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LOAN/DEPOSIT RATIOS OF EUROPEAN BANKS

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Loan/deposit ratios of European banks

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Preface

This master dissertation concludes my Master in Economics at Ghent University. With great pleasure I gained valuable insights into the world of economics and I will continue to keep myself updated on economic environment. Especially the world of financial economics and banking has captured my interest which drove me to choose this particular subject.

I would like to thank Prof. Dr. Rudi Vander Vennet and Mathieu Simoens for the productive discussions we had and the guidance they provided while writing my thesis. I would also like to thank the many friends who sharpened my understanding in the discussions we had when proof-reading my dissertation. This analysis was made during the 2020 corona pandemic. Luckily, this has not affected the work and the ones around me.

June 1st , 2020
David Beijer
Ghent

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List of abbreviations

BIS	Bank for International Settlements
CET1	Common Equity Tier 1
CIR	Cost-income ratio
DFR	Deposit facility rate
EBA	European Banking Authority
ECB	European Central Bank
EMF	European Mortgage Federation
ESRB	European Systemic Risk Board
GFC	Global financial crisis
HHI	Hirschman-Herfindahl index
HQLA	High quality liquid assets
IMF	International Monetary Fund
LCR	Liquidity coverage ratio
MFI	Monetary Financial Institutions
NCB	National Central Bank
NIRP	Negative interest rate policy
NSFR	Net stable funding ratio
RWA	Risk weighted assets
SDW	Statistical Data Warehouse

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1 Introduction

Europe has the largest banking landscape in the world providing three-quarters of corporate and nine-tenths of household financing. This makes the banking-system inseparable from the Euro-zone economy and an important driver of financial stability (Lakhani, Reid, & Templeman, 2019).

European banks are facing a challenge. Whilst monetary policy makers try to stimulate the economy through unconventional measures, the environment created by said policies leaves unintended consequences. One of these is launching a protracted period of low banking profitability which, together with a highly competitive landscape, forces banks to take on more risk (Deutsche Bundesbank, 2019).

The loan-deposit-ratio (LDR) of European banks is a reflection of risk-taking and is therefore a parameter of interest. Since the global financial crisis (GFC) the average LDR of European banks has declined from 1.43 to 1.03; an indication that loans and deposits in Europe are now evenly matched. Although this is a promising figure, Scandinavian countries show high LDRs in comparison to their European peers. Denmark, Finland, Sweden report average LDRs between 1.75 and 2.5 which not only suggests a funding gap, but also implies a credit risk due to a high amount of loans. Our interest centers on whether the risk from a high LDR is hedged by retaining more capital and liquid asset holdings. Is there, in other words, a trade-off between the LDR versus capital adequacy and liquid assets ratios?

Q1: *Is there a trade-off at play between high loan-to-deposit ratios versus capital adequacy- and liquidity asset ratios of European banks?*

The challenging environment described above resembles that of the Japanese. From 1990 to 2015 the LDR and net interest margin (NIM) have moved downwards simultaneously. A sharp increase in deposits together with a highly competitive banking landscape has led to further decreasing margins in Japan implicating a loss of pricing power for banks and ultimately a risk for financial stability. Following these developments in Japan, we additionally explore the correlation between the LDR and NIM of European banks.

Q2: *What is the correlation between the loan-to-deposit-ratio and the net interest margin of European banks?*

We investigate these two questions using data from the Statistical Data Warehouse (SDW) of the European Central Bank (ECB) in a panel dataset of 28 European countries ranging from 2007 until 2019. The correlations are explored by estimating static linear regressions with Arellano robust errors.

We found no evidence of a trade-off taking place between the LDR versus capital adequacy and liquid asset ratios. Rather the opposite holds true: more capital and liquid assets are associated with lower LDRs on average. We found from related literature that more capital increases lending and funding. The negative correlation with the LDR implies that the latter must show a bigger increase. We ascribe this to the low interest rate environment. Liquid assets, in addition, are not used to lower the risk profile of a bank but are rather sitting idle on the balance sheet not being converted into loans and earning interest. We did find a modest positive correlation between the LDR and the NIM. Together with the declining LDR in Europe this provides some evidence for Japanification of European banks.

To the best of our knowledge the literature has not paid much attention to this subject, which makes this unchartered territory. This study, therefore, will hopefully provide a platform for further research on the liquidity and credit risks that can result from high LDRs and, in times of economic slowdown, the pressure on banks' interest margins when the LDR declines.

This report presents our findings as follows : section 2 gives a literature review followed by the description of the data and a descriptive analysis in Section 3. Section 4 deals with the empirical methodology. Section 5 presents the empirical results and robustness checks. Section 6 discusses the findings and in section 7 we conclude.

2 Literature review

2.1 The loan-to-deposit ratio

Bank intermediation is about deposit taking and extending credit, which take place on either side of the balance sheet (Kashyap, Rajan, & Stein, 1999). In doing so, banks fulfill an important role as financial intermediaries in the economy. By converting of short-term liabilities into long term assets banks are involved in the process of maturity transformation.

