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

- 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 $\neq$ 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

The government of a small open economy borrows from a monopolist and from markets
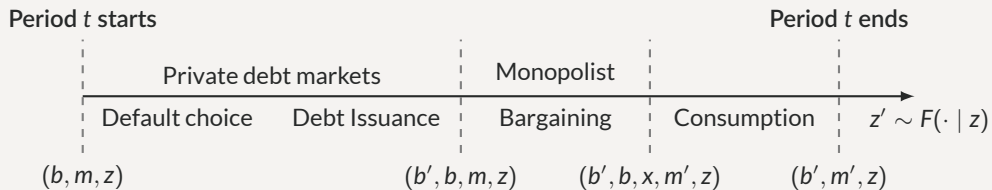
- Income $y(z_t)$ follows an AR(1) process in logs
    - … Only one good, representative risk-averse household, expected utility
- Renegotiate the swap m each period
    - … Involves a transfer x and a new loan size m'
    - … Swap is non-defaultable $\implies$ Repaying m is the natural threat point

- 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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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)

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

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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%

· Swaps shoot up before *and during* defaults

Swaps around default events

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

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Swaps around default events

Swap size as % of annual income (vertical axis left), *years since default* (horizontal axis), *%* (vertical axis right)

swap size m — interest rate r (rhs)

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Swaps around default events
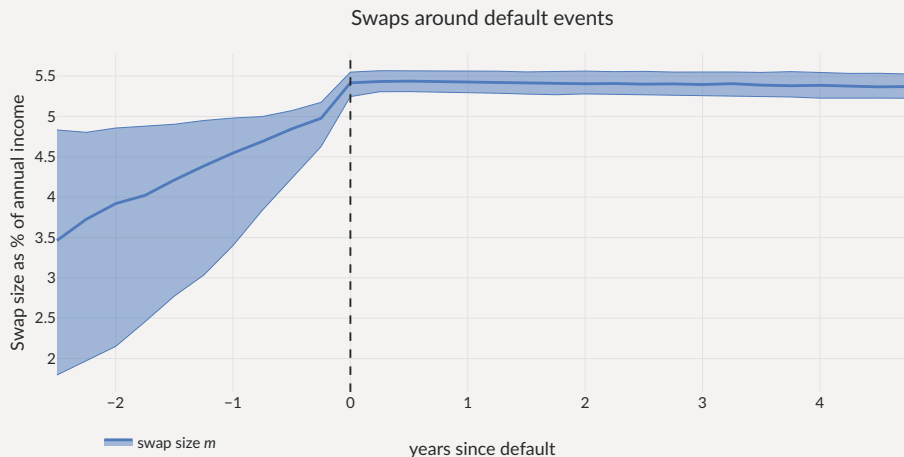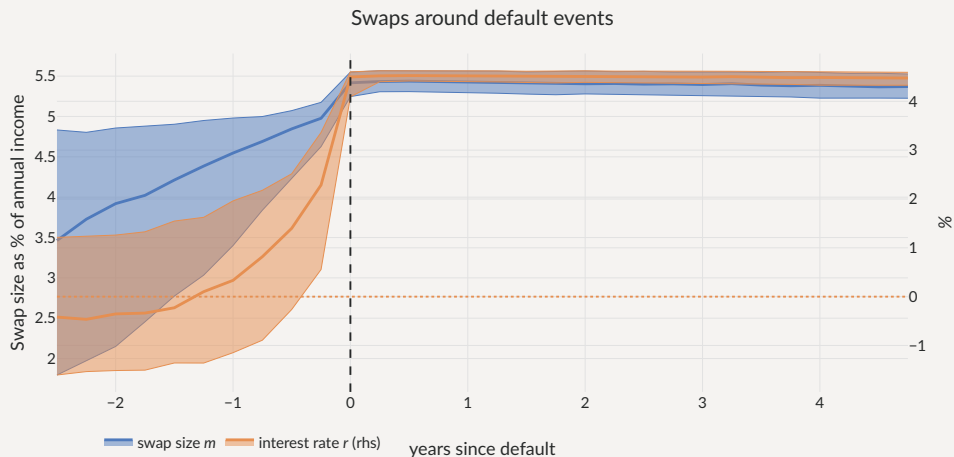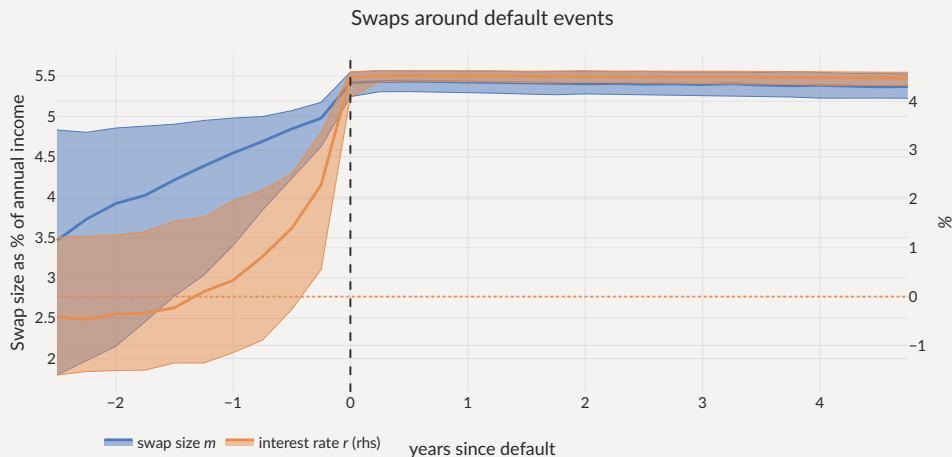
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Limiting swaps in default

