Government Debt and Banking Fragility: The Spreading of Strategic Uncertainty

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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 ($\gamma$) and intermediation breakdown ($\psi$)

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

\[
\max E[\pi u \left( c^E(s) \right) + (1 - \pi) u \left( c^L(s) \right)]
\]

such that

\[
i_0 + q_0 b_0 \leq d + x_0
\]

\[
\pi c^E(s) \leq q_1(s) (b_0 - b_1(s)) + \varepsilon l_1(s) \forall s
\]

\[
(1 - \pi) c^L(s) \leq b_1(s) + R (i_0 - l_1(s)) - \delta_2(s) \forall s
\]

\[
E\delta_2(s) \geq Rx_0.
\]
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 $F(\frac{B_1}{A_2})$
Arbitrage by Risk Neutral Investors implies:

\[
1 - F \left( \frac{B_1}{A_2} \right) \frac{R}{R} = q_1
\]  

- \( R \) 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 \( \omega \) such that \( u'(c^E) = \omega \)
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**Debt Fragility**

- multiplicity through debt pricing as in Calvo (1988)

\[ B_1 = B_0 + \frac{G_1}{q_1} \]  

(8)

- investors price debt in period 1:

\[ 1 - F \left( \frac{B_0 + G_1/q_1}{A(1 - \psi 1\{B\})} \right) = Rq_1. \]  

(9)

- fragility from multiple solutions to (9)
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 $\hat{q}_1 < q_1^*$.
- 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:

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

- Banking contract protected but probability of sovereign default is amplified - Diabolic loop!!
- Welfare dominated due of deadweight costs of default.
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 $T(q_1) > 0$. 

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$\bar{q}_1 \approx q_1$ $1 = R$ $q_1^*$
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

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

such that

\[
i_0 + q_0 b_0 \leq d
\]

\[
\pi c^E = q_1^* (b_0 - b_1) - L_1 \quad (11)
\]

\[
(1 - \pi) c^L = R i_0 + b_1 + r^b L_1. \quad (12)
\]

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 \(q_0\)

\[
q_0 = \frac{1}{R} > \nu \frac{1}{R} + (1 - \nu) \frac{p}{R} \quad (13)
\]
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 - $\psi$ fraction of investors’ endowment is lost
Social welfare with and without a bailout

\[ W^{BB} - W^{NB} \]

\[ = \pi \left[ u\left( c^*E \right) - u\left( \hat{c}^E \right) \right] + \left( 1 - \pi \right) \left[ u\left( c^*L \right) - u\left( \hat{c}^L \right) \right] \]

\[ - \omega \left( \frac{1}{R} - q_{1}^{NB} \right) B_{0}^{B} \]

\[ + \frac{\omega}{R} \left[ \left( p^{BB} - p^{NB} \right) \gamma + \psi \right] \bar{A}. \]

- 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

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

- Rewrite as:

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

\[
\left(p^{DI} - p^{NI}\right)\gamma + \psi > 0.
\]  \hspace{1cm} (17)

Will a bailout be provided?

**Proposition**

The government will bailout the banks when \(\psi\) is large and \(\gamma\) 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 bail 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.