The loan-to-deposit ratio (LDR) comprises of loans relative to the amount of deposits banks have on their balance sheet. It defines the level of efficiency with which banks perform their intermediation. The LDR measures the coverage of loans with stable funding, like deposits from non-financial corporations (NFCs) and households.

An LDR of 1 implies that loans and deposits are on an even keel. Due to the maturity transformation banks are exposed to a liquidity risk; not having enough liquid funds to meet one's liabilities (Casu, Girardone, & Molyneux, 2006). Below 1 the LDR is a characterization of low intermediation activity because banks, invest their funds in other assets than loans (Satria, Harun, & Taruna, 2016) (van den End, 2013).

When banks give out more loans than deposits the LDR is above 1.This suggests that banks have to replenish a funding gap by resorting to wholesale- or interbank-funding. Different types of market funding could imply higher risk due to volatility (van den End, 2013). In a tightening market access to financing becomes more difficult which could ultimately result in a fire sale spiral (Danmarks Nationalbank, 2018). The need for market funding exposes banks to an additional liquidity risk. Furthermore, increased lending could signal diminished lending standards implying a credit risk as well; the risk of a counterparty not being able to meet its contractual obligations.

Figure 2.1 shows the LDR of 10 European countries over time and we observe that for the past 11 years the LDR varied widely (graph with full sample can be found in appendix B.1). Scandinavian countries Denmark, Sweden and Finland show high LDRs compared to their European peers with averages of 2.87, 2.23 and 1.59 respectively. For Denmark and Sweden, the ratio has been declining over the years whereas Finland's LDR varied between the 1.5 and 1.75. France (1.24), the Netherlands (1.21) and Italy (1.23) are close to the European average (1.23). Ireland (1.434) and Spain (1.49) show the high average LDRs during the GFC compared to Germany (1.09), France, Netherlands and Belgium (0.75).

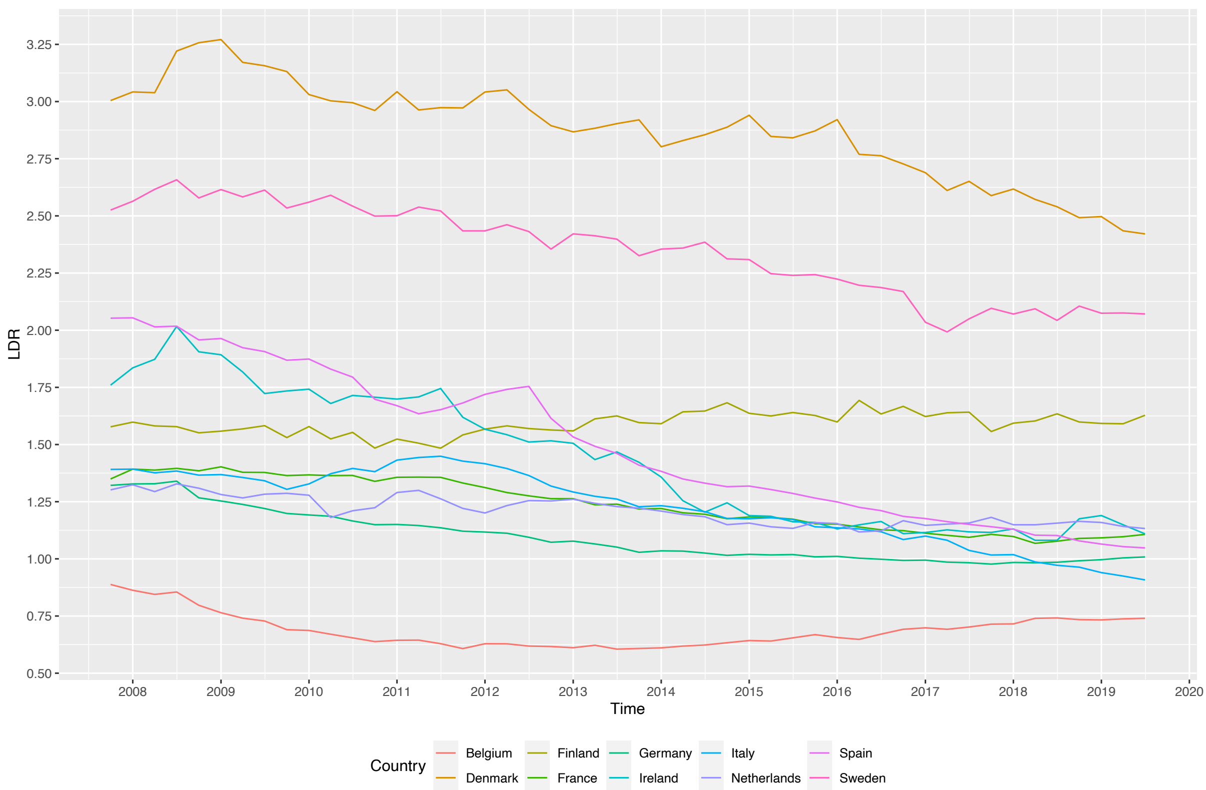
To minimize the liquidity risk and credit risk van den End (2013), Satria, Harun & Taruna (2016) propose setting lower and upper boundaries on the LDR as a macroprudential tool. This measure has been announced but, is not in effect yet in Europe (ESRB, 2020).

The high LDRs of the Scandinavian countries, however, continue to imply riskiness. Could it be that countries hedge the liquidity and credit risk by increased liquid assets holdings and higher capital bases? Is there, in other words, a trade-off at play between high LDRs versus capital adequacy and liquid asset ratios? We formalize our first research question as follows.

Q1: *Is there a trade-off at play between high loan-to-deposit ratios versus capital adequacy and liquidity asset ratios of European banks?*

To the best of our knowledge not much attention has been paid to this subject; exploring the relation between the LDR specifically and, its interaction with capital ratios and liquid asset ratios. The interaction between capital, liquid assets, lending and the funding structure of banks on the other hand has been extensively discussed in the literature.

Figure 2.1 LDRs of European banks over time.



2.2 Capital, liquid assets, deposits and lending

2.2.1 Capital, deposits and lending

An early bank model by Bernanke and Gertler (1987) suggests that the amount of capital banks hold determines the volume of deposits it can use to finance loans and securities. Because deposits are supposed to be risk-free the capital base covers the risk from possible low returns on loans and securities. Thus implying that deposit-taking and lending are associated through the capital base.

It has been also argued that deposit-taking and lending, in the shape of loan commitments, are expressions of liquidity provision on demand. That is to say, the two activities both require liquid asset holdings. As banks increase their deposit base this leads to more liquid assets relating to an increase in loan commitments (Kashyap, Rajan, & Stein, 1999).

Capital and liquid assets can be of importance for lending and deposit taking. The literature does not always provide an unequivocal answer on how these influence each other. This has much to do with investigated time periods as the economic and monetary environment affects bank characteristics and vice versa. For instance, over the past few years the low interest rate environment has drastically altered the way banks do business (Brei, Borio, & Gambacorta, Bank intermediation in a low interest rate environment, 2019). The same goes for the impact of the Basel III framework on bank intermediation, e.g. the transition to more stringent regulation can have a different impact on banks compared to when they have reached the new standard (BIS, 2019).

Norden and Weber (2010) show that deposits decreased relative to the interbank liabilities as a source of funding for German banks in 1992 - 2002. They do not provide evidence that this impacted lending. Instead they show that banks' capital ratios are positively associated with loan growth (Norden & Weber, 2010).

Following the financial and sovereign crisis European banks initially decreased lending in 2012 due to deleveraging (EBA, 2015), the reduction of balance sheet size by cutting down risk exposures (Bologna, Caccavaio, & Miglietta, 2014). Between 2013 – 2015 banks increased lending as well as their capital ratios implying an improvement of capital positions compatible with lending (EBA, 2015).

This positive correlation between bank capital and credit supply is confirmed by Gambacorta and Shin (2016), Polizzi, Scannella and Suárez (2020). Equity and debt funding become safer as additional capital reduces its costs. The implication is that banks receive more funding and increase lending (Gambacorta & Shin, BIS Working Papers No 558. Why bank capital matters for monetary policy, 2016). Naceur & Roulet (2017) also report a positive correlation between bank capital and lending in the United States during the period of 2008 – 2015. They do not find a significant correlation for European banks and ascribe it to the credit crunch and deleveraging.

2.2.2 Capital, liquid assets, lending and funding structure of banks in the low interest rate environment

In June 2014 the ECB lowered its deposit facility rate (DFR) into negative territory which forces banks to pay for excess liquidity they hold at the central bank. Other short-term rates followed this development squeezing margins in the euro area. Brei, Borio & Gambacorta (2019) analyze the effects of the low interest rate environment on banks' balance sheet structure. They assess that liquid asset holdings increase across all banks due to the absorption of central bank liquidity. In addition, capital constraint banks reduce their intermediation activity because of deleveraging or by shifting from high risk to less riskier loans. Furthermore, a reduction of the interest rate causes banks to increase their share of deposits relative to funding on the money market (Brei, Borio, & Gambacorta, Bank intermediation in a low interest rate environment, 2019).

Kim & Sohn (2017) explore the relations between capital, lending and liquidity of US banks and demonstrate that the effect of an increase in bank capital on credit growth is positively related to a bank's liquidity holdings. For low liquidity ratios an increase in bank capital negatively impacts lending growth. The sign reverses when liquid asset holdings are above a certain threshold (Kim & Sohn, 2017).

This is in accordance with Cornett et al. (2011) who show that during 2007-2009 banks exposed to higher liquidity risk increased their liquid asset holdings which reduced their capacity to create loans. Alpher et al. (2012) find that liquidity is important for credit supply as more liquid banks tend to lend more. Conversely, Naceur & Roulet (2017) show that European banks' liquid assets holdings reduces lending activities due to the low interest rate environment. Banks may prefer holding safe low-yielding liquid assets rather than low-yielding, risky, semiliquid loans.

Demiralp, Eisenschmidt and Vlassopoulos (2017) examined the effects of this negative interest rate policy (NIRP) on liquid asset holdings and how it affects the banks' balance sheet. They show that banks relying heavily on deposit funding adjust their balance sheet by reducing liquidity to fund more loans (Demiralp, Eisenschmidt, & Vlassopoulos, Negative interest rates, excess liquidity and bank business models: Banks' reaction to unconventional monetary policy in the euro area, 2017).

Heider, Saidi and Schepens (2019) counter this evidence. Banks are unwilling to charge negative rates to their depositors. As a consequence, banks with more dependence on deposit funding relative to low-deposit banks experience a lower reduction in their cost of funding and tend to lend less, and to more riskier firms (Heider, Saidi, & Schepens, Life below zero: bank lending under negative policy rates, 2018). Harrison, Klocanas & Sigee (2016) argue that banks who rely on income from securities, also implying a low LDR, are possibly more vulnerable to the NIRP because the policy depresses bond yields.

Based on these studies we determine that high LDRs should be associated with higher capital bases. The liquid asset hedge on the other hand is not that apparent. The literature, additionally, suggests relations between monetary policy and the LDR through the funding structure of banks. High deposit banks appear more vulnerable to the NIRP.

Another correlation worth examining is that between the LDR and net interest margin (NIM). The ability of banks to price loans without changing demand, i.e. pricing power, depends on the path of the LDR and is subject to competition (Harrison, Klocanas, & Sigee, 2016). This loss of pricing power is felt in Japan since 2004 where deposits grew harder than loans in the past 20 years causing a decline in LDRs. Competition in the loan market together with surplus deposits in Japan led to a decline in LDRs from 1.3 in 1990 to 0.65 in 2015 (Harrison, Klocanas, & Sigee, 2016) resulting in a loss of pricing power and control over loan yields. If European banking is resembling the Japanese situation this causes a concern for financial stability. That is why it is important to explore these correlations.

2.3 The net interest margin

2.3.1 The NIM in the literature

The net interest margin (NIM) is used to measure banking performance. Besides interest received from loans banks earn revenue from other interest earning assets, like securities or bonds. Banks raise funds by taking deposits, issuing securities (e.g. covered bonds), through the interbank market or by raising capital. European banks rely heavily on profits from the net interest income. It accounts for almost 60 % of the total operating income (ECB, 2019). There are many bank characteristics affecting the NIM. We discuss the ones of importance for this study.

Loans are the riskiest type of assets and determine the largest portion of risk-weighted assets (RWA) through credit risk (EBA, 2019). When financial conditions are loosened it induces a stronger relation between larger credit expansions and riskier allocations (Deutsche Bundesbank, 2019). Credit expansion accompanied by loose lending standards are driven by shifts in credit supply and higher risk appetite of financial intermediaries (IMF, 2018). Increased credit risk enables banks to charge higher rates on loans and thus increase their NIM (Angori, Aristei, & Gallo, 2019). However, a decline in credit quality can also reduce profits due to higher impairments (Menicucci & Paolucci, 2016).

We explained that capital is important for credit extension. It also plays a role in the NIM. A high capital base suggests lower risk, which reduces the cost of funding and thus increases the interest income (García-Herrero & Gavilá, 2009). Demirgüç-Kunt & Huizinga (1999) use bank-level data for 80 industrial and developing countries from 1988-95 to analyze which bank characteristics are of importance to banks' interest margins. They find a positive correlation between banks' equity and the interest margin. This finding is confirmed by Abreu & Mendes (2002), Menicucci & Paolucci (2016), and Angori, Aristei & Gallo (2019) in a European cross-country analysis. Dietrich & Wanzenried (2011) examine the effects of capital on the NIM and report different effects for different time periods. They report no significant influence of equity on the NIM before the global financial crisis hit the world, whilst during the crisis the effect is significantly negative. They argue that safer banks, through higher capital, attracted more deposits during the crisis but were not able to convert these into loans due to low demand.

Dietrich & Wanzenried (2011), Angori, Aristei & Gallo (2019) also examine the effect of the cost-income ratio (CIR), this ratio measures the cost-effectiveness of a bank, on the NIM. They report that this ratio has a negative effect on the NIM.

The effect of the amount of loans or loan growth on the interest margin depends on the environment in which banks operate and not only in times on crises. Dietrich & Wanzenried (2011) find that banks with higher lending growth rates have a higher NIM. Demirgüç-Kunt & Huizinga (1999) and Abrue & Mendes (2002) report that banks with a higher loan ratio have a higher NIM.
Klein (2020) demonstrates that the inverse relation also exists. She reports a positive impact of the NIM on new lending in an analysis of Euro-area banks; indicating that as the NIM increases or decreases lending does the same. However, she also finds that banks in an NIRP-environment supplement their income by granting more loans regardless of the average margin they earn (Klein, 2020).

Norden & Weber (2010) consider the effect of the ratio of deposits to interbank funding on the net interest income. They find that savings banks in Germany with a higher share of deposits have a higher net interest income compared to banks which rely more on interbank funding. Garcia & Guerreiro (2015) report negative effects of the yearly growth of deposits on the NIM these are, however, statistically insignificant. Dietrich & Wanzenried (2011) report the same sign but find significant effects.

2.3.2 NIM in the European banking environment

Banks actively manage their NIM with the goal of keeping it as stable as possible over time. They do so by exercising market power, but at the same time they are subject to a number of constraints like competition and the monetary environment (Deutsche Bundesbank, 2019).

A bank's risk appetite can be substantially affected by changes in the net interest margin. Since the NIM is a mix of interest-bearing products it is therefore linked to market interest rates (Busch & Memmel, 2015). Ever since monetary policymakers reacted with a broad range of measures in response to the financial and sovereign debt crisis, the policy rates have been decreased to extremely low levels (Klein, 2020).

The ECB signals that the low interest rate environment will persist (Jochnick, 2019). New customer loans are priced below outstanding loans. Combined with a highly competitive banking market and competition from capital markets this implicates that margins continue to be pressurized (ECB, 2019). This is consistent with the findings of Dietrich & Wanzenried (2011) who report that increased competition negatively affects banking performance. In addition, the positive correlation between market power and being able to set a higher spread found by Angori, Aristei & Gallo (2019) further confirms this correlation. Moreover, banks have a difficult time of charging negative rates onto retail deposits (ECB, 2019) (Heider, Saidi, & Schepens, 2018) leading margins to shrink even further

Euro area banks are countering the declining interest income by making various adjustments to their business policy. Banks try to offset the low margins by increasing their business volume and maturity transformation (Deutsche Bundesbank, 2019) (ECB, 2019). Higher maturity transformation is followed by heightened risk. Combined with the fact that banks assume these risks rather than raising the lending rate could be the result of intense competition in the lending business (Deutsche Bundesbank, 2019). Brei, Borio & Gambacorta (2019) report that banks will shift their activity from interest generating business into fee-related activities. This diversification partly offsets the negative effects of low interest rates on the NIM. However, the market for fee-related business is limited.

The European banking environment might resemble the Japanese situation that has been going on since 2004 (Harrison, Klocanas, & Sigee, 2016). Compressed margins and low profitability are sources of this increased risk taking (Deutsche Bundesbank, 2019) (IMF, 2018). Since maturity transformation and increased risk taking are reflected by the LDR, understanding its correlation with the NIM is important for financial stability. If the European banks are on the same course as the Japanese, this could have future consequences for the financial system. The correlation between a banks LDR and its NIM brings us to our second research question.

Q2: *What is the correlation between the loan-to-deposit-ratio and the net interest margin of European banks?*

3 Data

3.1 Data source and manipulation

The data used for this analysis originates from the Statistical Data Warehouse (SDW), the online free data delivery service of the ECB. In the production of the data the ECB is assisted by National Central Banks (NCBs) and sometimes other governmental authorities. NCBs collect the data from monetary financial institutions (MFIs), financial intermediaries and other domestic sources. After aggregation by NCBs the ECB combines and compiles the data (ECB, 2014).

In this study a total of 12 variables are used over a time span of 11 years (2007 Q4 – 2019 Q3) involving 28[1] member states of the European Union. These variables were produced by information on both domestic and foreign credit institutions within each country of interest. The frequency of the data is dependent on the period. From 2007 Q4 until 2009 Q4 data are only provided annually. From 2010 Q2 – 2014 Q4 biannually. The frequency increases to quarterly from 2014 Q4 – 2019 Q3. This variation in the frequency results in gaps in our data. Subject to data being omitted from the regressions we opted to interpolate missing (in)dependent[2] variables using linear interpolation. The dependent variable LDR was not interpolated while some countries missed too much observations. To check whether the interpolation had any effect on the estimations we re-estimated the equations using bi-annual and annual data. We conclude that the interpolation does not affect the standard errors and continue to work with quarterly interpolated data. The results of these regressions can be found in appendix C.1.

Not all ratios and variables required for our analyses were on hand in the SDW. As a result, we computed some of our variables from the existing ones in the database (see table 3.3 for summary). Altogether we created a panel dataset ranging from 2007 Q4 to 2019 Q3 and including 28 countries which yielded 1264 observations in total, taking into account the missing observations in the LDR.

Table 3.1 Panel summary table

Dataset		
N = Country	**T = Time**	**Total***
28	48	1264

*Total observations is actually 1344. Missing observations (80) led to drop in panel size.

[1] The United Kingdom was still a member state in the period under consideration.

[2] The dependent variable LDR was not interpolated since too many variables were missing for Croatia, Hungary, Latvia and the United Kingdom.

3.2 Variables

This section specifies the variables used in our models (table 3.2 for summary). The variables requiring attention are detailed below.

3.2.1 Dependent variables

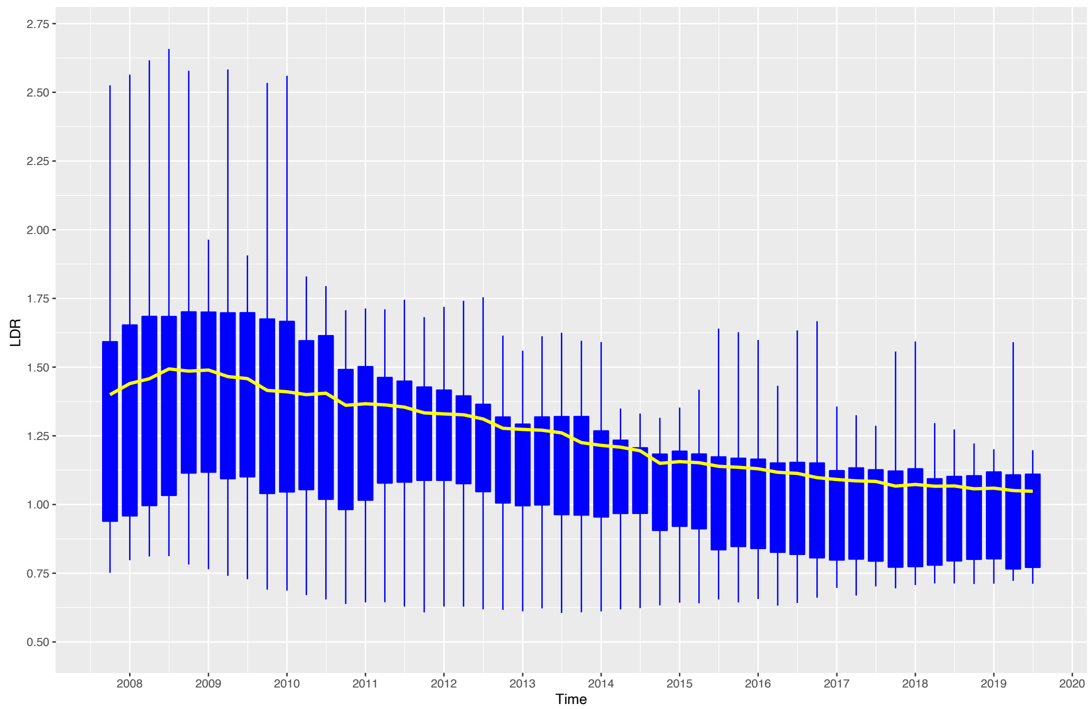
3.2.1.1 Loan-to-deposit ratio

The LDR is calculated by the ratio of loans to deposits. The ratio is computed by taking the aggregate amount of loans and deposits per period from countries MFIs excluding NCBs.

$$LDR = \frac{Loans}{Deposits} \tag{3.1}$$

Figure 3.1 presents the LDR of European banks from 2007 to 2019. With minima of 0.75 and maxima around 2.5 between 2007 and 2010 the LDR showed quite some variability in the Europe. Since 2010 the LDR of European banks more or less fluctuates between 0.75 and 1.75. Note that outliers have been removed from this graph as countries like Denmark and Sweden still retain very high LDRs (table 3.4). The average LDR of European banks, indicated in yellow, increased until the second half of 2008 when it was 1.45. In good economic times, before the second half of 2008 (figure 3.1), the LDR tends to rise to finance credit growth, because of abundantly available market funding (van den End, 2013).

