Government Debt and Banking Fragility: The Spreading of Strategic Uncertainty

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Motivation

- Bank-Sovereign linkages have been important in the EA Sovereign Debt Crisis
- Termed Diabolic Loop, Doom Loop, Deadly Embrace ....
- Belief that banks and sovereigns are dragging one another deeper into insolvency
- Our aim is to understand why these linkages exist ...
- ... and look for some simple remedies

The Diabolic Loop

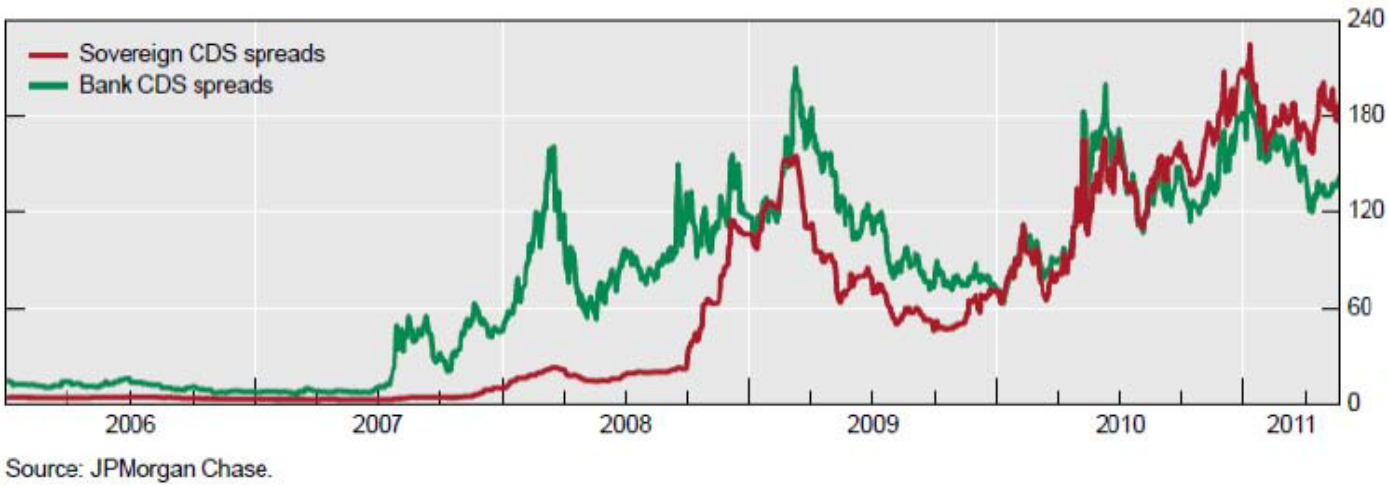

Figure: Credit Default Swaps

Questions

- How does the 'diabolic loop' linking debt and financial fragility operate?
- Can we avoid it?

The Diabolic Loop: a Short Summary

- Pessimism reduces value of debt
- banks lose valuable liquid wealth
- government bail out
- likelihood of default increases
- reduces value of debt ...

Can we avoid it?

- Yes if banks issue equity or if no government bailout
- Government cannot commit not to bail out ex post
- ... so banks do not issue equity (zero weight in Basel)
- (If government could commit, banks would issue equity)
- Diabolic Loop alive and well!!

Approach

- Diamond-Dybvig Banks + Calvo Debt Uncertainty
- General Equilibrium Model, Three periods
- Agents: households, investors, government
- Shocks
  - Pricing of Government Debt: Sunspots
  - Fundamentals: Government Finance, Long Term Investment

Related Literature: Sovereign Default and Banks

Bank bond holdings as microfoundation for default costs

- Gennaioli, Martin and Rossi (2013)

Models of the 'diabolic loop'

- Acharya, Drechsler and Schnabl (2013)
- Uhlig (2013)
- Bronner, Erce, Martin and Ventura (2013)
- Leonello (2013)
- Farhi and Tirole (2014)
- Bocola (2014)

Empirical evidence on sovereign-banking linkages

- Battistani, Pagano and Simonelli (2013)

Our emphasis

- Multiple equilibria as a source of sovereign crises
- Equity buffers as potential loss absorbers
- Banks' absence of incentives to issue equity

Households

- as in Diamond-Dybvig framework
- risk averse
- idiosyncratic liquidity needs
- deposit endowment in bank

