

The Impact of Sovereign Shocks

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Sovereign and Banking Systemic Risk

- **EVENTS:** Financial markets have recently responded dramatically to sovereign shocks
 - ▶ “European banking stocks have now lost 22 per cent of their value in the two days of trading following the UK’s EU vote” (FT.com June 27, 2016)
 - ▶ Massive government interventions in the banking system have made countries more *fiscally* fragile
- **LITERATURE:**

Recent research has focused on banking systemic risk (Adrian and Brunnermeier (2015); Acharya et al. (2010); Brownlee and Engle (2010); Acharya et al. (2012); Giglio et al. (2012))

... but also some interest in sovereign systemic risk (Billio et al. (2013); Gennaioli et al. (2014))
- **EVIDENCE:** Some evidence:
 - ▶ Correlation between sovereign and banking default risk has increased sharply and significantly
 - ▶ “Risk Transfer” between financial sector and government balance-sheets (Acharya et al. (2011))

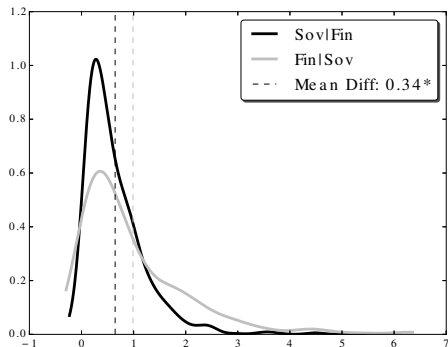
Sovereign vs Financial Shocks: Empirical Evidence

- The severity of sovereign shocks versus banking shocks (q=98%)

$$\Delta CDS_t^i = \alpha_q + \mathbf{X}_t' \gamma_q + \beta_q^{i \leftarrow j} \Delta CDS_t^j + \epsilon_t^i, \quad i, j \in \{\text{sovereign, financials}\}$$

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- ▶ **Large** sovereign spillovers are more frequent–fatter right tail than financial spillovers
- ▶ “Risk Transfer” between financial sector and government balance-sheets (Acharya et al. (2011))

In This Paper

- We investigate interrelationships between sovereign credit risk and macro-financial systemic risk by
 - ▶ Studying the **dynamic propagation** mechanism of **sovereign** and **banking shocks**
 - ▶ Exploring the potential **mechanisms of shock transmission**
 - ▶ Quantifying the implications for the **real economy**
- The two main challenges:
 - ▶ How to test and **quantify** the propagation of shocks *within* and *across* the systems
 - ▶ How to **identify** sovereign versus banking shocks

Highlights of Findings

- 1 Empirical evidence on:
 - ▶ **strong co-movements** among sovereign and banking systemic risk
 - ▶ **overreaction** of systemic risk to macroeconomic shocks
 - ▶ **time-varying** nature of systemic risk
- 2 Sovereign shocks
 - ▶ impact *significantly* and *persistently* the stability of the system, especially for the financial sector
- 3 Mechanisms of Contagion Risk
 - ▶ Fragility has a **fiscal nature**
 - ▶ **Bank exposure** drives contagion risk *across* macro-systems
- 4 Sovereign systemic risk has an *indirect* impact on the real economy, through the financial system

Challenge 1: Defining and Measuring Systemic Risk

- *What is Systemic Risk?* the risk that the capacity of the entire financial system is impaired and is a function of
 - ▶ Financial and economic linkages
 - ▶ Size of the financial/sovereign network
 - ▶ Fragility of the “lender of last resort”
- *How do we measure Systemic Risk?* **Distress Insurance Premium (DIP:** Huang et al. (2009)), a credit-portfolio measure that captures:
 - ▶ Probability of occurrence of a *rare* credit event
 - ▶ Magnitude of the default loss
 - ▶ Degree of interconnectedness of the macro-system

Distress Insurance Price

- Assume a hypothetical investor holds a portfolio of liabilities of N entities
 - ▶ Systemic Risk as *insurance price* for hedging catastrophic losses, i.e. losses greater than 10%
- The T -year Distress Insurance Price (DIP) is defined as:

$$DIP_t(T) = E^{\mathbb{Q}}[L_{t+T} \times \mathbb{1}\{L_{t+T} \geq 10\%\}]$$

where L_t is the liability-weighted total loss $L_t = \sum_{i=1}^N w_{i,t} L_{i,t}$ with $w_{i,t} = Debt_{i,t} / \sum_i Debt_{i,t}$.

