Banking Supervision, Monetary Policy and Risk-Taking: Big Data Evidence from 15 Credit Registers

Carlo Altavilla
European Central Bank

Miguel Boucinha
European Central Bank

José-Luis Peydró
Imperial

Frank R. Smets
European Central Bank

ASSA 2020 Annual Meeting
American Economic Association
San Diego, 3 January 2020

What we do

- **The role of banking supervision for bank risk-taking and interactions with monetary policy**

  i. Banking supervision: centralised vs. country-level supervision

  ii. Interaction between banking supervision and monetary policy

- **First to use more than 1 Credit Register**

  ✓ To our knowledge, literature has exclusively analysed only 1 credit register for all banking questions,

  ....but missing external validity and heterogeneous effects across countries

  ✓ We address both issues by using multiple credit registers (our *Big Data*)

Preview of questions and results

1. **The role of Banking Supervision**

   Does centralised (ECB) vs. local banking supervision affect bank risk-taking?

2. **The mechanism**

   Is the result due to **different incentives** or **capacity constraints**?

3. **Interaction with Monetary Policy (MP)**

   Does the interaction between bank supervision & MP affect risk-taking?

Preview of questions and results

1. **The role of Banking Supervision**

   Does centralised (ECB) vs. local banking supervision affect bank risk-taking?

   ✓ **YES.** Centralised supervision reduces lending to risky borrowers, especially in stressed countries.

2. **The mechanism**

   Is the result due to **different incentives** or **capacity constraints**?

   ✓ Higher quantity and quality of (human) resources available influence the ability of the (centralized) supervisor to reduce excessive risk-taking

3. **Interaction with Monetary Policy (MP)**

   Does the interaction between bank supervision & MP affect risk-taking?

   ✓ **YES**. MP easing tends to increase bank lending towards riskier firms, but in stressed countries this risk-taking is offset by centralized supervision.

Contribution to the literature

- **Banking supervision: Centralized vs. local**
  Agarwal-Lucca-Seru-Trebbi, *QJE* 2014
  Granja, J., and Leuz, C. (2017). Kandrac, J., and Schlusche, B. (2019).
  Calzolari et al., RFS2019, Beck et al., EP2013

- **Monetary policy & Risk taking**
  Adrian-Shin, *Handbook ME*; Kashyap-Stein, *AER* 2000; Dell'Ariccia-Laeven-Suarez, *JF* 2017
  Jimenez-Ongena-Peydró-Saurina, *AER* 2012 & *Econometrica* 2014; Rajan 2005 Jackson Hole

- **All questions using single credit registers**
  Mian, 2006; Khwaja and Mian, 2008; Paravisini, 2008; Amiti and Weinstein, 2011; Schnabl, 2012

Contribution

- ✓ Centralized vs. local supervision affects credit supply/risk-taking (not just different risk assessments) & interaction between supervision & monetary policy

- ✓ Underlying mechanism: availability of broader and better (human) resources to central supervisors

- ✓ First findings on cross-country heterogeneity using multiple credit registers, for a key question results are identical, but for supervision and monetary policy huge differences

Outline

- Big data: 15 credit registers

- Empirical analysis
  - Supervision and risk-taking
  - The mechanism
  - Supervision and monetary policy

- Conclusions

The dataset

Time and Country coverage

Sample size

- ✓ T: June 2012 – December 2017
- ✓ N: 15 Credit Registers

15 Credit Registers

- ✓ AT, BE, CZ, DE, ES, IE, IT, RO, SI, FR, LT, LV, MT, PT, SK
- ✓ Stressed vs. non-stressed countries
- ✓ Non euro area countries
- ✓ Important event: November 2014 ECB supervisor for some euro area banks, and not for non-euro area banks

Variables

Measures of loan exposure

Loan (bank, firm) identifiers
Type of exposure (loans, debt securities)
Credit commitment or drawn (value of the loan)
Credit lines (the value of credit undrawn)

Credit risk variables

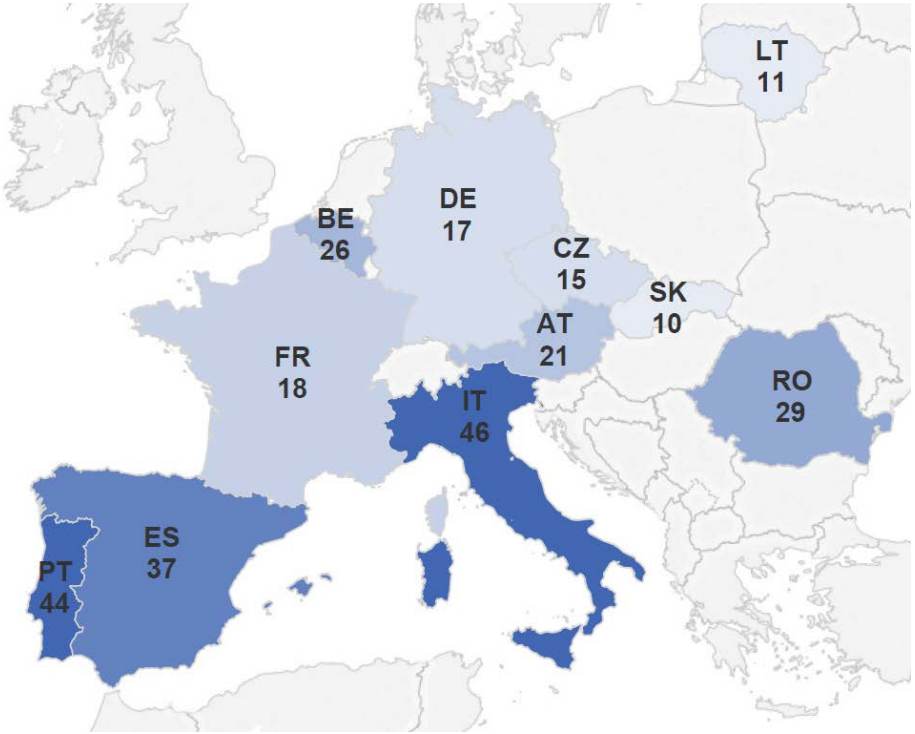
Collateral type (yes, no)
Arrears (part of the loan that is past due)
Prob. of default (between 0 and 1)
Non-performing status

Borrower attributes

Country of residence
Institutional sector
Sector of economic activity
Size

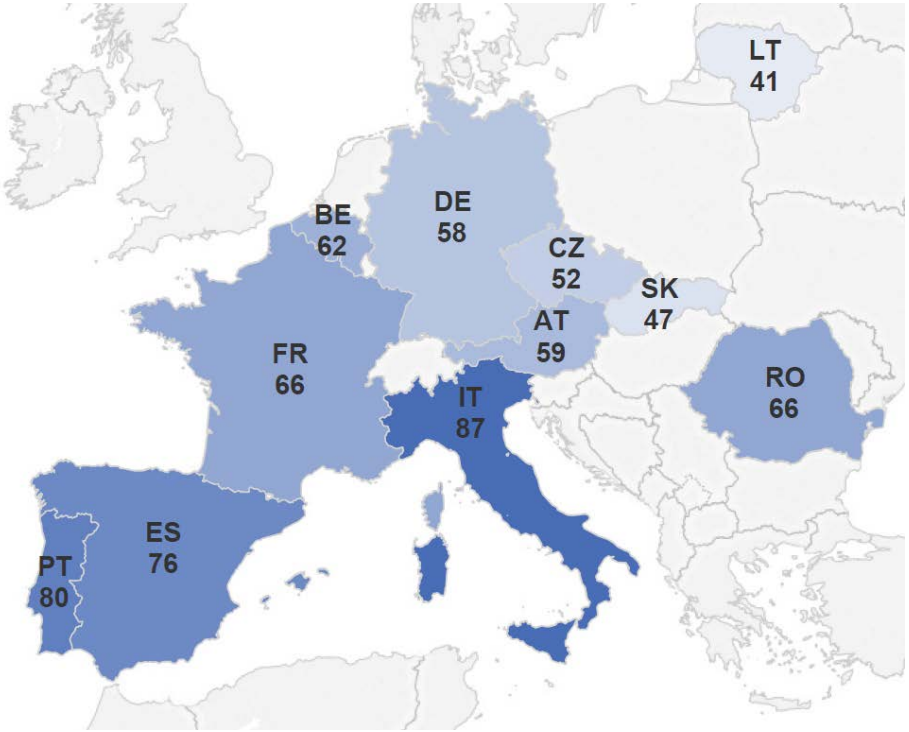
Exploiting granularity via transaction level data

Share of firms with multiple bank relationships
(% of total borrowers)



Notes: for each country, the chart shows the share of non-financial corporations with multiple bank relationships as share of total borrowers.