- **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

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

Legend: No swap — Unrestricted, θ = 0.5

z

Default Barriers with Swaps

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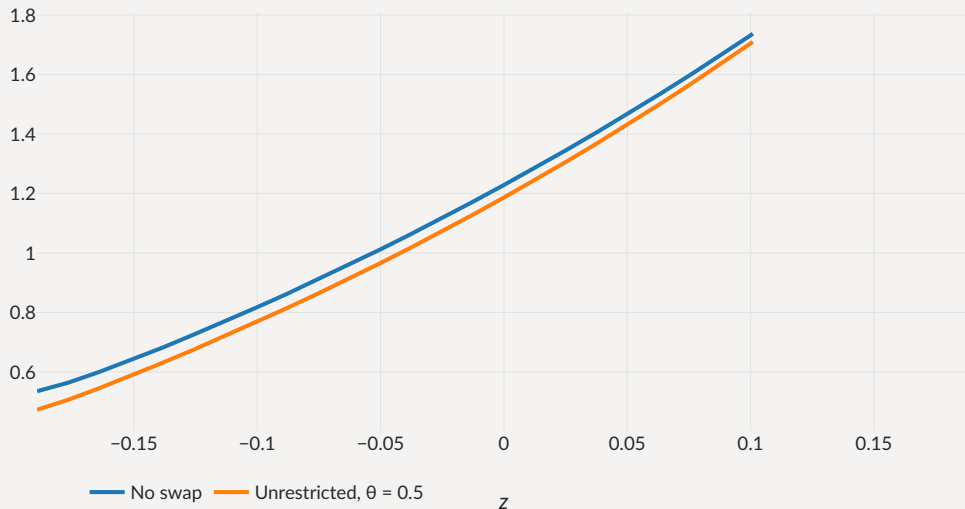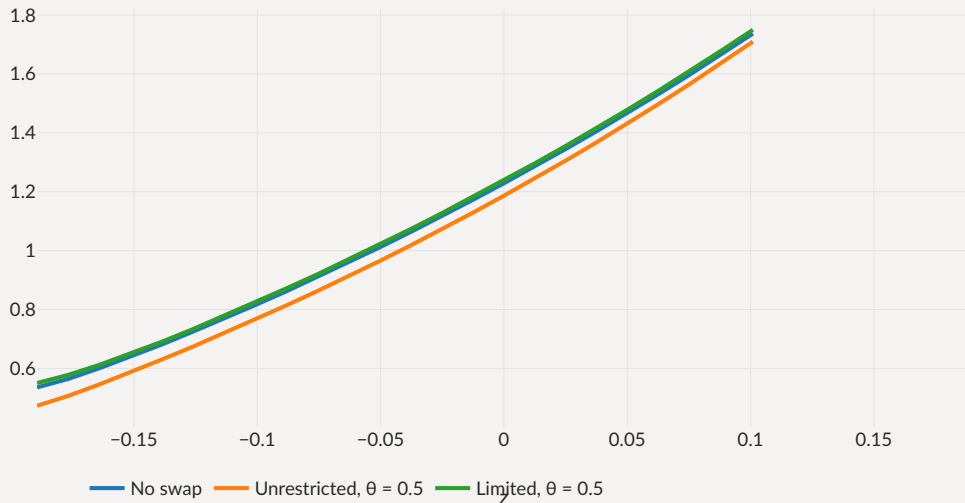
· **Unrestricted**: default more often,   **Limited**: marginal impact

