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The conditional impact of market consolidation and market power on banking stability – Evidence from Europe

Sarah Herwald, Simone Voigt & André Uhde *

Abstract: Employing data on 3,943 banks from the EU-15 between 2013 and 2020, this paper empirically analyzes the relationship between banking market consolidation, market power and banking stability, separately for the loan and deposit market. We initially find that European banks follow a loss-leader pricing strategy and cross-subsidize between both markets. In addition, it is observed that the empirical link between consolidation and market power is weak and thus, provokes diametral findings. Investigating the conditionality of consolidation and market power further reveals that, although the negative impact of consolidation on stability is reduced, it is not fully crowded out, even if banks exhibit stronger market power in the loan and deposit market. Analyzing likely impact channels, different determinants of bank distress as well as effects from the lower bound and negative interest rates regime provides further important insights.

Keywords: Consolidation, market power, banking stability, European banking

JEL Classification: G15, G21, G38

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1. Introduction and motivation

The desire for a stronger consolidation of the European banking market has been regularly voiced by banking regulators and supervisors since the global financial crisis from 2007. In recent months, however, the calls have become louder for two reasons (ECB, 2021, 2020). *First*, it is claimed that the European market was overbanked and that stronger market consolidation and hence, less competition, might help to create a more balanced "level-playing field", to give European banks a better opportunity to stand up to their foreign competitors. *Second*, it is argued that stronger consolidation may increase bank profitability by unlocking cost savings and revenue synergies to such an extent that banks may better cover their cost of capital and especially costs from recent challenges, such as the zero lower bound, the negative interest rates regime or the Corona pandemic. As a consequence, since increasing profitability may mitigate a risky “gambling for profitability” and help to build up capital buffers, stronger consolidation along with an increase in market power is also seen to be beneficial to banking stability by improving the resilience and efficiency of the banking system and strengthening its ability to adapt to structural challenges.

Academic research has responded to the addressed issues and analyzed the impact of increasing market consolidation on bank profitability and stability providing both, ambiguous theoretical predictions and countervailing empirical evidence (Section 2.). Next to the fact, that conflicting empirical results may be traced back to the selection of sampled countries and banks as well as different time periods, we propose that the technique used to empirically measure consolidation (concentration) may serve as further explanation (Schaeck et al., 2009; Berger et al., 2009; Beck et al., 2006b). Hence, most studies rely on structural measures such as the *k-bank concentration ratios* or the *Herfindahl-Hirschman-Index* (Herfindahl, 1950; Hirschman, 1964) to measure consolidation. However, while structural measures are a simple- and easy to implement-strategy to proxy banking market concentration, they are less reliable when measuring competition in banking markets (Jiang et al., 2022; Claessens and Laeven, 2004; Bikker and Haaf, 2002), which is due to the fact that structural concentration measures may adequately reflect competition

intensities only, if the sampled banks are homogenous and hence, market concentration (the market structure) impacts the conduct of all banks equally (e.g., Dell'Ariccia, 2001). This limitation becomes even more severe as intense competition is also observed in stronger concentrated markets (e.g., Claessens and Laeven, 2004, 2005). If this is also true for the European banking market, the idea to enhance bank profitability by increasing market consolidation is not on target, since increasing competition usually reduces profitability and thus, may reduce financial stability at banks.

Against this background and considering that market structures differ substantially between national banking markets in the Euro area, the paper at hand employs structural concentration measures, non-structural competition measures as well as their conditionality to empirically investigate the nexus between consolidation, market power (competition) and banking stability. We do so by employing the most recent and granular banking sample for Western Europe, including annual unconsolidated bank balance sheet and income statement data on 3,943 commercial banks, savings banks and cooperative banks headquartered in the EU-15 over the period from 2013 to 2020. Our paper contributes to the literature by several aspects.

First, we do not rely on structural country or market wide concentration measures to proxy banking market competition. Rather, we employ the non-structural product-specific Lerner Index to determine bank market power in the loan and deposit market separately and at the individual bank level. We believe that this is an insightful strategy since previous empirical studies mostly employ structural concentration measures and provide mixed evidence for both, a concentration-stability and -fragility relationship with respect to loan and deposit markets. Moreover, next to Forssbæck and Shehzad (2015), the study at hand is only the second comprehensive study that consistently applies the product-specific Lerner Indices to investigate the impact of market power in the loan and deposit market on bank profitability, risk and stability.

Second, interacting the concentration and Lerner Index measures, we are able to investigate the impact of the *conditionality* between consolidation and market power on bank profitability,

risk and stability. In this context, the study at hand is the first to examine conditionality with a comprehensive focus on the European banking market.

Third, determinants of banking stability beyond concentration and competition have been intensely investigated by academic research. Hence, next to the macroeconomic and regulatory environment, especially bank-specific indicators from the *CAMEL rating system*[1] have been proved to provide accurate predictions of bank distress (Galán, 2021; Citterio, 2020). Taking this into account, we explicitly interact the conditionality between consolidation and market power with several institutional and bank-specific factors. Our results provide further important insights and complement previous findings from studies of bank distress.

Fourth, employing concentration and product-specific Lerner Index measures allows analyzing if and to what extent conditional effects may influence (i) a bank's investment quality (pricing of loans) and (ii) a bank's funding costs (pricing of deposits). In particular, as our analysis period covers the zero lower bound and negative interest rate regime in Europe, we are able to analyze whether and how banks may pass through low or negative interest rates to customers and how the passing through may affect banks' interest margins (profitability) and stability.

Finally, and *fifth*, we further use the variation in our sample by explicitly considering the different banking groups. Accordingly, we are the first to control if the impact of the conditionality between consolidation and market power on profitability and stability differs with regard to banking specialization.

The analysis at hand initially reveals that European banks may follow a loss-leader pricing strategy and cross-subsidize between loan and deposit markets. In addition, it is indicated that the empirical link between consolidation and market power is weak and thus, provokes diametral

[1] The CAMEL rating system was developed by the U.S. National Credit Union Administration (NCUA) in 1979 to classify a bank's overall solvency condition. The five components used to assess a bank's financial health are **C**apital Adequacy, **A**sset Quality, **M**anagement Capability, **E**arnings Quantity and Quality, and Adequacy of **L**iquidity.

findings, i.e., greater banking market consolidation may reduce banking stability, whereas stronger market power (less competition) in the loan and deposit market may improve financial stability. Taking this into account and interacting the concentration measure with the respective Lerner Indices to control for conditionality in a next step, we find that – although the negative impact of consolidation on banking stability is reduced – , it is not fully crowded out, even if banks exhibit stronger market power in the loan and deposit market.

Results from further analyses provide additional important implications. *First*, we do not observe any statistical effect for the subsample of more functionally and geographically diversified commercial banks, whereas our baseline findings are qualitatively reiterated for the subsamples of savings banks and cooperative banks, which are more strongly affected by (regional) market consolidation. *Second*, investigating different impact channels reveals that increasing consolidation along with stronger market power may positively affect bank asset returns, whereas return volatility is increased, and capital ratios are reduced, which provokes an overall decrease in banking stability. *Third*, controlling for different determinants of bank distress indicates that better capitalization, higher profitability, larger liquidity buffers, economic upturns and tighter capital regulation may mitigate, but not wipe out, the negative impact of greater market consolidation on stability, which is even true for banks exhibiting stronger market power in the loan and deposit market. And *fourth*, controlling for the zero lower bound and negative interest rate regime in Europe reveals that our baseline findings vary with the strength of the interest-rate pass through mechanism and that the loss-leader pricing strategy has a stronger destabilizing effect for banks with greater market power in the loan market under negative market rates.

The remainder of the paper is organized as follows. Section 2. presents the theoretical and empirical background and Section 3. discusses the related literature. While Section 4.1. presents the data and variables as used in our analysis, Section 4.2. introduces the empirical model. Results from the empirical are presented and discussed in Section 5. Finally, Section 6. summarizes and provides important implications.

2. Theoretical and empirical background

As briefly addressed in Section 1., the broad strand of previous related literature provides countervailing predictions and evidence concerning the impact of increasing consolidation on profitability and banking stability. The conflicting arguments and results are subsumed under the *concentration-stability* and *concentration-fragility view*.

To begin with, it is argued and empirically shown that larger banks with stronger market power in more consolidated and less competitive markets may charge *higher interest rates on loans*. As a result, larger banks may enhance *profits* and *capital ratios* that protect them against external macroeconomic and liquidity shocks and promote financial stability (Bretschger et al., 2012; Gropp et al., 2011; Boyd et al., 2004; De Nicoló, 2004; Matutes and Vives, 2000). In contrast, it is also suggested and empirically demonstrated that higher loan interest rates charged by larger banks may induce borrowers to take on risky investments to compensate higher loan repayments, thus providing a risk-shifting towards banks with strong market power (Caminal and Matutes, 2002; Boyd and De Nicoló, 2005). Accordingly, the likelihood of loan defaults may increase and induce a higher probability of bank failures. In addition, Schaeck and Cihák (2012) provide evidence that larger banks may hold lower capital ratios whereas smaller banks in competitive markets may increase their capital reserves, suggesting that the competitive pressure incentivizes smaller banks to raise their capital ratios as a quality signal to attract potential borrowers. However, enhancing capital ratios through more profitable investments may be challenging since smaller banks with less market power and operating in more competitive markets are forced to set prices close to marginal costs (Jiang et al., 2022; Demirgüc-Kunt and Detragiache, 2002; Hellmann et al., 2000). In this context, Boyd and De Nicoló, (2005) as well as Gropp et al. (2011) show that stronger competition indeed tends to lower loan interest rates at smaller banks but reduces adverse selection and moral hazard at the same time and thus, supports banking stability. In addition, Goetz (2018) provides empirical evidence that competition may increase stability, as it improves bank profitability.

Similarly, it is argued and empirically demonstrated that a higher "*charter or franchise value*" of larger banks in more consolidated markets may deter excessive risk-taking behavior by the bank's management (Keeley (1990). Hence, as higher franchise values result in higher opportunity costs when going bankrupt, bank managers or, even more, the bank's shareholders may not accept risky investments that could jeopardize their future profits (Park and Peristiani, 2007; Repullo, 2004; Allen and Gale, 2000; Chan et al., 1986; Marcus, 1984). In contrast, Akins et al. (2016) empirically show that also smaller banks exhibiting lower franchise values and operating in a more competitive environment may be less prone to engage in risky investments.

Furthermore, it is suggested that banks with stronger market power have advantages in the provision of *credit monitoring services*, may more intensively engage in *credit rationing* and may retrieve *private information* from a more distinctive relationship lending (Uhde and Heimeshoff, 2009; dell'Ariccia and Marquez, 2006; Berger et al., 2005; Petersen and Rajan, 1995). If this is true, stronger lending to high-quality borrowers and gaining more profound information about debtors should increase the overall loan-portfolio quality and hence, contribute to financial soundness (Marquez, 2002; Boot and Thakor, 2000). In contrast, banks with less market power and operating in competitive loan markets may be forced to decrease *lending standards*, suffer from *less timely loan loss recognition* and tend to "*zombie lending*" (Jiang et al., 2022; Tracey, 2022; Acharya, 2020; Bushman et al. 2016), i.e., they provide cheap lending to highly leveraged and less creditworthy borrowers inducing lower loan-portfolio quality and financial distress (Petersen and Rajan, 1995).

It is further argued that larger banks in more concentrated markets may be able to *diversify* loan-portfolio risks more efficiently due to higher *economies of scale and scope* (Boyd and Prescott, 1986). Additionally, and next to this functional diversification effect, larger banks with cross-border business activities may also gain economies of scale and scope by geographical risk diversification (Méon and Weill, 2005). In contrast, however, it is proposed that stronger

diversification benefits may reduce managerial efficiency, the effectiveness of internal corporate control and thus, increase operational risk (Cetorelli et al., 2007). Moreover, Goetz (2018) as well as Anginer et al. (2014) empirically show that greater competition encourages smaller banks to diversify risks more intensively, which results in an increase in overall asset quality. In contrast, Jiang et al. (2022) provide evidence that an intensification of competition may increase a bank's provision of nontraditional, riskier banking services (e.g., investment banking).

Finally, Schaeck et al. (2009) provide empirical evidence that an intensification of competition in banking markets may decrease the probability of suffering from a *systemic crisis*. In contrast, it is also found that more concentrated banking markets may be more stable than competitive markets since fewer and larger banks may be easier to monitor, which enhances supervisory efficiency and prevents from financial crises (Deltuvaité 2010; Beck et al., 2006a Allen and Gale, 2000). In this context, however, it is also argued that the *organizational complexity* of a bank may increase with its size resulting in lower transparency and a decrease in financial stability, especially at larger and more complex banks (Beck et al., 2006a, 2006b; De Nicoló, 2004). Additionally, considering that larger banks may be more likely to receive public guarantees or subsidies, which is discussed as the *"too big to fail"-doctrine* (Boyd and Runkle, 1993; Mishkin, 1999), the moral hazard problem becomes more severe for larger banks' managers who may take on more risky investments under a *government's safety net* (Boyd and De Nicoló, 2005; De Nicoló and Lucchetta, 2009).

3. Related literature

As shown in Section 2., a huge strand of theoretical and empirical research has analyzed the impact of banking market concentration and competition (market power) on bank profitability and stability yet. However, these studies focus either on concentration or competition (market power) and thus, do not control for a possible conditionality between concentration and

competition (market power) in banking. In addition, most previous studies have addressed the banking market as a whole, rather than analyzing the deposit and loan market separately.

So far, and to the best of our knowledge, only one study provided by Forssbæck and Shehzad (2015) have investigated the relationship between concentration, competition (market power) and stability while considering conditional effects and focusing on the loan and deposit market, respectively. Their study is based on data from 800 banks operating in 48 countries worldwide over the period from 1995 to 2007. Banking stability is proxied by the widely used Z-score measure, while banking market concentration is measured as the total assets of the three largest banks divided by the total assets of all commercial banks per country. In addition, product-specific Lerner Indices are used to proxy the banks' market power (competition intensities) in the loan and deposit market, respectively.