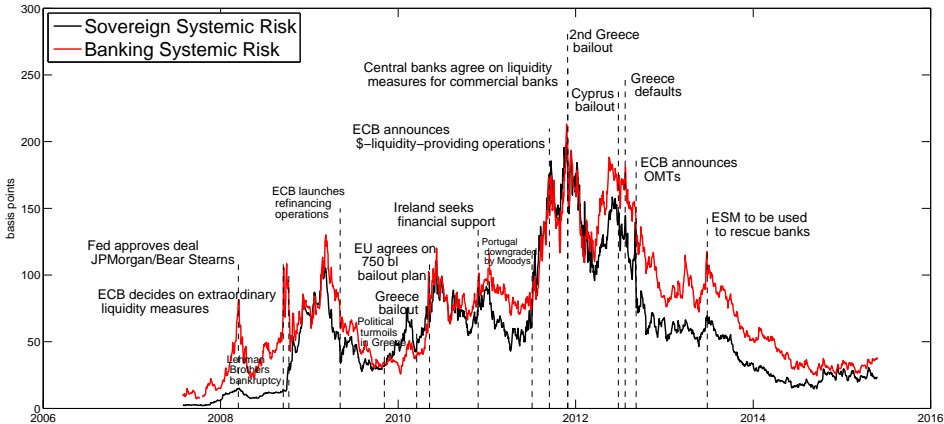
- It is a risk-neutral, sub-additive risk measure suitable for portfolio analysis

Data

- Two macro-systems (or portfolios) of 28 European countries and 163 European financial institutions
- We collect
 - ▶ 5-year Credit Default Swap (CDS) spreads [Markit]
 - ▶ Government public debt [Eurostat and IMF]
 - ▶ Book data of financial institutions [Compustat International, Datastream, Bloomberg]
- Sample period: July 2007 to May 2015

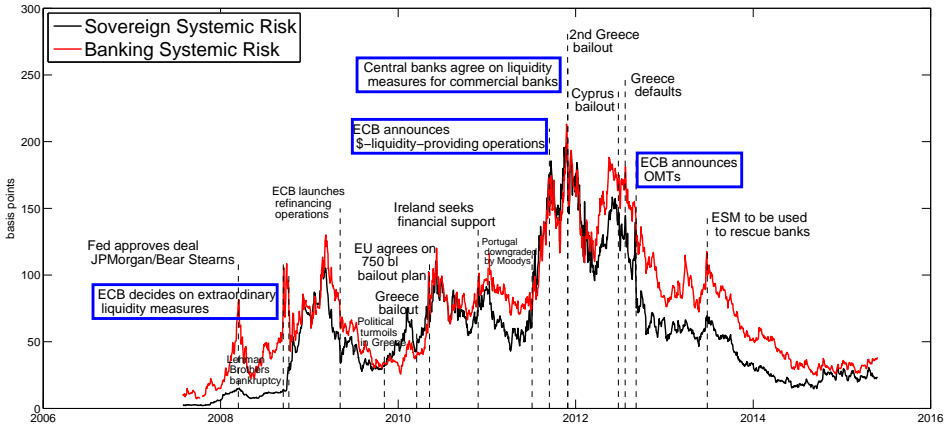
Distress Insurance Premium: $E^{\mathbb{Q}} [L_{t+5} \times \mathbb{1} \{L_{t+5} \geq 10\%\}]$