Share of firms with multiple bank relationships
(% of total exposure)



Notes: for each country, the chart shows the share of non-financial corporations with multiple bank relationships as share of total exposure.

- ✓ firm-time (ft), firm-bank (fb), and bank-time (bt) FE or
- ✓ sector-time (st) (or sector-country-size-time), firm-bank (fb), and bank-time (bt) FE

Outline

- Big data: 15 credit registers
- Empirical analysis
  - Supervision and risk-taking
  - The mechanism
  - Supervision and monetary policy
- Conclusions

Do banks supervised by the ECB/SSM behave differently?

$$\text{Loans}_{b,s,f,t} = \alpha^{FE} + \delta \text{BQ}_{f,t-1} + \theta \text{Sup}_{b,t-1} + \lambda \left(\text{BQ}_{f,t-1} \times \text{Sup}_{b,t-1} \right) + \Omega X_{b,f,t-1} + \epsilon_{b,s,f,t}$$

firm with no arrears

$$0 \leq \text{BQ}_{f,t-1} = \left(\frac{\text{Arrears}_{f,t-1}}{\text{Exposure}_{f,t-1}} \right) \leq 1$$

all of the firm's exposures are in arrears

$$\text{Sup}_{b,t} = \begin{cases} 1 & \text{if b is centrally supervised at period t} \\ 0 & \text{otherwise} \end{cases}$$

$X_{b,f,t-1}$ contains NPL, BQ (bad quality/risk), Sup and their interactions

Hypothesis to test

$\lambda < 0$: once a bank becomes centrally (SSM/ECB) supervised, it provides less credit to riskier borrowers

Banking supervision: results

	Stressed Countries		Non-Stressed Countries	
	i = -1		i = -1	
	(1)	(2)	(5)	(6)
$BQ_{f,t+i}$	-0.246*	-	-0.185***	-
	(0.0245)		(0.0424)	
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.434***	-0.268***	-0.363***	-0.0450
	(0.0666)	(0.0954)	(0.108)	(0.0980)
N	40,626,537	30,703,723	6,879,163	3,672,419
R-squared	0.704	0.771	0.815	0.845
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Results:

Centralised supervision leads banks to cut lending to ex-ante riskier borrowers (BQ x Sup <0)

The effect is stronger for stressed countries.

Banking supervision: results

	Stressed Countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.246*	-	-0.135***	-	-0.185***	-	-0.0510*	
	(0.0245)		(0.0488)		(0.0424)		(0.0278)	
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.434***	-0.268***	-0.440***	-0.200**	-0.363***	-0.0450	-0.255***	0.101
	(0.0666)	(0.0954)	(0.0598)	(0.0872)	(0.108)	(0.0980)	(0.0571)	(0.0937)
N	40,626,537	30,703,723	41,181,446	31,393,573	6,879,163	3,672,419	6,866,876	3,672,058
R-squared	0.704	0.771	0.707	0.772	0.815	0.845	0.826	0.846
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	Y	N	Y	N	Y	N	Y
Sector*Time	Y	-	Y	-	Y	-	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

Results:

Centralised supervision leads banks to cut lending to ex-ante riskier borrowers
=> Not efficient funding of illiquid viable firms, rather bad risk-taking

The effect is stronger for stressed countries.

Banking supervision, risk-taking and productivity

$$Loans_{c,b,s,f,t} = \alpha^{FE} + \rho Prod_{c,s,t} + \theta Sup_{b,t-1} + \delta BQ_{f,t-1} + \lambda \left(BQ_{f,t-1} \times Sup_{b,t-1}\right) + \tau \left(BQ_{f,t-1} \times Prod_{c,s,t}\right) + \sigma \left(Prod_{c,s,t} \times Sup_{b,t-1}\right) + \Omega X_{b,f,t-1} + \epsilon_{c,b,s,f,t}$$

$Prod_{c,s,t}$ is a cost-adjusted measure of sectoral labour productivity for each sector in each country

Hypothesis to test

$\sigma < 0$: once a bank becomes centrally (SSM/ECB) supervised, it decreases the credit supply towards more productive firms

Banking supervision, risk-taking and productivity

	Stressed countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.0756*		-0.174***		-0.146***		-0.0563*	
	(0.0401)		(0.0557)		(0.0443)		(0.0253)	
$BQ_{f,t+i}$ x $Sup_{b,t+1}$	-0.429***	-0.285***	-0.448***	-0.202**	-0.394***	-0.00276	-0.256***	0.0386
	(0.0659)	(0.0942)	(0.0651)	(0.0899)	(0.112)	(0.120)	(0.0513)	(0.0972)
$Prod_{s,t+i}$	-0.213***		-0.251***		0.349***		-0.100	
	(0.0408)		(0.0445)		(0.104)		(0.0994)	
$BQ_{f,t+i}$ x $Prod_{s,t+i}$	0.288***		0.0995**		0.246**		0.399***	
	(0.0812)		(0.0414)		(0.107)		(0.0812)	
$Prod_{s,t+i}$ x $Sup_{b,t-1}$	0.0426	-0.0115	0.0546	0.0113	-0.0220	0.176	0.116**	0.189
	(0.0383)	(0.0351)	(0.0381)	(0.0392)	(0.0635)	(0.140)	(0.0580)	(0.151)
N	37,753,379	28,374,474	32,123,122	24,285,787	5,750,158	2,713,259	4,676,219	2,182,565
R-squared	0.714	0.779	0.728	0.789	0.835	0.867	0.855	0.873
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	Y	N	Y	N	Y	N	Y
Sector*Time	Y	-	Y	-	Y	-	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

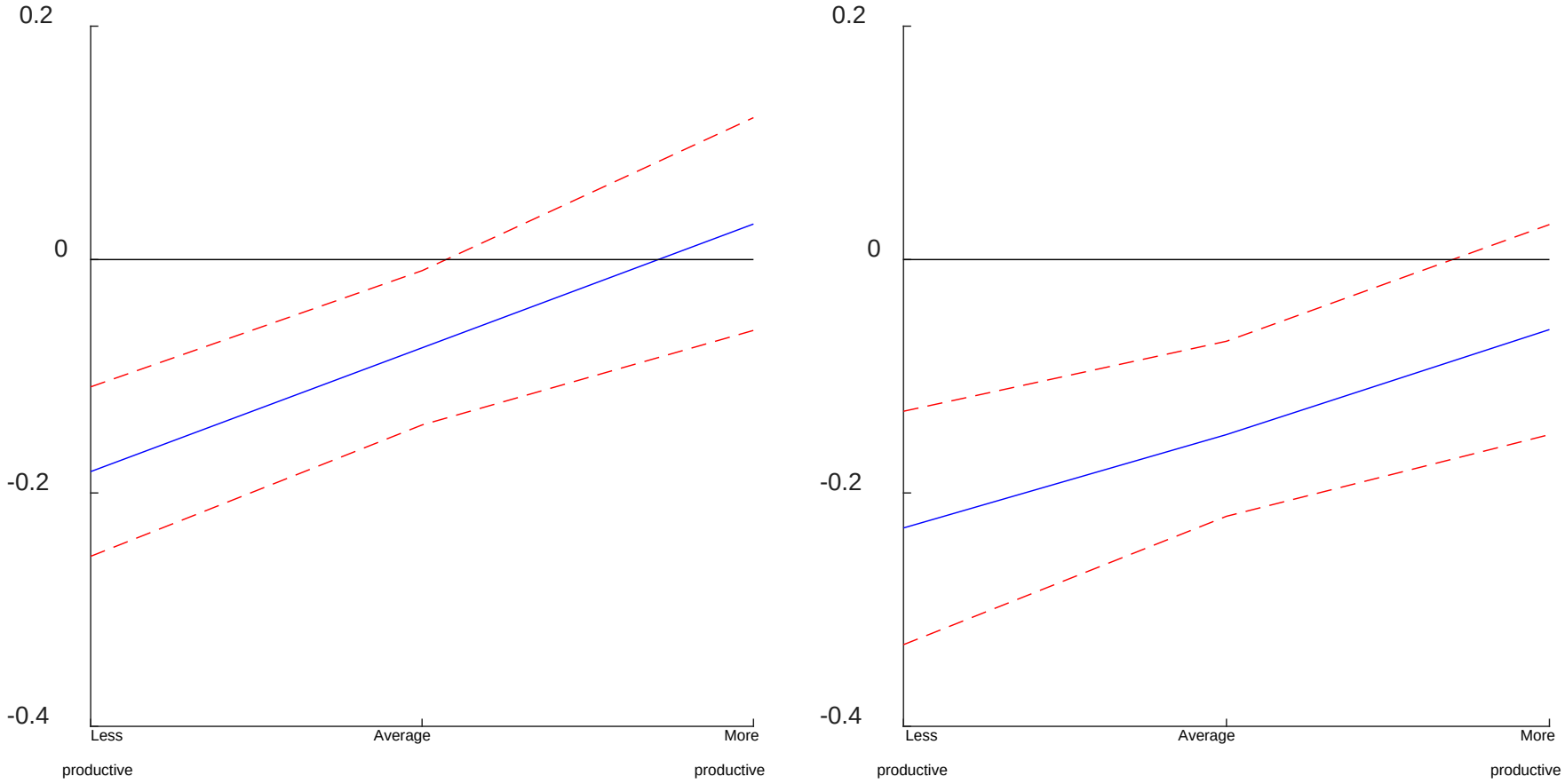
The Centralisation of bank supervision do not curtail lending supply to more productive firms

