Central Bank Swap Lines as Bilateral Sovereign Debt

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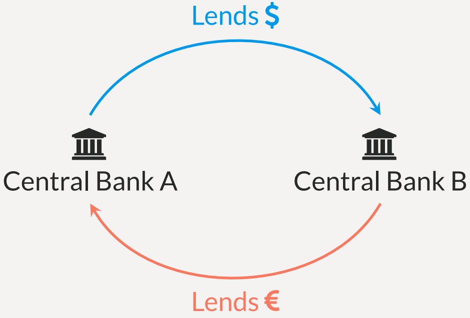
What is a Central Bank swap?

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

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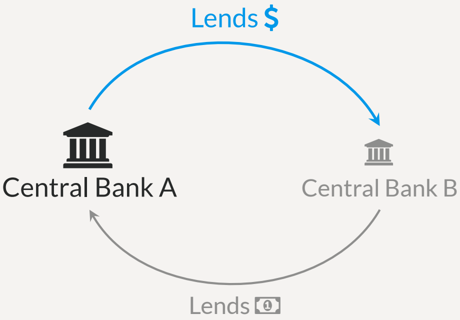

which can be asymmetric in practice

- 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)	Bilateral loan (swap line)
Defaultable	Non-defaulteable (Central Bank)
Many different lenders	No coordination issues
Interest rate (spreads) mainly reflects default risk	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

Literature

