A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk

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◊ NYU Stern

Five Star Conference
Questions

1. Did financial sector bailouts ignite sovereign credit risk in the developed economies?
   - were there important immediate costs to the bailouts (as opposed to just distortions of future incentives)

2. What mechanisms underlie the relationship between financial sector and sovereign credit risk?
   - transmission of risks (spillover) between the sectors
   - trade-off between financial sector and sovereign credit risk

3. Does sovereign credit risk also feedback onto financial sector credit risk?
   - the ongoing banking crisis: impact of default risk in Greece, Ireland, Portugal, Italy(!)
Motivation:
Bailout of Irish Banks
On September 30, 2008 the government of Ireland announced a guarantee of all deposits of its six biggest banks.

Later all unsecured bondholders of these banks receive a government guarantee.

Credit default swap (CDS) fee for buying protection on Irish banks fell from 400 bps to 150 bps.

From the standpoint of stabilizing the financial sector, the end goal of the guarantees appeared to have been met.

What impact would these provisions have on the credit risk of the government of Ireland?
Bailouts and Risk Transfer

- Just one of the Irish banks, Anglo Irish, cost the government Euro 25 Billion or 11.26% of GDP by Aug’10

- Ireland received 85 Billion Euro rescue package by European Union and IMF in Nov’10 and now needs another 24 Billion Euro for lenders

- Total is approximately 70% of 2010 GDP
A Motivating Example: The Case of Ireland

Chart similar across many countries:

1. sovereign CDS close to 0 through first-half 2008
2. post bailout announcement (9/30/2008): sovereign CDS jumps up, bank CDS drops down
3. subsequent positive comovement
bank CDS has increased substantially
not much change in sovereign CDS
During the Bailout Period


- bank CDS decreases substantially
- strong increase in sovereign CDS
post bailout

positive comovement

a merger of financial sector and and sovereign?
Models trade-off between sovereign and financial sector credit risk

Government can transfer resources to financial sector
- Transfer alleviates under-provision of financial services (debt overhang)
- Funding the transfer induces underinvestment in corporate sector and dilutes existing sovereign bondholders

Solve government’s problem and resulting sovereign bond price
1. Under certainty about future output and no-default
2. Allowing for strategic default
3. Under uncertainty about future output

Empirical evidence from financial crisis of 2007 to 2010
Three dates: \( t = 0, 1, 2 \)

Sectors: Financial, Corporate, and Government

Financial sector:

\[
\max_{s_0^s} E_0 \left[ \left( w_s s_0^s - L_1 + \tilde{A}_1 + A_G + T_0 \right) \times 1 \{ -L_1 + \tilde{A}_1 + A_G + T_0 > 0 \} \right] - c(s_0^s)
\]

1. Produces financial services \( s_0^s \) for per-unit wage \( w_s \) at cost of \( c(s_0^s) \)
   - an input to corporate sector production
   - revenue captured only if solvent at \( t=1 \) (otherwise goes to debtholders)

2. Incentive to produce depends on \( p_{solv} = E_0 \left[ 1 \{ -L_1 + \tilde{A}_1 + A_G + T_0 > 0 \} \right] \)
   - \( L_1 \) are liabilities due at \( t=1 \)
   - \( \tilde{A}_1 \) uncertain payoff of assets at \( t=1 \)
   - \( A_G \) a fraction \( k_A \) of outstanding sovereign debt
   - crisis \( \rightarrow \) low \( p_{solv} \) (debt-overhang) \( \rightarrow \) under-provision of financial services
   - \( T_0 \) is value of govt transfer (bailout)
Corporate sector:

\[
\max_{s_0^d, K_1} E_0 \left[ f(K_0, s_0^d) - w_s s_0^d + (1 - \theta_0) \tilde{V}(K_1) - (K_1 - K_0) \right]
\]

1. Buys \( s_0^d \) financial services to produce output \( f(K_0, s_0^d) \) at \( t=1 \)

2. Makes investment \( K_1 \) at \( t=1 \) in project with uncertain payoff \( \tilde{V}(K_1) \) at \( t=2 \)
   - \( V(K_1) = E_0 \left[ \tilde{V}(K_1) \right] = K_1^\gamma, \ 0 < \gamma < 1 \)

3. Tax rate \( \theta_0 \) set at \( t = 0 \) and levied at \( t = 2 \)
   - funds existing govt debt and new transfer \( T_0 \)
   - distorts incentive to invest \( \rightarrow \) underinvestment:

\[
\frac{dK_1}{d\theta_0} = \frac{V'(K_1)}{(1 - \theta_0)V''(K_1)} < 0
\]

Example: HP threatens to reduce investment in Ireland if taxes hiked to fund bailout (11/21)

