

## BANK CHARACTERISTICS AND THE TRANSMISSION OF MONETARY POLICY: PANEL EVIDENCE FROM THE GERMAN SAVINGS BANK SECTOR

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**Purpose:** This study assesses the transmission of ECB monetary policy to credit supply within Germany's savings-bank sector. A central aim is to quantify how bank-level balance-sheet features – such as size or capital – shape real loan growth.

**Design/methodology/approach:** We assemble an annual bank-level panel of 491 Sparkassen (4103 observations, 2000-2019) from Bankscope/Orbis, which is winsorized and deflated. Our empirical strategy employs fixed-effects regressions of real loan growth on lagged policy-rate changes and control variables. To uncover heterogeneity, we complement this with median-split and a detailed 4×4 size-by-capital quartile analysis.

**Findings:** On average, a one percentage point (p.p.) monetary policy rate increase reduces real loan growth by approximately 0.6 p.p. We find that equity growth and deposit inflows mitigate this contraction, whereas higher capital ratios and provisioning amplify it. The heterogeneity is pronounced: capital strength dominates bank scale as a determinant of sensitivity. A quartile analysis reveals a U-shaped pass-through pattern, with the strongest effects at the low- and high-capital tails. The cushioning effect of size is primarily evident when capital is scarce. These asymmetries imply a regionally uneven transmission of monetary policy, a critical concern given Sparkassen's statutory local lending mandates.

**Research limitations/implications:** The annual frequency and pre-2020 coverage of our data limit direct inference for the recent monetary tightening cycle. We acknowledge the potential endogeneity of funding and equity dynamics. Future research should extend the sample period and exploit higher-frequency supervisory data to confirm these dynamics.

**Practical implications:** Our findings suggest that credible guidance on the usability of capital buffers and carefully calibrated reserve-tiering can dampen excessive credit contraction where liability costs are binding. Furthermore, a closer coordination of macro-prudential tools with the monetary policy cycle can help reduce the regional disparities in credit availability.

**Social implications:** The heterogeneous pass-through of monetary policy risks widening existing regional inequalities in credit access, investment, and employment. A targeted design of prudential regulation can therefore serve as a tool to support broader local economic development objectives.

**Originality/value:** This paper provides long-horizon, micro-econometric analysis of the bank lending channel for the German Sparkassen sector. Its multi-layer heterogeneity design uncovers a U-shaped pass-through pattern relative to capital levels. The results yield concrete, evidence-based policy design insights for one of Europe's most important decentralized, deposit-funded banking pillars.

**Keywords:** Bank lending channel, Monetary policy, Sparkassen (German savings banks).

**Category of the paper:** Research paper.

## 1. Introduction

The prolonged period of exceptionally low interest rates that followed the global financial crisis fundamentally reshaped the economics of banking across advanced economies. In the euro area, the European Central Bank (ECB) lowered its deposit facility rate below zero in June 2014 and maintained a negative policy stance for more than eight years – marking the longest such episode among major monetary jurisdictions. Empirical studies have examined how this regime affected the behavior of commercial banks, particularly through margin compression and altered lending patterns (Heider, Saidi, Schepens, 2019). By contrast, Germany's public savings banks (Sparkassen) – despite their systemic importance – have received comparatively limited academic attention. Notable exceptions include Köhler (2018), who analyses the role of non-traditional income sources in enhancing Sparkassen's profitability, and Michaelis (2023), who provides micro-level evidence on deposit pricing responses to negative policy rates. Nonetheless, comprehensive evaluations of how these institutions adapted to sustained monetary accommodation remain scarce.

Sparkassen constitute the largest component of Germany's three-pillar banking system. As of end-2023, they accounted for approximately 40% of loans to domestic companies and self-employed individuals, and around 36% of mortgage lending to private households, reflecting their systemic importance in regional credit provision (Moody's Investors Service, 2025). Their public mandate obliges them to promote regional economic development, with a governance structure characterized by municipal trusteeship that insulates them from shareholder pressure while embedding political objectives through local oversight (Hardie, Howarth, 2009; Puri, Rocholl, Steffen, 2011). This combination of significant market share, decentralized risk-taking, and a developmental remit positions Sparkassen as a natural conduit for the transmission of monetary policy, particularly when policy ventures into unconventional territory.

The study examines how Sparkassen respond to monetary accommodation and how their behavior contributed to monetary transmission through the lending channel. This question is salient for several reasons. Sparkassen account for approximately 30% of total banking-sector assets in Germany; any systematic shift in their behavior has macroeconomic implications. Their public-interest mandate may induce responses to interest rate cuts that differ meaningfully from those of profit-maximizing commercial banks, potentially amplifying or dampening regional credit cycles. A clearer understanding of how Sparkassen adapted during the accommodation phase is essential for anticipating the effects of policy reversal.

This study contributes to the literature in three key ways. First, it provides the first long-horizon, micro-econometric assessment of how Sparkassen adjusted lending, in response to successive phases of ECB monetary accommodation between 2000 and 2019, using a granular panel dataset of 491 institutions. While retrospective in scope, this historical perspective offers a valuable benchmark for evaluating the resilience and policy sensitivity of decentralized, deposit-funded banks under tightening conditions. Second, by interacting policy shocks with quartile-based and median-split heterogeneity structures, the analysis reveals significant within-pillar variation – particularly across capitalization and size profiles – that would be masked in standard specifications. Third, the findings have direct policy implications for the design of interest-rate tools and countercyclical buffers in a banking system characterized by public ownership, local political accountability, and structural exposure to margin compression.

The remainder of the paper is structured as follows. Section II reviews the relevant literature. Section III outlines the data sources and econometric methodology. Section IV presents the baseline results and explores heterogeneity across Sparkassen characteristics. Section V concludes.

## **2. Monetary Policy, Bank Heterogeneity and the German Savings Bank Sector**

A broad base of empirical and theoretical research agrees that extended periods of very low or negative policy rates diminish the net-interest margins, which serve as a key income stream for banks funded primarily by retail deposits. Cross-country studies by Altavilla, Canova, and Ciccarelli (2016) and Demiralp, Eisenschmidt, and Vlassopoulos (2021), alongside ECB analysis, show that from 2014 to 2019, net-interest margins were mechanically compressed because deposit rates failed to adjust in line with declining policy rates. Brunnermeier and Koby (2018) introduced the 'reversal rate' concept, which captures how excessive monetary easing can paradoxically tighten financial conditions once it crosses a critical threshold, primarily by squeezing bank margins.

