Central Bank Swap Lines as Bilateral Sovereign Debt

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Uses of Swap Lines

- Swap line: two lines of credit involving two central banks
  - … Each makes available some of its own currency to the other, for a fixed term
  - … Short-term arrangements (typically one year, typically renewed)

- Used to mainly involve AEs Fed–ECB–BoE–BoJ–SNB
  - … to support lender-of-last-resort functions with multinational firms

- Large increase in bilateral swaps and loans involving EMs since early 2000s
  - … for EM, swap resources are hard currency
  - … for EM, swap can be used for financing BoP (or as borrowed reserves)
  - … EMs borrowing from swap lines tend to use different counterparts

Question How do swap lines interact with sovereign debt?

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How do Central Bank Swap Lines affect the Market Structure of Sovereign Debt?

We abstract from currencies, collateral, and focus on the borrowing

Tradeoff

- Borrowing with bonds
  - … interest rate reflects default risk
- Borrowing from the swap line
  - … interest rate and drawings negotiated

!! Defaulting on the debt does not mean defaulting on the swap

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A New Landscape for Sovereign Borrowing

Prelim. data

- Swap lines are an *example* of a new type of sovereign borrowing arrangement
  - Short maturity but rolled over, with renegotiation
  - Difficult to default on — Central bank ≠ Treasury
  - Cheaper than borrowing on the market
- Other examples: Central bank deposits, (collateralized) bilateral loans, IMF programs…

The Dangers of Borrowing through Swap Lines

Main findings

- Swap drawings small relative to debt, but
  - Presence of swaps affects sovereign debt markets
    - … can provide financing when other sources dry up
    - … can increase risk-taking

- Lending around or in default maximizes surplus in swap negotiations
  - 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 induce relational overborrowing similar to the debt dilution problem
  - Surplus requires spreads — spreads require risk

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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); Bahaj, Fuchs, and Reis (2024)
- Sovereign debt/default with interactions from 'official' debt
  - … Boz (2011), Hatchondo, Martinez, and Onder (2014), Arellano and Barreto (2023), Hatchondo, Martinez, and Sosa-Padilla (2024), Liu, Liu, and Yue (2024)

Model

Environment

The government of a small open economy borrows from a monopolist and from markets

- 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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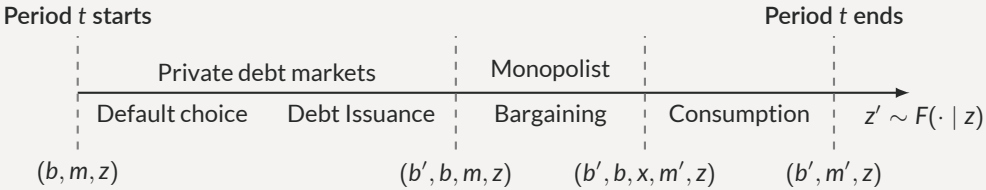
Timeline of events



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

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

- At state z, owing b in bonds and m on the swap and having issued b'

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

Government surplus

Lender surplus

- Lender's surplus

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

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- Government's surplus

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

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Bargaining: intuition

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- When future value of relationship is high: monopolist willing to lend at low rates

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- If default risk is low, not much role for monopolist
- Default risk opens up spreads, monopolist can lend more cheaply than market

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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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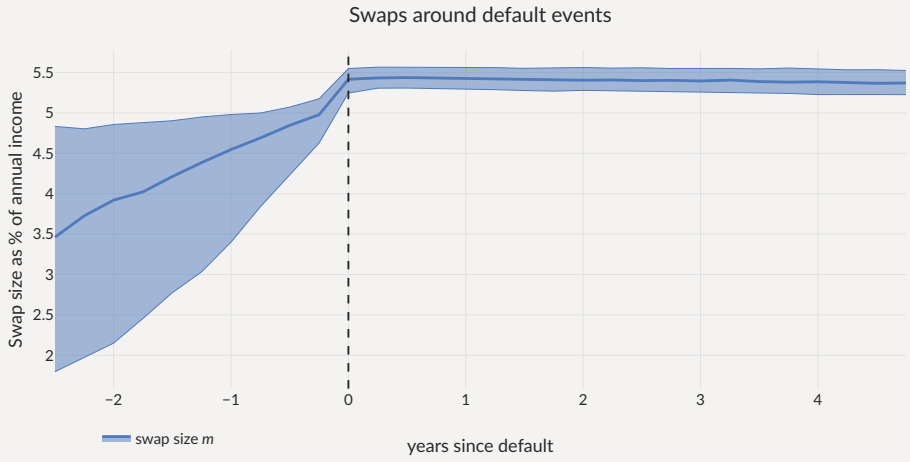
How do swaps affect equilibrium?