- 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 $\quad x = \frac{1}{1+r}m' - m$
  - … Interest rate to reflect market power
  - … Interest rate to reflect outside options

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Bargaining stage with monopolist

- At income state z and loan m, solve

Government surplus

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

Lender surplus

- 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

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

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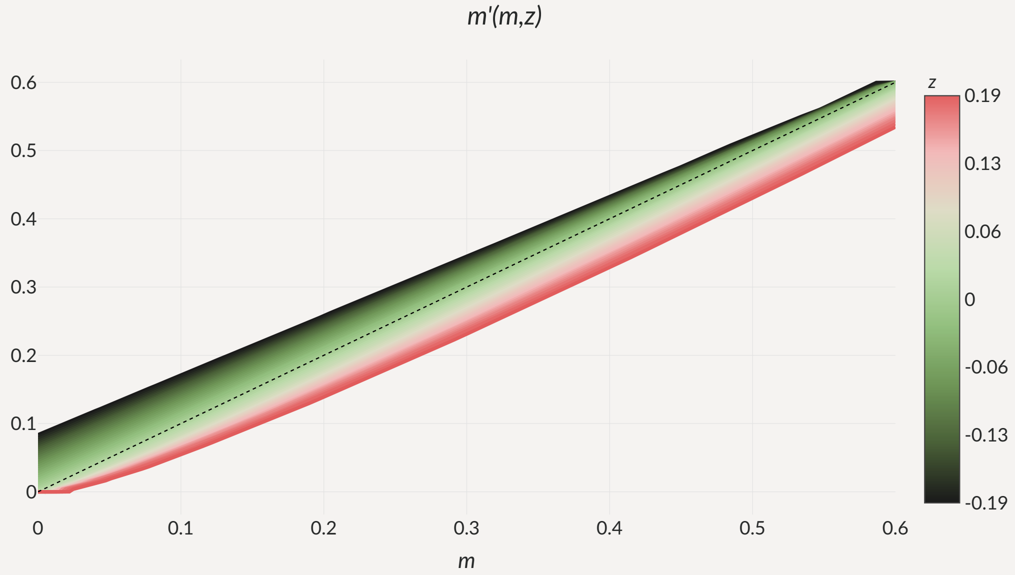
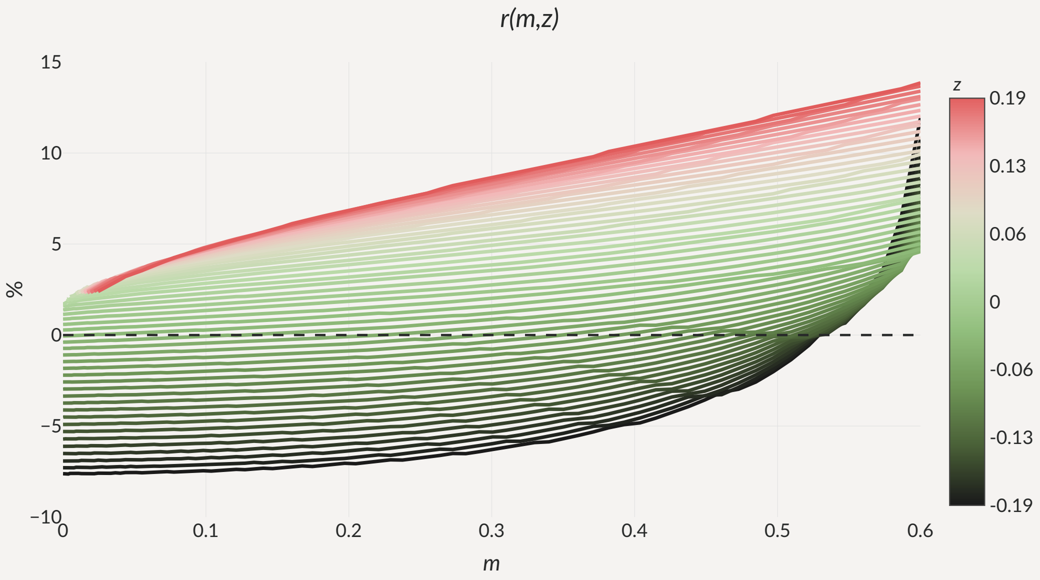
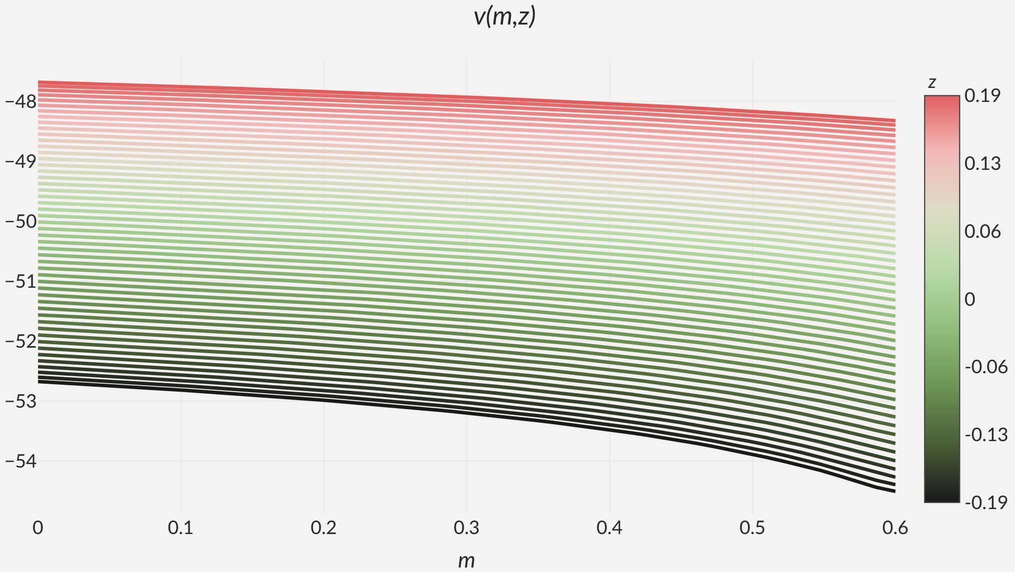
Swap Line Terms: Loan Dynamics



