Sovereign and Country Risk

Macroeconomics B

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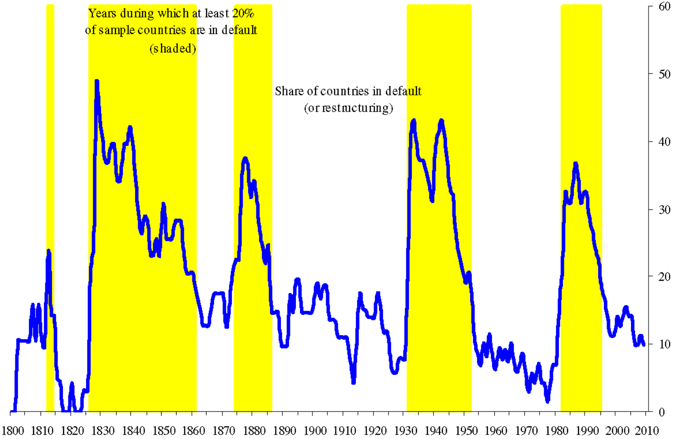
Introduction

- So far we have assumed that all debt is repaid
- But there are numerous episodes where countries do not repay their debt
- Actually repayment is not so natural in an international context
  - No strong legal system at the international level and no international government to enforce contracts
- The risk of default is non negligible. Focus on sovereign debt
- Evidence on country default
- How does default affect international capital flows? Large literature
- Read Harms VI.3.1

Figure 2. Global Sovereign External Default Cycles: 1800-2009
Share of countries in default or restructuring



Sources: Lindert and Morton (1989), Macdonald (2003), Purcell and Kaufman (1993), Reinhart, Rogoff, and Savastano (2003), Suter (1992), and Standard and Poor's (various years).
Notes: Sample includes all countries, out of a total of 70 listed in Appendix Table 1, that were independent states in the given year. Specifically, the number of countries increases from 19 in 1800 to 32 in 1826, as Latin American colonies gained independence; following World War II, newly-independent Asian states swell the number to 58 and in the following decades as African nation-sates are born the number of sovereign increases to a total of 70—the full sample.

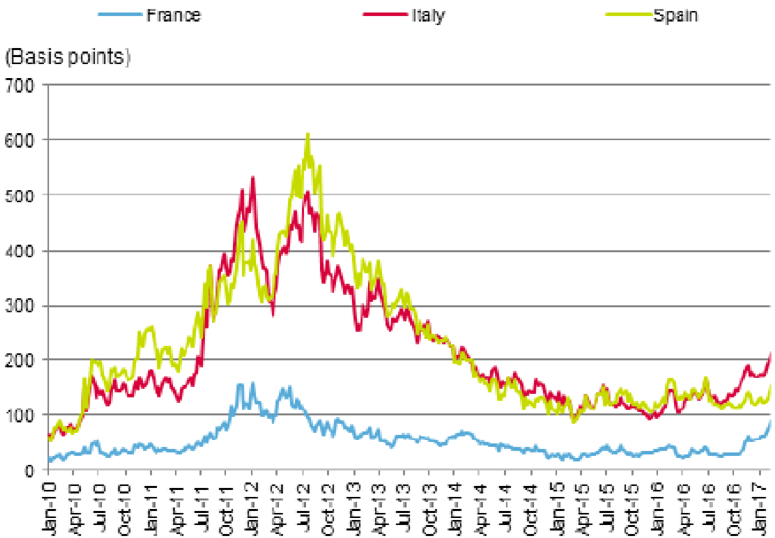
Table 2. An Early History of External Debt Defaults: Europe before the Twentieth Century