	No swap	Unrestricted, $\theta = 0.25$	Unrestricted, $\theta = 0.5$
Avg spread (bps)	804	1,841	2,396
Std spread (bps)	470	1,099	1,541
$\sigma(c)/\sigma(y)$ (%)	111	111	110
Debt to GDP (%)	21.4	20.8	20.2
Swap to GDP (%)	0	3.74	3.32
Corr. swap & spreads (%)	–	53.8	62.2
Default frequency (%)	6.53	13	14.7
Welfare gains (rep)	–	-0.082%	-0.41%

When is the Swap Used?

- Swaps shoot up before *and during* defaults



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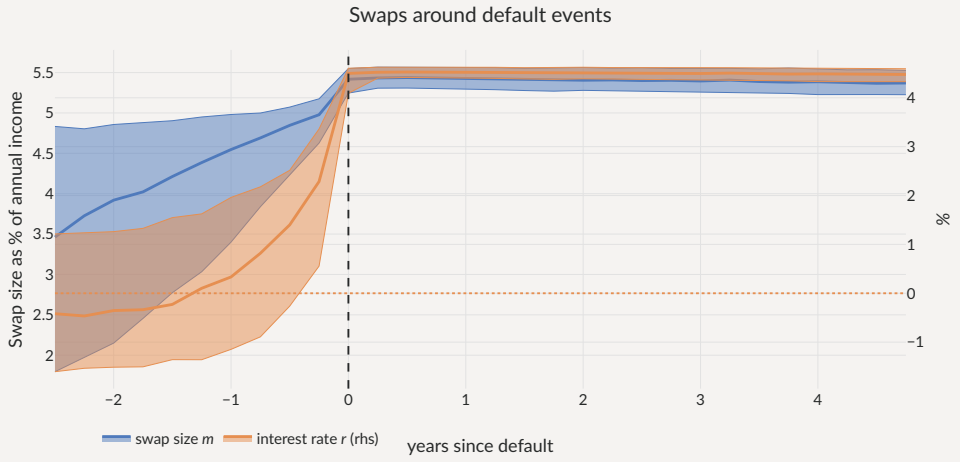

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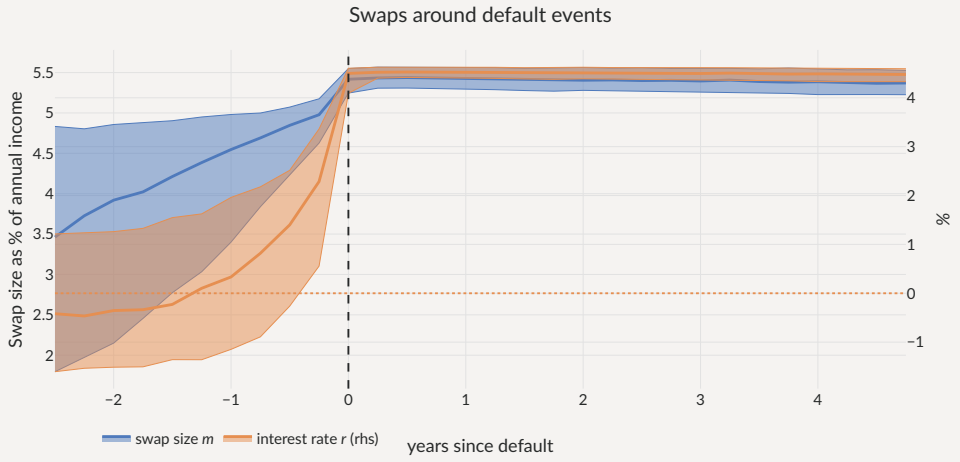

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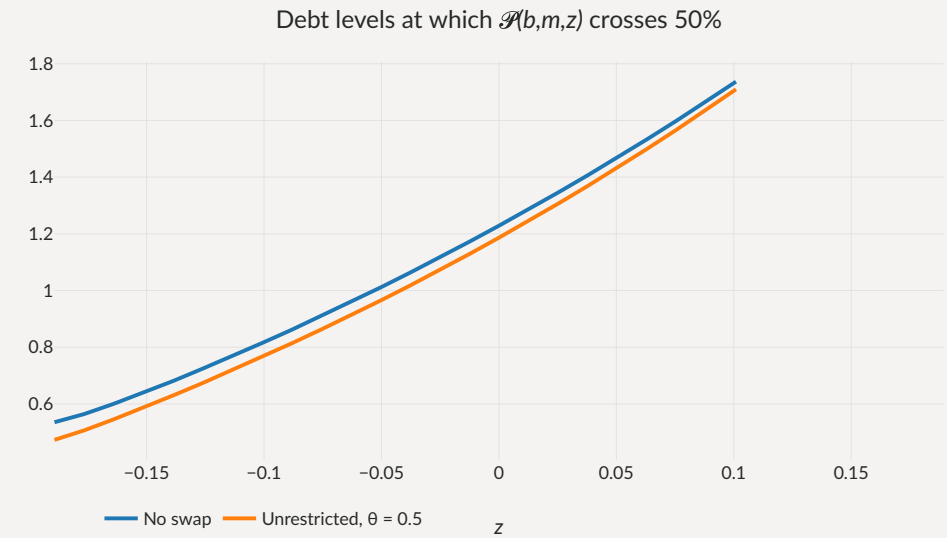
Limiting swaps in default