Default Probability $\mathscr{P}(b,m,z)$
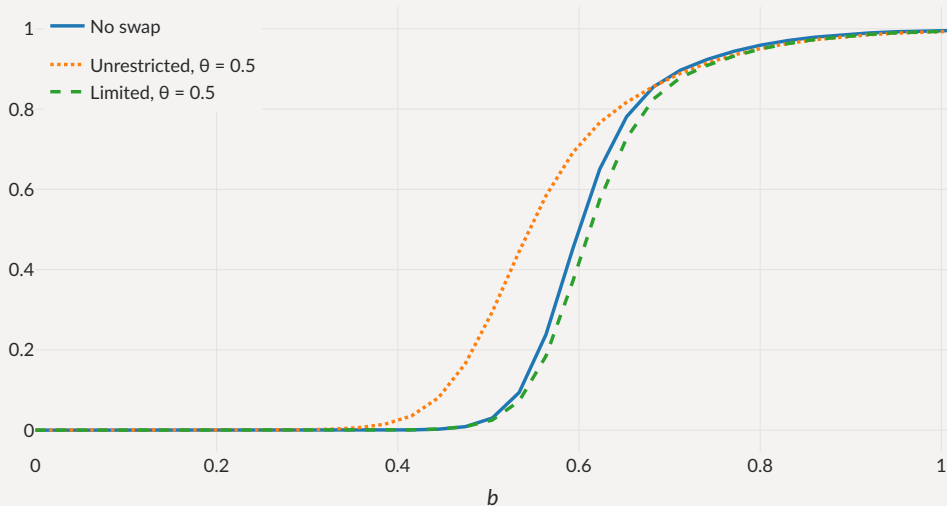
If **Limited** swaps help repay the debt,

Why are there more defaults with swaps?

Debt Levels with Swaps

Distribution of debt levels

Legend: No swap

X-axis: Debt-to-GDP (%)

Distribution of debt levels

Legend:
- No swap
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X-axis: Debt-to-GDP (%)

Distribution of debt levels

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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Monopolist's profits

