Central Bank Swap Lines as Bilateral Sovereign Debt

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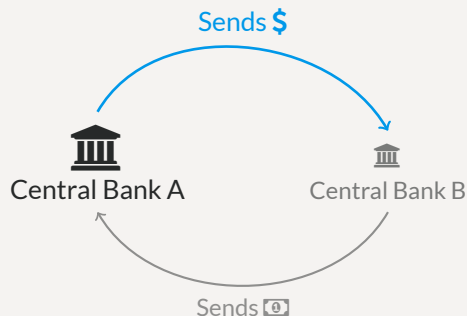June 2023

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 undone

Sends $

Central Bank A   Central Bank B

Sends €

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

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

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Sends 💵

which can be **asymmetric**
in practice

· The Fed doesn't really want
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· Mexican authorities may need
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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?

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)

Model with Swaps only

Model with Swaps and Debt

Concluding remarks

Model with Swaps only

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
    - ... Interest rate to vary over time
    - ... Interest rate to reflect market power
    - ... Interest rate to reflect outside options

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

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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

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

- Lender surplus

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

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

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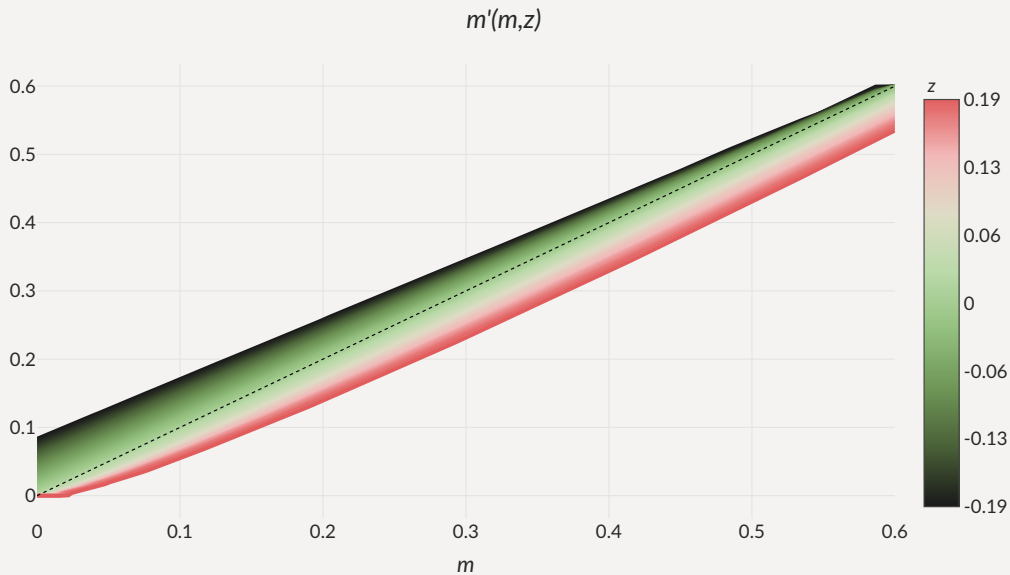- Government (borrower) surplus