The distributional effects of negative interest rates depend critically on banks' liability structures. Heider, Saidi, and Schepens (2019) exploit the 2014 introduction of the ECB's negative deposit facility rate to show that institutions with large, sticky retail-deposit bases experienced a quasi-exogenous increase in relative funding costs. These banks responded by curtailing lending and reallocating portfolios toward riskier borrowers. Their findings resonate with the broader literature on the risk-taking channel of monetary policy (Dell'Ariccia, Laeven, Suárez, 2017; Bottero et al., 2022), which posits that accommodative policy incentivizes greater risk-taking, especially among banks facing compressed margins. Capital-based heterogeneity further shapes these responses: Kishan and Opiela (2000) and Jiménez et al. (2012) document

that well-capitalized banks are better positioned to absorb monetary shocks, whereas poorly capitalized peers either contract credit or raise their risk profile in an effort to restore balance sheet strength. However, Gropp and Heider (2010) caution that banks may refrain from deploying capital buffers – even in downturns – due to reputational concerns, thus potentially blunting the intended countercyclical function of prudential regulation.

Since Sparkassen typically earn around 75% of their income through maturity transformation and operate with deposit-to-loan ratios close to one, reduced interest margins pose a direct risk to the sustainability of their core business strategy. Following the ECB's move into negative policy territory in 2014, micro-level evidence shows that many German savings banks responded by introducing account maintenance fees and applying negative interest rates on large corporate deposits, thereby limiting the pass-through of policy accommodation to depositors (Michaelis, 2023). Simultaneously, Sparkassen have ramped up efforts to diversify their income streams. According to Köhler (2018), expanding fee and commission revenues, especially from payments and brokerage services, enhances their profitability on a risk-adjusted basis and stabilizes earnings.

The distinctive public mandate and governance model of Sparkassen introduces an additional institutional layer into the transmission of monetary policy. Local government trustees, who prioritize regional development over shareholder returns, promote long-term relationship lending with SMEs – a feature that contributes to the stronger credit supply sensitivity to conventional monetary tightening identified by De Santis and Surico (2013). While the traditional literature on German banking structures has emphasized the resilience of Sparkassen in such regimes, the post-2014 environment of persistently negative policy rates introduced novel pressures that these earlier studies did not fully anticipate. More recent contributions, including Heider, Saidi, and Schepens (2019) and Bottero et al. (2022), have begun to unpack how liability structures and risk-taking behavior adapt under such conditions, highlighting incomplete pass-through and heightened incentives for portfolio rebalancing. Rating-agency reports suggest that the partial normalization of interest rates since late 2022 has provided relief on margin pressure. Yet they also point to mounting challenges related to valuation losses on securities holdings and increased credit risk, as fixed-rate assets accumulated during the low-rate period are progressively repriced in a steeper yield environment (Moody's Investors Service, 2025).

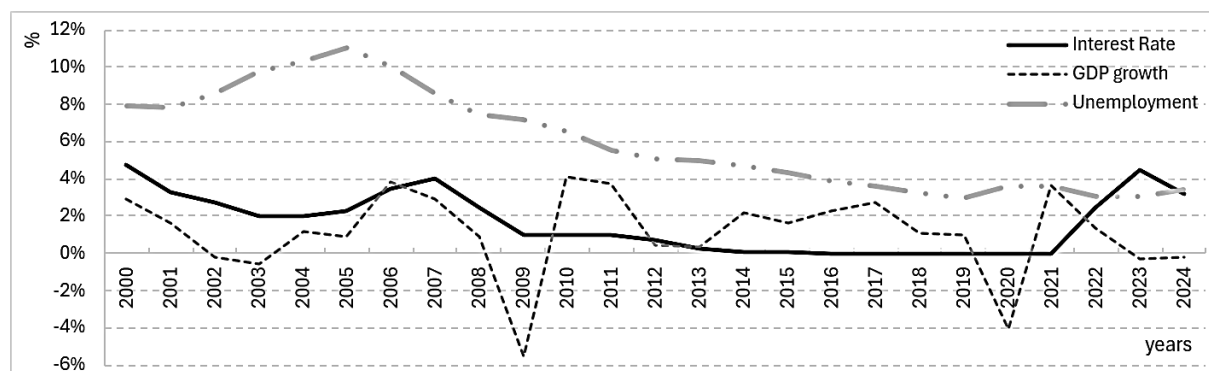
Taken together, the literature suggests that any rigorous assessment of how ECB monetary accommodation has affected Sparkassen must account for several interrelated mechanisms. First, the direct mechanical compression of net-interest income – arising from the inability to pass negative rates onto retail depositors – posed a structural challenge to their income model. Second, heterogeneity in funding cost pressures, particularly among institutions heavily reliant on core deposits, altered the distributional impact of negative rates across the sector. Third, the interaction between monetary policy and capital adequacy influenced risk-taking behavior, as thinly capitalized banks faced stronger incentives to curtail lending or rebalance

toward higher-yield assets to restore buffers. Finally, many Sparkassen strategically expanded their reliance on fee and commission income, particularly in payments and brokerage services, thereby partially insulating profits from interest-rate shocks.

### 3. Data and Econometric Methodology

The empirical analysis is based on an annual unconsolidated financial statements for Public Sparkassen/Landesbanken Banks from Germany over the period 2000-2019. The database was created by joining BankScope with the Orbis/BankFocus files. This allowed us to obtain long enough time-series to observe both the macro backdrop – policy rates, unemployment, GDP growth – and balance-sheet dynamics – total assets, loans, deposits, loan-loss provisions and profitability. The database was winsorized using 1st and 99th percentile for each bank-level variable. Finally the cleaned unbalanced panel contained 491 banks and 4103 observations suited to testing the bank-lending channel and its conditioning factors.

The macroeconomic environment in Germany after 2000 is presented below.



**Figure 1.** Interest rates, GDP growth and unemployment rate in Germany.

Source: ECB, IMF.

The distribution on histogram of main variables used in the studies showing the banks characteristics is illustrated in the appendix. The main descriptive characteristics of the variables used in the model are outlined in the Table 1 below. The average loan growth in the examined group of banks amounted to 2.96% over the sample period, although the results were highly dispersed (Std. Dev. = 3.64 percentage points). During the same period, the average annual growth of equity was only 0.06%, compared with an average annual growth of customer deposits of 3.25%. The average ROA indicates low profitability, while the mean LLP stood at 0.12%.

**Table 1.**  
*Descriptive statistics of variables used in the model*

Variable	Obs	Banks	Median	Mean	Std.dev	Min	Max
$\Delta\text{Loans}$	4103	491	2.43	2.96	3.64	-8.49	35.41
$\Delta\text{Equity}$	4103	491	0.05	0.06	0.06	-0.05	0.45
$\Delta\text{CustDep}$	4103	491	2.55	3.25	3.43	-8.21	41.60
ROA	4103	491	0.17	0.15	0.10	0.00	0.77
Size	4103	491	14.22	14.44	1.00	11.72	18.16
CAP	4103	491	16.26	17.03	4.02	9.61	33.83
LLP	4103	491	0.50	0.12	0.74	-3.49	3.03
GDPG	4103	491	1.57	1.32	2.20	-5.55	4.15
Unempl	4103	491	7.61	4.87	1.44	2.98	11.01
$\Delta\text{IR}$	4103	491	0.00	-0.27	0.57	-1.50	1.75

Note:  $\Delta\text{Loans}$  – real loan growth rate, calculated as the log difference of bank loans (percentage points);  $\Delta\text{Equity}$  – real equity growth rate (percentage points);  $\Delta\text{CustDep}$  – real growth rate of customer deposits (percentage points); ROA – return on assets, defined as net income divided by total assets (percentage points); Size – logarithm of total assets; CAP – Tier 1 capital ratio, measuring core equity relative to risk-weighted assets (percentage points); LLP – loan-loss provisions ratio, calculated as loan-loss provisions divided by total assets (percentage points); GDPG – annual GDP growth rate in Germany (percentage points); Unempl – unemployment rate in Germany (percentage points);  $\Delta\text{IR}$  – ECB interest rate change (percentage points). Real values deflated by author from nominal based on country inflation.