Banking supervision, risk-taking and productivity

Stressed countries

Non-stressed countries

$$\frac{dLoans}{dBQ}\Big|_{Prod} = \delta + (\tau \times Prod)$$



The change in credit supply due to the reduction in firm creditworthiness is larger for less productive firms

Banking supervision: some robustness checks

1. On the cross-section

- ✓ Focusing on banks around threshold to become centrally supervised
- ✓ Controlling for lagged bank size in interactions (in addition to the level)

2. Non euro-area EU countries (external placebo):

- ✓ Comparing banks in Romania and Czech Republic (not included in SSM) as if they would have followed the ECB rules to define centrally supervised banks

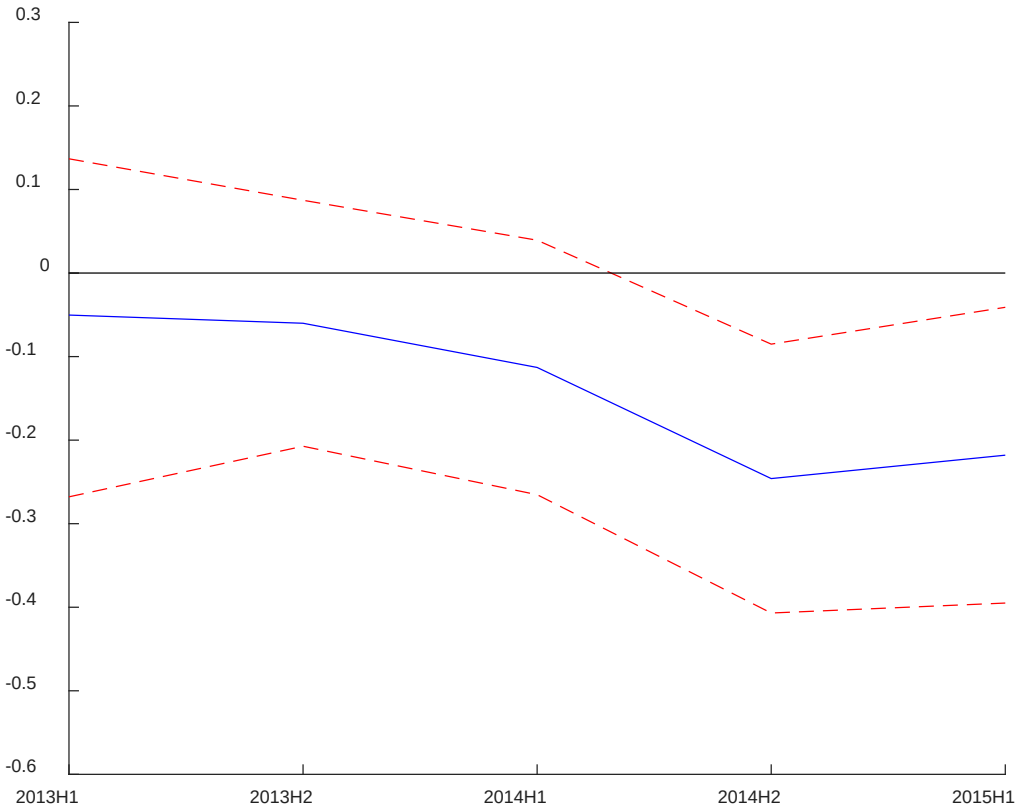
3. On the time series

- ✓ Checking for alternative dates for the start of bank supervision
- ✓ Allowing more time for the materialisation of ex-post risk

Robustness on the timing of banking supervision

$$Loans_{b,s,f,t} = [\dots] + \lambda \left(BQ_{f,t-1} \times Sup_{b,t} \right) + \epsilon_{b,s,f,t}$$

$$Sup_{b,t} = \begin{cases} 1 & \text{if } t \geq 2012H1 \dots .2015H1 \\ 0 & \text{otherwise} \end{cases}$$



Notes: Estimated coefficient of the interaction BQ*Sup from equation (1), based on different dates for the effective start of bank supervision. The specifications control for Bank*time, Bank*firm, and Firm*time fixed effects (Country*time and sector*time fixed effects are spanned by the previous effects).

Outline

- Big data: 15 credit registers
- Empirical analysis
  - Supervision and risk-taking
  - The mechanism
  - Supervision and monetary policy
- Conclusions

The mechanism

Why does centralised supervision reduce excessive risk-taking?

1. **Capacity hypothesis**

   Resources available, including number and skill/training of supervisors

   Question: Does the centralisation of banking supervision increase the risk sensitivity of credit supply for very large banks?

2. **Incentive hypothesis**

   Local regulators easier to capture by large banks, revolving doors, lobbying

   Question: Does the centralisation of banking supervision increase the risk sensitivity of credit supply for weaker banks (as proxied by higher NPL ratios)?

The mechanism

$$Loans_{b,s,f,t} = \alpha^{FE} + \beta_1\left(NPL_{b,t-1} \times BQ_{f,t-1} \times Sup_{b,t-1}\right) + \beta_2\left(Size_{b,s,t-1} \times BQ_{f,t-1} \times Sup_{b,t-1}\right) + \beta_3\left(Large_b \times BQ_{f,t-1} \times Sup_{b,t-1}\right) + \Omega X_{b,f,t-1} + \epsilon_{b,s,f,t}$$

1. **Capacity hypothesis**

   - $\beta_3 < 0$

2. **Incentive hypothesis**

   - $\beta_1 < 0$

Banking supervision mechanism: large banks

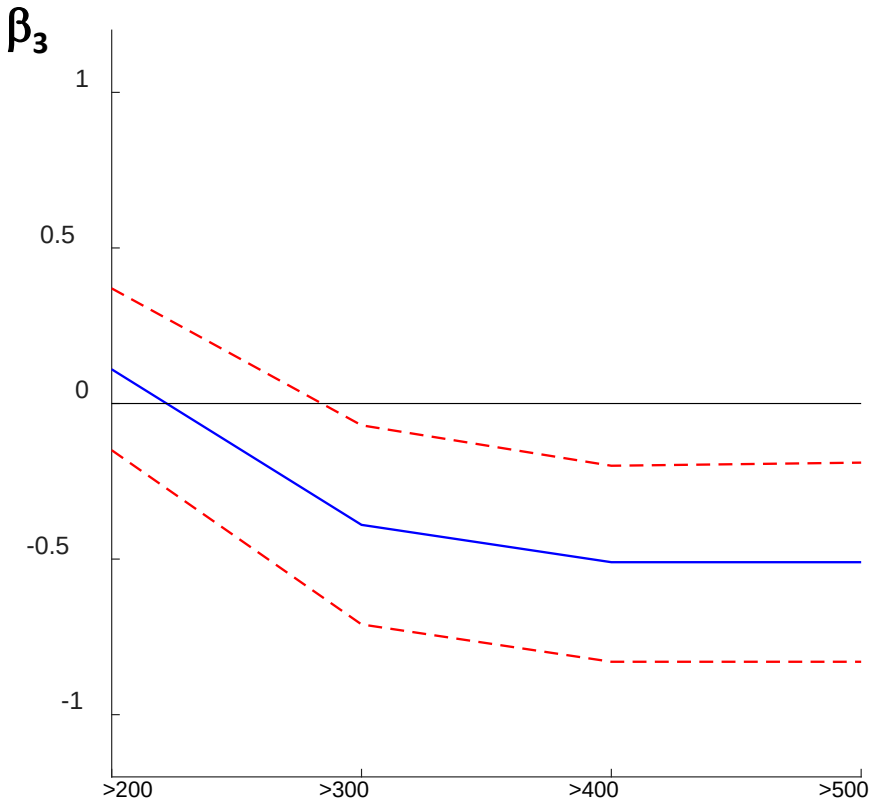
	Stressed Countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.171***	-	-0.173***	-	-0.194***	-	-0.184***	-
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.365***	-0.218**	-0.400***	-0.197***	-0.282***	-0.0276	-0.219***	0.0724
$NPL_{b,t-1}$ x $BQ_{f,t+i}$	1.932***	2.106***	1.299***	1.670***	1.441***	2.244***	1.460***	2.054**
$NPL_{b,t-1}$ x $BQ_{f,t+i}$ x $Sup_{b,t-1}$	1.17	1.031	0.97	0.308	-0.492	0.471	0.856	1.287
$Size_{b,s,t-1}$ x $BQ_{f,t+i}$	0.000203	-0.00448	0.0006	-0.00234	0.00197	0.00268	-0.00148	-0.000256
$Size_{b,s,t-1}$ x $BQ_{f,t+i}$ x $Sup_{b,t-1}$	0.00421	-0.000585	0.00478	-0.000975	0.00700	-0.00531	-0.00402	-0.0122**
$Large_b$ x $BQ_{f,t+i}$	0.358***	0.305*	0.503***	0.398**	0.327***	0.0132	0.648***	-0.342
$Large_b$ x $BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.470**	-0.319*	-0.404**	-0.219*	-0.824***	-0.0537	-0.367***	0.152
N	39,811,038	29,856,793	36,120,663	27,285,698	6,262,908	2,915,490	5,642,723	2,641,856
R-squared	0.705	0.773	0.716	0.780	0.835	0.866	0.851	0.869
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	Y	N	Y	N	Y	N	Y
Sector*Time	Y	-	Y	-	Y	-	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

No major differences across NPL => weak support for incentive hypothesis

Important difference for very large banks => confirming capacity hypothesis

Banking supervision mechanism: large banks

Thresholds for Large banks



Non-linearity for very large banks not driven by specific threshold

Banking supervision mechanism: large banks

	Full sample		Restricted Sample	
> 200 bn	-0.215**	0.206	-0.174	0.112
	(0.109)	(0.142)	(0.111)	(0.159)
> 300 bn	-0.425***	-0.198	-0.396***	-0.388*
	(0.147)	(0.178)	(0.147)	(0.196)
> 400 bn	-0.438**	-0.325*	-0.407**	-0.513***
	(0.190)	(0.176)	(0.190)	(0.192)
> 500 bn	-0.470**	-0.319*	-0.443**	-0.508**
	(0.207)	(0.190)	(0.206)	(0.196)
Largest bank in country	0.00383	0.0388	0.000374	0.0158
	(0.147)	(0.107)	(0.138)	(0.153)
N	39,811,038	29,856,793	26,535,557	17,059,229
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Results

Non-linearity for very large banks not driven by specific threshold

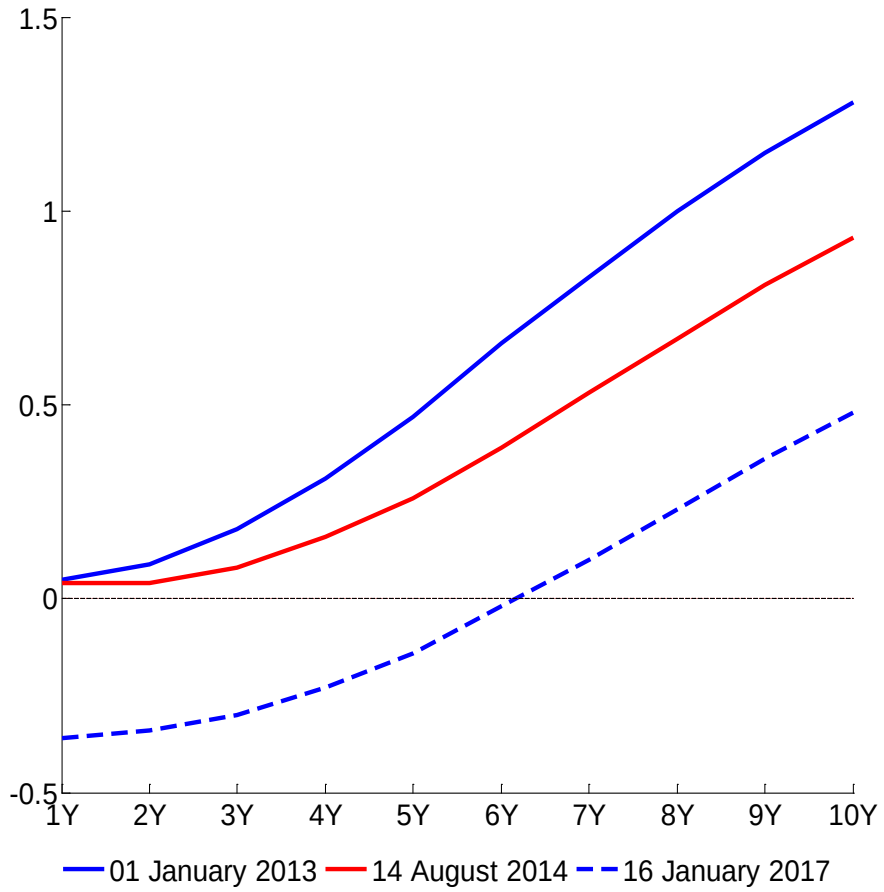
No difference for the largest bank in a given country

Outline

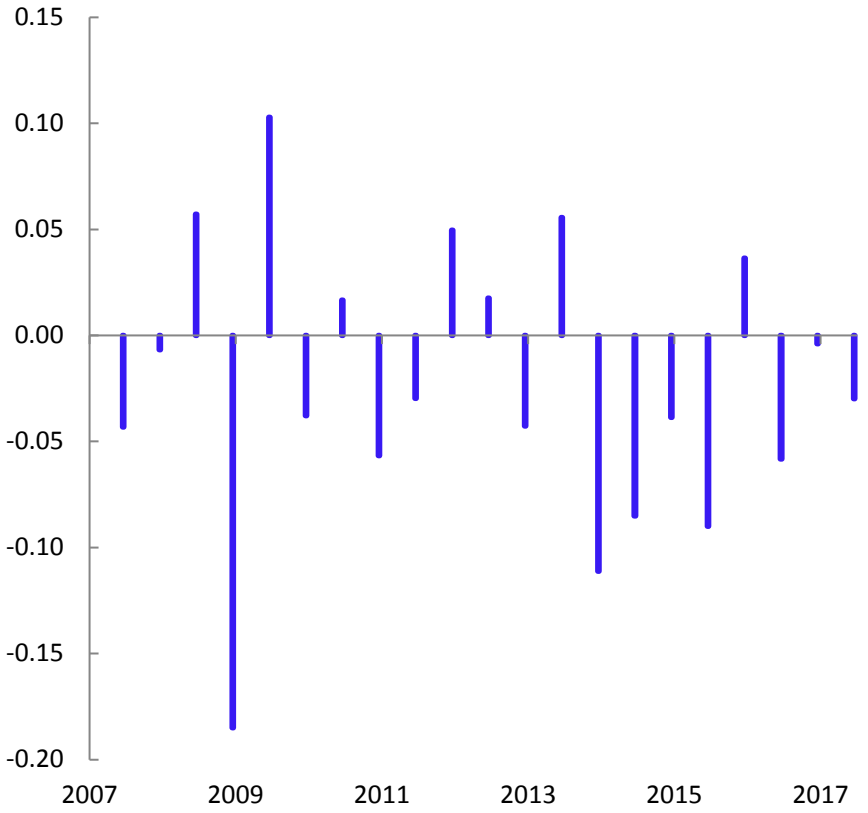
- Big data: 15 credit registers
- Empirical analysis
  - Supervision and risk-taking
  - The mechanism
  - Supervision and monetary policy
- Conclusions

Monetary policy surprises

Term structure of OIS yields at different dates (percentages per annum)



Monetary policy surprises



Source: Altavilla, Brugnolini, Gürkaynak, Motto, Ragusa, 2019.

Note: policy surprises from high-frequency intraday yields at different maturities during dates of policy announcements Positive (negative) values indicates policy tightening (easing)

Interaction between banking supervision and monetary policy

$$Loans_{b,s,f,t} = \alpha^{FE} + \delta BQ_{f,t-1} + \theta Sup_{b,t-1} + \lambda\left(BQ_{f,t-1} \times Sup_{b,t-1}\right) + \mu Shock^{MP}_{t-1} + \psi\left(Shock^{MP}_{t-1} \times BQ_{f,t-1}\right) + \phi\left(Shock^{MP}_{t-1} \times Sup_{b,t-1}\right) + \eta\left(Shock^{MP}_{t-1} \times BQ_{f,t-1} \times Sup_{b,t-1}\right) + \Omega X_{b,f,t-1} + \epsilon_{b,s,f,t}$$

$X_{b,f,t-1}$ includes all remaining double and triple interactions; also with size

Hypotheses to test:

1) $\psi < 0$ MP easing tends to increase lending towards riskier firms

2) $\eta > 0$ but this is cancelled by centralised supervision

Interaction between Banking Supervision and Monetary Policy

	Stressed Countries		Non Stressed Countries	
	(1)	(2)	(3)	(4)
$BQ_{f,t-1}$	-0.422***		-0.254***	
	(0.0626)		(0.0534)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.527***	-0.328*	-0.248*	-0.113
	(0.125)	(0.198)	(0.133)	(0.178)
$BQ_{f,t-1}$ x $Shock^{MP}_{t-1}$	-0.0170**		-0.0168***	
	(0.00713)		(0.00583)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$ x $Shock_{t-1}^{MP}$	0.0403***	0.0535**	0.0222***	0.0278**
	(0.0154)	(0.0233)	(0.00811)	(0.0125)
N	39,811,038	29,856,793	6,262,908	2,915,490
R-squared	0.705	0.773	0.835	0.866
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Results

Monetary Policy interaction:

1. MP easing leads banks to increase lending towards riskier firms
   *(BQ*Shock<0)*
2. But this risk-taking of MP is canceled by centralized supervision
   *(BQ*Sup*Shock>0)*

Banking Supervision and Monetary Policy

	Stressed countries				Non-stressed countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t-1}$	-0.0280	-0.0588*	-0.0599*		-0.0881	-0.146***	-0.152***	
	(0.0510)	(0.0264)	(0.0324)		(0.0597)	(0.0457)	(0.0453)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.428***	-0.367***	-0.362***	-0.207*	-0.401***	-0.319***	-0.312***	-0.086*
	(0.0622)	(0.0553)	(0.0552)	(0.112)	(0.117)	(0.0977)	(0.0975)	(0.045)
$BQ_{f,t-1}$ x $Shock_{t-1}^{MP}$	-0.0209**	-0.0143***	-0.0112***		-0.0219***	-0.0275***	-0.0249***	
	(0.00486)	(0.00463)	(0.00432)		(0.00508)	(0.00719)	(0.00712)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$ x $Shock_{t-1}^{MP}$		0.0175	0.0370**	0.0475**		0.0165**	0.0117*	0.0372*
		(0.0101)	(0.0159)	(0.0241)		(0.0083)	(0.00518)	(0.0197)
$Large_b$ x $BQ_{f,t-1}$	0.268**	0.328**	0.361**	0.211	0.291***	0.314***	0.328***	0.145
	(0.131)	(0.149)	(0.141)	(0.190)	(0.0791)	(0.0933)	(0.0881)	(0.316)
$Large_b$ x $BQ_{f,t-1}$ x $Sup_{b,t-1}$		-0.580***	-0.627***	-0.434**		-0.813***	-0.831***	-0.4798*
		(0.208)	(0.202)	(0.205)		(0.163)	(0.158)	(0.255)
$Large_b$ x $BQ_{f,t-1}$ x $Shock_{t-1}^{MP}$		-0.0136	-0.0465***	-0.0223*		-0.0122	-0.033*	-0.141***
		(0.00929)	(0.00841)	(0.0119)		(0.0148)	(0.0178)	(0.0460)
$Large_b$ x $BQ_{f,t-1}$ x $Shock_{t-1}^{MP}$ x $Sup_{b,t-1}$			0.0513***	0.0452***			0.0208*	0.164***
			(0.00886)	(0.0146)			(0.0108)	(0.046)
N	39,811,038	39,811,038	39,811,038	29,856,793	6,262,908	6,262,908	6,262,908	2,915,490
R-squared	0.705	0.705	0.705	0.773	0.835	0.835	0.835	0.866
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	N	N	Y	N	N	N	Y
Sector*Time	Y	Y	Y	-	Y	Y	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

Outline

- Big data: 15 credit registers
- Empirical analysis
  - Supervision and risk-taking
  - The mechanism
  - Supervision and monetary policy
- Conclusions

Conclusions

1. **The role of Banking Supervision**

   Does centralised (ECB) vs. local banking supervision affect bank risk-taking?

   ✓ **YES.** Centralised supervision reduces lending to risky borrowers, especially in stressed countries.

2. **The mechanism**

   Is the result due to **different incentives** or **capacity constraints**?

   ✓ Higher quantity and quality of (human) resources available influence the ability of the (centralized) supervisor to reduce excessive risk-taking

3. **Interaction with Monetary Policy (MP)**

   Does the interaction between bank supervision & MP affect risk-taking?

   ✓ **YES**. MP easing tends to increase bank lending towards riskier firms, but in stressed countries this risk-taking is offset by centralized supervision.

Thank you

Dataset characteristics

	Reporting Threshold	Initial Sample (in million)	# of banks Original Sample	Final Sample (in million)	# of banks Final Sample
Austria	350,000	1.4	1601	0.5	65
Belgium	0	13.3	144	6.2	36
Germany	1,000,000	11.1	1828	4.7	498
Spain	6,000	23.6	283	16.7	133
France	25,000	37.7	522	24.8	295
Ireland	500	4.3	4	-	-
Italy	30,000	148.2	1576	28.2	731
Lithuania	290	0.3	166	0.3	11
Latvia	0	12.7	109	-	-
Malta	5,000	0.1	26	-	-
Portugal	50	8.8	198	6.2	107
Slovenia	0	0.2	26	-	-
Slovakia	0	0.9	30	0.6	11
Romania	4,440	20.2	96	2	52
Czech Republic	0	4.8	41	1.5	18

Descriptive statistics

	Stressed Countries			Non-Stressed Countries		
	Mean	St.Dev.	# obs.	Mean	St.Dev.	# obs.
Loan volume (Loans)	516	12,078	48,507,843	1,716	15,649	8,526,222
Borrower Quality (BQ)	0.05	0.19	45,828,620	0.03	0.16	7,396,700
Centralised Supervision (Sup)	0.34	0.47	48,507,843	0.50	0.50	8,526,222
Monetary Policy Shock ($Shock^{MP}$)	-1.04	4.22	48,507,843	-1.15	4.25	8,526,222
NPL ratio (NPL)	0.20	0.10	48,507,843	0.05	0.04	8,526,222
Size	5.35	6.22	48,507,691	15.13	11.41	8,526,194
Large	0.16	0.36	48,507,843	0.07	0.26	8,526,222
Productivity (Prod)	217.7	183.9	40,171,006	240.69	173.54	6,496,651

Stressed countries: Italy, Spain and Portugal

Non-Stressed Countries: Austria, Belgium, Germany, Lithuania and Slovakia

Robustness on banking supervision

Robustness: Credit drawn

	Stressed Countries		Non-Stressed Countries	
	i = -1	i = 1	i = -1	i = 1
	(1)	(2)	(3)	(4)
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.230***	-0.241***	-0.0658	0.00577
	(0.0706)	(0.0830)	(0.0569)	(0.0532)
N	25,407,607	26,098,126	2,945,492	2,929,344
R-squared	0.900	0.900	0.940	0.942
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	Y	Y	Y	Y
Bank*Time	Y	Y	Y	Y

Robustness on banking supervision

Robustness: restricted sample for euro area banks (6 banks per country) and placebo test based on non-euro area countries and banks

	Stressed Countries		Non-Stressed Countries		EU non EA	
	i = -1	i = 1	i = -1	i = 1	i = -1	i = 1
	(1)	(2)	(3)	(4)	(5)	(6)
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.338**	-0.167*	-0.000281	-0.0618	0.361	0.385
	(0.155)	(0.088)	(0.194)	(0.151)	(0.250)	(0.217)
N	1,474,985	1,533,704	227,494	225,952	349,429	319,001
R-squared	0.857	0.861	0.871	0.868	0.826	0.829
Fixed effects						
Bank*Firm	Y	Y	Y	Y	Y	Y
Firm*Time	Y	Y	Y	Y	Y	Y
Bank*Time	Y	Y	Y	Y	Y	Y

Supervision and bank credit supply

	Stressed Countries		Non Stressed Countries	
	(1)	(2)	(3)	(4)
$Sup_{b,t-1}$	0.110*	0.110*	0.0578	0.155**
	(0.0616)	(0.0642)	(0.0652)	(0.0698)
$BQ_{f,t-1}$	-0.0450	-	-0.0997**	-
	(0.0456)		(0.0439)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.447***	-0.358***	-0.446***	-0.272***
	(0.0673)	(0.104)	(0.112)	(0.0963)
N	39,820,155	29,866,102	6,263,603	2,916,268
R-squared	0.682	0.751	0.830	0.859
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank	Y	Y	Y	Y

Robustness on banking supervision

Capacity and incentive hypotheses: 20 individual regressions for each alternative measure of large banks (non-stressed countries)

	Full sample		Restricted Sample	
> 200 bn	-0.740***	-0.162	-0.707***	-0.187
	(0.157)	(0.246)	(0.154)	(0.243)
> 300 bn	-0.785***	0.287	-0.749***	0.277
	(0.166)	(0.493)	(0.164)	(0.481)
> 400 bn	-0.785***	0.287	-0.749***	0.277
	(0.166)	(0.493)	(0.164)	(0.481)
> 500 bn	-0.824***	-0.0537	-0.790***	-0.0724
	(0.160)	(0.469)	(0.156)	(0.445)
Largest bank in country	-0.188	0.529	-0.184	0.562
	(0.194)	(0.362)	(0.188)	(0.368)
N	6,262,908	2,915,490	5,663,549	2,342,131
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Number of supervised banks

	201412	201506	201512	201606	201612	201706	201712
IT	14	14	15	15	14	14	12
ES	15	15	14	14	14	14	14
PT	4	4	4	4	4	4	4
FR	10	10	13	13	13	13	12
AT	6	6	6	6	6	6	5
BE	6	6	6	6	6	6	6
LT	0	3	3	3	3	3	3
SK	3	3	3	3	3	3	3
DE	21	21	22	22	21	21	21

Non-performing status

	Non-performing but not in default	Default because of unlikely to pay	Default because of past due more than 90 days	Default because of both unlikely to pay and past due more than 90 days	Default
Austria	Y	Y	Y	Y	Y
Belgium	N	Y	Y	Y	N
Cyprus	Y	Y	Y	N	N
Germany	-	-	-	-	-
Spain	N	Y	Y	N	N
France	-	-	-	-	-
Ireland	Y	N	N	N	Y
Italy	Y	Y	Y	Y	Y
Lithuania	N	Y	Y	N	N
Latvia	N	N	Y	N	N
Malta	Y	Y	Y	Y	N
Portugal	Y	Y	Y	N	Y
Romania	-	-	-	-	-
Slovenia	Y	Y	N	Y	N
Slovakia	Y	Y	Y	N	N

Definition of variables used in the regression

	Exposure	NPL Ratio	NPL Ratio excl. Sector	Borrower Quality
Austria	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure
Belgium	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure
Germany	Credit Drawn	Probability of default	Probability of default	Probability of default
Spain	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure
France	Credit Drawn + Undrawn	Non-performing status	-	-
Italy	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure
Lithuania	Credit Drawn + Undrawn	Non-performing status	Non-performing status	-
Portugal	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure
Slovakia	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure
Romania	Credit Drawn + Undrawn	Non-performing status	Non-performing status	Arrears / Exposure

Establishment of European banking supervision

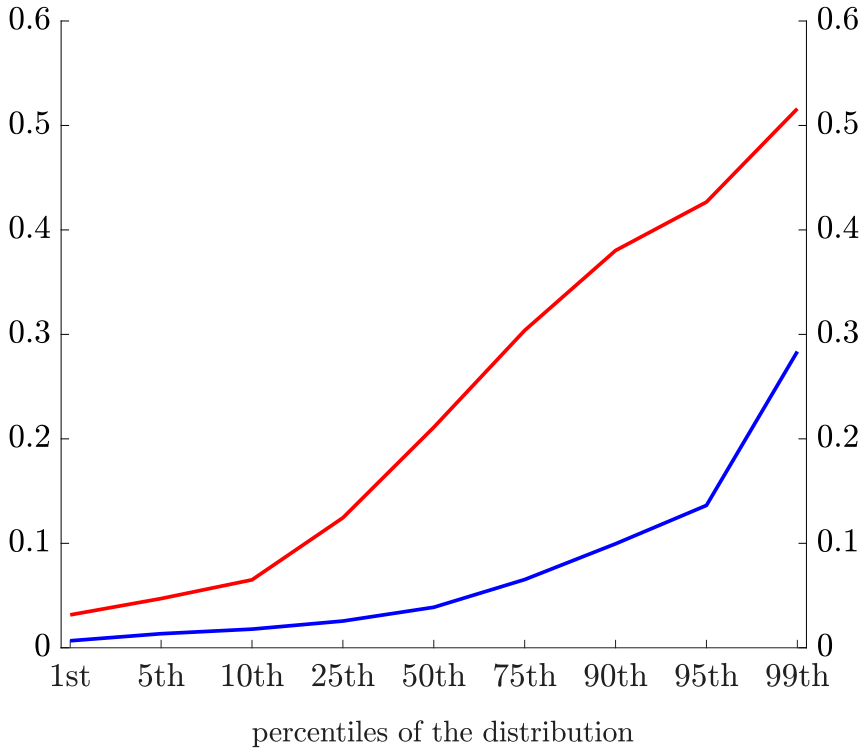
Single Supervisory Mechanism becomes operational in November 2014

Significance criteria

1. Size	the total value of its assets exceeds €30 billion
2. Economic importance	Total assets exceeding €5 billion and 20% of GDP of the Member State.
3. Cross-border activities	Total assets exceeding €5 billion and the ratio of its cross-border A/L in more than one other participating country to its TA/L above 20%.
4. Direct public financial assistance	it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility.
5. Three most significant institutions	it is one of the three most significant credit institutions in a participating Member State

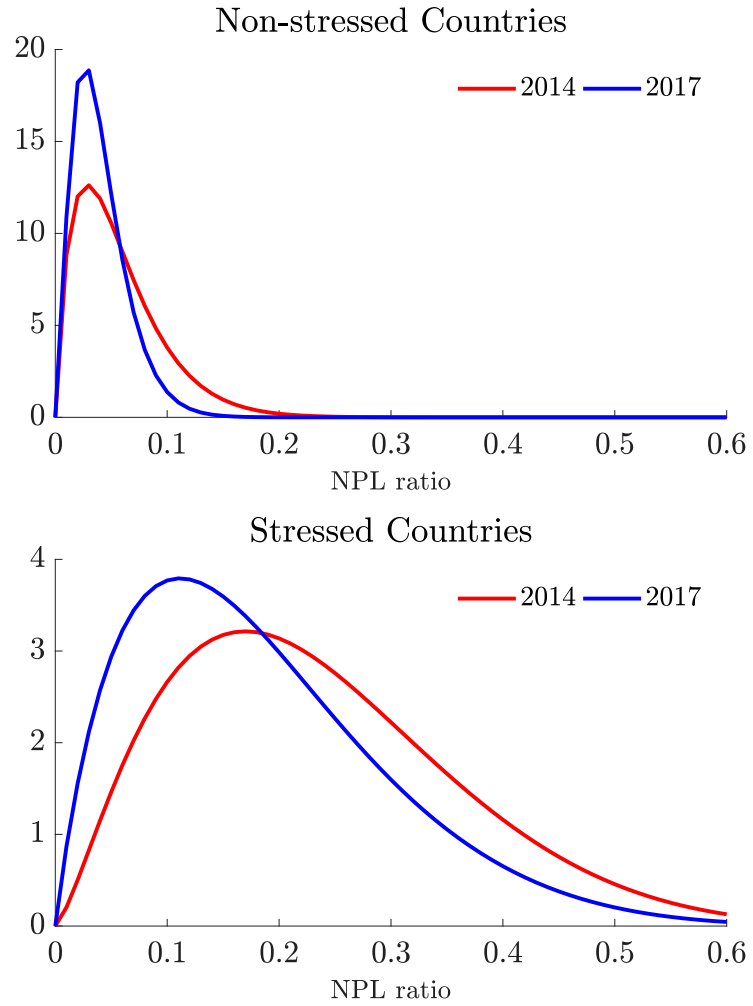
Exploiting granularity at bank-firm level

Bank NPL ratio
(share of total exposure)



Note: Stressed countries are IT, ES, PT; Non-stressed countries are AT, BE, DE, LT, SK, FR. Percentile of firm-bank-time on the x-axis. Pooling data at country, time, bank, borrower level.

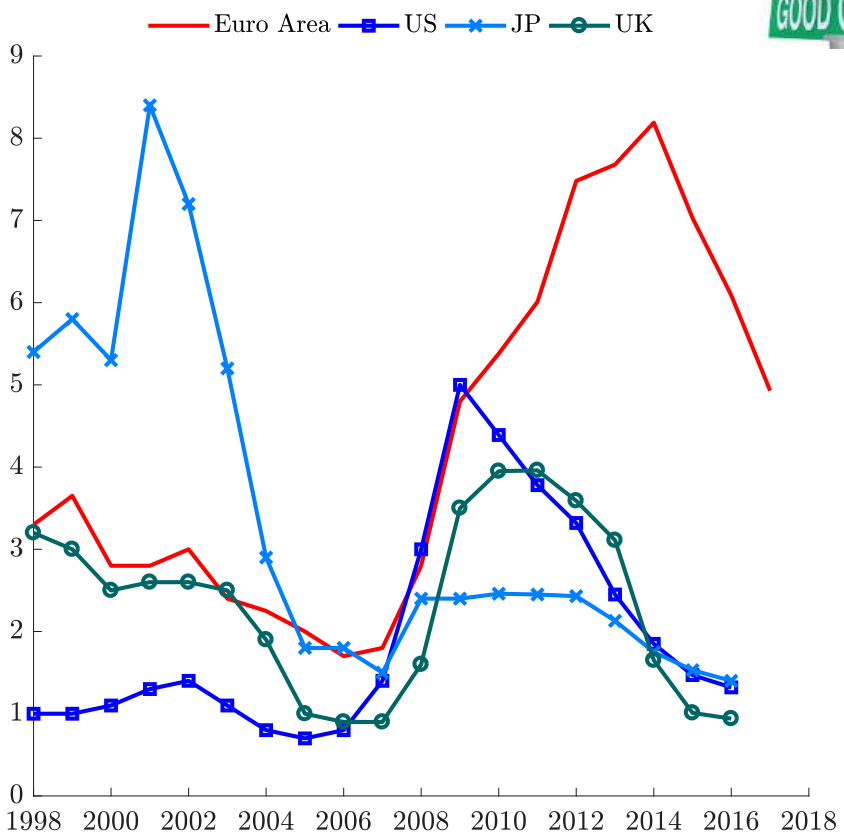
Bank NPL ratio by year
(share of total exposure)



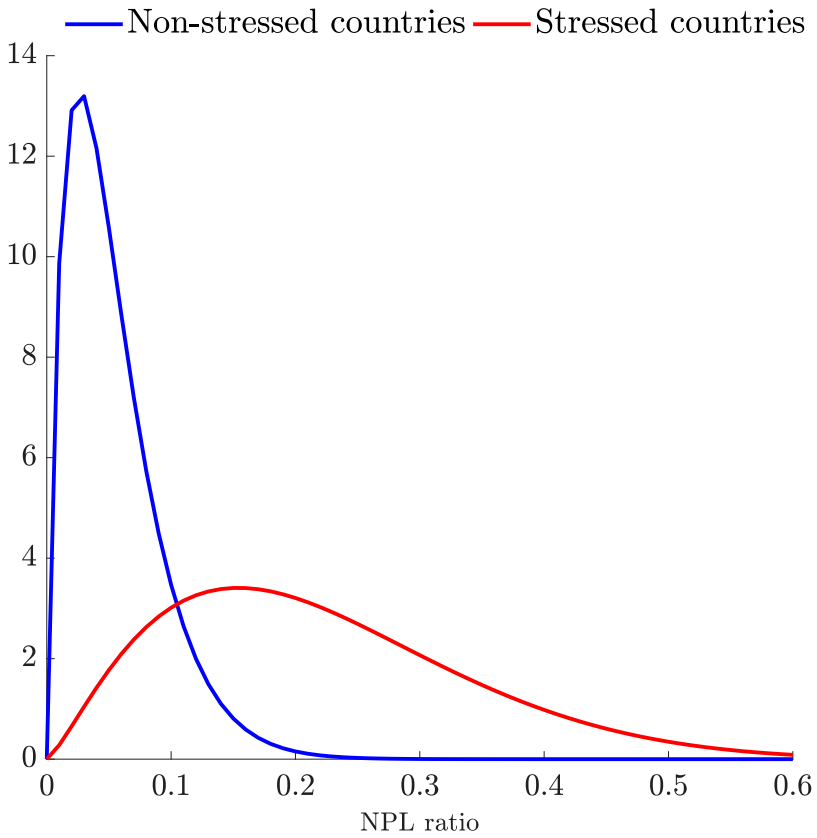
Note: Stressed countries are IT, ES, PT; Non-stressed countries are AT, BE, DE, LT, SK, FR. Pooling data at country, time, bank level. NPL ratio on x-axis.

Non-performing loans: large cross-country heterogeneity

Bank Non-Performing Loans
(% of gross loans)



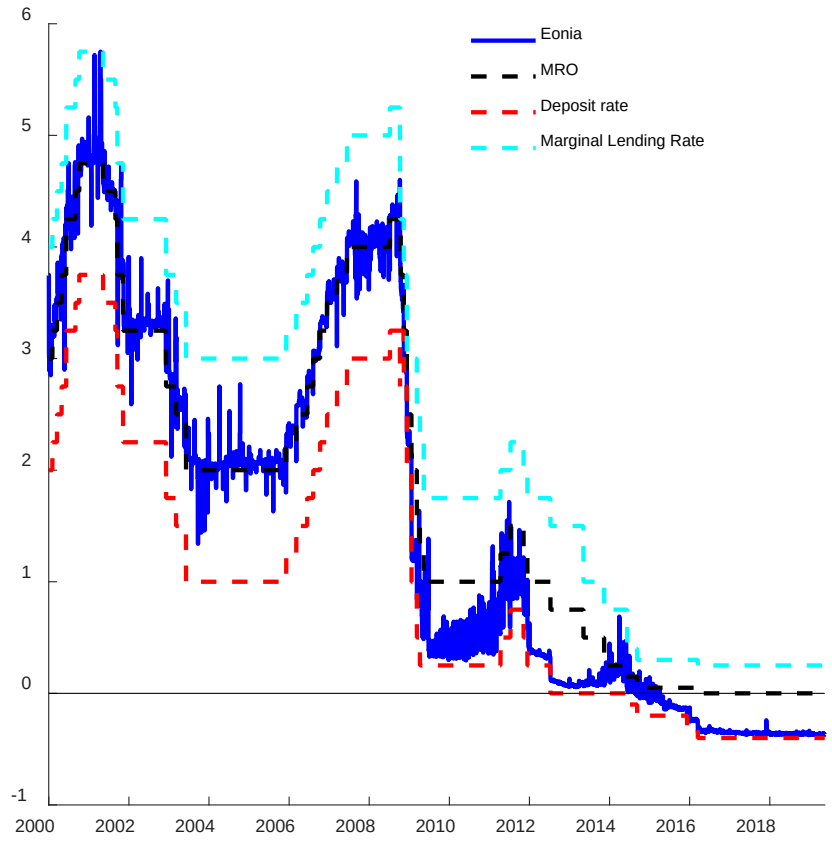
Bank Non-Performing Loans in the euro area
(% of gross loans)



Bank NPL is a key component of bank balance sheet strength, which is crucial not only for bank risk-taking and supervision but also for monetary policy (e.g. Shin, 2016; Freixas-Rochet, 2008), and there is much more variation across banks on NPLs than on capital

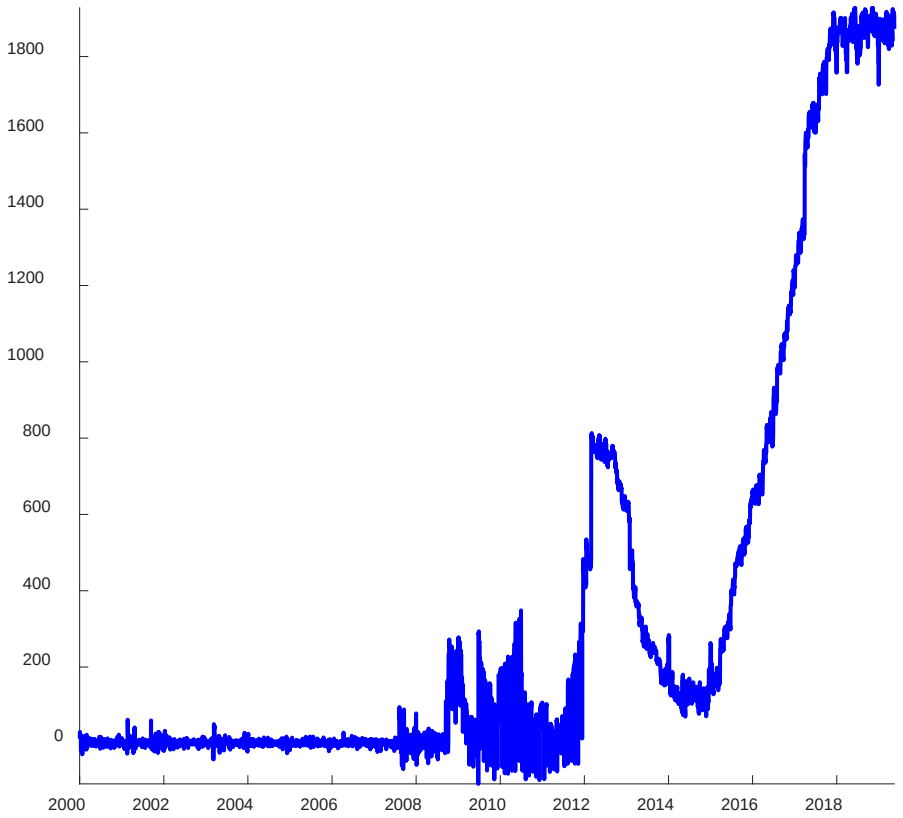
Monetary policy in the euro area

Interest rate corridor

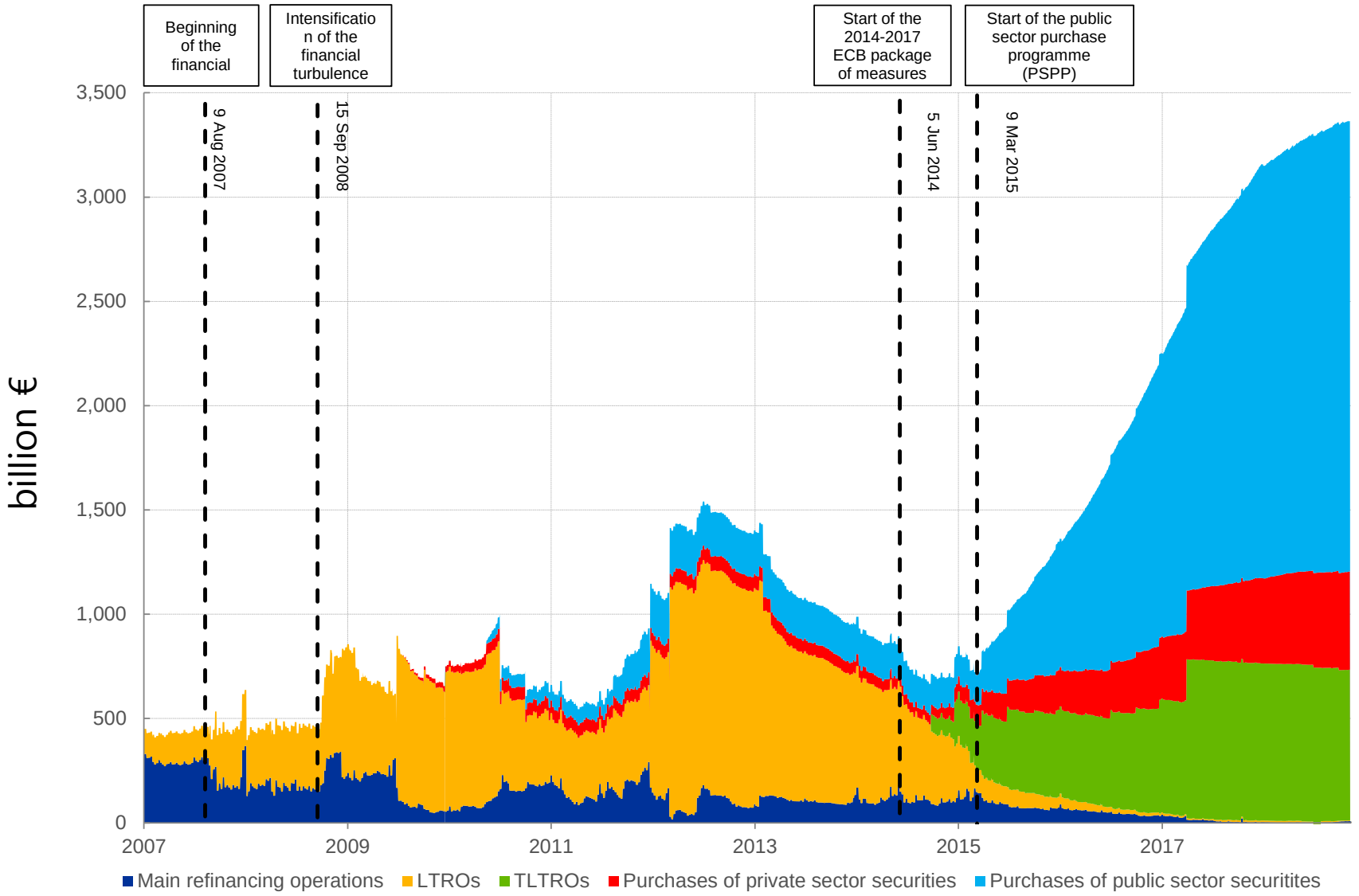


Excess Liquidity

(Current Account + Deposit Facilities - Reserve requirements)



ECB monetary policy assets



Source: ECB. Latest observation: 9 November 2018.