Chapter 24: Sovereign Debt and Default Risk

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Outline

Introduction

Removing Full Commitment

The bulk of the textbook assumes **full commitment** to repay debt. This chapter removes that assumption:

- Interest rates become **endogenous**, rising with the perceived default probability
- Debt-sustainability calculations based on constant risk-free rates (Chapter 15) no longer hold
- Sustainability depends on the **incentives and constraints** shaping repayment decisions

Removing Full Commitment (cont.)

Historical scope: Latin American debt crises of the 1980s (high world rates, collapsing commodity prices, over-borrowing); but also the **Eurozone crisis** of 2011–2012 (Greece, Portugal, Spain, Ireland) — the mechanisms operate across emerging *and* advanced economies.

Business-cycle motivation: emerging markets show consumption *more volatile* than output and strongly **procyclical borrowing** (borrow in booms, repay in recessions) — contrary to consumption smoothing. A leading explanation: **credit access shrinks in downturns**. This chapter builds the canonical model in which sovereign risk shapes borrowing opportunities (Eaton-Gersovitz, Aguiar-Gopinath, Arellano).

Empirical Patterns

Excess Volatility of Consumption

Aguiar-Gopinath (2007), Neumeyer-Perri (2005): consumption is **less** volatile than income in small open *advanced* economies, but **more** volatile than income in *emerging* economies (cf. Table 23.1). Investment behavior is similar across groups $\Rightarrow$ the excess volatility is accounted for by **external borrowing**: trade deficits in booms, surpluses in recessions (countercyclical trade balance).

Excess Volatility of Consumption (cont.)

What rationalizes this? Borrowing opportunities. Consider the budget constraint:

$$C_{t+1} + K_{t+1} = Y_t + K_t(1-d) + q(Y_t, \eta_t, B_{t+1})B_{t+1} - B_t$$

where B is net external liabilities, q the debt issuance price, η a price shock.

A price q that **increases with income** and **decreases with debt** is key to generating the countercyclical trade balance and procyclical borrowing (Alvarez-Parra et al.; García-Cicco et al.; Neumeyer-Perri).

Sovereign Defaults: Definitions and Facts

Default event (rating agencies): any restructuring offer with terms *less favorable* than the original — legal defaults *and* pre-emptive restructurings (38% of 1978–2010 restructurings were pre-emptive; Asonuma-Trebesch).

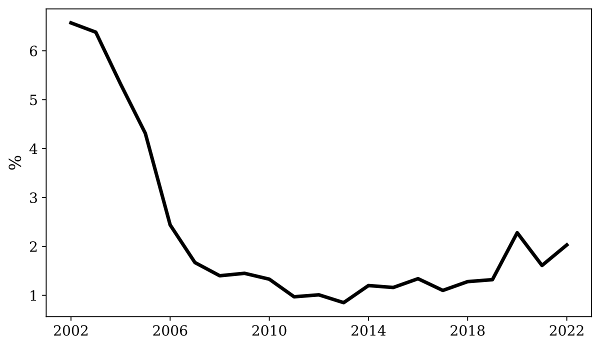
Present-value haircut:

$$\text{Haircut} = 1 - \frac{\sum_{t=1}^{\infty} \frac{x_t^{Post}}{(1+i)^t}}{\sum_{t=1}^{\infty} \frac{x_t^{Pre}}{(1+i)^t}}$$

with i the post-restructuring yield. Average haircut: **37%** (Cruces-Trebesch). **201** defaults to private creditors, 1970–2020.

Sovereign Defaults: Definitions and Facts (cont.)

Emerging economies' public debt in default, % of combined GDP, 2002–2022 — about 2% at end-2022



Sovereign Defaults: Definitions and Facts (cont.)

Three facts (Aguiar-Amador): (i) defaults occur in **bad times** (60%+ when GDP below trend); (ii) followed by years of **negotiations** (average 3.2 years; pre-emptive 12 months vs. post-default 60 months); (iii) end with a **restructuring** exchanging old for new instruments.

