Official Sovereign Debt

Cristina Arellano Leonardo Barreto

FRB Minneapolis U of Minnesota

April 2024

Introduction

- Much of the emerging markets sovereign debt is from official lenders
  (Schlegl-Trebesch-Wright 2019)
  - Official lenders: bilateral governments and multilateral organizations
  - Flows in during disasters – wars, natural, financial (Horn-Trebesch-Reinhart 2020)
- Debt tends to increase during sovereign defaults
  (Arellano-MateosPlanas-RiosRull 2023, Benjamin-Wright 2009)

What is the role of official debt during sovereign defaults?

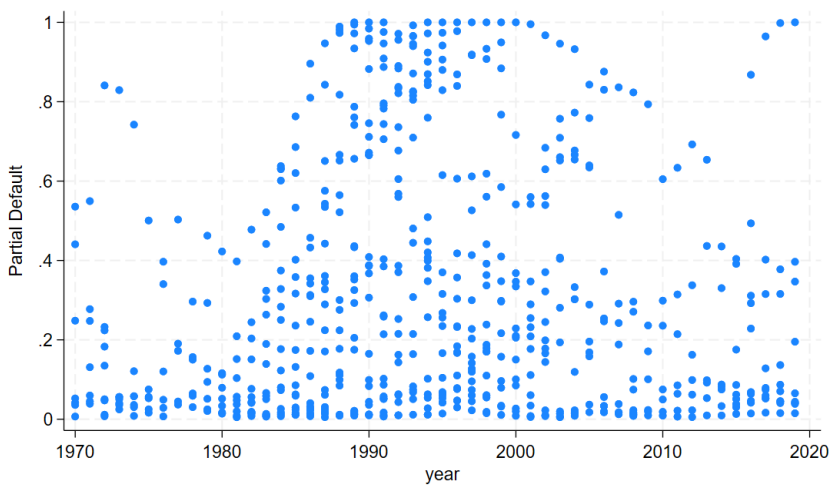
Can official debt be used to improve resolutions of sovereign defaults?

What we do

- Document patterns of official and private debt during defaults in emerging markets
  - Official debt flows in during sovereign defaults
- Framework of sovereign partial default with official and private debt
  - Official debt: longer maturity and more concessional (no acceleration clauses in default and lower recoveries)
  - Sovereign can default: default does not eliminate debt nor precludes borrowing
  - Longer maturity better for debt capacity, more concessional worse for debt capacity
  - Can rationalize much of the patterns
- Counterfactuals: voluntary swaps of private for official during defaults is welfare improving

Partial Default Over Time and Countries

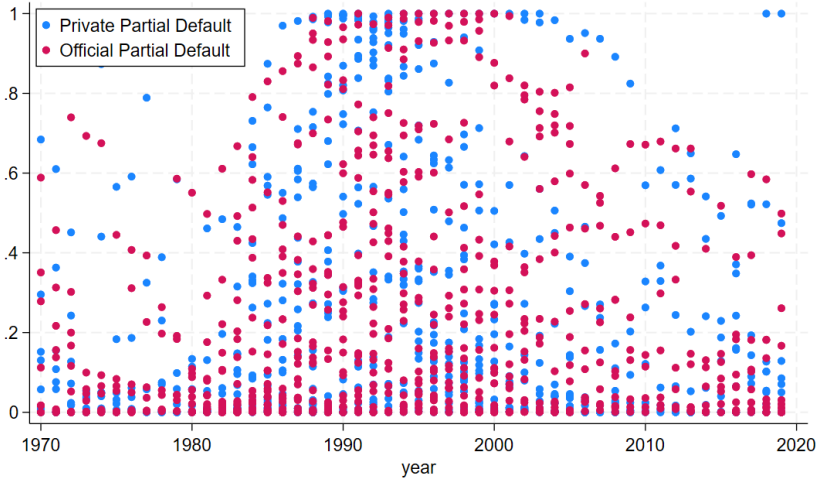
30 countries, 50 years



- Partial default (debt in arrears/ debt due) varies widely, mean 32% and st. dev. 24%

