Default and Interest Rate Shocks: Renegotiation Matters

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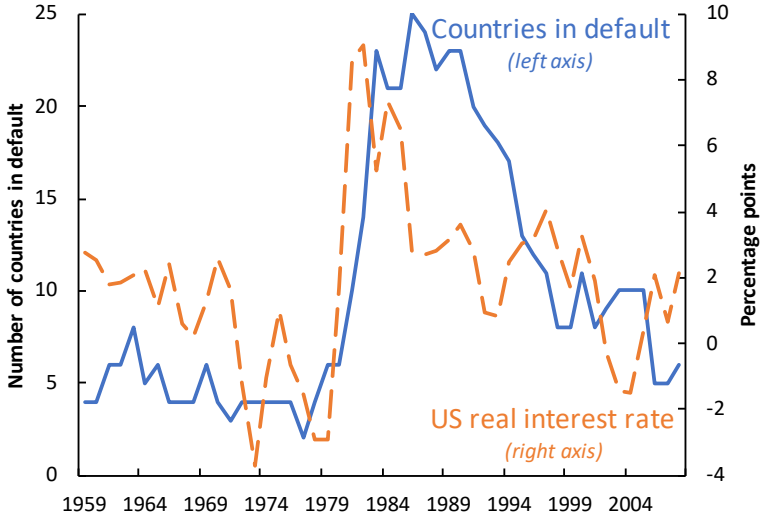
Default status and US real interest rate



This paper

- Did the Volcker Shock cause the defaults?
- Direct mechanism: higher $r \implies$ higher borrowing costs
- Our paper: Version of the model with *endogenous renegotiation*
- Renegotiation mechanism: higher $r \implies$ higher expected haircut

Renegotiation mechanism

- High interest rates while bargaining makes lenders more impatient.
- Key: interest rate still high when bargaining.
- Race between
  - Persistency of interest rate shock
  - How fast a renegotiation opportunity arrives.

Quantitative results

- Direct is small
  - 6% of defaults only triggered if interest-rate is high
- Renegotiation mechanism is larger
  - 22% of defaults only triggered if interest-rate are high
- Lower bound?

Related literature

- **Sovereign default model**
  - Aguiar and Gopinath (2006), Arellano (2008)
- **Long-term debt**
  - Hatchondo and Martinez (2009), Chatterjee and Eyigungor (2012), Arellano and Ramanarayanan (2012)
- **Debt renegotiation**
  - Yue (2010), Hatchondo, Martinez, and Sosa-Padilla (2014)
- **Varying risk free interest rates**
  - Guimaraes (2011), Johri, Khan, and Sosa-Padilla (2016), Tourre (2017)

Simple model, environment

- Risk-free interest rate: r
  - We then do comparative statics
- Output shock: y, with $\mathbb{E}[y] = 1$ and CDF $F(y)$
- Lenders: risk neutral, discount future at rate r
- Short-term debt only