- expected tax revenue \( T = \theta_0 V(K_1) \)
- \( T \) rises in \( \theta_0 \) then falls (Laffer curve)
The Government’s Problem

1. Risk-Neutral representative consumer owns bonds and equity
   ⇒ Government’s objective is to maximize expected total output

   *Uses Transfer (Bailout) to alleviate under-provision of financial services (debt-overhang)*

2. Funds the Transfer and Existing Govt Debt with Taxes:
   - Existing Debt: \( N_D \) outstanding bonds with face value 1
   - Transfer: \( N_T \) new bonds issued \( \Rightarrow T_0 = P_0 N_T \)
   - Defaults if: \( \theta_0 \tilde{V}(K_1) < N_D + N_T \) ⇒ deadweight loss of \( D \)

3. Govt chooses tax rate \( \theta_0 \) and new bond issuance \( N_T \) to maximize total output:
   - subject to equilibrium conditions and price \( P_0 \)
   - Insolvency ratio \( H = \frac{N_T + N_D}{T} = \frac{N_T + N_D}{\theta_0 \tilde{V}(K_1)} \)
   - rewrite using \( T \) and \( H \) instead of \( \theta_0 \) and \( N_T \)
Consider first certain output, \( \bar{V}(K_1) = V(K_1) \), and no default \( H = 1 \)

We show that under sufficient conditions:

1. As \( L_1 \uparrow \) (more severe debt-overhang) \( \Rightarrow \hat{T} \) (tax revenue) \( \uparrow \) and \( \hat{T}_0 \) (transfer) \( \uparrow \)
   - more severe debt-overhang \( \Rightarrow s_0 \downarrow \) (worse under-provision of financial services)
   - \( \Rightarrow \) greater marginal gain from increasing the transfer (bailout)

2. As \( N_D \uparrow \) (larger existing govt debt) \( \Rightarrow \hat{T} \) (tax revenue) \( \uparrow \) but \( \hat{T}_0 \) (transfer) \( \downarrow \)
   - larger debt \( \Rightarrow \) need more tax revenue to get same transfer (\( \hat{T} \uparrow \))
   - but incur greater underinvestment cost for same amount of transfer (\( \hat{T}_0 \downarrow \))
Under strategic default, optimal to set $N_T \to \infty$ ($H \to \infty$)

Captures full tax revenue by diluting existing bondholders to zero
$
\Rightarrow \text{greater } T_0 (\uparrow s_0) \text{ with lower } \theta_0 (\downarrow \text{underinvestment})
$

But suffer dead-weight loss $D$

- $k_A$ (fin sector sovereign holdings) $\left[-\right] \to \text{‘collateral damage’}$
With Uncertainty

Uncertain output: $\tilde{V}(K_1) = V(K_1)\tilde{R}_V$

1. $p_{\text{def}} = \text{prob}\left(\tilde{R}_V < H\right)$

2. $P_0 = E_0\left[\min\left(1, \frac{1}{H}\tilde{R}_V\right)\right]$

3. $T_0 = (T - \frac{N_D}{H})E_0\left[\min\left(H, \tilde{R}_V\right)\right]$

- Sovereign chooses $H$ (insolvency ratio) on an interval, not just 1 or $\infty$

$\uparrow H \Rightarrow$ sovereign ‘sacrificing’ its creditworthiness to increase the bailout

- $T_0$ (bailout) $\uparrow$
- $p_{\text{def}}$ (probability of sovereign default) $\uparrow$
- $P_0$ (gouv bond price) $\downarrow$
Comparative Statics for Debt Overhang \((L_1)\)

- \(\mathcal{T}\) (expected tax revenue) increases in \(L_1\)
- High \(L_1\) (‘crisis’) \(\rightarrow H \uparrow\) (spillover, emergence of sovereign credit risk)
- \(H \uparrow\) increases \(T_0\) while \(P_0 \downarrow\)
  - dotted line shows when total default becomes optimal
  - default allows for larger \(T_0\) with smaller \(\mathcal{T}\)
Debtholders of Financial sector may liquidate/run if they fear insolvency:

\[ \tilde{A}_1 + T_0 < L \]

To prevent liquidation, govt ‘promises’ to pay bondholders (from tax revenues)

\[ \max(L - \tilde{A}_1 + T_0, 0) \]

This ‘guarantee’ is pari-passu with other government claims.

\[ \Rightarrow \] Equivalent to issuing \( L - \tilde{A}_1 + T_0 \) new govt bonds

Greatly affects (recovery) value of fin sector bondholders

The guarantee channel of sovereign credit risk affects bank debt over and above its effect on bank equity/assets
Empirical Implications I: Financial Sector → Sovereign