Monopolist's profits increasing in debt (cond. on repayment) – surplus requires spreads
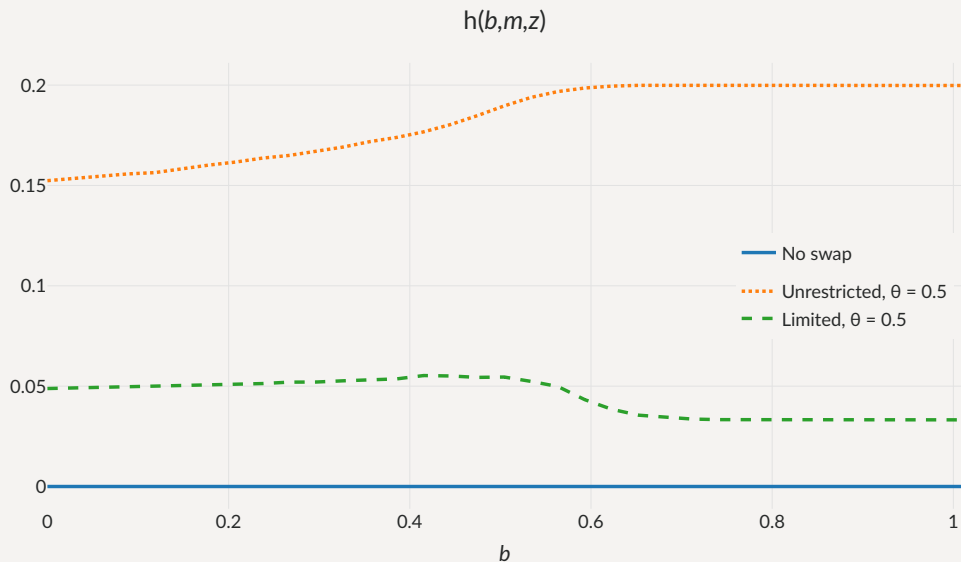
h(*b,m,z*)

Legend:
- No swap
- Unrestricted, θ = 0.5
- Limited, θ = 0.5

Risk-taking incentives

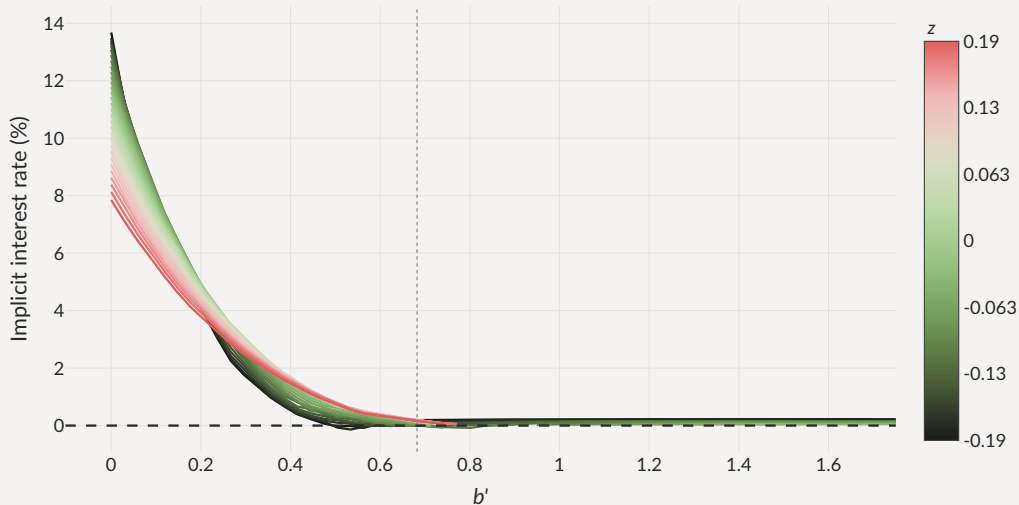Surplus on swap requires spreads: relationship creates incentives for risk taking