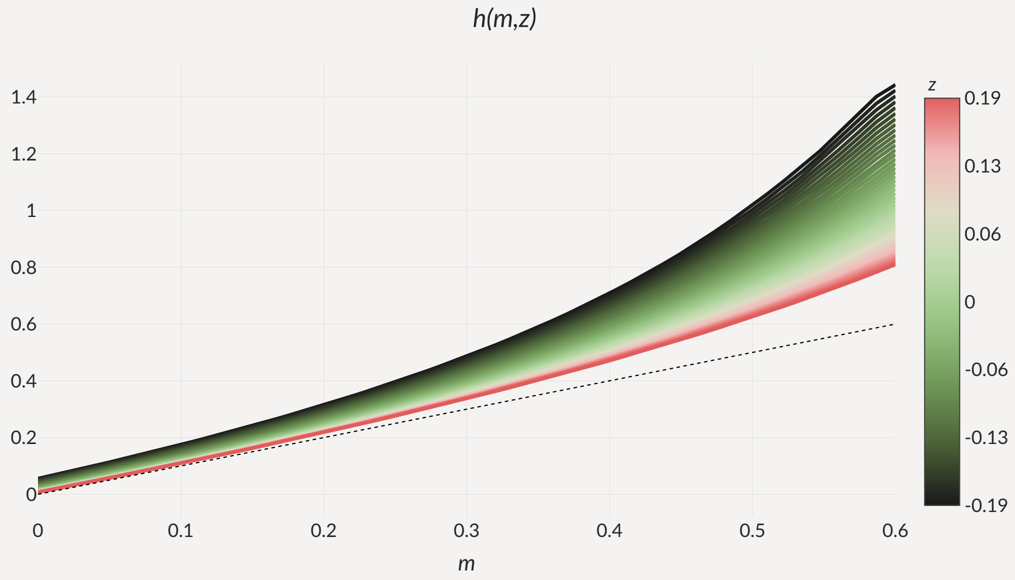
Swap Line Terms: Implicit interest rate



Swap Line Terms: Borrower's value function



Swap Line Terms: Lender's value function



Swap Line Terms: Takeaways

key requirement:
threat point value decreasing in m

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

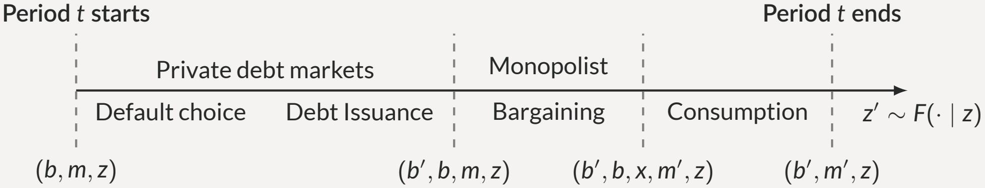
- This creates convexity in the lender's value function
  … making the lender act 'as if' risk-loving

- 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

  ... for each unit, get q, 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

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

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same sdf as monopolist

Bargaining stage

- Same as before 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 state

- In default,

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

- 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
  - ... extra dimension of gambling for delayed reentry

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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	0.9852
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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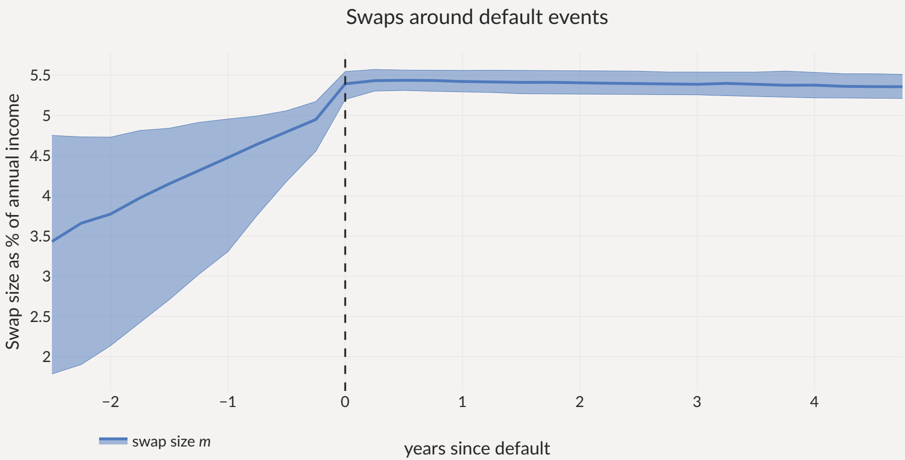
How do swaps affect equilibrium?

	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



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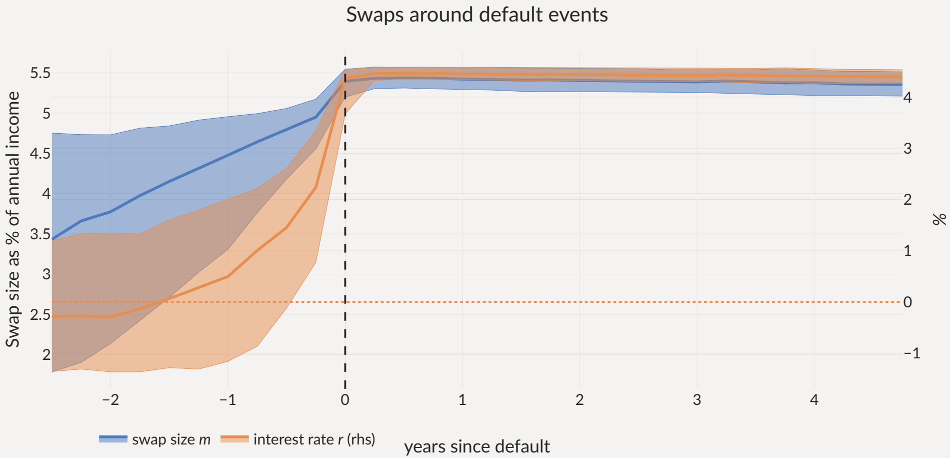

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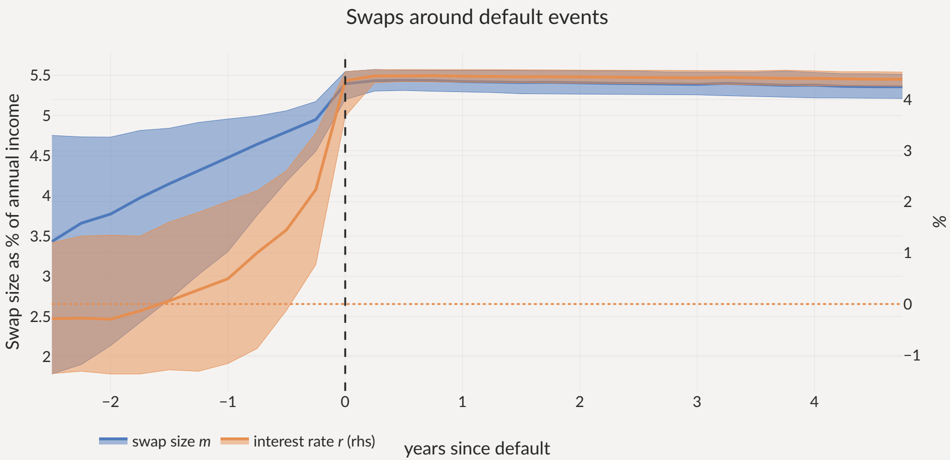

