Central Bank Swap Lines as Bilateral Sovereign Debt

Francisco Roldán
IMF

César Sosa-Padilla
Notre Dame

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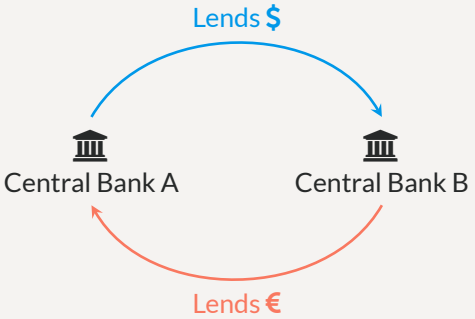
What is a Central Bank swap?

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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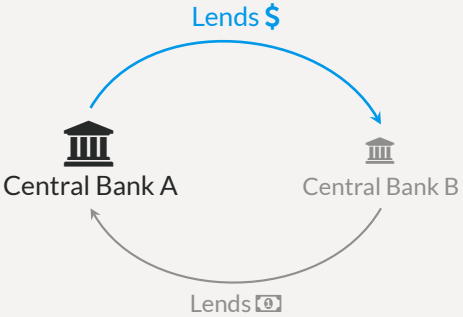

which can be asymmetric in practice

- 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

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

- Should expect
  - ... Implicit interest rate r to vary over time
  - ... Interest rate to reflect market power
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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

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

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

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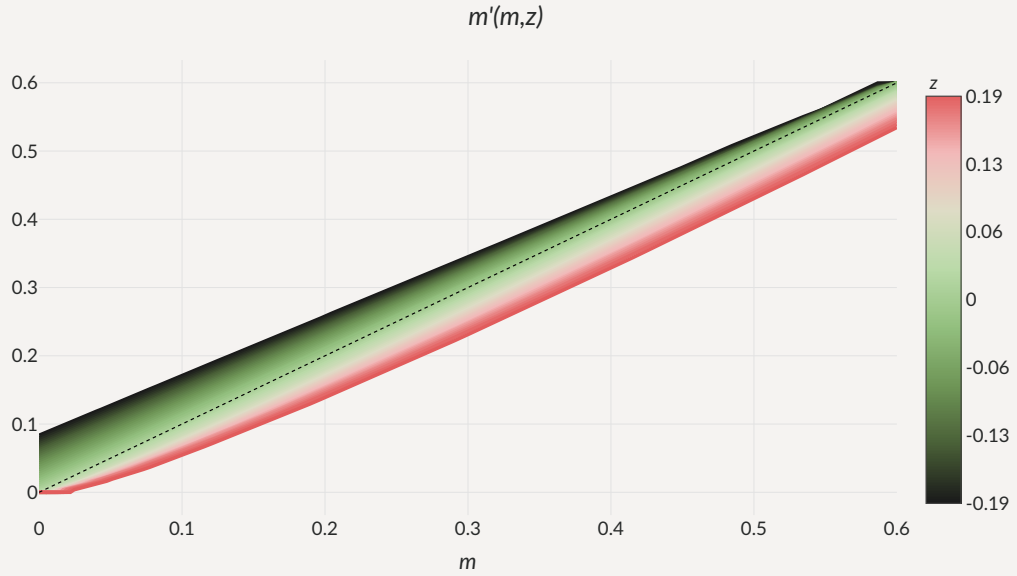
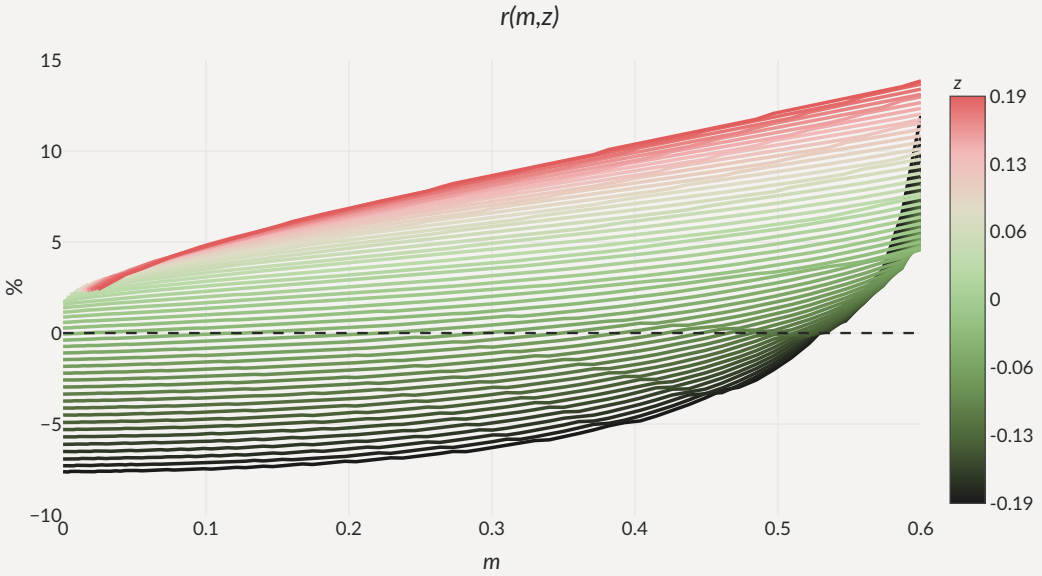
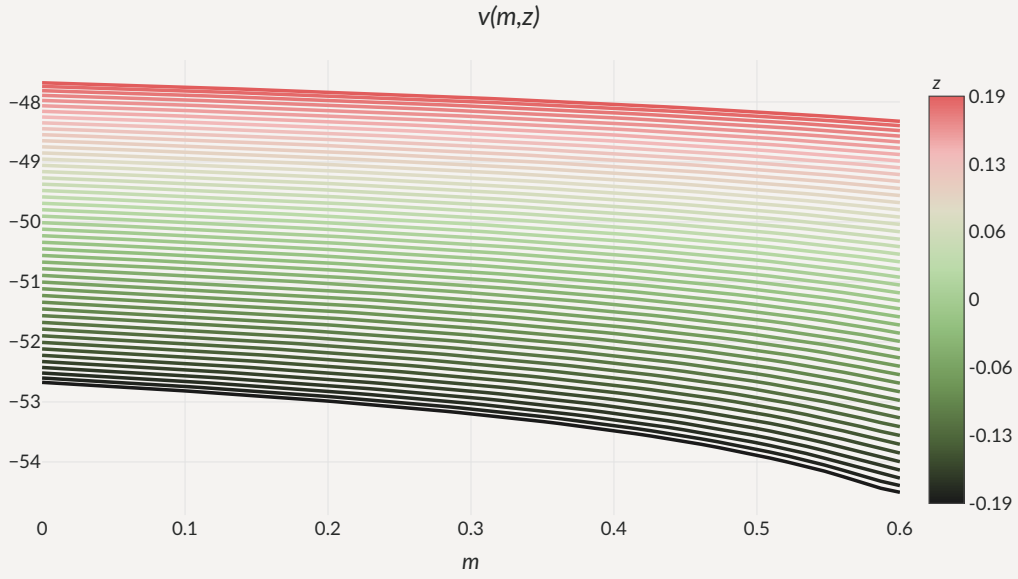
Swap Line Terms: Loan Dynamics