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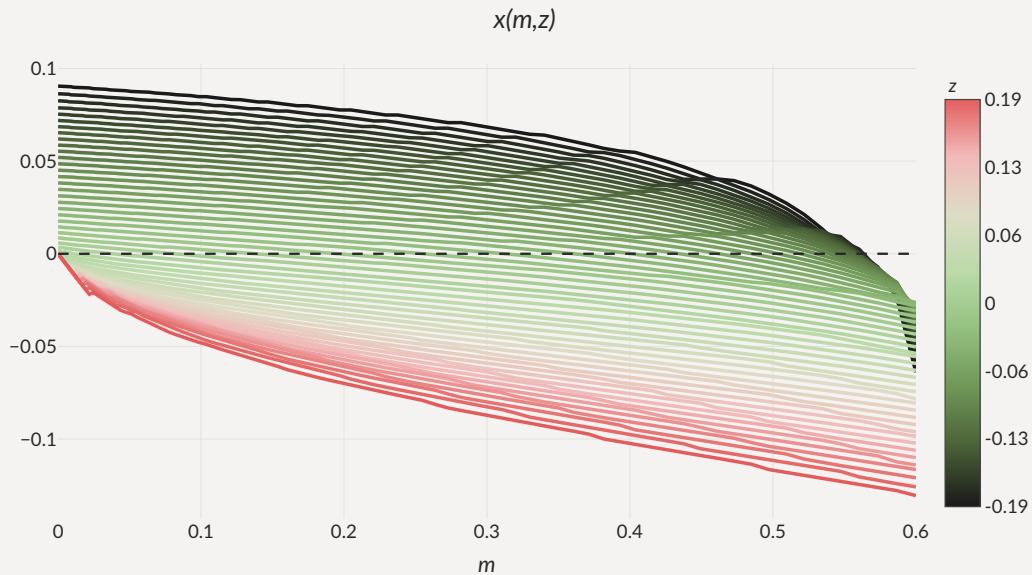
- Value functions $v(m, z)$ and $h(m, z)$ encode expected outcomes of future rounds

$m'(m,z)$

$x(m,z)$

$r(m,z)$
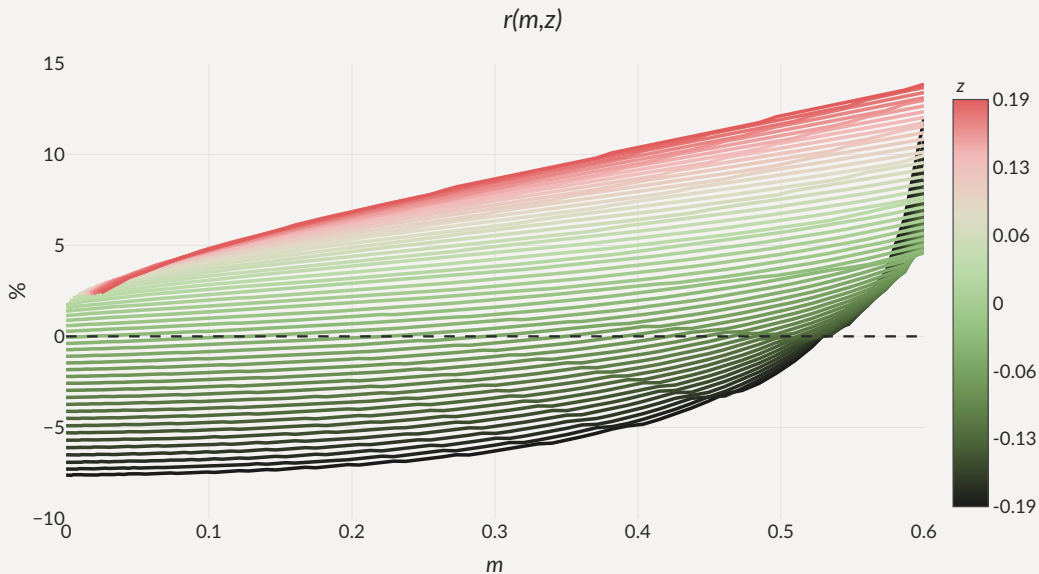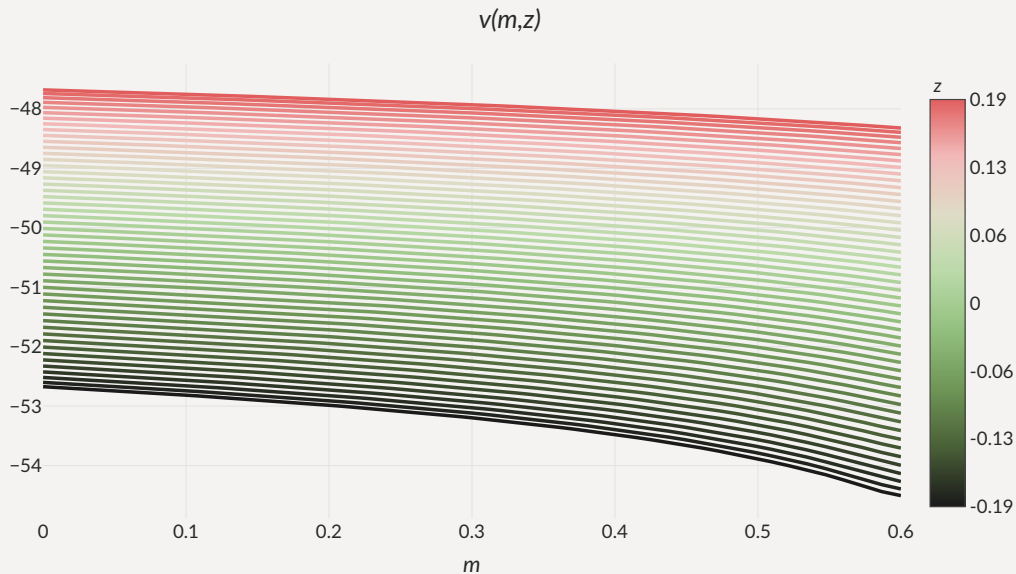
$v(m,z)$

