

Central Bank Swap Lines as Bilateral Sovereign Debt

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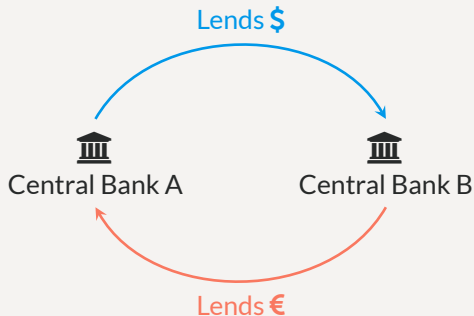
University of Waterloo
April 2024

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What is a Central Bank swap?

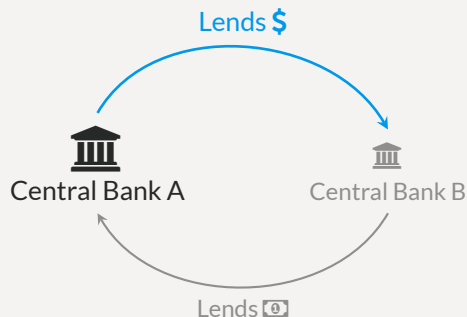
Swaps are **symmetric** currency exchanges

- 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

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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?**

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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 create incentives similar to the **debt dilution** problem
 - Surplus requires spreads – spreads require risk

- Central Bank swaps among advanced economies
... Bahaj and Reis (2021); Cesa-Bianchi, Eguren-Martin, and Ferrero (2022)
- Data on Central Bank swaps for EMs
... Perks, Rao, Shin, and Tokuoka (2021); Horn, Parks, Reinhart, and Trebesch (2023)
- Sovereign debt/default with interactions from 'official' debt
... Boz (2011), Hatchondo, Martinez, and Onder (2014), Arellano and Barreto (2023)

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**


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

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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 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

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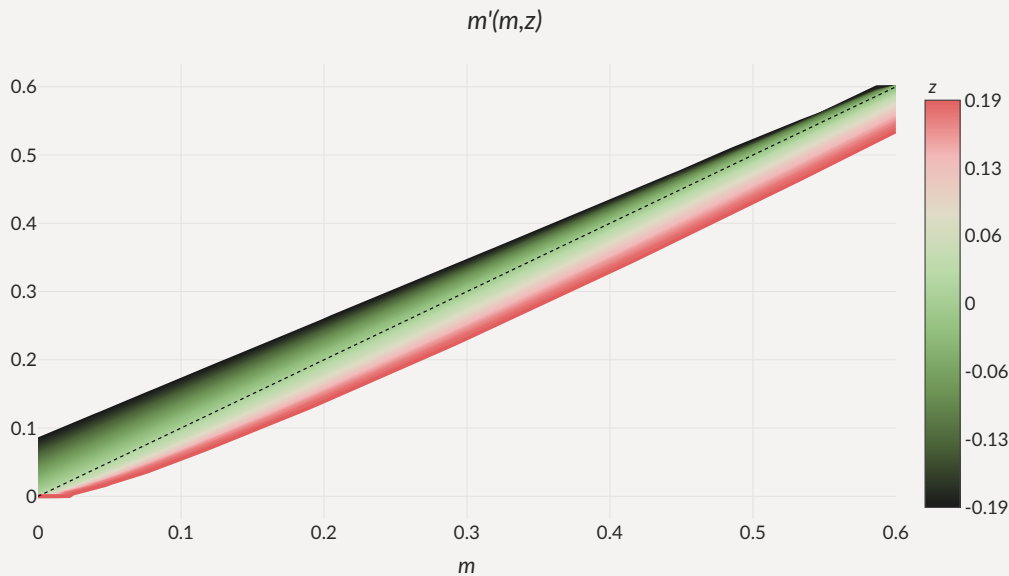
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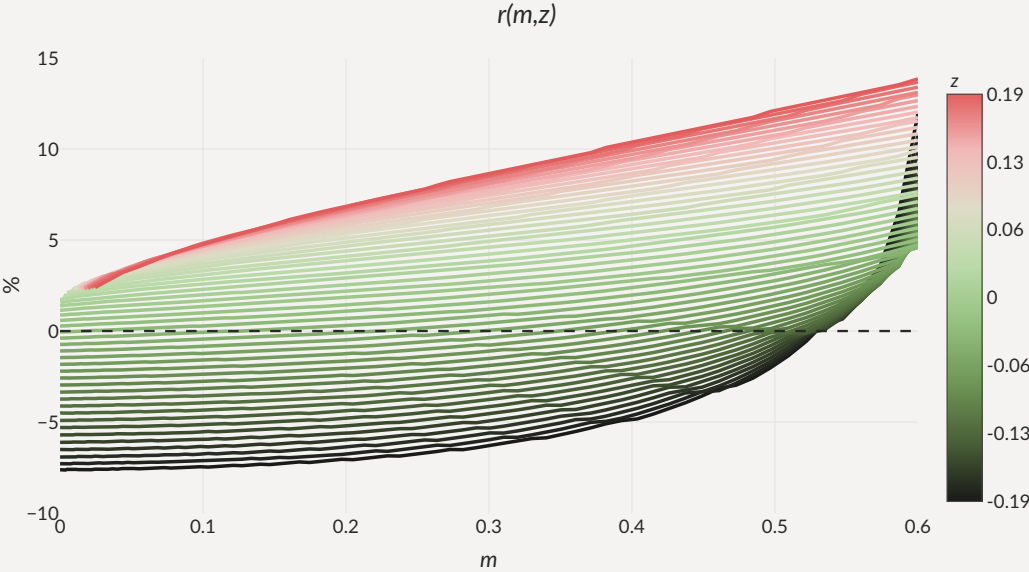
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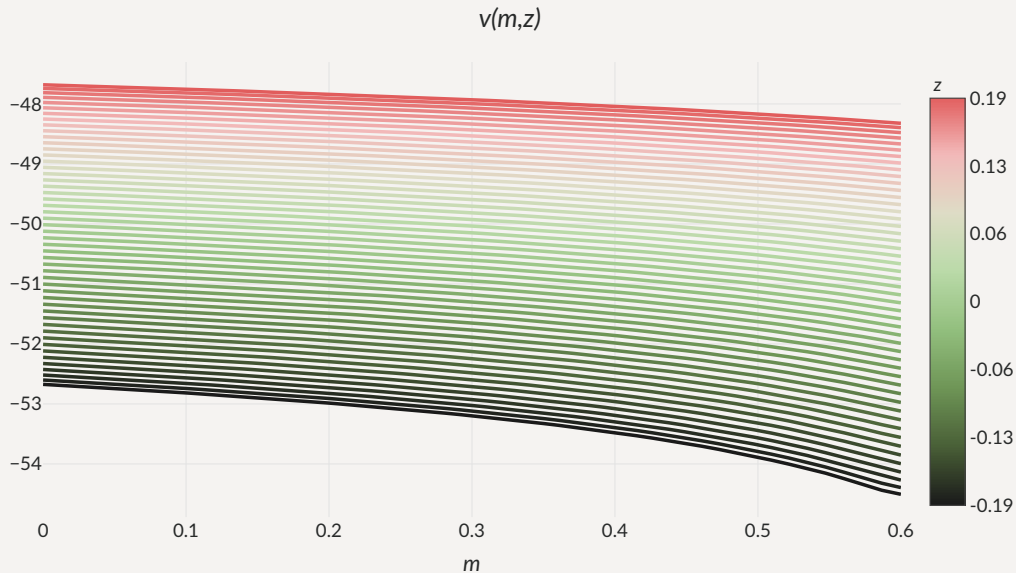
Swap Line Terms: Loan Dynamics