Sovereign Spreads (Table 24.1)

Sovereign spread yield (EMBI, basis points), Q1 1994–Q4 2019, selected countries

	$\mathbb{E}$(Spread)	σ(Spread)	ρ(Spread, GDP)
Argentina	732	377	-0.5
Brazil	514	380	-0.2
Ecuador	1021	647	-0.6
Korea	162	116	-0.7
Mexico	318	221	-0.4
Slovak Republic	57	36	-0.6
Turkey	385	199	-0.5
Average Emerging	**362**	**224**	-0.4

Sovereign Spreads (Table 24.1) (cont.)

The premium over US Treasuries is **large, volatile, and countercyclical** — rising when GDP is below trend. The quantitative model below makes the spread endogenous with exactly these properties.

Determinants and Costs of Sovereign Risk

Fixed-effects panel regression $\log(\text{Spread})_{it} = \alpha + \beta X_{it} + \delta_i + \eta_{it}$, 33 emerging markets, 1994–2018:

Panel regressions

	Coeff.	SE
Public debt to GDP	0.020	(0.004)
Real GDP growth	-0.042	(0.006)
Reserves to GDP	-0.033	(0.017)
Net gov borrowing to GDP	0.020	(0.014)
VIX	0.034	(0.003)

$(R^2 = 0.77$, $N = 523)$

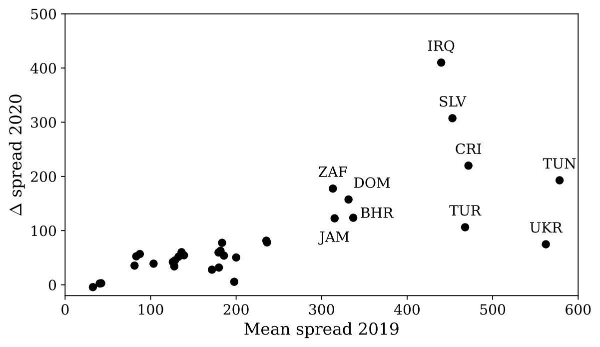
Determinants and Costs of Sovereign Risk (cont.)

Spreads rise with **debt** and **global risk** (VIX); fall with **growth** and **reserves**.

Costs: a 100bp spread increase raises firms' borrowing costs by 64bp; without the 2012 spread spike, Italian GDP would have fallen 3.2% instead of 6.4% (Arellano-Bai-Bocola).

Spreads After COVID-19

EMBI spread increase after COVID-19 against the pre-COVID spread



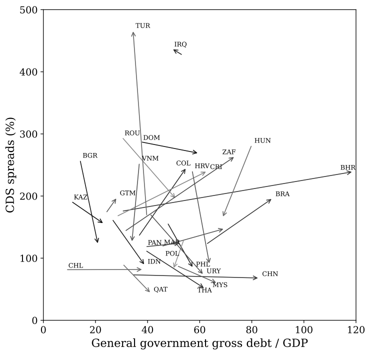
Riskier countries suffered larger deteriorations; countries below 300bp saw rises under 100bp.

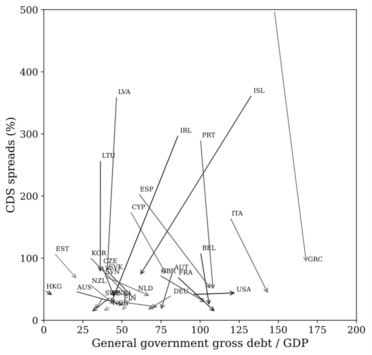
Debt Intolerance

Debt intolerance: the mapping from public debt to default risk — varying widely across countries and over time (Reinhart-Rogoff-Savastano).

Debt Intolerance (cont.)

CDS spreads vs. public-debt ratios, emerging and advanced economies, arrows from 2010 to 2023



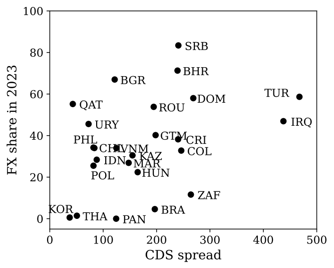


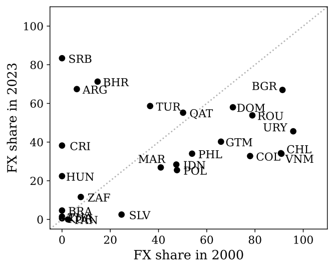
Debt Intolerance (cont.)

