A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk

Viral Acharya, Itamar Drechsler and Philipp Schnabl$^\diamond$

$^\diamond$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

From Financial Sector Credit Risk to Sovereign Credit Risk

- 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

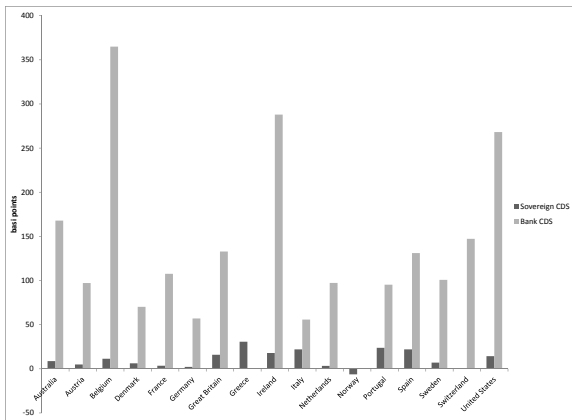- Total is approximately 70% of 2010 GDP

A Motivating Example: The Case of Ireland
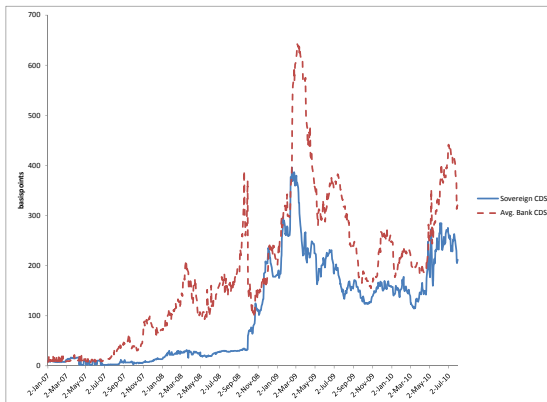
- Chart similar across many countries:
  1. sovereign CDS close to 0 through first-half 2008
  2. post bailout announcement (9/30/2008): sovereign CDS jumps up, bank CDS drops down
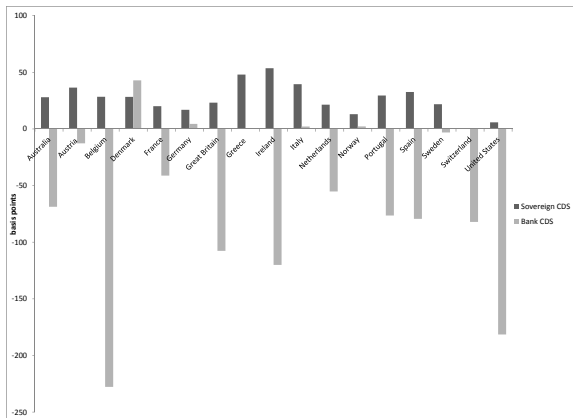 3. subsequent positive comovement

Pre-Bailouts: Europe

3/1/2007 – 9/26/2008

- bank CDS has increased substantially
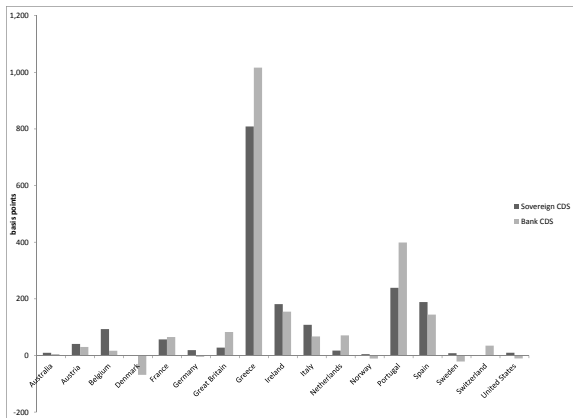- not much change in sovereign CDS

During the Bailout Period

9/27/2008 – 10/21/2008

- bank CDS decreases substantially
- strong increase in sovereign CDS

Post Bailout

10/22/2008 – 6/30/2010

- positive comovement
- a merger of financial sector and and sovereign?