Figure 3.1 LDR of 28 European countries. Indicated in yellow is the average LDR

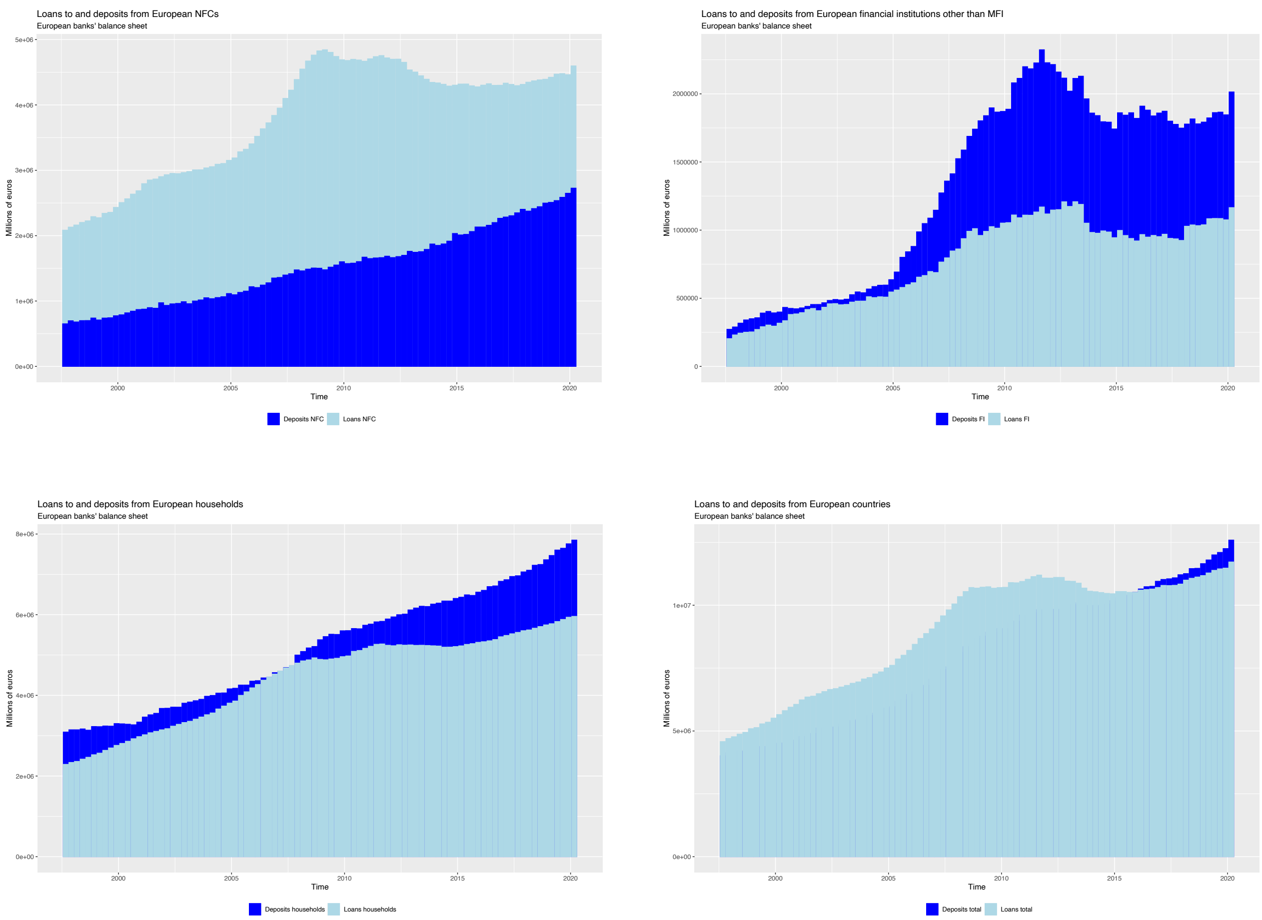


This pro-cyclical behavior of financial intermediaries in run up to the crisis caused debt overhang. Furthermore, the GFC revealed frailties in European banks' business models, such as heavy reliance on short-term wholesale funding and insufficient capital buffers (ECB, 2012). Brought on by these frailties the Basel committee introduced the net-stable-funding-ratio (NSFR).

The NSFR requires banks to hold enough stable funding for core, mostly illiquid, assets. Stable funding includes liabilities and capital which stay within the institution for more than 1 year (BIS, 2014). This concerns deposits and most of the capital base. We note from figure 3.1 that since the GFC the LDR has been steadily decreasing to 1.05 in the 3rd quarter of 2019. More stringent regulation and (unconventional) monetary policy are possibly at the root of this trend.

Figure 3.2 shows the aggregate number of loans and deposits of European countries split into different sectors. Lending to these sectors accounts for most of lending in the Euro area (Altavilla, Andreeva, Boucinha, & Holton, 2019). We did not take into account loans to governments. As a consequence this image might be somewhat overstated, but it could help explain the declining trend in the LDR. It shows that the amount of loans to NFCs well exceeds the amount of deposits. This image is different for lending and deposit taking from households. Since 2008 deposits are outstripping lending to households. The same goes for deposits and loans of financial institutions other than MFIs. Adding these up shows us that the total amount of deposits has surpassed the loan volume in Europe, potentially contributing to the declining LDR we saw in figure 3.1.

Figure 3.2 Loans to and deposits from European countries split up in different sectors.



Although the average LDR of European banks is declining our first research question derives from the case of the Scandinavian countries Denmark, Finland and Sweden. Since these countries have such high LDRs the trade-off might manifest itself here.

Scandinavian countries fund their mortgages with covered bonds (European Mortgage Federation, 2019), but this does not necessarily have to be the case for loans to NFCs. This way of funding implies that a least a part of lending is not covered by stable funding. This exposure to market funding implies a higher liquidity risk (van den End, 2013). We expect that in order to enhance their risk profile banks the liquidity risk from the funding gap or the credit risk from the high LDR is covered by retaining more capital and/or liquid assets.