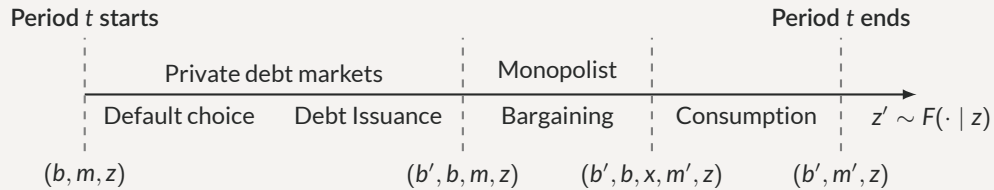# Swap Line Terms: Lender's value function

$h(m,z)$
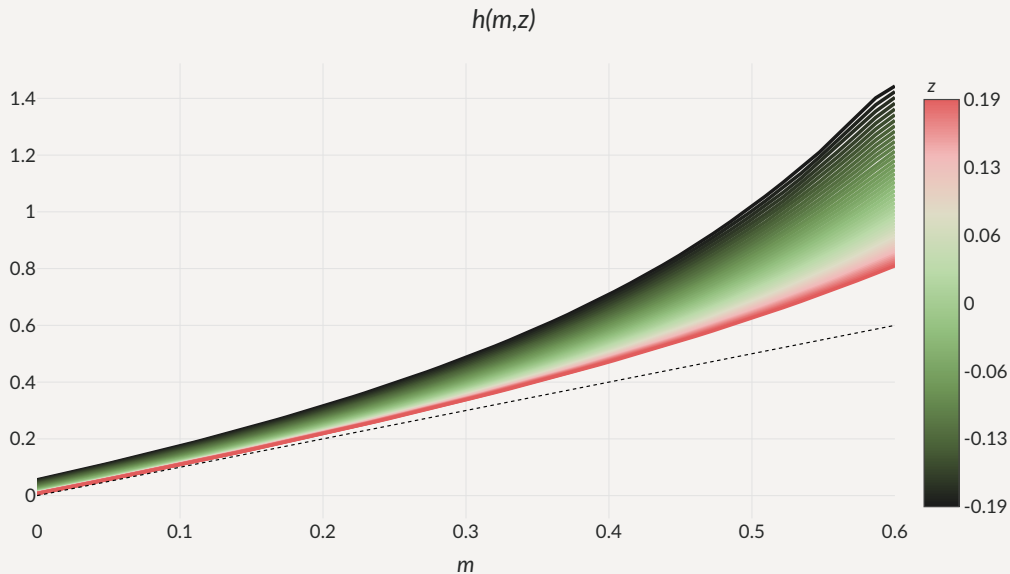
The threat point is less 'credible' when m is large

