Determinants of bank performance: evidence from replicating portfolios[1]

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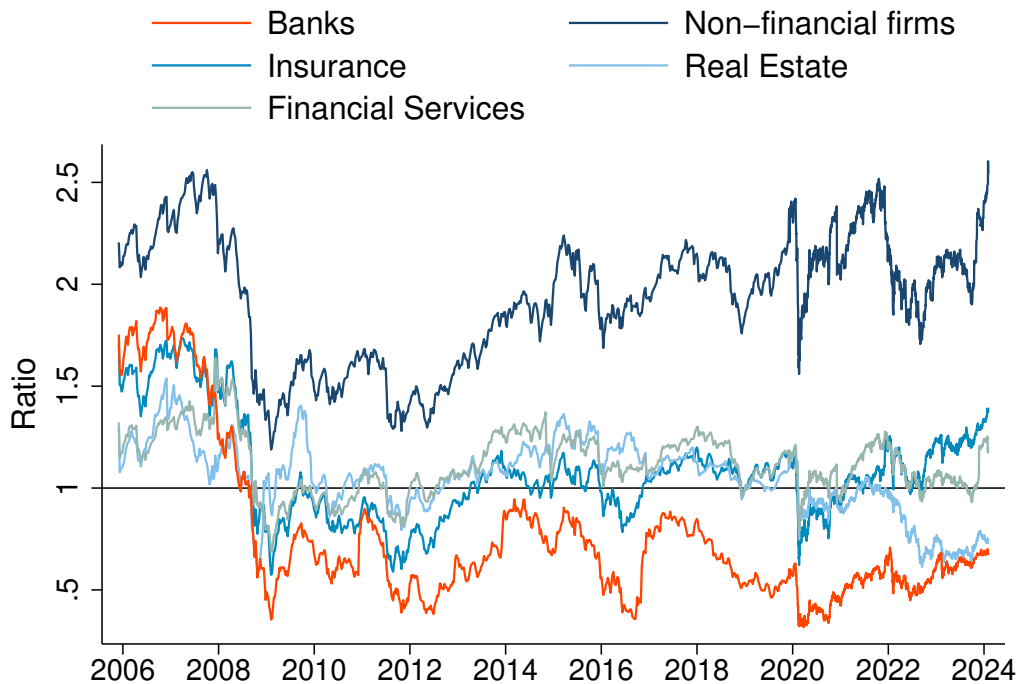
[1]The views expressed are those of the authors and do not necessarily reflect those of the ECB.

Introduction

Motivation Euro area banks have been underperforming for years

Price-to-book ratios across sectors



Notes: Price-to-book ratios based on the market value of the company computed as share price × number of shares and the book value measured by the most recent available information on the book value of equity from financial reporting.

Introduction

Key challenge How to quantitatively evaluate banks' performance? What is the reference point?

$\Rightarrow$ **Rely on 'edge' relative to replicating portfolios**

Key questions

- What are the drivers of euro area banks' performance?
  - Regulation
  - Competition
  - Cost efficiency
  - Monetary policy
- What does the edge capture in addition to standard measures?
- How does bank performance affect their lending to the real economy?

Overview of the paper

Methodology

- Use confidential **bank-, asset-, and loan-level data** to construct detailed measures of the maturity and risk profile of banks' different balance sheet items
- Construct banks' **edge** compared to returns on a benchmark portfolio with similar maturity and risk characteristics as the banks' portfolios

Overview of the paper

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Key results

- Low cost efficiency and competition from non-banks determine banks' edge
- Bank edges provides additional information about banks' resilience to shocks compared to standard metrics (e.g. ROE)
- Banks with higher edge were able to lend more to firms during the pandemic, which also supported investment of these firms

Contribution to the literature

Valuation of banks (Atkeson et al., 2019; Sarin and Summers, 2019, 2016; Begenau et al., 2015; Begenau and Stafford, 2019)

Links between bank profitability and

- **monetary policy** (Flannery, 1981; Hancock, 1985; Bourke, 1989; Saunders and Schumacher, 2000; Claessens et al., 2018; Brunnermeier and Koby, 2018; Alessandri and Nelson, 2015; Borio et al., 2017; English et al., 2018; Altavilla et al., 2018; Williams, 2020)
- **regulation** (Berger and Bouwman, 2013; Calomiris and Kahn, 1991; Diamond and Rajan, 2001; Holmstrom and Tirole, 1997; Allen et al., 2011; Mehran and Thakor, 2011)
- **competition** (Berger and Hannan, 1989; Claessens and Laeven, 2004; Drechsler et al., 2021; Stiglitz and Weiss, 1981; Boyd and De Nicolo, 2005; Schaeck et al., 2009)

Key contribution Construct granular measure of performance capturing maturity and risk of the whole balance sheet structure, analyse its determinants and its impact of lending.

Estimating the edge

Data

Confidential **balance sheet and income statement data** from 2014 Q4 to 2023 Q2 for euro area banks, augmented with information on

- maturity and risk of **loans and deposits** (bank level – IBSI – and loan level – AnaCredit)
- maturity and risk of **securities held** (instrument level, Securities Holdings Statistics Group (SHSG))
- maturity and risk of **securities issued** (instrument level, Centralized Securities Database (CSDB))

Financial market yields

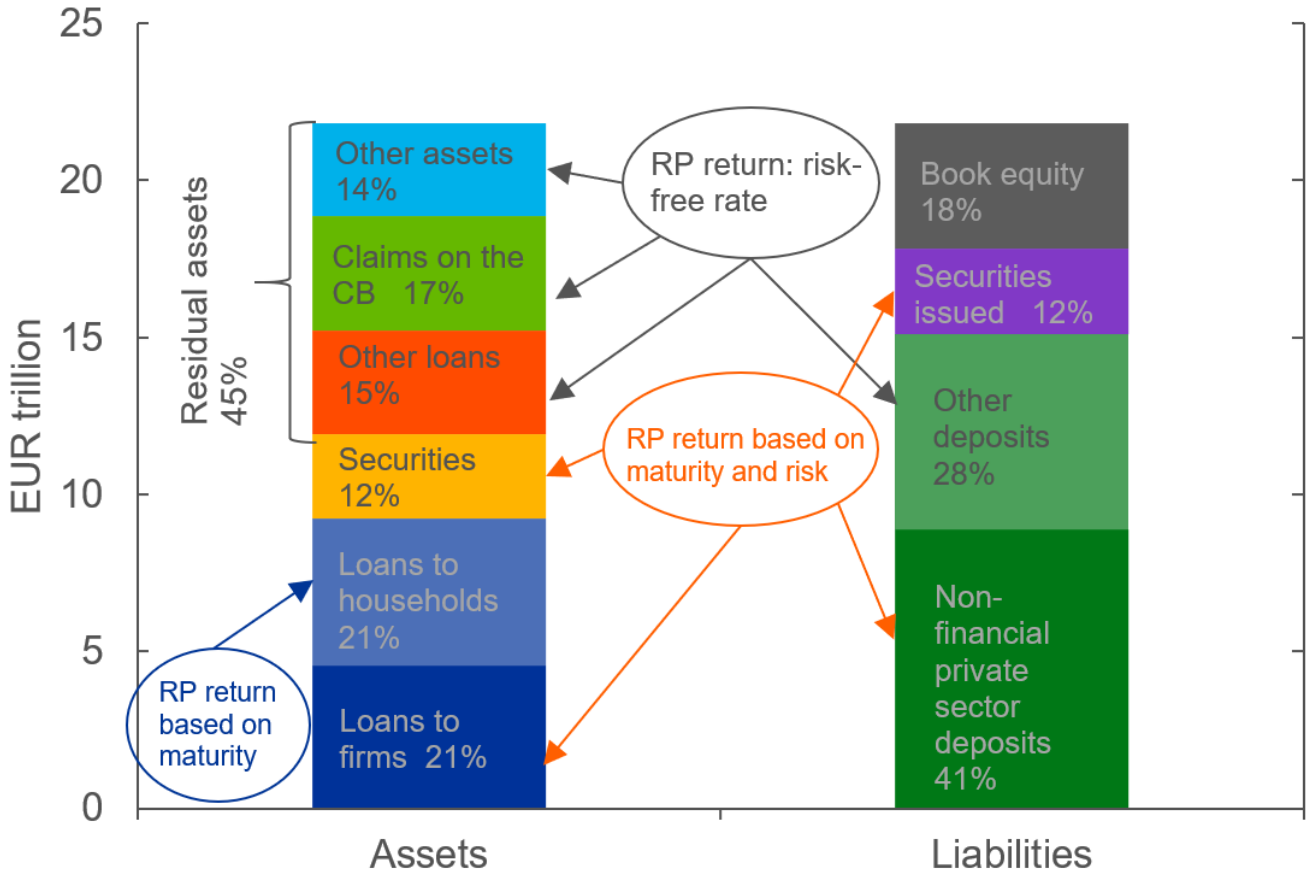
- Corporate bond yields and ratings (IHS Markit iBoxx)
- Euro area sovereign yield curves (ECB-SDW)
- Sovereign ratings from Standard&Poor's, Moody's and Fitch

Estimating the edge – general approach

Focus on maturity and credit risk exposure due to banks' role in maturity transformation and credit provision.