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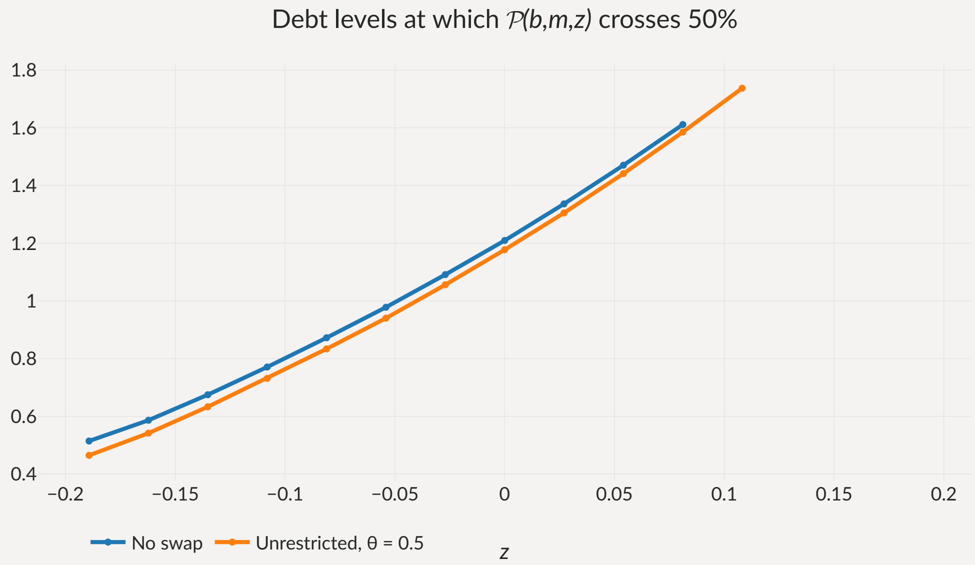
Limiting swaps in default

- **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



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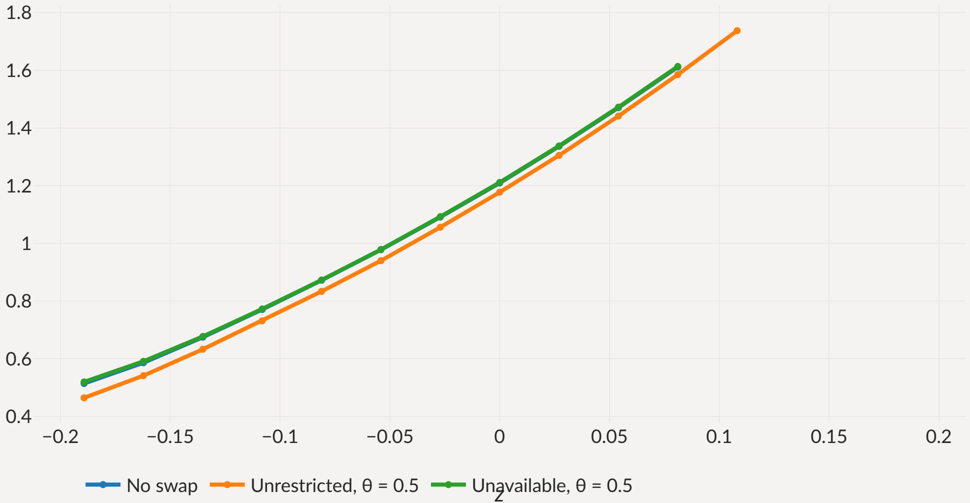
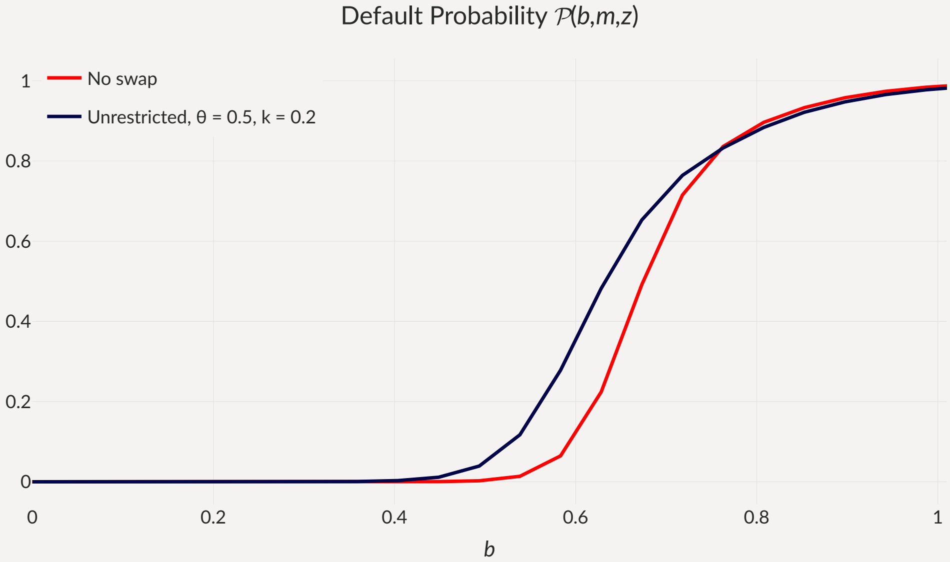
Debt levels at which $\mathcal{P}(b,m,z)$ crosses 50%