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

	No swap	Unrestricted, $\theta = 0.5$	Limited, $\theta = 0.5$
Avg spread (bps)	804	2,396	1,216
Std spread (bps)	470	1,541	779
$\sigma(c)/\sigma(y)$ (%)	111	110	113
Debt to GDP (%)	21.4	20.2	21.7
Swap to GDP (%)	0	3.32	1.05
Corr. swap & spreads (%)	–	62.2	69.4
Default frequency (%)	6.53	14.7	9.34
Welfare gains (rep)	–	-0.41%	-0.084%

Default Barriers with Swaps

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



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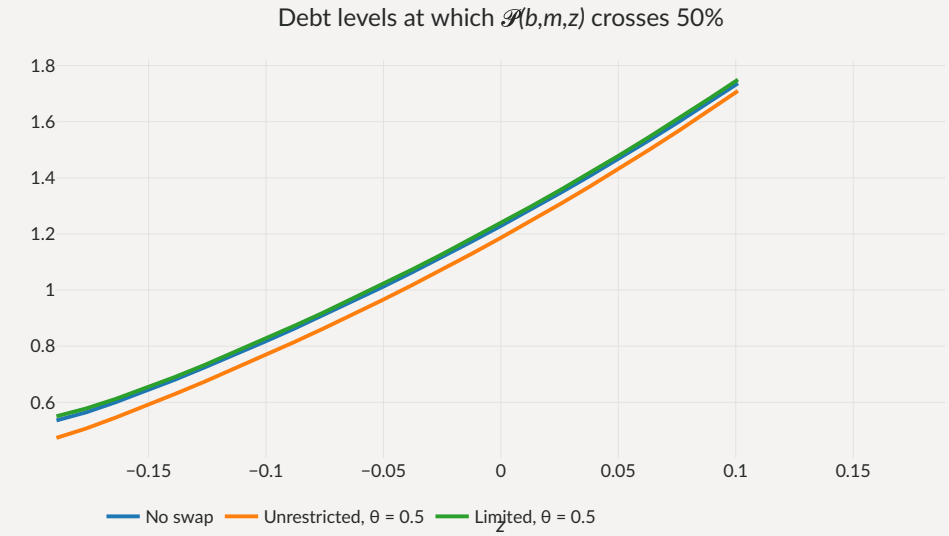
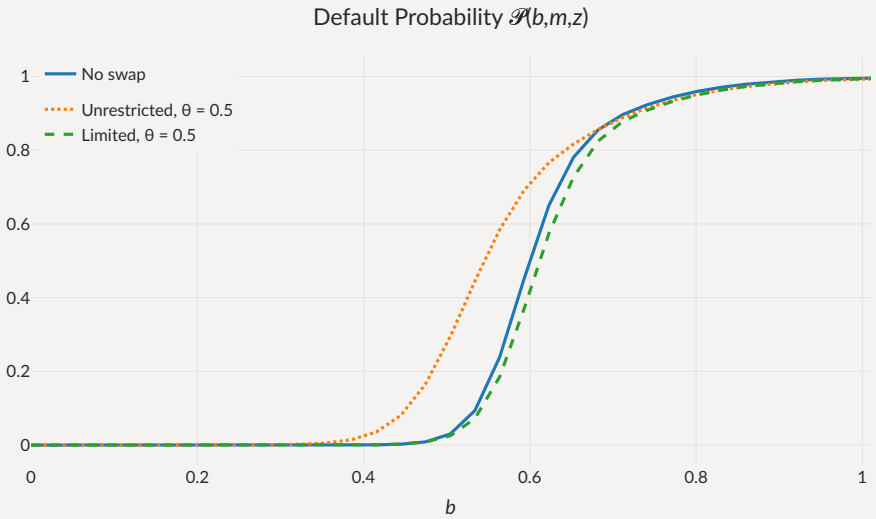