Source: Author's calculations made in StataSE19.

The baseline econometric specification used to capture the bank-lending channel's sensitivity to monetary policy, moderated by bank characteristics, is formulated as:

$$\begin{aligned} \Delta\text{Loans}_{i,t} = & \alpha_1 + \alpha_2\Delta\text{Loans}_{i,t-1} + \alpha_3\Delta\text{Equity}_{i,t-1} + \alpha_4\Delta\text{DepCust}_{i,t-1} + \alpha_5\text{ROA}_{i,t} \\ & + \alpha_6\text{Size}_{i,t} + \alpha_7\text{CAP}_{i,t} + \alpha_8\text{LLP}_{i,t} + \alpha_9\text{GDPG}_t + \alpha_{10}\text{unempl}_t \\ & + \Delta\text{IR}_{t-1} + \vartheta_{i,t} + \varepsilon_t \end{aligned} \quad (1)$$

Here,  $\Delta\text{Loans}_{i,t}$  represents the real growth rate of loans calculated as the log difference of bank loans (expressed in percentage points),  $\Delta\text{Equity}_{i,t}$  represents real equity growth rate (in p.p.),  $\Delta\text{CustDep}_{i,t}$  represents real growth rate of customer deposits (in p.p.),  $\text{ROA}_{i,t}$  is return on assets, defined as net income divided by total assets (in p.p.),  $\text{Size}_{i,t}$  is calculated as logarithm of total assets;  $\text{CAP}_{i,t}$  means Tier1 capital ratio, measuring core equity relative to risk-weighted assets (in p.p.);  $\text{LLP}_{i,t}$  (loan-loss provisions ratio) is calculated as loan-loss provisions divided by total assets (in p.p.). The model contains also macroeconomic variables:  $\text{GDPG}_t$  – annual GDP growth rate (in p.p.),  $\text{Unempl}_t$  – unemployment rate (in p.p.);  $\Delta\text{IR}_{t-1}$  – ECB interest rate change (in p.p.). The indexes are marked:  $i$  – bank,  $t$  – year. Real values were deflated by author from nominal based on country inflation.

To minimize interpretational ambiguity, we verified that all flow variables are expressed as real annual percentage-point changes and that levels (e.g., the Tier-1 ratio) are likewise in percentage points. This distinction matters for elasticities: the estimated policy coefficient is read as a semi-elasticity of real loan growth with respect to a one-percentage-point change in the policy rate, whereas coefficients on  $\Delta\text{Equity}$  and  $\Delta\text{Customer Deposits}$  capture the marginal contribution of funding and capital generation to credit supply at the annual horizon. Variable winsorization at the 1st/99th percentiles reduces the influence of extreme tails, and results are read in that metric throughout, which limits the scope for outlier-driven inferences.

The deposit-facility rate is the preferred stance indicator for deposit-funded institutions because it most directly maps into liability remuneration; nevertheless, the qualitative interpretation we offer relies on policy stance rather than any one operational rate. The macro block (GDP growth and unemployment) functions as a parsimonious guardrail against conflating aggregate demand conditions with bank-supply responses.

The baseline standard errors are clustered at the bank level, reflecting serial correlation in bank-specific shocks. Given that the policy variable varies primarily over time, one could also contemplate two-way clustering (bank  $\times$  year); however, because we already include macro controls and fixed effects, and because the inference is not driven by marginal t-statistics near conventional thresholds, our qualitative conclusions are not sensitive to reasonable choices of clustering. We therefore retain bank-level clustering for transparency and comparability with the related literature.

#### 4. Empirical Results

We estimate pooled OLS, random-effects, and (benchmark) bank fixed-effects specifications. A Hausman test strongly favors fixed effects ( $\chi^2 = 888.15$ ,  $p = 0.000$  presented in Table 2), and all inference is based on bank-clustered standard errors. Reporting OLS and RE alongside FE (models 1-2 and 3-5 in Table 2, respectively) aids comparability and shows that our qualitative conclusions are not an artefact of model choice.

The final fixed-effects estimates (model 5, Table 2), confirm that the transmission of ECB policy to Sparkassen credit supply is strongly mediated by balance-sheet characteristics. In the fixed-effects specification, a 1 p.p. rise in the deposit-facility rate is associated with a 0.61 p.p. fall in real loan growth. Increases in real equity growth are associated with markedly higher loan growth, consistent with internally generated capital providing headroom to sustain lending under tighter policy – a pattern consistent with the balance-sheet channel documented by Kishan & Opiela (2000) and, for euro area banks, Jiménez et al. (2012). Likewise, deposit inflows matter: a 1 p.p. rise in real customer deposits lifts lending by 0.22 p.p., echoing the liability-structure mechanism stressed by Heider, Saidi & Schepens (2019). By contrast, thicker regulatory capital buffers dampen credit: every additional percentage-point of the capital ratio lowers loan growth by 0.17 p.p., consistent with evidence that better-capitalized banks lend more cautiously (Gropp & Heider 2010). Higher provisioning is likewise associated with lower loan growth. Dell’Ariccia, Laeven & Suárez (2017) document a related risk-taking channel for U.S. banks. Size and contemporaneous profitability (ROA) are not statistically significant once unobserved heterogeneity is absorbed, implying that it is the dynamic flow variables – equity and deposits – rather than static levels that condition Sparkassen’s sensitivity to monetary policy. Together, the results corroborate the literature’s core insight: bank-level capital

generation, funding mix and risk provisioning crucially shape how monetary policy changes propagate to the real economy.