Debt Tolerance with Swaps

Repay less often with swaps. More often with Limited



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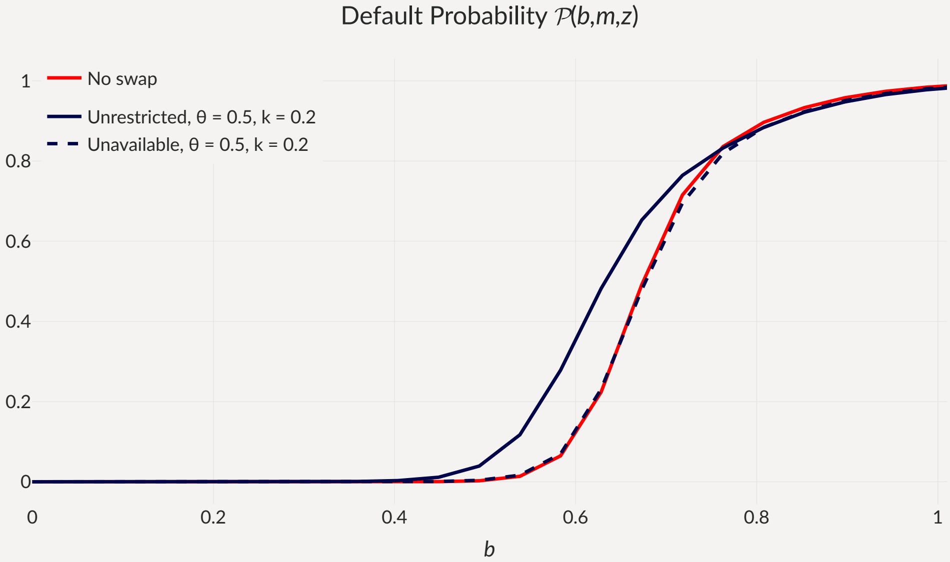

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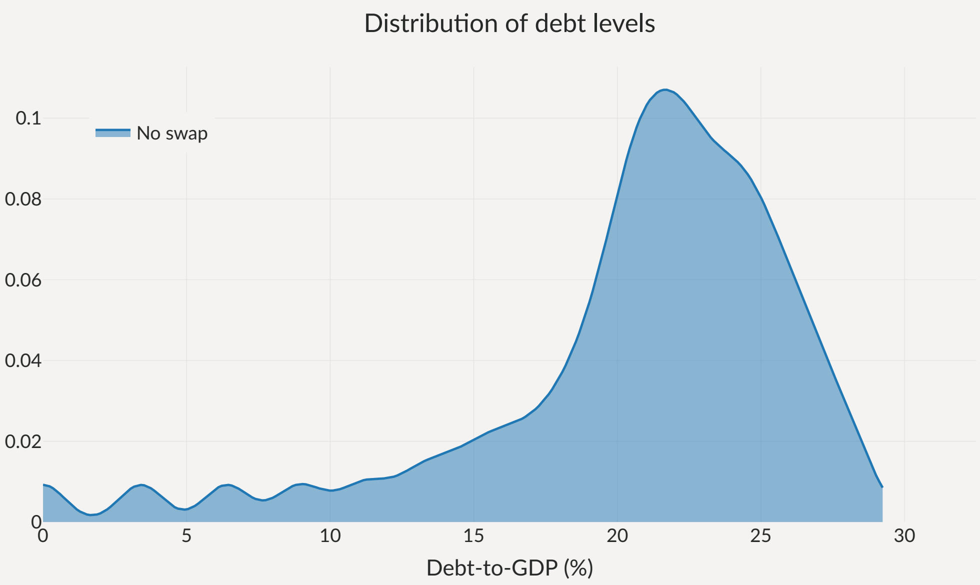