Investors

- risk neutral
- discount future consumption at $\frac{1}{R}$
- endowment A_t in period $t = 0, 1, 2$.
- A_2 is government tax base, includes costly default (γ) and intermediation breakdown (ψ)

$$A_2 = \bar{A}(1 - \psi \mathbb{1}\{B\})(1 - \gamma \mathbb{1}\{G\}). \quad (1)$$

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Banks

- DD: competitive, contracting environment in period 0 determines
  - consumption profile: $(c^E(s), c^L(s))$ - contingent on sunspot shock s
  - portfolio of two-period government debt and illiquid investment: b_0, i_0 - funded with deposits from households and equity from investors
  - government debt can be traded in the middle date so liquid
  - illiquid investment yields $R > 1$ in two periods, ε liquidation value
- Period 1: provide $c^E(s)$, **sell debt** and/or liquidate LR project if needed
- Period 2: provide $c^L(s)$ from assets, pay dividends $\delta_2(s)$ to investors

Optimal Contract

$$\max E[\pi u\left(c^E(s)\right) + (1-\pi)\, u\left(c^L(s)\right)] \tag{2}$$

such that

$$i_0 + q_0 b_0 \leq d + x_0 \tag{3}$$

$$\pi c^E(s) \leq q_1(s)\,(b_0 - b_1(s)) + \varepsilon l_1(s)\,\forall s \tag{4}$$

$$(1-\pi)\, c^L(s) \leq b_1(s) + R\,(i_0 - l_1(s)) - \delta_2(s) \forall s \tag{5}$$

$$E\delta_2(s) \geq R x_0. \tag{6}$$

Government

- sells two-period debt in period 0, B_0, at price q_0
- sells one-period debt in period 1 at price q_1: finance G_1 and support banks if needed
- period 2 tax rate satisfies:

$$\tau = \frac{B_1}{A_2}.$$

Sovereign Default

- stochastic tax capacity: $\tilde{\tau} \sim F(\cdot)$
- no strategic default - repay if possible: $\tilde{\tau} \geq \frac{B_1}{A_2}$,
- default otherwise: probability $F(\frac{B_1}{A_2})$

Period 1 Pricing of Debt

- Arbitrage by Risk Neutral Investors implies:

$$\frac{\overbrace{1 - F\left(\frac{B_1}{A_2}\right)}^{\text{repayment probability}}}{R} = q_1 \tag{7}$$

- R is discount rate of investor
- determines q_1 given (B_1).

Optimistic Equilibrium: First-Best Allocation

- assume no default solves (7)
- assume sunspots do not affect equilibrium
- bank contract independent of strategic uncertainty
- no liquidations

Proposition

In the optimal banking contract with $q_0 = q_1 = \frac{1}{R}$*: (i)* $c^{*L} > c^{*E}$ *and (ii)* $l_1 = 0$*.*

- Markets Clear
- First-Best Allocation: defines investor Pareto weight ω such that $u'(c^{*E}) = \omega$

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Debt Fragility

- multiplicity through debt pricing as in Calvo (1988)

$$B_1 = B_0 + G_1/q_1 \tag{8}$$

- investors price debt in period 1:

$$1 - F\left(\frac{B_0 + G_1/q_1}{\bar{A}(1 - \psi \mathbb{1}\{B\})}\right) = Rq_1. \tag{9}$$

- fragility from multiple solutions to (9)