**Table 2.**  
*OLS, FE and RE estimation*

VARIABLES	(1) reg	(2) re	(3) fe	(4) re vce bank robust	(5) fe vce bank robust
$\Delta\text{Loans}_{t-1}$	0.294*** (0.013)	0.294*** (0.013)	<b>0.132***</b> <b>(0.014)</b>	0.294*** (0.024)	<b>0.132***</b> <b>(0.022)</b>
$\Delta\text{Equity}_{t-1}$	12.718*** (1.211)	12.718*** (1.211)	<b>9.988***</b> <b>(1.353)</b>	12.718*** (2.148)	<b>9.988***</b> <b>(2.612)</b>
$\Delta\text{CustDep}_{t-1}$	0.239*** (0.015)	0.239*** (0.015)	<b>0.216***</b> <b>(0.015)</b>	0.239*** (0.034)	<b>0.216***</b> <b>(0.036)</b>
$\text{ROA}_t$	0.464 (0.512)	0.464 (0.512)	<b>-0.688</b> <b>(0.882)</b>	0.464 (0.578)	<b>-0.688</b> <b>(0.962)</b>
$\text{Size}_t$	-0.000 (0.050)	-0.000 (0.050)	<b>0.696</b> <b>(0.732)</b>	-0.000 (0.058)	<b>0.696</b> <b>(0.797)</b>
$\text{CAP}_t$	0.007 (0.013)	0.007 (0.013)	<b>-0.170***</b> <b>(0.031)</b>	0.007 (0.015)	<b>-0.170***</b> <b>(0.043)</b>
$\text{LLP}_t$	0.093 (0.104)	0.093 (0.104)	<b>-0.205*</b> <b>(0.116)</b>	0.092 (0.167)	<b>-0.205</b> <b>(0.206)</b>
$\text{GDPG}_t$	-0.027 (0.024)	-0.027 (0.024)	<b>0.016</b> <b>(0.023)</b>	-0.027 (0.026)	<b>0.016</b> <b>(0.026)</b>
$\text{Unempl}_t$	-0.428*** (0.043)	-0.428*** (0.043)	<b>-0.488***</b> <b>(0.063)</b>	-0.428*** (0.050)	<b>-0.488***</b> <b>(0.078)</b>
$\Delta\text{IR}_{t-1}$	-0.510*** (0.099)	-0.510*** (0.099)	<b>-0.612***</b> <b>(0.100)</b>	-0.510*** (0.120)	<b>-0.612***</b> <b>(0.130)</b>
Constant	2.437*** (0.825)	2.437*** (0.825)	<b>-3.443</b> <b>(10.864)</b>	2.437*** (0.938)	<b>-3.443</b> <b>(11.787)</b>
Observations	4,103	4,103	4,103	4,103	4,103
Number of Banks	491	491	491	491	491
Hausman Chi2 test			888.15		
Hausman test p-value			0.000		
R <sup>2</sup> within	0.260	0.154	0.177	0.154	0.177
R <sup>2</sup> between		0.686	0.143	0.686	0.143
R <sup>2</sup> overall		0.260	0.158	0.260	0.158

Note. Definitions of variables used in the model are presented below Table 1. Standard errors in parentheses below the coefficient estimates. \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels respectively.

Source: Author's estimation results made in StataSE19.

At the macro level, the estimated balance-sheet elasticities imply that the effectiveness of ECB rate moves depends critically on the equity-generation capacity and deposit dynamics of Sparkassen, a group that originates roughly two-fifths of German SME credit. When policy tightens, those savings banks that can replenish equity internally or attract fresh retail deposits continue to lend, muting the aggregate credit slowdown in their regions; conversely, highly capitalized or heavily provisioned Sparkassen curtail credit more sharply, amplifying contractionary impulses in areas that are already cyclically fragile. Because Sparkassen's lending is geographically bound by statute, such heterogeneous responses can translate into uneven regional transmission of monetary policy, with credit-rich districts facing shallower slowdowns than credit-poor ones. From a monetary-policy perspective, this heterogeneity

weakens the “one-size-fits-all” nature of the single policy rate and raises the risk that the ECB must move rates further than otherwise to achieve a given macro target.

The results also speak to the current normalization cycle. As rates rise and the stock of negative-rate reserves is wound down, Sparkassen with ample retained earnings and stable deposit franchises will deleverage less aggressively, supporting a smoother pass-through to the real economy. By contrast, institutions that entered the tightening phase with thin equity growth and elevated provisioning will experience a double squeeze: higher funding costs on the liability side and tighter capital constraints on the asset side. This asymmetry argues for supervisory guidance that makes capital buffers genuinely usable in downturns and for tiered reserve remuneration that limits the burden on deposit-rich banks. Finally, because Sparkassen fulfil a statutory development mandate, their credit decisions feed directly into local investment and labour-market conditions; hence a policy-induced pull-back by weaker savings banks could widen regional growth differentials, complicating Germany’s fiscal equalisation mechanism and, by extension, the euro area’s aggregate demand management. In sum, the micro evidence suggests that maintaining robust equity generation and predictable buffer policies at Sparkassen is not merely a prudential concern but a prerequisite for smooth and regionally balanced monetary transmission in Europe’s largest economy.

To gauge whether the aggregate lending-channel estimates mask economically meaningful interactions between capital strength and size, we partition the panel at the sample medians of capital ratios and total assets. This yields four mutually exclusive subsamples: small-low-CAP banks, large-low-CAP banks, small-high-CAP banks, and large-high-CAP banks. Each subsample is re-estimated with the full fixed-effects specification. Table 3 below reports the coefficient on the lagged annual change in the ECB interest rate, which captures the semi-elasticity of real loan growth with respect to monetary policy change.

**Table 3.**

*The ECB interest-rate changes ( $\Delta IR_{t-1}$ ) on loans growth rate ( $\Delta Loans_t$ ) – estimated coefficient for the groups of banks located below and above the median of the distribution of Size and CAP*

	Size 0-50%	Size 50-100%
CAP 0-50%	-0.740***	-0.260
CAP 50-100%	-0.755***	-0.682***

Note. Full estimation results in the Appendix in Table 9. Definitions of CAP and Size are presented below Table 1. \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels respectively.

Source: Author’s estimation results made in StataSE19.

Pass-through is very strong and quite similar for small high-CAP banks (-0.755\*\*\*) and small low-CAP banks (-0.740\*\*\*). A one-percentage-point increase in the policy rate reduces real loan growth by 0.74 p.p. for small, thinly capitalized Sparkassen and by 0.26 p.p. for their large, thinly capitalized peers. The result echoes the balance-sheet channel documented by

Kishan & Opiela (2000) and Jiménez et al. (2012): when regulatory buffers are thin, even municipally owned savings banks deleverage in response to higher funding costs to preserve minimum capital ratios.

Once buffers are ample, however, size no longer insulates lending: both small and large high-CAP banks exhibit sizable and significant semi-elasticities (-0.755 \*\*\* and -0.682 \*\*\*, respectively). This pattern implies that securities-portfolio repricing or opportunity-cost considerations eclipse scale advantages when surplus capital is abundant. This is reminiscent of findings that very high capital ratios can coincide with conservative (low-risk) balance-sheet management.

The median-split (presented in an abbreviated form in Table 3, and the full results in Table 9 in Appendix) shows that capital adequacy is the decisive margin of heterogeneity: small low-CAP banks contract sharply, while large low-CAP peers respond more weakly; once buffers are ample, size effects fade. We interpret this asymmetry as the interaction of regulatory constraints (when buffers are thin) with liability-cost management (larger franchises can re-price or diversify their funding base). This reading does not rely on any additional estimation; it simply organizes the already-reported pattern into a mechanism consistent with the literature on balance-sheet channels and liability-side pass-through.

To uncover the full interaction between capital adequacy and scale, we estimate the benchmark fixed-effects specification separately for every intersection of the four size quartiles and the four capital quartiles. Table 4 below reports the semi-elasticity of real loan growth with respect to a one-percentage-point change in the ECB deposit-facility rate (full results in Tables 10a and 10b in Appendix).

**Table 4.**

*The ECB interest-rate changes ( $\Delta IR_{t-1}$ ) on loans growth rate ( $\Delta Loans_t$ ) – estimated coefficient for the groups of banks located the subsequent quarters of the distribution of Size and CAP*

	Size 0-25%	Size 25-50%	Size 50-75%	Size 75-100%
CAP 0-25%	-0.909**	-0.405	-0.332	0.293
CAP 25-50%	-0.834	-1.060***	-0.418	-0.613*
CAP 50-75%	-0.760	-0.441	-0.259	-0.721*
CAP 75-100%	-0.972**	-0.758*	-1.136**	-0.708*

Note. Full estimation results in the Appendix in Tables 10a and 10b. Definitions of CAP and Size are presented below Table 1. \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels respectively.

Source: Author's estimation results made in StataSE19.

Generally, milder policy pass-through coefficients are observed for several bank categories in the middle of the capital distribution (CAP 25-75%), particularly within the CAP 50-75% quartile where elasticities range from -0.259 to -0.760 and are often insignificant. However, the CAP 25-50% quartile also contains a segment (Size 25-50%) with a notably strong and

significant pass-through (-1.060\*\*\*). Under-capitalized Sparkassen (CAP 0-25%) reduce lending by -0.91 p.p. in the smallest size quartile, reflecting regulatory pressure to rebuild buffers. Over-capitalized Sparkassen (CAP 75-100%) also contract sharply (-0.97 to -1.14 p.p.), consistent with the argument that, when safe yields rise, holding liquid securities can dominate new lending (see Behn, Haselmann, Wachtel, 2016). This U-shape mirrors the buffer-usability narrative: credit is most elastic when buffers are either scarce or so ample that banks prefer to preserve them.

Size moderates transmission only when capital is scarce. In the lowest-capital quartile, small Sparkassen (Size 0-25%) show the steepest contraction (-0.909\*\*), while the largest banks in the same capital bracket actually display a positive but insignificant coefficient (0.293). This pattern is consistent with liability-cost asymmetries: larger institutions can re-price corporate deposits and access wholesale liquidity more readily (Heider, Saidi, Schepens 2019). For the buffer-rich quartile, however, size no longer insulates lending: semi-elasticities remain sizable and significant across three of the four size groups, with the largest absolute response (-1.136\*\*) occurring in the upper-middle size bracket (Size 50-75%).

Across the 16 cells of the quartile analysis, the policy coefficient ranges from +0.293 to -1.136, a significant spread that the estimate (-0.612) and even the median split results (which range from -0.260 to -0.755) conceal. The dispersion underscores that capital and scale interact non-linearly – the same policy move can be twice as contractionary for a small, under-capitalized savings bank as for a large, mid-capital peer, and almost identical for a medium-sized, over-capitalized institution.

Because Sparkassen are geographically confined, the size-capital mosaic maps directly into spatial credit outcomes. Rural districts dominated by small, weakly capitalized banks will face the sharpest loan contraction when the ECB tightens, whereas regions served by mid-tier buffers experience milder effects; paradoxically, affluent areas with buffer-rich Sparkassen may also see pronounced slowdowns as those banks hoard surplus capital or probably rotate into securities. At the system level, such heterogeneity implies that aggregate monetary transmission is the population-weighted average of highly divergent local elasticities, complicating policy calibration.

The 4×4 grid (Table 4) uncovers a U-shaped relation: pass-through is weakest in the middle of the capital distribution and strongest at both tails. We refrain from attaching additional quantitative claims and instead emphasize the design implication: where buffers are either scarce (regulatory defense) or abundant (opportunity cost of expanding loans when safe yields rise), lending reacts the most. This suggests that policy instruments which shape the effective usability of buffers (e.g., supervisory guidance on draw-downs) or the relative pricing of reserves (e.g., tiering) can materially influence the dispersion of credit responses across otherwise similar institutions.

Because Sparkassen are geographically circumscribed, the size-capital mosaic maps directly into spatial credit conditions: districts dominated by small, weakly capitalised institutions face sharper slowdowns when policy tightens, while regions with mid-tier buffers see milder effects; buffer-rich areas may also slow as banks prefer securities over new lending. This mapping follows mechanically from institutional statutes and the heterogeneity already documented; it does not require additional econometrics.

Together with the baseline and median-split results, the quartile grid completes a three-layer narrative: capital adequacy is the primary filter through which monetary shocks pass, size modulates that effect when buffers are thin, and extreme capital positions – whether scarce or abundant – amplify the contractionary impulse.

The three-layer analysis draws a clear picture of how ECB policy shocks propagate through Germany's savings-bank pillar. The pooled fixed-effects benchmark shows that a 1 p.p. rate hike trims Sparkassen loan growth by roughly 0.6 p.p. on average (model 5, Table 2), with equity and deposit inflows cushioning the shock and both thin capital buffers and higher provisions amplifying it. Splitting the sample at the medians of size and Tier-1 capital (Table 3) reveals that capital adequacy is the decisive margin of heterogeneity, i.e. low-CAP small banks contract by about -0.74 p.p., while high-CAP small banks contract by -0.76 p.p.; the only muted reaction (-0.26 p.p.) occurs for large low-CAP banks. Pushing disaggregation to the  $4 \times 4$  size-capital grid (Table 4) uncovers a U-shaped pattern: pass-through is mild in the middle of the capital distribution but steep at both tails, reaching -0.91 p.p. for small, under-capitalized banks and -1.14 p.p. for buffer-rich institutions, while size moderates the effect solely in the low-CAP tier. Together the results show that capital strength dominates scale, that extreme buffer positions – whether deficits or surpluses – magnify monetary transmission, and that these balance-sheet asymmetries will translate into regionally uneven credit cycles unless buffer-usability rules and tiered-reserve design are aligned with the policy cycle.

Building on the observed heterogeneity in policy pass-through, we provide a model-based assessment to quantify the potential of macroprudential tools. Our fixed-effects estimates (Table 4) show that the semi-elasticity of loan growth to a 1 p.p. rate hike ranges from -0.26 to -1.14 p.p. across bank types, compared with -0.61 in the overall FE model (Table 2, model 5).