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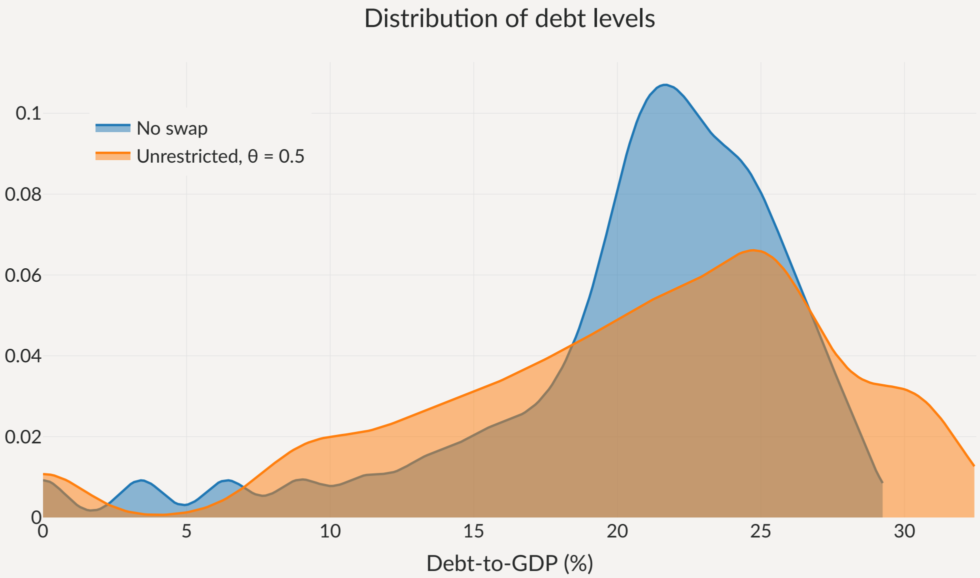

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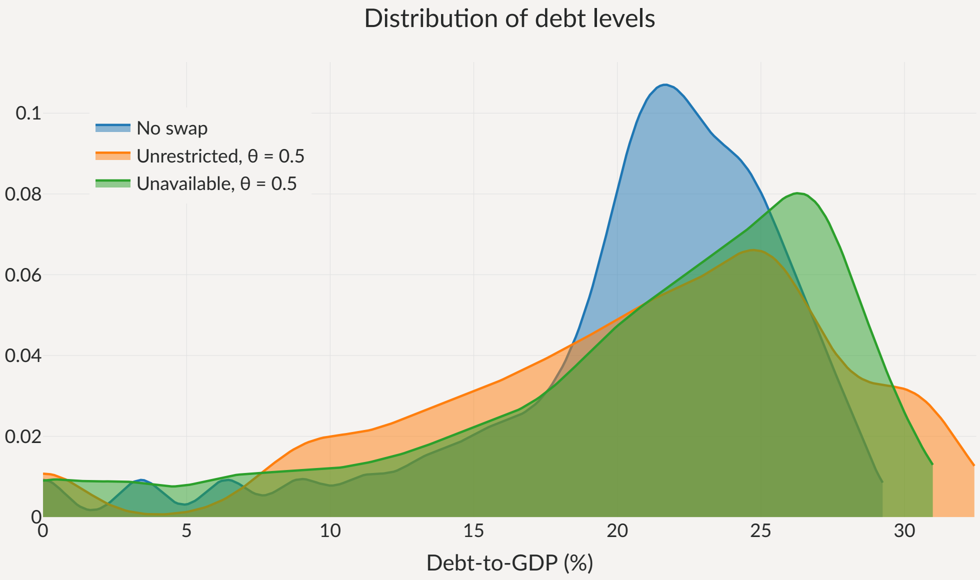
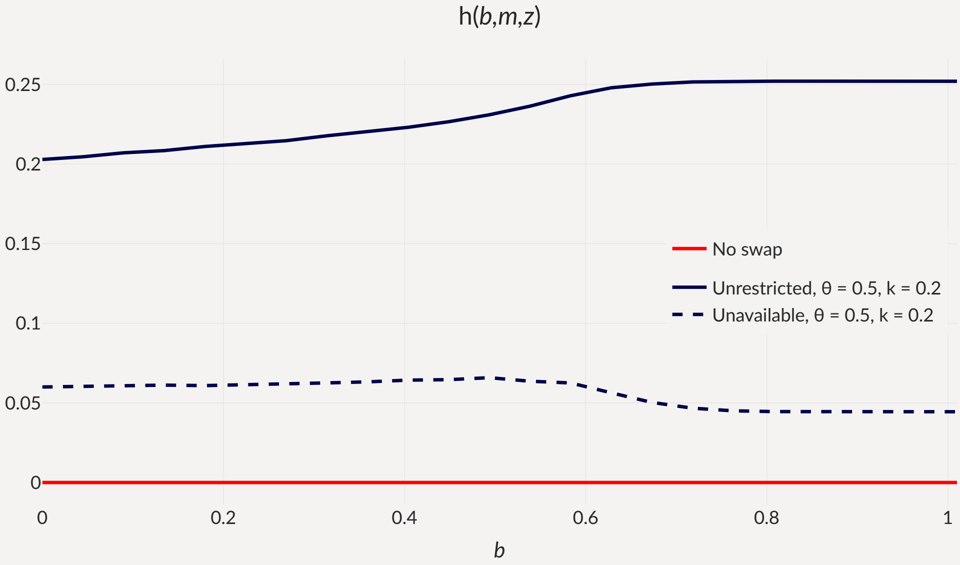