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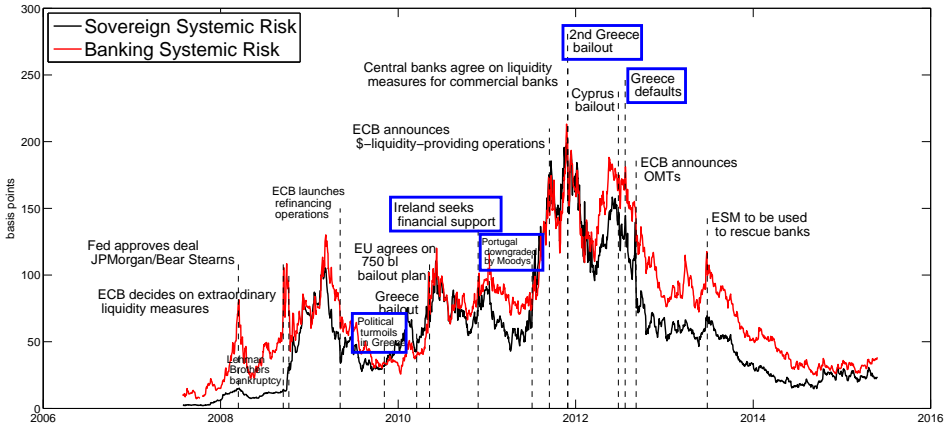
- ▶ overreacts to macroeconomic shocks: announcements and policy actions
- ▶ reaches the highest point in the Fall 2011

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Empirical Framework: Structural VAR

- An econometric approach to quantify the impact *within* and *across* networks
- The econometric choice: a bivariate VAR approach

$$y_t = \Phi z_t + u_t$$

where

$y_t = \Delta \mathbf{DIP}$ daily

$z_t = [y_{t-1}^\top, \dots, y_{t-J}^\top, x_t^\top]$ lags + exogenous

$u_t = \mathbf{B}\epsilon_t$ jointly correlated innovations (spillover across systems)

ϵ_t i.i.d. shocks

\mathbf{B} : rate of transmission

Empirical Framework: Structural VAR

- How to identify the off-diagonal of \mathbf{B} ?
- Structural decomposition of shocks (Romer and Romer (1989); Mertens and Ravn (2010))
 - ▶ Partition $\mathbf{B} = [\beta^{sov}, \beta^{bank}, \tilde{\beta}]$ such that shocks are decomposed into sovereign and banking specific

$$u_t = \beta^{sov} \epsilon_t^{sov} + \beta^{bank} \epsilon_t^{bank} + v_t$$

- ▶ Instruments $\mathbb{1}_{sov}$ and $\mathbb{1}_{bank}$ for ϵ_t^{sov} and ϵ_t^{bank} where $\mathbb{1} = \{-1, 0, +1\}$ is a signed variable

Empirical Framework: Structural VAR

- We instrument ϵ_t^{sov} and ϵ_t^{bank} :

$$u_t = \beta^{sov} \underbrace{\mathbb{1}_{sov} \xi_{sov}}_{\epsilon^{sov}} + \beta^{bank} \underbrace{\mathbb{1}_{bank} \xi_{bank}}_{\epsilon^{bank}} + v_t$$

$$u_t = \begin{bmatrix} \beta^{sov \leftarrow sov} & \beta^{sov \leftarrow bank} \\ \beta^{bank \leftarrow sov} & \beta^{bank \leftarrow bank} \end{bmatrix} \begin{bmatrix} \mathbb{1}_{sov} \xi_{sov} \\ \mathbb{1}_{bank} \xi_{bank} \end{bmatrix} + v_t$$

$$\mathbb{1} = \{-1, 0, +1\}$$

ξ_j : size of the exceptional shock

$\beta^{Y \leftarrow X}$: impact of shock X onto Y risk

- The **impact matrix** becomes (after normalizing)

$$\mathbf{B} = \begin{bmatrix} \xi_{sov} & B^{sov \leftarrow bank} \\ B^{bank \leftarrow sov} & \xi_{bank} \end{bmatrix}$$

where $B^{sov \leftarrow bank} = \beta^{sov \leftarrow bank} / \xi_{bank}$ and $B^{bank \leftarrow sov} = \beta^{bank \leftarrow sov} / \xi_{sov}$

Challenge //: Shock Identification

- How to identify instruments $\mathbb{1}_{sov}$ and $\mathbb{1}_{bank}$? Our approach fuses narrative with statistics (Collin-Dufresne et al. (2010))

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A news is *relevant* when it includes:
 - ▶ policy announcement (CBs, EU, individual countries)
 - ▶ Rating agencies' actions
 - ▶ Social unrest
 - ▶ Extraordinary events (bankruptcy)