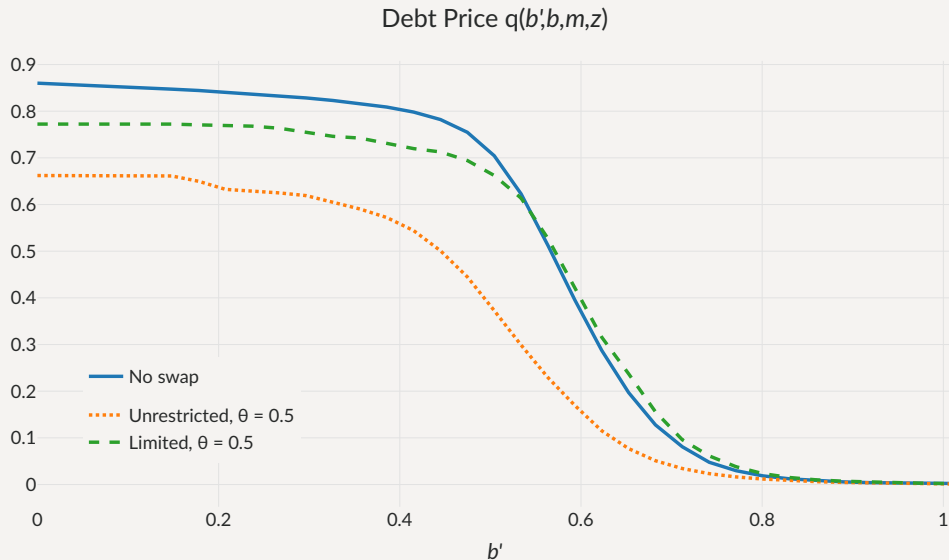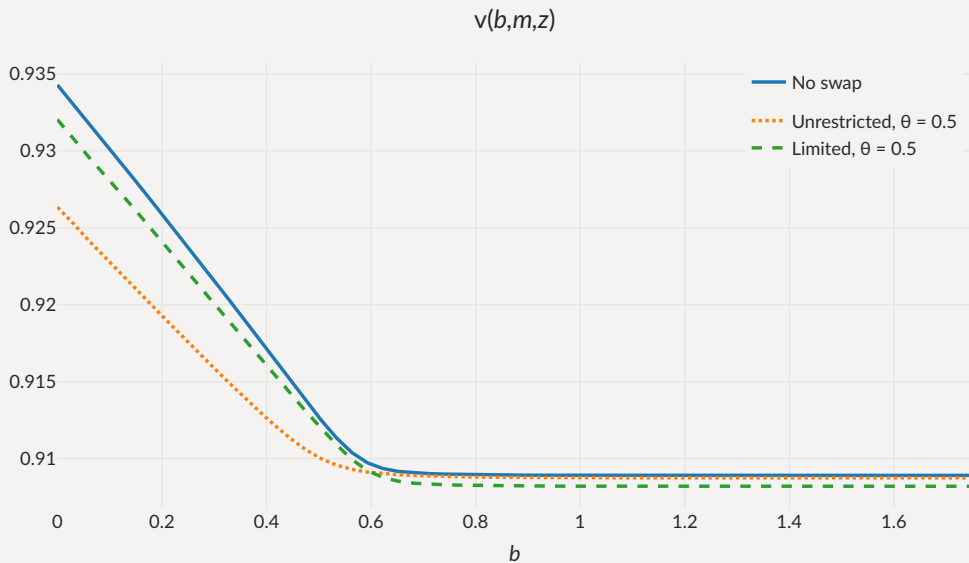### Interest rate on the swap (Unrestricted)
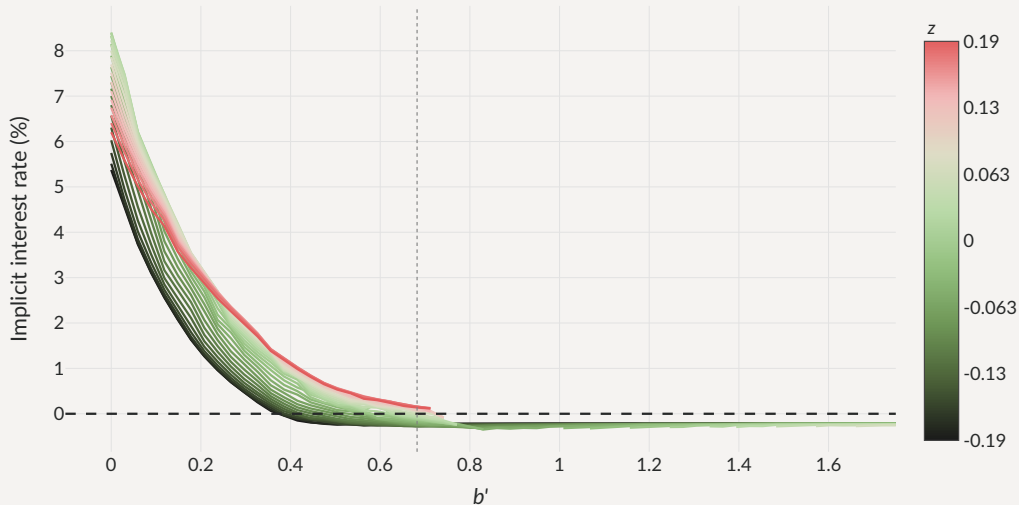
Risk-taking incentives