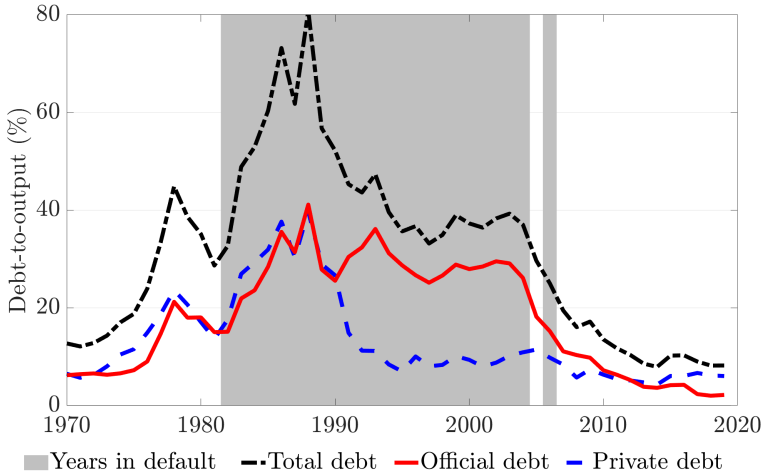
Partial Default: Private and Official

30 countries, 50 years



- Partial default on private and official debt correlated = 72 %

Official and Private Debt in Peru



- Official debt accounts for much of the debt at the end of the default episode

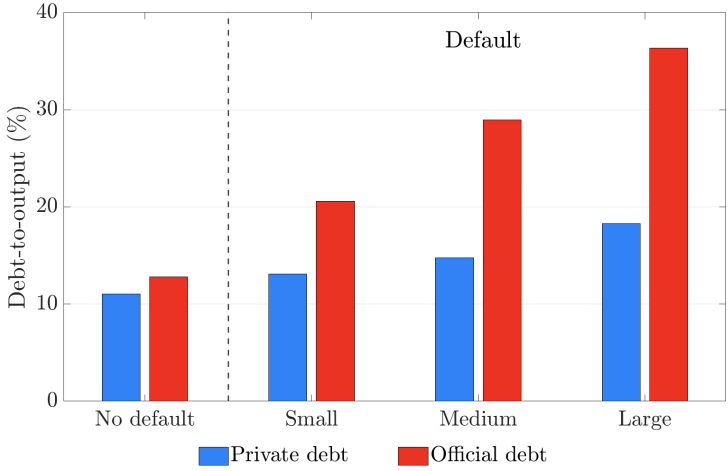
Debts during Defaults

30 countries, 50 years

	No default	Partial default
Partial default	0	32
Debt to output (in %)		
Total	23	44
Official	13	29
Private	11	15
Spreads	4	11
Output	2	-3

- Partial defaults associated with higher debt, spreads, and lower output
- Official debt more than doubles during defaults, private increases only moderately
- Default episodes last on average 10 years, haircuts 60% for official and 40% for private

Debts during Default



- Official debt flows in during defaults, more so in severe defaults

Model: Environment

- Small open economy with stochastic endowment z_t that borrows internationally
- Borrows long-term from official and private lenders with decay ϑ^i
- Each contract a_t^i has a coupon due and the sovereign can partially default on it

$$(1 - d_t^i)\ a_t^i(\vartheta^i + r)$$

- Partial default lowers the payment and accelerates default on μ^i of the legacy debt

$$a_{t+1}^i = (1 - \mu^i d_t^i)(1 - \vartheta^i)a_t^i\ + ...$$

(acceleration clauses act as shortening the duration upon default)

- A fraction of the defaulted coupons accumulate as future debts with factor κ^i

$$a_{t+1}^i = (1 - \mu^i d_t^i)(1 - \vartheta^i)a_t^i + \kappa^i d_t^i a_t^i\ + ...$$

(concessional loans have low κ^i)

- Official and private debt differ in: duration ϑ^i, acceleration μ^i, and concessional κ^i

Sovereign Borrower

- Preferences over consumption $E\sum_{t=0}^{\infty}\beta^t u(c_t)$
- Consumption is income y_t net of repayment of debt service and new borrowings ℓ^i

$$c_t = y_t - \sum_{i=f,b}(1-d_t^i)a_t^i(\vartheta^i + r) + \sum_{i=f,b} q_t^i \ell_t^i$$

- Laws of motion for debts: legacy debts, accumulation of defaulted debt, new borrowings

$$a_{t+1}^i = (1-\mu^i d_t^i)(1-\vartheta^i)a_t^i + \kappa^i d_t^i a_t^i + \ell_t^i$$

- During defaults income is lower: $y_t = z_t\psi(d_t^f, d_t^b, z_t) \leq z_t$
- Sovereign can always borrow, even with default, but prices q_t^i respond
- Bond prices compensate lenders for loss from default