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 2. Read news articles and split them into
 - ▶ *bank specific*: if it has a direct impact on the banking system
 - ▶ *sovereign specific*: if it has a direct impact on the sovereign system

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 3. Compute shock size as $\Delta DIP_t^i \times \mathbf{1}_t$ with $i = sov, bank$ and $\mathbf{1}_t$ is a dummy if at t there is an event. Keep $\Delta DIP_t^i \times \mathbf{1}_t \geq 5bps$ ($\approx 8\%$)

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 4. Build $\mathbb{1}_{i,t} = \{-1, 0, +1\}$ for $i = sov, bank$ by setting the sign so that
 - ▶ +1: mitigate the risk
 - ▶ -1: increase the risk

Shock Identification: Some Examples

Sovereign Shocks

- Apr 22, 2010: Eurostat says Greece's 2009 budget higher than reported. Papandreou asks for activation of EU aid
- May 5, 2010: Violent protest erupt in Athens against austerity measures
- July 26, 2012: Draghi's famous "Whatever it takes"
- Sept 6, 2012: ECB announces OMT to buy government bonds if a country ask for financial assistance

Banking Shocks

- Oct 8, 2008: ECB decides on extraordinary liquidity measures for banks
- Sept 15, 2011: ECB announces additional US dollar liquidity-providing operations
- Oct 6, 2011: ECB announces second covered bond purchase program
- Feb 10, 2012: Moody's downgrades 37 Italian banks

Empirical Findings

$$\mathbf{B} = \begin{bmatrix} \xi_{sov} & B^{sov \leftarrow bank} \\ B^{bank \leftarrow sov} & \xi_{bank} \end{bmatrix}$$

REMINDE: $B^{Y \leftarrow X}$ effect of X -shock onto the system Y (coefficients in basis points)

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Within-System Average Shock Impact				
	<i>Coefficient</i>	<i>t-Stat</i>	<i>Confidence Intervals</i>	
ξ_{sov}	-7.72	-10.62	-9.23	-6.30
ξ_{bank}	-7.03	-13.60	-8.06	-6.02

Across-System Average Spillover Rate				
	<i>Coefficient</i>	<i>t-Stat</i>	<i>Confidence Intervals</i>	
$B^{sov \leftarrow bank}$	0.36	4.90	0.22	0.51
$B^{bank \leftarrow sov}$	0.76	13.61	0.64	0.87

Empirical Findings: Exceptional Shocks

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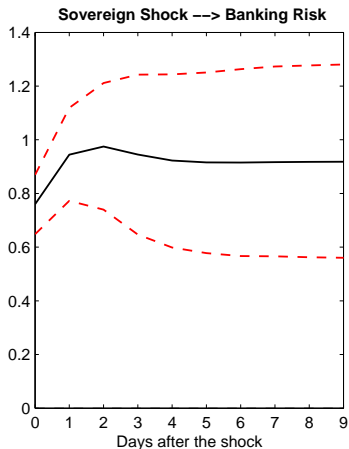
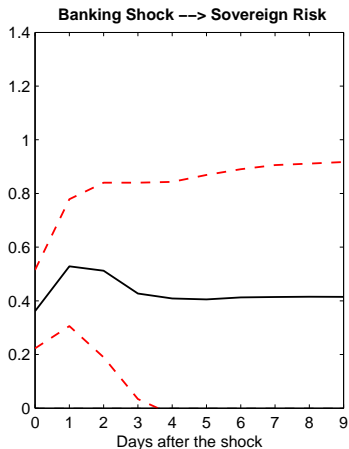
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$$B^{bk,sov} / B^{sov,bk} \approx 2.11$$

Empirical Findings: Impulse Response Functions



- Sovereign shocks larger on impact but also persistent

So Far... and Next

- Evidence on:
 - ▶ **strong co-movements** among sovereign and banking systemic risk
 - ▶ **overreaction** of systemic risk to macroeconomic shocks
 - ▶ **time-varying** nature of systemic risk
- Sovereign shocks
 - ▶ have **significant implications** for the stability of the system, especially for the financial sector
 - ▶ are **persistent** as opposed to banking shocks
- Now let's dig into these macroeconomic systems