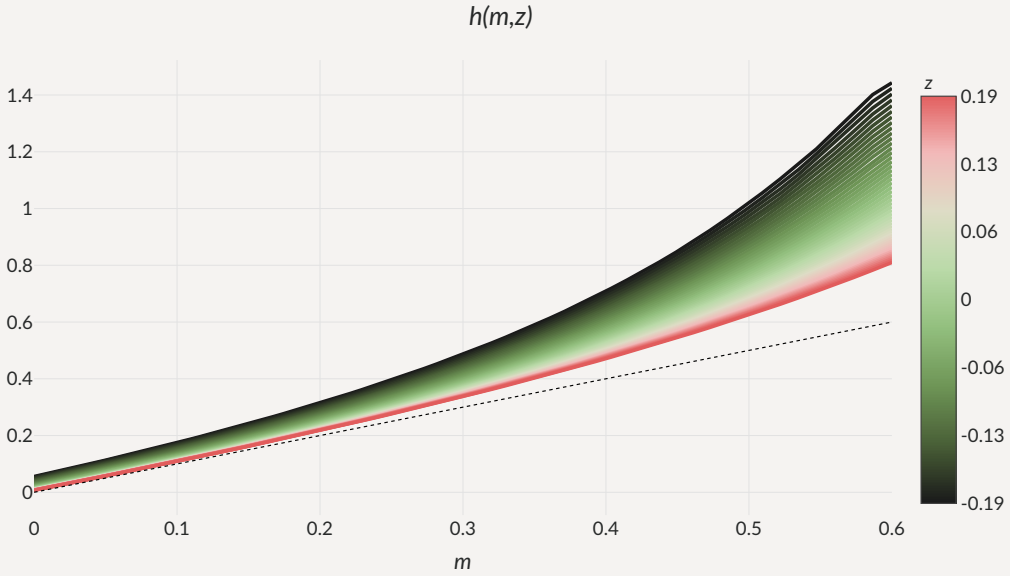
Swap Line Terms: Implicit interest rate



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

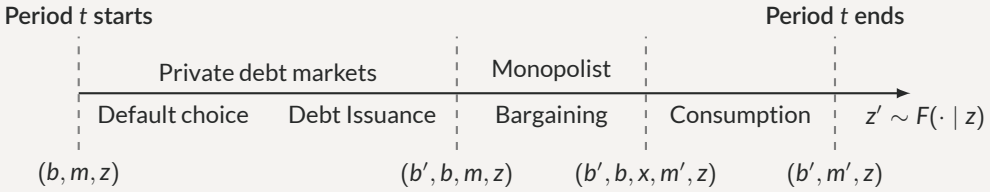
- This creates convexity in the lender's value function
  … making the lender act 'as if' risk-loving

- 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

  ... 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

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

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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,

