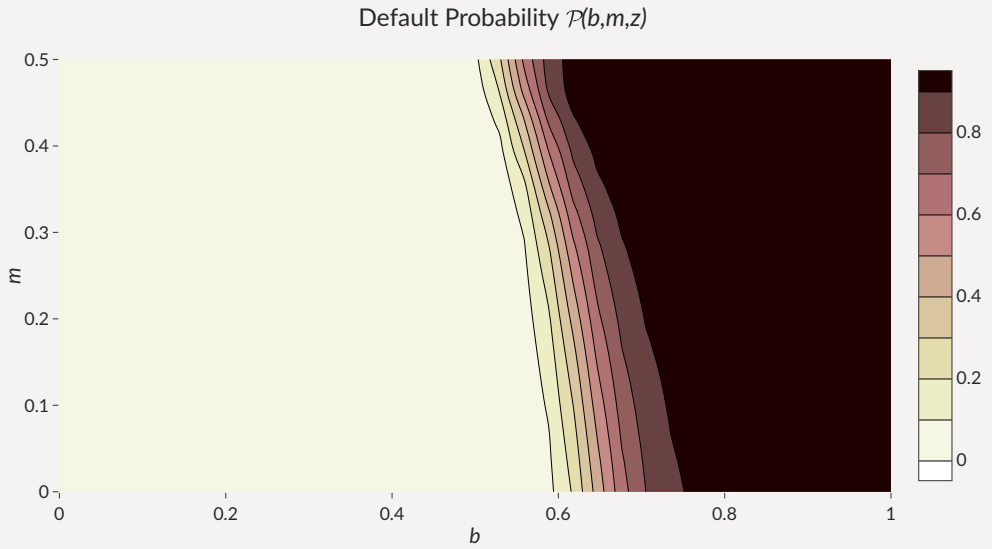
$$\mathcal{L}_R(b', x, m, m', z) = (a - x + \beta_L \mathbb{E}\left[h(b', m', z') \mid z\right]) - (a + m + \beta_L \mathbb{E}\left[h(b', 0, z') \mid z\right])$$

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

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

Default probability

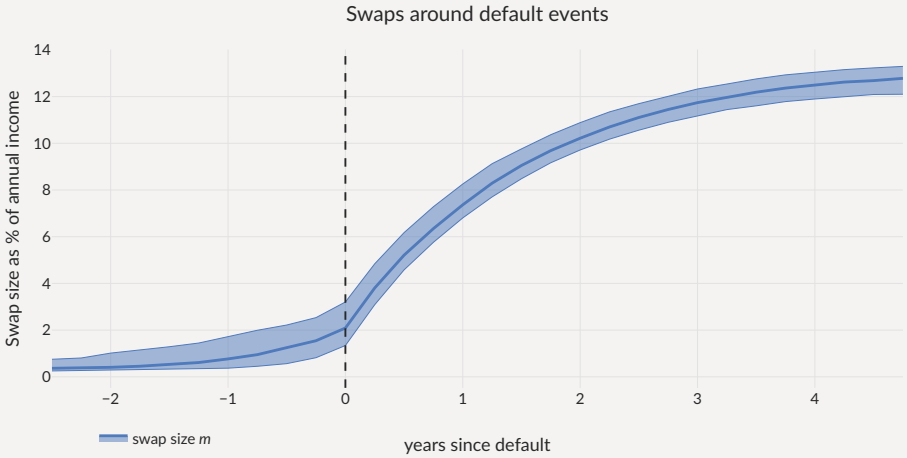
Both types of debt are clearly complements



When is the Swap Used?