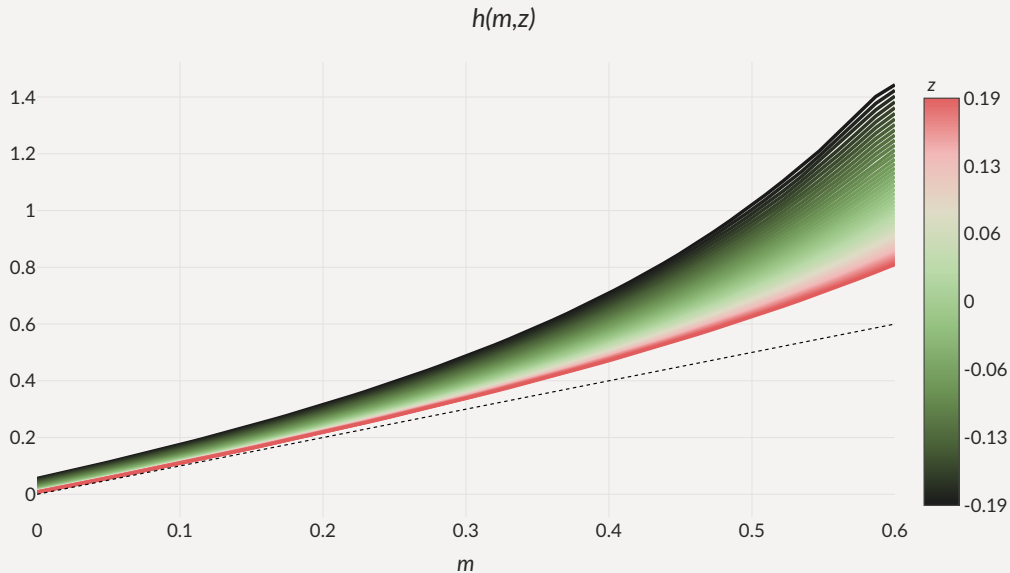
Swap Line Terms: Implicit interest rate



Swap Line Terms: Borrower's value function



Swap Line Terms: Lender's value function



Swap Line Terms: Takeaways

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

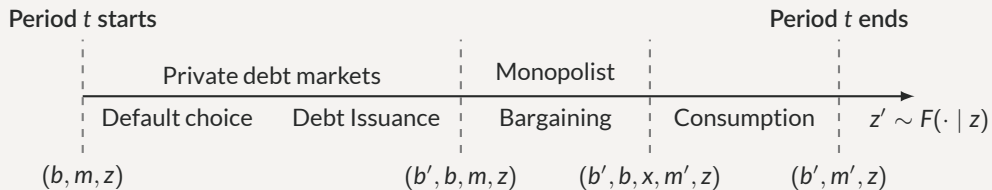
key requirement:

threat point value decreasing in m

- 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
... for each unit, get q , 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

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

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same sdf as monopolist

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

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

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

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

Default state

- In default,

$$v_D(m, z) = u \left(y(z) - \underbrace{\phi(y(z))}_{\text{default cost}} + \underbrace{x_D(m, z)}_{\text{swap transfer}} \right) + \beta \mathbb{E} [\psi v(0, m'_D, z') + (1 - \psi) v_D(m'_D, z') \mid z]$$