Debt Prices with Swaps

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

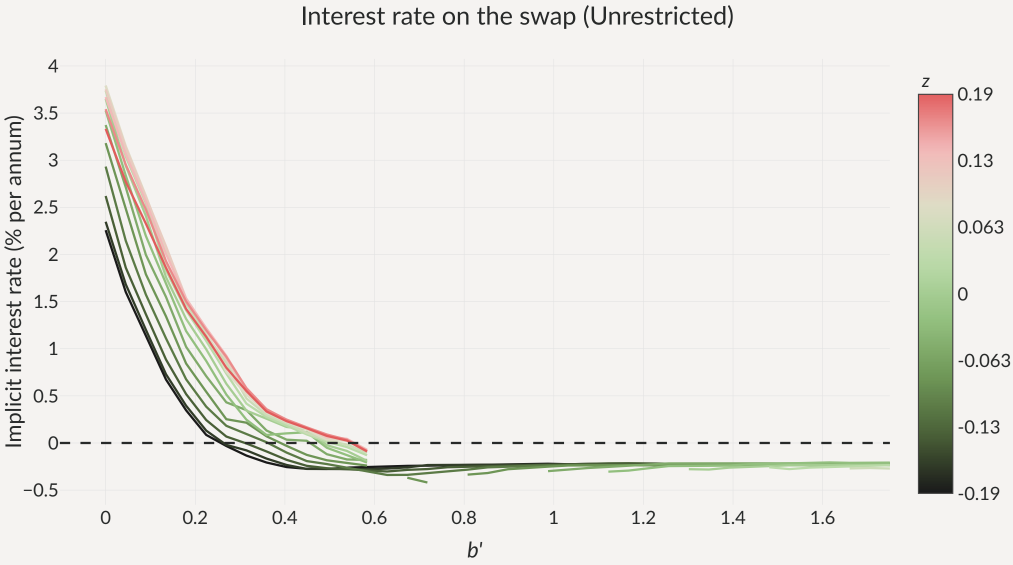
Monopolist's profits

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



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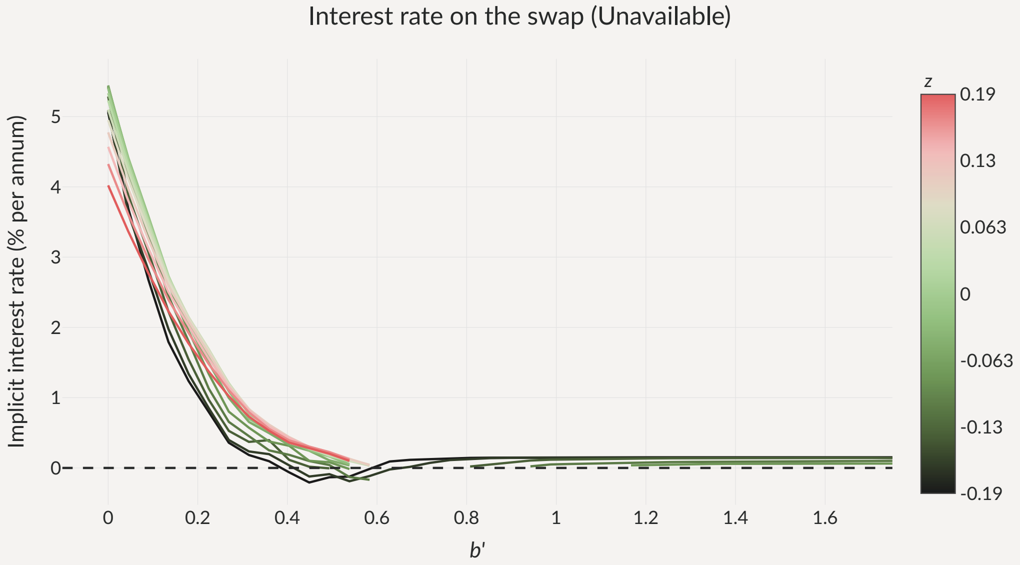
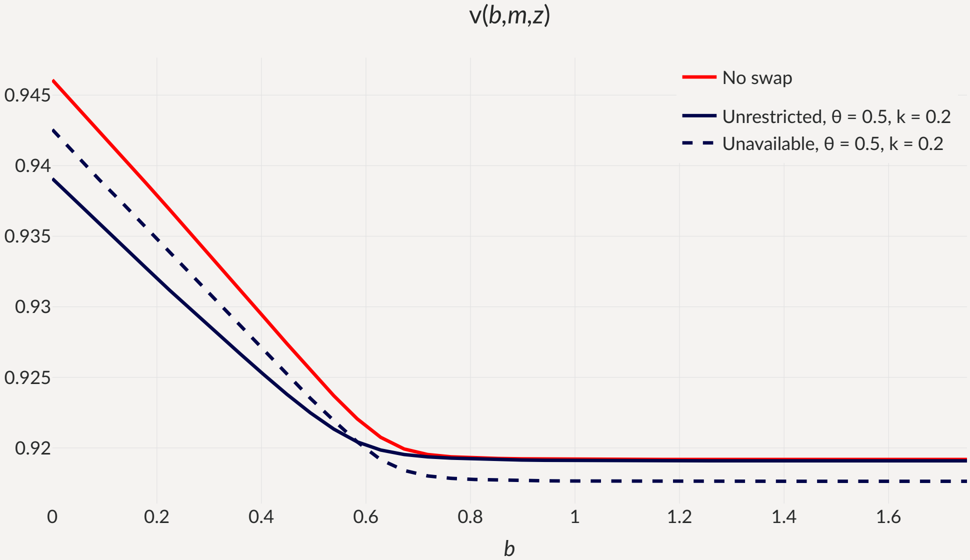