Debt Tolerance with Swaps

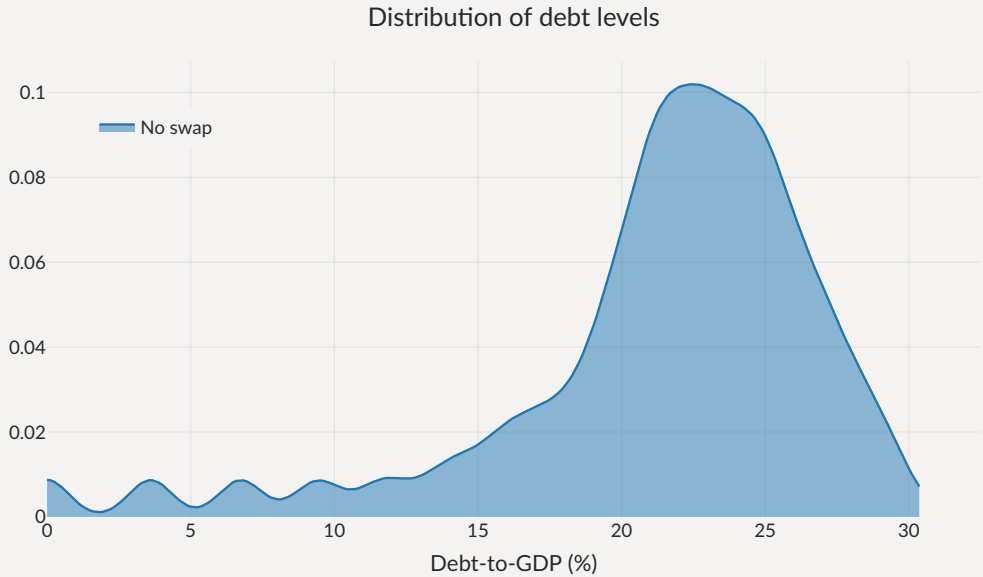
- **Unrestricted**: default more often, **Limited**: marginal impact



If **Limited** swaps help repay the debt,

Why are there more defaults with swaps?

Debt Levels with Swaps



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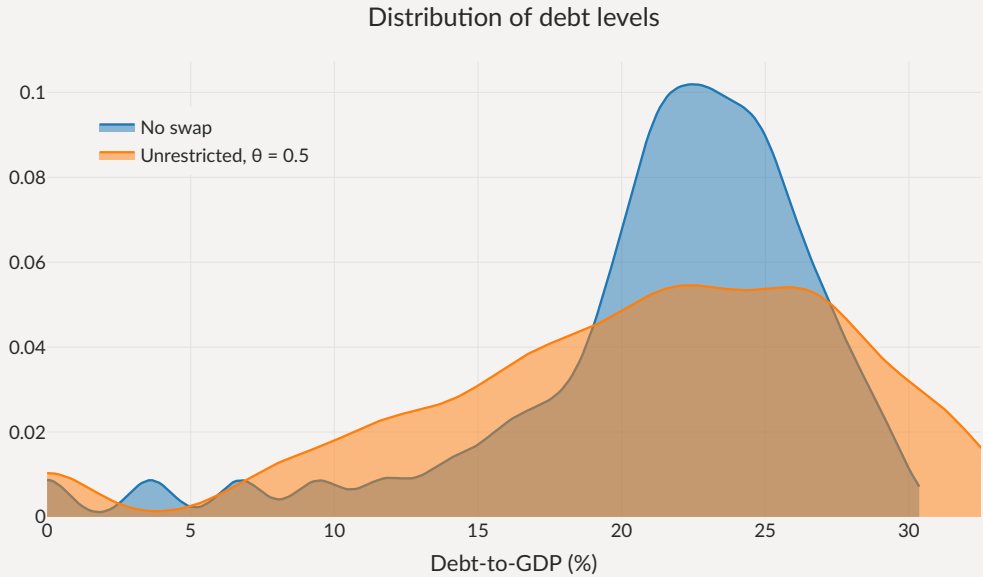

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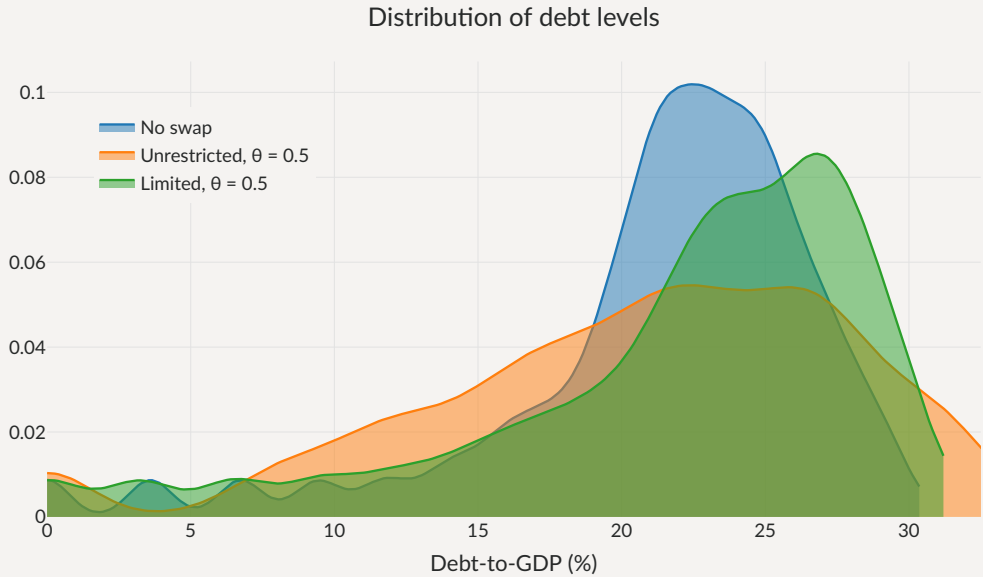