- Negotiate $x_D(m, z)$ and $m'_D(m, z)$ with common knowledge of **default** status
- Bargaining in default not **disciplined** by market
 - ... similar to model with monopolist only
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Quantitative Effects of Swap Lines

Calibration

- Calibrate to Argentina without swaps (as in Roch & Roldán, 2023)

	Parameter	Value
Sovereign's discount factor	β	0.9504
Sovereign's risk aversion	γ	2
Preference shock scale parameter	χ	0.02
Lender's bargaining power	θ	0.5
Risk-free interest rate	r	0.01
Duration of debt	ρ	0.05
Income autocorrelation coefficient	ρ_z	0.9484
Standard deviation of y_t	σ_z	0.02
Reentry probability	ψ	0.0385
Default cost: linear	d_0	-0.24
Default cost: quadratic	d_1	0.3

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How do swaps affect equilibrium?

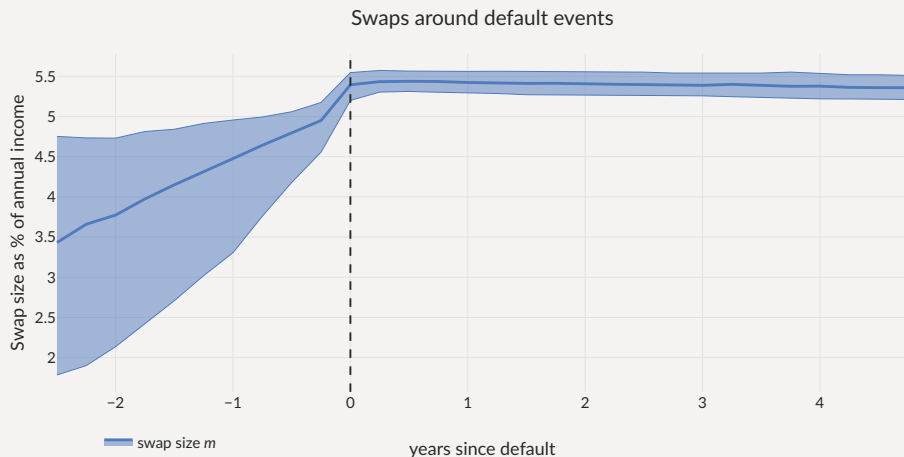
	No swap	Unrestricted, $\theta = 0.25$	Unrestricted, $\theta = 0.5$
Avg spread (bps)	901	1899	2447
Std spread (bps)	532	1137	1578
$\sigma(c)/\sigma(y)$ (%)	110	110	110
Debt to GDP (%)	20.5	20.2	19.6
Swap to GDP (%)	0	3.68	3.25
Corr. swap & spreads (%)	–	55.4	62.6
Default frequency (%)	7.07	13.2	15.2
Welfare gains (rep)	–	-0.059%	-0.36%

When is the Swap Used?

▶ Limited

▶ More

- Swaps shoot up before *and during* defaults



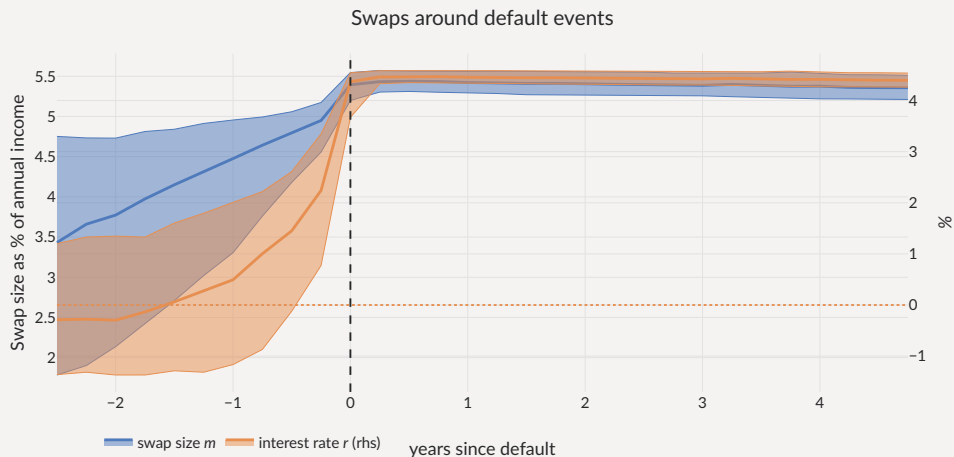
- Also consider **Limited** versions: $m' \leq \Gamma(m)$ while in default

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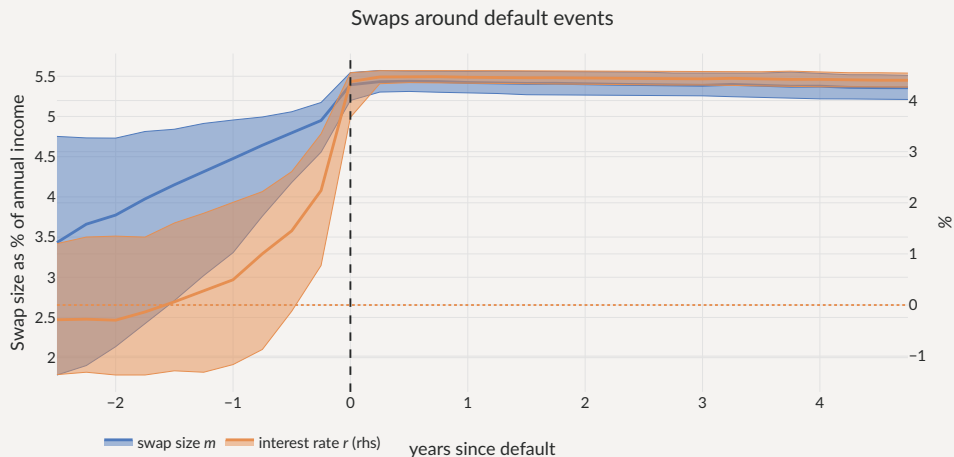
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Limiting swaps in default