Forssbæck and Shehzad (2015) initially provide evidence of an overall positive linear relationship between banking stability and market power in loan and deposit markets. Furthermore, they show that decreasing competition, represented by stronger market power in both submarkets, may foster financial stability. Employing interaction terms of both Lerner Indices and the concentration measure in order to identify conditional effects, the study additionally reveals that the positive effect of market power in the loan market may be stronger in banking markets with above-average concentration levels. In contrast, they do not find any statistical evidence for banks with market power in the deposit market in this context.

The analysis at hand complements and extents the study provided by Forssbæck and Shehzad (2015) for four aspects. *First*, including data on 3,943 domestic banks operating in the EU-15, our study includes the most comprehensive banking sample for Europe. *Second*, the study at hand employs the most recent sample for Europe, covering the period from 2013 to 2020, which allows us to control for the impact of the zero lower bound and negative interest rate regime. *Third*, we do not only empirically investigate the impact of the conditionality between concentration and

competition (market power) on banking stability but dig deeper by analyzing likely impact channels as well as the relation between conditionality and different determinants of bank distress. *And fourth*, using a granular sample including commercial banks, savings banks, and cooperative banks allows controlling for the heterogeneity of the European banking system and investigating the concentration-competition-stability nexus separately for each banking group.

4. Empirical methodology

4.1. Data and sources

Tables A1 and A2 in *Appendix A* present notes, data sources and descriptive statistics with regard to variables used to compute the concentration measure, product-specific Lerner Indices and the Z-score measure. Tables A3, A4 and A6 provide further information concerning the evolvement of these measures over time. In addition, the development of the averaged components of both Lerner Indices is shown in Tables A5a and A5b and illustrated in Figures A1(a) – A1(d).

4.1.1. Concentration measure

We retrieve annual unconsolidated bank balance sheet and income statement data on 3,943 commercial banks, savings banks and cooperative banks headquartered in the EU-15[2] between 2013 and 2020 from the *BankFocus database* compiled by *Moody's Analytical* and provided by *Bureau van Dijk*. Following related previous empirical studies (e.g., Uhde and Heimeshoff, 2009), and to establish comparability with the most related study provided by Forssbæck and Shehzad

[2] The EU-15 countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

(2015), we proxy banking market concentration by the *3-Bank Concentration Ratio* as our first independent variable of interest.[3]

The k-bank concentration ratio is a structural indicator, measuring consolidation at the country- or market level by summing up the market shares s_i of the k largest banks in a relevant banking market for each single year t:

$$CR_{k,t} = \sum_{i=1}^{k} s_{i,t}. \quad (1)$$

In line with previous studies, we calculate the *3-bank concentration ratio (Concentration)* as the ratio of total assets held by the three largest banks to the entire banking market's total assets per country and year. Obviously, a higher value signifies greater banking market concentration.

As shown by Tables A2 and A3, the mean of the concentration ratio is at 0.4425 with a standard deviation of 0.1630, while we observe the most concentrated banking market with a concentration value of 0.9921 in Greece in 2013 and 2016 and the less consolidated banking market with a minimum value of 0.2879 in Germany in 2019. Furthermore, as displayed by Table A3, the country-averaged concentration ratios have slightly decreased between 2014 and 2019 by 7.85 percentage points and have increased by 2.28 percentage points since 2019. Finally, Table A3 indicates that concentration ratios remarkably differ across the European countries, providing sufficient variation in our sample.

[3] Note that we also employ the 5-*bank concentration ratio (CR5)* as well as the *Herfindahl-Hirschman-Index (HHI)* as alternative concentration measures. However, since the baseline results are qualitatively reiterated, we do not report them in this paper but provide them on request.

4.1.2. Product-specific Lerner Indices

As our second independent variable of interest, we include the Lerner Index (Lerner, 1934), which is the most popular and widely used "non-market-structure"-indicator of competition and market power in the empirical banking literature (Shaffer and Spierdijk, 2017).[4] As a non-structural indicator, the Lerner Index measures the intensity of market or pricing power (competition intensity) at the individual bank-level. In its general form, the Lerner Index calculates a price-to-cost margin as:

$$Lerner_{it} = \frac{(P_{it} - MC_{it})}{P_{it}}, \tag{2}$$

where P_{it} denotes the price of total assets and MC_{it} is the marginal costs of total assets for bank i in year t. The Lerner Index takes on values between 0 and 1, while a value of 0 indicates perfect competition since banks operating in a fully competitive environment are not able to demand mark-up prices. In contrast, a value of 1 reflects a monopolistic banking market where the mark-up price exceeds marginal costs at most.

Based on the theoretical framework of the *Monti-Klein model* (Freixas and Rochet, 2008), the empirical analysis at hand does not focus on competition in a banking market as whole, but rather uses *product-specific Lerner Indices*, which measure a bank's market power in the *loan* and *deposit market* separately on a bank-year level. Hence, a bank is assumed to produce loans and deposits as two outputs by utilizing three inputs, i.e., funding, labor and fixed capital. The marginal

[4] We prefer the Lerner Index among other non-structural measures, like the Boone Indicator (Boone, 2008) or the Panzar-Rosse H-statistic (Panzar and Rosse, 1987) since the product-specific Lerner Index permits the separate measurement of banks' market power in the loan and deposit market. Moreover, for the study at hand, the Lerner Index is superior to other indices as it measures market power at the bank-level and over time and does not require assumptions on firm heterogeneity or equilibrium markets (e.g., Shaffer, S., Spierdijk, L., 2017).

costs of the two outputs are retrieved by estimating the following translog cost function (TCF) for each bank *i* and year *t*:

$$\begin{aligned}\ln(TC_{it}) = \alpha_0 + \sum_{s=1}^{s} \alpha_{1s} + \beta_L \ln(L_{it}) + \beta_D \ln(D_{it}) \\ + \frac{1}{2}\beta_{LL}(\ln(L_{it}))^2 + \frac{1}{2}\beta_{DD}(\ln(D_{it}))^2 \\ + \frac{1}{2}\beta_{LD} \ln(L_{it})\, ln(D_{it}) \\ + \sum_{k=1}^{3} \gamma_k \ln(w_{kit}) + \sum_{k=1}^{3}\sum_{m=1}^{3} \frac{1}{2}\delta_{km} \ln(w_{kit}) \ln(w_{mit}) \\ + \sum_{k=1}^{3} \eta_{kL} \ln(w_{kit}) \ln(L_{it}) \\ + \sum_{k=1}^{3} \theta_{kD} \ln(w_{kit}) \ln(D_{it}) + \lambda_1 T + \lambda_2 T^2 \\ + \sum_{k=1}^{3} \lambda_{kw} \ln(w_{kit})\, T + \lambda_L \ln(L_{it})\, T + \lambda_D \ln(D_{it})\, T \\ + \varphi \ln(E_{it}) + \varepsilon_{it}.\end{aligned} \tag{3}$$

In line with the related literature, total costs (TC) are calculated as the natural log of the sum of a bank's accounting values of total interest expense and total operating expense per year. α_0 is a constant and α_{1s} represents specialization dummies for the different groups of banks (commercial banks, savings banks, cooperative banks) as included in our analysis. Loans (L_{it}) are proxied by the natural log of a bank's accounting value of total earning assets per year, while deposits (D_{it}) are calculated as the natural log of a bank's accounting value of customer deposits per year. The calculation of the three input prices (w_{kit}) – funding costs, labor costs and cost of

fixed capital – is based on the following log-ratios of accounting values per bank and year, respectively: total interest expense over total liabilities, personnel expense over total assets and operating expenses over fixed assets. Technical changes over time are captured by the time trend variable T. This variable is set to the value of 1 in the first year of the sample period (2013) and increases by the value of 1 every subsequent year, reaching the maximum value of 8 in 2020. A bank's total equity (E_{it}) is included since equity can be used as a substitute for deposits during the funding process. In addition, the TCF includes quadratic terms of each variable to test for non-linear relationships. Finally, interaction terms are employed to capture the potential mutual price dependencies with regard to total costs.

Corresponding to Forssbæck and Shehzad (2015), we estimate the TCF using constrained linear regressions (Huang et al., 2018),[5] and set five constraints to ensure homogeneity of degree one in input prices and symmetry in cross-price effects.[6] Subsequently, having calculated the partial derivations of the TCF with respect to both outputs, the marginal costs of loans (MC_{it}^{L}) and deposits (MC_{it}^{D}) for each bank *i* and year *t* are obtained by multiplying the derivative by the ratio of total costs (TC_{it}) to the respective output variable ($L_{it}; D_{it}$), respectively:

[5] Before estimating the TCF, we have to revise bank-year data from the BankFocus database as follows. We initially drop observations with zero or negative values for total assets, total equity, total loans and total deposits. In addition, we eliminate observations with zero or negative values for the income and expense variables. Finally, as a plausibility check, we calculate the ratios of total loans to total assets as well as total deposits to total assets and remove observations that are greater than 1.

[6] Following related empirical studies (e.g., Huang et al., 2018) the constraints are applied as follows. $\sum_{k=1}^{3}\gamma_k = 1$ restricts the sum of coefficients of the input prices to be equal to one. Imposing $\sum_{k=1}^{3}\eta_{kL} = 0$ and $\sum_{k=1}^{3}\theta_{kD} = 0$ constraints the coefficients of the interaction between the input prices and the outputs to be zero. In addition, the coefficients of the input price interactions and of the interaction between time trend and input prices must sum up to zero, which is assured by $\sum_{k=1}^{3}\sum_{m=1}^{3}\frac{1}{2}\delta_{km} = 0$ and $\sum_{k=3}^{5}\lambda_k = 0$.

$$MC_{it}^{L} = \left[\beta_L + \beta_{LL}\ln(L_{it}) + 0.5 * \beta_{LD}\ln(D_{it}) + \sum_{k=1}^{3}\eta_{kL}\ln(w_{kit}) + \lambda_L T\right]\frac{TC_{it}}{L_{it}}, \quad (4a)$$

$$MC_{it}^{D} = \left[\beta_D + \beta_{DD}\ln(D_{it}) + 0.5 * \beta_{LD}\ln(L_{it}) + \sum_{k=1}^{3}\theta_{kD}\ln(w_{kit}) + \lambda_D T\right]\frac{TC_{it}}{D_{it}}. \quad (4b)$$

Finally, marginal costs from Equations (4a) and (4b) are used to calculate the product-specific Lerner Indices for the loan market ($LI(L)_{it}$) and deposit market ($LI(D)_{it}$) as:

$$LI(L)_{it} = \frac{r_{it}^{L} - r_{jt} - MC_{it}^{L}}{r_{it}^{L}} = \frac{1}{\varepsilon^{L}(r_{it}^{L})} \quad (5a)$$

and

$$LI(D)_{it} = \frac{r_{jt} - r_{it}^{D} - MC_{it}^{D}}{r_{it}^{D}} = \frac{1}{\varepsilon^{D}(r_{it}^{D})}, \quad (5b)$$

where $r_{i,t}^{L}$ denotes the lending rate calculated as the ratio of the accounting value of total interest income to total earning assets per bank *i* and year *t*. $r_{i,t}^{D}$ is the deposit rate calculated as the ratio of the accounting value of total interest expense to customer deposits for bank *i* and year *t*. r_{jt} is an opportunity interest rate for a given alternative money, capital or interbank market funding with matching maturities in year *t* and proxied by the 12-month EURIBOR as obtained from the

ECB's Statistical Data Warehouse.[7] Finally, MC_{it}^{L} and MC_{it}^{D} denote a bank's annual marginal costs for loans and deposits as computed by Equations (4a) and (4b).

As shown by equations (5a) and (5b), the product-specific Lerner Indices for the loan market and deposit market are inversely related to the elasticities of the demand for loans ($\frac{1}{\varepsilon^{L}(r_{it}^{L})}$) and the supply of deposits ($\frac{1}{\varepsilon^{D}(r_{it}^{D})}$), respectively. Moreover, the numerators of the product-specific Lerner Indices include the calculation of absolute margins. As regards the loan market, the absolute margin is measured as the spread between a bank's lending rate and the opportunity interest rate minus a bank's marginal costs for loans (markup of the lending rate). For the deposit market, it is the difference of the spread between the opportunity interest rate and the deposit rate minus the marginal costs for deposits (markdown of the deposit rate).

Assuming imperfect Cournot competition between a finite number of banks by including the opportunity interest rate r_{jt} provokes that the original range of Lerner Index values between 0 and 1 no longer applies for the product-specific Lerner Indices. Rather, the product-specific Lerner Indices may also exhibit negative values. As shown by Table A2, the mean of the Lerner Index for the loan market is at 0.9643 with a standard deviation of 0.1351, while we observe a maximum value of 1.2217 and a minimum value of 0.568. The mean of the Lerner Index for the deposit market is at –1.0697 with a standard deviation of 0.9634, while its maximum is at 1.1304 and the minimum value is at –5.5627.

As further reported by Table A4, the bank-averaged Lerner Indices for the loan market have increased by 0.3501 points over the sample period, whereas the averaged Lerner Indices of

[7] Note that, in the Monti-Klein model, banks set their lending and deposit rates autonomously but take the opportunity interest rate for an alternative funding source as given (Freixas and Rochet, 2008). The implementation of an alternative funding source is necessary for the assumption that a bank's volume of loans (the lending rate) does not influence the volume of deposits (the deposit rate), and vice versa. Excluding such cross-effects between loans and deposits is an essential condition to calculate the product-specific Lerner Indices.

the deposit market have decreased by 2.1233 points between 2013 and 2020. In this context, Tables A5a and A5b as well as Figures A1(a) – (d) report that the EURIBOR as well as averaged lending and deposit interest rates have decreased in almost all EU-15 countries between 2013 to 2020 due to the zero lower bound and negative interest rate regime. Additionally, it is shown that averaged spreads, absolute margins and Lerner Indices exhibit positive values for the loan market but have decreased on average over time. In contrast, spreads, absolute margins and Lerner Index values are negative for the deposit market but have increased, i.e., negative values have become smaller during the sample period. As indicated by Table A5b in this context, observing negative margins in the deposit market is not driven by the level of marginal operating costs, but by the spread between the EURIBOR and the deposit interest rate, which is negative for all European countries during the sample period.[8]

Positive absolute margins and Lerner Index values for the loan market combined with respective negative values in the deposit market suggest a loss-leader pricing strategy by European banks. Accordingly, although bank deposits are not profitable themselves when creating negative margins, banks maintain their deposit business as a refinancing source in order to exercise their market power in the loan market and perform cross-subsidizing, i.e., profits from the loan market are (partly) used to compensate losses from the deposit market. These findings are in line with those provided by Carbó et al. (2009) and Maudos and Fernández de Guevara (2007) who have investigated market power of European banks during earlier time periods.