Relational overborrowing

Surplus

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

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- Low rates when $\mathbb{E}\left[h(b', m', z') - h(b', 0, z')\right] \gg 0$ (e.g. when $> m'$)
- High rates when $m - B(b', b, m, z) \gg 0$

- Lender surplus today $\mathbb{E}\left[h(b', m', z') - h(b', 0, z')\right]$ is high ($> m'$) when
  - high rates in the future
  - $m' \gg B(b'', b', m', z')$
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- Lender surplus today $\mathbb{E}\left[h(b', m', z') - h(b', 0, z')\right]$ is high $(> m')$ when
  - high rates in the future
  - $m' \gg B(b'', b', m', z')$
  - $q(b'', b', m', z')$ is low
  - $b' \gg 0$

Relational overborrowing

Surplus

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

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

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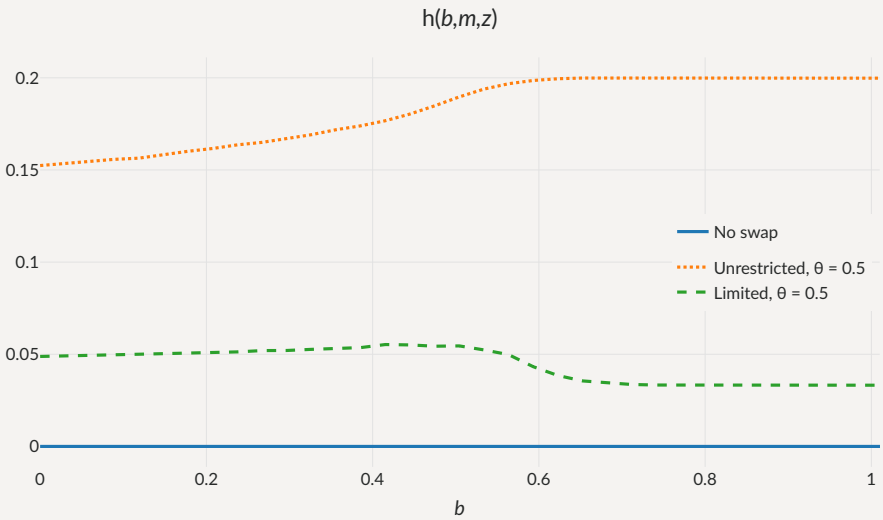
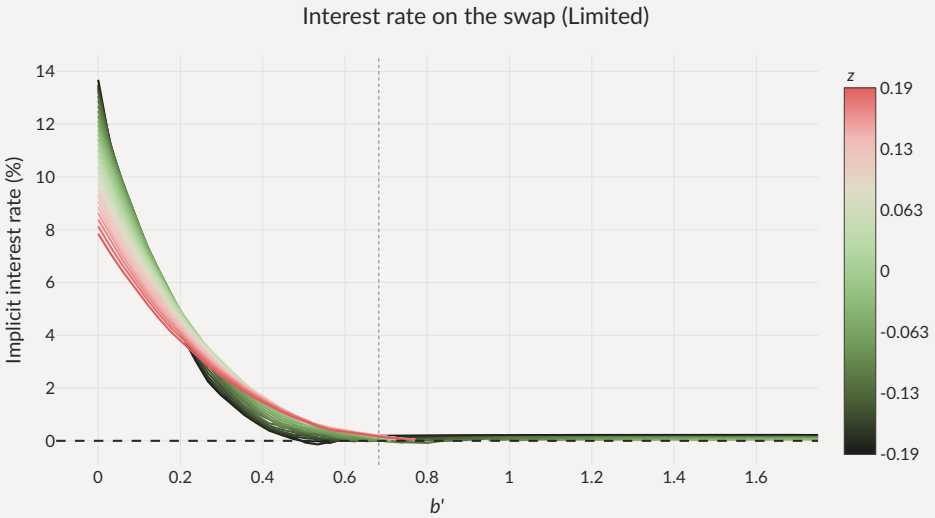
Monopolist's profits