This Paper

- 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

Model

- Three dates: t = 0, 1, 2
- Sectors: Financial, Corporate, and Government

Financial sector:

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

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 $p_{solv} = E_0 \left[1_{\left\{ -L_1 + \tilde{A}_1 + A_G + T_0 > 0 \right\}} \right]$
   - 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 –> low p_{solv} (debt-overhang)–> under-provision of financial services
   - T_0 is value of govt transfer (bailout)

Corporate Sector

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 θ_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 $\quad \mathcal{T} = \theta_0 V(K_1)$
   - $\mathcal{T}$ rises in θ_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 → $T_0 = P_0 N_T$

   - Defaults if: $\theta_0 \tilde{V}(K_1) < N_D + N_T \Rightarrow$ deadweight loss of D

3. Govt chooses tax rate θ_0 and new bond issuance N_T to maximize total output:

   - subject to equilibrium conditions and price P_0

   - Insolvency ratio $\quad H = \dfrac{N_T + N_D}{\mathcal{T}} = \dfrac{N_T + N_D}{\theta_0 V(K_1)}$

   - rewrite using $\mathcal{T}$ and H instead of θ_0 and N_T

## Optimal $\mathcal{T}$ under Certainty and No Sovereign Default

Consider first certain output, $\tilde{V}(K_1) = V(K_1)$, and no default $H = 1$

We show that under sufficient conditions:

1. As $L_1 \uparrow$ (more severe debt-overhang) $\Rightarrow \hat{\mathcal{T}}$ (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) $\Rightarrow \hat{\mathcal{T}}$ (tax revenue) $\uparrow$ *but* $\hat{T}_0$ (transfer) $\downarrow$

   - larger debt $\rightarrow$ need more tax revenue to get same transfer ($\hat{\mathcal{T}} \uparrow$)
   - but incur greater underinvestment cost for same amount of transfer ($\hat{T}_0 \downarrow$)

Strategic Sovereign Default Under Certainty

1. Under strategic default, optimal to set $N_T \to \infty$ ($H \to \infty$)
2. Captures full tax revenue by diluting existing bondholders to zero
$\Rightarrow$ greater T_0 ($\uparrow s_0$) with lower θ_0 ($\downarrow$ underinvestment)
3. But suffer dead-weight loss D

Default and No–Default Regions
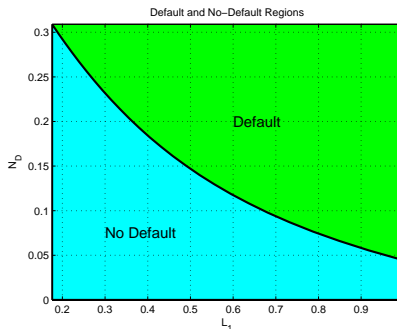
- k_A (fin sector sovereign holdings) $[-] \to$ 'collateral damage'

With Uncertainty

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

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

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

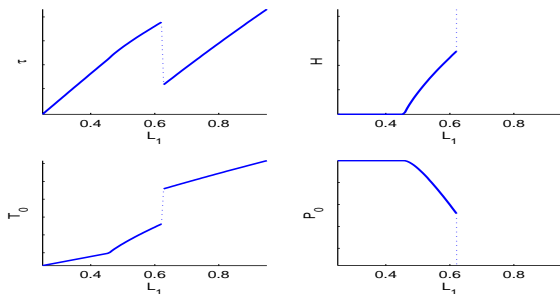3. $T_0 = (\mathcal{T} - \frac{N_D}{H})E_0\left[\min\left(H, \tilde{R}_V\right)\right]$

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

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

- T_0 (bailout) $\uparrow$
- p_{def} (probability of sovereign default) $\uparrow$
- P_0 (govt 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 $\mathcal{T}$

Government 'Guarantee'

- 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 $\quad L - \tilde{A}_1 + T_0 \quad$ 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 $\rightarrow$ Sovereign