- **Heterogeneity**: Thailand/Uruguay carry 50%+ debt with modest risk; Turkey shows substantial risk at lower ratios
- Some accumulate debt without more risk (China, Thailand); others see risk rise (Brazil)
- The mapping **shifts over time**: Portugal, Greece, Latvia de-risked 2010–2023 without major debt reductions; pre-2008, markets priced near-zero Eurozone risk

Original sin (Eichengreen-Hausmann): difficulty issuing debt in own currency; the exchange rate depreciates in bad times, inflating the foreign-currency burden.

FX debt share vs. CDS spread (positive association); FX share 2023 vs. 2000 (many countries reduced it)



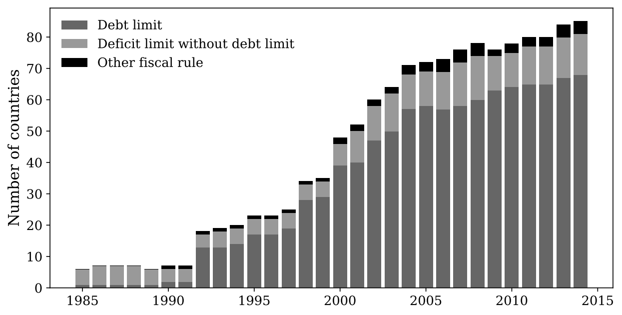


Remedies

Sovereign debt lacks a **bankruptcy protocol**; sovereign immunity limits collateral pledging and court enforcement. Credibility devices: issuing under foreign jurisdictions; acceleration and cross-default clauses.

Remedies (cont.)

Number of countries with fiscal rules, 1985–2019 — rising steeply; most include debt limits



Remedies (cont.)

Challenges for debt-limit rules: cross-country and time variation in debt intolerance makes a *common* limit (e.g., Maastricht) too tight for low-intolerance countries and ineffective for high-intolerance ones. Alternatives: fiscal *standards* guided by risk analysis (Blanchard-Leandro-Zettelmeyer), **spread-anchored** rules (Hatchondo-Martinez-Roch), interest-payment anchors (Furman-Summers).

Remedies (cont.)

Low-income countries: official, often concessional debt dominates; restructurings rarely involve face-value write-offs; rates do not reflect default risk; China's growing role as lender (Belt and Road).

A Stylized Two-Period Default Model

Environment

Small open economy (Eaton-Gersovitz tradition): a benevolent government maximizes

$$u(C_1) + \beta \mathbb{E} u(C_2)$$

with $u' > 0$, $u'' < 0$, Inada. Endowments: $Y_1 = 0$ (forcing borrowing), Y_2 stochastic with cdf F, density $f > 0$.

Environment (cont.)

- Bonds promise one unit at $t = 2$; bought by **risk-neutral competitive** foreign investors with discount rate 1 (zero required net return)
- **No commitment**: the government can default in period 2
- Default cost: lose a fraction $\phi > 0$ of Y_2 — without a cost, no debt could exist; with no benefit to default, no defaults would occur
- **Markov-Perfect equilibrium**: the period-1 government takes the default strategy of its period-2 self as given

Period 2: The Default Decision

Consumption given debt B_2 and default decision $D_2 \in \{0, 1\}$:

$$C_2 = \begin{cases} Y_2 - B_2 & \text{if } D_2 = 0 \\ Y_2 - \phi Y_2 & \text{if } D_2 = 1 \end{cases}$$

Period 2: The Default Decision (cont.)

The government maximizes $u(C_2)$, so it defaults iff the default cost is smaller than the repayment:

$$\hat{D}_2(B_2, Y_2) = \begin{cases} 1 & \text{if } Y_2 < B_2/\phi \\ 0 & \text{otherwise} \end{cases}$$

Defaults occur in bad times (low Y_2) and are more likely with more debt — exactly as in the data.

Equilibrium consumption: $\hat{C}_2(B_2, Y_2) = Y_2 - \hat{D}_2 \phi Y_2 - (1 - \hat{D}_2) B_2$.