Value and Bond Prices Functions

- Let $a^i = (f, b)$: $V(f, b, z) = \max_{\ell^f, \ell^b, d^f, d^b} \{u(c) + \beta E_z V(f', b', z')\}$

  subject to budget constraint, laws of motion for debts

- No separate problem in default, partial default a period by period decision

- Bond prices compensate lenders for default losses for each type of debt

$$q^i(f', b', z) = \frac{1}{1+r} \; E \left((1 - d^i(s'))(\vartheta^i + r) + \left[\kappa^i d^i(s') + (1 - \vartheta^i)(1 - \mu^i d^i(s')) \right] q^i(f'', b'', z') \right)$$

- Default next period + value of accumulated arrears + future coupons

Characterization of Partial Default

- Partial default on each type of debt $i \in \{f, b\}$ chosen to expand the budget

$$-y_{d^i}(z, d^f, d^b) = a^i[(r + \vartheta^i) - q^i(\kappa^i - \mu^i(1 - \vartheta^i))]$$

- LHS, marginal costs of partial default for output losses
- RHS, marginal benefits from expansion of resources from default: coupon savings $a^i(r + \vartheta^i)$ - net accumulated arrears evaluated at market prices $a^i q^i(\kappa^i - \mu^i(1 - \vartheta^i))$
- High debt a^i, low bond prices q^i increase default incentives

Simple Economy Characterization

- Show that longer-term debt gives greater debt capacity
- Different from standard full default theory: short-term debt associated more debt capacity (related to Aguiar-Amador-Werning-Hopenhayn 2019 and Arellano-Ramanarayanan 2012)

Simple Economy

- Consider $u(c) = c \geq 0$, $\vartheta^f = 0$, $\vartheta^b = 1$, $\kappa^i = \mu^i = 0$ for all i, and $(1 + r)\beta < 1$
- Absent default, constant output $z_t = z$. Falls to z_L if $d_{f,t} > 0$ or $d_{b,t} > 0$.
- Key differences with standard model: market access during default + partial default (default only on coupons)

Simple Economy Characterization

- Debt capacity depends on default incentives
- Default is binary: $d^b = d^f = \{0, 1\}$

  Consumption with repayment $\quad c = z - rf - (1+r)b + q^f(f', b')(f' - f) + q^b(f', b')b'.$

  Consumption with default $\quad c = z_L + q^f(f', b')(f' - f) + q^b(f', b')b'$

- Default: $d^b = d^f = 1 \qquad$ if $\qquad rf + (1+r)b \geq z - z_L$

Simple Economy Characterization

Only Private Loans

- Private loan that maximizes budget: $b'_{\max} = \frac{z - z_L}{1+r}$ with $q^b = 1$
- Consumption maximized at $t = 1$ with $c_1 = z - (1+r)b_1 + \frac{z - z_L}{1+r}$
- Committed to repay $(1+r)b'_{\max}$ the next period, but otherwise no further commitments

Only Official Loans

- Official loan maximizes budget $f'_{\max} = \frac{z - z_L}{r}$ and promises to pay $rf = z - z_L$ for $t \geq 2$
- Consumption maximized at $t = 1$ with $c_1 = z - rf_1 + (\frac{z - z_L}{r} - f_1)$
- Consumption committed to be low for $t \geq 2$, $c_t \leq z_L$

Lemma

Official loans expand the budget set more than private loans for $b \leq f$

$$q(f'_{max}, b' = 0)f'_{max} = \frac{z - z_L}{r} > q(f' = 0, b'_{max})b'_{max} = \frac{z - z_L}{1+r}.$$

Quantitative Analysis

- Parameterize model to panel data of official and private debt and partial default
  - Default costs estimated from auxiliary statistical model using data
  - Model parameters estimated using moment-matching exercise
- Evaluate performance for debts during partial defaults
- Counterfactuals and welfare:
  - Official debt increases welfare for highly indebted economies
  - Room for voluntary swaps of private for official during defaults

