Bank Exposures and Sovereign Stress Transmission

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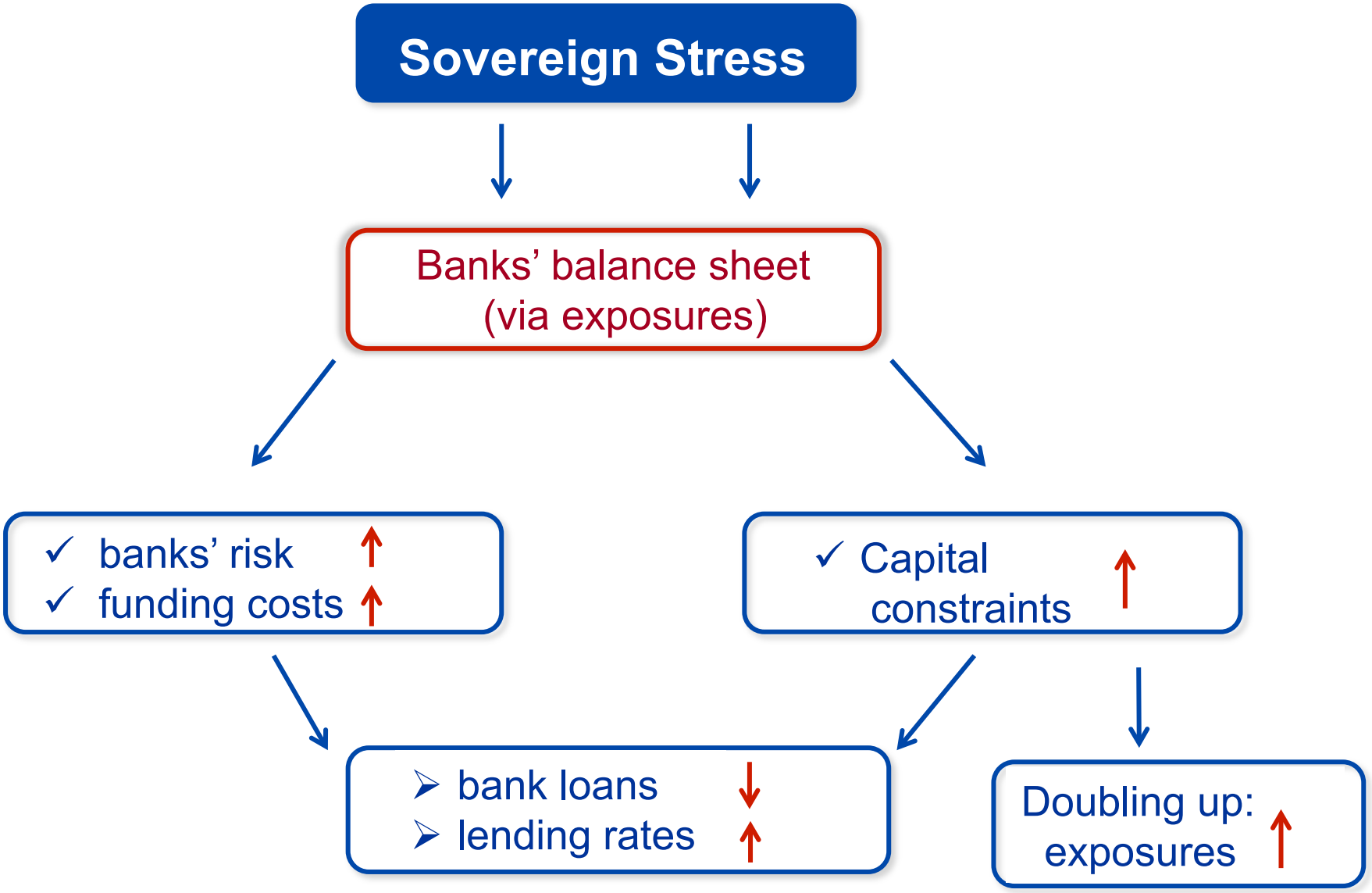
The opinions in this presentation are those of the authors and do not necessarily reflect the views of the European Central Bank and the Eurosystem.

Basic idea



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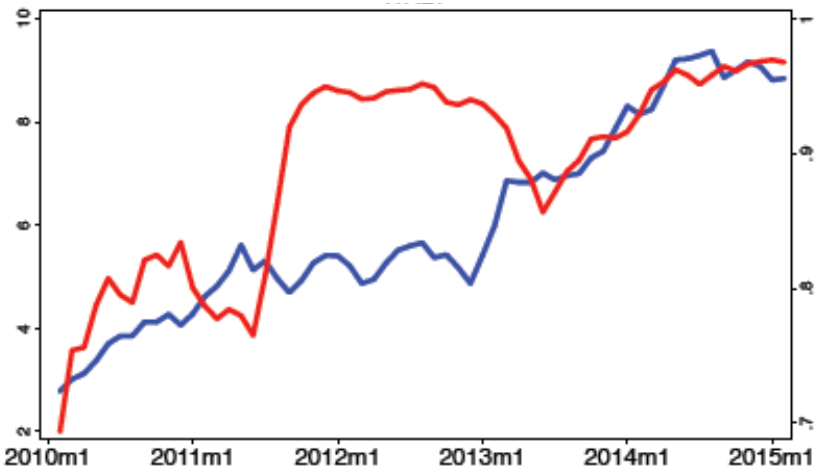
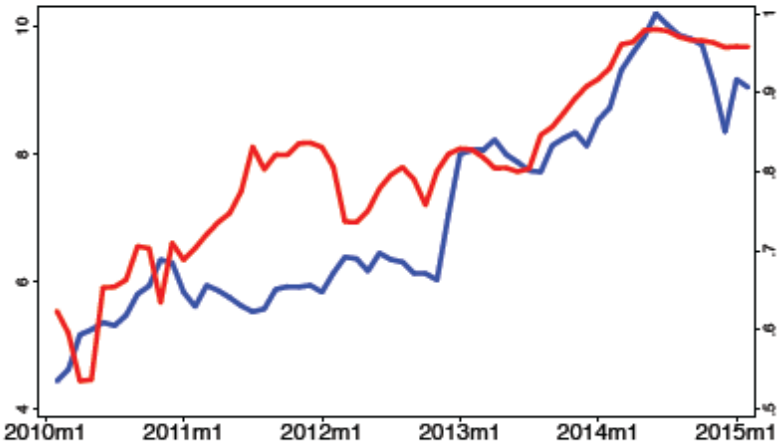
Motivation: bank-sovereign nexus & exposures in the periphery

Italy



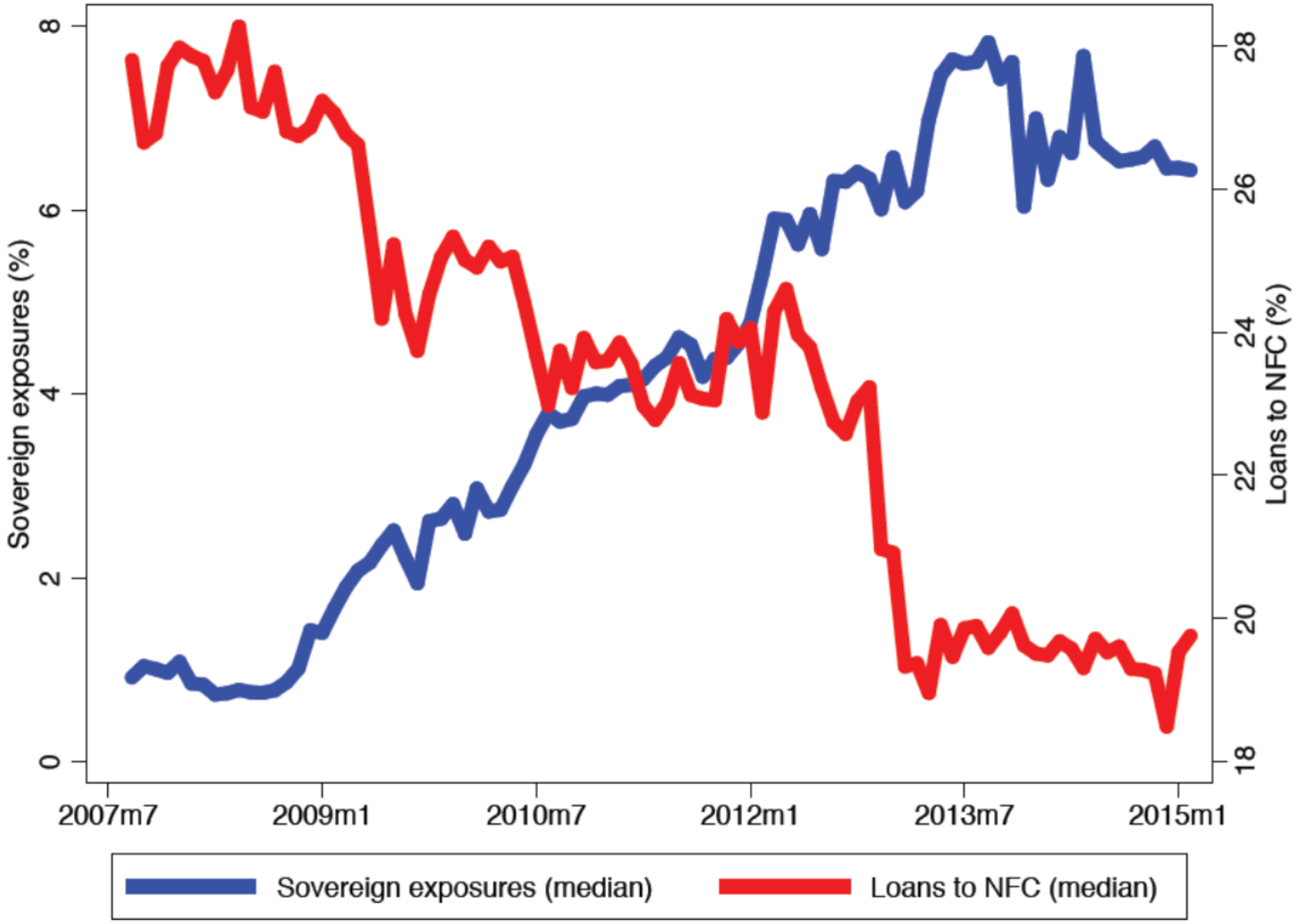
Spain



Domestic sovereign exposures, L12 — 24-m. correlation btw CDS

Note: The red line is the 24-month rolling correlations between sovereign and bank. The blue line is the average domestic sovereign exposures (of domestic banks) as % of average total assets in each country. Sample: August 2007 - February 2015.

Motivation : sovereign exposures & lending in the periphery



Note: **Median of periphery countries** (Greece, Ireland, Italy, Portugal and Spain)
Sample: August 2007 - February 2015.

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Our contribution

Apply panel data estimation to euro-area **bank-level data** to assess:

- **how much bank exposures contributed to transmitting sovereign stress to**
  - **i. bank default risk**
  - **ii. lending to firms**
- **how exposures themselves reacted to the return on sovereign debt**

Data are novel under three respects:

1. time-series – track effects of sovereign shocks month-by-month
2. granular – observe 252 banks compared with approximately 90 (consolidated) banks of the EBA tests. (22 banks in 2009, 91 in 2010, 90 in 2011, 123 in 2014)
3. representative – our data for outstanding loans cover about 70% of the euro-area aggregate, while syndicated loans (used by other studies) cover less than 10%.

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Preview of the results

- For periphery banks with **larger sovereign exposures**, increases in sovereign risk and in domestic sovereign yields translate into:
  - larger increase in bank solvency risk
  - stronger reduction of loans and a sharper increase in lending rates to firms
- Following **increases in sovereign risk** and **high expected returns** on domestic sovereign bonds:
  - periphery banks, especially less capitalized ones, increase domestic exposures

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Literature

We add to research on sovereign-bank nexus, and on the role of banks' sovereign exposures:

- **Risk transmission from sovereigns to banks**

  Acharya, Drechsler & Schnabl (2014) ("post-bailout changes in sovereign CDS explain changes in bank CDS")

- **Sovereign shock transmission to bank loans (and real activity)**

  Bofondi, Carpinelli & Sette (2013), De Marco (2013), Gennaioli, Martin & Rossi (2013), Popov & van Horen (2013), Acharya, Eisert, Eufinger & Hirsch (2015), etc.

- **Effect of sovereign risk on banks' exposures ("carry trade", etc.)**

  Battistini, Simonelli & Pagano (2014), Acharya & Steffen (2015)

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Outline

- Data and sample structure

- Assessing the contribution of sovereign exposures on
  - ✓ bank solvency risk
  - ✓ loans and lending rates

- Doubling-up: effect of sovereign yields on exposures

- Conclusions

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Data: variables and sources

➢ Individual bank data

- ✓ **Bank-level balance sheet items (IBSI)**: main assets, sovereign exposures, loans to NFC & households. Source: ECB
- ✓ **Bank-level interest rates (IMIR)**: on new business volumes. Source: ECB
- ✓ **Bank-level capital ratio.** Source: SNL
- ✓ **Bank-level 5-year CDS premia**. Source: Datastream

➢ Country data

- ✓ **Balance sheet items (BSI)**. Source: ECB
- ✓ **Expected 10-year govt. bond yield**: 3 & 12-month horizon survey-based forecasts. Source: Consensus Economics Inc.
- ✓ **10-year sovereign debt yields and 5-year CDS**. Source: Datastream

All data are monthly, 2007-2015

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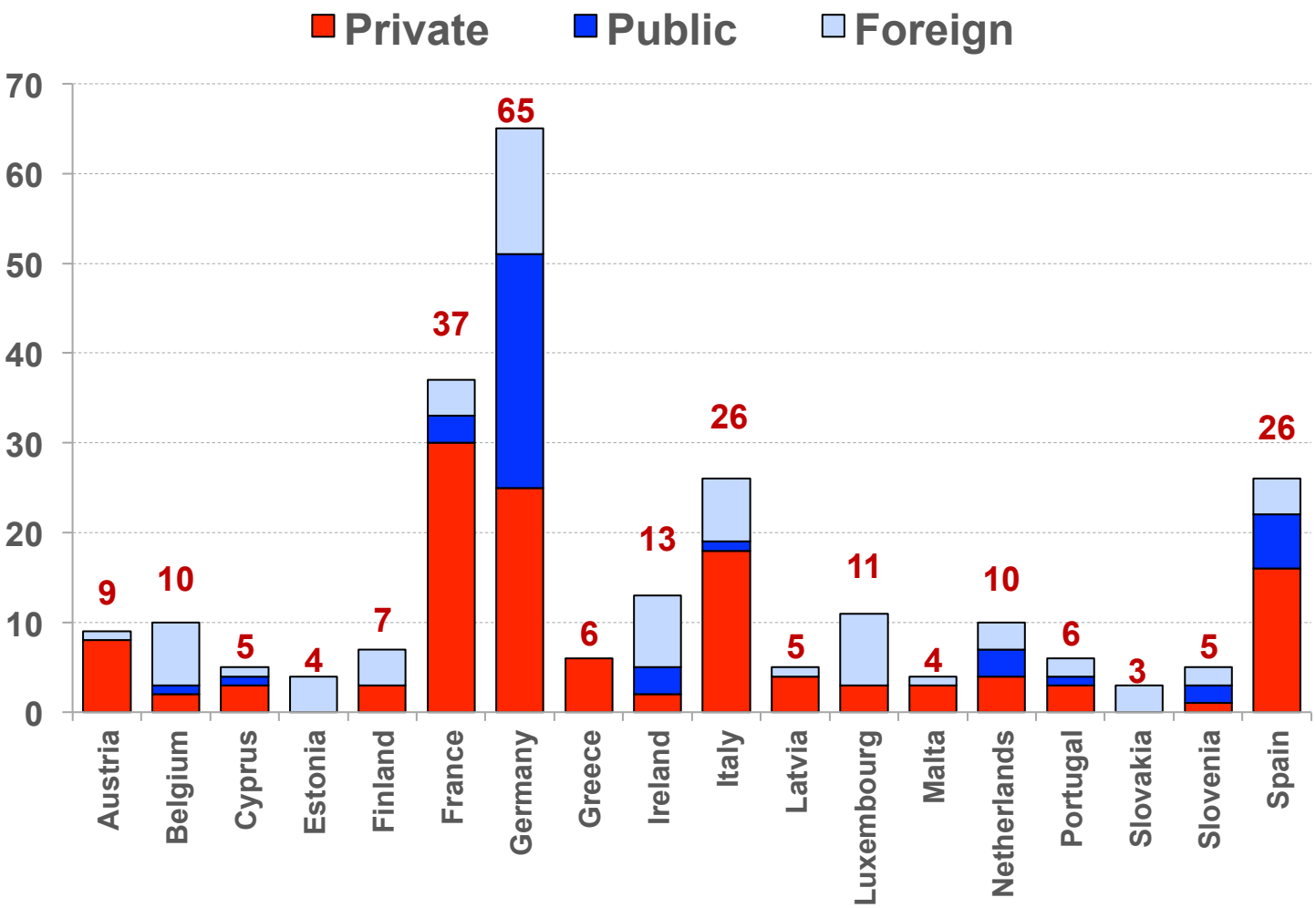
Sample structure

Monetary Financial Institutions (MFIs) included in the sample, by ownership structure



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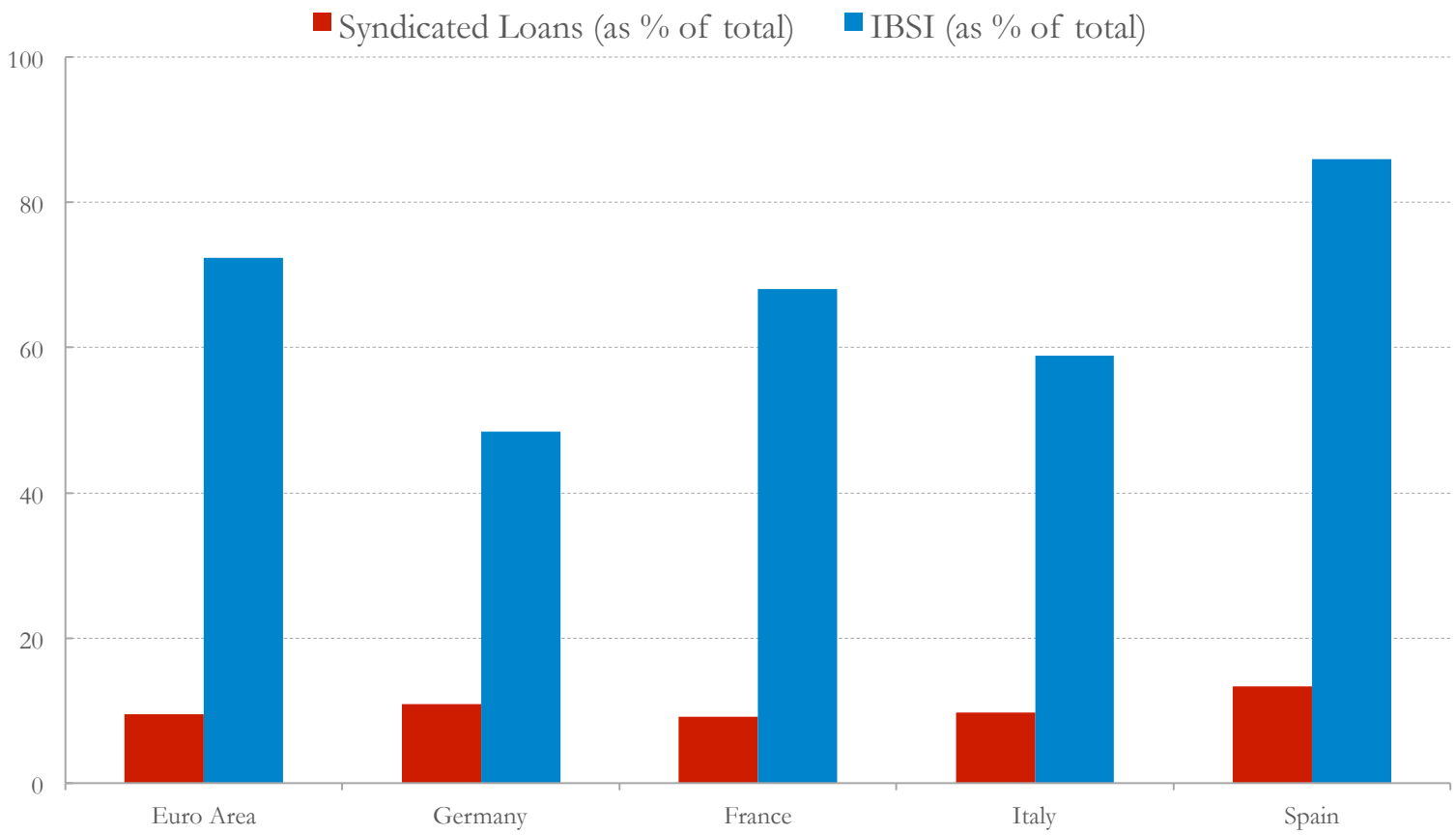
Sample structure

Sample representativeness: ratio of IBSI loans (our data) and syndicated loans to BSI (aggregate) loan data (in %), avg. 2012-15



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Descriptive statistics

Panel A: Domestic Exposures, Loans and Interest Rates				Std. Dev.	
	N	mean	median	between	within
Dom. Gov. Bond (%)	20543	4	2	5.6	2.6
Non-Dom. Gov. Bond (%)	20432	1.8	0.3	3.1	2.1
Loans to NFC (%)	20609	18.1	16	13.6	4.1
Lending rate (NFC)	15866	3.6	3.3	1.1	1.2

Panel B: Bank Characteristics				Std. Dev.	
	N	mean	median	between	within
Total Assets (bn)	20653	80	35	118.2	24.3
Leverage ratio	19542	18	14.5	12	5.2
Deposit/liabilities (%)	20538	64.3	67.7	22.3	7
Borrowing from ECB/liabilities	3864	4.9	1.4	5.8	4.2

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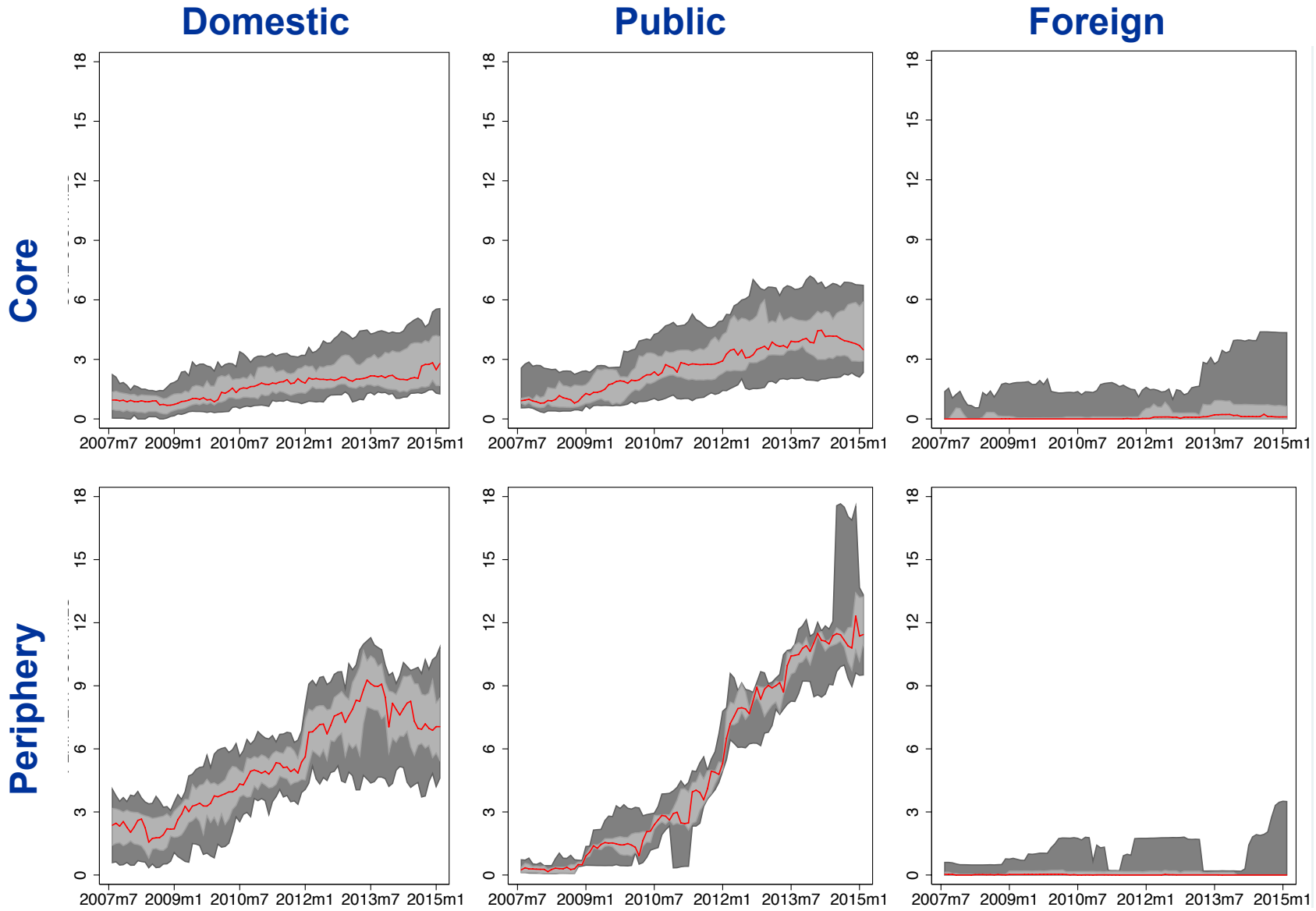
Domestic sovereign holdings, by bank ownership



Note: The dark shaded area is the 25th -75th percentile, the light shaded area is the 40th-60th percentile. The red solid line is the median of the country-area cross-sectional distribution. The core countries are Belgium, France, Germany and Netherland. The periphery countries are Greece, Ireland, Italy, Portugal and Spain. Sample: August 2007 - February 2015.

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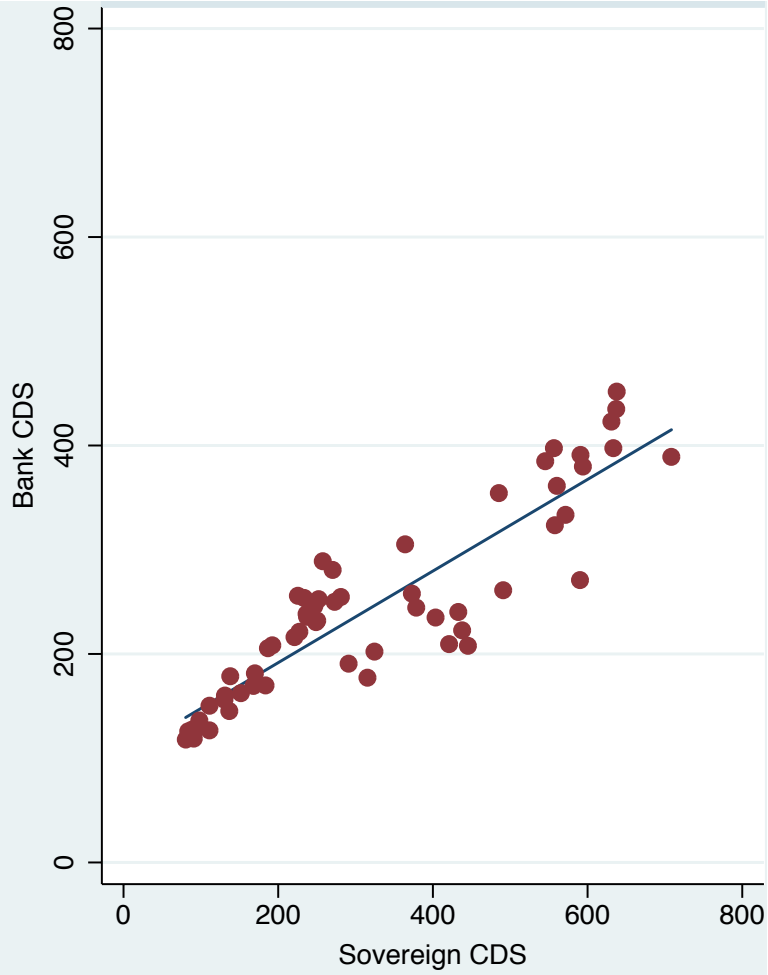
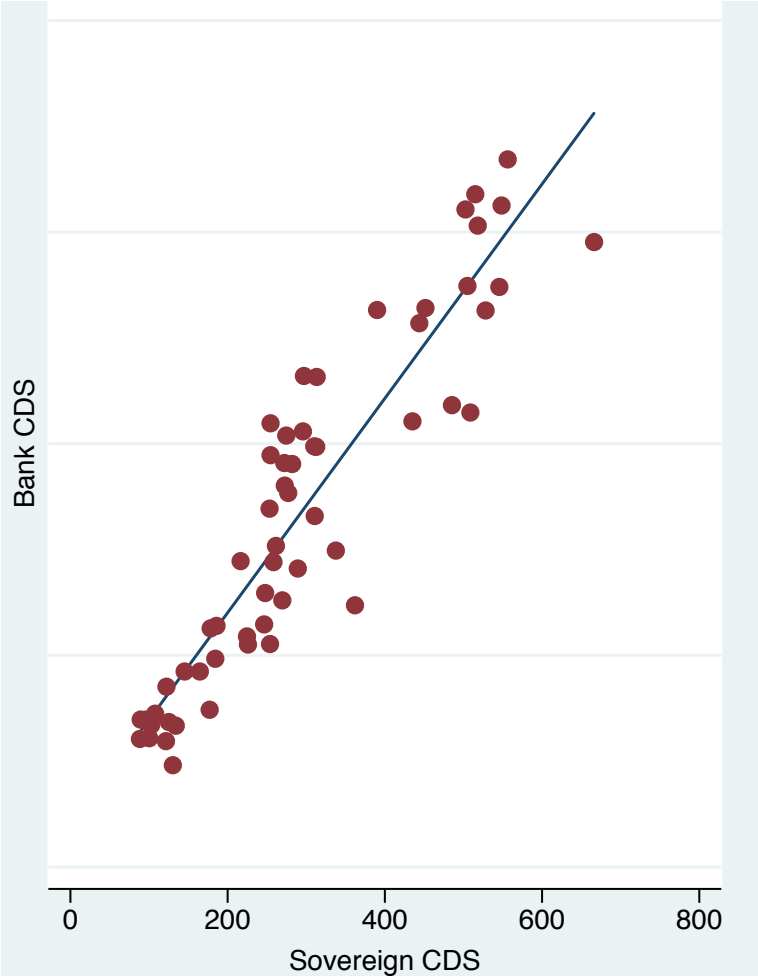
Breakdown by exposures, periphery countries

Low-Exposure Banks



High-Exposure Banks



Note: Bank CDS are computed as the average of the CDS of the individual banks. Sovereign CDS is computed as the simple average of the sovereign CDS. The countries are Ireland, Italy, Portugal and Spain. The group "low exposure" ("high exposure") contains the banks whose 2009 exposure to domestic debt is below (above) the 25 (75) percentile. Sample: January 2010 - February 2015.

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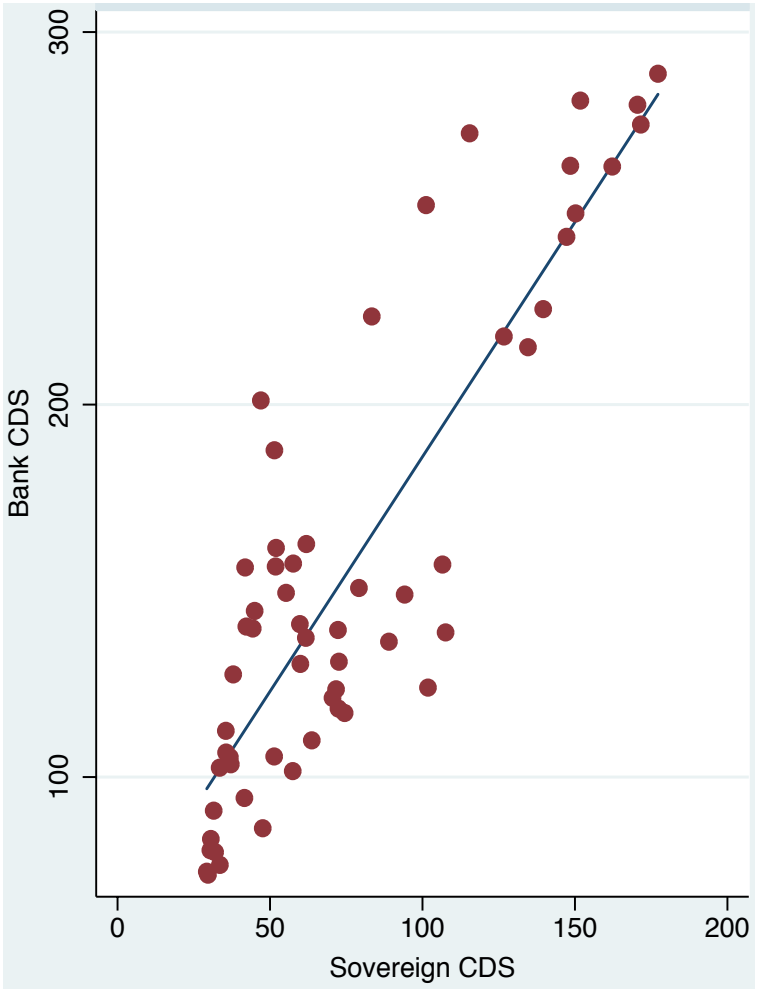
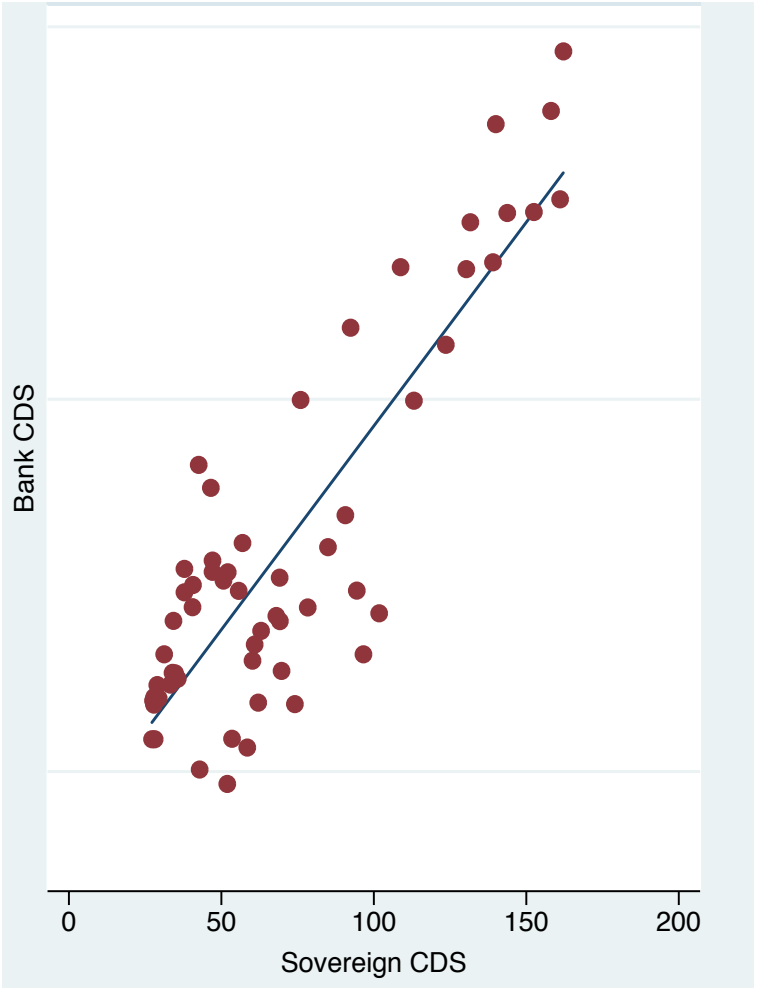
Breakdown by exposures, core countries

Low-Exposure Banks



High-Exposure Banks



Note: Bank CDS are computed as the average of the CDS of the individual banks. Sovereign CDS is computed as the simple average of the sovereign CDS. The countries are Austria, France, Germany, and Netherlands. The group "low exposure" ("high exposure") contains the banks whose 2009 exposure to domestic debt is below (above) the 25 (75) percentile. Sample: January 2010 - February 2015.

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Empirical methodology

- We estimate a **panel data model:**

$$CDS_{ijt} = \alpha_i + \gamma_t + \beta_1 Sov.CDS_{jt} + \beta_2 Sov.Exp_{ijt-1} + \beta_3 Sov.CDS \times Sov.Exp_{ijt-1}$$
$$+ \beta_4 X_{ijt-1} + \beta_5 Y_{jt-1} + \varepsilon_{ijt}$$

The **coefficient β_3** captures the association between sovereign and bank credit risk due to sovereign exposures

Controls:

- ✓ Time fixed effects control for aggregate determinants of credit spreads (demand for credit, govt. as ultimate backstop, etc.)
- ✓ Bank fixed effects control for time-invariant characteristics of banks
- ✓ Direct effects of sovereign CDS and banks' exposures
- ✓ Bank balance sheet characteristics; Leverage ratio, Deposits/Liabilities
- ✓ Country-specific controls: BLS (demand for loans), EDF (risk of loan pool)

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Domestic exposures and sovereign risk

$$CDS_{ijt} = \alpha_i + \gamma_t + \beta_1 Sov.CDS_{jt} + \beta_2 Sov.Exp_{ijt-1} + \beta_3 Sov.CDS \times Sov.Exp_{ijt-1} + \beta_4 X_{ijt-1} + \beta_5 Y_{jt-1} + \varepsilon_{ijt}$$

	(1) all	(2) core	(3) periph
Sov.CDS5y$_t$	0.56***	0.54**	0.48***
	(0.14)	(0.23)	(0.18)
Sov.Exposures$_{t-1}$	3.88	0.26	4.62
	(2.37)	(1.02)	(4.97)
Sov.CDS5y$_t$ x Sov.Exposures$_{t-1}$	0.03	0.00	0.05**
	(0.02)	(0.00)	(0.02)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.73	0.72	0.7
Banks	108	67	41
Observations	8553	5235	3318

Dependent variable: Bank CDS. The periphery countries are Cyprus, Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, France, Germany and Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m12.

* p<0.1, ** p<0.05, *** p<0.01

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Domestic exposures and sovereign risk

$$CDS_{i,j,t} = \alpha_i + \gamma_t + \beta_1 \cdot Sov.CDS_{j,t} + \beta_2 \cdot Sov.Exposures_{i,j,t-1} +$$
$$\beta_3 \cdot Sov.CDS_{j,t} \times Sov.Exposures_{i,j,t-1} + \beta_4 \cdot X_{i,j,t-1} + \epsilon_{i,j,t}$$

	(1) all	(2) core	(3) periph
$Sov.CDS5y_t$	0.56***	0.54**	0.48***
	(0.14)	(0.23)	(0.18)
$Sov.Exposures_{t-1}$	3.88	0.26	4.62
	(2.37)	(1.02)	(4.97)
$Sov.CDS5y_t$ x $Sov.Exposures_{t-1}$	0.03	0.00	0.05**
	(0.02)	(0.00)	(0.02)

Direct effect

Balance sheet effect

100 bps Sov.CDS ⬆

- **Baseline effect for all banks: 48 bps**
- **Additional exposure-related effect for the median bank: 25 bps**

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Robustness checks

- **Check no. 1 (potential endogeneity of government CDS):**
  - ✓ Several papers argue that risk transmission can go (and actually went) both ways: Acharya et al. (2014), Cooper and Nikolov (2013) and Leonello (2014)
  - ✓ Reverse causality should concern mainly SIFI, whose distress would prompt government bailout **drop SIFI from regression: results unchanged**
- **Check no. 2 (potential endogeneity of bank exposures):**
  - ✓ E.g., distressed bank may "bet for resurrection" by raising their exposure to high-yield government debt **replace lagged exposures with beginning-of-sample exposures: results unchanged**
- **Check no. 3 (CDS premium may misprice government credit risk):**
  - ✓ **Replace government CDS premia with unexpected change in yields**, as alternative measure of sovereign stress. Expectations are based on consensus data for France, Germany, the Netherlands, Italy and Spain only**: results unchanged**

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  - ✓ bank solvency risk
  - ✓ **loans and lending rates**

- Doubling-up: effect of sovereign yields on exposures

- Conclusion

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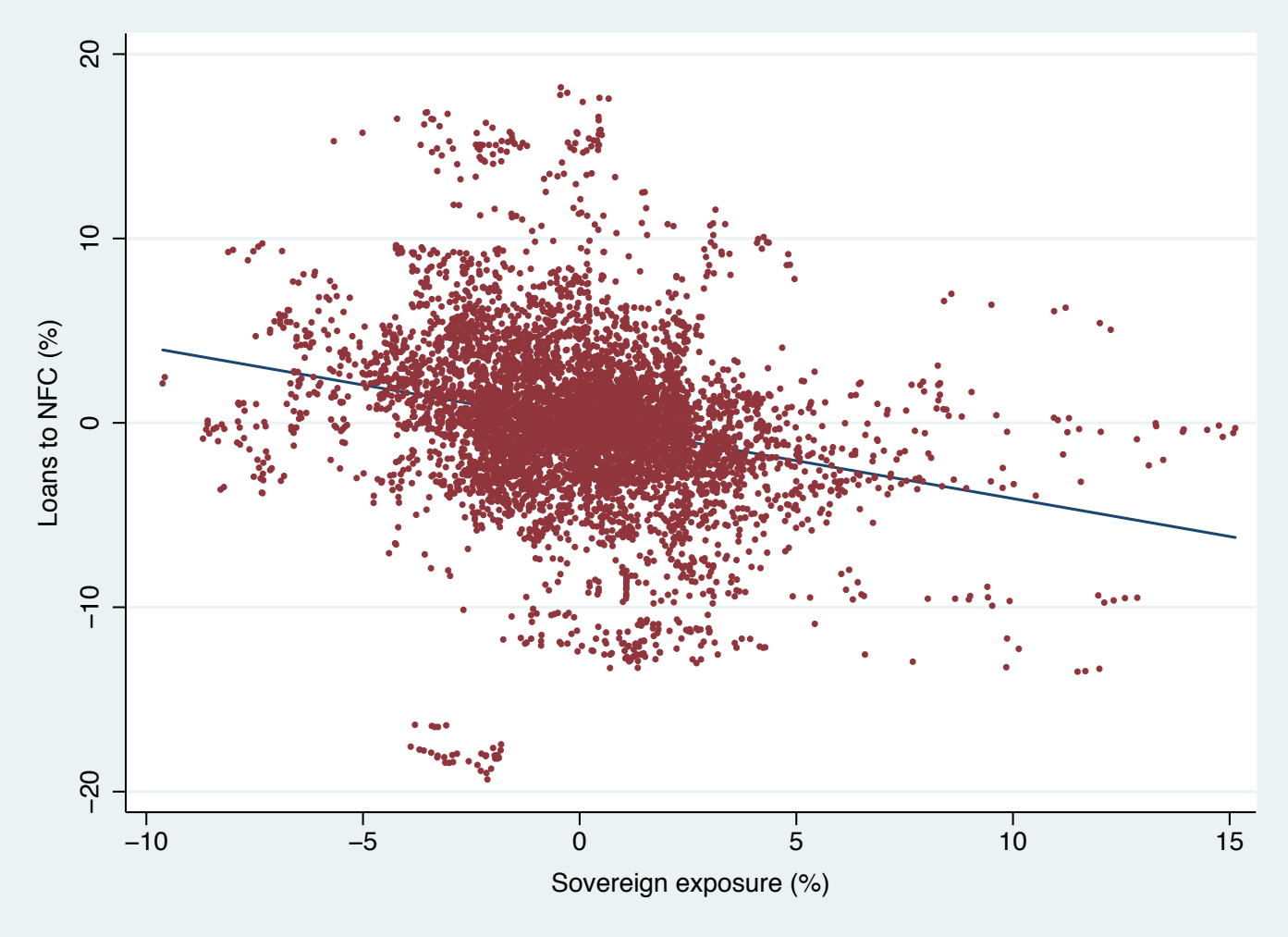
Sovereign exposures and lending: periphery banks



Note: Residuals of loan and sovereign exposure regressions on bank fixed effects and time dummies.
The periphery countries are Greece, Ireland, Italy, Portugal and Spain.
Sample: August 2007 - February 2015.

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Sovereign stress and bank lending: loans to firms

$$Loans_{ijt} = \alpha_i + \gamma_t + \varphi_1 Sov.Yield_{jt-2} + \varphi_2 Sov.Exp_{ijt-3}$$
$$+\varphi_3 Sov.Yield_{jt-2} \times Sov.Exp_{ijt-3} + \varphi_4 X_{ijt-2} + \varphi_5 Y_{jt-2} + \varepsilon_{ijt}.$$

	(1) all	(2) core	(3) periph
Sov.Yield10y$_{t-2}$	-0.24	-0.56	0.13
	(0.17)	(0.8)	(0.2)
Sov.Exposures$_{t-3}$	-0.04	0.11	-0.13
	(0.08)	(0.08)	(0.12)
Sov.Yield10y$_{t-2}$ x Sov.Exposures$_{t-3}$	-0.04**	-0.01	-0.05**
	(0.02)	(0.03)	(0.02)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.93	0.92	0.94
Banks	202	136	58
Observations	16699	11409	4762

Dependent variable: Total loans to NFC (% of asset). The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, France, Germany, Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m2.
* p<0.1, ** p<0.05, *** p<0.01

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Did other balance sheet variables also play a role?

	(1) all	(2) core	(3) periph
$Sov.Yield10y_{t-2}$	0.31	1.9	-0.44
	(0.45)	(1.28)	(0.31)
$Sov.Exposures_{t-3}$	-0.11	0.05	-0.15
	(0.07)	(0.07)	(0.1)
$Sov.Yield10y_{t-2}$ x $Sov.Exposures_{t-3}$	-0.03*	-0.01	-0.04**
	(0.02)	(0.03)	(0.02)
$Sov.Yield10y_{t-2}$ x $Dep/Liability_{t-3}$	0.00	-0.01	0.01*
	(0.01)	(0.01)	(0.01)
$Dep/Liability_{t-3}$	0.01	0.05	-0.1
	(0.04)	(0.05)	(0.07)
$Sov.Yield10y_{t-2}$ x $Leverage_{08}$	-0.02	-0.01	-0.01**
	(0.01)	(0.02)	(0.01)
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.94	0.93	0.94
Banks	177	120	52
Observations	12782	8698	3724

same amplification effect of exposures

higher dep./liab. ratio reduces impact on loans..

…while higher leverage increases it

Dependent variable: Total loans to NFC (% of asset). The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, France, Germany, Netherland, Slovenia, Slovakia. Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2.
* p<0.1, ** p<0.05, *** p<0.01

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Sovereign stress and bank lending: lending rates

$$Lending.Rate_{ijt} = \alpha_i + \gamma_t + \lambda_1 Sov.Yield_{jt} + \lambda_2 Sov.Exp_{ijt-1}$$
$$+ \lambda_3 Sov.Yield_{jt} \times Sov.Exp_{ijt-1} + \lambda_4 X_{ijt-1} + \lambda_5 Y_{jt-1} + \varepsilon_{ijt}.$$

	all		core		periph	
	(up1y)	(ov.1y)	(up1y)	(ov.1y)	(up1y)	(ov.1y)
$Sov.Yield10y_t$	0.14***	-0.09	0.24***	-0.12	0.10***	-0.09
	(0.03)	(0.07)	(0.06)	(0.09)	(0.04)	(0.1)
$Sov.Exposures_{t-1}$	-0.03***	-0.08***	-0.02	-0.11***	-0.05***	-0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
$Sov.Yield10y_t$ x $Sov.Exposures_{t-1}$	0.01***	0.03***	0.00	0.03***	0.01***	0.02**
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Country trend	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.81	0.58	0.84	0.61	0.79	0.58
Banks	144	138	92	88	52	50
Observations	11388	6772	7153	4415	4235	2357

Dependent variables: Lending rates to NFCs. The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, Germany, Netherland. Banks controls: capital-asset ratio; deposit-liability ratio. Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m2. * p<0.1, ** p<0.05, *** p<0.01

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$$Lending.Rate_{ijt} = \alpha_i + \gamma_t + \lambda_1 Sov.Yield_{jt} + \lambda_2 Sov.Exp_{ijt-1}$$
$$+ \lambda_3 Sov.Yield_{jt} \times Sov.Exp_{ijt-1} + \lambda_4 X_{ijt-1} + \lambda_5 Y_{jt-1} + \varepsilon_{ijt}.$$

	all		core		periph	
	(up1y)	(ov.1y)	(up1y)	(ov.1y)	(up1y)	(ov.1y)
$Sov.Yield10y_t$	0.14***	-0.09	0.24***	-0.12	0.10***	-0.09
	(0.03)	(0.07)	(0.06)	(0.09)	(0.04)	(0.1)
$Sov.Exposures_{t-1}$	-0.03***	-0.08***	-0.02	-0.11***	-0.05***	-0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
$Sov.Yield10y_t$ x $Sov.Exposures_{t-1}$	0.01***	0.03***	0.00	0.03***	0.01***	0.02**
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)

100 bps Sov.Yields ↑

- **Baseline effect for all banks: 14 bps**
- **Additional exposure-related effect for the median bank: 8 bps**

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Nexus between sovereign yields and exposures

- **"Carry trade" hypothesis**: banks increase exposures when they expect high returns on sovereign debt
  - ✓ especially if they are undercapitalized: "betting for resurrection"

- Since we have only the breakdown between domestic and non-domestic euro-area exposures, we can investigate the "carry trade" hypothesis only for periphery country banks:
  - ✓ for core country banks, no opportunities to engage in carry trades on *their domestic* sovereign debt

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Sovereign exposures and sovereign CDS

$$Sov.Exp_{ijt} = \alpha_i + \gamma_t + \mu_1 \Delta Sov.CDS_{jt} + \mu_2 \Delta Sov.CDS_{jt} \times T1cer_{ij08} + \mu_4 X_{ijt} + \varepsilon_{ijt}$$

	(1)	(2)
	(core)	(periph.)
$DSov.CDS5y_t$	-2.93	0.89**
	(1.92)	(0.39)
$DSov.CDS5y_t$ x $t1cer_{08}$	0.37	-0.15**
	(0.23)	(0.06)
Time FE	Yes	Yes
Bank FE	Yes	Yes
Adjusted R^2	0.95	0.75
Banks	41	33
Observations	2960	2230

Dependent variable: domestic exposures. The variable "$t1cer_{08}$" is the Tier1 capital ratio at the end of 2008. The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Estonia, Finland, France, Germany, Netherland, Slovenia, Slovakia. Banks controls: (lagged) deposit-liability ratio.
Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01

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Sovereign exposures and sovereign CDS

$$Sov.Exp_{ijt} = \alpha_i + \gamma_t + \mu_1 Exp.Ret_{jt} + \mu_2 Exp.Ret_{jt} \times Lev_{ij08} + \mu_4 X_{ijt} + \varepsilon_{ijt}$$

	3-month		12-month	
	(core)	(periph.)	(core)	(periph.)
$Exp.Returns_t$	1.54***	0.30	0.63**	0.00
	(0.29)	(0.23)	(0.24)	(0.22)
$Exp.Returns_t$ x $HighLeverage_{08}$	0.10	0.35**	0.09	0.41***
	(0.09)	(0.14)	(0.08)	(0.12)
Time FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.64	0.62	0.63	0.62
Banks	97	40	97	40
Observations	8740	3514	8740	3514

Dependent variable: domestic exposures. The variable "$HighLeverage_{08}$" is the Leverage ratio (capital over assets) at the end of 2008. The periphery countries are Italy and Spain. The core countries are France, Germany, and Netherland. Banks controls: (lagged) deposit-liability ratio.

Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01

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Outline

- Data and Sample structure
- Identifying the banks' balance sheet channel
  - ✓ Effects on bank solvency risk
  - ✓ Effects on Loans and Lending rates
- Doubling-up: Effect of sovereign yields on exposures
- **Conclusions**

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Conclusions

During the euro debt crisis, the exposures of banks to domestic sovereign debt in periphery countries have:

- ✓ amplified the impact of sovereign risk on the credit risk of those banks
- ✓ amplified the reduction in lending to firms and the rise in lending rates

➢ Increases in yields and in expected returns of domestic sovereign bonds have

- ✓ increased the exposures of domestic sovereign debt of less capitalized periphery banks, consistently with the "carry trade" hypothesis

➢ **Ongoing work:**

1. instrument for sovereign exposures with supply of domestic sovereign debt interacted with bank characteristics (public/private, dom./foreign)
2. allow also for "moral suasion" hypothesis (besides "carry trade" hypothesis) in determination of sovereign exposures

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Thank you!

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Background slides

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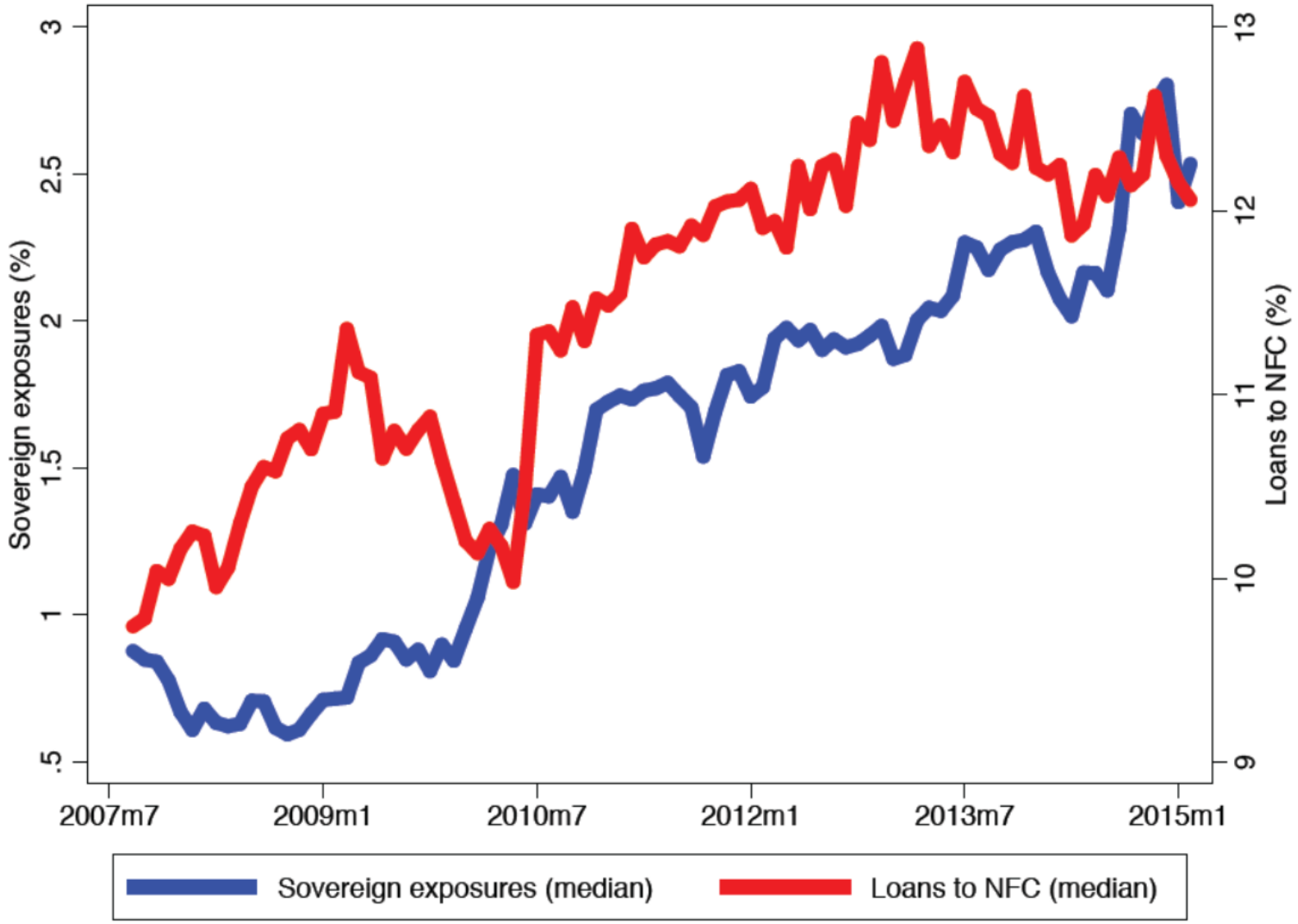
Sovereign exposures and lending: median core bank



Note: The core countries are Austria, Belgium, France, Germany, Luxemburg and Netherland. Sample: August 2007 - February 2015.

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Sample structure

Monetary Financial Institutions (MFIs)
included in the sample by ownership structure

	Total	Domestic		Foreign
		Private	Public	
Austria	9	8	0	1
Belgium	10	2	1	7
Cyprus	5	3	1	1
Estonia	4	0	0	4
Finland	7	3	0	4
France	37	30	3	4
Germany	65	25	26	14
Greece	6	6	0	0
Ireland	13	2	3	8
Italy	26	18	1	7
Latvia	5	4	0	1
Luxembourg	11	3	0	8
Malta	4	3	0	1
Netherlands	10	4	3	3
Portugal	6	3	1	2
Slovakia	3	0	0	3
Slovenia	5	1	2	2
Spain	26	16	6	4
Total	**252**	**131**	**47**	**74**

Note: For each country, the table shows the main assets, loans to NFCs and holdings of government debt securities covered by our individual bank dataset in Jan-2015 as percentage of the of aggregate data as reported in BSI statistics of the ECB.

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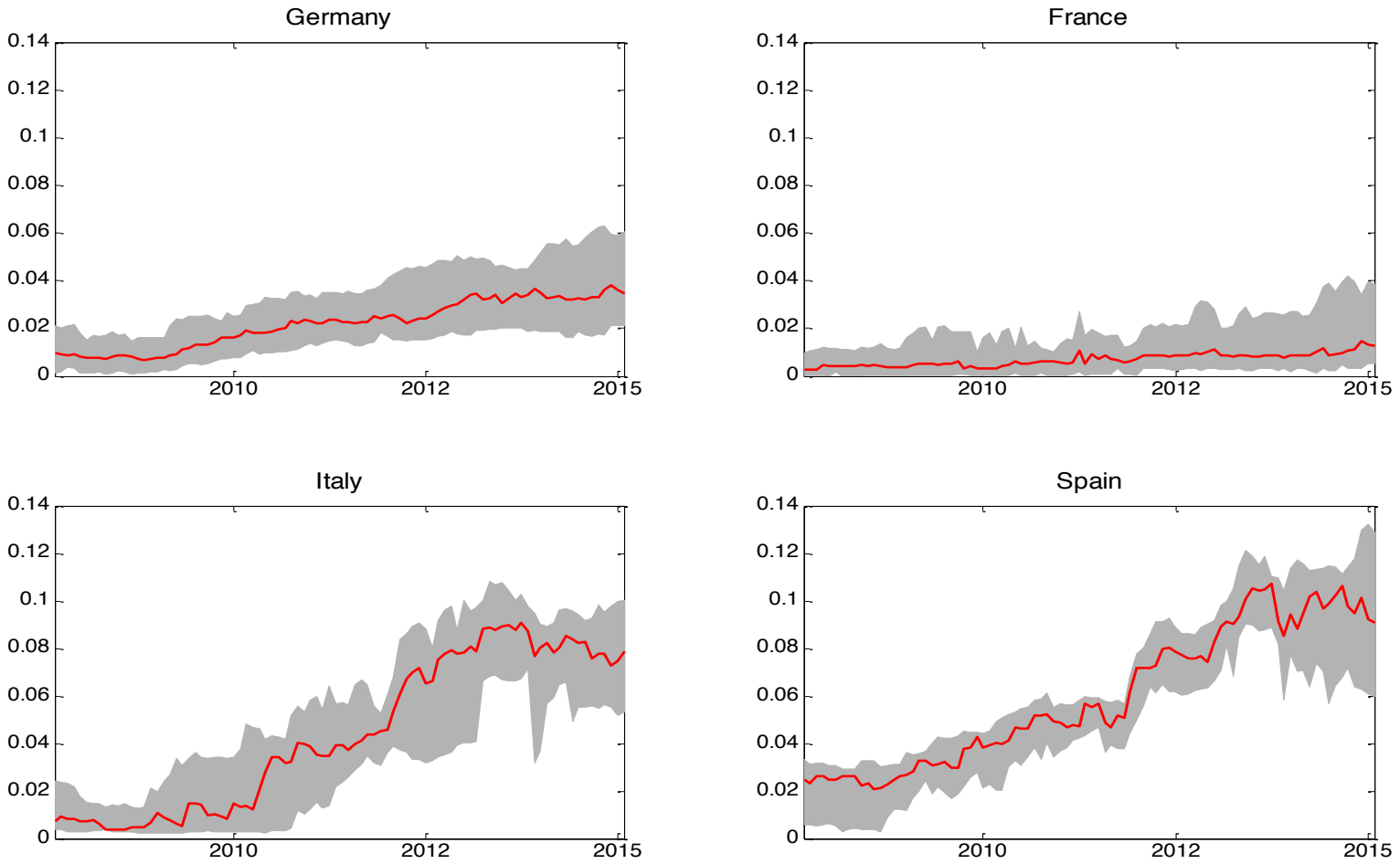
Domestic sovereign holdings as % of main assets



Note: The shaded area is the 25th -75th percentile. The red solid line is the median of the country-specific cross-sectional distribution. Sample: August 2007 - February 2015.

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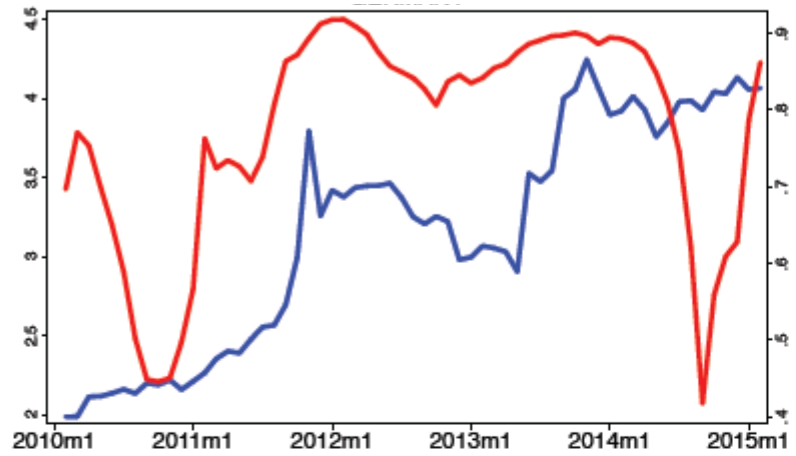
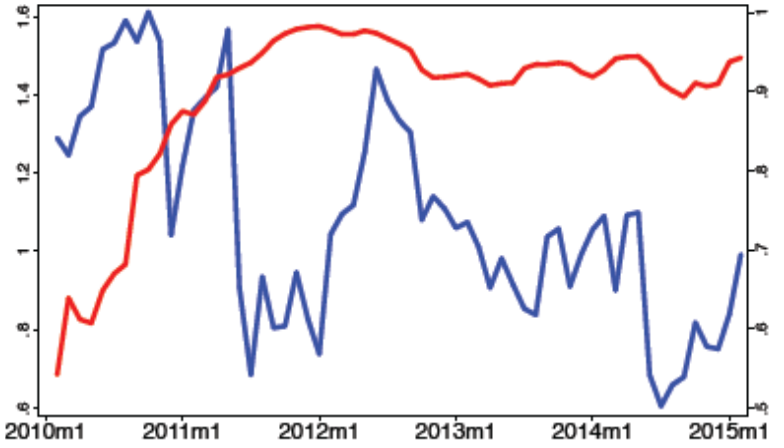
Bank and domestic sovereign risk: aggregate time series

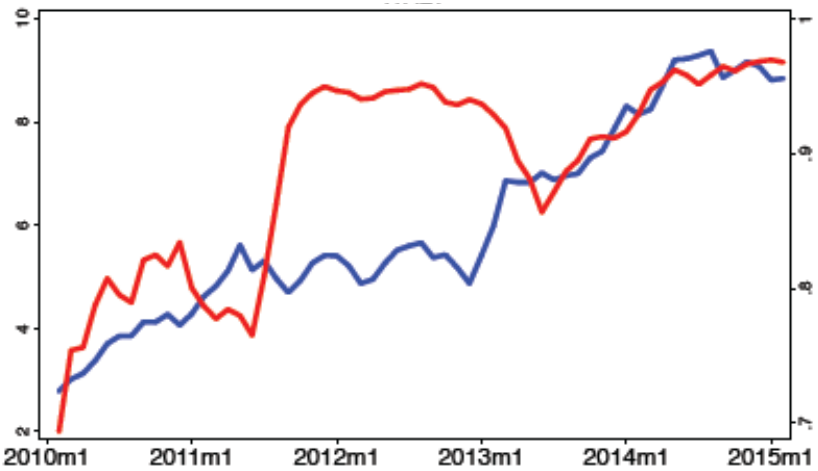
Germany



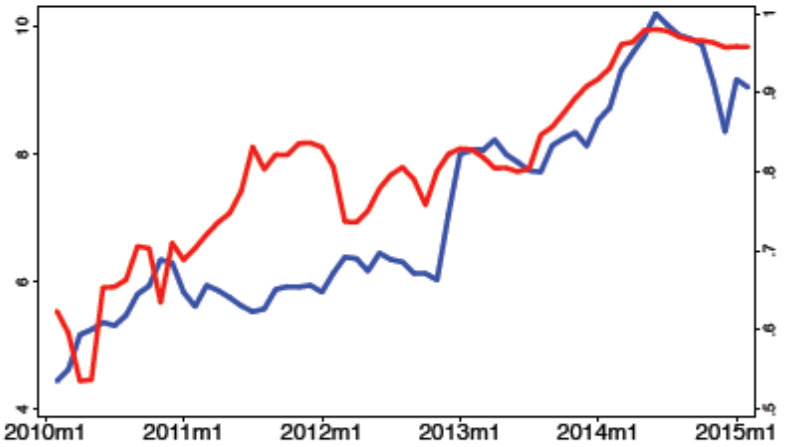
France



Italy



Spain



Domestic sovereign exposures, L12

24-m. correlation btw CDS

Note: The red line is the 24-month rolling correlations between sovereign and bank. The blue line is the average domestic sovereign exposures (of domestic banks) as % of average total assets in each country. Sample: August 2007 - February 2015.

Sovereign exposures and yield on sovereign debt

$$Sov.Exposures_{i,j,t} = \alpha_i + \gamma_t + \beta_1 \cdot \Delta Sov.Yield_{j,t} + \beta_2 \cdot \Delta Sov.Yield_{j,t} \times T1cer_{i,j,08} + \beta_3 \cdot X_{i,j,t} + \epsilon_{i,j,t}$$

	(1)	(2)
	(core)	(periph.)
ΔSov.Yield10y$_t$	-0.66	1.17*
	(1.78)	(0.68)
ΔSov.Yield10y$_t$ x t1cer$_{08}$	-0.11	-0.18*
	(0.29)	(0.11)
Time FE	Yes	Yes
Bank FE	Yes	Yes
Adjusted R^2	0.94	0.76
Banks	48	29
Observations	3376	2016

Dependent variable: domestic exposures. The variable "t1cer$_{08}$" is the Tier1 capital ratio at the end of 2008. The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Estonia, Finland, France, Germany, Netherland, Slovenia, Slovakia. Banks controls: (lagged) deposit-liability ratio.
Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01

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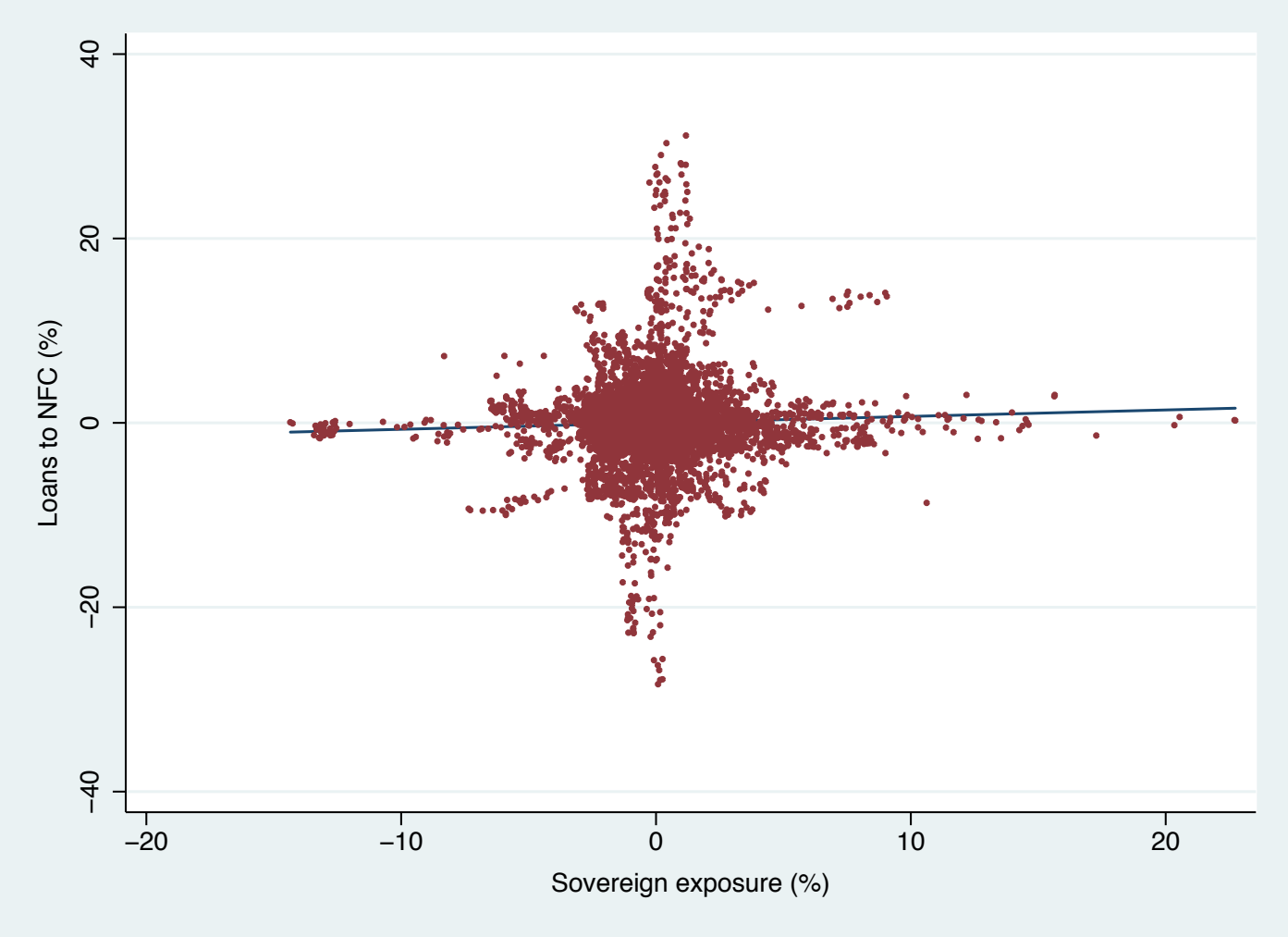
Sovereign exposures and lending: core banks



Note: Residuals of loan and sovereign exposure regressions on bank fixed effects and time dummies.
The core countries are Austria, Belgium, France, Germany, Luxemburg and Netherland.
Sample: August 2007 - February 2015.

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Empirical methodology

- **We estimate a panel data model:**

$$CDS_{i,j,t} = \alpha_i + \gamma_t + \beta_1 \cdot Sov.CDS_{j,t} + \beta_2 \cdot Sov.Exposures_{i,j,t-1} + \beta_3 \cdot Sov.CDS_{j,t} \times Sov.Exposures_{i,j,t-1} + \beta_4 \cdot X_{i,j,t-1} + \epsilon_{i,j,t}$$

Our coefficient of interest, β_3, captures the association between sovereign and bank credit risk due to the banks balance sheet channel

Controls:

- **Time fixed effect** control for aggregate determinants of credit spreads (demand channel, ultimate backstop, etc.)
- **Bank fixed effects** control for time-invariant characteristic of banks
- **Direct effects** of sovereign CDS and banks' exposures
- **Bank balance sheet characteristic** (Leverage ratio, Dep./Liab.)

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Sovereign exposures and yield on sovereign debt

$$Sov.Exposures_{i,j,t} = \alpha_i + \gamma_t + \beta_1 \cdot \Delta Sov.Yield_{j,t} + \beta_2 \cdot \Delta Sov.Yield_{j,t} \times T1cer_{i,j,08} + \beta_3 \cdot X_{i,j,t} + \epsilon_{i,j,t}$$

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