Fin sector crisis → severe debt-overhang ($L_1$) → Bailouts

1. Bailouts reduce bank credit risk, trigger increase in sovereign credit risk

2. *Spillover*: Pre-bailout financial sector distress predicts post-bailout increase in $H$ (insolvency ratio) and sovereign CDS

3. Emergence of a positive relationship between the level of govt debt and sovereign credit risk (CDS)
Sov. CDS change vs. Pre-bailout Financial Sector Distress

- Financial Sector Distress: average bank CDS pre-bailout (21 Sep 2008)
- Sovereign CDS change: pre- to post-bailout
Emergence of Sovereign Credit Risk

Sov. CDS vs. Debt/GDP

- Pre-Bailouts: low-$H$ region, not much relationship
- Post-Bailouts: sovereigns increase $H$, relationship becomes apparent
Pre-bailout debt-to-gdp and fin sector distress

- **strongly predict** post-bailout sovereign CDS, debt-to-gdp
- no relation pre-bailouts
Empirical Implications II: Sovereign → Financial Sector

Bailouts → emergence sovereign credit risk → affects bank credit risk

1. Increase in sovereign CDS raises Bank CDS
2. Empirical identification problem: unobserved third factor (e.g., gdp growth)
3. Examine co-movement of sovereign and bank CDS

$$\Delta \log(\text{Bank CDS}_{ijt}) = \alpha_i + \delta_t + \beta \Delta \log(\text{Sovereign CDS}_{jt}) + \gamma \Delta X_{ijt} + \varepsilon_{ijt}$$

$X_{ij}$ control for
- Market-wide factors
- Time and bank fixed-effects
- Bank stock return
### Market-Wide Controls and Time Fixed-Effects

<table>
<thead>
<tr>
<th></th>
<th>Pre-Bailout (1)</th>
<th>Pre-Bailout (2)</th>
<th>Pre-Bailout (3)</th>
<th>Pre-Bailout (4)</th>
<th>Pre-Bailout (5)</th>
<th>Pre-Bailout (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta ) Log(Sovereign CDS)</td>
<td>0.017 (0.010)</td>
<td>0.003 (0.017)</td>
<td>0.448* (0.169)</td>
<td>-1.293** (0.387)</td>
<td>0.221** (0.026)</td>
<td>0.163** (0.033)</td>
</tr>
<tr>
<td>( \Delta ) Log(CDS Market Index)</td>
<td>0.962** (0.043)</td>
<td>0.893** (0.216)</td>
<td>0.722** (0.034)</td>
<td></td>
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<tr>
<td>( \Delta ) Volatility Index</td>
<td>0.671** (0.113)</td>
<td>-0.946** (0.238)</td>
<td></td>
<td>0.057 (0.051)</td>
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<th>Pre-Bailout (5)</th>
<th>Pre-Bailout (6)</th>
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<tbody>
<tr>
<td>Week FE</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
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<tr>
<td>Interactions</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
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<tr>
<td>Observations</td>
<td>2,891</td>
<td>2,891</td>
<td>254</td>
<td>254</td>
<td>6,500</td>
<td>6,500</td>
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<tr>
<td>Banks</td>
<td>62</td>
<td>62</td>
<td>53</td>
<td>53</td>
<td>59</td>
<td>59</td>
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<tr>
<td>R-squared</td>
<td>0.262</td>
<td>0.476</td>
<td>0.114</td>
<td>0.599</td>
<td>0.338</td>
<td>0.479</td>
</tr>
</tbody>
</table>

- post-bailout: \( \beta \) is positive, very statistically significant
- around bailouts: \( \beta \) negative
Time Series of $\beta$

3-month moving average of $\beta$ estimates and 95% confidence interval
Controlling Also For Bank Stock Returns

<table>
<thead>
<tr>
<th></th>
<th>Pre-Bailout</th>
<th>Δ Log(Bank CDS)</th>
<th>Bailout</th>
<th>Post-Bailout</th>
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<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Δ Log(Sovereign CDS)</td>
<td>0.014</td>
<td>0.004</td>
<td>0.449**</td>
<td>-1.02</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.018)</td>
<td>(0.164)</td>
<td>(1.034)</td>
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<tr>
<td>Equity Return</td>
<td>-0.306*</td>
<td>-0.194</td>
<td></td>
<td>-0.145**</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.185)</td>
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<td>(0.030)</td>
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<td>Other Controls</td>
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<td>Y</td>
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<td>Week FE</td>
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<td>Banks</td>
<td>62</td>
<td>62</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.271</td>
<td>0.517</td>
<td>0.126</td>
<td>0.854</td>
</tr>
</tbody>
</table>

- sovereign CDS *still* very significant
- govt guarantees favor debt over equity → change in value of guarantee matters *even* after controlling for stock return
Sovereign → Financial Sector: Stress Tests