1. Extract **balance sheet duration** using the cash-equivalent share and average maturity of key balance sheet positions.
2. **Construct a bond portfolio** that features approximately the same maturity exposure as implied by a specific balance sheet position and compute its return. To also capture **risk**, the 3 steps are performed separately for different risk buckets (where relevant).
3. **Calculate a synthetic version** of the bank by adding up the benchmark bond returns of all balance sheet positions using the balance sheet shares as weights.

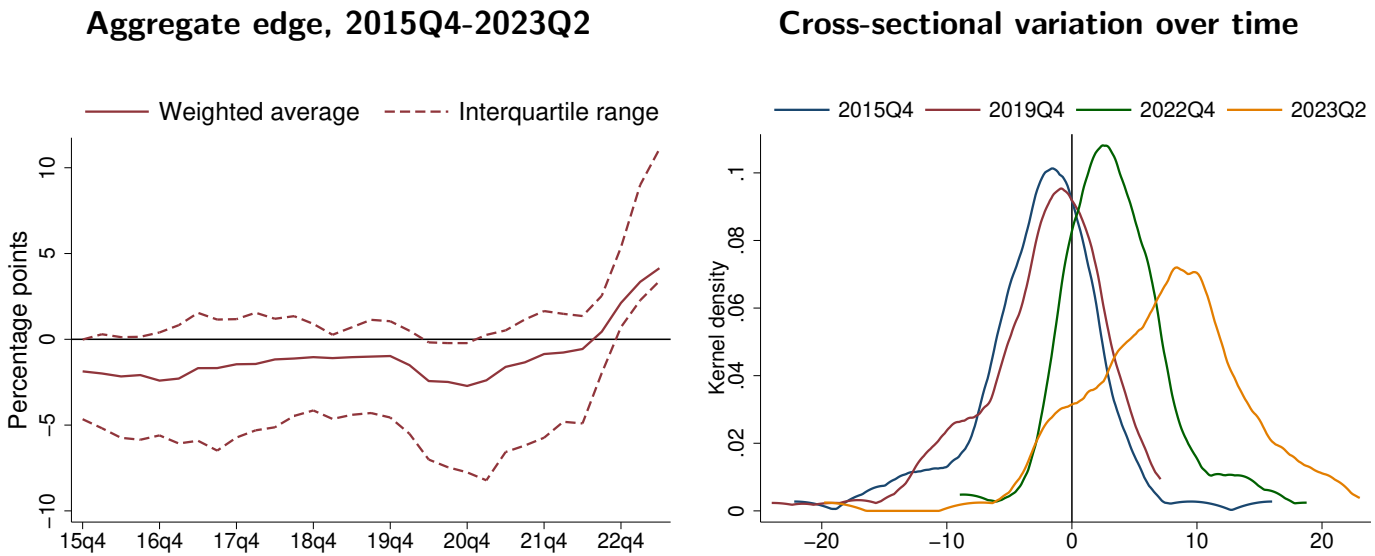
Aggregate bank balance sheet



Notes: Composition of total assets/liabilities as of 2021Q2 based on sample of 96 banks for which we can compute the edge.

→ Details

Aggregate edge



Notes: Edge is difference between realized return and replicating portfolio return. Returns are computed by taking the sum of net income in the recent four quarters and dividing this by the average of equity in the previous 5 quarters. Equity is the residual of assets minus securities issued and deposits.

→ Components

→ Details

Drivers of the edge

Empirical approach to assessing the determinants

Consider **structural** determinants

- Competition, $Com_{b,t}$: BLS survey responses on competition from non-banks
- Regulation, $Reg_{b,t}$: change in regulatory capital requirements
- Cost efficiency, $CIR_{b,t}$: cost to income ratio

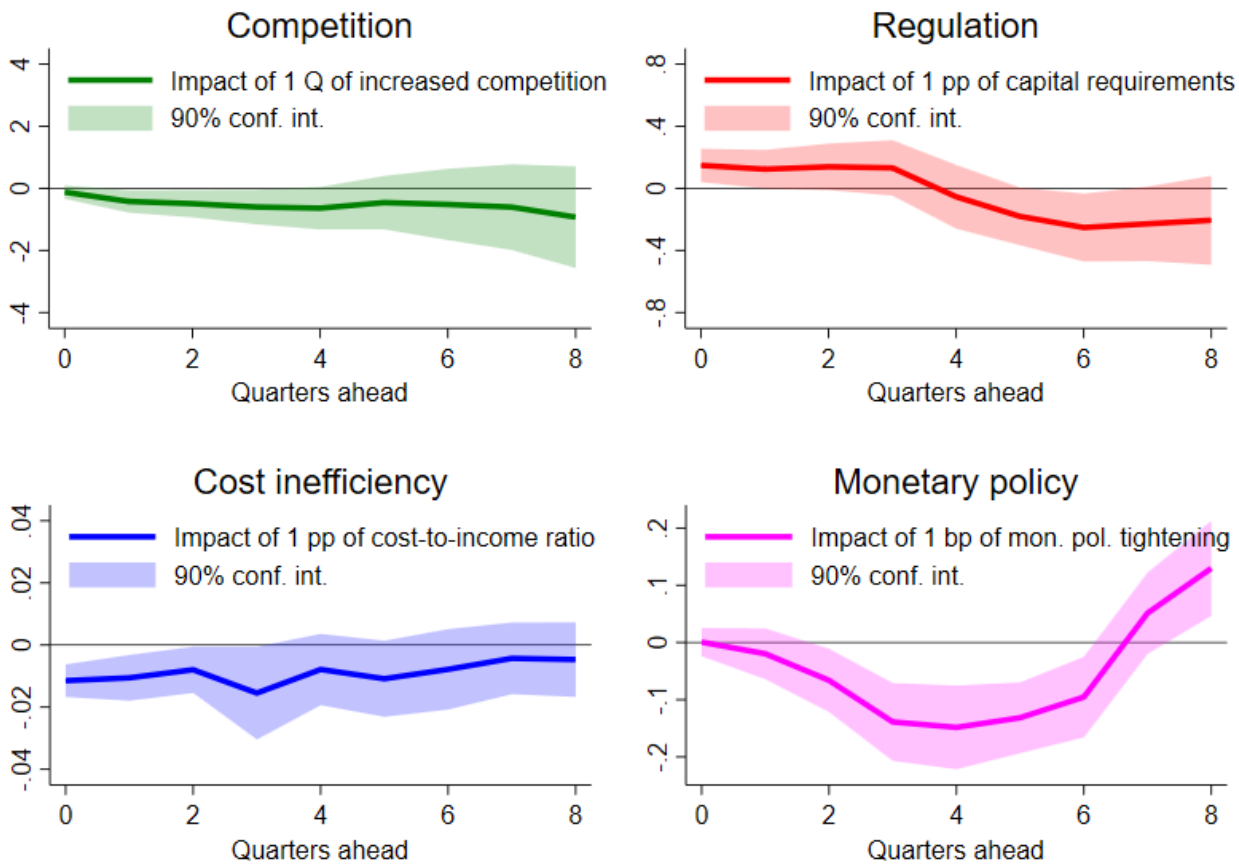
and **monetary policy**:

- MP_t: 1st principal component of high-frequency surprises from ECB monetary policy events

Use local projection-style regression of change in aggregate edge, $Edge_{b,t+k,t-1}$, on the change in all determinants and controls $X_{b,t}$ with bank μ_b and country-time $\mu_{c,t}$ FE for horizons $h = 0, \ldots, 8$:

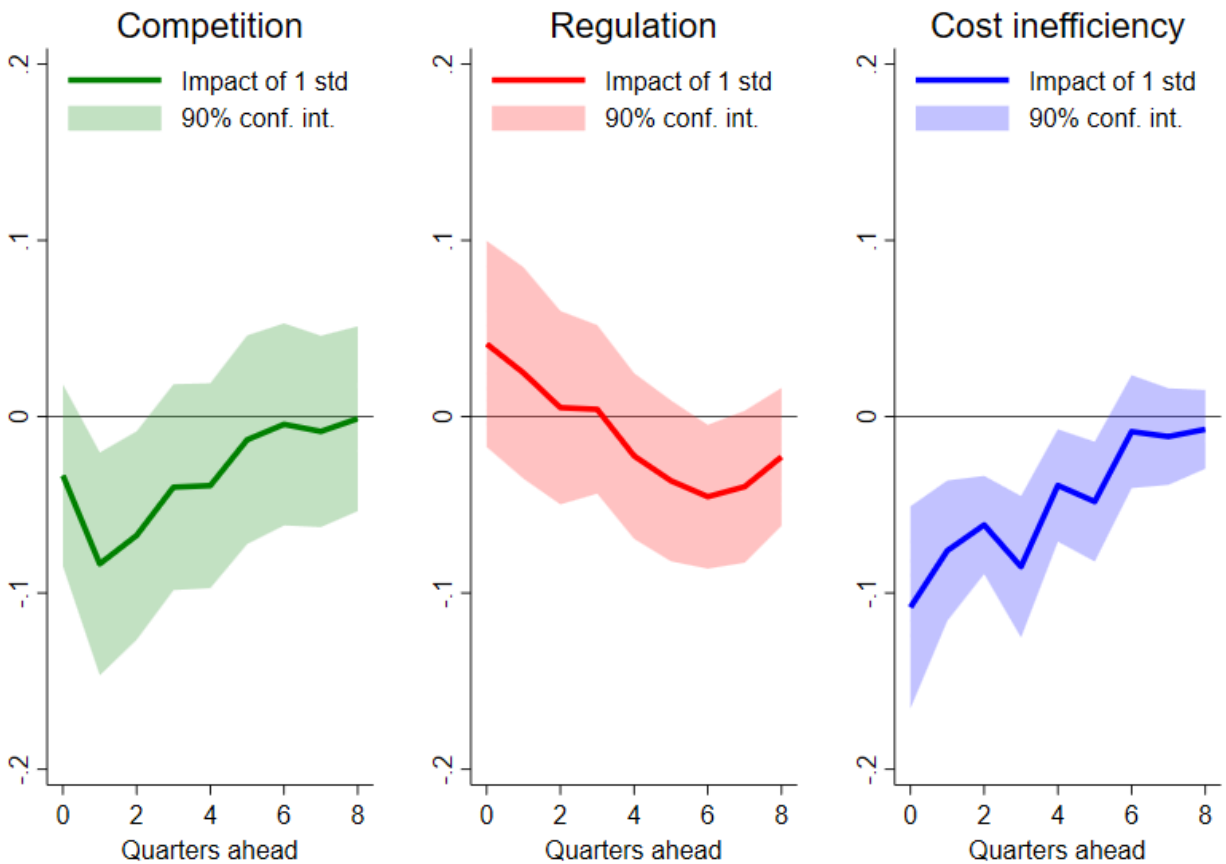
$$\begin{aligned}\Delta Edge_{b,t+k,t-1} =& \beta_{1,k}\Delta Com_{b,t} + \beta_{2,k}\Delta Reg_{b,t} + \beta_{3,k}\Delta CIR_{b,t} + \beta_{4,k}\Delta MP_t \\ &+ \beta_{5,k}X_{b,t} + \mu_b + \mu_{c,t} + u_{b,t,k}\end{aligned}$$

Short-term effects from determinants on edge



Notes: Charts show the change in total edge relative to 1 standard deviation for one a standard deviation of the change in each potential determinant. Confidence bands based on robust standard errors clustered at the bank level.

Does the edge capture more than net worth?

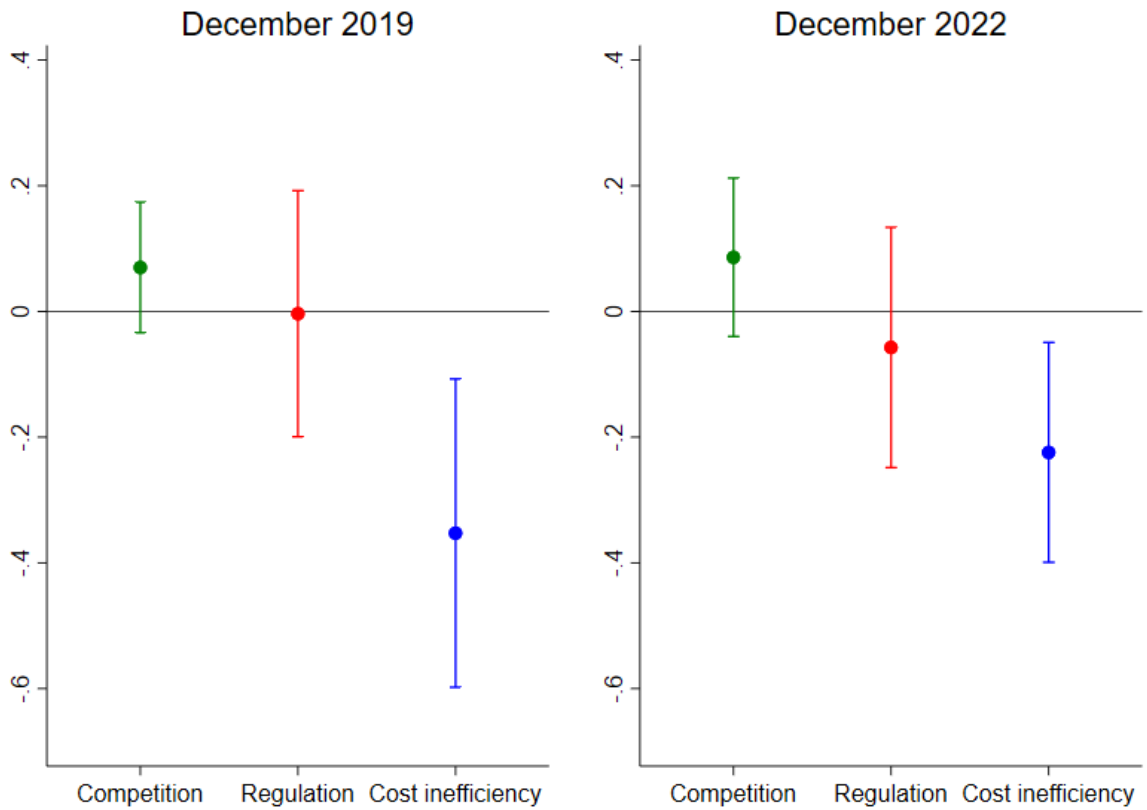


Notes: Charts show the change in total edge relative to 1 standard deviation for one a standard deviation of the change in each potential determinant. Each determinant is split between the part predicted by (lagged) measures of net worth/riskiness (CET1 ratio, leverage ratio, average risk weight) and the part orthogonal to these measures. Confidence bands based on robust standard errors clustered at the bank level.

→ Details

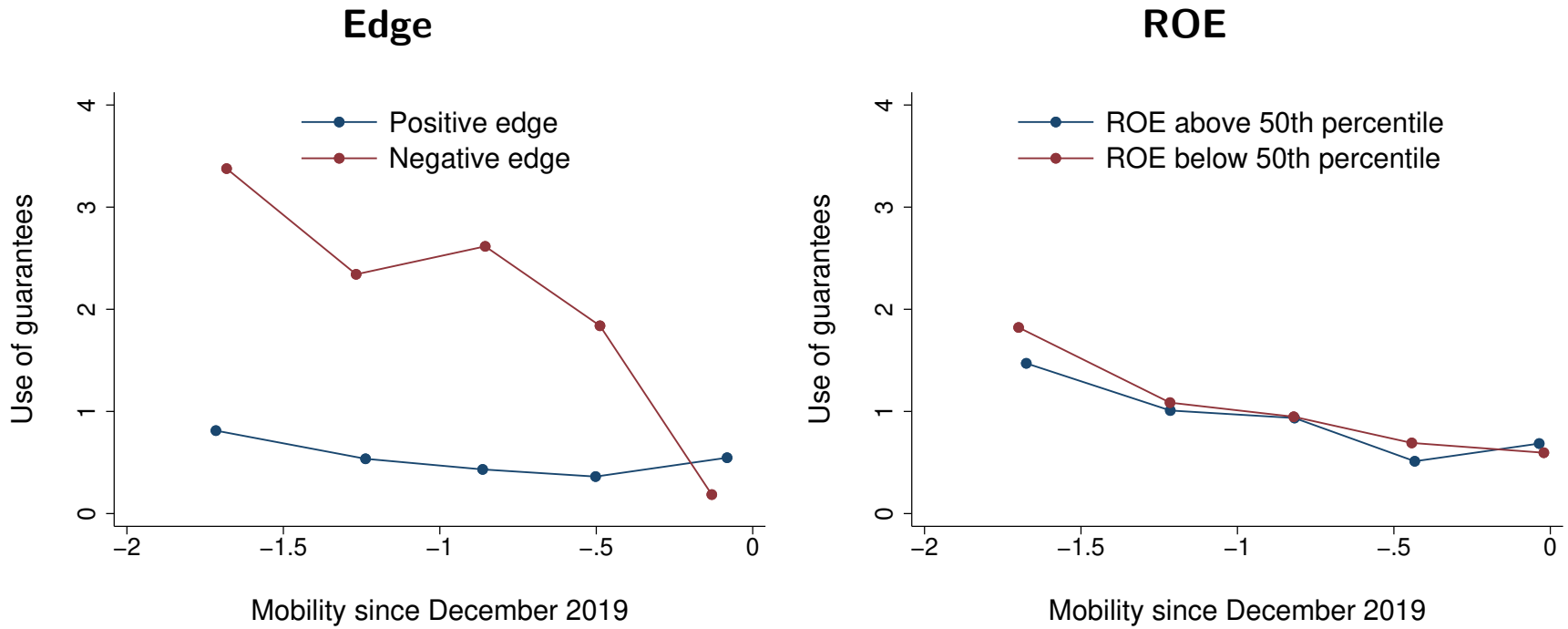
→ Components

Long-term effects from determinants orthogonal to banks' net worth



Notes: Charts show the change in total edge relative to 1 standard deviation for one a standard deviation of the change in each potential determinant. Each determinant is split between the part predicted by (lagged) measures of net worth/riskiness (CET1 ratio, leverage ratio, average risk weight) and the part orthogonal to these measures.Confidence bands based on robust standard errors.

Does banks' edge really matter? Evidence from policy dependence during the pandemic



Notes: Data split into 5 bins for banks with positive edge/value above the 50th percentile (blue) or negative edge/value below the 50th percentile (red) in December 2019. Y-axis are changes with respect to level in December 2019. X-axis are deviations in mobility in workplaces from baseline cumulated since December 2019 (mobility).

→ Residuals
→ Credit risk
→ Stock market performance

Real effects of edges

Measuring the impact of edge on lending conditions

Use **control function approach**

First, extract component of edge related to cost inefficiency and isolate the rest:

$$Edge_{b,t} = \beta_1 \widehat{u}^{Com}_{b,t} + \beta_2 \widehat{u}^{Reg}_{b,t} + \beta_3 \widehat{u}^{CIR}_{b,t} + \beta_4 X_{b,t} + \epsilon_{b,t},$$

using determinants orthogonal to net worth (→ Details)

Second, predict loan volumes with component of edge related to cost inefficiency:

$$log(loans)_{b,f,t} = \gamma_1 Edge_{b,t} + \gamma_2 \widehat{\epsilon}_{b,t} + \gamma_3 \widehat{u}^{Com}_{b,t} + \gamma_4 \widehat{u}^{Reg}_{b,t} + \gamma_5 X_{b,t} + \mu_{f,t} + u_{b,f,t}$$

Impact of edge on banks' lending conditions

Dependent variable:	(1) Loan volume	(2) Loan volume	(3) Loan volume	(4) Loan volume	(5) Loan volume
Bank edge	0.032**	0.036*	0.022*	0.022*	0.027**
	(0.016)	(0.019)	(0.011)	(0.011)	(0.011)
Endogenous component $\hat{\varepsilon}_{b,t}$		-0.037*	-0.022**	-0.023**	-0.024**
		(0.021)	(0.010)	(0.010)	(0.010)
Bank ROE					-0.003
					(0.004)
Firm-time FE	YES	YES	YES	YES	YES
Bank controls	NO	NO	YES	YES	YES
Bank net worth var.	NO	NO	NO	YES	YES
Other edge determ.	NO	NO	NO	YES	YES
Model	IV	CFA	CFA	CFA	CFA
Observations	16,698,211	16,698,211	16,698,211	16,698,211	16,698,211
Adj. R-squared		0.43	0.43	0.43	0.43

Notes: Standard errors clustered at the bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

→ Firm types
→ ROE

From bank lending to real effects

First, aggregate predicted loan volumes at firm level in March 2020

$$\widehat{log(loans)}_f = \sum_b w_{b,f} \widehat{log(loans)}_{b,f,\text{March 2020}}$$

Second, regress growth in firm investment between 2019 and 2020 on bank loans predicted by edges in March 2020

$$\Delta I_f = \beta_1 \widehat{log(loans)}_f + \beta_2 X_{b(f)} + \beta_3 X_f + \mu_{\text{ILS}} + u_f$$

Impact of edge on firms' investment

Dependent variable:	(1) Investment growth, 2020	(2) Investment growth, 2020
Banks' loan volume (predicted)	2.95**	
	(1.29)	
Banks' loan volume (predicted) x (I=2020Q1)		4.50**
		(1.89)
Sample	Cross-section	Panel
Bank controls	YES	YES
Firm controls	YES	YES
ILS FE	YES	NO
Firm FE	NO	YES
Country x Year FE	NO	YES
Observations	181,934	332,978
R-squared	0.05	0.31

Notes: Standard errors clustered at the main bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

→ Robustness

Conclusion

Conclusion

- We construct a measure of bank performance using granular data which provides information beyond standard measures of net worth.
- This 'edge' is determined mainly by banks' cost efficiency.
- Banks with a higher edge rely less on policy support, lend more to the private sector in times of crisis and have a larger impact on firms' investment.

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Appendix

Estimating the edge – details for loans to firms (1/2)

Data on maturity

- Use AnaCredit to compute cash-equivalent share (loans with maturity up to 3 months), average maturity and distance to inception of the loan separately for 9 bins based on 3 risk categories and 3 original maturity categories
  - Maturity: residual maturity for fixed rate loans and remaining periods of interest fixation for flexible rate loans
  - Risk categories based on risk-weights (computed from PDs using supervisory formulas): low: up to 20%, medium: over 20% and up to 50%, and high: over 50%
- backcast relevant variables for periods before AnaCredit is available (pre 2018Q3) using the distribution of original maturities from iBSI.
  - For banks with no data (not in AnaCredit, not reporting probabilities to default), assume average of relevant variables in each bin is the same as for the other banks in the bank's country.

→ back

Estimating the edge – details for loans to firms (2/2)

Data for replicating portfolio

Use yields of risk-matched euro area sovereign and corporate bonds.

- For low risk loans: bonds rated AAA to AA-,
- For the medium risk loans: bonds rated A+ to A-
- For high risk loans: bonds rated BBB+ and below
- Based on the standardised approach for corporate risk weights in Basel framework
- Timing: use the yields measured at time $t - x$, where x is the average distance to inception of the loans.

→ back

Estimating the edge – details for loans to households (1/2)

Data on maturity

- Use iBSI data to construct shares of 3 maturity bins: up to 1 year, over 1 year and up to 5 years, over 5 years
- Use additional assumptions to compute cash-equivalent shares (CES), the residual maturity and the distance to inception based on these shares.
  - CES: assume 70% of loans with residual maturity of up to 1 year are cash-equivalent (based on AnaCredit information for firms)
  - Residual maturity: use calibrated midpoints for each bin (based on AnaCredit for firms but adjusted to reflect longer maturity of housing loans)
    - Residual maturity up to 1 year: 8 months
    - Residual maturity 1 to 5 years: 36 months
    - Residual maturity over 5 years: 120 months
  - Distance to inception: get original maturity based on midpoints and compute difference to residual maturity:
    - Original maturity up to 1 year: 8 months
    - Original maturity 1 to 5 years: 48 months
    - Original maturity over 5 years: 180 months

→ back

Estimating the edge – details for loans to households (2/2)

Data for replicating portfolio

- Use the yields of sovereign bonds of the country the bank is located in
- Focus on sovereign:
  - Lower risk of housing loans compared to firms (lower NPL ratio, more collateralisation)
  - More closely linked to the macroeconomic developments in the country of the borrower.

→ back

Estimating the edge – details for securities

For securities held and issued, we use the same approach based on instrument-level data (CSDB and SHSG for holding struture)

Data on maturity

- By bank, compute average cash-equivalent share and maturity for 3 risk categories
- For securities issued, also include the time since issuance

Data for replicating portfolio

Use yields of risk-matched euro area sovereign and corporate bonds for each risk category:

- Low: bonds rated AAA to AA-
- Medium: bonds rated A+ to A-
- High: bonds rated BBB+ and below

→ back

Estimating the edge – details for deposits (1/2)

Data on maturity

- Use 5 original maturity categories from iBSI (overnight, redeemable at notice with maturity of up to 3 months, redeemable at notice with maturity of more than 3 months, maturity up to 2 years, maturity over to 2 years).
- Assume 50% of the first 2 categories are cash equivalent
- Average maturity for the remainder based on midpoints for each category
  - Redeemable at notice with maturity of more than 3 months: 6 months
  - Maturity up to 2 years: 12 months
  - Maturity over 2 years: 36 months
  - Correct for stability of deposits by adding 5 years to resulting average maturity (see e.g. Drechsler, Savov, and Schnabl, 2021)
- Split into insured and uninsured deposits to account for risk

→ back

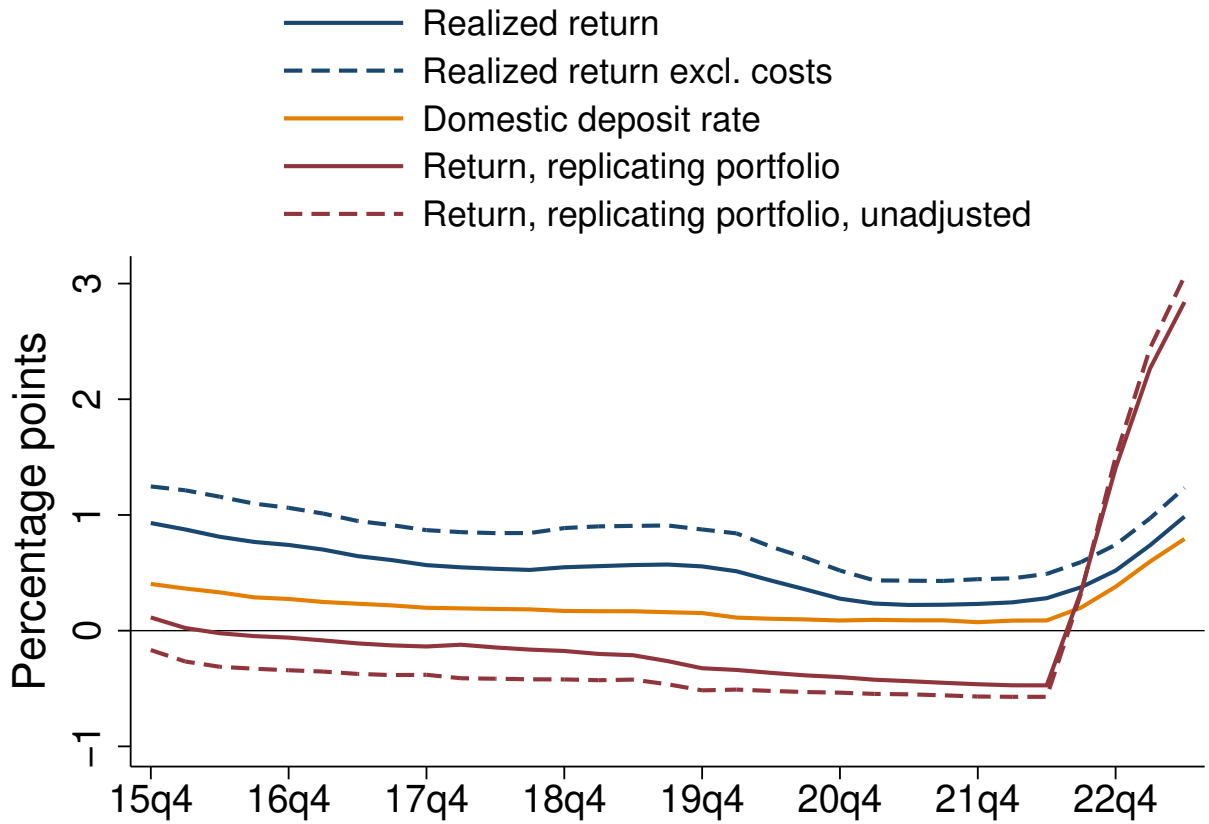
Estimating the edge – details for deposits (2/2)

Data for replicating portfolio

- Insured deposits: use sovereign bonds of the country the bank is located in
- Uninsured deposits: use corporate and sovereign bonds from risk category of the bank (based on its overall rating)

→ back

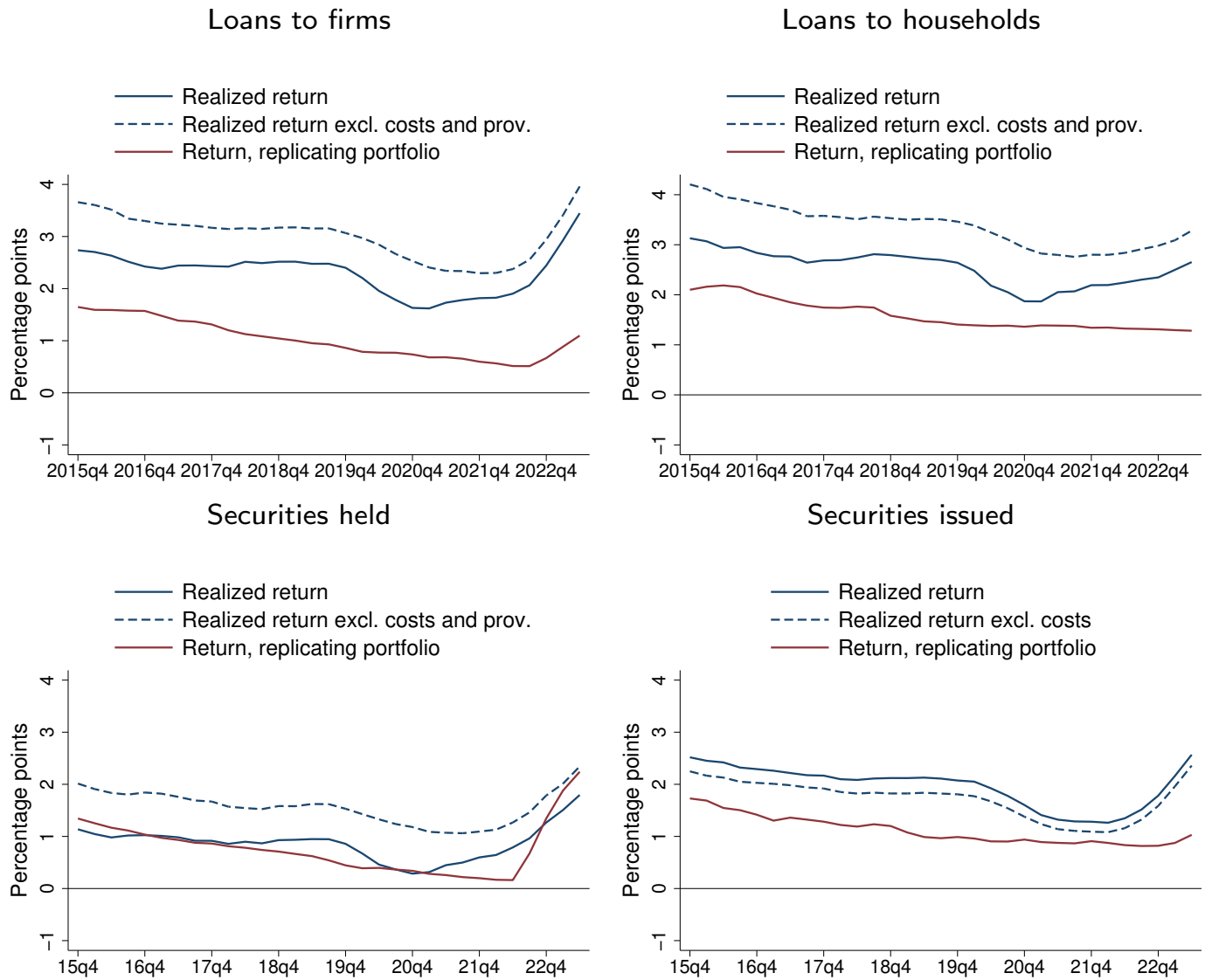
Adjustment to maturities of deposits



Notes: Returns are computed by taking the sum of income in the recent four quarters and dividing this by the average of outstanding amounts in the previous 5 quarters. Adjustment for costs distributes operating expenses, non-interest income and provisions to balance sheet item based on its share in the total balance sheet.

→ back

Realised and benchmark returns – details



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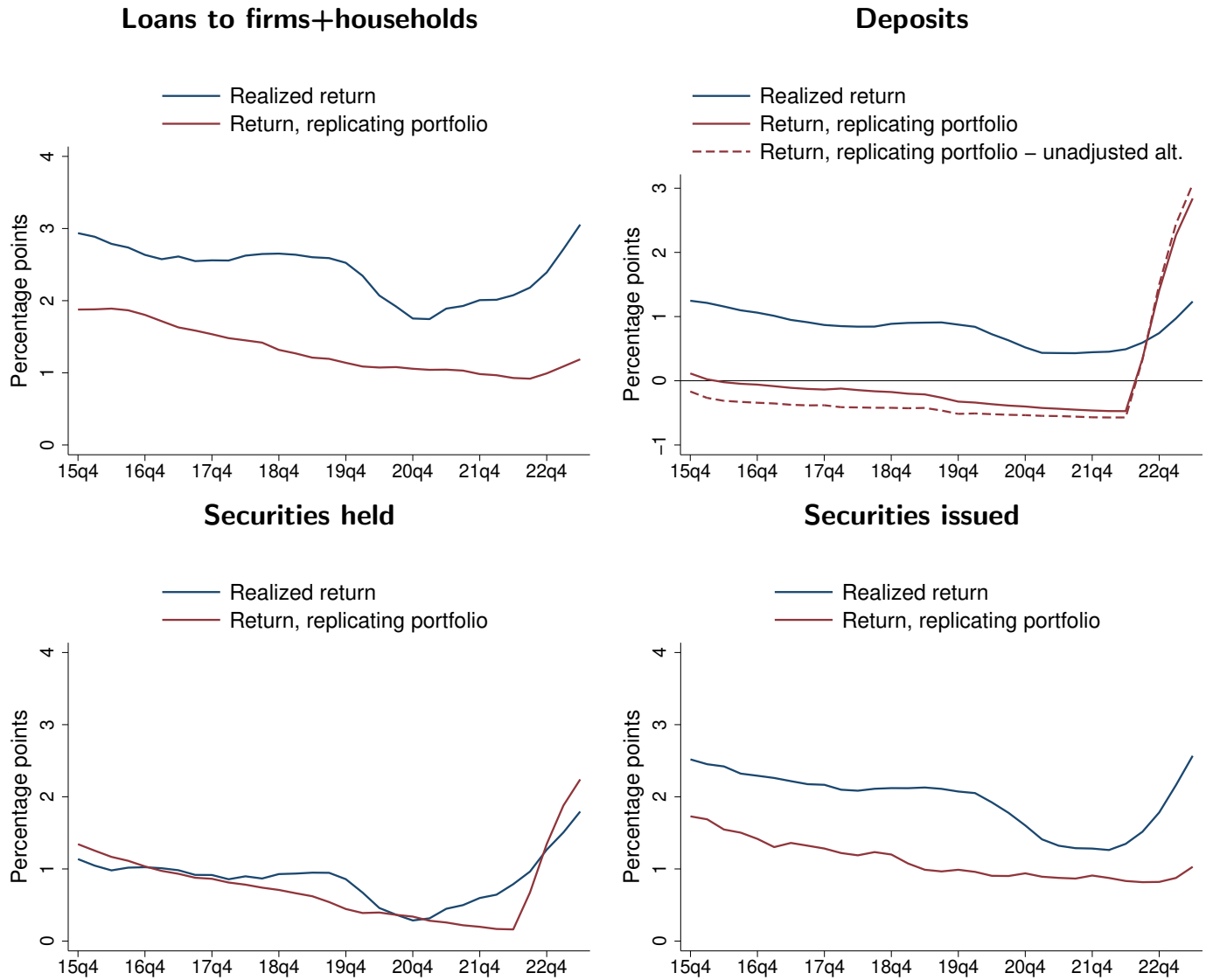
→ back

Realised and benchmark returns



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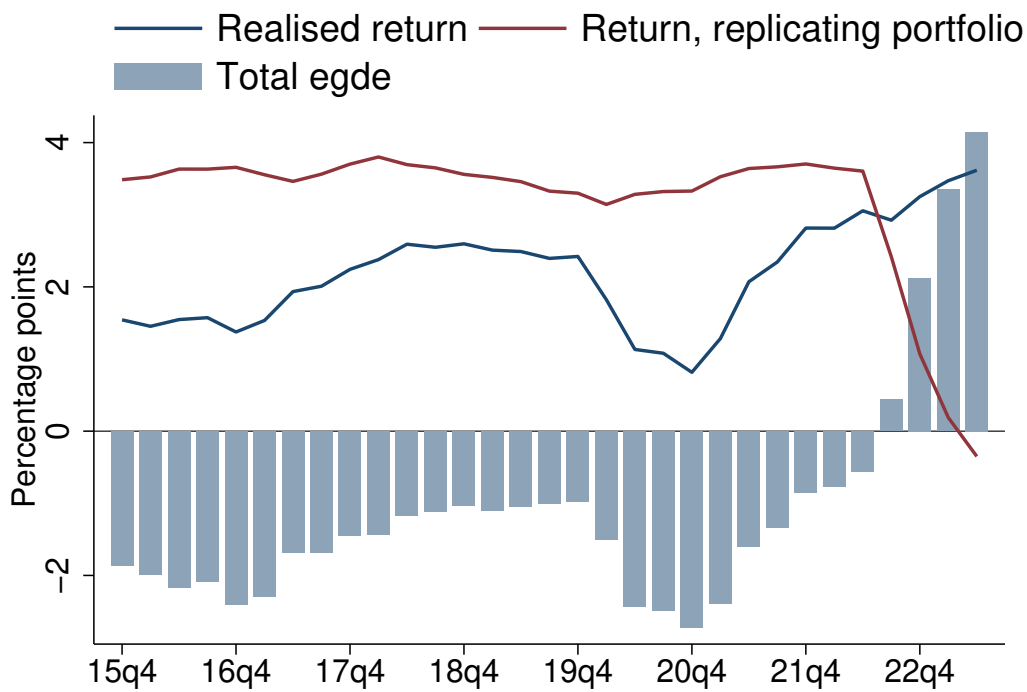
→ back

Final edge over time

Compute total edge as:

$$Edge_t = \frac{\sum_{k=0}^{3} net\ income_{t-k}}{1/5 \sum_{k=0}^{4} book\ equity_{t-k}} - \frac{\sum_i A_t^i \times RP_t^i - \sum_j L_t^j \times RP_t^j}{1/5 \sum_{k=0}^{4} book\ equity_{t-k}}$$

Average returns and edge



→ back

Is the edge just a different measure of net worth?

Need to make sure that the edge reflects more than just the leverage or net worth of the banks, we thus proceed in a 2-step procedure. First, regress potential drivers on net worth

$$Reg_{b,t} = \beta_1 RW_{b,t} + \beta_2 Lev_{b,t} + \beta_3 CET1_{b,t} + \mu_t + \mu_{c,t} + u^{Reg}_{b,t}$$
$$Com_{b,t} = \beta_1 RW_{b,t} + \beta_2 Lev_{b,t} + \beta_3 CET1_{b,t} + \mu_t + \mu_{c,t} + u^{Com}_{b,t}$$
$$CIR_{b,t} = \beta_1 RW_{b,t} + \beta_2 Lev_{b,t} + \beta_3 CET1_{b,t} + \mu_t + \mu_{c,t} + u^{CIR}_{b,t},$$

where $RW_{b,t}$: average risk-weight, $Lev_{b,t}$: leverage ratio, $CET1_{b,t}$: CET1 capital ratio

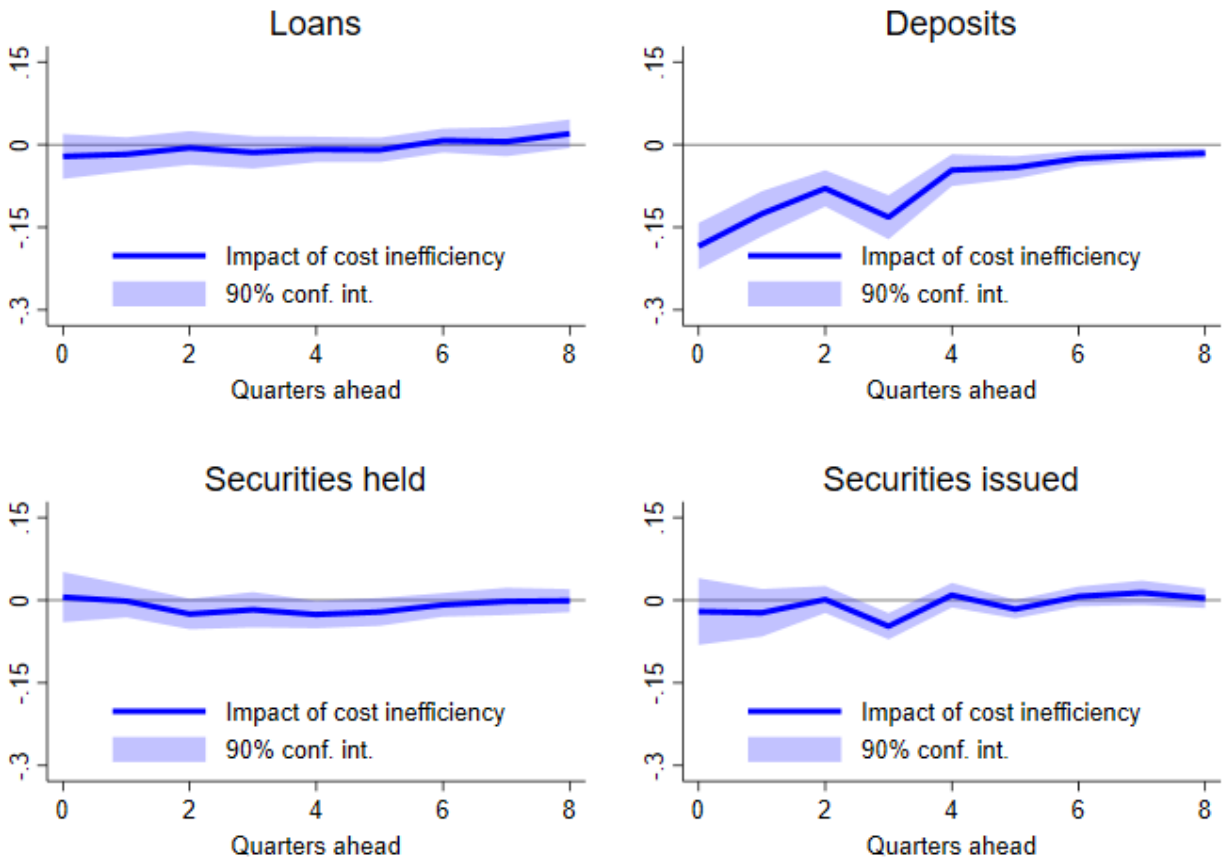
Then check whether part driven by net worth or orthogonal part drives edge

$$\begin{aligned}\Delta Edge_{b,t+k,t-1} =& \beta_{1,k} \Delta \widehat{Com}_{b,t} + \beta_{2,k} \Delta \widehat{Reg}_{b,t} + \beta_{3,k} \Delta \widehat{CIR}_{b,t} \\ &+ \beta_{4,k} \Delta \widehat{u}^{Com}_{b,t} + \beta_{5,k} \Delta \widehat{u}^{Reg}_{b,t} + \beta_{6,k} \Delta \widehat{u}^{CIR}_{b,t} \\ &+ \beta_{7,k} X_{b,t} + \mu_{b,t} + \mu_{c,t,k} + u_{b,t,k}\end{aligned}$$