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

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  - ... 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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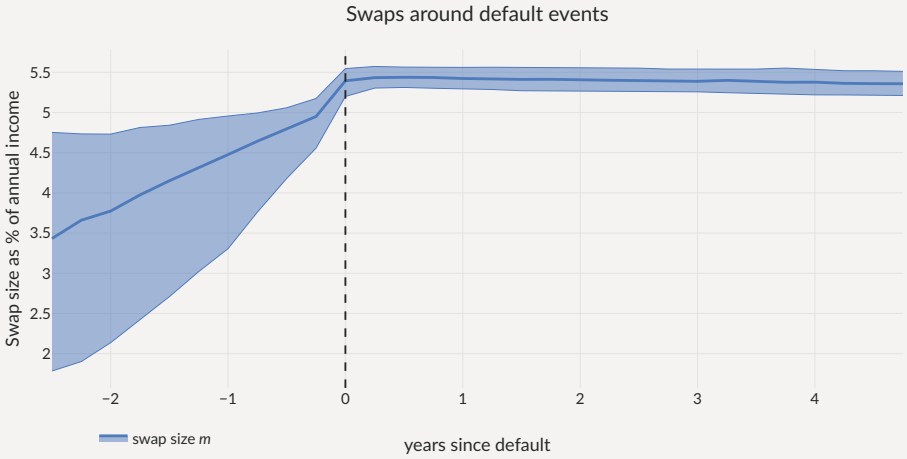
How do swaps affect equilibrium?

	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?

- Swaps shoot up before *and during* defaults



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

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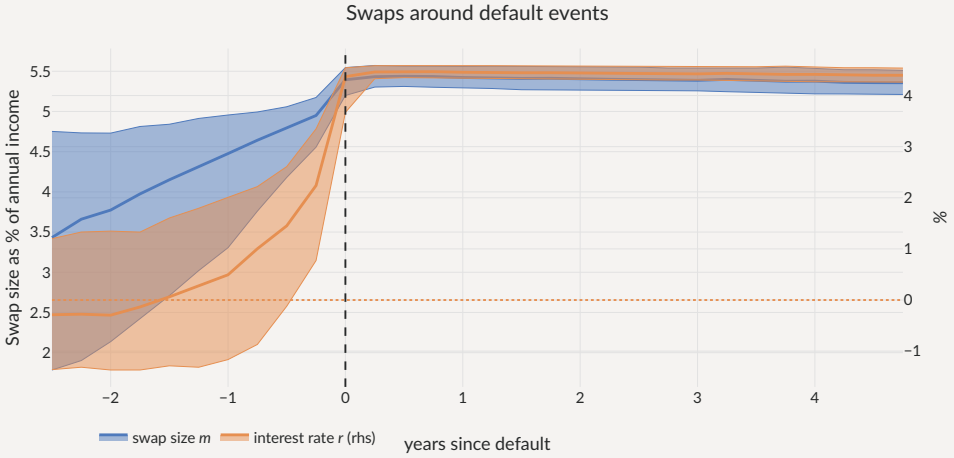

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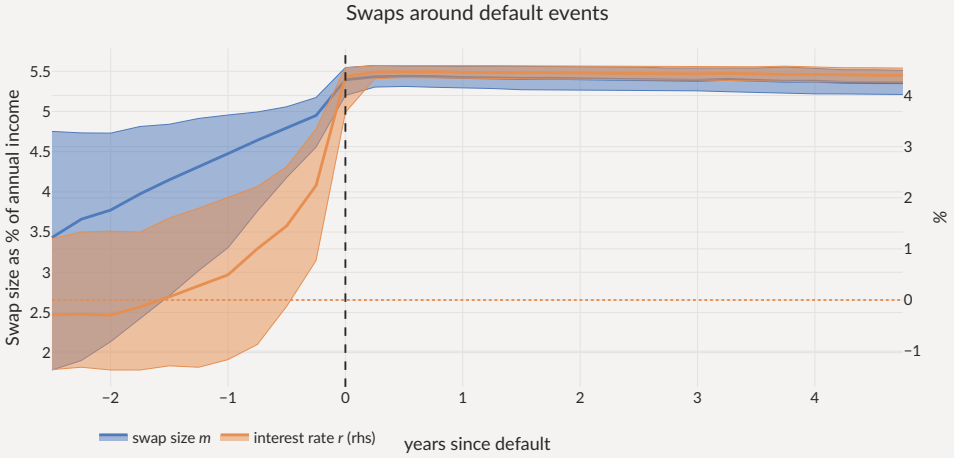