Using the quartile specification, one can ask how a change in countercyclical capital buffers (CCyB) that shifts behavior would operate across bank groups. The mechanism of a CCyB release lowers effective regulatory capital requirements, thereby freeing balance-sheet capacity for lending. In the most vulnerable banks (small, low-CAP), a 1 p.p. rate increase generates, on average, a 0.91 p.p. decline in loan growth, while loosening the capital ratio by 1 p.p. implies an increase in loan growth of 0.36 p.p. (model 1, Table 10a). However, this group comprises banks that generate only about 1% of aggregate credit, so the real-economy impact of CCyB decisions in this segment is minimal. Changing CCyB for all low-CAP banks (regardless of size) would affect about 25% of aggregate credit volume; nevertheless, given the documented U-shape and the lack of statistical significance of the CAP variable in the CAP 0-25% & Size

50-75% and 75-100% groups – i.e., models (9) and (13) in Table 10b – the aggregate result cannot be determined unambiguously.

On the other hand, for large banks with high CAP (CAP 75-100%, Size 75-100%), it should be noted that although a rate increase is accompanied by a 0.71 p.p. decline in loan growth, CCyB-type changes are unlikely to be the binding margin for these banks, which typically operate with capital ratios well above supervisory minima; accordingly, we expect limited lending impact from CAP adjustments in this cell. One should also remember that these banks generate about 20% of aggregate loan volume.

Second, a tiered reserve system alleviates funding-cost pressure. Assuming it boosts deposit growth by 1 p.p. during tightening, our estimated coefficient on  $\Delta\text{CustDep}$  (0.22 p.p., Table 2, model 5) implies a direct offset of over 35% of the baseline monetary-policy effect (-0.61 p.p.). The coefficient on  $\Delta\text{CustDep}$  is heterogeneous in our quartile distribution (all values available in Table 10a and Table 10b): for small, low-CAP banks it equals 0.13 (15% of the baseline policy effect). A similar effect can be observed among large banks with relatively high CAP, e.g., CAP 50-75%, Size 75-100%, where the  $\Delta\text{CustDep}$  coefficient is 0.12 (17% of the baseline effect). However, in the group Size 25-50% and CAP 0-25%, a 0.43 coefficient on  $\Delta\text{CustDep}$  implies 100% of the baseline effect (though here the coefficient is not statistically significant). This again illustrates the non-linearity of the relationship. This demonstrates that tiering can significantly mute lending-channel contraction by supporting stable deposit funding, but that we are dealing with U-shaped reactions.

In conclusion, coordinating monetary policy with these tools is critical. It dampens excessive credit contraction in reactive parts of the system, promotes regionally balanced transmission, and reduces the need for the ECB to enact disproportionately large rate moves to achieve its macro objectives.

## 5. Conclusion

This study set out to measure how European Central Bank policy shocks travel through Germany's public savings-bank sector and to determine the extent to which balance-sheet heterogeneity shapes that transmission. Using a twenty-year, bank-level panel of 491 Sparkassen, the benchmark fixed-effects regression revealed a statistically powerful lending channel: a one-percentage-point increase in the deposit-facility rate lowers real loan growth by roughly 0.6 percentage points. Equity accumulation and retail-deposit inflows counteract that contraction, whereas a higher Tier-1 ratio and larger loan-loss provisions reinforce it. Taken on its own, however, this pooled result masks wide variation – an intuition confirmed by progressively disaggregating the sample.

When the panel is split at the medians of assets and capital, capital adequacy clearly dominates scale. For instance, drawing from the median split analysis, small low-capital Sparkassen reduce lending by about 0.74 percentage points after a standard rate hike. The reaction of their well-capitalized (high-CAP) counterparts is strong as well, with small high-CAP banks showing a similar contraction (-0.755\*\*\*) and large high-CAP banks also contracting significantly (-0.682\*\*\*). In contrast, large low-capital Sparkassen display a notably muted and statistically insignificant response (-0.260) to a similar policy shock. Size moderates the shock only when buffers are thin: large, under-capitalized savings banks contract less than small, equally weak peers, presumably because broader funding bases allow them to absorb a rise in funding costs. Once buffers are ample, scale ceases to matter. Pushing the disaggregation further to a sixteen-cell size-by-capital grid exposes a pronounced non-linearity: pass-through tends to be milder for banks in the upper-middle of the capital distribution (CAP 50-75%) yet intensifies at both the low-capital and high-capital tails. It reaches almost one percentage point for the smallest, weakly capitalized banks (-0.909\*\*) and exceeds one percentage point for certain buffer-rich institutions (-1.136\*\*). The pattern suggests two distinct mechanisms: capital scarcity forces deleveraging to defend regulatory ratios, whereas surplus capital raises the opportunity cost of loan expansion when safe yields rise. Because Sparkassen lend strictly within their municipalities, this size-capital mosaic translates into geographically uneven credit cycles as the policy stance tightens.

For bank management, the results validate a focus on organic equity generation and on safeguarding stable retail funding: both reduce the contractionary impact of tightening without compromising risk discipline. For supervisors, credible, stigma-free buffer usability and calibrated reserve tiering can dampen excessive contraction where liability costs bind. Coordination between monetary and macro-prudential authorities can reduce the likelihood that a single policy rate yields uneven regional outcomes in a decentralized banking pillar. These are design-level takeaways implied by the observed ordering of coefficients rather than by any unreported estimates.

These findings carry several policy implications. First, the effectiveness of counter-cyclical capital buffers hinges on credible guidance that makes draw-downs stigma-free; without such clarity, the safest Sparkassen may reduce lending most in a downturn. Second, the tiered-reserve system should be calibrated with an eye to liability-cost asymmetries, as deposit-rich, low-capital banks bear the sharpest margin squeeze and thus the steepest contraction. Third, closer coordination between monetary and macro-prudential authorities is warranted: synchronized buffer release, targeted risk-weight adjustments, and liquidity facilities can offset the uneven real-sector impact that a single policy rate imposes on a structurally diverse banking landscape. Neglecting these asymmetries risks forcing the ECB to move rates further than otherwise to achieve a given macroeconomic objective.

Our annual panel is well suited to tracing medium-run balance-sheet adjustment but may understate intra-year rebalancing or credit-line management. The sample ends in 2019; we therefore refrain from generalizing quantitatively to the recent tightening cycle and treat our findings as a historically grounded benchmark. Finally, while the institutional homogeneity of Sparkassen is an asset for identification, it also means that external validity to shareholder-owned, wholesale-funded banks should be inferred cautiously. These limitations qualify interpretation without detracting from the internal consistency of the results presented.