- · 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

Period t starts   **Period t ends**

| Private debt markets | | Monopolist | |
| Default choice | Debt Issuance | Bargaining | Consumption | $z' \sim F(\cdot \mid z)$ |

(b, m, z) (b', b, m, z) (b', b, x, m', z) (b', m', z)

- 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

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

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Bargaining stage

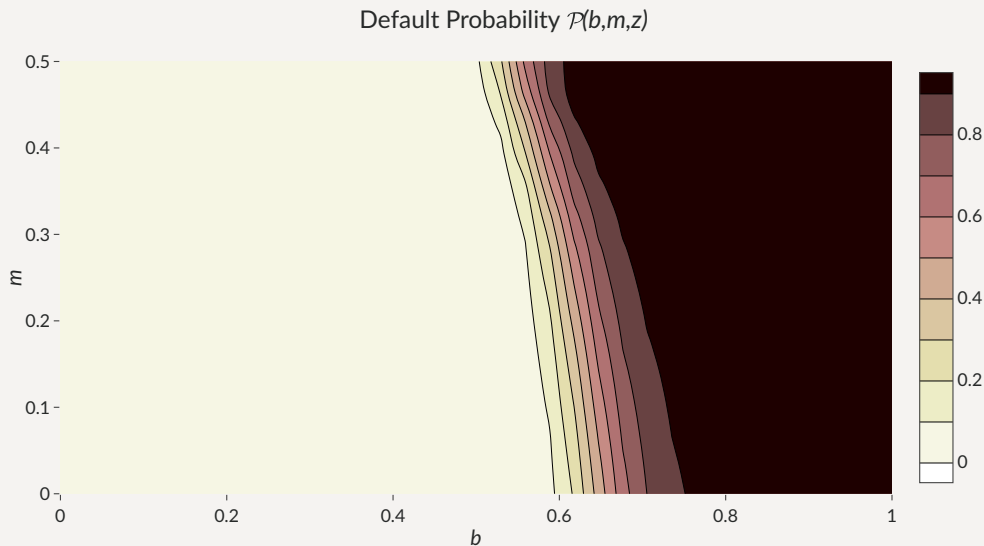- Similar to the case with swaps only with extra state variables (b, b')

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

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

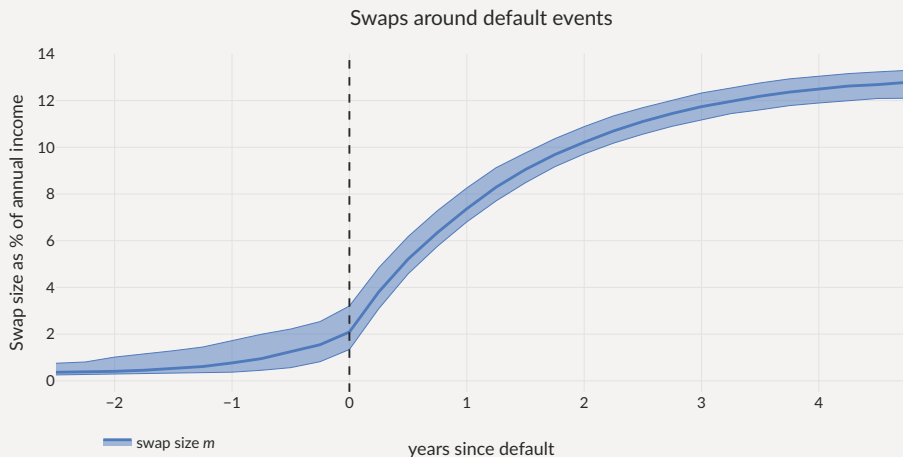$$B(b', b, m, z) = q(b', b, m, z)(b' - (1 - \rho)b) - \kappa b$$

Both types of debt are clearly complements

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

When is the Swap Used?