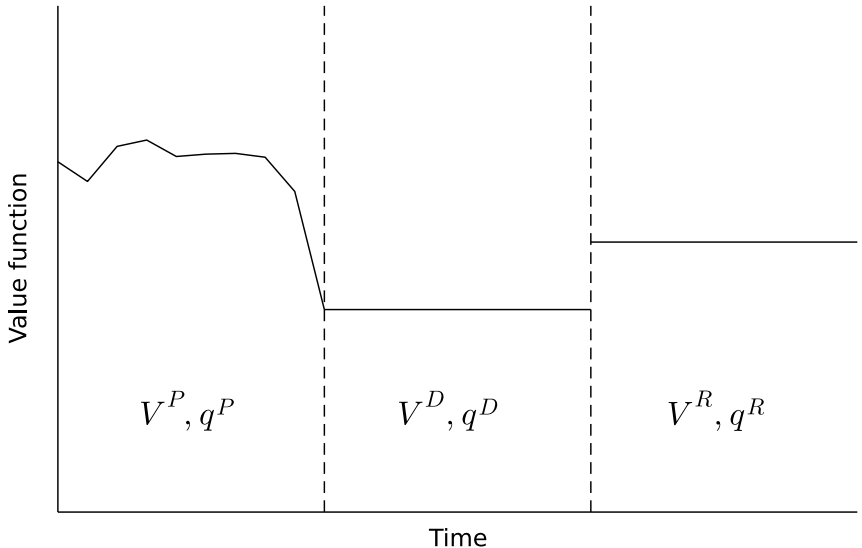
Simple model, environment

- Government: preferences described by $u(c)$ with standard properties
  - Inherits debt b, observes (y, r), and decides to default or repay
  - If repay: pay b, issue b' at price q^P
  - If default: output is λ, $0 < \lambda < 1$

Simple model, environment

- A renegotiation opportunity arrives with probability θ
  - Nash bargaining solution
  - After renegotiation, output is 1 forever and government pays a constant coupon ρ to the lenders

Simple model, timeline



Renegotiation Solution

- **PROPOSITION:** *A higher interest rate implies better negotiating terms for the country, so $V^R(r)$, the value after renegotiation, is increasing on r*

- Thus,

$$V^D(r) = u(\lambda) + \beta \left[(1-\theta) V^D(r) + \theta V^R(r) \right]$$

or

$$V^D(r) = \frac{1}{[1-\beta(1-\theta)]} \left[u(\lambda) + \beta\theta V^R(r) \right]$$

is increasing in r

Value while good standing

- The problem while the government repays can be written as:

$$V^P(b, y; r) = \max_{b'} \left\{ u(c) + \beta \mathbb{E} \left[\max V^P\left(b', y'; r\right), V^D(r) \right] \right\}$$

$$s.t. \qquad c + b = y + \frac{1}{1+r} \left[1 - F\left(y^T\right) \right] b'$$

where y^T is defined by:

$$V^P\left(b', y^T; r\right) = V^D(r)$$

- Increases in r reduce the possibility set and increase both $V^D(r)$ and y^T

Model without renegotiation

- In the model with no renegotiation:

$$V^P(b,y) = \max_{b'} \left\{ u(c) + \beta \mathbb{E}\left[\max V^P\left(b', y'\right), V^D \right] \right\}$$

$$s.t. \qquad c + b = y + \frac{1}{1+r}\left[1 - F\left(y^T\right)\right] b'$$

where y^T is defined by:

$$V^P\left(b', y^T\right) = V^D$$

Full model, environment

- Small open economy, stochastic income y_t

$$\log y_t = \rho \log y_{t-1} + \epsilon_t,\ \epsilon_t \sim N\left(0, \sigma_\epsilon^2\right)$$

- Preferences for consumption each period $u\left(c_t\right) = \frac{c_t^{1-\sigma}-1}{1-\sigma}$

Full model, environment

- Long-term bonds b_t, price q_t, mature at rate γ, law of motion:

$$b_{t+1} = (1 - \gamma)\, b_t + i_t$$

- Quadratic default costs
  - In default, income is $h(y_t) = y_t - \max\left\{0, \phi_0 y_t + \phi_1 y_t^2\right\}$, $\phi_0 < 0 < \phi_1$

Full model, new features

- Volcker Shock: $r_t \in \{r^H, r^L\}$ Markov chain, transition matrix $\pi_{i,j}$, $i, j \in \{H, L\}$
- An opportunity to renegotiate arrives with probability θ:
  - Face value of debt changes to b_t^R
  - Sovereign gains access to financial markets
  - Output is still stochastic after renegotiation

Calibration: We follow standard practice!