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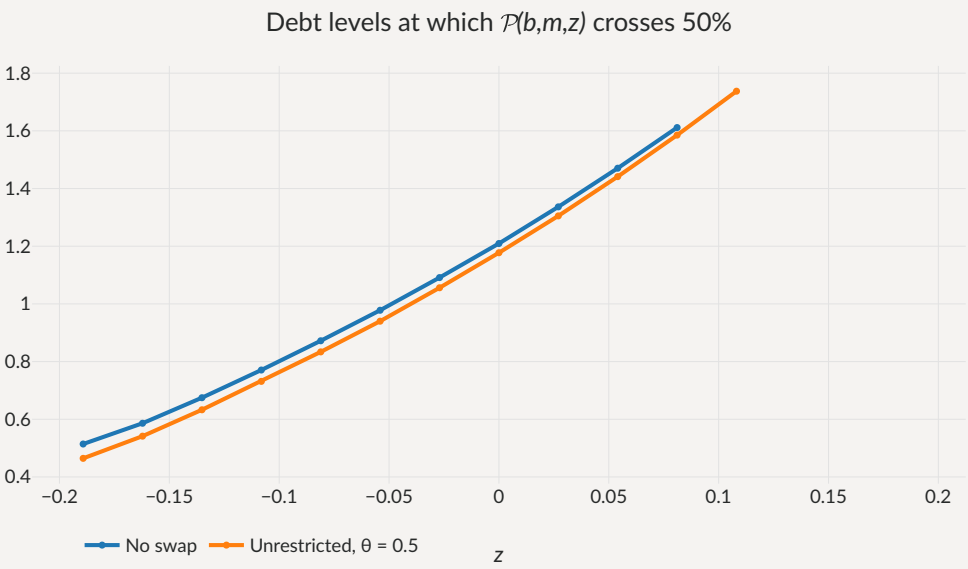
Limiting swaps in default

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

	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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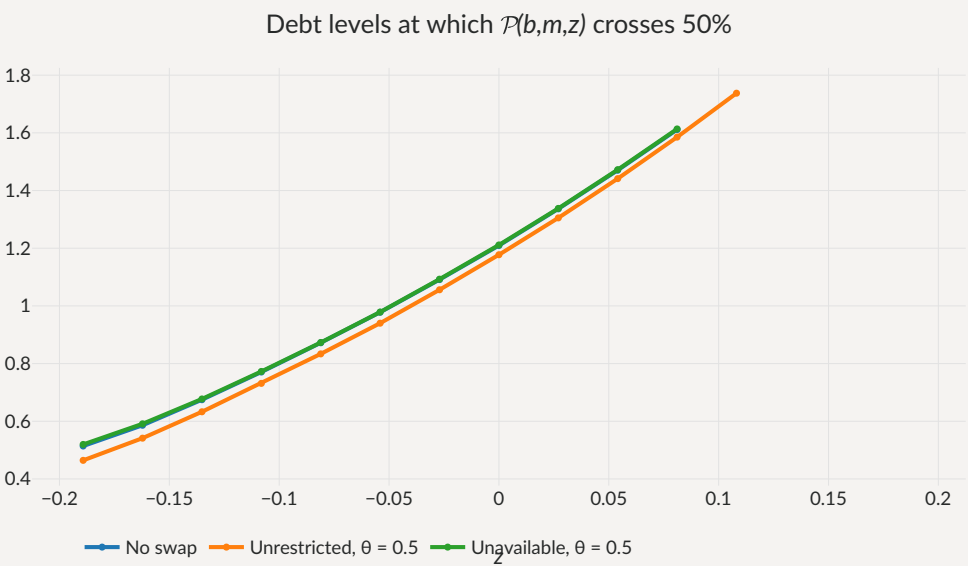
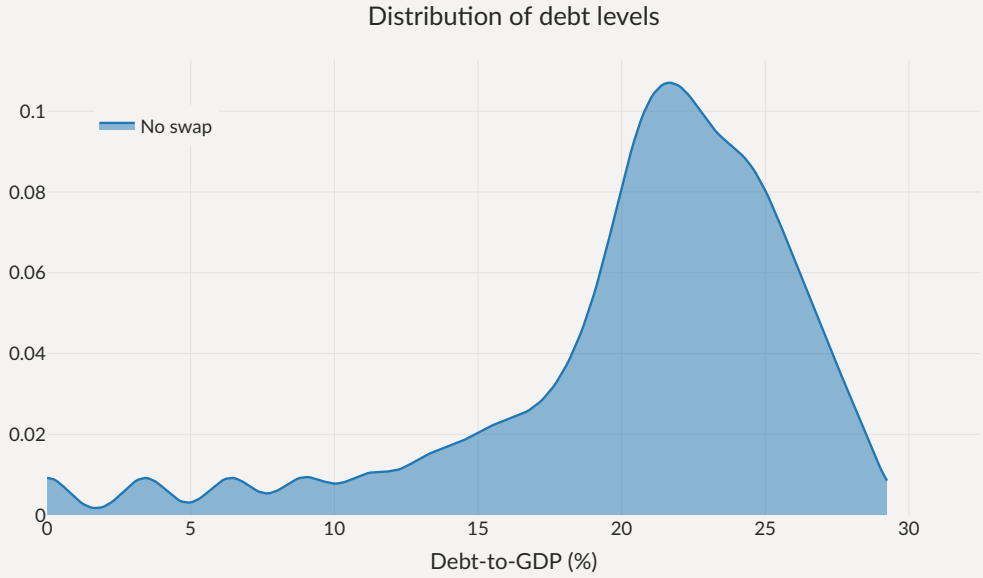