Default Cost Estimation

- Assume default cost function symmetric across both debts $y = z\, f(d_b) f(d_f)$
- Estimate log linear version $\hat{y} = \hat{z} - \alpha d_b - \alpha d_f$
- We have data on y, d_f, d_b, but z is unobservable, use Kalman Filter to recover z
- Auxiliary state space model with restrictions from theory estimated country by country with MLE

$$x_{t+1} = Ax_t + \Sigma\varepsilon_{t+1}$$

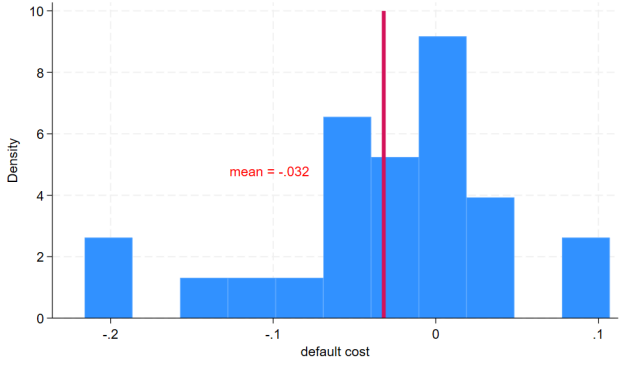
$$s_{t+1} = Gx_t$$

$$x = \begin{bmatrix} z & d_b & d_f & b+f \end{bmatrix}'$$

$$s = \begin{bmatrix} y & d_b & d_f & b+f \end{bmatrix}'$$

$$G_1 = \begin{bmatrix} 1 & -\alpha & -\alpha & 0 \end{bmatrix}$$

Mean estimated α= -3.2%



Parameter Settings

- Estimate 7 parameters to match 10 moments: properties of debts, partial default, official/private debt service to debt, and estimated α
- Default cost function: symmetric, convex in default, fixed cost

$$y = z\,(1 - \gamma\, d_b^2)(1 - \gamma d_f^2)(1 - \phi \mathcal{I}_{d,\hat{z}>0})$$

- Other parameters set from literature+data: risk free rate $r = 0.02$, risk aversion coefficient $\sigma = 2$, endowment process: $\rho = 0.87$, $\sigma_z = 0.05$

Debt contracts	
Decay parameters	$\vartheta_f = 0.10$, $\vartheta_b = 0.20$
Net recovery factor	$\hat{\kappa}^f = 0.15$, $\hat{\kappa}^b = 0.34$
Default Costs	
Based on partial default	$\gamma = 0.06$
Asymmetric endowment	$\phi = 1.2$
Discount factor	$\beta = 0.96$

Official debt: 9 year duration

Private debt: 5 year duration

Moment Matching Exercise

	Data	Model
Total Debt	32	34
Official Debt	20	23
Private Debt	13	12
Partial Default	32	33
Official debt service/debt	12	12
Private debt service/debt	21	21
sd(Total Debt)	18	17
sd(Official Debt)	12	11
sd(Private Debt)	8	6
Estimated α	3	2

7 parameters to target 10 moments

$$\text{Partial default} = \frac{d^b b(\vartheta^b + r) + d^f f(\vartheta^f + r)}{b(\vartheta^b + r) + f(\vartheta^f + r)}$$

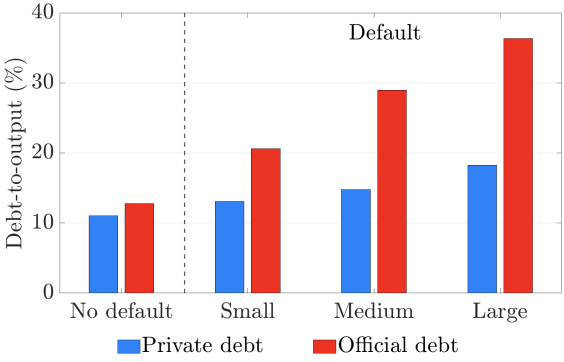
- Partial default and α inform default costs
- Debt service/debt inform debt duration
- Mean and volatility of official and private debts inform recoveries and durations
- Means and volatility of total debt, β

Moments Conditional on Partial Default

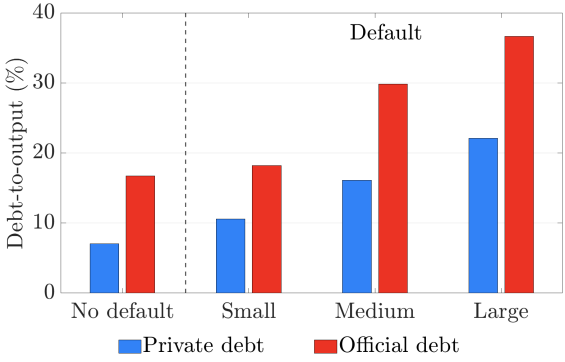
	Data		Model	
	No default	Partial default	No default	Partial default
Debt to output	23	44	24	45
Official	13	29	17	29
Private	11	15	7	16
Private spreads	4	8	1	5
Partial default	0	32	0	33