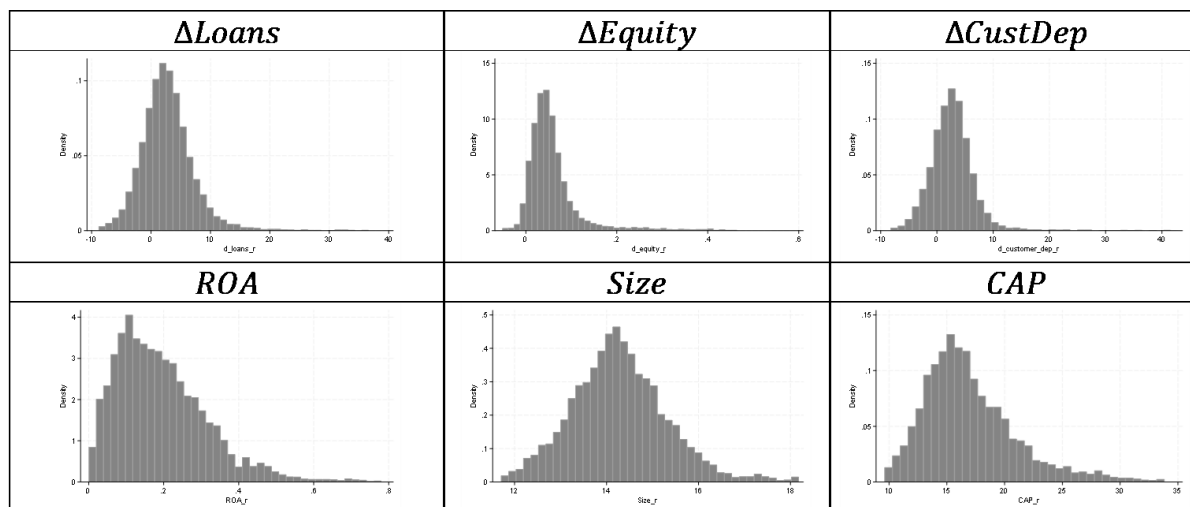
Even with these caveats, the evidence underscores a broader lesson: public ownership and developmental mandates do not immunize Sparkassen from pro-cyclical behavior when buffers bind or when excess capital becomes costly. As the ECB pursues policy normalization, understanding how such balance-sheet asymmetries amplify or attenuate credit supply is essential for maintaining regionally balanced transmission throughout Europe's largest economy.

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## Appendix



**Figure 2.** Growth rate distribution of loans, equity and customer deposits and bank-characteristics distribution of ROA, Size and CAP.

Source: Author's calculations made in StataSE19.

**Table 5.**  
*Correlation matrix*

	$\Delta$ Loans	$\Delta$ Equity	$\Delta$ CustDep	ROA	Size	CAP	LLP	GDPG	Unempl	$\Delta$ IR
$\Delta$ Loans	1									
$\Delta$ Equity	0.333***	1								
$\Delta$ CustDep	0.376***	0.202***	1							
ROA	0.067***	0.168***	0.023**	1						
Size	0.090***	0.042***	0.119***	0.039***	1					
CAP	0.055***	0.004	-0.044***	0.13***	-0.071***	1				
LLP	-0.197***	-0.506***	-0.07***	-0.014	-0.117***	-0.009	1			
GDPG	0.051***	0.114***	-0.045***	0.035***	0.005	0.042***	-0.165***	1		
Unempl	-0.228***	-0.103***	-0.135***	0.18***	-0.134***	-0.217***	0.503***	0.053***	1	
$\Delta$ IR	-0.031***	-0.061***	0.052***	0.004	-0.007	0.041***	-0.05***	0.294***	-0.05***	1

Source: Author's estimation results made in StataSE19.

**Table 8.**  
*Descriptive statistics of real loan changes per Year*

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No of obs.	435	437	429	437	433	436	449	443	449	451	453	455	468	468	504	390	394	392	392	353
$\Delta$ Loans (average)	4.0	2.7	2.1	2.1	-0.1	0.4	1.3	0.5	0.2	2.2	3.1	4.2	2.7	2.4	2.2	4.0	4.2	3.7	3.6	4.3

Source: Author's estimation results made in StataSE19.

**Table 9.**

*Fixed effect estimation results for the group of banks located below and above the median of the distribution of Size and CAP*

VARIABLES	(1) fe SizeH1 CAPH1	(2) fe SizeH1 CAPH2	(3) fe SizeH2 CAPH1	(4) fe SizeH2 CAPH2
$\Delta\text{Loans}_{t-1}$	0.167*** (0.032)	0.125*** (0.029)	0.103*** (0.026)	0.099*** (0.028)
$\Delta\text{Equity}_{t-1}$	11.650*** (2.714)	11.628*** (3.706)	9.124*** (2.072)	13.048*** (2.990)
$\Delta\text{CustDep}_{t-1}$	0.233*** (0.031)	0.142*** (0.036)	0.281*** (0.024)	0.099*** (0.035)
$\text{ROA}_t$	-2.420 (2.175)	-1.721 (1.822)	-0.581 (1.492)	2.825* (1.619)
$\text{Size}_t$	1.229 (1.529)	2.702 (1.930)	-0.334 (1.298)	0.205 (1.176)
$\text{CAP}_t$	-0.224** (0.096)	-0.211*** (0.056)	-0.060 (0.069)	-0.132*** (0.050)
$\text{LLP}_t$	0.132 (0.270)	-0.197 (0.253)	-0.294 (0.210)	-0.083 (0.220)
$\text{GDPG}_t$	0.062 (0.047)	0.124** (0.053)	-0.040 (0.040)	-0.093** (0.045)
$\text{Unempl}_t$	-0.420*** (0.141)	-0.634*** (0.148)	-0.223** (0.109)	-0.755*** (0.121)
$\Delta\text{IR}_{t-1}$	-0.740*** (0.207)	-0.755*** (0.216)	-0.260 (0.168)	-0.682*** (0.216)
Constant	-10.592 (21.654)	-28.082 (27.141)	8.294 (20.257)	4.299 (18.389)
Observations	980	1,094	1,110	919
No of Banks	115	131	131	114
R-squared	0.189	0.192	0.217	0.180

Source: Author's estimation results made in StataSE19.

**Table 10a.**

*Fixed effect estimation results for the group of banks located the subsequent quarters of the distribution of Size and CAP*

VARIABLES	(1) fe SizeQ1 CAPQ1	(2) fe SizeQ1 CAPQ2	(3) fe SizeQ1 CAPQ3	(4) fe SizeQ1 CAPQ4	(5) fe SizeQ2 CAPQ1	(6) fe SizeQ2 CAPQ2	(7) fe SizeQ2 CAPQ3	(8) fe SizeQ2 CAPQ4
$\Delta\text{Loans}_{t-1}$	0.132** (0.058)	0.128 (0.083)	0.143* (0.075)	0.072 (0.064)	0.045 (0.056)	0.365*** (0.060)	0.071 (0.053)	0.205*** (0.050)
$\Delta\text{Equity}_{t-1}$	0.706 (5.216)	0.096 (9.641)	7.310 (8.984)	17.052* (8.823)	17.266*** (3.776)	5.206 (6.618)	18.107** (7.523)	3.333 (6.542)
$\Delta\text{CustDep}_{t-1}$	0.133** (0.059)	0.037 (0.095)	-0.072 (0.077)	0.114 (0.085)	0.427*** (0.054)	0.133** (0.055)	0.320*** (0.059)	0.067 (0.072)
$\text{ROA}_t$	1.672 (4.491)	3.486 (6.267)	0.900 (3.227)	-2.311 (5.507)	-2.918 (3.446)	-7.979* (4.101)	-9.643** (3.827)	-0.047 (3.030)
$\text{Size}_t$	3.288 (3.399)	5.280 (3.603)	1.260 (5.967)	5.953 (5.845)	2.086 (3.174)	-1.126 (2.582)	-1.939 (2.600)	4.400 (3.561)
$\text{CAP}_t$	-0.357** (0.178)	0.497** (0.241)	-0.153 (0.160)	-0.033 (0.128)	-0.693*** (0.224)	-0.368** (0.157)	-0.215* (0.119)	-0.312*** (0.085)
$\text{LLP}_t$	-0.770 (0.499)	-0.983 (0.907)	-0.178 (0.695)	-0.027 (0.525)	0.869* (0.454)	-0.264 (0.563)	-0.339 (0.573)	-0.426 (0.388)
$\text{GDPG}_t$	0.053 (0.080)	0.159 (0.129)	0.232** (0.117)	0.199* (0.116)	0.112 (0.088)	-0.026 (0.080)	-0.080 (0.095)	0.151 (0.095)

Cont. table 10a.