- European Bank Stress Tests
  - Collect bank-level sovereign holdings data as of March 31st, 2010

- Shows banks have substantial sovereign debt holdings
  - Strong ‘Home bias’ in sovereign holdings: 69.4%

- Use reported positions to examine co-movement of sovereign and bank CDS
  - Compute sovereign exposure with holdings as weight
  - Exclude home-holdings to avoid bias from economic shocks in home country
## Size of Sovereign Bond Holdings of European Banks

<table>
<thead>
<tr>
<th>Sovereign Holdings</th>
<th>Euro Bank Stress Tests Sample, March 31, 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (1)</td>
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<tr>
<td>Bank Characteristics</td>
<td></td>
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<tr>
<td>Risk-weighted Assets (EUR million)</td>
<td>91</td>
</tr>
<tr>
<td>Tier 1 Capital Ratio (%)</td>
<td>91</td>
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<tr>
<td>Sovereign Exposure</td>
<td></td>
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<tr>
<td>Sovereign Holdings (gross, EUR million)</td>
<td>91</td>
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<tr>
<td>Sovereign Holdings (net, EUR million)</td>
<td>91</td>
</tr>
<tr>
<td>Home Sovereign Holdings (gross, EUR million)</td>
<td>91</td>
</tr>
<tr>
<td>Home Sovereign Holdings (net, EUR million)</td>
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<tr>
<td>Home Share (%)</td>
<td>91</td>
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<tr>
<td>Greek Sovereign Holdings</td>
<td>91</td>
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<tr>
<td>Share Banking Book (%)</td>
<td>91</td>
</tr>
</tbody>
</table>
Home Bias in Sovereign Bond Holdings
### Co-movement of Bank CDS and Foreign Sovereign CDS

The table shows regression of change in bank CDS on change in exposure to sovereign bank holdings. The sovereign bond holdings data were collected from the website of the Committee of European Banking Regulators and nation websites of the respective bank regulators. We construct the exposure variable as the weighted average of country CDS with sovereign holdings as weights. Changes are computed as log changes. The data covers the period from 3/1/2010 to 4/30/2010. Columns (2), (5) and (6) include bank fixed effects. Column (3) includes week fixed effects. Column (4) to (6) include day fixed effect. The exposure variable in Column (6) excludes German bonds. The standard errors are clustered at the bank-level (51 banks). ** 1% significant, * 5% significant, and +10% significant.

<table>
<thead>
<tr>
<th>Sample</th>
<th>All</th>
<th>All</th>
<th>All</th>
<th>All</th>
<th>All</th>
<th>Excluding Germany</th>
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<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
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<tr>
<td>Change in Sovereign Exposure</td>
<td>0.325**</td>
<td>0.326**</td>
<td>0.261**</td>
<td>0.141**</td>
<td>0.135**</td>
<td>0.137**</td>
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<tr>
<td></td>
<td>(0.027)</td>
<td>(0.028)</td>
<td>(0.027)</td>
<td>(0.049)</td>
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<tr>
<td>Bank FE</td>
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<td>N</td>
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<td>Week FE</td>
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<td>Y</td>
<td>N</td>
<td>N</td>
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<td>Day FE</td>
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<tr>
<td>Banks</td>
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<td>51</td>
<td>51</td>
<td>51</td>
<td>0.357</td>
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<tr>
<td>R-squared</td>
<td>0.173</td>
<td>0.188</td>
<td>0.228</td>
<td>0.342</td>
<td>0.357</td>
<td>0.357</td>
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<tr>
<td>Adjusted R-Squared</td>
<td>0.173</td>
<td>0.170</td>
<td>0.224</td>
<td>0.329</td>
<td>0.329</td>
<td>0.329</td>
</tr>
</tbody>
</table>
Future costs of bailouts (e.g., moral hazard) are far from being the only important ones.

Costs are clear and present as bailouts have led to the emergence of sovereign credit risk:
- Gov. Budget constraint has tightened (gov. pockets are finite)– the elimination of slack is priced by the markets.

Resulting credit riskiness of sovereign debt feeds back onto financial sector:
- the ongoing banking crisis: impact of default risk in Greece, Ireland, Portugal, Italy.

Immediate stabilization of the financial sector by bailouts can be a Pyrrhic victory:
- the restructuring of financial sector debt should be considered more seriously.
Figure 4. Up-front Government Financing Need to Shore Up the Financial Sector 1/
(Percent of 2008 GDP)

1/ Includes capital injections, purchase of assets, and lending by treasury that require up-front government outlays.
What if the Sovereign Cannot Do a Bailout? – Iceland vs. Ireland CDS

Viral Acharya, Itamar Drechsler and Philipp Schnabl

A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk