Lender of Last Resort versus Buyer of Last Resort – Evidence from the European Sovereign Debt Crisis

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Sovereign crisis caused massive run on European banks

- European financial sector was hit by common asset shock in summer of 2011, with credit downgrade of 2 largest peripheral Eurozone countries (Italy and Spain)
  - "Fitch cut Spain's long-term credit rating to AA- from AA+. It cut Italy to A+ from AA-." (WSJ, Oct 7, 2011)

- Exposure of European banks to risky sovereign debt caused major stock markets decline (Acharya and Steffen, 2015), and massive withdrawals of U.S. money market funds (MMFs).
  - Eurostoxx -20%, CAC40 -21%, DAX -16% (between June 1, 2011 and Dec 1, 2011)
  - U.S. prime MMFs holdings of Eurozone banks fell from 30% of their assets in May 2011 to 11% by Dec 2011 (ICI)

ECB interventions

2 types of interventions: **lender of last resort** (LOLR) vs. **buyer of last resort** (BOLR)

1. LOLR: 3-year Long-Term Refinancing Operations (LTRO)
   - ECB **provides liquidity** to the banks against collateral
     - LTRO 1: ECB allotted EUR 489 billion to 523 banks - Dec 2011
     - LTRO 2: EUR 530 billion to 800 banks - March 2012
   - "haircut subsidy" but higher interest rate than prevailing market rates
2. BOLR: Outright Monetary Transactions (OMT) - Sept 2012
   - following the "whatever it takes" speech (July 2012)
   - ECB could **purchase unlimited amounts of gvt bonds** with a maturity of 1 to 3 years
   - conditions: country had to comply with reform efforts required by the European Stability Mechanism (ESM)

LOLR vs. BOLR: theoretical framework

- Bagehot (1873): LOLR should lend freely to any private bank able to offer "what in ordinary times is reckoned a good security" as collateral, but at a penalty rate.
    - Providing liquidity might prevent inefficient fire sales and help banks deleverage and sell risky assets (Diamond and Rajan, 2011)
    - **Moral hazard** problem created by the existence of a LOLR (Fischer, 1999): using LOLR money to buy risky sovereign bonds becomes a way to gamble for resurrection for weak banks (Diamond and Rajan, 2011; Acharya and Tuckman, 2014; Crosignani, 2015)
- In presence of uncertainty about future liquidity:
  Intervention should **move illiquid assets into safer hands** (Diamond and Rajan, 2011)
    - BOLR: costly as central bank pays for the put option impaired banks have, and healthy potential buyers may also sell
    - LOLR: increase incentives to become illiquid

This paper: LOLR/BOLR, sovereign debt concentration, and fire sale risk

In this paper, we use the ECB's consecutive LOLR/BOLR interventions as a laboratory to study the effects of LOLR/BOLR on
sovereign debt concentration, **fire sale risk**, and financial stability.

Our questions:

- What is the effect of holding sovereign bonds at the announcement of LOLR/BOLR interventions?
- How do banks react to LOLR/BOLR interventions?
  - How do they adjust their portfolio of sovereign bonds?
- What are the consequences of banks' reaction to LOLR/BOLR on asset prices?

This paper: empirical analyses

In this paper, we study

- the overall impact on bank performance linking ECB interventions to bank equity and CDS prices in an event study.

- transmission channels of ECB interventions to banks
  1. **Holdings channel**: linking banks' abnormal performance to their sovereign bond holdings (based on data disclosed by the European Banking Authority)
  2. **Fire sale risk channel**:
     - looking at the evolution of sovereign debt concentration
     - studying the interaction between bank risk and sovereign risk
     - explaining this interaction with bank characteristics

Summary of results

While European banks become riskier after LTRO, we find a permanent stabilization of bank risk after OMT.

1. **Holdings channel**: we find a reduction of risk and increasing equity value of banks
   - holding *short-term* GIIPS sovereign bonds after LTRO
2. **Fire sale risk channel**:
   - increasing sovereign debt concentration in domestic banks after LTRO (risk taking of weak banks after LTRO documented by Drechsler et al., 2014)
   - an increase in bank risk increases the risk of home sovereign bonds after LTRO
   - the bank $\rightarrow$ sovereign effect increases with the bank's holdings of home sovereign bonds
   - OMT attracted new investors to the GIIPS sovereign bond market, reducing fire sale risk

Outline

1. Impact of monetary policy on bank risk

2. Mechanisms of unconventional monetary policy transmission
   - Holdings channel
   - Fire sale risk channel

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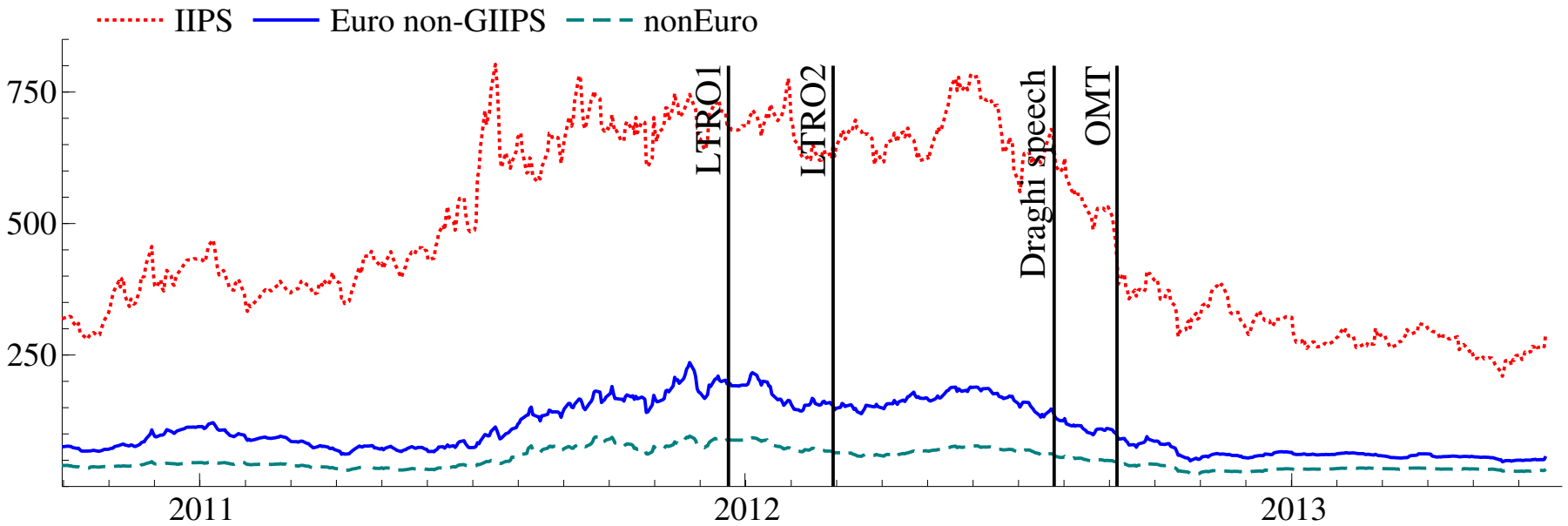
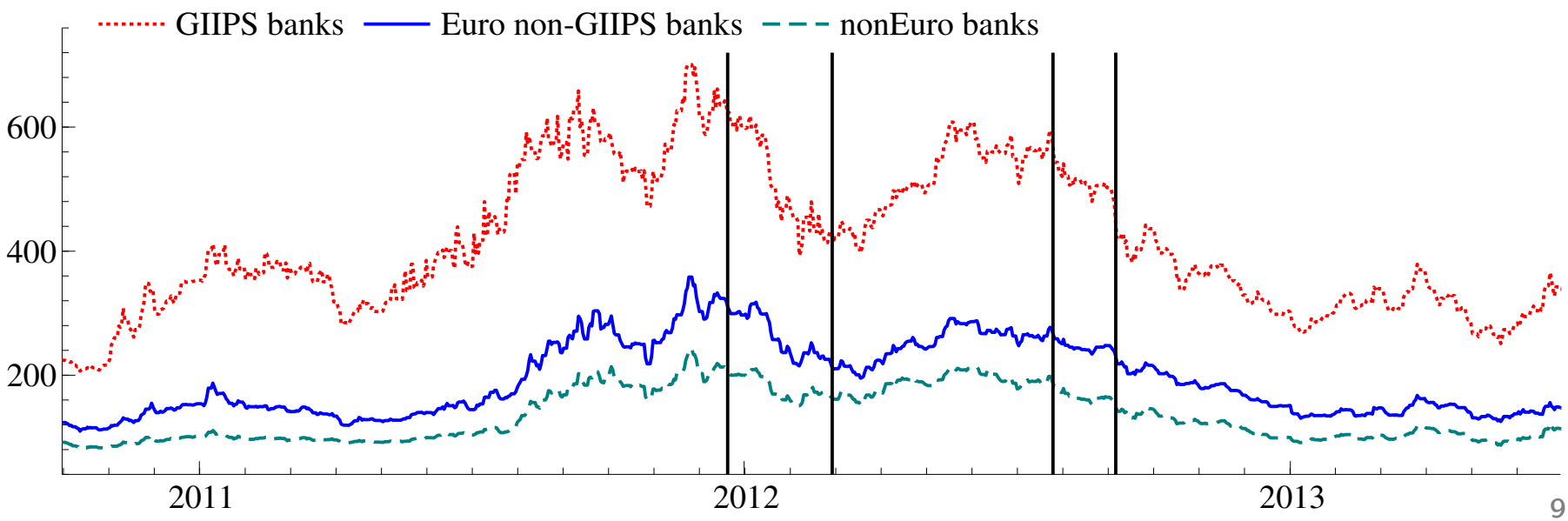
Sovereign risk and bank risk evolution (avg. 5-yr CDS)





ECB interventions and bank risk

Panel A: Change in average bank 5-yr CDS (%)

	GIIPS (IS)	Euro nonGIIPS	nonEuro
LTRO1 - LTRO2	-20 (-30)	-24	-19
LTRO2 - OMT	25 (47)	23	18
post OMT	-27 (-39)	-45	-55

Panel C: Change in average bank equity prices (%)

	GIIPS (IS)	Euro nonGIIPS	nonEuro
LTRO1 - LTRO2	15 (8)	30	25
LTRO2 - OMT	-60 (-62)	-36	-11
post OMT	36 (29)	41	7

OMT reduced the risk of GIIPS banks

Significant reduction of GIIPS bank risk (both 5-yr and 3-yr CDS spreads) around the OMT.

[-1;1] average cumulative abnormal CDS changes (ACAR) for all publicly traded European banks that participated in the EBA stress tests:

	Average 5-yr CDS CAR			**Average 3-yr CDS CAR**		
	GIIPS	Euro core	non Euro	GIIPS	Euro core	non Euro
LTRO	13.586	12.904**	6.042*	6.888	12.333**	3.112
12-8-2011	(0.623)	(2.028)	(1.752)	(0.447)	(1.982)	(1.325)
LTRO 1	-18.817	-10.914*	-3.599	-12.425	-11.224*	-2.623
12-21-2011	(-0.877)	(-1.726)	(-1.043)	(-0.816)	(-1.776)	(-1.120)
LTRO 2	-3.357	-4.109	-1.741	-1.999	-3.827	-1.492
2-29-2012	(-0.158)	(-0.607)	(-0.469)	(-0.134)	(-0.584)	(-0.577)
Draghi speech	-18.275	-4.410	-2.837	-9.818	-2.367	-2.298
7-26-2012	(-1.542)	(-0.584)	(-0.685)	(-0.823)	(-0.322)	(-0.778)
OMT	**-35.656*** **	-7.368	-4.251	**-38.422*** **	-5.973	-3.110
9-06-2012	(-3.362)	(-1.061)	(-1.068)	(-3.483)	(-0.895)	(-1.118)

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LTRO improved collateral value of short-term GIIPS bonds

Linear regression analysis of the determinants of [-1;1] cumulative abnormal banks' 5-year CDS changes and equity returns surrounding the different ECB interventions:

CARs around LOLR

	5-yr CDS	**Equity**
	LTRO prelim	LTRO 2
GIIPS 1-3year/Assets	**-751.35****	**216.78*****
	(-2.35)	(2.90)
GIIPS long/Assets	191.17	-51.74
	(1.05)	(-1.16)
Euro non-GIIPS/Assets	59.53	24.88*
	(0.61)	(1.78)
Controls	Y	Y
N	27	33
R^2 (%)	50.24	56.98

OMT abnormal performance is not related to banks' sovereign bond holdings

Linear regression analysis of the determinants of [-1;1] cumulative abnormal banks' 5-year CDS changes and equity returns surrounding the different ECB interventions:

CARs around BOLR

	5-yr CDS	**Equity**
	OMT	OMT
GIIPS 1-3year/Assets	1249.70*	-99.27
	(1.69)	(-1.00)
GIIPS long/Assets	-302.37	122.05*
	(-0.80)	(1.95)
Euro non-GIIPS/Assets	-47.98	20.40
	(-0.57)	(0.75)
Controls	Y	Y
N	25	33
R^2 (%)	63.46	29.58

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Summary of results for fire sale risk channel

1. Increasing sovereign debt concentration in domestic banks following LTRO
2. Greater influence of domestic bank risk on sovereign risk after LTRO
3. Influence is related to GIIPS bank's home sovereign bond holdings
4. New investors return to GIIPS sovereign bonds after OMT

Home bias and svg debt concentration increases after LTRO

Post LTRO: transfer of GIIPS svg bonds from non-GIIPS banks (-15 EUR bn) to GIIPS banks (+55 EUR bn).

Change in sovereign bond holdings (EUR bn) for all publicly traded European banks that participated in the EBA stress tests:

Panel A: Change in sovereign bond holdings (€ billion)

	Change in home exposure			Change in GIIPS exposure	
	GIIPS	Italy	Spain	Euro non-GIIPS	non-Euro
Dec 2010 - Dec 2011	-17	-16	1	-59	-18
Dec 2011 - Jun 2012 (post LTRO)	**55**	**36**	**13**	**-9**	**-6**
Jun 2012 - Dec 2012 (post OMT)	**12**	**14**	**-3**	**4**	**-1**
Dec 2012 - Dec 2013	-8	11	-18	13	-1

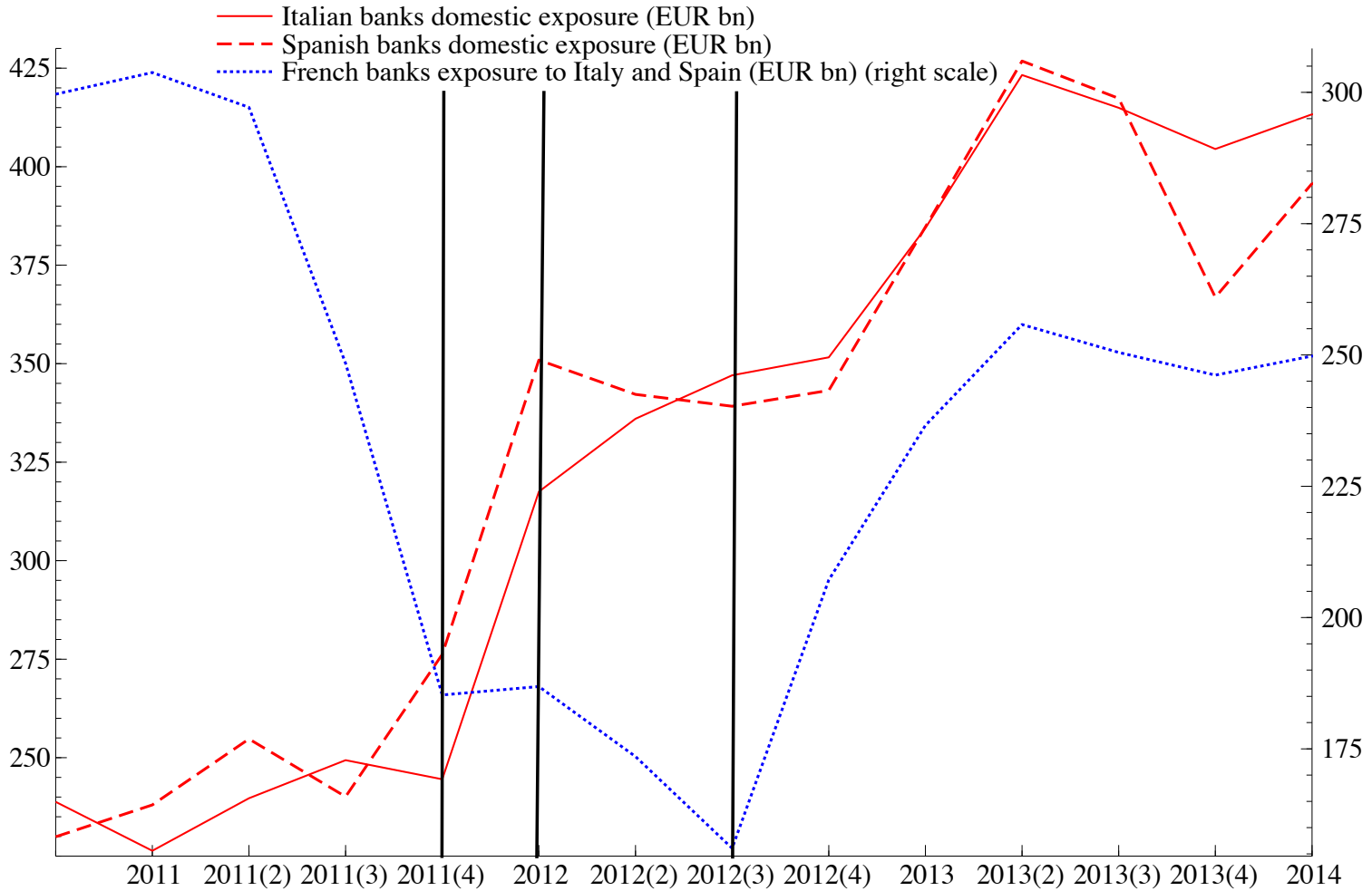
Panel B: Change in sovereign bond holdings (% of country outstanding debt)

	Change in home exposure			Change in GIIPS exposure	
	GIIPS	Italy	Spain	Euro non-GIIPS	non-Euro
Dec 2010 - Dec 2011	-1.3	-1.4	-2.0	-3.6	-0.8
Dec 2011 - Jun 2012 (post LTRO)	**1.8**	**1.9**	**1.2**	**-0.6**	**-0.3**
Jun 2012 - Dec 2012 (post OMT)	**0.2**	**0.8**	**-1.3**	**0.1**	**-0.1**
Dec 2012 - Dec 2013	-1.2	0.1	-3.9	0.9	-0.1

French banks GIIPS exposure increases after OMT

Domestic exposures of Italian and Spanish banks increases after LTRO and OMT. French banks buy Italian and Spanish bonds again following the OMT.

National banking sectors' exposure to Italian and Spanish official sectors (EUR bn):



Source: BIS Consolidated Banking Statistics and ECB.

Studying the bank-sovereign nexus

Granger-causality tests performed in both directions:

- sovereign risk predicting bank risk
- bank risk predicting sovereign risk

$$\begin{aligned} \triangle bank_{jt} &= \alpha_{1j} + \varphi_{1j} \triangle bank_{jt-1} + \beta_{1j} \triangle svg_{jt-1} + \varepsilon_{jt} \\ \triangle svg_{jt} &= \alpha_{2j} + \varphi_{2j} \triangle svg_{jt-1} + \beta_{2j} \triangle bank_{jt-1} + \xi_{jt} \end{aligned}$$

where $\triangle bank_{jt}$ is the daily percentage change in average five-year bank CDS prices of country j, and $\triangle svg_{jt}$ is the daily percentage change in the five-year sovereign CDS price of country j.

Bank risk → sovereign risk after LTRO

Greater influence of domestic banking sector risk on sovereign risk ($\hat{\beta}_{2j}$) during the post-LTRO period:

	Sovereign risk → Bank risk ($\hat{\beta}_1$)			Bank risk → Sovereign risk ($\hat{\beta}_2$)		
	Crisis	**post LTRO**	**post OMT**	**Crisis**	**post LTRO**	**post OMT**
Spain	0.151***	0.145**	0.197***	0.005	0.056	0.030
	(2.74)	(2.24)	(2.91)	(0.02)	(0.29)	(0.12)
Italy	0.190	-0.147	**0.277****	-0.072	**0.271***	-0.047
	(0.45)	(-1.17)	(2.10)	(-0.37)	(1.66)	(-0.23)
Germany	0.189***	0.032	-0.040	0.095	0.186*	0.285
	(2.66)	(0.58)	(-1.00)	(0.40)	(1.72)	(1.37)
France	0.142**	-0.067	0.113**	0.260**	**0.534*****	0.438*
	(2.02)	(-1.32)	(2.55)	(2.40)	(4.09)	(1.88)
UK	0.088	-0.073	0.119	0.254*	**0.241****	0.023
	(0.97)	(-0.75)	(1.31)	(1.79)	(2.57)	(0.25)

Crisis period: 6-01-2011 - 12-07-2011, post-LTRO period: 12-08-2011 - 7-25-2012, post-OMT period: 7-26-2012 - 12-31-2012.

Channels of monetary policy transmission

Sovereign risk $\rightarrow$ bank risk	Bank risk $\rightarrow$ sovereign risk
credibility of government guarantee	government guarantee
moral suasion	government's holdings of bank equity shares
riskier loans	impaired lending
banks' holdings of sovereign bonds	**fire sale risk**

Only the last two channels (holdings and fire sale risk) are related to the home sovereign bond holdings of the bank.

Explaining the bank-sovereign nexus

$$\hat{\beta}_{1i\tau} = \delta_{1\tau} \frac{\text{Home holdings}_{i\tau}}{\text{Assets}_{i\tau}} * d_{GIIPS,i} * d_\tau + \delta_{2\tau} \frac{\text{Home holdings}_{i\tau}}{\text{Assets}_{i\tau}} * d_\tau + \delta_{3\tau} d_{GIIPS,i} * d_\tau + \delta_\tau + \eta_{i\tau}$$

$$\hat{\beta}_{2i\tau} = \lambda_{1\tau} \frac{\text{Home holdings}_{i\tau}}{\text{Assets}_{i\tau}} * d_{GIIPS,i} * d_\tau + \lambda_{2\tau} \frac{\text{Home holdings}_{i\tau}}{\text{Assets}_{i\tau}} * d_\tau + \lambda_{3\tau} d_{GIIPS,i} * d_\tau + \lambda_\tau + \varsigma_{i\tau}$$

where

- $\hat{\beta}_{1i\tau}$ is the estimate capturing the influence of sovereign risk on the risk of domestic bank i in period τ,
- $\hat{\beta}_{2i\tau}$ is the estimate capturing the influence of the risk of bank i on home sovereign risk in period τ,
- $\frac{\text{Home holdings}_{i\tau}}{\text{Assets}_{i\tau}}$ is the fraction of the bank's home sovereign bond holdings divided by its total assets,
- $d_{GIIPS,i}$ is a dummy variable equal to one when bank i is located in a GIIPS country.

Explaining bank risk → sovereign risk

Bank risk → Sovereign risk ($\hat{\beta}_2$)