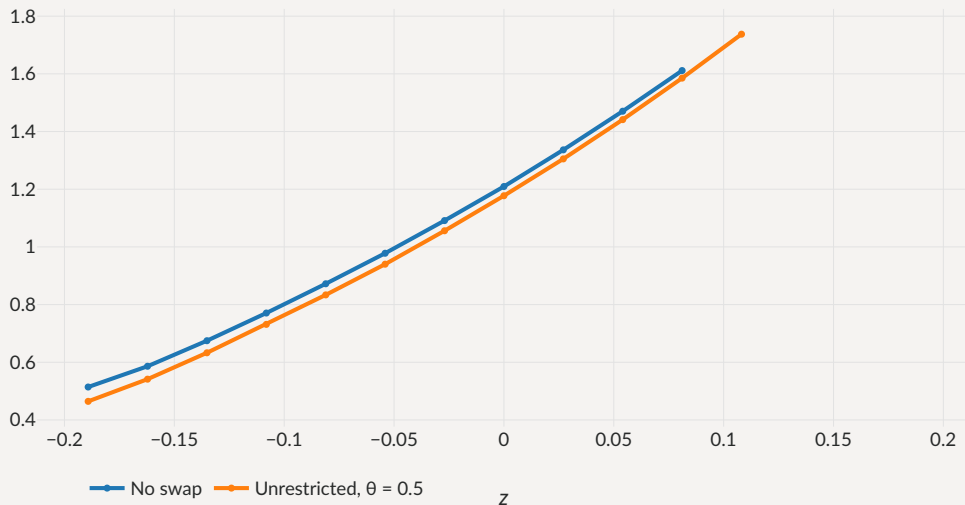
- **Unavailable:** entire swap must be repaid while in default $\Gamma(m) = 0$

	No swap	Unrestricted, $\theta = 0.5$	Unavailable, $\theta = 0.5$
Avg spread (bps)	901	2447	1406
Std spread (bps)	532	1578	960
$\sigma(c)/\sigma(y)$ (%)	110	110	114
Debt to GDP (%)	20.5	19.6	20.5
Swap to GDP (%)	0	3.25	1.27
Corr. swap & spreads (%)	–	62.6	70.1
Default frequency (%)	7.07	15.2	10.7
Welfare gains (rep)	–	-0.36%	-0.22%

Default Barriers with Swaps

- Unrestricted: default barrier moves inward, Limited: marginal impact

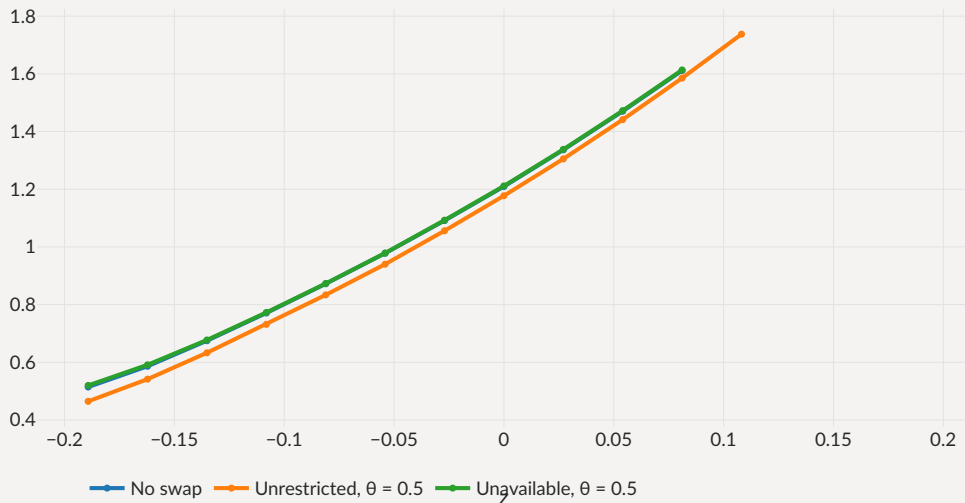
Debt levels at which $\mathcal{P}(b,m,z)$ crosses 50%



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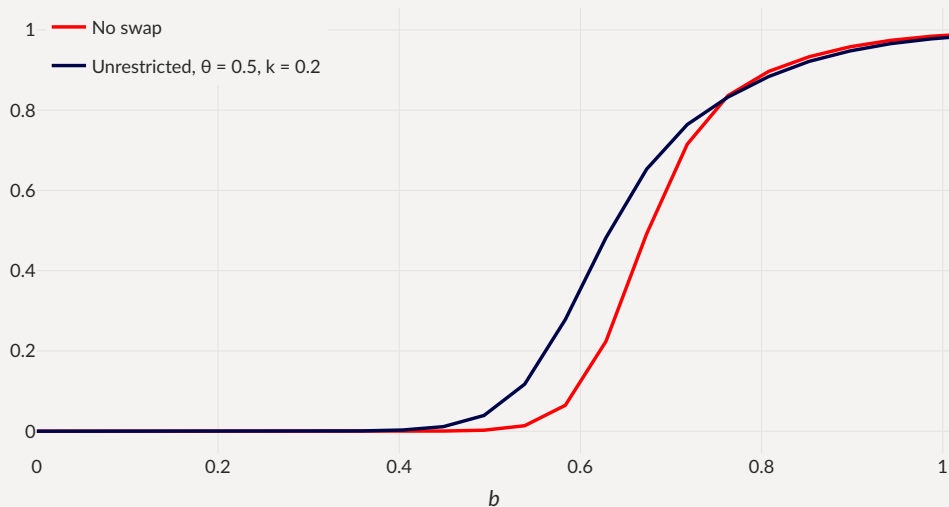
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Debt Tolerance with Swaps