Detecting Sources of Fragility: The Sovereign System

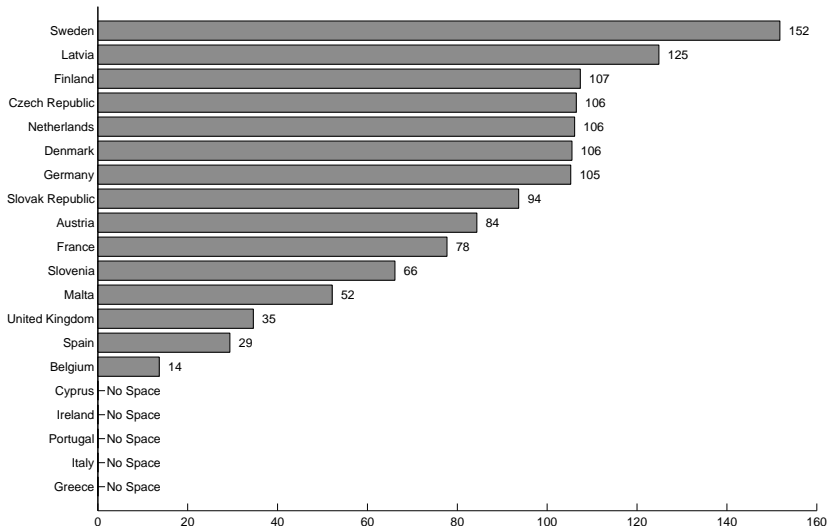
- Do **fiscal constraints** matter for the fragility of the network?
- We measure the degree to which a government is *fiscally constrained* by
 - ▶ Room for fiscal maneuver (**Fiscal Space**)
 - ▶ Level of **indebtedness** relative to GDP
- We measure systemic risk of sub-systems of governments to investigate where fragility is located

Measuring Fragility: Fiscal Space

- Fiscal Space is the difference between the theoretical government debt limit and its actual level Fiscal Space

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Fiscal Space and Indebtedness

- We sort countries according to their fiscal space and debt-to-GDP ratios

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- REMIND: $B^{Y \leftarrow X}$ effect of X -shock onto the system Y

Countries sorted on Fiscal Space									
	High Fiscal Space				Low Fiscal Space				
	Coefficient	t-Stat	Confidence Intervals		Coefficient	t-Stat	Confidence Intervals		
ξ_{sov_i} / ξ_{sov}	0.02	7.04	0.020	.03	ξ_{sov_i} / ξ_{sov}	0.60	7.34	0.46	0.78
$B^{sov_i \leftarrow bank}$	0.008	4.25	0.005	0.01	$B^{sov_i \leftarrow bank}$	0.22	4.5	0.13	0.33

Fiscal Space and Indebtedness: Spillover Rate

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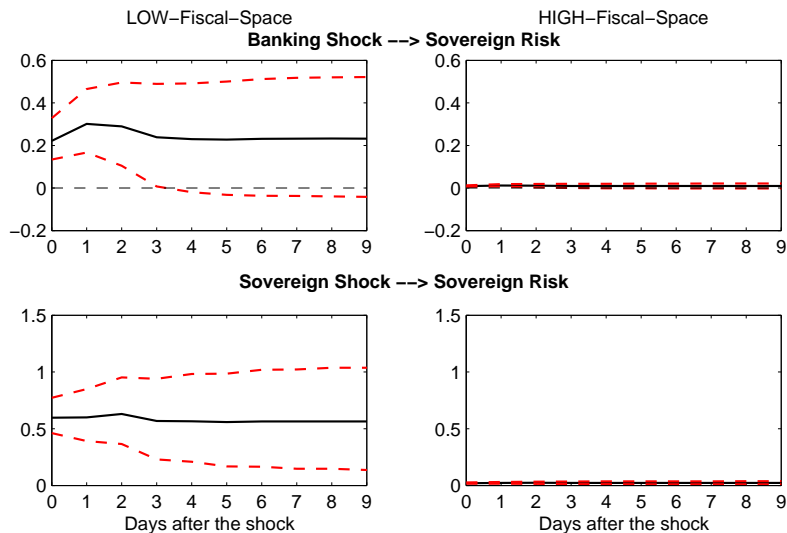
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Fiscal Space and Indebtedness: IRFs