Fin sector crisis $\rightarrow$ severe debt-overhang (L_1) $\rightarrow$ 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)
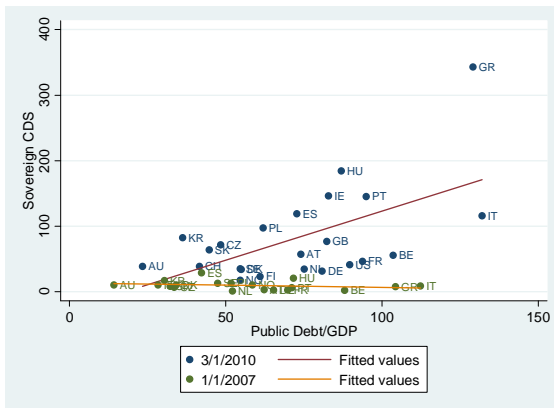
Spillover
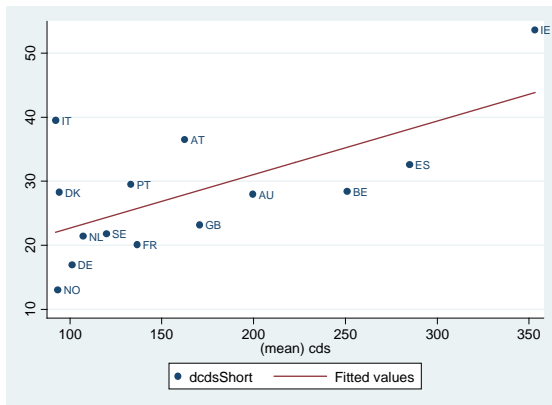
Sov. CDS change vs. Pre-bailout Financial Sector Distress

- 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

Spillover and the Emergence of Sovereign Risk

| | Log (Sovereign CDS) | | | |
| | Pre-Bailout | | Post-Bailout | |
	(1)	(2)	(3)	(4)
Pre-bailout Gov't Debt (in %)	0.006	0.005	0.015*	0.013+
	(0.004)	(0.005)	(0.006)	(0.007)
Pre-bailout Fin. Sector Distress		0.311		0.965*
		(0.208)		(0.357)
Observations	15	14	17	15
R-squared	0.134	0.171	0.261	0.488

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 $\rightarrow$ Financial Sector

Bailouts $\rightarrow$ emergence sovereign credit risk $\rightarrow$ 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

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

- post-bailout: β is positive, very statistically significant

- around bailouts: β negative

Time Series of β
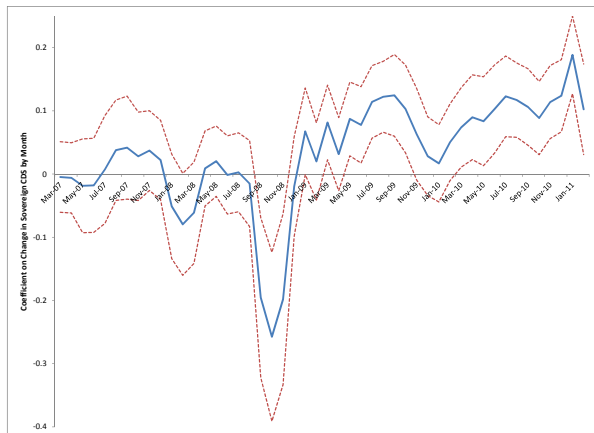
3-month moving average of β estimates and 95% confidence interval

Controlling Also For Bank Stock Returns

| | Δ Log(Bank CDS) | | | | | |
| | Pre-Bailout | | Bailout | | Post-Bailout | |
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(Sovereign CDS)	0.014	0.004	0.449**	-1.02	0.197**	0.146**
	(0.010)	(0.018)	(0.164)	(1.034)	(0.028)	(0.033)
Equity Return	-0.306*		-0.194		-0.145**	
	(0.142)		(0.185)		(0.030)	
Other Controls	Y	Y	Y	Y	Y	Y
Week FE	N	Y	N	Y	N	Y
Interactions	N	Y	N	Y	N	Y
Observations	2,891	2,891	254	254	6,500	6,500
Banks	62	62	53	53	59	59
R-squared	0.271	0.517	0.126	0.854	0.349	0.495