Debt Levels with Swaps



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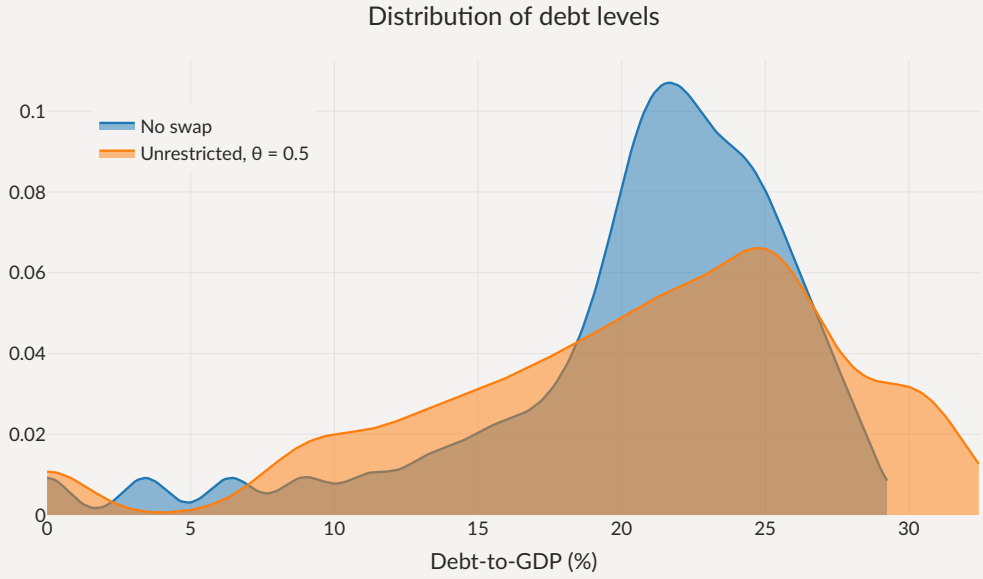

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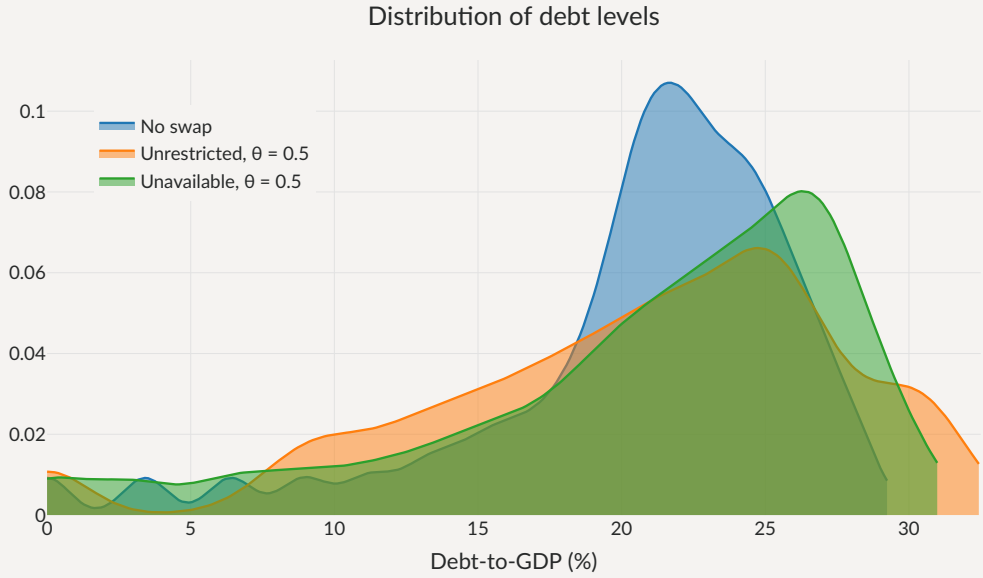
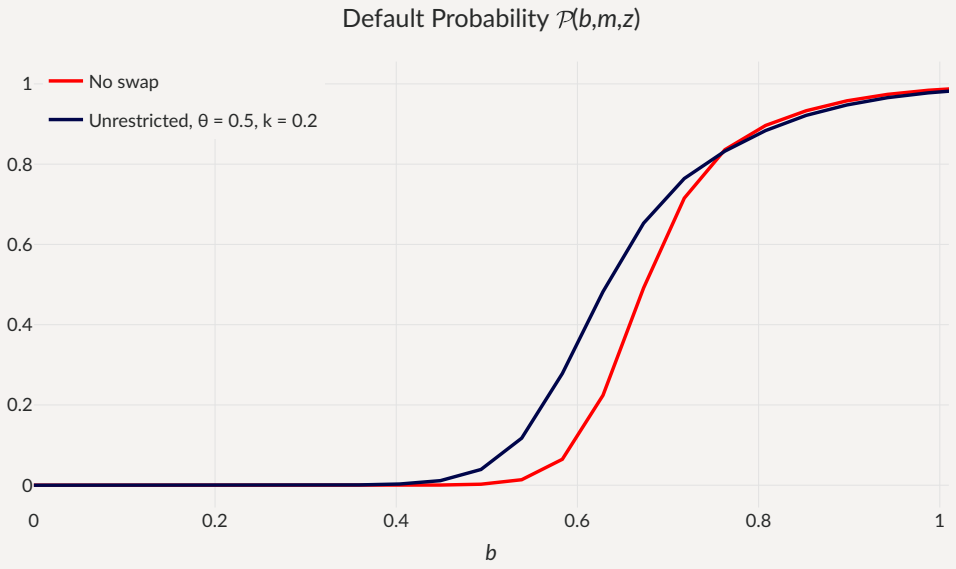


Debt Tolerance with Swaps

Repay less often with swaps. More often with Limited



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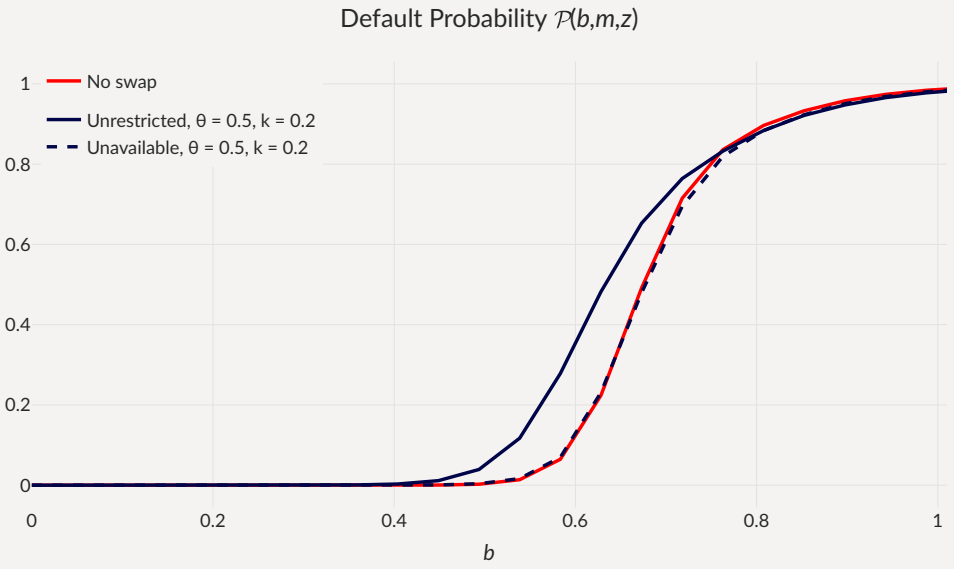
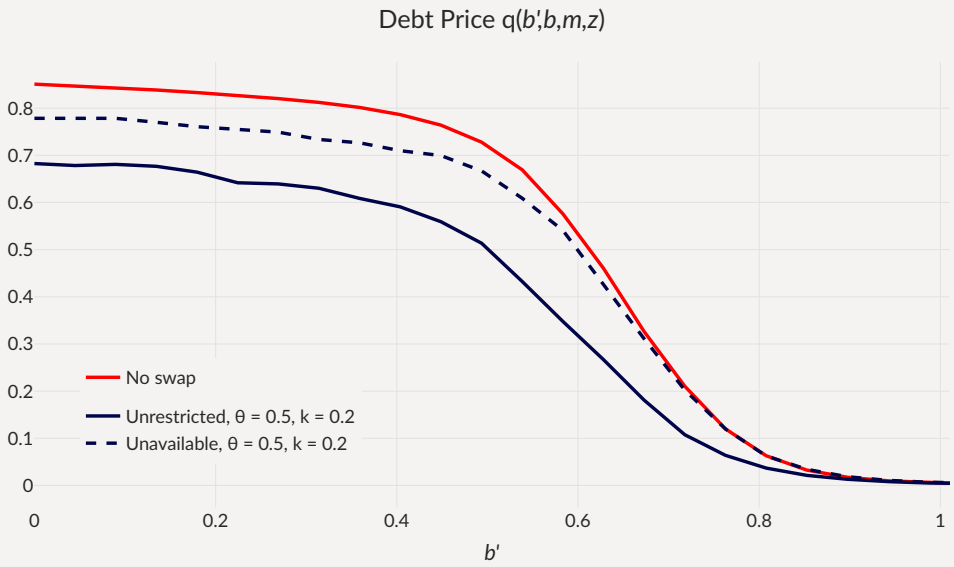


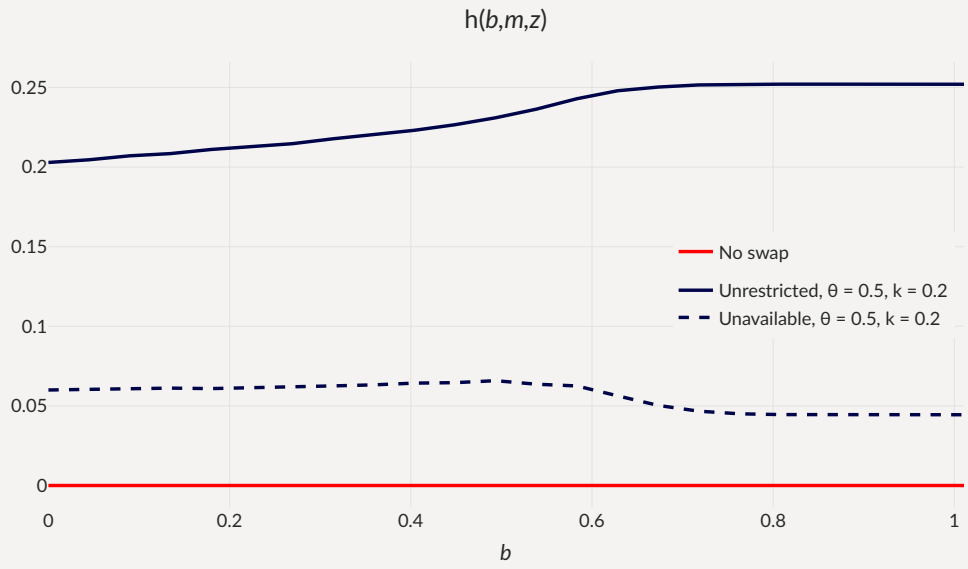
Debt Prices with Swaps

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



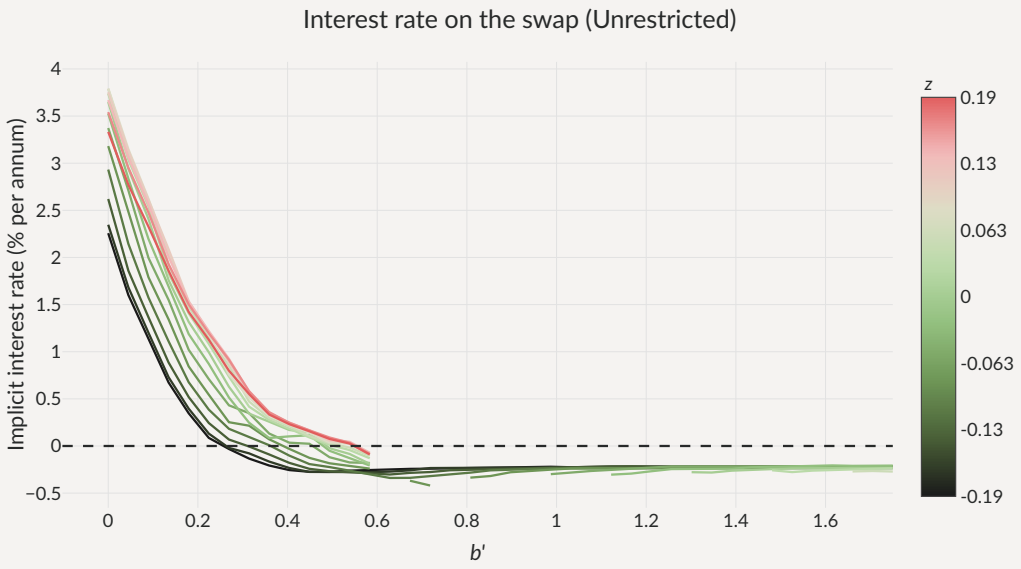
Monopolist's profits

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



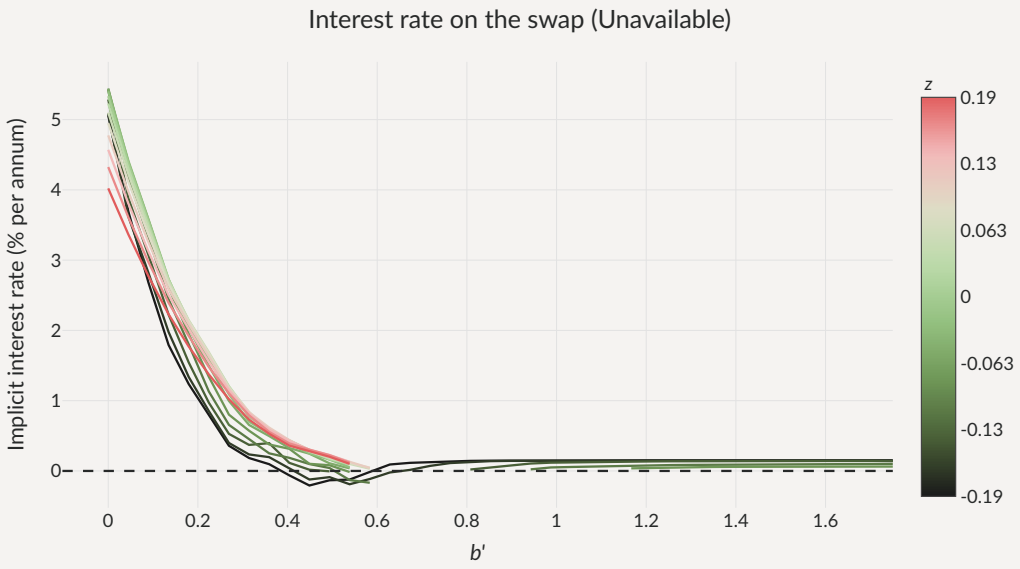
Risk-taking incentives

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



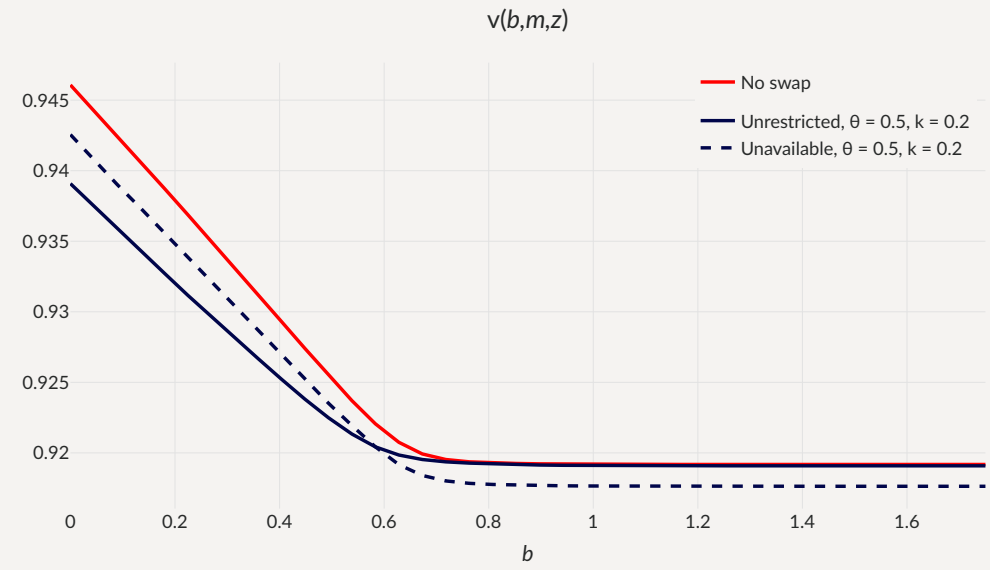
Risk-taking incentives

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



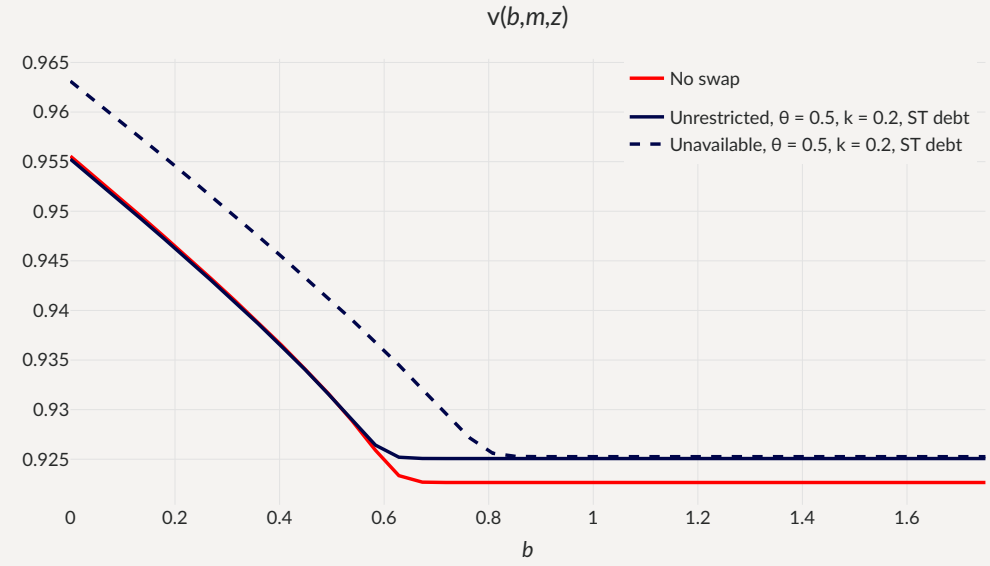
Welfare effects of swap lines

Limited ⋡ Unrestricted, but…



Welfare effects of swap lines — Short-term debt

Solving model with short-term debt: gains of swaps



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%

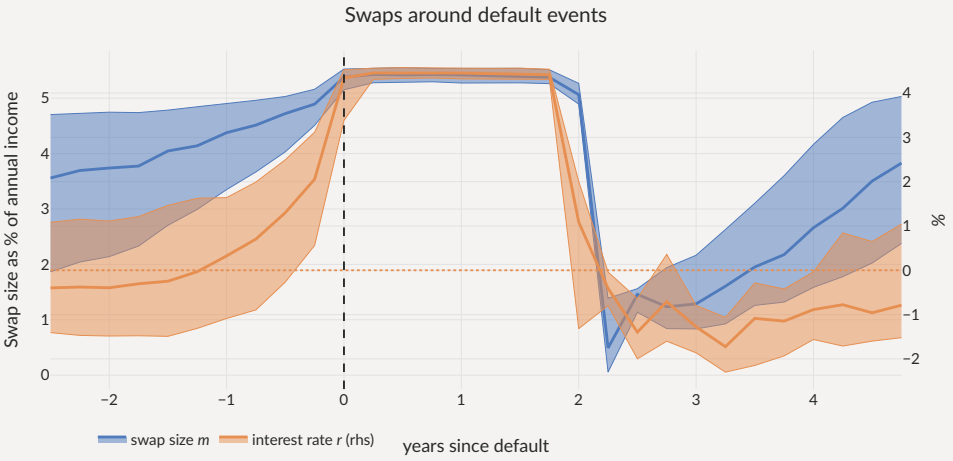
Concluding remarks

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



When is the Swap Used?

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