Finally, Table B3 in the *Appendix B* reports that both Lerner Indices are strongly negatively correlated suggesting that market power in loan and deposit markets may differ. Hence, the strong negative correlation may be explained by the fact that strong competition in the deposit markets

[8] Note that we further elaborate on the difference between the values of both Lerner Indices and especially on negative absolute margins and Lerner Index values for the deposit market when controlling for the robustness of our baseline results under the zero lower bound and negative interest rate regime in Section 5.2.4.

makes it more difficult for banks to attract deposits to refinance loans, which in turn keeps competition in loan markets low. In addition, and more interesting for the analysis at hand, correlations from Table B3 give a first hint that the structural concentration measure may not adequately reflect competition (market power) since this measure is positively correlated with deposit market power but negatively correlated with loan market power as measured by respective Lerner Indices.

4.1.3. Z-score

Turning to our dependent variable, we proxy the banks' distance to insolvency by employing a modified version of the *Altman Z-score* (Altman, 2000).[9] This ratio has become a popular measure of bank soundness in previous empirical work on financial stability (e.g., Hesse and Cihák, 2007; Uhde and Heimeshoff, 2009; Laeven and Levine, 2009; Chiaramonte et al., 2015; Barra and Zotti, 2019) and is denoted as follows:

$$\ln(z_{i,t}) = \frac{\mu_{it} + k_{it}}{\sigma_{it}}. \tag{6}$$

We construct the Z-score per bank *i* and each single year *t* and define μ as the return on average assets before taxes (ROAA), *k* as the equity capital in percent of total assets and σ as the standard deviation (volatility) of the ROAA, calculated by "rolling window" techniques using a three-year rolling standard deviation of the ROAA. Building the Z-score this way, the measure is designed to indicate the number of standard deviations a bank's asset return has to drop below its

[9] Note that we are not able to employ a market-based distress measure, such as the Merton-based distance-to-default (DtD) or expected default frequency (EDF), since our sample consists of both, listed and non-listed European banks.

expected value before the bank's equity is depleted, and the bank becomes insolvent. Hence, a higher (lower) Z-score implies a lower (higher) probability of insolvency risk.

Table A2 reports the descriptive statistics for the Z-score measure. As shown, the mean of this ratio is at 3.8572 with a standard deviation of 0.9677, while we observe a maximum value of 6.2961 and a minimum value of 0.7240. Table A6 additionally shows that Z-score values from banks in our sample have fluctuate over time but slightly increased by 0.2629 points between 2013 and 2020 on average.

4.1.4. Control variables

When investigating the impact of market concentration and market power (competition) on banking stability, it is essential to control for further bank-specific, macroeconomic and regulatory factors that may also affect stability and hence, help mitigate omitted variable biases.

To begin with, we include bank-specific control variables following the CAMEL rating system. These rating indicators are widely used in related studies since they provide accurate predictions of bank distress (e.g., Galán, 2021; Citterio, 2020).

To begin with, we control for a bank's capital adequacy by including the one-period lagged capital to total assets ratio (*Capital ratio*$_{t-1}$). The relationship between a bank's capital ratio and its financial soundness is not clear. On the one hand, previous empirical studies provide evidence that better capitalized banks with a higher "franchise or charter value" (Keeley, 1990) may engage in less risky activities to protect their higher charter values (Allen and Gale, 2000; Repullo, 2004). In addition, higher capital buffers may better protect banks against external macroeconomic and liquidity shocks (Boyd and De Nicoló, 2005). On the other hand, previous research demonstrates that especially better capitalized banks may exhibit larger amounts of risky loans in their balance sheets. This is due to the fact that stronger capitalized, and hence, less leveraged banks, may face

weaker debt covenants and higher shareholder pressure (Gambacorta and Mistrulli, 2004). Accordingly, financial stability will decrease when shareholders exert pressure to pursue a more profitable but riskier investment strategy, which is less monitored by debt holders (Rajan and Zingales, 1995).

We further include a bank's asset quality, which is measured by the ratio of a bank's net impairment charges to net interest income (*Asset quality*$_{t-1}$). Since impairment charges display a worsening quality of bank assets, we expect a negative impact of this measure on financial stability (Berger at al., 2016; Chiaramonte et al., 2016).

In order to control for the efficiency of a bank's (risk) management, we employ the one-period lagged cost-to-income ratio (CIR_{t-1}), which is built as the ratio of total operating expenses to operating revenues.[10] Academic research shows that the relationship between a bank's risk management efficiency and its financial soundness is ambiguous. Hence, according to the "skimping"- hypothesis, it is shown that reducing risk management efforts in order to operate more cost-efficiently, may not negatively affect a bank's loan-portfolio quality in the short term. Rather, and given that the loan and borrower quality deteriorate slowly, a decrease in the (loan) portfolio quality is only found in the long run (Williams, 2004). In contrast and referring to the "bad management"-hypothesis, Berger and DeYoung (1997) empirically show that both, risk management efficiency and loan-portfolio quality decrease, if bank managers exhibit poor skills in loan scoring, estimating collateral-values and monitoring borrowers. As a consequence, managers with poor skills may more strongly allocate loans with low or even negative net present values.

[10] We acknowledge the fact that the cost-to-income ratio is only a rough measure of the efficiency of a bank's (risk) management. The lack of more precise management data is a well-known problem with regard to European banks. As a consequence, most European empirical studies are forced to rely on the cost-to-income ratio (e.g., Louzis et al., 2012; Farruggio and Uhde, 2015) arguing that the efficiency of a bank's (risk) management is reflected in the bank's cost structure.

Turning to bank profitability, we employ the one-period lagged net interest margin (NIM_{t-1}), which is measured as a bank's net interest revenues as a share of interest-bearing (total earning) assets. We suggest a positive relationship between profitability and a bank's financial stability since more profitable banks may have higher capital ratios (Schaeck and Cihák, 2012; Flannery and Rangan, 2008).

Finally, we control for the strength of a bank's liquidity position by employing the natural logarithm of the accounting value of a bank's liquid assets ($Liquid\ assets_{t-1}$). Previous studies provide evidence that greater liquidity is beneficial to financial stability since liquidity buffers may protect from future losses (Cipollini and Fiordelisi, 2012; Chiaramonte et al., 2016). In contrast, it is also argued and empirically demonstrated that banks with larger liquidity buffers may be less stable as higher buffers may encourage banks to increase their (loan) risk exposure when liquidity buffers can absorb potential future (loan) losses (e.g., Wagner, 2007).

Next to bank-specific determinants, we additionally control for the *country-specific macroeconomic and banking regulation environment*. We include the change of the slope of the yield curve ($\Delta Yield\ Curve$) to control for the impact of economic growth and business cycles on bank soundness. As a leading indicator for future prospects of the economy (Estrella and Hardouvelis, 1991), we calculate the slope of the yield curve as the annual change of the difference between the ten-year and two-year government bond yields per country and year. In line with previous related studies, we expect an increase in banking stability during a prospering economy since investment opportunities grow and the borrowers' solvency may be higher under increasing economic performance which in turn raises the banks' asset quality (Louzis et al., 2012; Ghosh, 2015).

Finally, we employ the capital regulatory index (*capital regulation*) as proposed by Barth et al. (2013). Based on several surveys provided by the *World Bank*, this index measures a bank's initial and overall capital stringency, while higher index values indicate greater capital stringency.

In line with previous studies, we argue that higher levels of capital stringency may induce a more prudent bank behavior, which in turn may increase financial stability (Uhde and Heimeshoff, 2009; Barth et al., 2004).

4.2. Empirical Model

We employ a linear model on panel data to empirically investigate the relationship between market concentration, market power (competition) and banking stability:

$$\log (Z)_{it} = \beta_{0i} + \beta_1 Concentration_{it} + \beta_2 LI(L)_{it} + \beta_3 LI(D)_{it} + \sum \beta_k x_{it-1,k} + \varepsilon_{it}, \qquad (7)$$

where $log\ (Z)_{it}$ denotes the logarithmized Z-score as a proxy for the financial soundness of bank i in a respective year t. *Concentration* reflects the 3-bank concentration measure on the country-year level and $Li(L)_{it}$ and $LI(D)_{it}$ denote the respective product-specific Lerner Indices for the loan and deposit market for bank i in a respective year t, respectively. $\sum x_{it-1,k}$ include the control variables, as described in Section 4.1.4. We lag each bank-specific control variable by one period to avoid multicollinearity and simultaneity. Finally, ε_{it} represents an independently and identically distributed error term and the betas are the regression coefficients to be estimated.

We employ a bank-specific random effects model with time dummies to capture time-specific effects, such as institutional changes or common shocks to the European banking market. Considering that our sample includes three different banking groups (commercial banks, savings banks and cooperative banks), we additionally cluster standard errors at the bank-level.

For the empirical analysis at hand, employing a random-effects model is a consequent empirical strategy since the random-effects model allows the estimation with unobserved individual heterogeneity that is constant over time. In this study, we are interested in investigating

how different levels of concentration and market power may affect banking stability. Considering that our sample is sufficiently heterogeneous due to the three different banking groups, we are convinced that the fixed difference between concentration and market power, and its corresponding impact on financial stability, varies across these groups. Accordingly, the random effects model is superior to the fixed effects model as random effects capture the effects of our variables of interest *between* the individual banking groups as well as the variation *within* these groups. Moreover, the random effect estimator allows controlling for important time-invariant control variables, e.g., the banking regulatory environment, which cannot be included into a fixed effects model.

5. Empirical results

Notes on variables and data sources are shown in Table B1 while the descriptive statistics are presented in Table B2 in the *Appendix B*. Results from our baseline regressions are reported by Table B4 while results from further analyses are shown in Tables B5 – B8. The correlation matrix is given by Table B3.

5.1. Baseline regressions

Specification (1) in Table B4 initially reveals that *concentration* enters the regression significantly negative at the one-percent level suggesting a decrease in European banks' financial soundness under increasing banking market concentration, which supports the *concentration-fragility view* as intensely discussed in Section 2. In addition, our result corresponds to previous empirical studies demonstrating a negative impact of consolidation on banking stability in Europe (e.g., Uhde and Heimeshoff, 2009; Forssbæck und Shehzad, 2015; Capraru and Andries, 2015; Calice et al., 2021).

Introducing the product-specific Lerner Indices (*LI(L), LI(D)*), specification (1) shows that both Lerner Indices turn out to be significantly positive, suggesting that stronger market power (less competition) in loan and deposit markets may positively affect banking stability. This finding supports arguments from the *concentration-stability view* and corresponds to results from the most related empirical study provided by Forssbæck und Shehzad (2015). In addition, observing a stronger positive impact for the loan market underlines our finding from Section 4.1.2. that European banks in our sample follow a loss-leader pricing strategy. Accordingly, the weaker positive impact of market power in the deposit market may be explained by the fact that banks keep the unprofitable deposit business as a refinancing source in order to exercise market power in the loan market.

Overall, and given that stronger market consolidation should increase an individual bank's market power, our analysis reveals a diametral finding, i.e., we observe a destabilizing effect due to stronger banking market consolidation, whereas we identify a positive impact on bank stability due to increasing market power. Our results support previous evidence that the empirical link between structural and non-structural measures is weak (Claessens and Laeven, 2004). While structural concentration measures proxy consolidation by focusing on the market structure at the country- or market-level, non-structural measures, like the Lerner Index, focus on the individual bank-level by measuring the price-setting of each bank under the framework of a given market structure, e.g., in more consolidated markets. As a consequence, structural concentration measures may adequately reflect market power only, if the banks are assumed to be a homogenous entity so that changes in the market structure (e.g., stronger consolidation) affect the conduct of all banks equally (e.g., Hannan, 1997; Dell'Ariccia, 2001). Considering that our sample of banks includes three different banking groups, the assumption of banking homogeneity does not hold.

Taking this into account, we proceed by investigating the *conditionality* of consolidation and market power and its impact on banking stability, following Forssbæck und Shehzad (2015).

Accordingly, we build interaction terms by multiplying the concentration measure with both Lerner Indices, respectively. In a first step, we include interactions between the "raw" measures of concentration and Lerner Indices. In a second step, we gradually employ interaction terms with above sample mean values (<SM) from the respective variables in order to investigate (in-)stability-effects for those banks that operate in more consolidated markets while exhibiting stronger market power.

As shown by regressions (2a) – (4b) in Table B4, we provide statistical evidence for *both* interaction terms only when employing above sample mean values. These interaction terms enter regression specifications (4a) and (4b) significantly negative at the one-percent level, respectively, while the stand-alone measures exhibit the expected signs and results from control variables remain qualitatively unchanged. Our results suggest that the negative impact of consolidation on banking stability may be reduced, but may not be crowded out completely, (even) at banks with stronger market power operating in more consolidated banking markets. This finding extends previous empirical evidence provided by Forssbæck und Shehzad (2015) as it holds regardless of whether banks exert stronger market power in the loan or deposit market.