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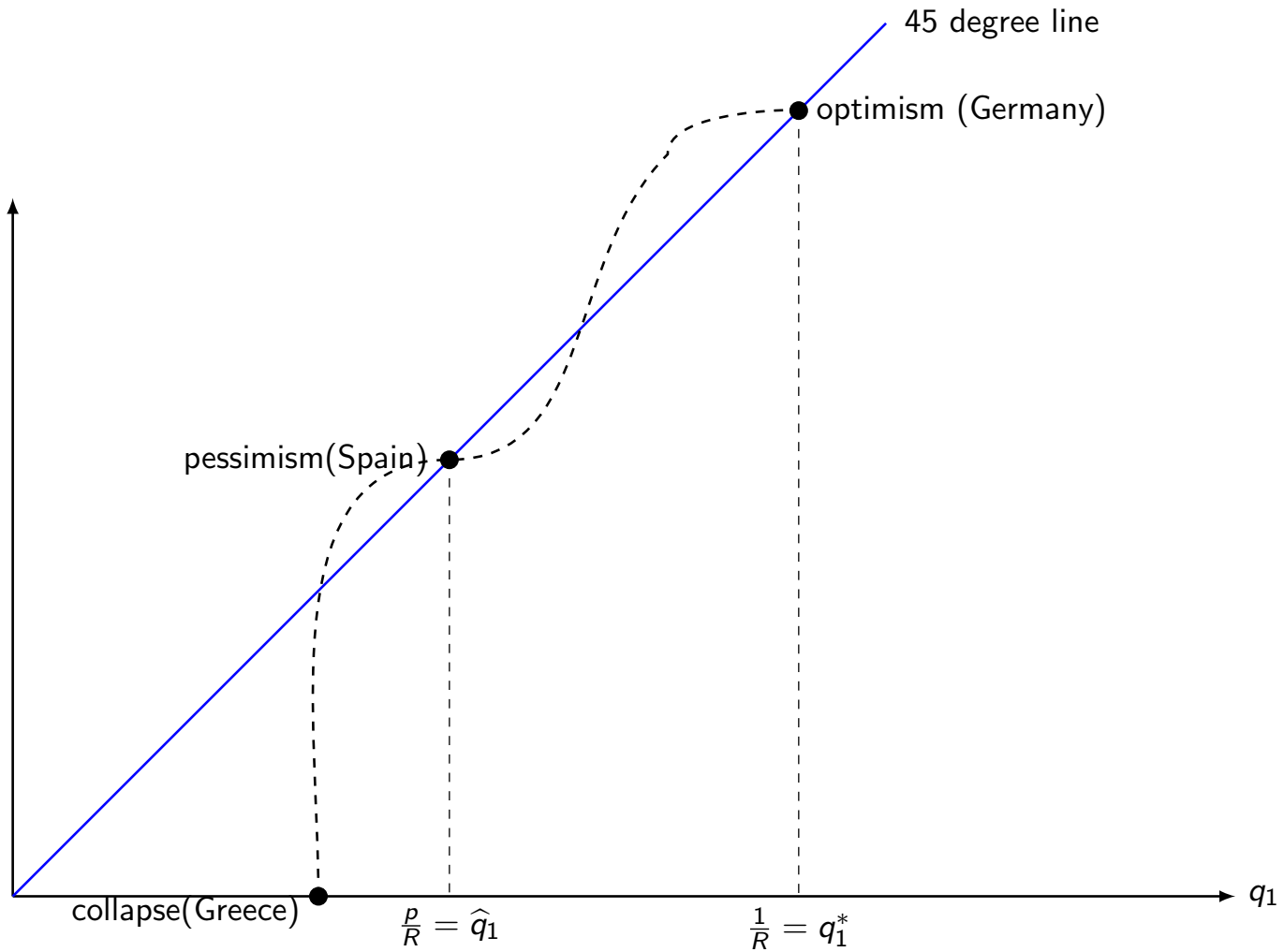
Figure: Example of Fiscal Fragility: $G_1 > 0$



How can the bank deal with strategic uncertainty?

- Debt is needed for liquidity but it is risky
- Optimal for risk-neutral investors to absorb the risk
- Private solution: bank sells equity claims to investors
- Public solution: government bails out the bank under pessimism

Private Solution: Equity as a Buffer

- equity can be issued to investors *ex ante*
- use proceeds to purchase enough bonds to pay early depositors under pessimism
- equity yields dividends if optimism, nothing otherwise
- expected return equal to R so attractive to investors
- fully insures depositors against pessimism
- no link between sovereign and the banks

Proposition

Selling equity to investors at $t = 0$ implements the first-best contract.

Public Solution: Government Bailout

- No equity, bonds enough to pay early types under optimism
- Under pessimism, period 1 debt price falls to $\widehat{q}_1 < q_1^*$
- Bank insolvent, requires a bailout
- Debt buyback: $T_1(q_1) = (q_1^* - \hat{q}_1)b_0$

Closing the Sovereign-Bank Loop

- Bailout affects Debt Valuation:

$$1 - F\left(\frac{B_0 + G_1/q_1 + T_1(q_1)/q_1}{A_2}\right) = Rq_1 \qquad (10)$$

- Banking contract protected but probability of sovereign default is amplified - Diabolic loop!!
- Welfare dominated due of deadweight costs of default