- Fiscal Space: Cumulative IRFs



Detecting Sources of Fragility: The Financial System

- Does **bank exposure** to fragile countries matter for shock contagion across networks?
- Sovereign exposure sheds light on
 - ▶ *Liability-side* effect: implicit guarantees on banks' liabilities
 - ▶ *Asset-side* effect: solvency and liquidity of banks' assets
- We measure systemic risk of sub-systems of banks to investigate channels of contagion
 - ▶ Bank exposure is obtained from 2010 BIS stress-test reports

Bank Exposure

- We sort banks according to their exposure to fiscally constrained governments

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- REMINDE: $B^{Y \leftarrow X}$ effect of X -shock onto the system Y

Banks Sorted on Exposure to Low Fiscal Space Countries Over Total Sovereign Exposure									
	Low Exposure					High Exposure			
	Coefficient	t-Stat	Confidence Intervals			Coefficient	t-Stat	Confidence Intervals	
$B^{bank_i \leftarrow sov}$	0.14	6.22	0.10	0.19	$B^{bank_i \leftarrow sov}$	0.30	6.53	0.22	0.41
$\xi_{bank_i} / \xi_{bank}$	0.15	9.71	0.13	0.19	$\xi_{bank_i} / \xi_{bank}$	0.30	9.68	0.25	0.37

Bank Exposure: Shock Spillover Rate

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Liability-side versus Asset-side Effect

- Liability-side or asset-side effect?
- We split banks exposed to fragile governments into *local* and *foreign*

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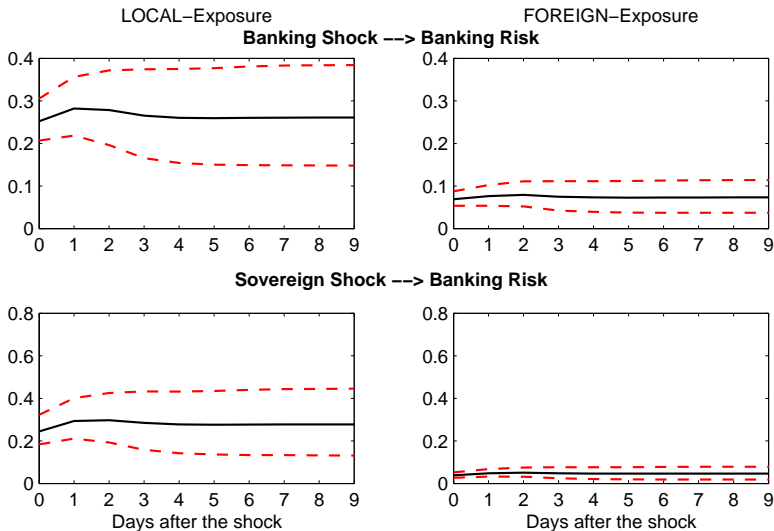
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- REMIND: $B^{Y \leftarrow X}$ effect of X -shock onto the system Y

Local versus Foreign Banks Exposed to Low Fiscal Space Countries									
Local Banks					Foreign Banks				
	Coefficient	t-Stat	Confidence Intervals			Coefficient	t-Stat	Confidence Intervals	
$B^{bank_i \leftarrow sov}$	0.24	6.76	0.18	0.32	$B^{bank_i \leftarrow sov}$	0.04	5.96	0.03	0.05
$\xi_{bank_i} / \xi_{bank}$	0.25	10.01	0.21	0.31	$\xi_{bank_i} / \xi_{bank}$	0.07	8.05	0.05	0.09

Liability-side versus Asset-side Effect: IRFs

- Bank Exposure to low Fiscal-space countries: Cumulative IRFs



So Far... and Next

- **Fiscal fragility** is a source of systemic shock
- **Bank exposure** to weakest countries drives contagion across systems
- **Liability-side** and **asset-side** effects
- What are the implications for the real economy?

Systemic Risk and the Real Economy

- Are **sovereign shocks** *also* relevant for the **real economy**?