Parameter		Value	Details
low r	r_L	1.2%	1955–1980
high r	r_H	6.2%	1981–1985
Pr(low to high r)	$\pi_{L,H}$	1%	Duration of 100 years
Pr(high to low r)	$\pi_{H,L}$	20%	Duration of 5 years
bond maturity	γ	0.75	Sixteen-month bonds
Pr(renegotiation)	θ	19.2%	5.2 years exclusion (Gelos et al. (2011))
risk aversion	σ	2	Standard
income process	ρ	0.705	AR(1) estimation with
	σ_ϵ	0.040	annual data 1933-1983

Internal Calibration

Parameter		Value	Moment	Data	Model
lenders' bargaining	α	0.11	average haircut	0.24	0.24
default cost	ϕ_0	-0.20	default probability	0.03	0.03
default cost	ϕ_1	0.23	average spreads	0.03	0.02
discount factor	β	0.82	debt-to-GDP ratio	0.19	0.19

Shocks that trigger default: Renegotiation vs. No renegotiation

- 20,000 simulations
- Look at first default after 500 periods
- Count defaults with high r and such that the country would not default if small r.
- Without renegotiation: 6% of Volcker shocks trigger a default
- With renegotiation: 22% of Volcker shocks trigger a default

Renegotiation failure in 1980s

- Renegotiation attempts every two years
- Unsuccessful until Brady Plan in 1989/1990
- Potential explanation: US regulators did not allow banks to write down the debt

"Had these institutions been required to mark their sometimes substantial holdings of underwater debt to market or to increase loan-loss reserves to levels close to the expected losses on this debt, then ... Manufacturers Hanover, Bank of America, and perhaps Citicorp would have been insolvent."

(Lewis William Seidman (2000), *Full Faith and Credit*)

History of lost decade

"The entire Ford administration, including me, told the large banks that the process of recycling petrodollars to the less developed countries was beneficial, and perhaps a patriotic duty." (Seidman 2000),

- 1979 reinterpretation of law
  - Loans to a single borrower could not exceed 10 percent of bank's capital: different government agencies in foreign countries are different borrowers
- Regulation during 1980s
  - No reserves provisions for delinquent LDCs loans

Renegotiation failure in 1980s

- Dooley 1995 (Pg. 271):

"...the events following the debt crisis cannot be adequately modeled as a game involving only debtors (developing-country governments) and creditors (commercial banks). By leaving out the interested and relatively wealthy third parties (industrial country governments), this framework fails to capture the basic nature of the problems generated by the crisis."

"Neither the banks nor the creditor governments, however, saw any advantage to presenting their position with excessive clarity. Banks were winning the game as it was being played, and governments that had asserted they would not "bail out the banks" were not anxious to concede that they were doing slowly what they would not do quickly."

Defaults Triggered by High r

	no renegotiation	renegotiation
$\theta = 1/5$	6%	22%
$\theta = 1/2$	8%	47%

US Banks and Volcker

- The risk of bank failures affected policy decisions by the Fed
- Volcker addressed the FOMC:

  'There is a substantive need for a relaxation of pressures in the private markets in the United States... Extraordinary things may have to be done. We haven't had a parallel to this situation historically except to the extent that 1929 is a parallel."

  (Transcript, FOMC Meeting, October 5th, 1982, pg 19.)

Empirical evidence

$$h^{SZ}_{i,e,j,t} = \alpha + \beta r_t + \Gamma Z_{i,e} + u_j + \epsilon_{i,e,j,t}$$

	Without controls	With controls		
	(1)	(2)	(3)	(4)
real risk-free rate	7.030**	7.015**	6.510*	6.329*
	(2.951)	(3.039)	(3.609)	(3.800)
maturity of instrument (years)		0.0960	-0.232**	-0.225**
		(0.0813)	(0.106)	(0.107)
coupon rate (fixed, percent)			0.939***	1.091***
			(0.168)	(0.377)
coupon rate (float, dummy)				1.914
				(4.254)
constant	37.06***	36.53***	36.36***	35.29***
	(5.196)	(5.367)	(6.284)	(6.965)
Observations	139	139	78	78
Number of episodes	17	17	14	14
Episode random effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

Calibration with fixed b^R back

Parameter		Value	Moment	Data	Model
Restructuring terms	b^R	**0.07**	average haircut	0.24	0.24
default cost	ϕ_0	-0.16	default probability	0.03	0.04
default cost	ϕ_1	0.18	average spreads	0.03	0.02
discount factor	β	0.78	debt-to-GDP ratio	0.19	0.10