Turning to the control variables, Table B4 reports that the coefficients of the *capital ratio* measure turn out to be significant positive at the one-percent level respectively suggesting that banking stability is induced by providing higher capital buffers that protect against external macroeconomic and liquidity shocks (Boyd et al., 2004). Introducing *asset quality*, this variable enters the regressions significantly negative at the one-percent level, respectively. As expected, our results indicates that a decrease in the quality of bank assets, as measured by higher impairment charges, may have a destabilizing effect, which is in line with previous findings provided by Berger et al. (2016) and Chiaramonte et al. (2016). As further shown, we observe a statistically negative impact of the *cost-to-income ratio* (*CIR*) on banking stability in each regression. Including the CIR as a proxy of the efficiency of a bank's (risk) management, the finding at hand supports arguments

from the “bad management”-hypothesis (Berger and DeYoung, 1997). Hence, it is argued and empirically demonstrated that both, risk management efficiency and loan-portfolio quality decrease, if bank managers exhibit poor skills in loan scoring, estimating collateral-values and monitoring borrowers. As a consequence, managers with poor skills may more strongly allocate loans with low or even negative net present value, which in turn may negatively affect a bank’s financial stability. Introducing *liquid assets*, this variable enters the regressions significantly negative at the one-percent level, respectively. Our finding is consistent with previous studies providing evidence that banks with larger liquidity buffers may be less stable since higher buffers may encourage banks to increase their (loan) risk exposure when liquidity buffers can absorb potential future (loan) losses (e.g., Wagner, 2007). Finally, and as expected, we observe a significantly positive impact of *capital regulation* on bank soundness in each regression. Our result corresponds to previous studies demonstrating that greater regulatory capital stringency may improve a bank’s capitalization and may encourage a more prudent behavior by bank managers (e.g., Uhde and Heimeshoff, 2009; Barth et al., 2004).

5.2. Further analyses

We proceed and present results from a variety of further analyses that may help to better understand the negative impact of the conditionality of market consolidation and market power on banking stability. Our goal is to further investigate this relationship by focusing on (i) probable impact channels (Section 5.2.1.), (ii) determinants of bank distress (Section 5.2.2.), (iii) different banking groups (Section 5.2.3.) and (iv) the role of the zero lower bound and negative interest rate regime (Section 5.2.4.).

5.2.1. Impact channels

To begin with, following theoretical predictions and previous evidence provided by the *concentration-stability* and *concentration-fragility view* as presented in Section 2., the positive or negative relationship between consolidation and banking stability may be attributed to different "impact channels". Taking this into account, we decompose the Z-score measure into its single components and perform regressions on the banks' *return on average assets* (*ROAA*), the *standard deviation of the ROAA* (*sdROAA*) and the *capital ratio*.[11] Observing any significant effects of the interaction terms (as employed in regression specifications (4a) and (4b) in Table B4) on these components may then be used to verify different impact channels.

As initially shown in Table B5, both interaction terms enter respective regression specifications (1a) and (1b) significantly positive, suggesting that an increase in market power may raise the bank's *ROAA* in more consolidated markets. Our finding is line with the *concentration-stability view* proposing that banks with stronger market power operating in less competitive, but more concentrated banking systems may be in a position to charge higher loan interest rates, and hence, enhance profits (e.g., Boyd et al., 2004). In addition, it is argued that these banks tend to engage in credit rationing since fewer credit investments of a higher quality will increase the return of the singular investment and hence foster profitability (Boot and Thakor, 2000).

However, as regression specifications (2a) and (2b) further reveal a significantly positive impact of both interaction terms on the standard deviation of the ROAA (*sdROAA*) respectively, we observe that profit enhancement comes with a higher return volatility. Our finding supports the *concentration-fragility view* suggesting that higher loan interest rates may induce borrowers to take on risky investments to compensate higher loan repayments, which in turn may positively

[11] Note that we exclude individual control variables due to high correlations with the respective dependent variables. Additionally, in regression specifications (3a) and (3b) *capital ratio* is excluded as a control variable but employed as the dependent variable.

affect the bank's return volatility (Bretschger et al., 2012; De Nicoló and Lucchetta, 2009; Boyd and De Nicoló, 2005). In addition, it is argued that banks exhibiting stronger market power in more consolidated markets, are more likely to receive public guarantees or subsidies, which is discussed as the "too big to fail"-doctrine (Mishkin, 1999). As a consequence, the moral hazard problem becomes more severe for bank managers, who may take on more risky investments under a government's safety net.

Finally, Table B5 reports that both interaction terms turn out to be significantly negative in regression specifications (3a) and (3b) implying a decrease in *capital ratios* at banks with stronger market power in more consolidated markets. Our finding corresponds to the *concentration-fragility view* suggesting that banks may reduce capital buffers when they operate under a government's safety net. In addition, our results supports the idea, that banks with stronger market power in consolidated markets may be less incentivized to maintain higher capital ratios as a quality signal to attract potential borrowers (Schaeck and Cihák, 2012).

Overall, results from regressions on single Z-score components reveal opposing impact channels, i.e., increasing consolidation along with increasing market power may positively affect bank profitability, whereas it enhances return-volatility and reduces capital ratios. These opposing impact channels may explain our baseline finding, that even stronger market power may not fully crowd-out the negative impact of stronger consolidation on banking stability. Accordingly, decreasing bank soundness may be due to the fact that the stability-enhancing effect of increasing returns may not fully compensate rising return volatilities and declining capital ratios. This finding holds regardless of whether banks have stronger market power in the loan or deposit market.

5.2.2. Bank-specific, macroeconomic and regulatory determinants

In a next step, we investigate if and how the destabilizing effect from the conditionality between consolidation and market power may be affected bank-specific characteristics as well as the macroeconomic and regulatory environment. Accordingly, we build respective interaction terms between the concentration measure, both Lerner Indices and the individual control variables as used in our baseline regressions.

As reported by respective specifications (3) from Tables B6a and B6b, and as compared to our baseline findings from specifications (4a) and (4b) in Table B4, we initially observe that the destabilizing effect is increased under a rising *cost-to-income ratio* (*CIR*). Accordingly, our results imply that banks exhibiting market power in the loan and deposit market may more strongly suffer from financial fragility under consolidation when the efficiency of their (risk) management declines. In contrast, Tables B6a and B6b further show that an increase in *profitability* (*NIM*) may reduce the negative impact of consolidation on financial stability at these banks. The same is true if *liquidity buffers* increase and *capital regulation* becomes tighter.

Moreover, we observe a stabilizing effect due to higher *capital ratios* and improving economic conditions (Δ*yield curve*) for banks with stronger market power in the deposit market only, whereas a stronger destabilizing effect due to a deterioration of *asset quality* is exceptionally observed for banks exhibiting greater market power in the loan market.

Overall, our results correspond to findings provided by previous studies analyzing the impact of different indicators on bank distress (e.g., Citterio, 2020). However, although most of the indicators prove to have a stabilizing effect at banks with stronger market power, we also observe that the negative impact of market consolidation on bank stability is never completely crowded out, i.e., coefficients from interaction terms (still) exhibit significantly negative signs.

5.2.3. Banking groups

We proceed by analyzing if our baseline findings remain robust across the different banking groups in our sample. Accordingly, we split the entire sample into subsamples including commercial banks, savings banks and cooperative banks. Subsequently, we repeat our baseline regressions from Table B4, regression specifications (4a) and (4b) for each subsample.

As shown by Table B7, regression specifications (1a) and (1b), we do not find any statistically significant effect of the concentration-Lerner Index interaction terms for the subsample of commercial banks, implying that our baseline findings are not driven by this banking group. In contrast, we observe a negative impact of both interaction terms on stability for the subsample consisting of savings banks in regression specifications (2a) and (2b). As compared to our baseline findings, the destabilizing effect is more pronounced for savings banks exhibiting stronger market power in the loan market while it is quantitatively unchanged for savings banks with stronger market power in the deposit market. Finally, regression specifications (3a) and (3b) indicate that the negative impact of consolidation on banking stability may be weaker but may not vanish completely for cooperative banks with stronger market power in the deposit market, whereas we do not find any statistical effect for the loan market.

In sum, our results may be explained by the fact that savings banks and cooperative banks exclusively operate in regional markets and thus, may be more strongly affected by (regional) market consolidation (e.g., Clark et al., 2018). In contrast, commercial banks from our sample are generally larger, internationally operating banks, that engage in investment banking beyond the traditional lending and deposit business. Hence, commercial banks may better evade the negative impact of consolidation on financial stability due to functional and geographic diversification.

5.2.4. Interest rate regime

In a final analysis, we control if our baseline findings are affected by the zero lower bound (2013 – 2016) and negative interest rate regime (2017 – 2020), as illustrated by the evolution of the EURIBOR in Figure A1(a).[12] In addition, Figures A1(c) and (d) as well as Tables A5a and A5b reveal that – while both, banks' lending and deposit rates continuously decrease during the zero lower bound and negative interest rate regime – spreads and absolute margins decrease in the loan market, whereas they increase in the deposit market, i.e., average negative values become smaller in value over time. Declining spreads and absolute margins in the loan market imply that even banks with market power are forced to (partly) pass through decreasing market rates to loan customers. In contrast, decreasing values of spreads and absolute margins in the deposit market support our observation that banks follow a loss-leader pricing strategy (Section 4.1.2.). Accordingly, banks may pass through decreasing market rates on the deposit-side but may subsidize deposit rates to retain depositors or attract new customers and thus, keep the unprofitable deposit business as a refinancing source in order to exercise their market power in the loan market.

Controlling for these effects, we split our entire sample into a subsample running from 2013 until 2016 to capture the zero lower bound regime and a subsample stretching from 2017 to 2020 to reflect the negative interest rate regime. Subsequently, we repeat our baseline regressions from Table B4, regression specifications (4a) and (4b) for each subsample. As shown by Table B8, regression specifications (1a) and (1b), we do not provide any statistical effect from both interaction terms under the zero lower bound regime. In contrast, the analysis reveals a negative impact on financial stability from both interaction terms for the period of negative market interest rates (specifications (2a) and (2b)). In this context, and as compared to our baseline findings, we observe a remarkably stronger destabilizing effect for banks exhibiting market power in the loan

[12] Note that the EURIBOR, as our proxy of the short-term market interest rate, never exhibits the value of zero during the sample period. Instead, it exhibits values near zero (2013 – 2016) or negative values (2017 – 2020).

market and a weaker negative impact on stability for banks with market power in the deposit market.

Overall, these results initially suggest that our baseline findings depend on the interest-rate pass through mechanism under the negative interest rate regime in Europe. Hence, we find that passing through decreasing market interest rates on the loan-side may have a stronger negative impact on bank soundness as compared to the deposit market. Furthermore, observing a weaker negative impact for the deposit market may also result from decreasing negative values of spreads and absolute margins suggesting that banks keep the unprofitable deposit business as a refinancing source, but subsidize deposit rates to retain depositors or attract new customers under the negative interest rate regime. In sum, these results imply that the loss-leader pricing strategy has a stronger destabilizing effect for banks with greater market power in the loan market under negative market rates and ongoing consolidation.

6. Summary and implications

Employing annual unconsolidated bank balance sheet and income statement data on 3,943 commercial banks, savings banks and cooperative banks headquartered in the EU-15 over the period from 2013 to 2020, the paper at hand empirically investigates the nexus between market consolidation, market power and banking stability.

The analysis at hand initially reveals that European banks may follow a loss-leader pricing strategy and cross-subsidize between loan and deposit markets. In addition, we provide evidence that the empirical link between consolidation and market power is weak and thus, provokes diametral findings, i.e., stronger banking market consolidation may foster bank distress, whereas stronger market power (less competition) in the loan and deposit market may improve banking stability. Taking this into account and controlling for the conditionality of consolidation and market power in a next step, we find that – although the negative impact of consolidation on

banking stability is reduced – , it is not fully crowded out, even if banks exhibit stronger market power in the loan and deposit market.

Results from further analyses provide additional important implications. *First*, we do not observe any statistically significant effect for the subsample of functionally and geographically diversified commercial banks, whereas our baseline findings are qualitatively reiterated for the subsamples of savings banks and cooperative banks, which may be more strongly affected by (regional) market consolidation. *Second*, investigating different impact channels reveals that increasing consolidation along with stronger market power may positively affect bank asset returns, whereas return volatility is increased, and capital ratios are reduced provoking an overall decrease in bank soundness. *Third*, controlling for different determinants of bank distress indicates that a better capitalization, a higher profitability, a stronger liquidity position, economic upturns and a tighter capital regulation may mitigate, but not wipe out, the negative impact of stronger market consolidation on stability in both, the loan and deposit market. And *fourth*, controlling for the zero lower bound and negative interest rate regime in Europe reveals that our baseline findings vary with the strength of the interest-rate pass through mechanism and that the loss-leader pricing strategy has a stronger destabilizing effect for banks with greater market power in the loan market under negative market rates and ongoing consolidation.

Overall, our analysis indicates that a stronger consolidation of the European banking market may foster profitability but may be detrimental to bank soundness. This is also true for banks exhibiting stronger market power in the loan or deposit market. Although the analysis implies an increase in profitability for these banks due to greater market consolidation, the increase in asset return volatility and the decline in capital ratios may outweigh the positive effect, finally resulting in financial fragility. Against this background, and since our results consistently support the *concentration fragility view*, the empirical exercise at hand casts doubts on the calls by bank regulators and supervisors to push consolidation of the European banking market in order to enhance bank profitability and create a "level-playing field".

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Appendix A

Table A1: Notes on variables and data sources used to calculate and estimate the Z-score, concentration ratios and Lerner Indices

Variable	Description	Data Source
Z-score	Natural log of the sum of equity capital to total assets and return on average assets before taxes (ROAA) divided by the standard deviation of ROAA per bank and year. Winsorized at the 1% and 99% percentile. A higher Z-score denotes greater bank stability.	Moody's BankFocus, own calc.
Capital ratio	A bank's capital to total assets ratio per year.	Moody's BankFocus, own calc.
ROAA	A bank's return on average assets (ROAA) before taxes per year.	
sdROAA	Standard deviation of a bank's return on average assets (ROAA) before taxes per year.	
Concentration	Ratio of total assets held by the three largest banks to the entire banking market's total assets per country and year A higher value implies greater banking market concentration.	Moody's BankFocus, own calc.
LI (L)	Lerner Index of the loan market per bank and year. This index measures the mark-up that banks demand from their customers related to marginal costs of loans. Higher values indicate more market power and thus, less competition. Winsorized at the 1% and 99% percentile.	Moody's BankFocus, own calc.
LI (D)	Lerner Index of the deposit market per bank and year. This index measures the mark-down that banks pay their customers related to marginal costs of deposits. Higher values indicate more market power and thus, less competition. Winsorized at the 1% and 99% percentile.	
Total cost	Natural log of the sum of a bank's accounting values of total interest expense and total operating expense per year.	Moody's BankFocus
Total equity	Natural log of a bank's accounting value of total equity per year.	
Total loans	Natural log of a bank's accounting value of total earning assets per year.	
Total deposits	Natural log of a bank's accounting value of customer deposits per year.	
Price of funding	Natural log of a bank's accounting value of total interest expense over total liabilities per year.	Moody's BankFocus, own calc.
Price of labor	Natural log of a bank's accounting value of personnel expense over total assets per year.	
Price of fixed capital	Natural log of a bank's accounting value of other operating expenses over fixed assets per year.	

continued on next page

Table A1: Notes on variables and data sources used to calculate and estimate the Z-score, concentration ratios and Lerner Indices (continued)

Variable	Description	Data Source
Commercial bank	Dummy variable that takes on the value of 1 if the bank is a commercial bank, and 0 otherwise.	Moody's BankFocus, own calc.
Savings bank	Dummy variable that takes on the value of 1 if the bank is a savings bank, and 0 otherwise.	
Cooperative bank	Dummy variable that takes on the value of 1 if the bank is a cooperative bank, and 0 otherwise.	
Time trend	Trend variable that takes on the value of 1 for the first year of the period analyzed (2013) and increases by the value of one for every subsequent year until the value of 8 for the last year (2020) of the sample period.	Own calc.
Lending interest rates	Ratio of the accounting value of a bank's total interest income to total earning assets per year.	Moody's BankFocus, own calc.
Deposit interest rates	Ratio of the accounting value of a bank's total interest expense to customer deposits per year.	
EURIBOR	12-month European Interbank Offered Rate per year.	ECB Statistical Data Warehouse
Marginal costs of loans	First partial derivative of the translog cost function with respect to total loans, multiplied by the ratio of the accounting values of a bank's total cost to total loans per year.	Moody's BankFocus, own calc.
Marginal costs of deposits	First partial derivative of the translog cost function with respect to total deposits, multiplied by the ratio of the accounting value of a bank's total cost to total deposits per year.	

Table A2: Descriptive statistics of the variables used to calculate and estimate the Z-score, concentration ratios and Lerner Indices

Variable	N	Mean	Std. dev.	Min	Max
Z-score	19865	3.8572	0.9677	0.7240	6.2961
Capital ratio	23574	0.1200	0.1148	0.2496	0.8902
ROAA	20025	–1.2670	1.0053	–9.1060	1.2319
sdROAA	24065	–1.5327	1.0039	–4.1725	1.5046
Concentration	28893	0.4425	0.1630	0.2879	0.9921
LI (L)	22199	0.9643	0.1351	0.568	1.2217
LI (D)	22210	–1.0697	0.9634	–5.5627	1.1304
Total cost	22935	2.7703	1.7871	–5.8091	10.4115
Total equity	23574	4.1631	1.7524	–5.2983	11.2683
Total loans	23575	6.3985	1.8986	–6.9078	14.2528
Total deposits	22986	6.0782	1.8857	–6.9078	13.2943
Price of funding	22901	–0.8595	1.0240	–8.5387	8.1303
Price of labor	22846	0.0011	0.6552	–9.2638	4.7580
Price of fixed capital	22660	3.3553	1.3635	–6.6203	18.2505
Commercial banks	31544	0.2100	0.4073	0	1
Savings banks	31544	0.1976	0.3981	0	1
Cooperative banks	31544	0.5924	0.4914	0	1
Time trend	31544	4.5	2.2913	1	8
Lending interest rate	23144	2.4438	1.1109	0.332	8.1448
Deposit interest rate	22539	1.3535	3.7606	0.0415	32.017
EURIBOR	31544	0.1032	0.3112	–0.2534	0.5753
Marginal costs of loans	22210	0.0163	0.0105	–0.0012	0.0785
Marginal costs of deposits	22210	–0.055	0.1012	–0.7321	0.0164

Table A3: Banking market concentration ratios per country and year

	2013	2014	2015	2016	2017	2018	2019	2020
Austria	0.3382	0.3927	0.3357	0.2990	0.3095	0.3074	0.3099	0.3316
Belgium	0.5668	0.5890	0.5705	0.5917	0.5904	0.5889	0.5823	0.6001
Denmark	0.8274	0.8208	0.8084	0.8232	0.8006	0.7935	0.7903	0.8058
Finland	0.9445	0.9423	0.9047	0.5702	0.5260	0.8469	0.8376	0.8309
France	0.4251	0.4438	0.4477	0.4459	0.4479	0.4557	0.4501	0.4537
Germany	0.4132	0.4181	0.4018	0.3853	0.3565	0.3144	0.2879	0.3325
Greece	0.9921	0.9917	0.9919	0.9921	0.9905	0.9895	0.9880	0.9817
Ireland	0.7570	0.7410	0.7253	0.6898	0.6316	0.6698	0.6877	0.7233
Italy	0.4131	0.4198	0.4171	0.4072	0.4318	0.4581	0.4675	0.4637
Luxembourg	0.3540	0.3549	0.3449	0.3249	0.3168	0.3453	0.3454	0.3903
Netherlands	0.9077	0.9079	0.8321	0.9091	0.9084	0.9053	0.9025	0.9001
Portugal	0.8174	0.7181	0.7093	0.6840	0.6957	0.6815	0.6957	0.6890
Spain	0.4607	0.4810	0.4945	0.5095	0.5125	0.5691	0.5569	0.5567
Sweden	0.9003	0.8946	0.8825	0.8750	0.8595	0.8510	0.8553	0.8588
United Kingdom	0.5762	0.6062	0.5823	0.5788	0.5927	0.4531	0.4518	0.4577
EU-15	0.4756	0.4878	0.4655	0.4323	0.4212	0.4193	0.4093	0.4321

Note: Own calculations based on banks' balance sheet data provided by Moody's BankFocus.

Table A4: Bank-averaged Lerner Index of the loan market and deposit market per country and year

	2013	2014	2015	2016	2017	2018	2019	2020
a) *Loans*								
Austria	0.7488	0.7453	0.8449	0.9694	1.0509	1.1079	1.0670	1.1610
Belgium	0.7522	0.7456	0.8399	0.9503	1.0509	1.0965	1.0640	1.1529
Denmark	0.8562	0.8492	0.9122	0.9808	1.0263	1.0634	1.0394	1.1058
Finland	0.6826	0.6924	0.8012	0.9591	1.0622	1.1433	1.0854	1.2040
France	0.8056	0.8008	0.8764	0.9721	1.0351	1.0832	1.0518	1.1397
Germany	0.8212	0.8093	0.8838	0.9762	1.0362	1.0858	1.0540	1.1409
Greece	0.8504	0.8576	0.9169	0.9842	1.0173	1.0418	1.0271	1.0851
Ireland	0.7258	0.6861	0.8112	0.9839	1.0353	1.0681	1.0411	1.1324
Italy	0.8074	0.7867	0.8489	0.9598	1.0318	1.0785	1.0459	1.1299
Luxembourg	0.6822	0.6682	0.7632	0.9584	1.0609	1.1117	1.0622	1.1549
Netherlands	0.8457	0.8407	0.8815	0.9795	1.0289	1.0608	1.0358	1.0981
Portugal	0.8247	0.8290	0.8865	0.9703	1.0412	1.0970	1.0627	1.1631
Spain	0.7914	0.7651	0.8330	0.9662	1.0471	1.1030	1.0626	1.1515
Sweden	0.8102	0.7883	0.8562	0.9768	1.0492	1.1019	1.0581	1.1321
United Kingdom	0.7591	0.7636	0.8646	0.9687	1.0378	1.0660	1.0346	1.0880
EU-15	0.7971	0.7894	0.8667	0.9718	1.0416	1.0937	1.0579	1.1472
b) *Deposits*								
Austria	–0.1953	0.0502	–0.0894	–0.7145	–1.4573	–2.2854	–1.9203	–3.7252
Belgium	–0.4565	–0.3654	–0.4886	–0.8922	–1.3057	–1.5286	–1.2896	–1.7049
Denmark	0.0427	0.1611	0.3262	0.1782	0.1800	–0.0291	0.4085	–0.6194
Finland	–0.1902	–0.1684	–0.3649	–0.8173	–1.4947	–2.4247	–1.9755	–3.7333
France	–0.6784	–0.6354	–0.7348	–0.9348	–1.1169	–1.3154	–1.1509	–1.4009
Germany	–0.5046	–0.3920	–0.5131	–0.8331	–1.1443	–1.5196	–1.3019	–2.1790
Greece	–0.6783	–0.6256	–0.7515	–0.8088	–0.8866	–0.9731	–0.9374	–1.1235
Ireland	–0.7771	–0.5750	–0.7505	–0.6692	–2.0490	–3.6577	–2.7633	–3.6768
Italy	–0.7147	–0.6350	–0.6626	–0.9487	–1.1940	–1.4326	–1.2754	–1.8719
Luxembourg	–0.1027	0.0310	–0.1533	–0.7303	–1.1100	–1.3371	–1.0934	–1.5014
Netherlands	–0.6530	–0.6567	–0.5848	–0.7286	–0.9241	–1.0339	–0.9718	–1.1657
Portugal	–0.8579	–0.5910	–0.6403	–0.8603	–1.5592	–2.6566	–2.1614	–4.5642
Spain	–0.5825	–0.4391	–0.4208	–0.8085	–1.4051	–2.2602	–1.8013	–3.2455
Sweden	–0.3981	–0.1320	0.0871	–0.4081	–0.9412	–1.3850	–1.0589	–1.8686
United Kingdom	–0.4933	–0.4008	–0.7002	–0.9544	–1.1705	–1.1938	–1.0821	–1.3833
EU-15	–0.4391	–0.3178	–0.4096	–0.7907	–1.2188	–1.7240	–1.4481	–2.5624

Note: Own estimations based on banks' balance sheet data and income statement provided by Moody's BankFocus.

Table A5a: Bank-averaged components of the Lerner Index of the loan market per country and year

	Lending rates (r_L)								Spreads (Lending rate (r_L) – EURIBOR)								Absolute margins (r_L − EURIBOR − mcl)							
a) Loans	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Austria	2.46	2.37	2.14	1.98	1.78	1.77	1.72	1.61	1.88	1.80	1.84	1.94	1.88	1.96	1.84	1.86	1.86	1.78	1.82	1.93	1.86	1.94	1.83	1.85
Belgium	2.65	2.42	2.45	2.10	2.03	2.08	1.97	1.65	2.08	1.86	1.84	2.06	2.13	2.27	2.08	1.90	2.25	2.13	2.20	2.27	2.20	2.33	2.15	2.02
Denmark	4.64	4.37	3.98	3.55	3.17	2.94	2.69	2.52	4.07	3.81	3.69	3.51	3.27	3.13	2.80	2.77	4.04	3.77	3.72	3.53	3.34	3.17	2.88	2.93
Finland	1.95	1.88	1.74	1.46	1.34	1.26	1.25	1.13	1.38	1.32	1.44	1.42	1.43	1.45	1.37	1.40	1.36	1.37	1.43	1.40	1.41	1.44	1.35	1.39
France	3.60	3.38	3.19	2.95	2.70	2.64	2.49	2.14	3.02	2.82	2.89	2.91	2.80	2.83	2.61	2.39	2.90	2.74	2.72	2.80	2.63	2.61	2.40	2.21
Germany	3.40	3.12	2.82	2.56	2.30	2.12	1.98	1.78	2.83	2.56	2.52	2.51	2.39	2.31	2.10	2.03	2.81	2.54	2.50	2.49	2.38	2.30	2.09	2.02
Greece	4.53	4.55	4.14	4.35	4.24	4.16	3.65	3.94	3.96	3.98	3.84	4.31	4.34	4.35	3.77	4.20	3.93	3.96	3.81	4.29	4.32	4.33	3.75	3.13
Ireland	2.32	1.80	1.37	3.88	3.43	3.39	3.45	3.18	1.74	1.24	1.07	3.84	3.53	3.58	3.57	3.44	1.70	1.24	1.35	3.60	3.25	3.17	3.18	2.59
Italy	3.52	3.08	2.67	2.38	2.38	2.38	2.20	1.95	2.94	2.52	2.37	2.33	2.47	2.56	2.31	2.21	2.84	2.45	2.32	2.33	2.47	2.56	2.29	2.19
Luxembourg	1.96	1.98	1.95	2.14	2.19	2.09	2.22	1.99	1.39	1.41	1.65	2.09	2.29	2.28	2.58	2.24	1.36	1.21	1.46	1.89	2.05	2.28	2.34	2.09
Netherlands	3.34	3.02	2.76	2.91	3.18	3.45	3.48	2.56	2.77	2.46	2.46	2.86	3.28	3.64	3.60	2.81	3.39	3.34	2.98	3.20	3.54	3.70	3.63	2.97
Portugal	4.40	3.82	3.18	2.48	2.21	2.08	1.89	1.55	3.82	3.26	2.88	2.44	2.30	2.27	2.00	1.91	3.70	3.18	2.79	2.34	2.21	2.18	1.91	1.80
Spain	2.88	2.67	2.19	2.22	1.96	2.00	1.99	1.85	2.30	2.10	1.90	2.17	2.06	2.19	2.11	2.11	2.52	2.09	1.91	2.12	2.13	2.18	2.09	2.15
Sweden	3.21	2.91	2.44	2.30	2.29	2.24	2.29	2.34	2.63	2.35	2.14	2.26	2.39	2.43	2.41	2.59	2.62	2.35	2.17	2.29	2.42	2.45	2.43	2.52
UK	3.02	3.04	3.13	3.01	2.83	3.39	3.69	3.11	2.45	2.47	2.83	2.96	2.93	3.58	3.74	3.36	2.42	2.40	2.87	3.05	3.05	3.49	3.81	3.40
EU-15	3.16	2.97	2.66	2.41	2.21	2.12	2.03	1.83	2.58	2.41	2.36	2.37	2.30	2.31	2.14	2.08	2.57	2.39	2.34	2.34	2.27	2.27	2.10	2.03

Note: Own calculations based on banks' balance sheet data and income statement provided by Moody's BankFocus.