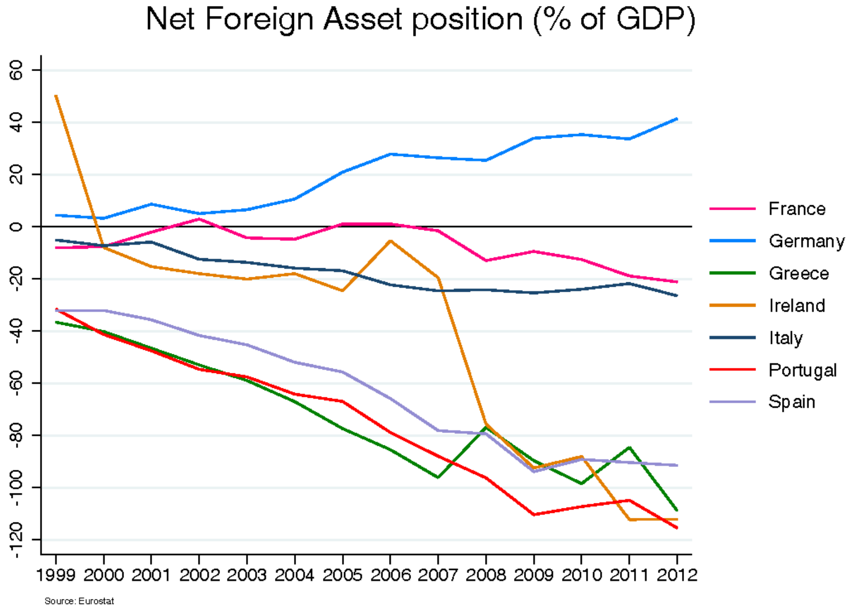
	1501–1800		*1801–1900*		
	number of defaults	*years of default*	*number of defaults*	*years of default*	*Total defaults*
Spain	6	1557, 1575, 1596 1607, 1627, 1647	7	1820, 1831, 1834, 1851 1867, 1872, 1882	13
France	8	1558, 1624, 1648, 1661 1701, 1715, 1770, 1788	n.a.		8[a]
Portugal	1	1560	5	1837, 1841, 1845 1852, 1890	6
Germany[b]	1	1683	5	1807, 1812, 1813 1814, 1850	6
Austria	n.a.	n.a.	5	1802, 1805 1811 1816, 1868	5
Greece	n.a.	n.a.	4	1826, 1843, 1860, 1893	4
Bulgaria	n.a.	n.a.	2	1886, 1891	2
Holland	n.a.	n.a.	1	1814	1
Russia	n.a.	n.a.	1	1839	1
Total	*16*		*30*		*46*

[a] Total for the period 1501–1800 only.
[b] Defaults listed are those for Prussia in 1683, 1807 and 1813, Westfalia in 1812; Hesse in 1814 and Sleswig-Holstein in 1850.

Source: "Debt Intolerance," Carmen M. Reinhart, Kenneth S. Rogoff, and Miguel A. Savastano NBER Working Paper No. 9908

Ten-Year Sovereign Bonds Over German Bund





Net Foreign Asset position (% of GDP)
60
40
20
0
-20
-40
-60
-80
-100
-120
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
France
Germany
Greece
Ireland
Italy
Portugal
Spain
Source: Eurostat

A Model with default, but no uncertainty

- Reference: Vegh, section 2.4, Harms VI.3.3
- Consider a two-period model
- To focus on debt, we will use the notation $D_2 = -B_2$
- In reality mainly sovereign debt. Here we consider total debt
- Why repay a debt?
- Must be some commitment device or a high cost of not repaying. Otherwise, don't repay
- Then nobody will lend: autarky
- We will consider a model without commitment, but with default cost

Default cost

- Assume that cost is proportional to $Y_2 : \phi Y_2$
  - trade or financial sanctions
  - internal political costs
  - no future borrowing (in a more dynamic framework)
- Then repay when the cost is too high, i.e. when:

$$Y_2 - (1+r)D_2 \geq (1-\phi)Y_2$$

- Repay when

$$D_2 \leq \frac{\phi Y_2}{1+r}$$

- Lenders will not lend more than $\frac{\phi Y_2}{1+r}$
- With low ϕ, countries are not able to borrow much even if they need to

Optimal behavior

- max $U(C_1) + \beta U(C_2) + \lambda(\frac{\phi Y_2}{1+r} - D_2)$
- Assume $\beta(1+r) = 1$
- FOC is:

$$\begin{aligned} U'(C_1) &= U'(C_2) + \lambda \\ \lambda(\frac{\phi Y_2}{1+r} - D_2) &= 0 \qquad \text{and} \qquad D_2 \leq \frac{\phi Y_2}{1+r} \end{aligned}$$

- There are 2 cases

2 cases

1. constraint not binding: $\lambda = 0$

$$U'(C_1) = U'(C_2) \Longrightarrow C_1 = C_2$$

   perfect consumption smoothing

2. constraint binding: $\lambda > 0$

$$U'(C_1) > U'(C_2) \Longrightarrow C_1 < C_2$$

   Consumption smoothing is not feasible

- There is never default
- Graph supply of funds

A Model with default and uncertainty

- Harms, VI.3.4
- With uncertainty, there are cases with default and cases without
- Default comes with bad shocks
- Lenders face a risk and charge a risk premium
- Let r^s be the interest rate on debt
- Let p be the probability of default
- Let z be the proportion of debt repaid when default: recovery rate
- $1 - z$ is *haircut*