	All bank CDS		Most liquid bank CDS	
Home holdings*GIIPS*crisis	**3.25*** **	**3.09** **	-0.05	-1.10
	(2.84)	(2.18)	(-0.02)	(-0.28)
Home holdings*GIIPS*LTRO	**3.66*** **	**3.41*** **	**6.79** **	**7.62*** **
	(3.38)	(3.02)	(2.51)	(2.71)
Home holdings*GIIPS*OMT	-3.12	-3.08	-5.96	-5.80
	(-1.66)	(-1.48)	(-1.12)	(-1.04)
Home holdings*crisis	**-3.33*** **	**-3.24*** **	-0.35	0.85
	(-6.53)	(-5.45)	(-0.10)	(0.23)
Home holdings*LTRO	0.61	0.83	**-5.60** **	**-5.88*** **
	(1.11)	(1.25)	(-2.10)	(-2.30)
Home holdings*OMT	-0.09	-0.03	3.62	3.28
	(-0.15)	(-0.05)	(0.70)	(0.63)
Controls	N	Y	N	Y
R^2 (%)	18.56	15.89	4.41	6.83
N	84	84	57	57
Banks	28	28	19	19

Explaining sovereign risk → bank risk

Sovereign risk → Bank risk ($\hat{\beta}_1$)

	All bank CDS		Most liquid bank CDS	
Home holdings*GIIPS*crisis	1.14	0.60	0.34	-0.05
	(0.92)	(0.64)	(0.34)	(-0.05)
Home holdings*GIIPS*LTRO	-0.47	-1.10	**-3.63****	**-3.51***
	(-0.66)	(-1.40)	(-1.99)	(-1.79)
Home holdings*GIIPS*OMT	0.28	-0.35	2.14	2.33
	(0.38)	(-0.44)	(1.25)	(1.49)
Home holdings*crisis	0.27*	0.39*	-0.13	0.12
	(1.75)	(1.76)	(-0.14)	(0.13)
Home holdings*LTRO	-0.29	-0.27	**2.39*****	**2.50*****
	(-1.22)	(-1.32)	(4.08)	(2.70)
Home holdings*OMT	**-0.49*****	**-0.40****	-1.90	-2.05
	(-3.30)	(-2.58)	(-1.16)	(-1.41)
Controls	N	Y	N	Y
R^2 (%)	34.23	43.43	60.44	59.58
N	84	84	57	57
Banks	28	28	19	19

Summary of channel effects

LTRO: negative effect of long-term GIIPS bond holdings on bank performance, not offset by positive effect of short-term GIIPS bond holdings

OMT: positive effect of long-term GIIPS bond holdings on bank performance

5-year bank CDS spread changes (bps)

	all	
	LTRO	OMT
Average raw change	-27	-186
1-3 year GIIPS bonds	**-34**	**-32**
long-term GIIPS bonds	**144**	**-48**

Bank equity returns (%)

	all	
	LTRO	OMT
Average raw return	-10	35
1-3 year GIIPS bonds	**15**	**-**
other GIIPS bonds	**-30**	**6**

Fire sale risk drives increase in bank risk after LTRO

$$\text{Realized performance}_i = \alpha + \beta_1 \frac{GIIPS\,1-3yr_i}{Assets_i} + \beta_2 \frac{GIIPS\,long_i}{Assets_i} + \beta_3 \frac{GIIPS\,1-3yr_i}{Tier1_i} + \beta_4 \frac{GIIPS\,long_i}{Tier1_i} + \gamma controls_i + \varepsilon_i$$

where $\frac{GIIPS_i}{Tier1_i} = \frac{GIIPS_i}{Assets_i} \times \frac{Assets_i}{Tier1_i}$.

5-year bank CDS spread changes (bps)

		all	
	channel	LTRO	OMT
Average raw change		-27	-186
1-3 year GIIPS bonds		**-34**	**-32**
	holdings	-244	184
	fire sale risk	210	-233
long-term GIIPS bonds		**144**	**-48**
	holdings	38	-48
	fire sale risk	106	-

Summary

While European banks become riskier after LTRO, we find a permanent stabilization of bank risk after OMT.

1. LTRO (ECB acting as LOLR): ECB provided banks with liquidity against collateral
   - improved the collateral value of short-term bonds, but
   - increased concentration of GIIPS sovereign debt in the domestic banking sector
   - increased fire sale risk

2. OMT (ECB acting as BOLR): ECB announced asset purchases
   - attracted new investors to GIIPS sovereign bond market
   - reduced GIIPS sovereign debt concentration and fire sale risk
   - significantly reduced risk of banks holding GIIPS sovereign bonds
   - sovereign risk still affects bank risk.