- During defaults, debt increases and spreads rise
- Official debt increases by more
- Default episodes on average 7 years in model vs 10 in data
- Match haircuts from official and private debt, 58% and 40%, similar for model and data

Debts during Default



Data



Model

- Official debt flows in during defaults, more so in severe defaults in model and data

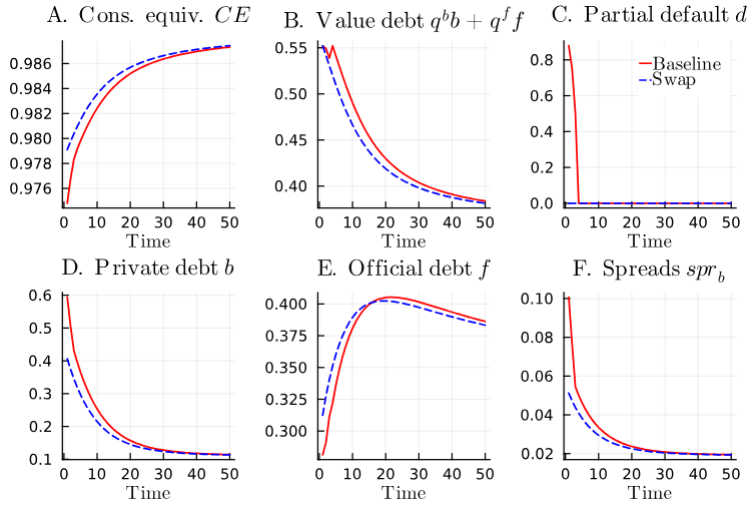
Voluntary Swaps during Defaults

- Official loans better for indebted economies, and official debt grows during defaults
- In baseline model each lender contracts independently
- Room for even more improvement with swaps of private for official

  (related to Aguiar-Amador (2024))
- Consider a state $\{b, f, y\}$. A candidate voluntary swap to $\{\hat{b}, \hat{f}, y\}$ is feasible if

Country Welfare	$V(\hat{b}, \hat{f}, y) \geq V(b, f, y)$
Value of Total Debt	$q^b(\hat{b}, \hat{f}, y)\hat{b} + q^f(\hat{b}, \hat{f}, y)\hat{f} \geq q^b(b, f, y)b + q^f(b, f, y)f$

Voluntary Swaps during Defaults



- In states with high private debt relative to official, feasible swaps more likely
- Rationalizes multilateral (IMF, World Bank) involvement during defaults

Role of Official Debt

	Baseline Model	Official=Private
Official Debt	23	13
Private Debt	12	13
Private Spreads	3.2	3.5
Consumption st. dev	0.96	0.97
Welfare (CE, %)		
No debt (mean $\tilde{y}$)	0.00	0.003
Mean debts b, f (mean $\tilde{y}$)	0.00	-0.078
High debts b, f (mean $\tilde{y}$)	0.00	-0.159
No debt (low $\tilde{y}$)	0.00	0.009

- Official debt reduces private indebtedness and private spreads
- Official debt reduces consumption volatility
- Official debt welfare enhancing when higher debt

Counterfactual Official Debt

- Official debt is best with long maturity + less concessional (except when very high debt..)

	Baseline	Official Debt		
		Equal to Private	Short+less concess.	Long+less concess.
Official debt	23	13	8	44
Private debt	12	13	14	11
Partial default	33	28	24	43
Spreads	3.2	3.5	3.7	3.0
Consumption st. dev	0.96	0.97	0.98	0.93
Welfare (CE, %)				
No debt (mean $\tilde{y}$)	0.00	0.003	0.022	0.072
Mean debts b, f (mean $\tilde{y}$)	0.00	-0.078	-0.126	0.077
High debts b, f (mean $\tilde{y}$)	0.00	-0.159	-0.308	0.068
No debt (low $\tilde{y}$)	0.00	0.009	0.055	0.137

Conclusion

- Official loans support economies during sovereign defaults
- With partial default, longer official debt gives greater debt capacity
- Model rationalizes the rising official debt during defaults
- Room for swaps of private for official during defaults (multilateral loans make sense)