Period 1: Bond Price and Borrowing

Competitive risk-neutral pricing: the price equals the expected recovery per bond:

$$q_1(B_2) = \mathbb{E}[1 - \hat{D}_2(B_2)] = \Pr(Y_2 \geq B_2/\phi) = 1 - F(B_2/\phi)$$

The bond price **decreases with issuance**: limited commitment endogenously restricts borrowing.

Period 1: Bond Price and Borrowing (cont.)

The government's problem:

$$\max_{B_2 \geq 0} u(C_1) + \beta \mathbb{E}\left[u(\hat{C}_2(B_2, Y_2))\right] \quad \text{s.t.} \quad C_1 = B_2 q_1(B_2)$$

Euler equation with default:

$$u'(C_1(B_2))\left[q_1(B_2) + B_2 \frac{dq_1(B_2)}{dB_2}\right]$$
$$= \beta \mathbb{E}\left[u'(\hat{C}_2(B_2, Y_2))\left(1 - \hat{D}_2(B_2, Y_2)\right)\right]$$

Two differences vs. no-default models: (i) the marginal revenue includes $B_2 dq_1/dB_2 < 0$ — an extra bond raises the default probability on *all* bonds; (ii) the repayment cost on the right is weighted by repayment states only (default wipes out the whole stock).

The Quantitative Default Model

Environment: Preferences, Income, Long-Term Debt

Infinite horizon; calibrated to **Mexico**. Preferences: $\mathbb{E}_t \sum_{j=t}^{\infty} \beta^{j-t} u(C_j)$.

Endowment: $\log Y_t = (1-\rho)\mu + \rho \log Y_{t-1} + \varepsilon_t$, $|\rho| < 1$, $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$.

Long-term bonds as decaying perpetuities (Hatchondo-Martinez; Arellano-Ramanarayanan): a bond issued at t pays $\delta(1-\delta)^{j-1}$ at $t+j$ for all $j \geq 1$. Debt evolves as:

$$B_{t+1} = (1-\delta)B_t + I_t$$

analogous to capital accumulation: the stock B_t summarizes the whole future payment stream — agents need not track issuance dates.

Environment: Budget, Default, Bond Market, Timing

Budget constraint (with market access):

$$C_t + \delta B_t = Y_t + I_t q_t$$

Default: on all current and future obligations; zero recovery (a simplification). Cost: stochastic exclusion from debt markets plus income loss $\phi(Y_t)$, with $\phi(Y)/Y$ **increasing in** Y — proportionally costlier to default in good times, key for spread dynamics (arises endogenously in Mendoza-Yue via imported intermediate inputs).

Environment: Budget, Default, Bond Market, Timing (cont.)

Bond market: competitive, risk-neutral foreign investors discounting at the global risk-free rate r; price pinned down by zero expected profits.

Timing: observe income $\rightarrow$ default decision $\rightarrow$ if repaying, pay coupons and rebalance the debt portfolio. **Markov-Perfect equilibrium**: strategies depend only on the payoff-relevant state (B_t, Y_t).

Recursive Formulation: Value Functions

Value at the start of a period:

$$V(B,Y) = \max_{D\in\{0,1\}} \left\{ DV^D(Y) + (1-D)V^R(B,Y) \right\}$$

Default value (re-entry with zero debt with probability ψ):

$$V^D(Y) = u(Y - \phi(Y))$$
$$+\beta \int \left[\psi V(0,Y') + (1-\psi)V^D(Y') \right] F(dY'|Y)$$

Repayment value:

$$V^R(B,Y) = \max_{B'\geq 0} \left\{ u(C) + \beta \int V(B',Y')F(dY'|Y) \right\}$$
$$\text{s.t.} \quad C = Y - \delta B + q(B',Y)\big[B' - (1-\delta)B\big]$$

Recursive Formulation: The Bond Price

Zero expected profits for risk-neutral lenders with opportunity cost r:

$$q(B', Y) = \frac{1}{1+r} \int \left[1 - \hat{D}(B', Y')\right] \times \left[\delta + (1-\delta) q(\hat{B}(B', Y'), Y')\right] F(dY'|Y)$$

The Bond Price: Interpretation

- First term inside the brackets: the expected value of the **next coupon** (δ per surviving bond)
- Second term: the expected **resale value** of all remaining coupons — the next-period price evaluated at the borrowing $\hat{B}$ lenders expect the sovereign to choose
- With long-term debt, today's price thus depends on expected *future borrowing*, not just the next default decision — the source of the debt-dilution problem below

Markov-Perfect Equilibrium

A Markov-Perfect Equilibrium consists of:

1. Value functions V, V^R, V^D;
2. a default rule $\hat{D}$ and a borrowing rule $\hat{B}$; and
3. a bond price function q,

such that:

(a) given $\hat{D}$ and $\hat{B}$, the value functions satisfy the three functional equations when the sovereign trades at q;

(b) given $\hat{D}$ and $\hat{B}$, the price q satisfies the lenders' zero-profit condition; and

(c) $\hat{D}$ and $\hat{B}$ solve the sovereign's dynamic programming problem at prices q.

Markov-Perfect Equilibrium (cont.)

Strategies depend only on payoff-relevant states (B_t, Y_t). Timing: observe Y $\to$ default decision $\to$ if repaying, pay coupons and rebalance debt.

Results: Matching Emerging-Market Business Cycles

Business cycle statistics, model vs. data (Mexico)

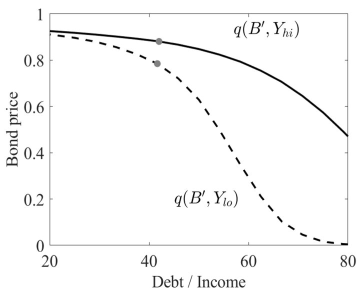
	Model	Data
Targeted		
Mean Debt-to-GDP	43	43
Mean Spread	3.2	3.2
Non-targeted		
$\sigma(C)/\sigma(Y)$	1.3	1.0
$\sigma(TB/Y)$	0.8	1.3
σ(Spread)	1.6	2.2
$\rho(TB/Y, Y)$	-0.7	-0.6
$\rho(C, Y)$	0.98	0.91
$\rho(\text{Spread}, Y)$	-0.8	-0.4
$\rho(\text{Spread}, TB/Y)$	0.9	0.6

Results: Matching Emerging-Market Business Cycles (cont.)

Key for hitting debt and spread levels jointly: **long-term debt** and the **convex default cost**. The model reproduces excess consumption volatility, countercyclical trade balances and spreads.

Mechanism: Endogenous Borrowing Opportunities

Bond price schedules for low income $Y_{lo} = \mathbb{E}(Y) - \sigma(Y)$ and high income $Y_{hi} = \mathbb{E}(Y) + \sigma(Y)$



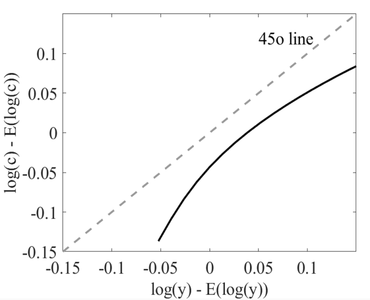
Dots mark the optimal choices starting from mean debt.

Mechanism: Endogenous Borrowing Opportunities (cont.)

- The bond price falls with debt and **rises with income**: low income today signals low income (and stronger default incentives) tomorrow
- The borrowing set **shrinks exactly when income drops** — when the sovereign needs it most
- In equilibrium, with low income the sovereign issues **fewer bonds at lower prices**

Mechanism: Endogenous Borrowing Opportunities (cont.)

Consumption policy under repayment from mean debt —
consumption drops more than income when income is low



Mechanism: Endogenous Borrowing Opportunities (cont.)

In the two-period model: with $Y_1 > 0$ and $F(\cdot|Y_1)$ decreasing in Y_1, the price $q_1(B_2, Y_1) = 1 - F(B_2/\phi|Y_1)$ is increasing in current income. This is the mechanism behind **excess consumption volatility**.

Normative Implications: Time Inconsistency I

Why would a benevolent government choose high sovereign risk? **Time inconsistency** (cf. inflation bias):

1. Cannot commit to future default decisions: committing to default less would raise bond prices *today* and expand the borrowing set — valuable since $\beta(1+r) < 1$ (the government is relatively impatient and gains from intertemporal trade).

Normative Implications: Time Inconsistency I (cont.)

Mateos-Planas et al.: under commitment with standard calibrations, the government would **not default at all** — the inability to commit accounts for essentially all equilibrium sovereign risk. Hatchondo et al. (2022): committing to a no-default rule would generate large welfare gains, but the temptation to break it would also be large.

Hence the observed devices: covenants, foreign jurisdictions, debt designed to be harder to restructure (Bolton-Jeanne).

Normative Implications: Time Inconsistency II (Debt Dilution)

2. Cannot commit to future borrowing — arises *only* with long-term debt. The period-t optimality condition:

$$u'(C_t)\left[q_t + \frac{\partial q_t}{\partial B_{t+1}}\left(B_{t+1} - (1-\delta)B_t\right)\right]$$
$$= \beta\mathbb{E}\left[V_1(B_{t+1}, Y_{t+1}) \mid Y_t\right]$$

The sovereign internalizes the price impact on *newly issued* bonds only — not on bonds sold *before* t. A government able to commit before t would also internalize how borrowing at t affects earlier bond prices (and utility).

Normative Implications: Time Inconsistency II (Debt Dilution) (cont.)

With **one-period debt** the problem vanishes: prices at t depend only on the default probability at $t+1$ (Aguiar-Amador 2019).

This **dilution** motive underlies fiscal rules limiting future borrowing (Hatchondo et al. 2022) and alternative bond contract designs that mitigate dilution (Chatterjee-Eyigungor 2015; Hatchondo-Martinez-Sosa Padilla 2016).

Summary

Key Takeaways (I)

1. **No commitment** $\Rightarrow$ **endogenous rates**: with default risk, interest rates rise with the perceived default probability; sustainability analysis must include repayment incentives. Relevant for emerging *and* advanced economies (Latin America 1980s, Eurozone 2011–12).

Key Takeaways (II)

2. **Facts**: consumption more volatile than output in emerging markets, driven by procyclical external borrowing; defaults are frequent (201 episodes 1970–2020), occur in bad times, take years to resolve (avg. 3.2), average haircut 37%; spreads are large, volatile, countercyclical (EM average 362bp, $\rho \approx -0.4$); spreads rise with debt and the VIX, fall with growth and reserves.

Key Takeaways (III)

2. **Debt intolerance**: the debt-to-risk mapping is highly heterogeneous across countries and shifts over time — challenging uniform debt-limit rules (Maastricht); "original sin" (FX-denominated debt) compounds risk; remedies include foreign jurisdictions, covenants, fiscal rules (increasingly common), spread-anchored rules.
3. **Two-period model**: default iff $Y_2 < B_2/\phi$ (bad times); price $q_1 = 1 - F(B_2/\phi)$ falls with issuance; the Euler equation includes the price impact $B_2 dq_1/dB_2$ on the entire stock and weights repayment states only.

Key Takeaways (IV)

5. **Quantitative model**: AR(1) income; long-term debt as δ-decaying perpetuities with $B_{t+1} = (1-\delta)B_t + I_t$; default cost $\phi(Y)$ with $\phi(Y)/Y$ increasing; stochastic market exclusion; Markov-Perfect equilibrium with V, V^D, V^R, price q from lenders' zero profits including the resale value of future coupons.

Key Takeaways (V)

2. **Fit** (Table 24.3): matches mean debt (43% of GDP) and spread (3.2%); delivers non-targeted $\sigma(C)/\sigma(Y) > 1$, countercyclical trade balance and spread. Long-term debt and the convex default cost are essential.

Key Takeaways (VI)

2. **Mechanism**: the bond price rises with income and falls with debt; the borrowing set shrinks in downturns, so consumption falls more than income — endogenous credit conditions generate the excess volatility.
3. **Time inconsistency**: (i) no commitment to future defaults — commitment would eliminate nearly all defaults and yield large welfare gains; (ii) no commitment to future borrowing (debt dilution, long-term debt only) — new issuance ignores the price impact on previously sold bonds. Both motivate fiscal rules and contract design.