- 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

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Sovereign Holdings
Euro Bank Stress Tests Sample, March 31, 2010

</div>

	N (1)	Mean (2)	Std.Dev (3)	50th Percentile (4)	5th Percentile (5)	95th Percentile (6)
Bank Characteristics						
Risk-weighted Assets (EUR million)	91	126,337	179,130	63,448	3,269	493,307
Tier 1 Capital Ratio (%)	91	10.2	2.4	9.8	7.2	14.4
Sovereign Exposure						
Sovereign Holdings (gross, EUR million)	91	20,668	27,948	7,930	105	81,765
Sovereign Holdings (net, EUR million)	91	19,719	27,329	6,960	105	78,959
Home Sovereign Holdings (gross, EUR million)	91	11,493	14,422	5,774	182	42,800
Home Sovereign Holdings (net, EUR million)	91	11,023	13,956	5,348	117	42,800
Home Share (%)	91	69.4	30.0	81.6	18.9	100
Greek Sovereign Holdings	91	669	2,844	0	0	5,601
Share Banking Book (%)	91	84.9	19.9	92.2	35.4	100.0

Home Bias in Sovereign Bond Holdings
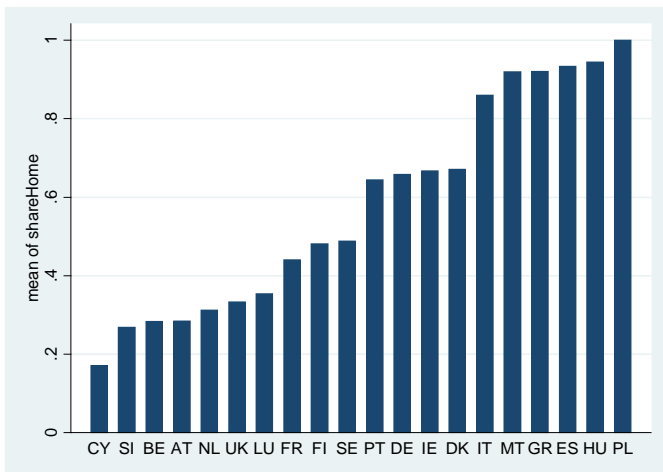
Co-movement of Bank CDS and Foreign Sovereign CDS

Sample	Change in Bank CDS					Excluding Germany
	All	All	All	All	All	
	(1)	(2)	(3)	(4)	(5)	(6)
Change in Sovereign Exposure	0.325**	0.326**	0.261**	0.141**	0.135**	0.137**
	(0.027)	(0.028)	(0.027)	(0.049)	(0.046)	(0.046)
Bank FE	N	Y	N	N	Y	Y
Week FE	N	N	Y	N	N	N
Day FE	N	N	N	Y	Y	Y
Observations	2,317	2,317	2,317	2,317	2,317	2,317
Banks	51	51	51	51	51	0.357
R-squared	0.173	0.188	0.228	0.342	0.357	0.357
Adjusted R-Squared	0.173	0.170	0.224	0.329	0.329	0.329

Conclusion

- 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

Up-Front Estimates of Bailout Costs

Figure 4. Up-front Government Financing Need to Shore Up the Financial Sector 1/
(Percent of 2008 GDP)
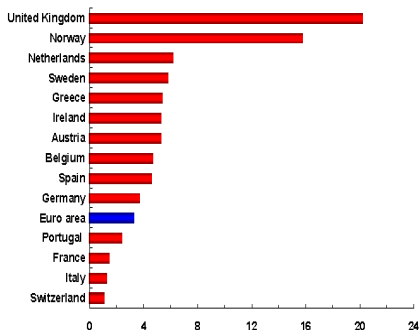
Source: IMF (2009a).
1/ Includes capital injections, purchase of assets, and lending by treasury that require up-front government outlays.

What if the Sovereign Cannot Do a Bailout? – Iceland vs. Ireland CDS