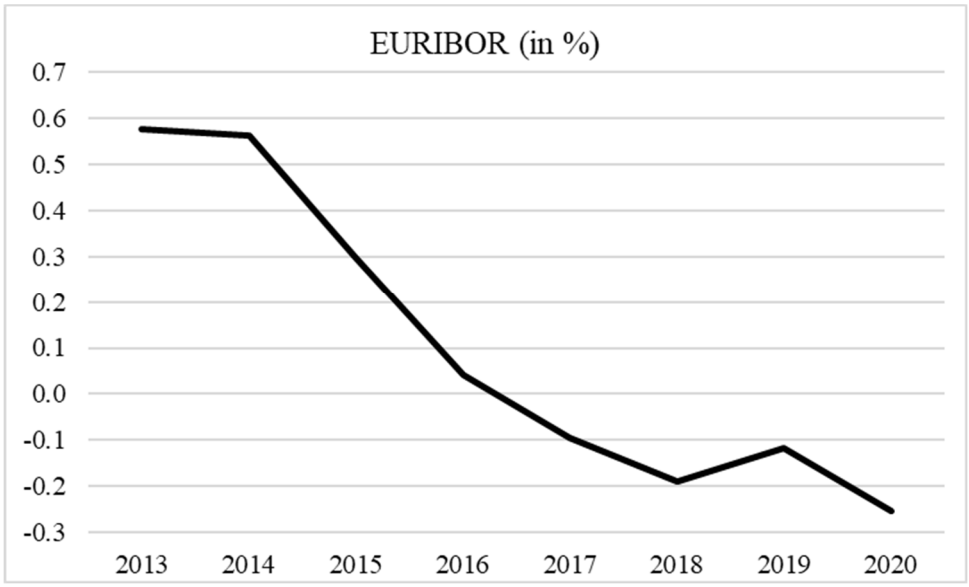
Table A5b: Bank-averaged components of the Lerner Index of the deposit market per country and year

	Deposit rates (r_D)								Spreads (EURIBOR – Deposit rate (r_D))								Absolute margins (EURIBOR $- r_D - mcd$)							
b) Deposits	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Austria	1.42	1.16	0.90	0.72	0.59	0.54	0.41	0.31	–0.85	–0.59	–0.60	–0.67	–0.69	–0.73	–0.52	–0.56	–0.70	–0.38	–0.46	–0.58	–0.60	–0.64	–0.43	–0.53
Belgium	4.64	3.58	3.17	4.21	3.15	3.26	3.16	1.95	–4.06	–3.01	–2.87	–4.17	–3.24	–3.45	–3.28	–2.20	–3.19	–2.01	–1.86	–3.30	–2.12	–2.23	–3.26	–2.19
Denmark	1.22	1.05	0.66	0.49	0.34	0.29	0.25	0.24	–0.65	–0.49	–0.36	–0.45	–0.43	–0.48	–0.36	–0.49	–0.18	–0.03	–0.07	–0.04	–0.02	–0.07	–0.05	0.13
Finland	1.91	2.77	1.47	0.71	0.47	0.31	0.38	0.17	–1.33	–2.22	–1.17	–0.66	–0.57	–0.50	–0.49	–0.42	–1.28	–2.18	–1.15	–0.65	–0.56	–0.49	–0.48	–0.41
France	5.24	4.98	4.37	3.97	3.50	3.23	3.09	2.78	–4.66	–4.42	–4.07	–3.93	–3.60	–3.42	–3.20	–3.03	–3.85	–3.58	–3.10	–3.17	–3.00	–2.75	–2.58	–2.83
Germany	1.63	1.34	1.08	0.87	0.71	0.62	0.56	0.38	–1.06	–0.78	–0.79	–0.83	–0.81	–0.81	–0.67	–0.63	–0.94	–0.68	–0.70	–0.75	–0.75	–0.76	–0.63	–0.59
Greece	3.09	2.41	2.81	1.83	1.40	1.28	1.18	0.94	–2.52	–1.85	–2.51	–1.78	–1.49	–1.47	–1.30	–1.19	–2.20	–1.57	–2.15	–1.52	–1.26	–1.24	–1.12	–1.03
Ireland	7.01	2.29	5.87	2.70	4.82	4.32	4.27	2.71	–6.44	–1.73	–5.57	–2.66	–4.91	–4.51	–4.38	–2.96	–6.41	–1.73	–5.54	–2.65	–4.90	–4.47	–4.36	–2.94
Italy	4.02	3.11	2.47	2.15	2.09	1.79	1.28	0.69	–3.44	–2.55	–2.18	–2.11	–2.19	–1.98	–1.39	–0.94	–3.47	–2.59	–2.19	–1.91	–2.21	–2.01	–1.40	–0.95
Luxembourg	3.31	3.86	2.47	2.85	2.98	3.51	3.93	2.99	–2.73	–3.30	–2.17	–2.81	–3.07	–3.70	–4.05	–3.24	–2.14	–2.01	–1.72	–2.30	–2.02	–2.63	–3.25	–2.42
Netherlands	2.81	2.63	4.40	2.64	2.84	2.74	2.71	1.65	–2.23	–2.07	–4.10	–2.60	–2.93	–2.93	–2.83	–1.90	–2.16	–1.99	–4.44	–2.51	–2.76	–2.45	–2.30	–1.63
Portugal	12.47	3.52	2.82	1.77	1.61	1.42	1.41	0.91	–11.89	–2.95	–2.52	–1.73	–1.71	–1.61	–1.52	–1.16	–11.67	–2.91	–2.49	–1.70	–1.69	–1.59	–1.50	–1.14
Spain	2.61	1.78	1.11	1.08	1.09	0.71	0.82	0.64	–2.03	–1.22	–0.81	–1.03	–1.18	–0.90	–0.94	–0.90	–1.86	–1.18	–0.77	–0.99	–1.14	–0.87	–0.92	–0.87
Sweden	1.40	1.01	0.58	0.40	0.55	0.49	0.42	0.36	–0.82	–0.45	–0.28	–0.36	–0.65	–0.68	–0.54	–0.61	–0.63	–0.27	–0.13	–0.22	–0.51	–0.53	–0.39	–0.47
UK	5.46	4.63	4.94	4.72	5.10	4.50	5.25	3.65	–4.89	–4.07	–4.64	–5.03	–5.19	–4.69	–5.37	–3.90	–5.20	–4.42	–4.76	–5.03	–5.40	–5.07	–5.91	–4.32
EU–15	2.18	1.86	1.52	1.27	1.14	1.02	0.95	0.71	–1.61	–1.30	–1.22	–1.23	–1.23	–1.21	–1.07	–0.96	–1.41	–1.09	–1.04	–1.07	–1.09	–1.07	–0.95	–0.89

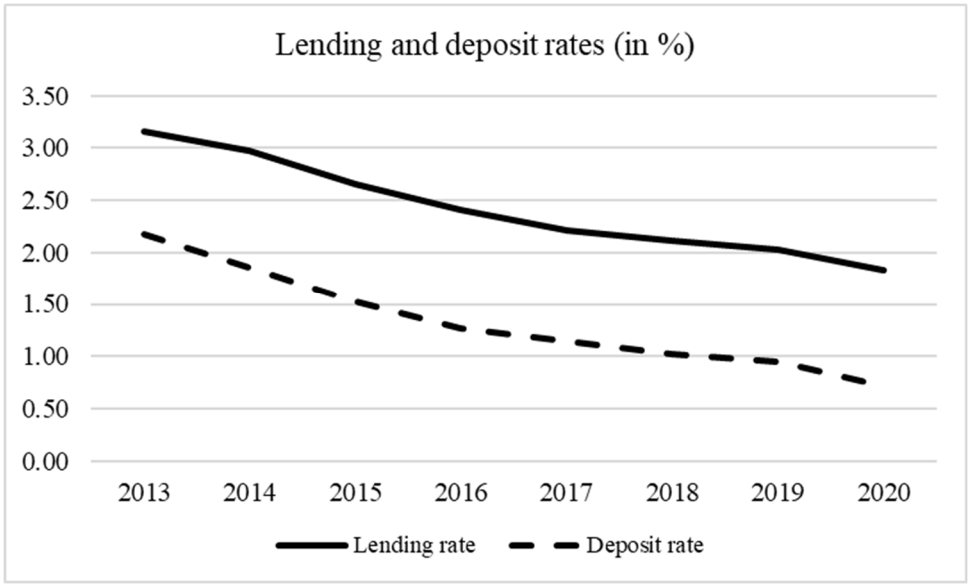
Note: Own calculations based on banks' balance sheet data and income statement provided by Moody's BankFocus.

Figure A1: Evolution of the bank-averaged components of the Lerner Indices

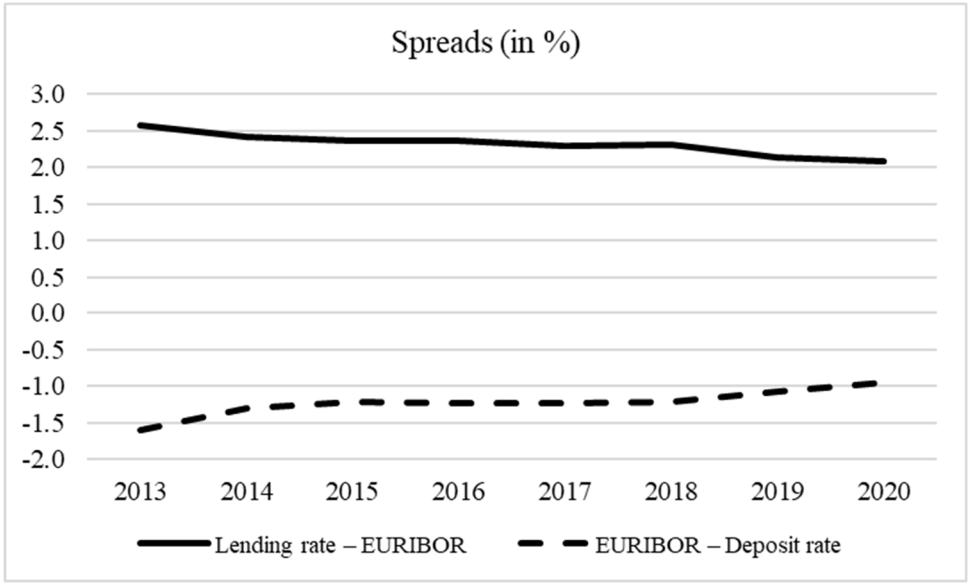
(a)



(b)



(c)


Spreads (in %)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
2013
2014
2015
2016
2017
2018
2019
2020
Lending rate – EURIBOR
EURIBOR – Deposit rate

(d)

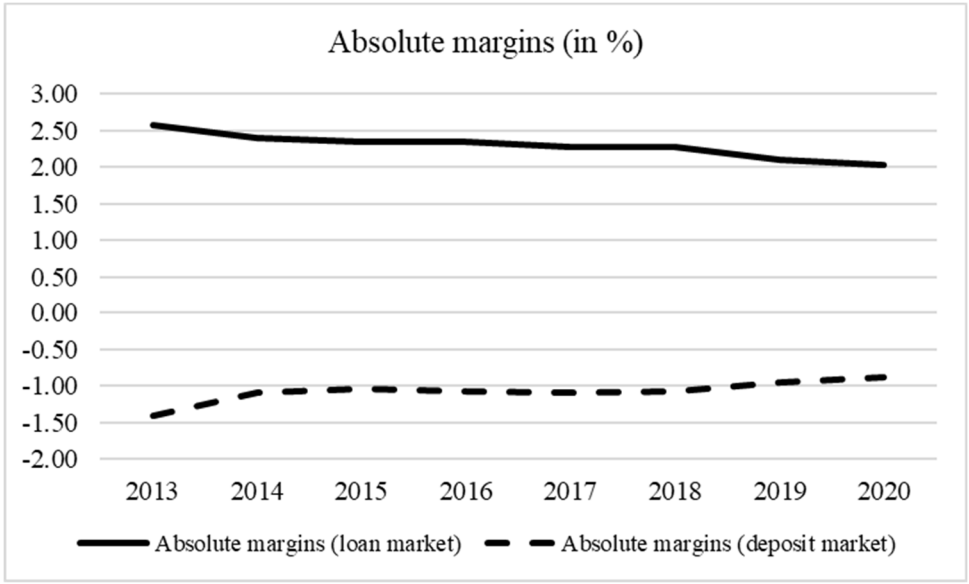

Absolute margins (in %)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
2013
2014
2015
2016
2017
2018
2019
2020
Absolute margins (loan market)
Absolute margins (deposit market)

Table A6: Bank-averaged Z-scores per country and year

	2013	2014	2015	2016	2017	2018	2019	2020
Austria	3.5329	3.6571	3.6548	3.5910	3.3952	3.4684	3.6141	3.5297
Belgium	3.0189	3.1622	3.3663	3.4887	3.1861	3.0977	3.0813	3.0796
Denmark	3.2205	3.0498	3.3309	3.5917	3.7876	3.6056	3.5153	3.3710
Finland	2.3013	3.7429	3.3487	3.2890	3.4714	3.5880	3.7643	3.7499
France	3.0416	2.9607	3.1412	3.2473	3.2078	3.1485	3.1486	3.0904
Germany	4.4132	4.3431	4.0914	4.2982	4.3681	4.3968	4.4970	4.5713
Greece	2.2295	2.1948	1.9492	2.5982	2.5556	3.0838	2.9586	3.2202
Ireland	-	3.0864	3.6461	3.7593	2.9482	3.1197	3.2382	3.2034
Italy	3.0739	3.2245	3.4230	3.1153	3.2824	3.4022	3.3575	3.2115
Luxembourg	2.5722	2.8712	3.1882	3.1567	3.1565	3.0877	3.1886	3.1530
Netherlands	3.1985	3.2595	3.2200	3.1961	3.4429	3.5424	3.7945	3.7503
Portugal	1.4766	2.9008	3.1457	3.2113	3.0650	3.0580	3.2870	3.3264
Spain	3.6606	3.6015	3.5467	3.5788	3.7031	3.6759	3.5953	3.5309
Sweden	3.5290	3.6974	3.3584	3.4768	3.4990	3.3937	3.4032	3.3929
United Kingdom	3.0266	3.1009	3.5404	3.3008	3.2145	3.1844	3.1877	3.2242
EU-15	3.6561	3.8612	3.7946	3.8728	3.8501	3.8539	3.9428	3.9190

Note: Own calculations based on banks' balance sheet data and income statement provided by Moody's BankFocus.