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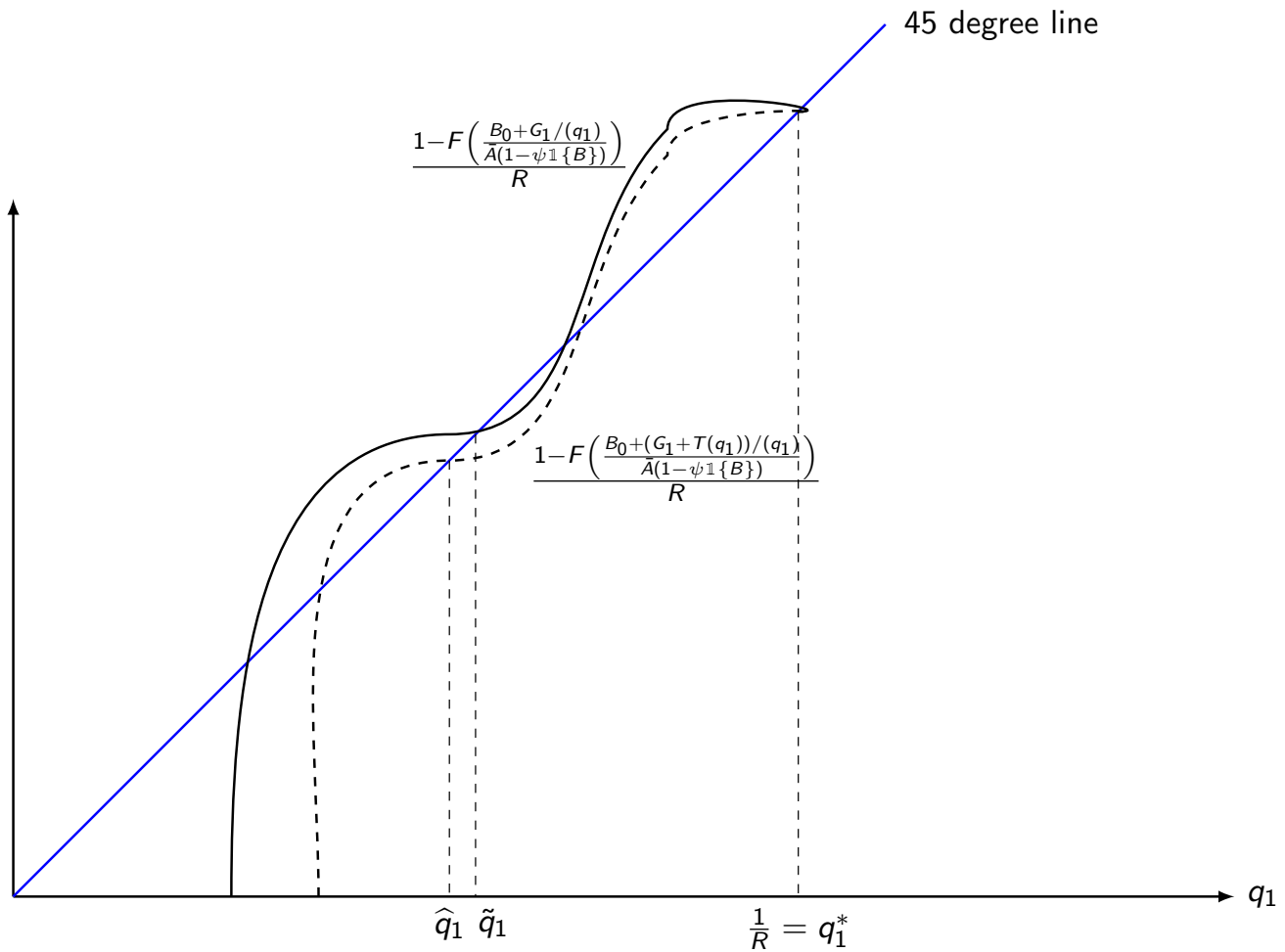
Figure: Fiscal Fragility: The Impact of $T(q_1)$



The solid curve displays the case in which $T(q_1) \equiv 0$. The dashed curve allows $T(q_1) > 0$.

The Diabolic Loop as a SPNE

- Two-Stage Game
- Banks: jointly choose size of government debt holdings and level of equity
- Two alternatives for the Government
- Discretion: chooses whether to bailout or not ex post
- Commitment: chooses whether to bailout or not ex ante
- Study a sub-game Perfect Nash Equilibrium with Sunspots

Outcome depends on commitment power

- Commitment: equity issued and no bailout (no linkage)
- Discretion: no equity issued, government bailout ex post (loop alive and well!!)