Unempl <sub>t</sub>	-0.251 (0.272)	0.527 (0.478)	-0.472 (0.449)	-0.515 (0.365)	-0.587** (0.250)	-0.638*** (0.231)	-0.620** (0.251)	-0.675** (0.276)
$\Delta IR_{t-1}$	-0.909** (0.354)	-0.834 (0.680)	-0.760 (0.521)	-0.972** (0.493)	-0.405 (0.379)	-1.060*** (0.357)	-0.441 (0.364)	-0.758* (0.398)
Constant	-35.711 (45.446)	-79.076 (50.778)	-9.575 (80.281)	-73.597 (78.310)	-16.960 (45.313)	26.839 (38.073)	36.473 (37.780)	-49.832 (51.759)
Observations	278	180	201	260	261	261	294	339
No of Banks	35	24	28	33	27	29	32	38
R-squared	0.160	0.134	0.140	0.149	0.384	0.340	0.301	0.308

Note.  $\Delta$ Loans – real loan growth rate, calculated as the log difference of bank loans (percentage points);  $\Delta$ Equity – real equity growth rate (percentage points);  $\Delta$ CustDep – real growth rate of customer deposits (percentage points); ROA – return on assets, defined as net income divided by total assets (percentage points); Size – logarithm of total assets; CAP – Tier 1 capital ratio, measuring core equity relative to risk-weighted assets (percentage points); LLP – loan-loss provisions ratio, calculated as loan-loss provisions divided by total assets (percentage points); GDPG – annual GDP growth rate in Germany (percentage points); Unempl – unemployment rate in Germany (percentage points);  $\Delta IR$  – ECB interest rate change (percentage points). Real values deflated by author from nominal based on country inflation.

Source: Author's estimation results made in StataSE19.

**Table 10b.**

*Fixed effect estimation results for the group of banks located the subsequent quarters of the distribution of Size and CAP*

VARIABLES	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	fe SizeQ3 CAPQ1	fe SizeQ3 CAPQ2	fe SizeQ3 CAPQ3	fe SizeQ3 CAPQ4	fe SizeQ4 CAPQ1	fe SizeQ4 CAPQ2	fe SizeQ4 CAPQ3	fe SizeQ4 CAPQ4
$\Delta Loans_{t-1}$	0.157*** (0.051)	0.031 (0.049)	-0.001 (0.053)	0.086 (0.061)	0.053 (0.054)	0.269*** (0.053)	0.027 (0.050)	0.236*** (0.065)
$\Delta Equity_{t-1}$	15.980*** (4.660)	25.973*** (5.031)	22.322*** (4.711)	-7.992 (9.203)	0.707 (3.519)	-0.503 (4.444)	15.183*** (4.790)	12.279 (7.929)
$\Delta CustDep_{t-1}$	0.231*** (0.049)	0.293*** (0.051)	0.198*** (0.056)	0.052 (0.092)	0.307*** (0.046)	0.181*** (0.046)	0.123* (0.066)	-0.095 (0.079)
ROA <sub>t</sub>	-6.553* (3.774)	-2.866 (3.439)	1.140 (2.449)	4.484 (5.189)	3.705 (3.206)	0.296 (2.110)	0.728 (3.958)	4.157 (2.720)
Size <sub>t</sub>	-1.291 (2.288)	-1.784 (2.946)	-2.101 (1.491)	6.204 (3.978)	-0.000 (2.827)	1.500 (2.374)	1.076 (3.317)	-2.012 (3.232)
CAP <sub>t</sub>	-0.035 (0.188)	-0.045 (0.145)	-0.351*** (0.113)	0.033 (0.117)	0.109 (0.120)	-0.378*** (0.135)	-0.287*** (0.095)	-0.088 (0.082)
LLP <sub>t</sub>	0.389 (0.483)	1.241*** (0.476)	0.495 (0.352)	-1.316** (0.563)	-0.872** (0.429)	-1.230*** (0.390)	0.258 (0.416)	0.175 (0.536)
GDPG <sub>t</sub>	-0.035 (0.076)	-0.079 (0.075)	-0.101 (0.074)	0.036 (0.115)	-0.128 (0.095)	0.101 (0.076)	-0.158* (0.088)	-0.145* (0.084)
Unempl <sub>t</sub>	-0.273 (0.239)	-0.690*** (0.245)	-1.228*** (0.221)	-0.257 (0.324)	-0.105 (0.206)	-0.143 (0.209)	-0.844*** (0.198)	-0.632** (0.284)
$\Delta IR_{t-1}$	-0.332 (0.355)	-0.418 (0.334)	-0.259 (0.347)	-1.136** (0.553)	0.293 (0.336)	-0.613* (0.319)	-0.721* (0.431)	-0.708* (0.418)
Constant	21.944 (34.283)	30.959 (44.612)	44.433* (23.352)	-88.880 (60.459)	0.313 (46.232)	-15.327 (37.908)	-6.443 (52.712)	37.579 (51.591)
Observations	248	325	287	226	266	271	217	189
No of Banks	26	40	34	28	33	32	28	24
R-squared	0.245	0.287	0.311	0.162	0.214	0.355	0.231	0.233

Note.  $\Delta$ Loans – real loan growth rate, calculated as the log difference of bank loans (percentage points);  $\Delta$ Equity – real equity growth rate (percentage points);  $\Delta$ CustDep – real growth rate of customer deposits (percentage points); ROA – return on assets, defined as net income divided by total assets (percentage points); Size – logarithm

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of total assets; CAP – Tier 1 capital ratio, measuring core equity relative to risk-weighted assets (percentage points); LLP – loan-loss provisions ratio, calculated as loan-loss provisions divided by total assets (percentage points); GDPG – annual GDP growth rate in Germany (percentage points); Unempl – unemployment rate in Germany (percentage points);  $\Delta$ IR – ECB interest rate change (percentage points). Real values deflated by author from nominal based on country inflation.

Source: Author's estimation results made in StataSE19.