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

Swaps around default events

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

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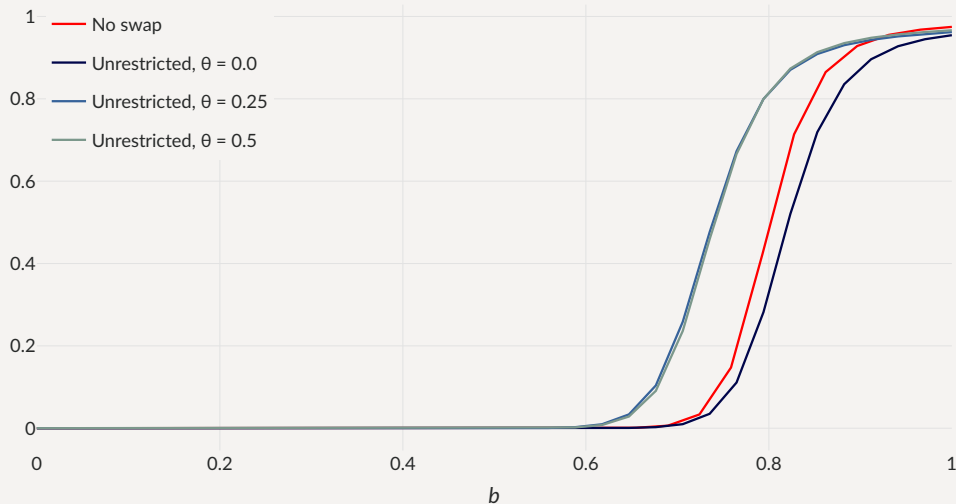
Swaps around default events

Swap size as % of annual income (left axis); % (right axis); years since default (x-axis)

Legend: swap size m — interest rate r (rhs)

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x-axis: years since default

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More repayment with Limited and with bargaining power

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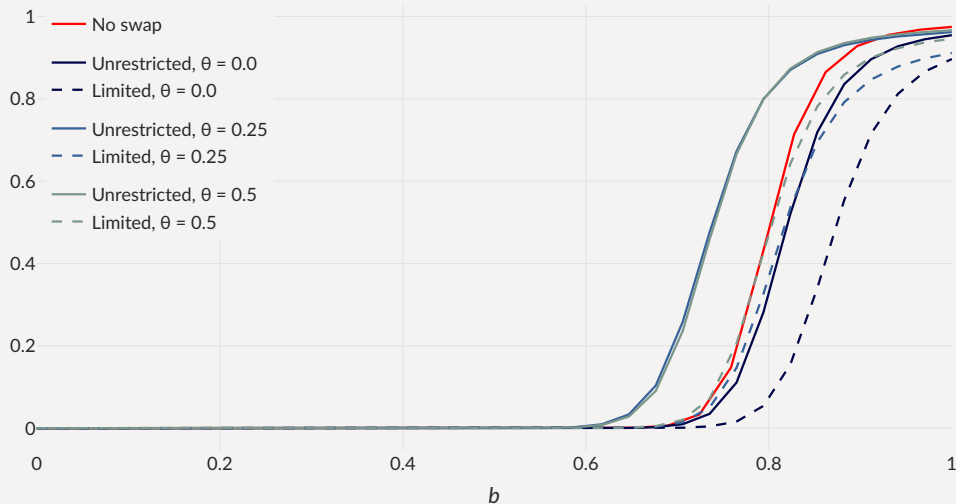
Legend:
- No swap
- Unrestricted, θ = 0.0
- Unrestricted, θ = 0.25
- Unrestricted, θ = 0.5