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



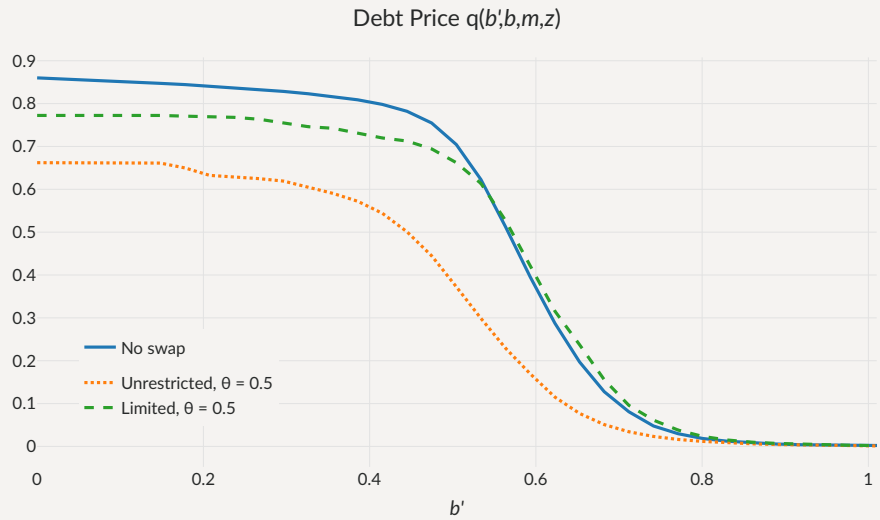
Risk-taking incentives

Surplus on swap requires spreads: relationship creates incentives for risk taking



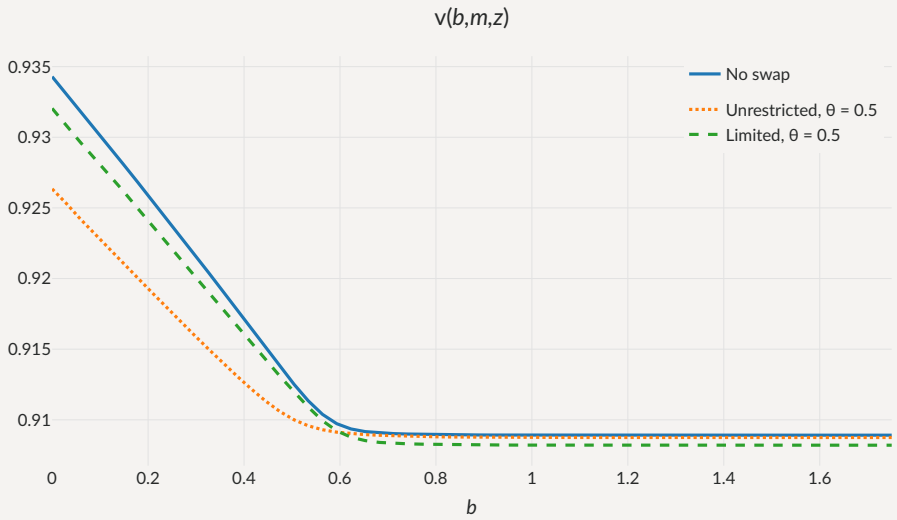
Debt Prices with Swaps

Equilibrium dynamics worsen prices: relational overborrowing similar to debt dilution



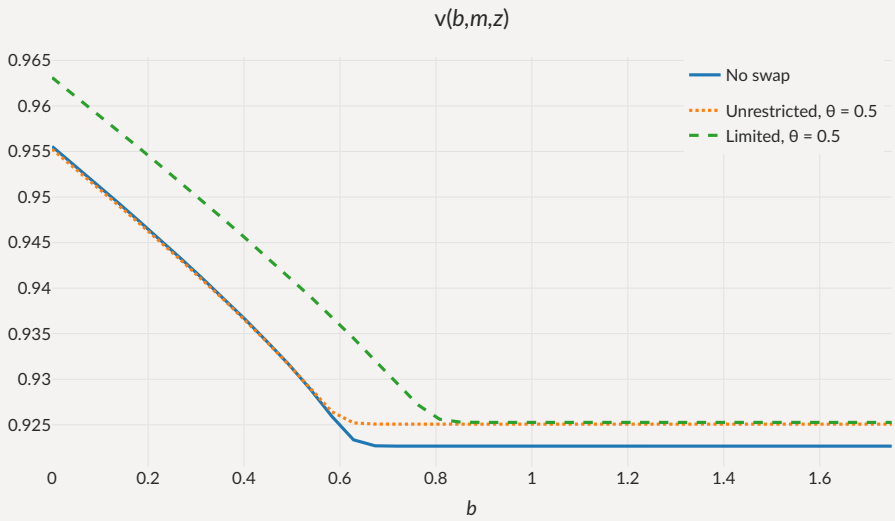
Welfare effects of swap lines

Limited $\gtrless$ 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	Limited, $\theta = 0.5$, 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	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