Shocks that trigger default: Renegotiation vs. Fixed bR

- Average paths around default:
  - 20,000 simulations
  - Look at periods before and after first default after 500 periods
- With fixed b^R: 7% of defaults triggered with high r
- With renegotiation: 12% of defaults triggered with high r

Average paths around default episodes

back

Distribution of haircuts back

Model, equilibrium

An equilibrium is value and policy functions, a bond price schedule q, an outside option Q, and a renegotiation rule b^R such that:

1. Given q, Q, and b^R, the value and policy functions solve the sovereign's problem
2. Given q, Q, and the value and policy functions, b^R solves the bargaining problem
3. The bond price schedule is consistent with zero profits in expectation

$$q\left(b', y, r\right) b' = \frac{\mathbb{E}\left[\left\{1 - d\left(b', y', r'\right)\right\}\left\{\left(\gamma + \left(1-\gamma\right) q\left(b'', y', r'\right)\right)\right\}\right] b'}{1+r} + \frac{\mathbb{E}\left[d\left(b', y', r'\right) Q\left(y', r'\right)\right]}{1+r}$$

where $b'' = b^P\left(b', y', r'\right)$

Characterization of the renegotiation game

- From the F.O.C. of the bargaining problem, we get

$$\alpha \frac{S^{SOV}\left(b^R, y, r\right)}{u'\left(y - \left(\gamma + (1-\gamma)\, q\left(b', y, r\right)\right) b^R + q\left(b', y, r\right) b'\right)} = (1-\alpha)\, S^{LEN}\left(b^R, y, r\right)$$

  where $b' = b^P\left(b^R, y, r\right)$

- If $\alpha = 0$, lenders have no bargaining power

$$S^{LEN}\left(b^R, y, r\right) = \left[\gamma + (1-\gamma)\, q\left(b', y, r\right)\right] b^R - Q\left(y, r\right) = 0$$

  which implies $b^R = 0$ (i.e., the standard model)

Characterization of the renegotiation game

- For the case of one-period debt ($\gamma = 1$), i.i.d. income shocks, r fixed at r^L or r^H, and steady state after default and renegotiation:
  - Proposition: For $\alpha \in [0, 1]$, a solution b^R exists in every state and is unique
  - Proposition: For any $\alpha \in [0, 1]$, high risk-free interest rate implies:
    - borrowing is more expensive $q\left(b', y, r^H\right) \leq q\left(b', y, r^L\right)$
    - lenders' outside option is lower $Q\left(y, r^H\right) \leq Q\left(y, r^L\right)$
    - sovereign gets higher debt relief $b^R\left(y, r^H\right) \leq b^R\left(y, r^L\right)$

High interest rates and default incentives

The sovereign defaults if

$$V^P(b, y, r) < V^D(y, r)$$

Standard mechanism:

- $V^P\left(b, y, r^H\right) < V^P\left(b, y, r^L\right)$ (*higher borrowing costs*)

Our mechanism (with persistent r):

- $V^D\left(y, r^H\right) > V^D\left(y, r^L\right)$ (*lower expected renegotiated debt*)

High interest rates and borrowing costs

$$q\left(b', y, r\right) = \underbrace{\frac{1}{1+r}}_{\text{Standard mechanism}} \mathbb{E}\left[\left\{1 - d\left(b', y', r'\right)\right\}\left\{\left(\gamma + (1-\gamma)\, q\left(b'', y', r'\right)\right)\right\}\right]$$

$$+ \underbrace{\frac{1}{1+r}}_{\text{Standard mechanism}} \mathbb{E}\left[d\left(b', y', r'\right) \underbrace{\frac{Q\left(y', r'\right)}{b'}}_{\text{Our mechanism}}\right]$$

Standard mechanism:

- Higher r reduces q because of higher discounting

Our mechanism (with persistent r):

- Higher r reduces expected $b^R \longrightarrow$ reduces value of holding defaulted debt Q