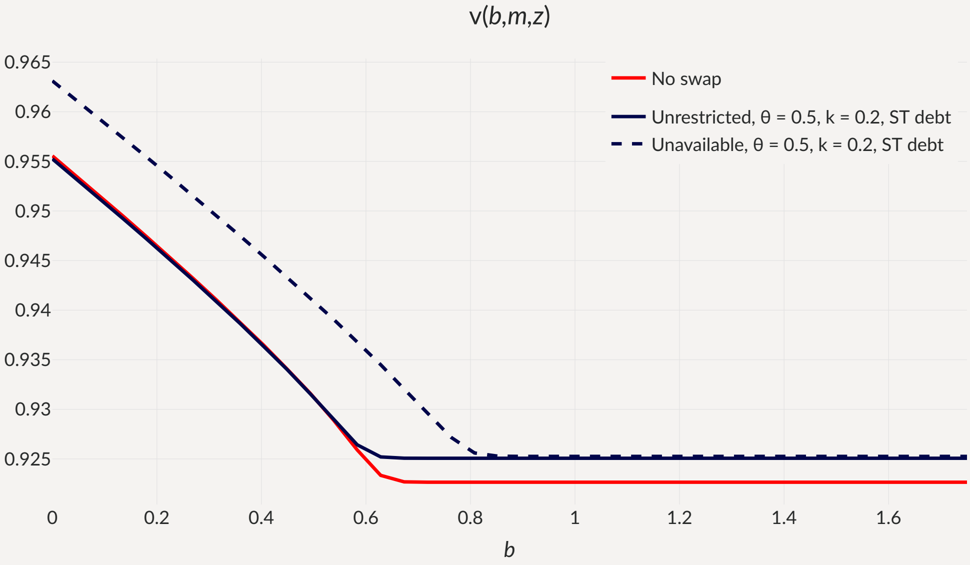
Welfare effects of swap lines

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

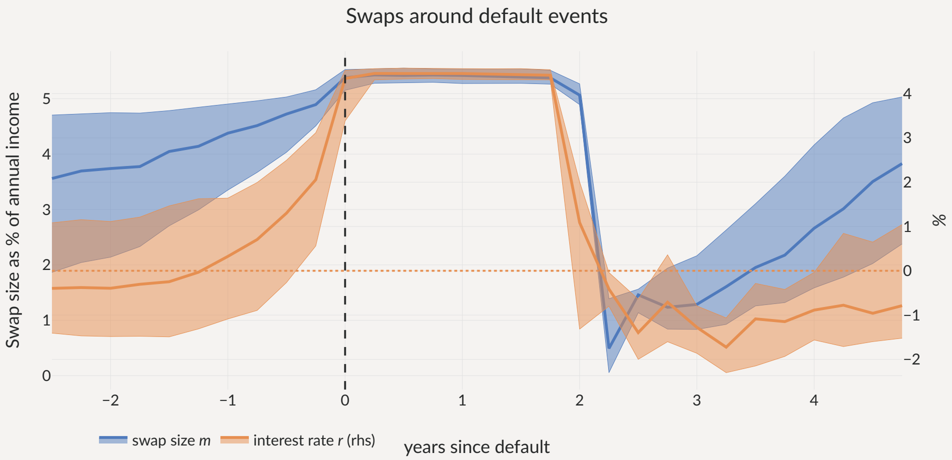
  … how to discipline in model?

  … 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?

When is the Swap Used?

◂ Back

- Further conditioning on default events lasting exactly two years



When is the Swap Used?

Back

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