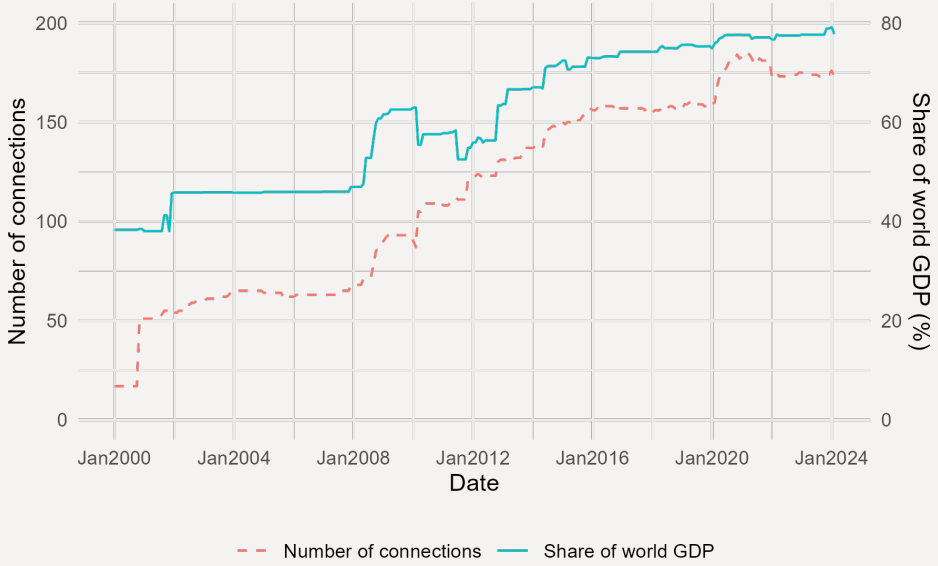
Concluding remarks

- Strong interaction between two markets for sovereign debt
  - … even if swaps are not used intensely on the equilibrium path
  - … three characteristics: short-term, renegotiated, difficult to default on
- Relational overborrowing
  - … unintended consequence of maximizing surplus over time
  - … arises as swap small relative to debt stock, large relative to debt service
- Large welfare effects, policy challenges
  - How to limit their use during defaults?
  - More gains from fiscal rules, state-contingent debt?
- Market power crucial in model
  - … how to discipline in model, how to affect in reality?

Scan to find the paper

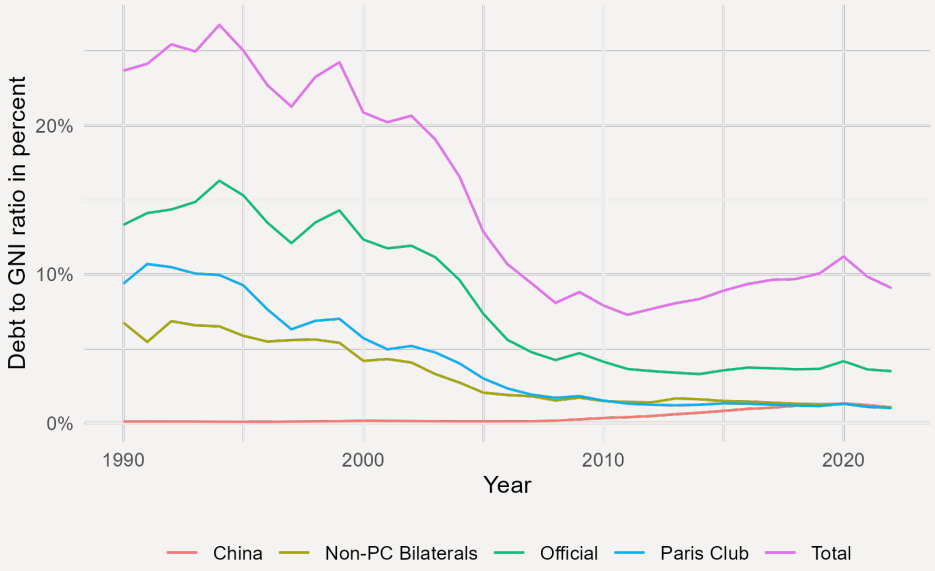
Motivating Evidence: Increase in `swaps connections'

Back



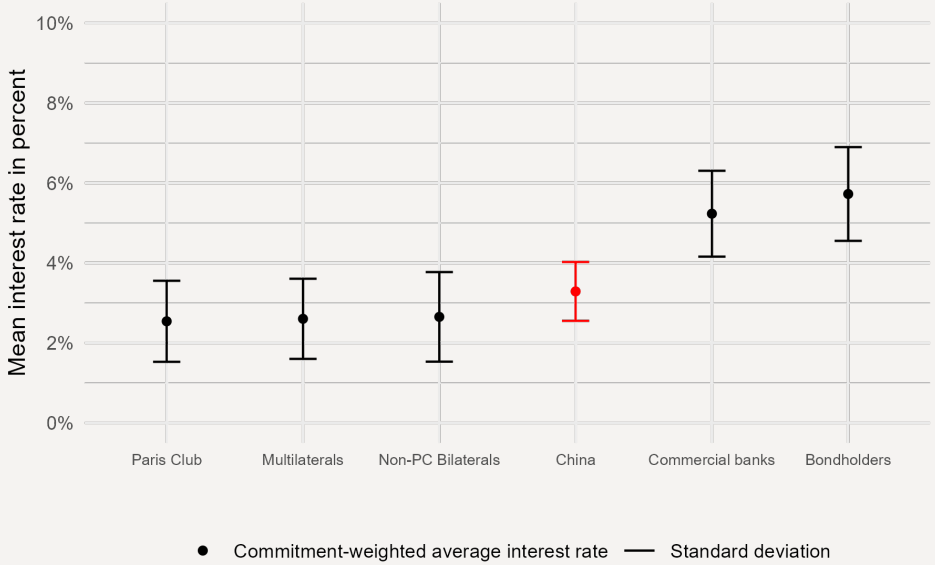
Motivating Evidence: External debt to GNI (weighted)