Repay less often with swaps. More often with Limited

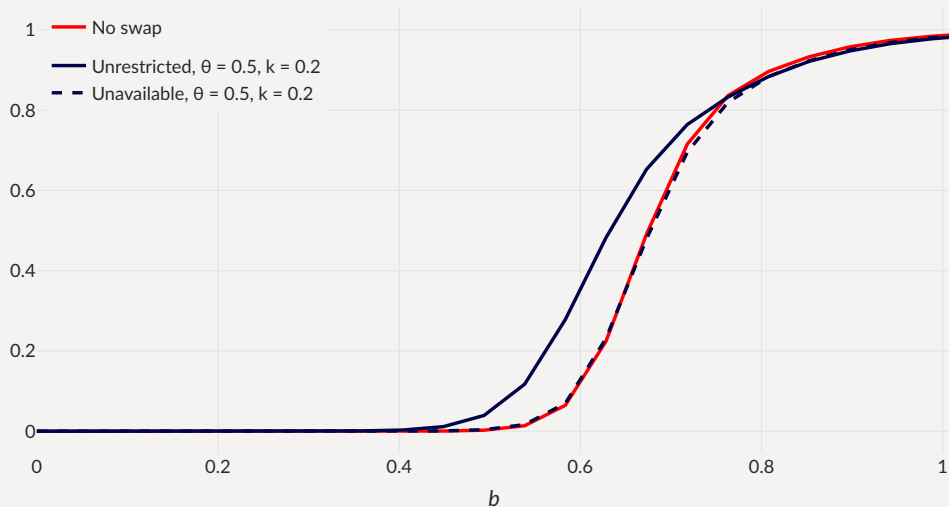
Default Probability $\mathcal{P}(b,m,z)$



Debt Tolerance with Swaps

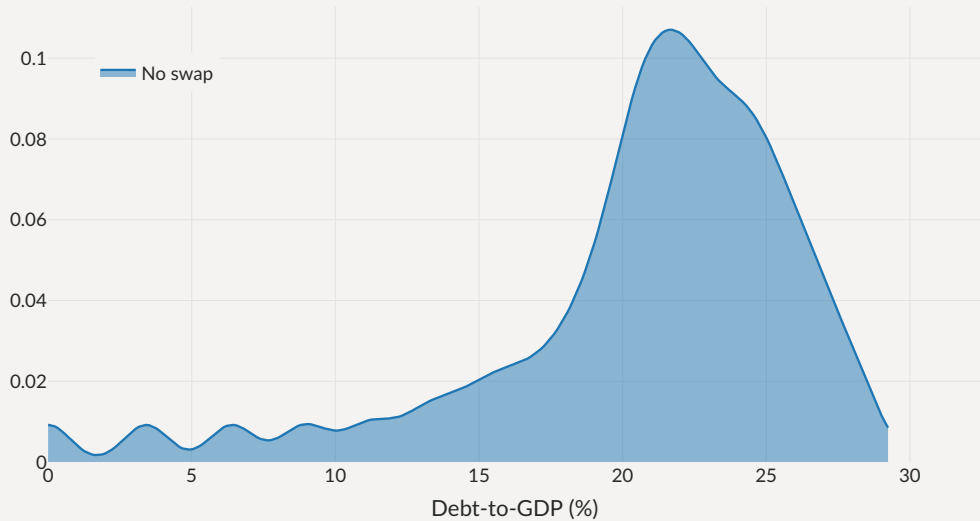
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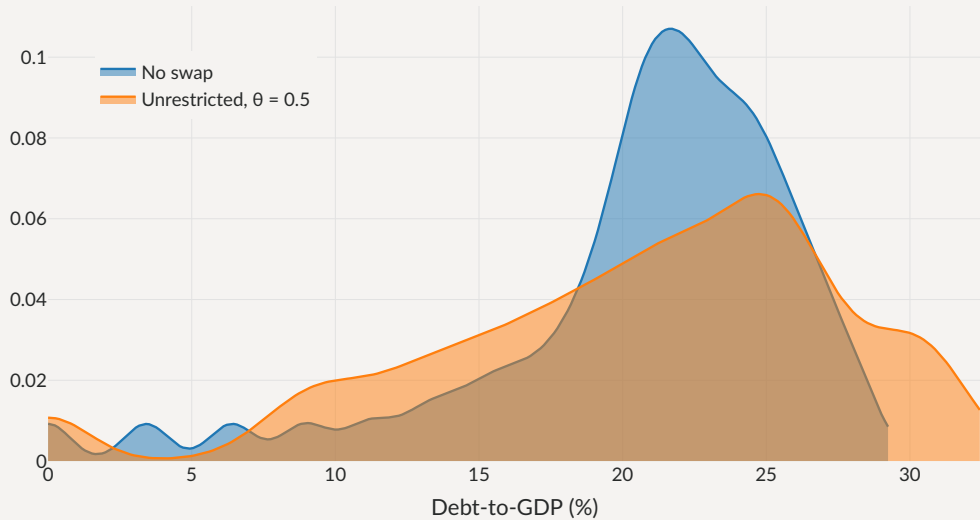
Debt Levels with Swaps