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

Interest rate on the swap (Limited)

Debt Prices with Swaps

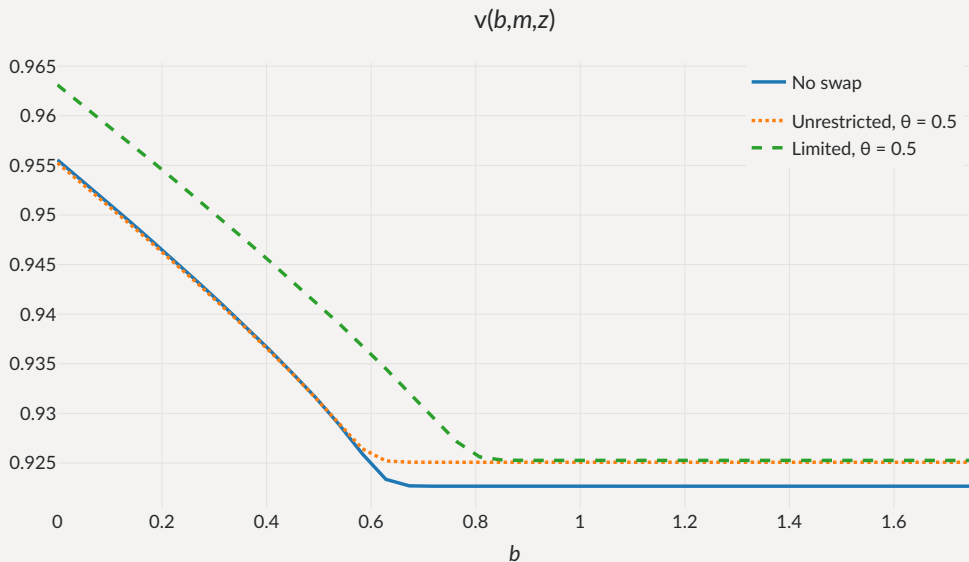Equilibrium dynamics worsen prices: relational overborrowing similar to debt dilution

Debt Price q(b',b,m,z)

- No swap
- Unrestricted, θ = 0.5
- Limited, θ = 0.5

b'

Welfare effects of swap lines

Limited $\succ$ Unrestricted, but...

v(*b,m,z*)

Welfare effects of swap lines — Short-term debt

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

v(*b,m,z*)

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

- 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
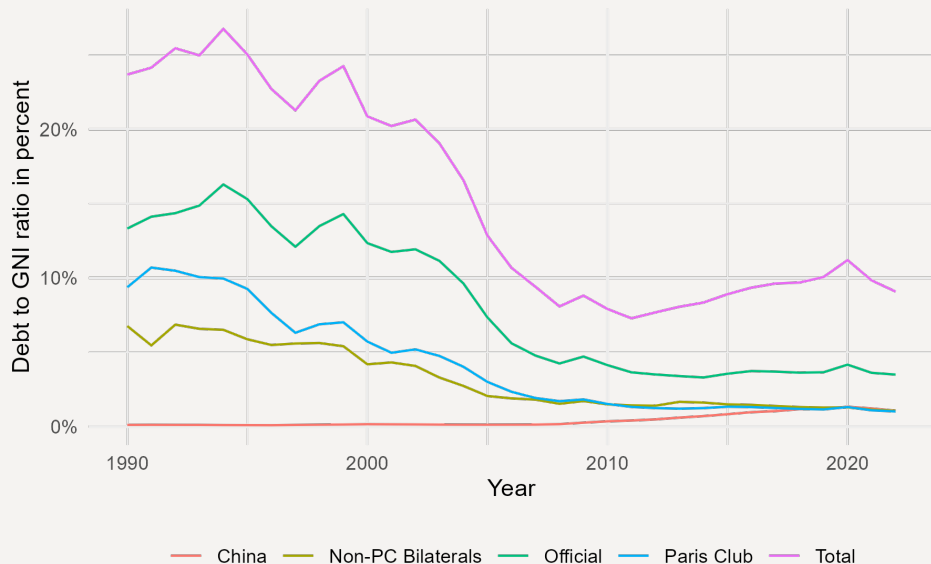 - … how to discipline in model, how to affect in reality?