Back



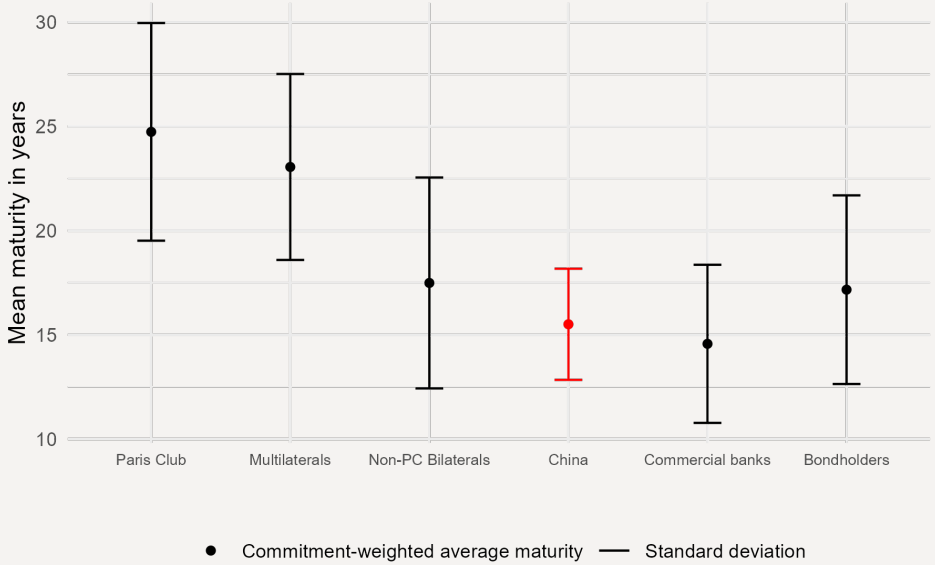
Motivating Evidence: Average Interest Rates

Back



Motivating Evidence: Average Maturity

Back



Motivating Evidence: Correl. btw bilateral rates and market rates

Back

$$r^{x}_{i,t} = r^{\text{Bond Mkt}}_{i,t} + \gamma_i + \epsilon_{i,t}, \qquad x \in \{\text{CHN, Paris Club}\}$$

Dep. Variable	Interest on loans from:	
	China	Paris Club
$r^{\text{Bond Mkt}}$	0.140**	0.380***
	(0.063)	(0.033)
No. countries	52	70
Observations	200	682
Country FEs	Yes	Yes
Adjusted R^2	0.825	0.777

*p<0.1; **p<0.05; ***p<0.01

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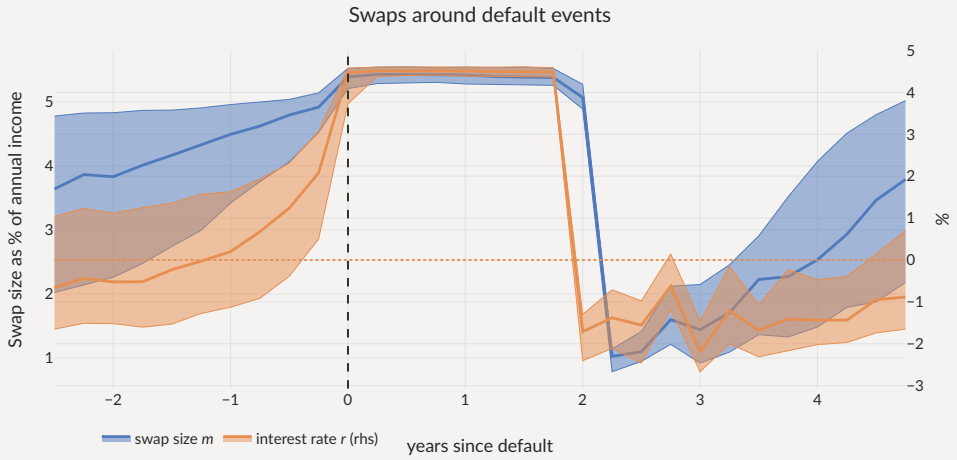
When is the Swap Used?

Back

- Further conditioning on default events lasting exactly two years



When is the Swap Used?

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