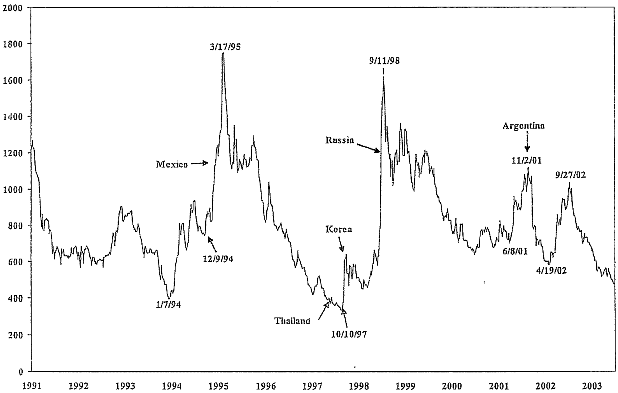


Figure 4.3. Interest rate spreads on emerging market bonds. End-of-week data, in basis points. *Source*: EMBI/ EMBI + series, J. P. Morgan Chase.

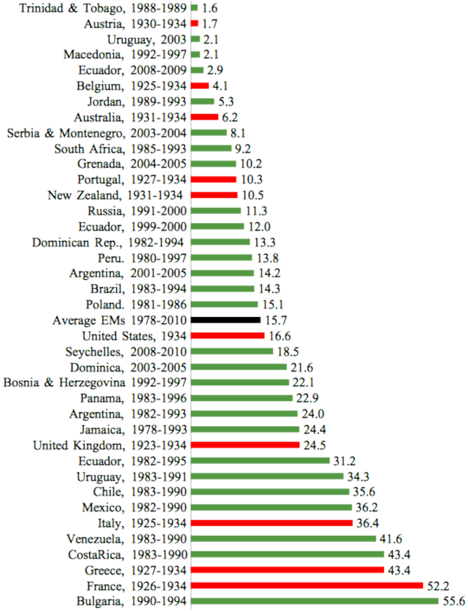


Figure: Reinhart and Trebesch (JEEA, 2016), Debt relief % GDP

- Assume perfectly competitive market and risk neutrality from lenders. Then:

$$1 + r = (1 - p)(1 + r^s) + pz(1 + r^s) = (1 - p(1 - z))(1 + r^s)$$

- Observe the spread $r^s - r$. Compute an estimate p for a given z

- We will assume $z = 0$:

$$1 + r = (1 - p)(1 + r^s)$$

- Compute p and r^s, as well as D_2 and CA in a two-period model
- Assume uncertainty about Y_2
- Uniform distribution:
$$Y_2 \in \left[0, Y_2^H\right]$$
- Remark about uniform distribution: If $x \in [a, b]$, $prob(x < x^*) = \frac{x^* - a}{b - a}$

- Also assume cost of default ϕY_2. Default if:

$$D_2 > \frac{\phi Y_2}{1+r^s}$$

- There is a critical level of Y_2 below which it becomes optimal to default:

$$D_2 = \frac{\phi Y_2^*}{1+r^s}$$

or

$$Y_2^* = \frac{(1+r^s)D_2}{\phi}$$

- Probability of default:

$$p = prob(Y_2 < Y_2^*) = \frac{Y_2^*}{Y_2^H} = \frac{(1+r^s)D_2}{\phi Y_2^H}$$

- In particular increases in D_2
- See empirical evidence from Kray-Nehru

TABLE 3. Basic Results

	(1)	(2)	(3)
	All	Low-Income Countries[a]	Middle-Income Countries[a]
Present value debt/exports	0.644 (0.152)***	0.143 (0.074)*	0.262 (0.060)***
Country Policy and Institutional Assessment (CPIA)	–0.557 (0.142)***	–0.311 (0.091)***	–0.020 (0.051)
Real GDP growth	–4.620 (2.085)**	–0.930 (1.199)	–2.080 (0.749)***
Constant	0.821 (0.512)	1.911 (0.789)**	–1.375 (0.925)
Number of observations	200	83	117
Out-of-sample predictive power (fraction of events correctly predicted)			
All episodes	0.71	0.75	0.78
Distress episodes	0.74	0.56	0.70
Normal time episodes	0.70	0.83	0.80

*Significant at the 10 percent level.

**Significant at the 5 percent level.

***Significant at the 1 percent level.

Note: Numbers in parentheses are standard errors.

[a] Marginal effects rather than slope coefficients are reported for first three variables to facilitate a comparison of the magnitude of estimated effects between these two columns.

Source: Authors' analysis of data described in *Appendix*.

- Determine r^s and risk premium
- From:

$$1 + r = \left(1 - \frac{(1 + r^s)D_2}{\phi Y_2^H}\right)(1 + r^s)$$

- Quadratic equation in $1 + r^s$
- Consider the lower root and get $r^s(D_2)$ with $\frac{\partial r^s}{\partial D_2} > 0$
- But D_2 is endogenous and can be determined from optimal borrowing

Optimal borrowing

- Consider linear utility function: $U = C_1 + \beta E C_2$
- Assume $\beta < \frac{1}{1+r}$ so there is an incentive to borrow
- Budget constraints:

$$\begin{aligned} C_1 &= Y_1 + D_2 \\ C_2^{ND} &= Y_2 - (1 + r^s) D_2 \\ C_2^{D} &= (1 - \phi) Y_2 \end{aligned}$$

- Utility can be written as:

$$U = Y_1 + D_2 + \beta \left\{ pE(C_2^D) + (1 - p) E(C_2^{ND}) \right\}$$

- where:

$$\begin{aligned} E(C_2^D) &= (1 - \phi) E(Y_2 \mid D) \\ E(C_2^{ND}) &= E(Y_2 \mid ND) - (1 + r^s) D_2 \end{aligned}$$

- Notice that:

$$pE(Y_2 \mid D) + (1-p)E(Y_2 \mid ND) = E(Y_2)$$

- Then rewrite:

$$\begin{aligned} U &= Y_1 + D_2 \left[1 - \beta \overbrace{(1-p)(1+r^s)}^{1+r} \right] \\ &\quad + \beta E(Y_2) - \underbrace{\beta \phi p E(Y_2 \mid D)}_{\text{loss of resources due to default}} \end{aligned}$$

- We have

$$E(Y_2) = \frac{Y_2^H}{2}$$

$$E(Y_2 \mid D) = \frac{Y_2^*}{2} = \frac{(1+r^s)D_2}{2\phi} = \frac{pY_2^H}{2}$$

- Last term becomes:

$$\frac{\beta\phi p^2 Y_2^H}{2}$$

- Hence

$$U = Y_1 + D_2\left[1 - \beta(1+r)\right] + \beta\frac{Y_2^H}{2} - \frac{\beta\phi p^2 Y_2^H}{2}$$

- Now take FOC w/D_2:

$$\left[1 - \beta(1+r)\right] = \beta\phi p Y_2^H \frac{\partial p}{\partial D_2}$$

- Marginal gain = marginal cost. Can be rewritten as:

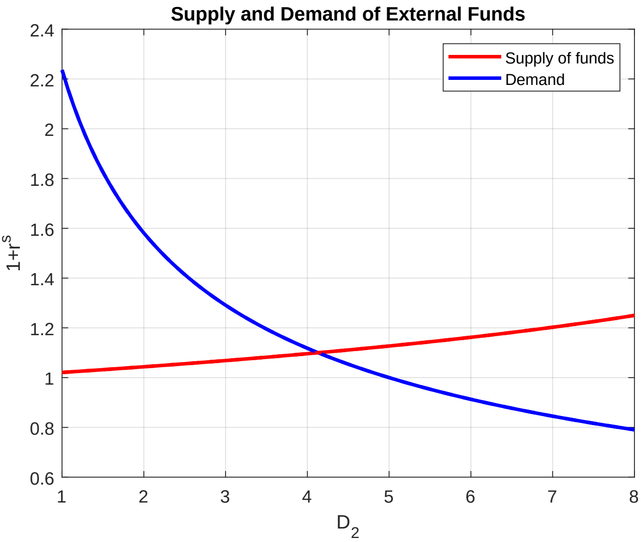
$$\rho - r = \phi p Y_2^H \frac{\partial p}{\partial D_2}$$

- Finally we get:

$$
\begin{aligned}
p &= \frac{\rho - r}{1 + 2\rho - r} \\
D_2 &= \frac{\phi Y_2^H (1+\rho)(\rho - r)}{(1+r)(1+2\rho - r)^2} \\
r^s &= \frac{1+r}{1+\rho}(1 + 2\rho - r) - 1
\end{aligned}
$$

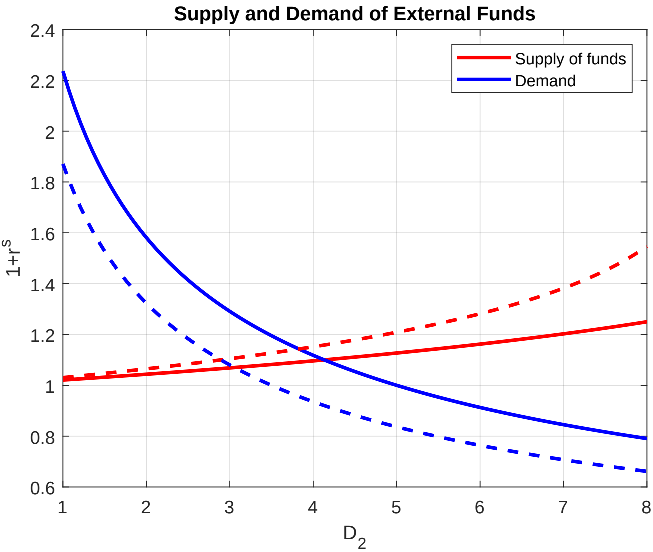
- p independent of ϕ
- D_2 increases in ϕ
- All increase in ρ

Equilibrium



$\phi = 0.5$, $Y_2^H = 100, \rho = 0.15, r = 0.05$

Decrease in ϕ



Welfare

- Utility can be written as:

$$U = Y_1 + \frac{1}{1+\rho}E(Y_2) + \phi \frac{Y_2^H(\rho - r)^2}{2(1+2\rho - r)(1+\rho)(\rho - r)}$$

- Utility increases with ϕ
- Higher costs of default increase welfare

Multiple equilibria

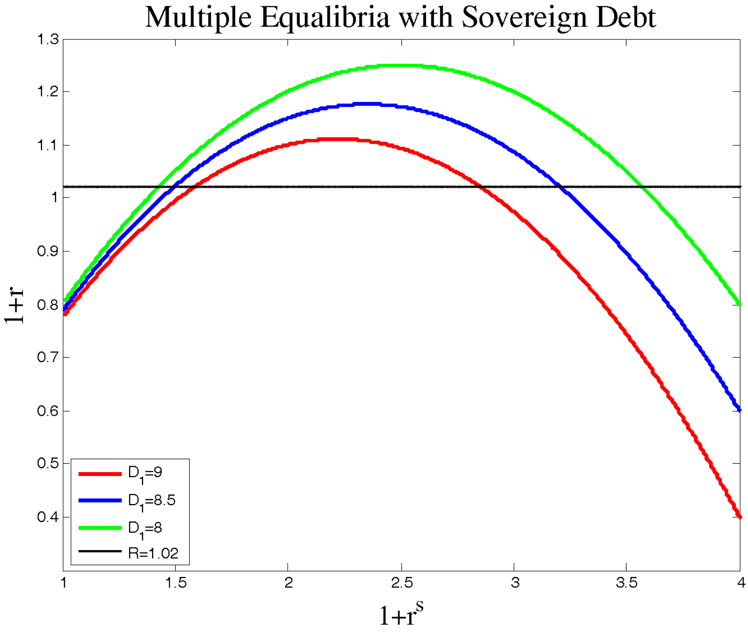
- How to explain sudden jump in risk premia in 2010?
- Potential explanation: multiple equilibria. Recent literature on self-fulfilling debt crises. Started with Calvo, AER, 1988
- Calvo: With initial debt level D_2, two levels of interest rate with good and bad equilibrium
- Works through the government budget constraint: high interest rate implies higher debt service $\Rightarrow$ default more likely $\Rightarrow$ justifies higher interest rate: self-fulfilling equilibrium
- Low interest rate $\Rightarrow$ low debt service $\Rightarrow$ no default $\Rightarrow$ low interest rate
- Sharp increase in interest rate may be explained by switch from the good to the bad equilibrium

- Similar in our model, although not through budget constraint
- Remember quadratic equation:

$$1 + r = \left(1 - \frac{(1 + r^s) D_2}{\phi Y_2^H}\right)(1 + r^s)$$

- Graphical representation
- Higher r^s means higher interest rate payment and higher probability of default: self-fulfilling.

- Technical problem in Calvo and in our model: the high interest rate solution is unstable
  - Leads to absurd comparative statics


Multiple Equalibria with Sovereign Debt
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
1+r
1
1.5
2
2.5
3
3.5
4
1+r^s
D_1=9
D_1=8.5
D_1=8
R=1.02

- ECB President Draghi:
  - "... *the assessment of the Governing Council is that we are in a situation now where you have large parts of the euro area in what we call a "bad equilibrium", namely an equilibrium where you may have self-fulfilling expectations that feed upon themselves and generate very adverse scenarios.*" (press conference, September 6, 2012).

- Role for the central bank?
  - See Bacchetta, Perazzi and van Wincoop (JIE, 2018)