Scan to find the paper

Motivating Evidence: Increase in `swaps connections'
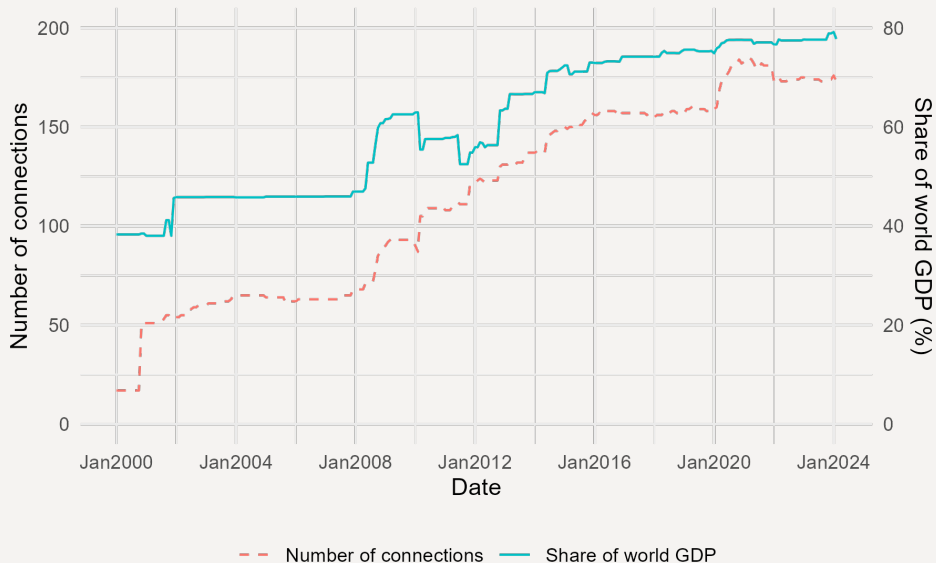
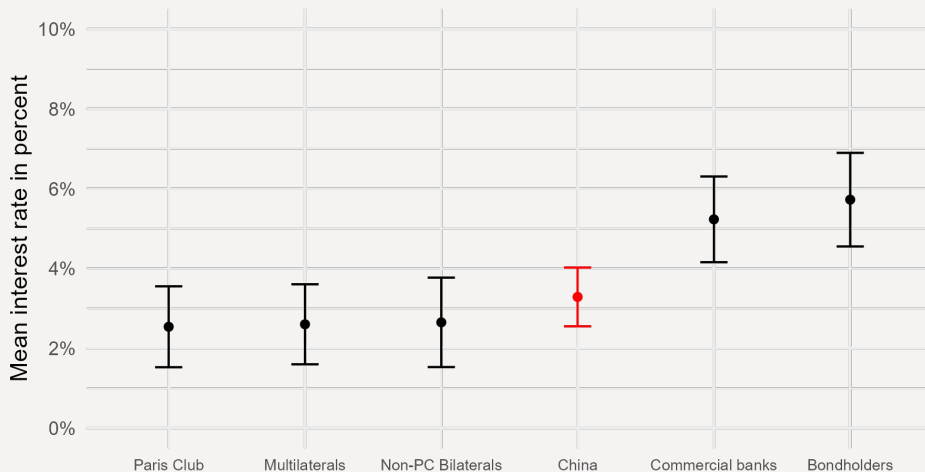Source: Bahaj, Fuchs, and Reis (2024)

Source: World Bank International Debt Statistics.