Distribution of debt levels



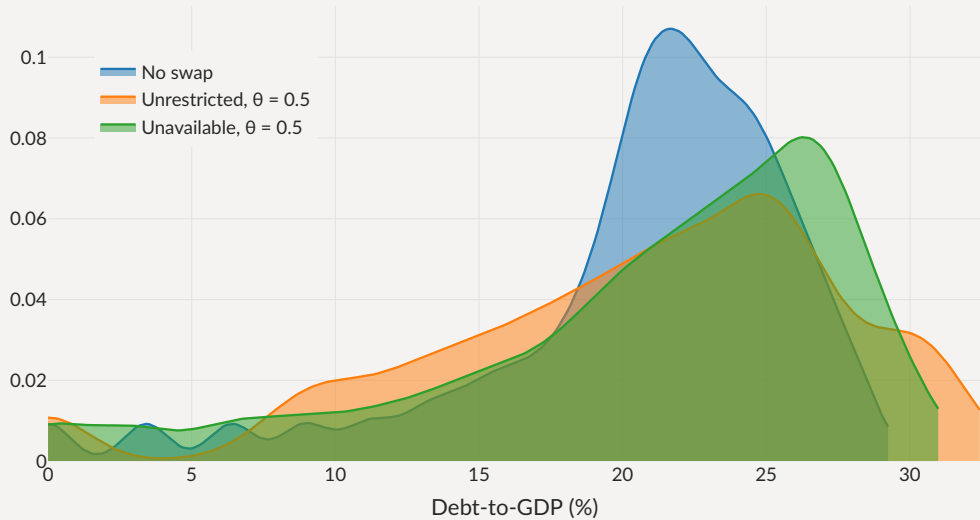
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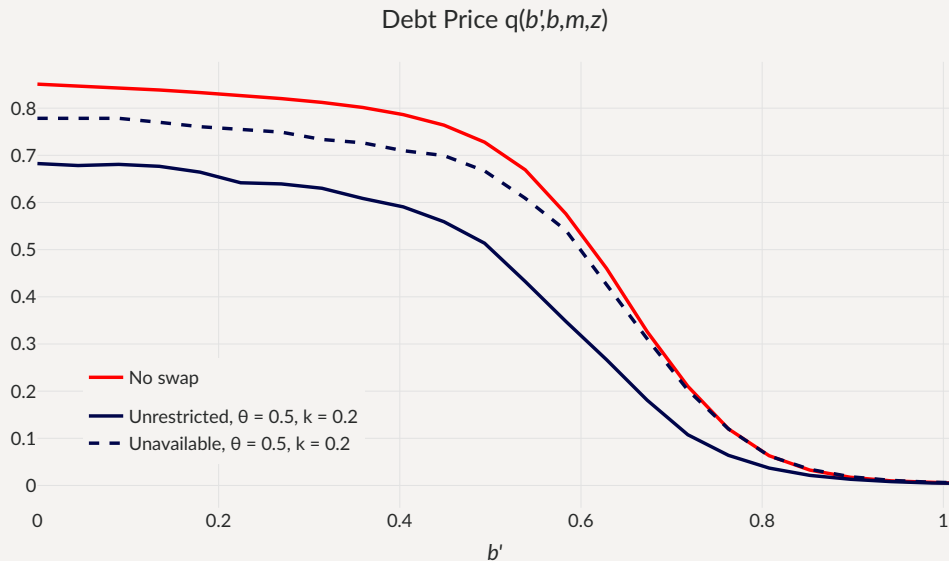
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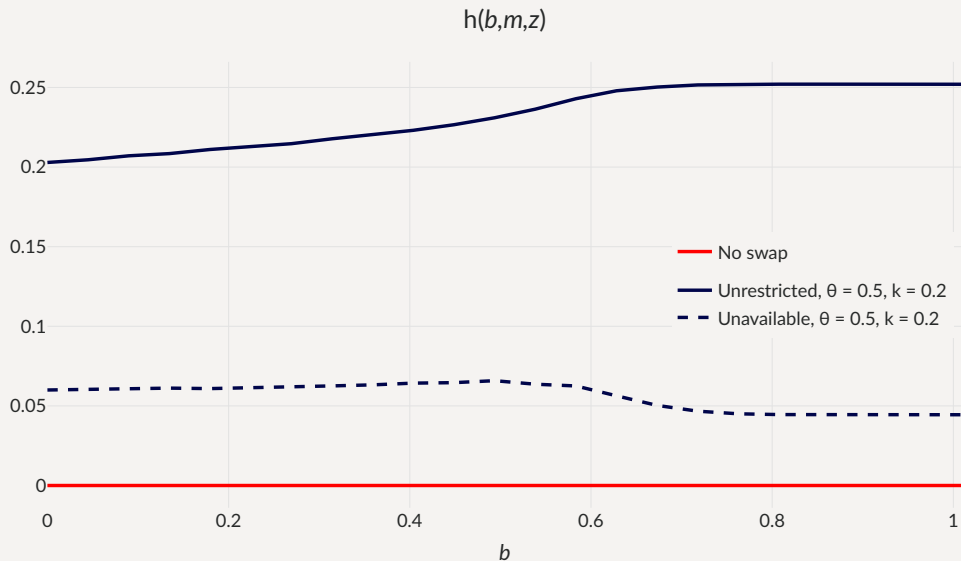
Debt Prices with Swaps