Appendix B

Table B1: Notes on variables and data sources

Variable	Description	Data Source
Z-score	Natural log of the sum of equity capital to total assets and return on average assets before taxes (ROAA) divided by the standard deviation of ROAA per bank and year. Winsorized at the 1% and 99% percentile. A higher Z-score denotes greater bank stability.	Moody's BankFocus, own calc.
Capital ratio$_{(t-1)}$	One-period lagged ratio of bank's capital to total assets per year. Winsorized at the 1% and 99% percentile.	Moody's BankFocus, own calc.
ROAA	Natural log of a bank's return on average assets (ROAA) before taxes per year. Winsorized at the 1% and 99% percentile.	
sdROAA	Natural log of the standard deviation of a bank's return on average assets (ROAA) before taxes per year. Winsorized at the 1% and 99% percentile.	
Concentration	Ratio of total assets held by the three largest banks to the entire banking market's total assets per country and year A higher value implies greater banking market concentration.	Moody's BankFocus, own calc.
LI (L)	Lerner Index of the loan market per bank and year. This index measures the mark-up that banks demand from their customers related to marginal costs of loans. Higher values indicate more market power and thus less competition. Winsorized at the 1% and 99% percentile.	Moody's BankFocus, own calc.
LI (D)	Lerner Index of the deposit market per bank and year. This index measures the mark-down that banks pay their customers related to marginal costs of deposits. Higher values indicate more market power and thus less competition. Winsorized at the 1% and 99% percentile.	
Asset quality$_{(t-1)}$	One-period lagged ratio of net impairment charges to net interest income per bank and year. Winsorized at the 1% and 99% percentile.	Moody's BankFocus, own calc.
CIR$_{(t-1)}$	Cost to income ratio. One-period lagged ratio of total operating expenses to operating revenues per bank and year. Winsorized at the 1% and 99% percentile.	
NIM$_{(t-1)}$	Net interest margin. One-period lagged net interest revenues as a share of interest-bearing (total earning) assets per bank and year. Winsorized at the 1% and 99% percentile.	
Liquid assets$_{(t-1)}$	Natural log of one-period lagged accounting value of liquid assets including held to maturity and other securities per bank and year. Winsorized at the 1% and 99% percentile.	
ΔYield curve	Annual change of the slope of the yield curve. The slope is calculated as ten-year minus two-year government bond yields per country and year.	Thomson Reuters Eikon/ Datastream, own calc.
Capital regulation	Capital Regulation Index that measures the overall capital stringency. Index is built by first principal component analysis of initial capital stringency and overall capital stringency. Higher index values indicate greater capital stringency.	Barth et al. (2013)

Table B2: Descriptive statistics

Variable	N	Mean	Std. dev.	Min	Max
Z-score	19865	3.8572	0.9677	0.7240	6.2961
Capital ratio$_{(t-1)}$	21029	0.1200	0.1150	0.0250	0.8902
ROAA	20025	–5.8627	1.0355	–13.7112	0.6599
sdROAA	24065	–1.5327	1.0039	–4.1725	1.5046
Concentration	28893	0.4425	0.1630	0.2879	0.9921
LI (L)	22199	0.9643	0.1351	0.5680	1.2217
LI (D)	22210	–1.0697	0.9634	–5.5627	1.1304
Asset quality$_{(t-1)}$	19869	0.0659	0.2861	–0.8159	1.5945
CIR$_{(t-1)}$	20768	0.7319	0.2043	0.1518	1.7495
NIM$_{(t-1)}$	20652	0.0196	0.0093	0.0003	0.0670
Liquid assets$_{(t-1)}$	21052	5.2922	1.8692	1.4086	11.3325
ΔYield curve	24962	–0.0025	0.0050	–0.0446	0.2422
Capital regulation	27719	6.6079	1.7922	3	8

Table B3: Correlation matrix (baseline regressions)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Z-score	1.00										
(2) Concentration	–0.22***	1.00									
(3) LI (L)	0.07***	–0.03***	1.00								
(4) LI (D)	–0.01	0.02***	–0.72***	1.00							
(5) Capital ratio$_{(t-1)}$	0.00	0.14***	0.04***	–0.02***	1.00						
(6) Asset quality$_{(t-1)}$	–0.21***	0.11***	–0.08***	0.07***	0.05***	1.00					
(7) CIR$_{(t-1)}$	0.02**	–0.12***	0.01*	0.00	0.01**	–0.12***	1.00				
(8) NIM$_{(t-1)}$	0.04***	0.14***	–0.16***	0.23***	0.07***	0.04***	–0.06***	1.00			
(9) Liquid assets$_{(t-1)}$	–0.03***	0.04***	0.02**	0.09***	–0.27***	0.09***	–0.11***	–0.25***	1.00		
(10) ΔYield curve	0.00	–0.07***	0.23***	–0.03***	0.01	–0.03***	0.00	0.00	0.00	1.00	
(11) Capital regulation	0.31***	–0.09***	0.02	0.11***	–0.12***	–0.08***	–0.05***	0.09***	0.26***	0.03***	1.00

***,**,* indicate statistical significance at the one-, five- and ten-percent level.

Table B4: Baseline regressions

	Z-score (1)	Z-score (2a)	Z-score (2b)	Z-score (3a)	Z-score (3b)	Z-score (4a)	Z-score (4b)
Concentration	–1.1456***	–0.7166	–1.1847***	–1.0287***	–1.2423***		
	(0.000)	(0.340)	(0.000)	(0.000)	(0.000)		
LI (L)	0.4574*	0.6256*	0.4585*		0.3653		0.3163
	(0.067)	(0.093)	(0.066)		(0.123)		(0.182)
LI (D)	0.0290***	0.0294***	0.0372**	0.0219**		0.0318***	
	(0.003)	(0.002)	(0.034)	(0.012)		(0.000)	
Concentration$_{(>SM)}$						–0.5126***	–0.8006***
						(0.000)	(0.000)
LI (L)$_{(>SM)}$				0.0644		0.0505	
				(0.549)		(0.347)	
LI(D)$_{(>SM)}$					0.2437***		0.0918***
					(0.000)		(0.000)
Concentration * LI (L)		–0.3958					
		(0.562)					
Concentration * LI (D)			–0.0200				
			(0.587)				
Concentration * LI (L)$_{(>SM)}$				–0.0898			
				(0.701)			
Concentration * LI (D)$_{(>SM)}$					–0.5142***		
					(0.001)		
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$						–0.2060***	
						(0.004)	
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$							–0.3763***
							(0.000)
Capital ratio$_{(t–1)}$	1.4228***	1.4164***	1.4241***	1.3649***	1.4223***	1.3980***	1.4483***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Asset quality$_{(t–1)}$	–0.2129***	–0.2137***	–0.2126***	–0.2139***	–0.2146***	–0.2146***	–0.2113***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CIR$_{(t–1)}$	–0.3150***	–0.3158***	–0.3146***	–0.3125***	–0.3030***	–0.3188***	–0.3085***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NIM$_{(t–1)}$	0.7296	0.7323	0.7517	1.1188	1.1801	0.9910	0.9526
	(0.769)	(0.768)	(0.762)	(0.658)	(0.631)	(0.695)	(0.699)
Liquid assets$_{(t–1)}$	–0.0697***	–0.0701***	–0.0694***	–0.0702***	–0.0689***	–0.0657***	–0.0646***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔYield curve	2.8382	2.8623	2.8424	2.7492	0.8157	1.9900	–0.6951
	(0.236)	(0.232)	(0.235)	(0.250)	(0.727)	(0.401)	(0.766)
Capital regulation	0.1833***	0.1831***	0.1834***	0.1840***	0.1864***	0.1760***	0.1814***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cluster at bank-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	16585	16585	16585	16585	16585	16585	16585
No. of groups	3032	3032	3032	3032	3032	3032	3032
Adj. R^2	0.1947	0.1944	0.1950	0.1921	0.1953	0.2194	0.2219

The random effects panel model estimated by regression specification (1) is $\log(\text{Z-score})_{it} = \alpha_i + \beta_1 \text{Concentration}_{i,t} + \beta_2 \text{LI(L)}_{i,t} + \beta_3 \text{LI(D)}_{i,t} + \beta_4 \text{Capital ratio}_{i,t-1} + \beta_5 \text{Asset quality}_{i,t-1} + \beta_6 \text{CIR}_{i,t-1} + \beta_7 \text{NIM}_{i,t-1} + \beta_8 \log(\text{Liquid assets})_{i,t-1} + \beta_9 \Delta\text{Yield curve}_{i,t} + \beta_{10} \text{Capital regulation}_{i,t} + \varepsilon_{i,t}$. Specification (2a) to (4b) include interactions of the *concentration* measure and the *Lerner Indices* for the loan market $LI(L)$) and the deposit market $LI(D)$), respectively. (>SM) indicates values above the respective sample mean values. Constant term is included but not reported. Heteroscedasticityconsistent *p*–values are in parentheses. ***,**,* indicate statistical significance at the one–, five– and ten–percent level.

Table B5: Impact channels

	ROAA (1a)	ROAA (1b)	sdROAA (2a)	sdROAA (2b)	Capital ratio (3a)	Capital ratio (3c)
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$	0.0846**		0.1171*		–0.1139***	
	(0.041)		(0.079)		(0.000)	
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$		0.1007*		0.3181***		–0.0619***
		(0.052)		(0.000)		(0.000)
Concentration $_{(>SM)}$	0.8687***	0.9580***	0.5840***	0.7742***	–0.0059	–0.1106***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.882)	(0.002)
LI (L)$_{(>SM)}$	–0.1472**		–0.0078		0.0142	
	(0.018)		(0.864)		(0.256)	
LI(D)$_{(>SM)}$		–0.0602***		–0.0821***		0.0183**
		(0.006)		(0.000)		(0.013)
LI (L)		–0.1859		–0.3103		–0.2642***
		(0.378)		(0.131)		(0.002)
LI (D)	–0.0019		–0.0223***		0.0178***	
	(0.827)		(0.008)		(0.000)	
Capital ratio$_{(t–1)}$	1.6255***	1.6151***	2.0563***	2.0215***		
	(0.002)	(0.002)	(0.000)	(0.000)		
Asset quality$_{(t–1)}$	–0.0667**	–0.0690**			–0.0401***	–0.0348***
	(0.022)	(0.017)			(0.001)	(0.005)
CIR$_{(t–1)}$			0.1285**	0.1198*	–0.0133	–0.0113
			(0.043)	(0.060)	(0.648)	(0.700)
NIM$_{(t–1)}$					6.1443***	6.6225***
					(0.000)	(0.000)
Liquid assets$_{(t–1)}$	–0.0695***	–0.0714***	0.0327***	0.0320***		
	(0.000)	(0.000)	(0.000)	(0.000)		
ΔYield curve	5.3644**	5.8867**	–5.8955**	–3.7758*	1.2253**	1.0337*
	(0.031)	(0.014)	(0.011)	(0.097)	(0.037)	(0.063)
Capital regulation			–0.1824***	–0.1865***		
			(0.000)	(0.000)		
Cluster at bank-level	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	17372	17372	16897	16897	18172	18172
No. of groups	3146	3146	3062	3062	3216	3216
Adj. R^2	0.1922	0.1904	0.2636	0.2658	0.0315	0.0368

The random effects panel model estimated by regression specifications (1a), (2a) and (3a) is $\log(\text{Z-score})_{it} = \alpha_i + \beta_1 \text{Concentration}_{i,t} * \text{LI(L)}_{i,t} + \beta_2 \text{Concentration}_{i,t} + \beta_3 \text{LI(L)}_{i,t} + \beta_4 \text{LI(D)}_{i,t} + \beta_5 \text{Capital ratio}_{i,t-1} + \beta_6 \text{Asset quality}_{i,t-1} + \beta_7 \text{CIR}_{i,t-1} + \beta_8 \text{NIM}_{i,t-1} + \beta_9 \log(\text{Liquid assets})_{i,t-1} + \beta_{10} \Delta\text{Yield curve}_{i,t} + \beta_{11} \text{Capital regulation}_{i,t} + \varepsilon_{i,t}$. The random effects panel model estimated by regression specifications (1b), (2b) and (3b) is $\log(\text{Z-score})_{it} = \alpha_i + \beta_1 \text{Concentration}_{i,t} * \text{LI(D)}_{i,t} + \beta_2 \text{Concentration}_{i,t} + \beta_3 \text{LI(L)}_{i,t} + \beta_4 \text{LI(D)}_{i,t} + \beta_5 \text{Capital ratio}_{i,t-1} + \beta_6 \text{Asset quality}_{i,t-1} + \beta_7 \text{CIR}_{i,t-1} + \beta_8 \text{NIM}_{i,t-1} + \beta_9 \log(\text{Liquid assets})_{i,t-1} + \beta_{10} \Delta\text{Yield curve}_{i,t} + \beta_{11} \text{Capital regulation}_{i,t} + \varepsilon_{i,t}$. The Z-score measure is substituted by its components (*ROAA*, *sdROAA* and *capital ratio*) in regression specifications (1a) to (3c). The measures of *asset quality* and *NIM* are excluded from regression specifications (1a) to (2b) due to high correlations with respective dependent variables. In regression specifications (3a) and (3b) *capital ratio* is excluded as a control variable but employed as the dependent variable. (>SM) indicates values above the respective sample mean values. Constant term is included but not reported. Heteroscedasticityconsistent *p*-values are in parentheses. ***,**,* indicate statistical significance at the one-, five- and ten-percent level.