x-axis: b

Debt Tolerance with Swaps

More repayment with Limited and with bargaining power

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

Legend:
- No swap
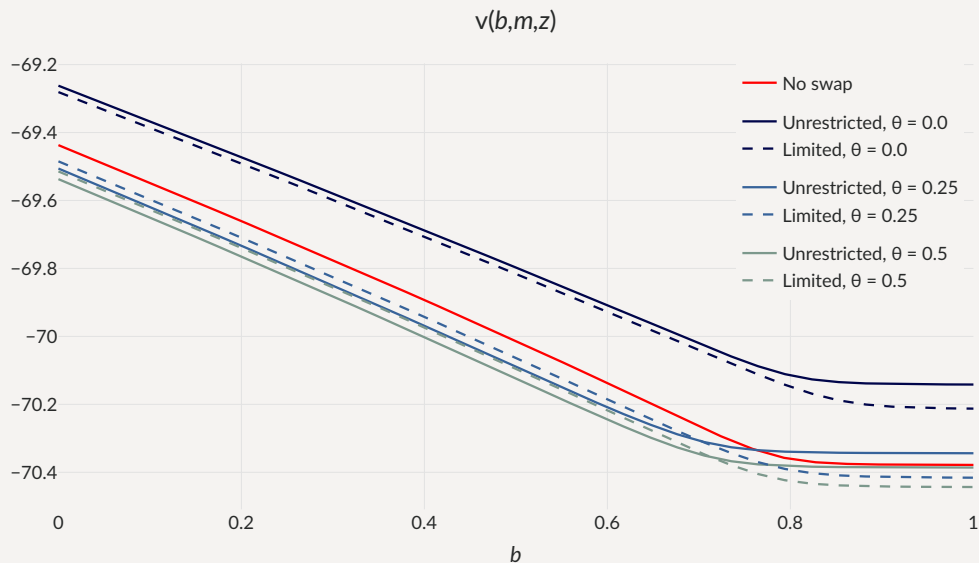- Unrestricted, $\theta = 0.0$
- Limited, $\theta = 0.0$
- Unrestricted, $\theta = 0.25$
- Limited, $\theta = 0.25$
- Unrestricted, $\theta = 0.5$
- Limited, $\theta = 0.5$

x-axis: b

Debt Prices with Swaps

More repayment with Limited but still lower prices — **Tell-tale sign of debt dilution**
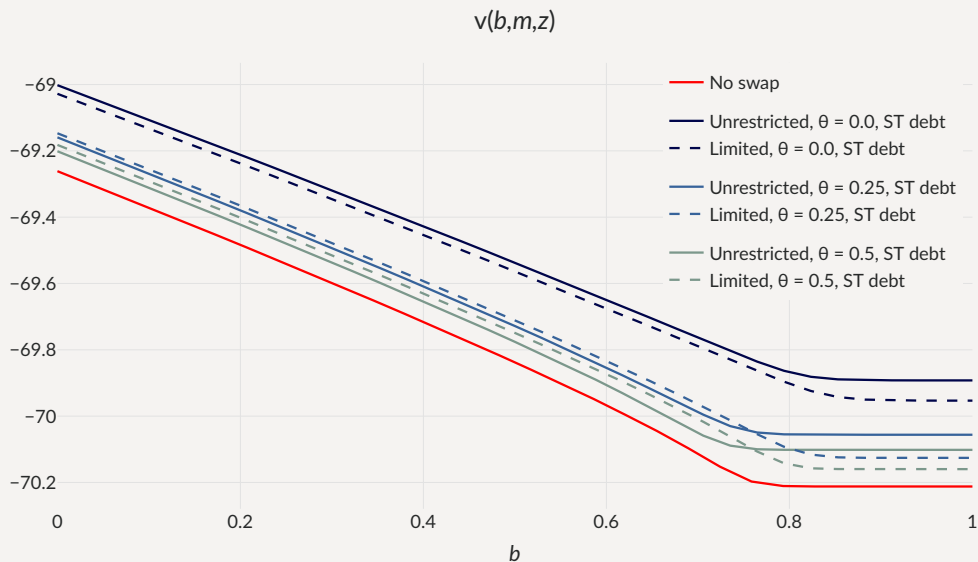
Debt Price q(b',b,m,z)

Welfare effects of swap lines

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

v(*b,m,z*)

Welfare effects of swap lines — Debt dilution

Solving model with short-term debt: gains of swaps

v(*b*,*m*,*z*)

Concluding remarks

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- 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?

- Further conditioning on default events lasting exactly two years

Swaps around default events