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



Monopolist's profits

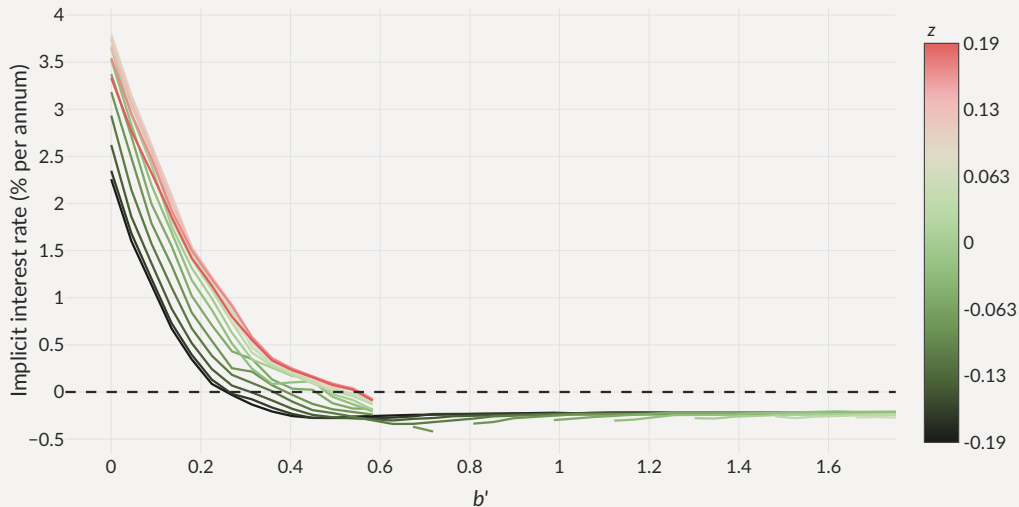
Monopolist's profits **increasing** in debt (cond. on repayment) – surplus requires spreads > 0



Risk-taking incentives

Surplus on swap requires spreads > 0 : monopolist provides **incentives** for risk taking

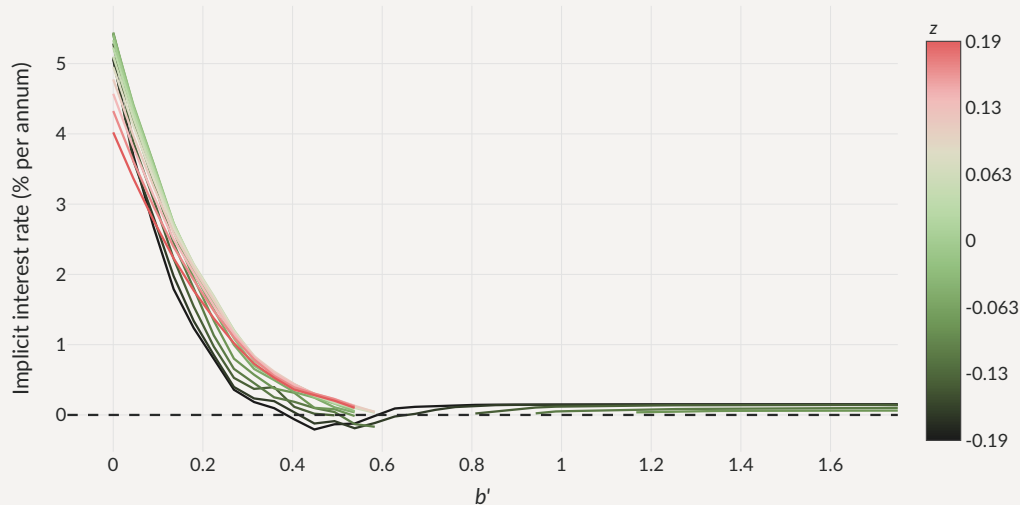
Interest rate on the swap (Unrestricted)



Risk-taking incentives

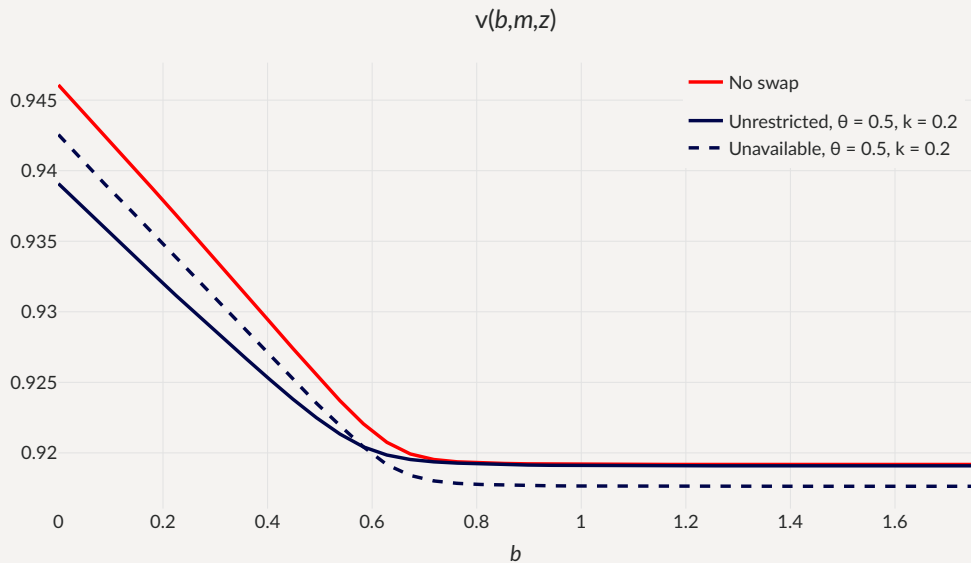
Surplus on swap requires spreads > 0 : monopolist provides **incentives** for risk taking