Motivating Evidence: Average Interest Rates

Mean interest rate in percent

● Commitment-weighted average interest rate — Standard deviation

Source: World Bank International Debt Statistics.
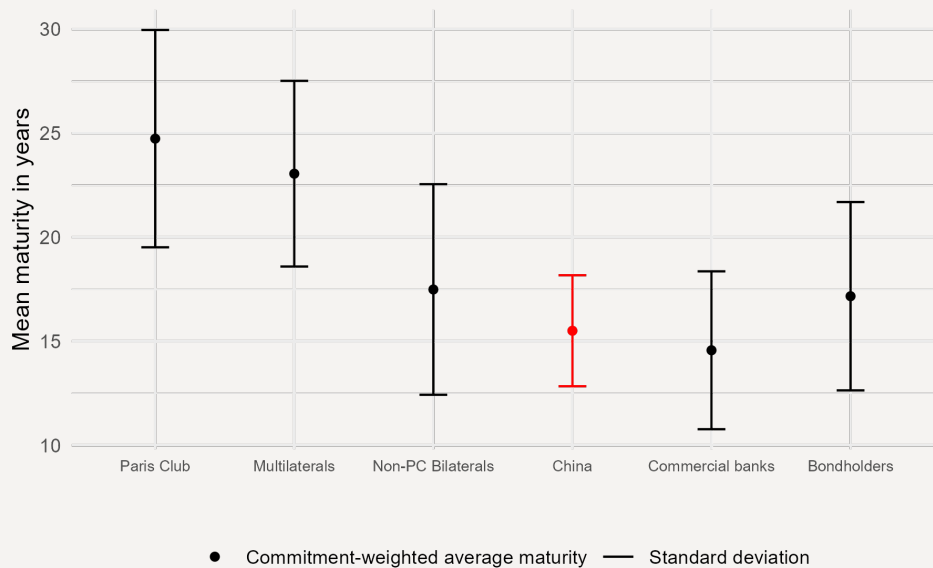
Source: World Bank International Debt Statistics.

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

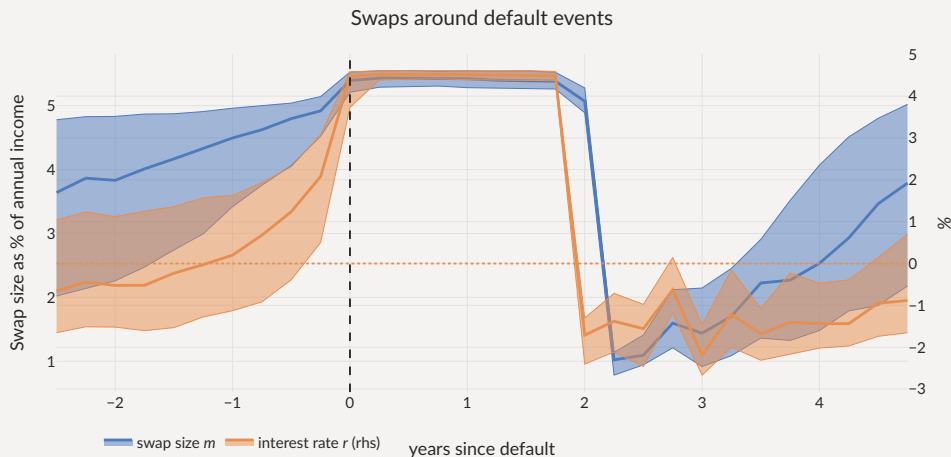| Dep. Variable	Interest on loans from:	
	China	Paris Club
$r^{\text{Bond Mkt}}$	0.140**	0.380***
	(0.063)	(0.033)
No. countries	52	70
Observations	200	682
Country FEs	Yes	Yes
Adjusted R^2	0.825	0.777

$^*p{<}0.1;\ ^{**}p{<}0.05;\ ^{***}p{<}0.01$

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- Further conditioning on default events lasting exactly two years

Swaps around default events

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

Swaps around default events