→ back – determinants

→ back – real effects

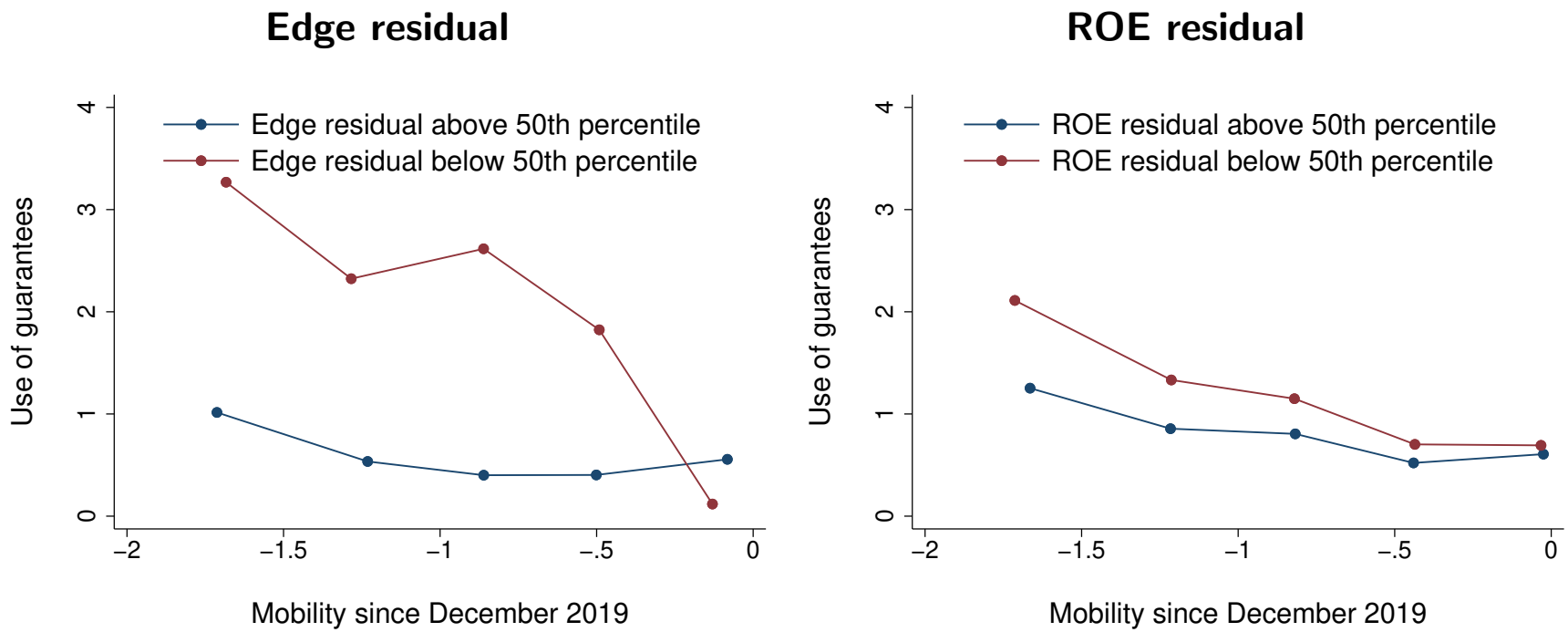
Impact of cost inefficiency on banks' edge by item



Notes: Charts show the change in total edge relative to 1 standard deviation for one a standard deviation of the change in cost inefficiency. Dependent variable and regressors are standardised. Each determinant is split between the part predicted by (lagged) measures of net worth/riskiness (CET1 ratio, leverage ratio, average risk weight) and the part orthogonal to these measures. Specification with bank and country-time FE, cluster at bank level.

→ back

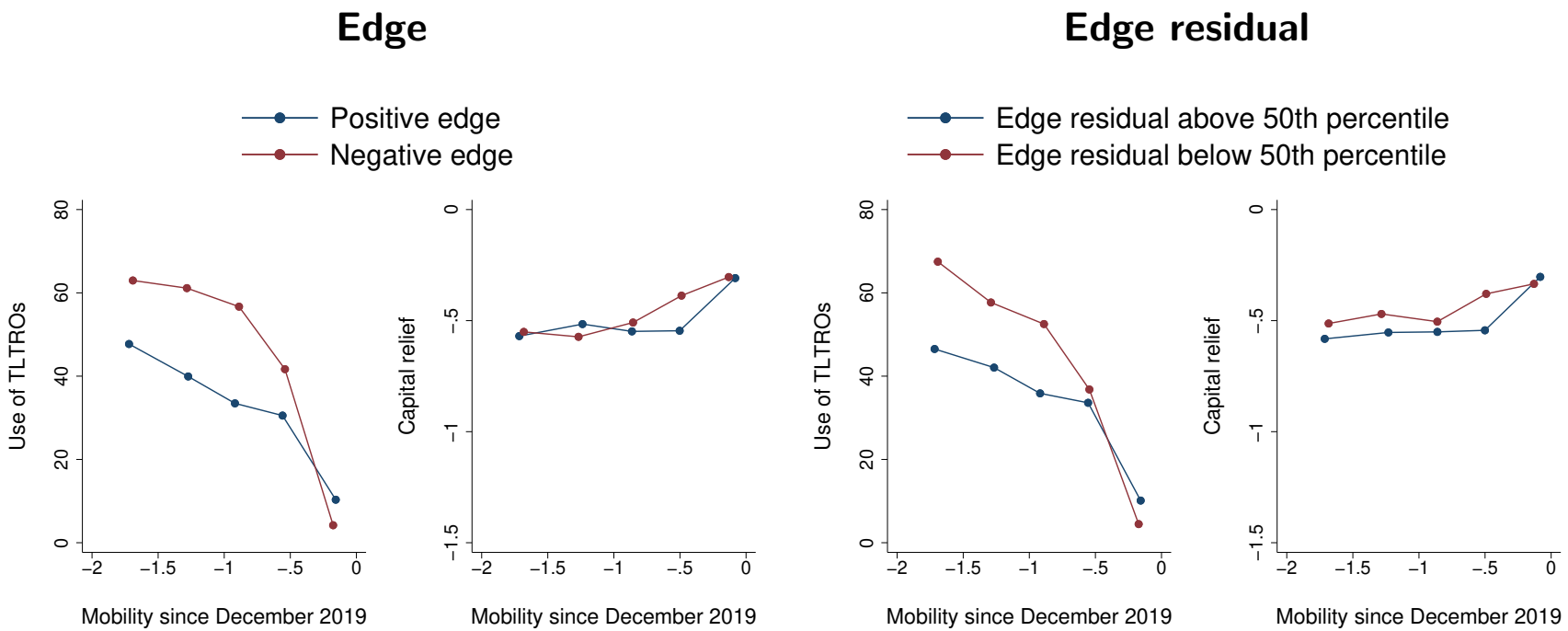
Does banks' edge really matter? Evidence from policy dependence during the pandemic – residuals



Notes: Data split into 5 bins for banks with positive edge/value above the 50th percentile (blue) or negative edge/value below the 50th percentile (red) in December 2019. Y-axis are changes with respect to level in December 2019. X-axis are deviations in mobility in workplaces from baseline cumulated since December 2019 (mobility). Residuals result from bank-level regressions of the edge/ROE on the CET1 capital ratio, the leverage ratio and the average risk weights.

→ back

Does banks' edge really matter? Evidence from policy dependence during the pandemic – other measures



Notes: Data split into 5 bins for banks with positive edge/value above the 50th percentile (blue) or negative edge/value below the 50th percentile (red) in December 2019. Y-axis are changes with respect to level in December 2019. X-axis are deviations in mobility in workplaces from baseline cumulated since December 2019 (mobility). Residuals result from bank-level regressions of the edge/ROE on the CET1 capital ratio, the leverage ratio and the average risk weights.