Systemic Risk and the Real Economy

- Are **sovereign shocks** *also* relevant for the **real economy**?
- We estimate the following VAR (Bloom (2009))

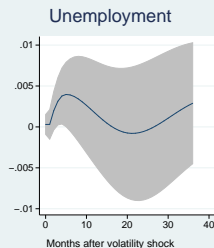
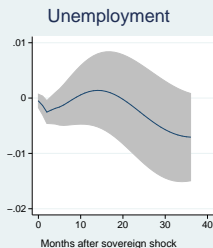
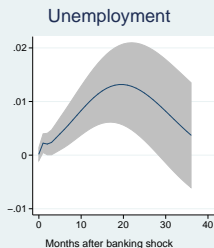
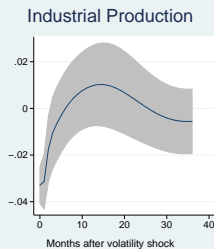
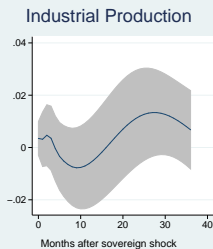
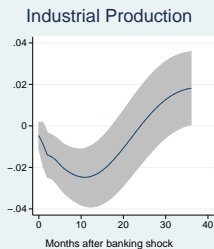
$$\mathbf{Y} = \begin{bmatrix} V2X_t \\ DIP_t^{Bank} \\ DIP_t^{Sov} \\ Euribor_t \\ IndProd_t \\ CPI_t \\ Unemp_t \end{bmatrix}$$

Systemic Risk and the Real Economy

- In this framework, shocks are meant to be innovations of the estimated VAR

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Conclusions

- This work provides a first empirical investigation of the dynamics of shock propagation *within* and *across* macro-financial systems
- Sovereign shocks impact **significantly** and **persistently** the probability of a collecting banking default
- The econometric framework provides policymakers and fund managers with a tool to monitor **shocks impacts** and **sources**
 - ▶ the analysis can be extended geographically and across sectors
- Future research:
 - ▶ Risk aversion matters in distress times as well as (physical) default risk. How much of the systemic variation is due to risk aversion?
 - ▶ How likely are *systemically relevant* shocks? What are the main determinants of the probability of a shock being systemic?

Fiscal Space

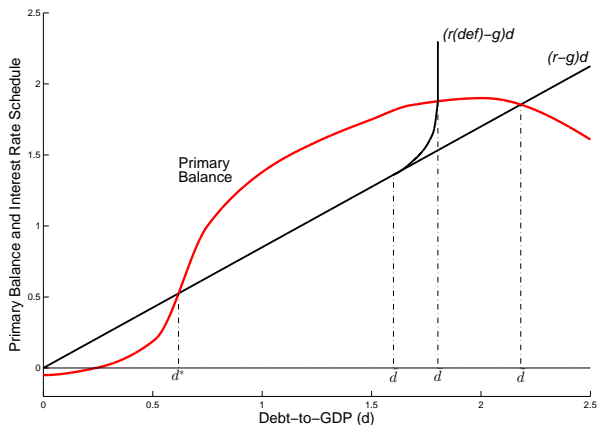
- Government budget constraint

$$d_{t+1} - d_t = (r_t - g) d_t - s_{t+1}$$

Fiscal Space

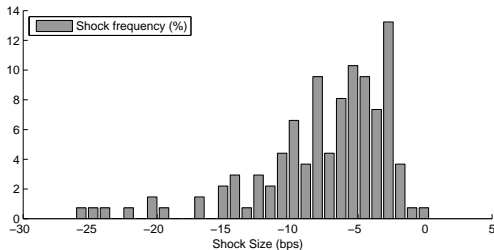
- Government budget constraint

$$d_{t+1} - d_t = (r_t - g) d_t - s_{t+1}$$

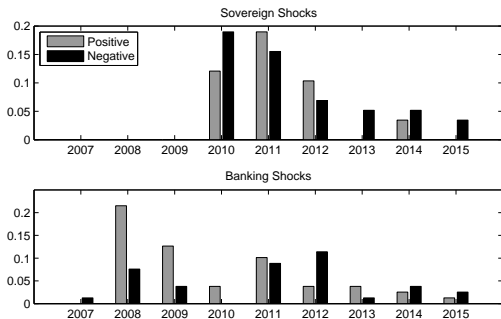


Shock Distribution: Size and Time

Panel A: Size



Panel B: Time



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