The banking contract with expected bailouts and no equity

$$\max_{b_0, i_0, L_1, b_1, c^E, c^L} \pi u\left(c^E\right) + (1-\pi)\, u\left(c^L\right)$$

such that

$$i_0 + q_0 b_0 \leq d$$

$$\pi c^E = q_1^* (b_0 - b_1) - L_1 \tag{11}$$

$$(1-\pi)\, c^L = R i_0 + b_1 + r^b L_1. \tag{12}$$

No equity and maximum debt holdings

- bailout anticipated then NO equity and very large government debt holdings
- Bank earns a DI subsidy from sovereign bond holdings
- 'Rebated' back to the government in the form of higher q_0

$$q_0 = \frac{1}{R} > \nu \frac{1}{R} + (1-\nu)\frac{p}{R} \tag{13}$$

Proposition

The optimal contract under the debt buyback scheme features maximum bank exposure to strategic uncertainty from the government debt market: (i) banks hold all the government debt (ii) no equity is issued voluntarily (iii) first best contract offered.

But will a bailout be provided?

- Calculate expected welfare with and without bailout given pessimism
- Banking contract optimal on the basis of expected bailout
- Find conditions such that bailout is indeed provided ex post

Bank Resolution Regime

- Important what happens when banks fail
- Assume orderly resolution, no bank runs
- Optimally 'haircut' all depositors: $\hat{c}^E$ and $\hat{c}^L$
- Real costs too - ψ fraction of investors' endowment is lost

Social welfare with and without a bailout

$$
\begin{aligned}
& W^{BB} - W^{NB} \qquad (14)\\
= \quad & \pi\left[u\left(c^{*E}\right) - u\left(\hat{c}^{E}\right)\right] + (1-\pi)\left[u\left(c^{*L}\right) - u\left(\hat{c}^{L}\right)\right]\\
- \quad & \omega\left(\tfrac{1}{R} - q_1^{NB}\right) B_0^B\\
+ \quad & \tfrac{\omega}{R}\left[\left(p^{BB} - p^{NB}\right)\gamma + \psi\right]\bar{A}.
\end{aligned}
$$

- Key terms
- Insuring depositors vs tax costs
- Difference in expected govt default costs
- Bank default costs when no bailout

Protecting depositors vs Tax costs

- Gains from redistribution

$$\pi\left[u\left(c^{*E}\right)-u\left(\hat{c}^{E}\right)\right]+(1-\pi)\left[u\left(c^{*L}\right)-u\left(\hat{c}^{L}\right)\right]- \omega\left(\frac{1}{R}-q_1^{NB}\right)B_0^{B} \quad (15)$$

- Rewrite as:

$$\pi\left[u\left(c^{*E}\right)-u\left(\hat{c}^{E}\right)\right]+(1-\pi)\left[u\left(c^{*L}\right)-u\left(\hat{c}^{L}\right)\right]- u'\left(c^{*E}\right)\left(\pi[c^{*E}-\hat{c}^{E}]+(1-\pi)[\frac{c^{*L}-\hat{c}^{L}}{R}]\right) \quad (16)$$

- Always positive due to concavity of utility
- Gains from bailout even greater if bank failure leads to runs and inefficient liquidations

Protecting banks vs Default costs

- DI saves bank breakdown costs but greater default risk

$$\left(p^{DI} - p^{NI}\right)\gamma + \psi > 0. \tag{17}$$

Will a bailout be provided?

Proposition

The government will bailout the banks when ψ is large and γ is small. There will exist a SPNE with a government debt buyback at a price of $q_1^T = \frac{1}{R}$ in the pessimistic sunspot state. The first best banking contract will be offered to households and no equity will be issued. Banks will buy all the government debt at $t = 0$.

Commitment

- A **committed government** chooses whether to bail out ex ante and sticks to its decision.
- The unique SPNE: Government does not bail the banks out. Banks offer the first best contract and self-insure through equity issuance.
- Pessimism sunspots occur but banking system immune

Intuition

- Insurance through bailouts is inefficient because of higher expected default costs.
- Insurance through equity issuance is preferred by committed government

Conclusions

- 'Diabolic loop' will exist as long as government debt has a zero risk weight and bank failure is costly
- Government debt is risky due to fundamental/strategic uncertainty
- Banks hold too much risky government debt when bailout expectations are high
- Governments bails out banks ex post: debt crisis magnified
- Voluntary equity issuance can (but will not) break the loop as long as bailout anticipated
- Remedies: (i) Positive risk weight on government debt and (ii) Better bank resolution mechanisms