Interest rate on the swap (Unavailable)



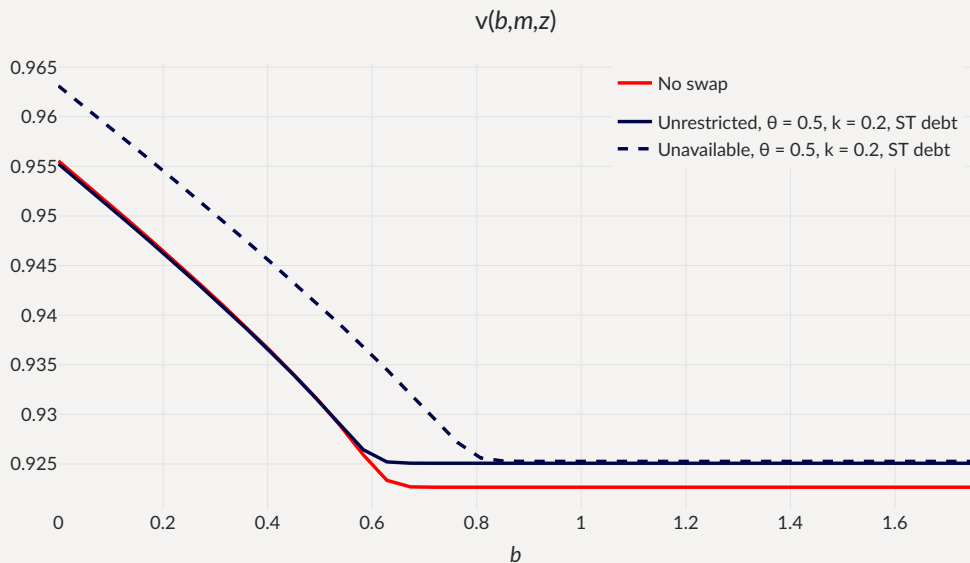
Welfare effects of swap lines

Limited \succcurlyeq Unrestricted, but...



Welfare effects of swap lines – Short-term debt

Short-term debt: swaps beneficial – interest on the swap **small** wrt to *whole* debt stock



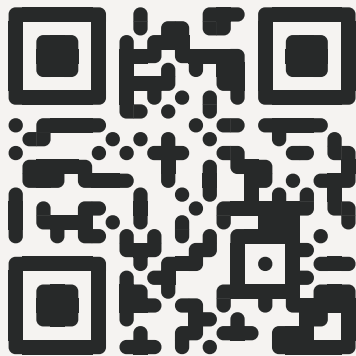
Welfare effects of swap lines – Short-term debt (cont'd)

	No swap, ST	Unrestricted, $\theta = 0.5$, ST	Unavailable, $\theta = 0.5$, ST
Avg spread (bps)	80.7	377	247
Std spread (bps)	110	373	197
$\sigma(c)/\sigma(y)$ (%)	129	130	138
Debt to GDP (%)	19.0	18.7	23.5
Swap to GDP (%)	0	3.13	3.65
Corr. swap & spreads (%)	–	54.9	50.3
Default frequency (%)	0.574	3.14	1.97
Welfare gains (rep)	–	-0.074%	0.8%

Concluding remarks

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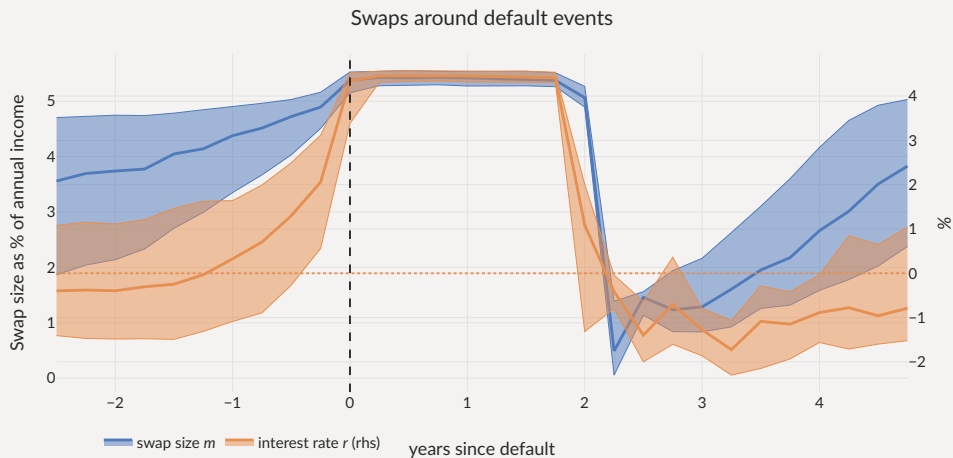
- Simple model with monopolist/fringe structure
- Strong interaction between two markets for sovereign debt
 - ... even if swaps are not used intensely on the equilibrium path
- Market power crucial in model
 - ... how to discipline in model?
 - ... how to affect in reality?
- Large welfare effects,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



Scan to find the paper

When is the Swap Used?

- Further conditioning on default events lasting exactly two years



When is the Swap Used?

- With Limited: $\Gamma(m) = m$