More

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

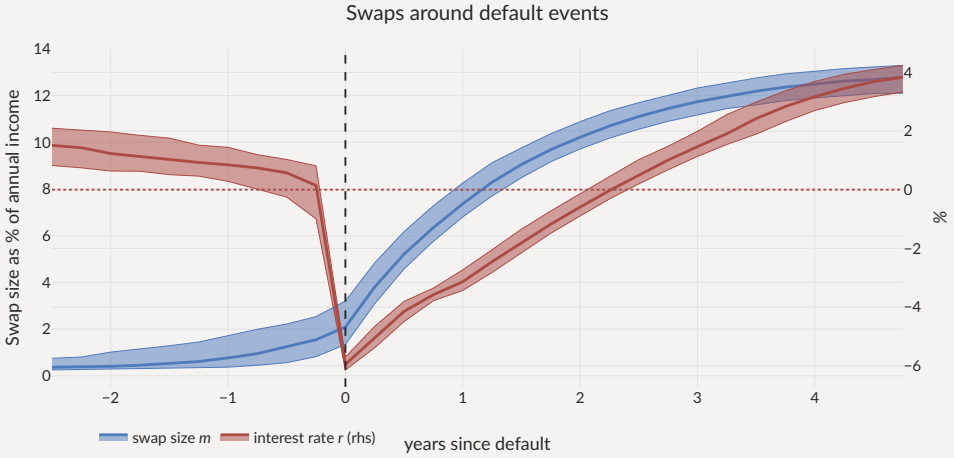


- Also consider Limited version: $m' \leq m$ while in default

When is the Swap Used?

More

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

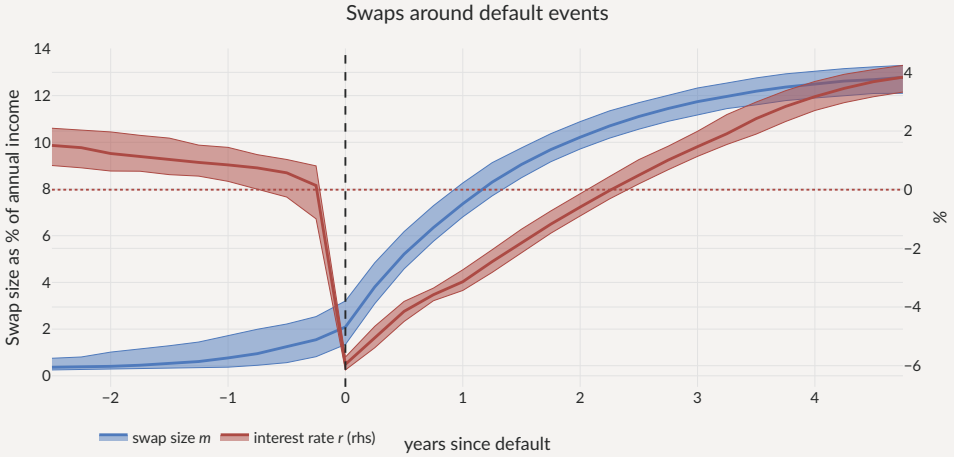


- Also consider Limited version: $m' \leq m$ while in default

When is the Swap Used?

More

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

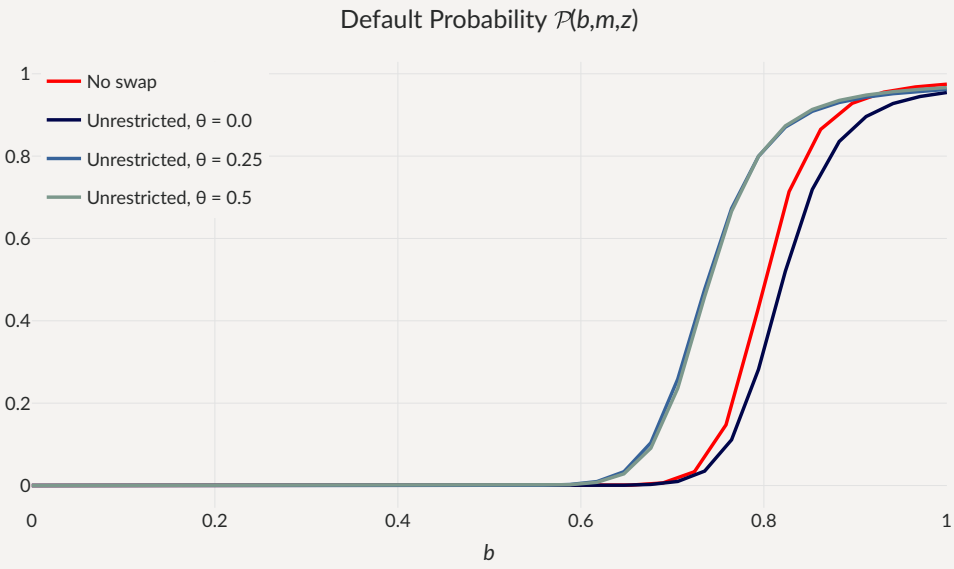


- Also consider Limited version: $m' \leq m$ while in default

Quantitative Effects of Swap Lines

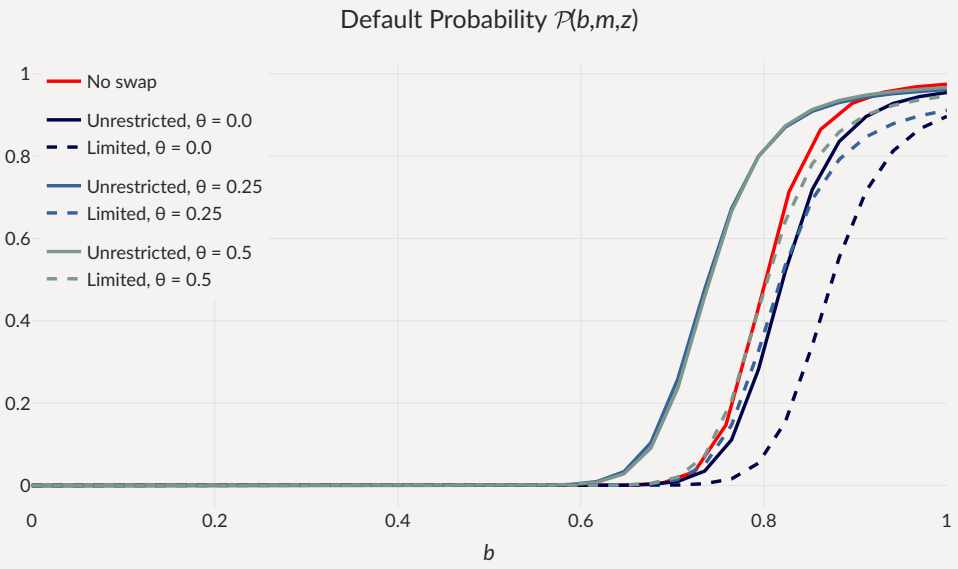
Debt Tolerance with Swaps

More repayment with Limited and with bargaining power



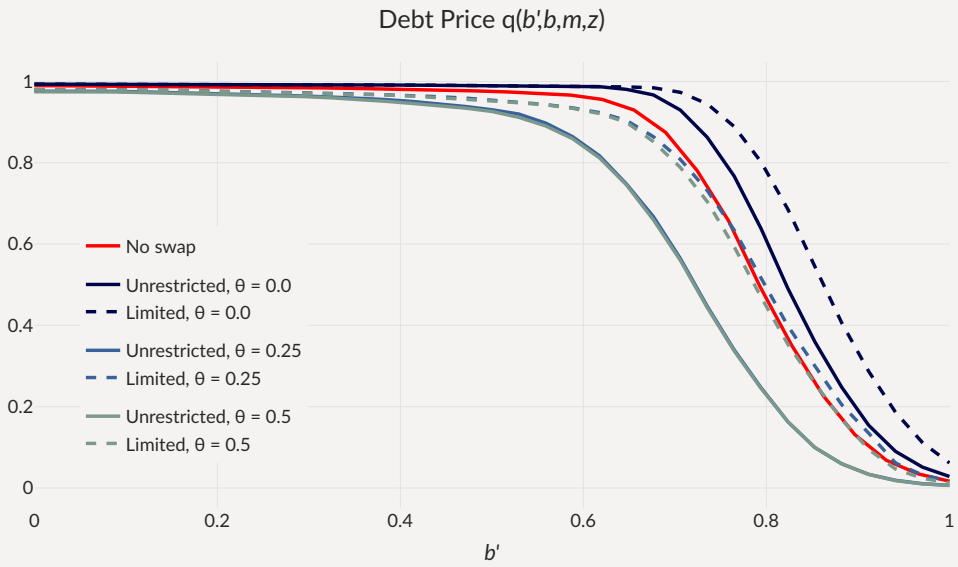
Debt Tolerance with Swaps

More repayment with Limited and with bargaining power



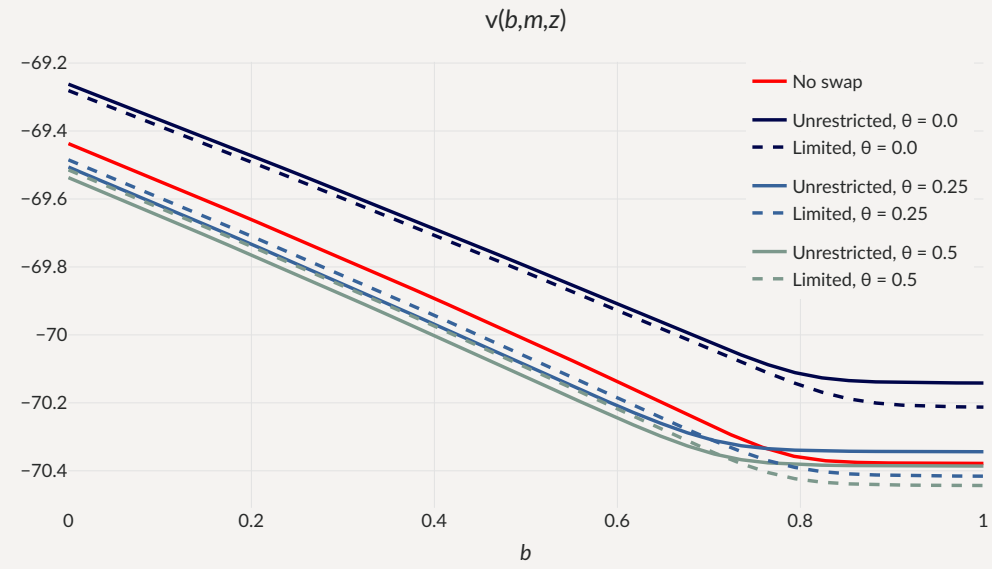
Debt Prices with Swaps

Limited: more repayment but lower prices — Tell-tale sign of debt dilution (+ more debt)



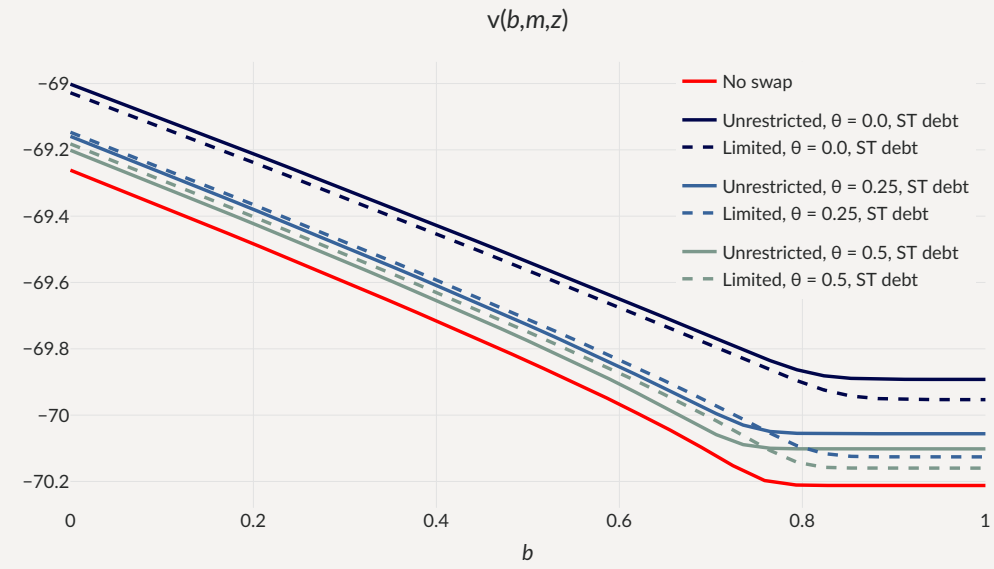
Welfare effects of swap lines

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?
  - Strengthen debt dilution – more gains from fiscal rules, state-contingent debt?

When is the Swap Used?

- Further conditioning on default events lasting exactly two years