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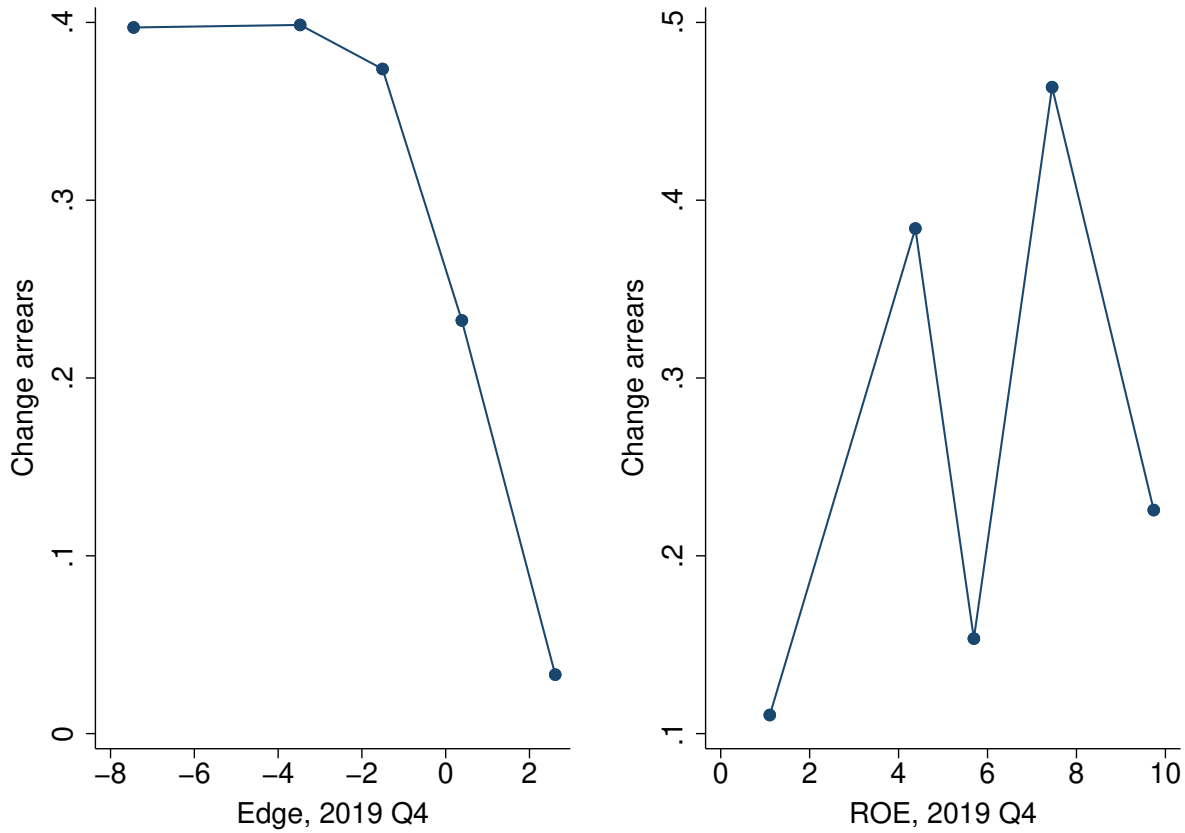
Does banks' edge really matter? Evidence from credit risk during the pandemic



Notes: Data split into 5 bins for banks with positive edge/value above the 50th percentile (blue) or negative edge/value below the 50th percentile (red) in December 2019. Change in the average share of arrears over total loans at the bank level between 2019 Q4 and 2021 Q4.

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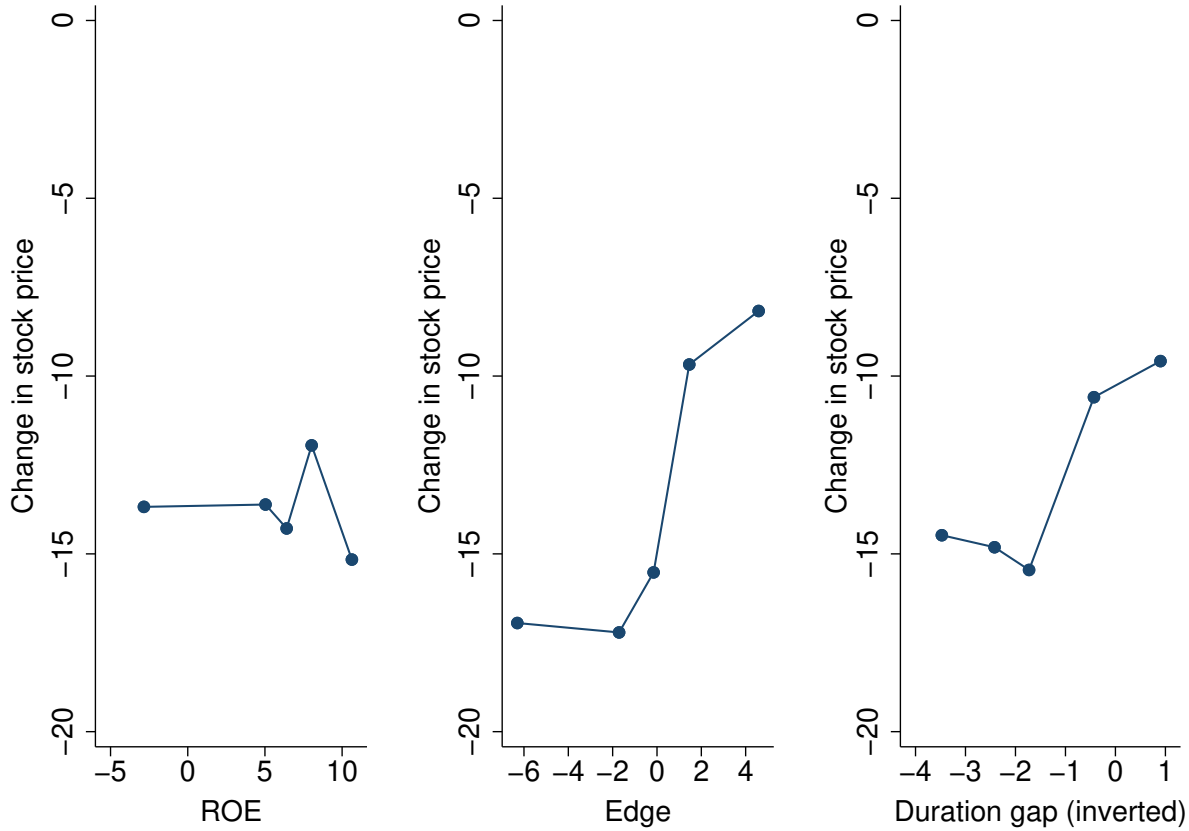
Does banks' edge really matter? Evidence from the March 2023 banking sector turmoil



Notes: Data split into 5 bins for banks with positive edge/value above the 50th percentile (blue) or negative edge/value below the 50th percentile (red) in December 2019. (Inverted) duration gap is the difference between the weighted average residual maturities for loans, deposits and securities as they enter the computation of the edge. Change in stock prices of euro area banks between 9 March 2023 and 20 March 2023, i.e., from just before the collapse of Silicon Valley Bank and right after the announcement of the merger between Credit Suisse and UBS.

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Impact of edge on banks' lending conditions – ROE

Dependent variable:	(1) Loan volume	(2) Loan volume	(3) Loan volume
Edge	0.041*	0.023**	0.027**
	(0.023)	(0.011)	(0.011)
Endogenous component $\hat{\varepsilon}_{b,t}$	-0.036*	-0.022**	-0.024**
	(0.021)	(0.010)	(0.010)
ROE	-0.004	-0.001	-0.003
	(0.005)	(0.004)	(0.004)
Firm-time FE	YES	YES	YES
Bank controls	NO	YES	YES
Bank net worth measures	NO	NO	YES
Other edge determinants	NO	NO	YES
Model	CFA	CFA	CFA
Observations	16,698,211	16,698,211	16,698,211
R^2	0.43	0.43	0.43

Notes: Standard errors clustered at the bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Impact of edge on banks' lending conditions – by firm type

	Dependent variable: loan volume			
	(1)	(2)	(3)	(4)
Sample split based on:	Firm ROA	Firm leverage	Firm productivity	Zombie indicator
Below threshold				
Bank edge	0.018**	0.022**	0.013	0.020**
	(0.009)	(0.010)	(0.008)	(0.009)
Above threshold				
Bank edge	0.022**	0.017*	0.026**	0.025***
	(0.010)	(0.009)	(0.010)	(0.009)
F-test: Below threshold = Above threshold				
Edge	0.425	0.320	0.066*	0.529
Firm-time FE	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES
Model	CFA	CFA	CFA	CFA
Observations	4,407,516	4,407,516	4,407,516	4,407,516
R^2	0.38	0.38	0.38	0.38

Notes: Standard errors clustered at the bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Impact of edge on firms' investment – robustness

Dependent variable:	(1) Investment growth, 2020	(2) Investment growth, 2020	(3) Investment growth, 2019 (placebo)	(4) Investment growth, 2020	(5) Investment growth, 2020
Banks' loan volume (predicted)	2.95**		-1.68		
	(1.29)		(2.04)		
Banks' loan volume (predicted) x (I=2020Q1)		4.50**			
		(1.89)			
Banks' loan volume (predicted), 2019				1.49	
				(1.40)	
Banks' loan volume (predicted), 2021					6.24
					(3.84)
Sample	Cross-section	Panel	Cross-section	Cross-section	Cross-section
Bank controls	YES	YES	YES	YES	YES
Firm controls	YES	YES	YES	YES	YES
ILS FE	YES	NO	YES	YES	YES
Firm FE	NO	YES	NO	NO	NO
Country x Year FE	NO	YES	NO	NO	NO
Observations	181,934	332,978	179,504	147,143	2,736
R-squared	0.05	0.31	0.02	0.05	0.04

Notes: Standard errors clustered at the main bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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