Table B6a: Bank-specific, macroeconomic and regulatory determinants

	Z-score (1)	Z-score (2)	Z-score (3)	Z-score (4)	Z-score (5)	Z-score (6)	Z-score (7)
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * Capital ratio$_{(t-1)}$	–0.4013						
	(0.441)						
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * Asset quality$_{(t-1)}$		–0.3879*					
		(0.100)					
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * CIR$_{(t-1)}$			–0.3259***				
			(0.000)				
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * NIM$_{(t-1)}$				–0.0884***			
				(0.010)			
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * Liquid assets$_{(t-1)}$					–0.0329***		
					(0.001)		
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * ΔYield curve						0.0922	
						(0.156)	
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$ * Capital regulation							–0.0337***
							(0.000)
Concentration$_{(>SM)}$	–0.6615***	–0.6813***	–0.4835***	–0.5701***	–0.5504***	–0.6829***	–0.5108***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LI (L)$_{(>SM)}$	0.0218	0.0168	0.0587	0.0225	0.0576	0.0119	0.0530
	(0.681)	(0.754)	(0.267)	(0.670)	(0.287)	(0.823)	(0.319)
LI (D)	0.0298***	0.0311***	0.0317***	0.0316***	0.0343***	0.0294***	0.0325***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Capital ratio$_{(t-1)}$	1.5300***	1.4196***	1.3654***	1.4291***	1.3831***	1.4277***	1.3898***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Asset quality$_{(t-1)}$	–0.2095***	–0.1843***	–0.2091***	–0.2131***	–0.2151***	–0.2100***	–0.2150***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CIR$_{(t-1)}$	–0.3263***	–0.3184***	–0.2524***	–0.3177***	–0.3200***	–0.3244***	–0.3157***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
NIM$_{(t-1)}$	0.5485	0.6539	1.2420	2.6149	1.1799	0.6403	1.0077
	(0.827)	(0.795)	(0.623)	(0.335)	(0.641)	(0.800)	(0.690)
Liquid assets$_{(t-1)}$	–0.0654***	–0.0651***	–0.0658***	–0.0638***	–0.0589***	–0.0649***	–0.0652***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔYield curve	1.9272	1.7218	1.6804	2.2513	1.9861	–2.5304	2.3000
	(0.418)	(0.479)	(0.477)	(0.339)	(0.404)	(0.547)	(0.332)
Capital regulation	0.1772***	0.1778***	0.1757***	0.1748***	0.1753***	0.1772***	0.1794***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cluster at bank-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	16585	16585	16585	16585	16585	16585	16585
No. of groups	3032	3032	3032	3032	3032	3032	3032
Adj. R^2	0.2194	0.2214	0.2224	0.2206	0.2243	0.2208	0.2230

The random effects panel models are described in Table B5. Regression specifications (1) to (7) include triple interaction terms of the *concentration* measure, the *Lerner Index* for the loan market *(LI(L))* and individual *bank-specific*, *macroeconomic* and *regulatory control variables*. (>SM) indicates values above the respective sample mean values. Constant term is included but not reported. Heteroscedasticityconsistent *p*-values are in parentheses. ***,**,* indicate statistical significance at the one-, five- and ten-percent level.

Table B6b: Bank-specific, macroeconomic and regulatory determinants

	Z-score (1)	Z-score (2)	Z-score (3)	Z-score (4)	Z-score (5)	Z-score (6)	Z-score (7)
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * Capital ratio$_{(t-1)}$	–0.0194*** (0.000)						
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * Asset quality$_{(t-1)}$		0.1074 (0.575)					
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * CIR$_{(t-1)}$			–0.4135*** (0.000)				
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * NIM$_{(t-1)}$				–0.1273*** (0.000)			
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * Liquid assets$_{(t-1)}$					–0.0445*** (0.000)		
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * ΔYield curve						–0.1723*** (0.006)	
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$ * Capital regulation							–0.0425*** (0.000)
Concentration$_{(>SM)}$	–0.7663*** (0.000)	–0.7125*** (0.000)	–0.7808*** (0.000)	–0.7774*** (0.000)	–0.7826*** (0.000)	–0.7233*** (0.000)	–0.7759*** (0.000)
LI (L)	0.3071 (0.199)	0.2884 (0.228)	0.3105 (0.191)	0.2920 (0.225)	0.3272 (0.167)	0.2993 (0.212)	0.3137 (0.188)
LI (D)$_{(>SM)}$	0.0755*** (0.000)	0.0442** (0.019)	0.0818*** (0.000)	0.0739*** (0.000)	0.0831*** (0.000)	0.0393** (0.037)	0.0812*** (0.000)
Capital ratio$_{(t-1)}$	1.1533*** (0.007)	1.5251*** (0.000)	1.4414*** (0.000)	1.4339*** (0.000)	1.4946*** (0.000)	1.5527*** (0.000)	1.4697*** (0.000)
Asset quality$_{(t-1)}$	–0.2065*** (0.000)	–0.1958*** (0.000)	–0.2130*** (0.000)	–0.2095*** (0.000)	–0.2087*** (0.000)	–0.2060*** (0.000)	–0.2095*** (0.000)
CIR$_{(t-1)}$	–0.3182*** (0.000)	–0.3196*** (0.000)	–0.3457*** (0.000)	–0.3147*** (0.000)	–0.3112*** (0.000)	–0.3269*** (0.000)	–0.3095*** (0.000)
NIM$_{(t-1)}$	0.2908 (0.905)	0.5981 (0.808)	0.8684 (0.725)	–0.8779 (0.720)	0.9638 (0.695)	0.3822 (0.877)	0.9148 (0.711)
Liquid assets$_{(t-1)}$	–0.0643*** (0.000)	–0.0607*** (0.000)	–0.0631*** (0.000)	–0.0640*** (0.000)	–0.0669*** (0.000)	–0.0600*** (0.000)	–0.0636*** (0.000)
ΔYield curve	0.3415 (0.886)	2.0520 (0.388)	–0.4455 (0.848)	–0.2687 (0.910)	0.7744 (0.742)	–3.7708 (0.234)	0.8545 (0.719)
Capital regulation	0.1814*** (0.000)	0.1800*** (0.000)	0.1809*** (0.000)	0.1819*** (0.000)	0.1812*** (0.000)	0.1806*** (0.000)	0.1787*** (0.000)
Cluster at bank-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	16585	16585	16585	16585	16585	16585	16585
No. of groups	3032	3032	3032	3032	3032	3032	3032
Adj. R^2	0.2256	0.2247	0.2213	0.2228	0.2208	0.2262	0.2197

The random effects panel models are described in Table B5. Regression specifications (1) to (7) include triple interaction terms of the *concentration* measure, the *Lerner Index* for the deposit market *(LI(D))* and individual *bank-specific*, *macroeconomic* and *regulatory control variables*. (>SM) indicates values above the respective sample mean values. Constant term is included but not reported. Heteroscedasticityconsistent *p*-values are in parentheses. ***,**,* indicate statistical significance at the one-, five- and ten-percent level.

Table B7: Banking groups

	Commercial banks		Savings banks		Cooperative banks	
	Z-score (1a)	Z-score (1b)	Z-score (2a)	Z-score (2b)	Z-score (3a)	Z-score (3b)
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$	–0.1321		–0.4742**		–0.1609	
	(0.324)		(0.011)		(0.115)	
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$		–0.1727		–0.3730**		–0.2965***
		(0.193)		(0.035)		(0.001)
Concentration$_{(>SM)}$	0.3124**	0.1316	–0.6192***	–1.1513***	–0.4438***	–0.6498***
	(0.035)	(0.306)	(0.004)	(0.000)	(0.001)	(0.000)
LI (L)		0.5175		0.0109		–0.2126
		(0.159)		(0.982)		(0.489)
LI (L)$_{(>SM)}$	0.0219		0.1577		0.0700	
	(0.796)		(0.483)		(0.430)	
LI (D)	–0.0175		0.0304		0.0434***	
	(0.593)		(0.156)		(0.000)	
LI(D)$_{(>SM)}$		0.0056		0.0236		0.1222***
		(0.926)		(0.380)		(0.000)
Capital ratio$_{(t-1)}$	2.1507***	2.1567***	0.1950	0.2522	2.5391***	2.4793***
	(0.000)	(0.000)	(0.780)	(0.735)	(0.000)	(0.000)
Asset quality$_{(t-1)}$	–0.3661***	–0.3650***	0.1787	0.1943	–0.0091	–0.0095
	(0.000)	(0.000)	(0.125)	(0.103)	(0.854)	(0.846)
CIR$_{(t-1)}$	–0.9787***	–0.9829***	0.5743***	0.5803***	0.2121	0.2170
	(0.000)	(0.000)	(0.002)	(0.002)	(0.161)	(0.154)
NIM$_{(t-1)}$	5.9613*	5.6484*	–16.5888***	–16.9559***	–11.0066***	–11.4344***
	(0.059)	(0.071)	(0.000)	(0.000)	(0.002)	(0.001)
Liquid assets$_{(t-1)}$	–0.0508***	–0.0535***	–0.0867***	–0.0837***	–0.0506***	–0.0490***
	(0.003)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
ΔYield curve	–2.9652	–2.8032	6.5395*	1.8386	17.4042***	14.9614***
	(0.544)	(0.573)	(0.051)	(0.682)	(0.001)	(0.004)
Capital regulation	0.0137	0.0149	0.2388***	0.2478***	0.1783***	0.1863***
	(0.439)	(0.397)	(0.000)	(0.000)	(0.000)	(0.000)
Cluster at bank-level	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	2497	2497	3704	3704	10384	10384
No. of groups	508	508	615	615	1909	1909
Adj. R^2	0.3248	0.3261	0.4041	0.4046	0.2197	0.2235

The random effects panel models are described in Table B5. The entire sample is split into three subsamples including commercials banks in regression specifications (1a) and (2a), savings banks in specifications (2a) and (2b) and cooperative banks in specifications (3a) and (3b). (>SM) indicates values above the respective sample mean values. Constant term is included but not reported. Heteroscedasticityconsistent *p*-values are in parentheses. ***,**,* indicate statistical significance at the one-, five- and ten-percent level.

Table B8: Interest rate regime

	EURIBOR > 0 (2013-2016)	EURIBOR > 0 (2013-2016)	EURIBOR < 0 (2017-2020)	EURIBOR < 0 (2017-2020)
	Z-score (1a)	Z-score (1b)	Z-score (2a)	Z-score (2b)
Concentration$_{(>SM)}$ * LI (L)$_{(>SM)}$	0.0149		–0.9632***	
	(0.861)		(0.004)	
Concentration$_{(>SM)}$ * LI (D)$_{(>SM)}$		–0.1772		–0.1570**
		(0.256)		(0.049)
Concentration$_{(>SM)}$	–0.9846***	–1.0819***	0.3027	–0.7753***
	(0.000)	(0.000)	(0.422)	(0.000)
LI (L)		1.9398***		–0.1867
		(0.000)		(0.665)
LI (L)$_{(>SM)}$	0.1367**		–0.0265	
	(0.035)		(0.958)	
LI (D)	–0.0112		–0.0162*	
	(0.781)		(0.062)	
LI(D)$_{(>SM)}$		0.1280***		0.0191
		(0.007)		(0.259)
Capital ratio$_{(t-1)}$	1.2542***	1.6146***	0.8891*	0.8565*
	(0.003)	(0.000)	(0.072)	(0.080)
Asset quality$_{(t-1)}$	–0.2884***	–0.2674***	–0.1664***	–0.1674***
	(0.000)	(0.000)	(0.000)	(0.000)
CIR$_{(t-1)}$	–0.1584	–0.1570	–0.1631**	–0.1622**
	(0.129)	(0.129)	(0.017)	(0.018)
NIM$_{(t-1)}$	8.9249***	3.2092	–3.1236	–3.1507
	(0.006)	(0.355)	(0.275)	(0.266)
Liquid assets$_{(t-1)}$	–0.0320***	–0.0293**	–0.0599***	–0.0625***
	(0.006)	(0.010)	(0.000)	(0.000)
ΔYield curve	5.2495	5.2869	–2.2800	–3.3685
	(0.188)	(0.190)	(0.499)	(0.291)
Capital regulation	0.1174***	0.1185***	0.2115***	0.2089***
	(0.000)	(0.000)	(0.000)	(0.000)
Cluster at bank-level	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
No. of obs.	7050	7050	9535	9535
No. of groups	2652	2652	2700	2700
Adj. R^2	0.1725	0.1833	0.2786	0.2783

The random effects panel models are described in Table B5. The entire sample is split into two subsamples. Regression specifications (1a) and (1b) report results from the subsample including the time period (2013-2016) when the EURIBOR was larger than zero whereas specifications (2a) and (2b) show results from the subsample including the time period (2017-2020) when the EURIBOR exhibited negative values. (>SM) indicates values above the respective sample mean values. Constant term is included but not reported. Heteroscedasticity consistent *p*-values are in parentheses. ***,**,* indicate statistical significance at the one-, five- and ten-percent level.