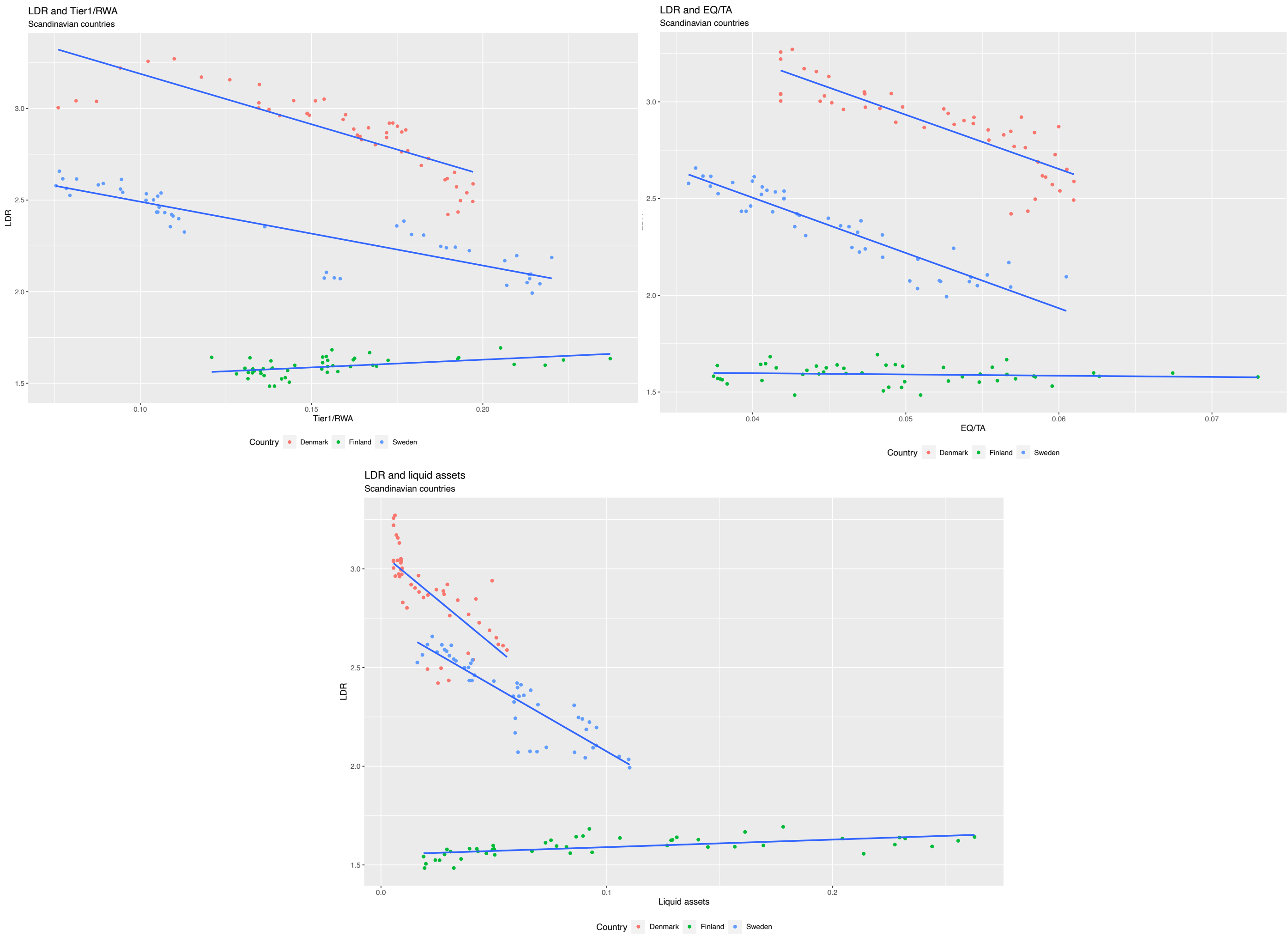
Table 3.2 features the descriptive statistics of Denmark, Finland and Sweden and the European average (table 3.4). We observe from column (2) and (3) that the amount of capital they retain over the whole time period is close to the European average. Taking a closer look at the risk density function (4) of the Scandinavian countries we see that these are well below the European average. Historically Scandinavian countries have had very low mortgage delinquency rates (Stanga, Vlahu, & de Haan, 2017).
These low RWAs should inflate the risk-based capital ratio, however, T1/RWA appears to be close to the European average. Moreover, the unweighted capital ratios of Scandinavian banks are among the lowest of European countries. In addition, the liquid asset ratio fluctuates more or less around the European average.

Table 3.2 Descriptive statistics of Scandinavian countries.

	(1)		(2)		(3)		(4)		(5)	
	LDR		**T1/RWA**		**EQ/TA**		**RWA/TA**		**Liquid assets**	
Country	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**
Finland	1.591	0.047	0.156	0.027	0.049	0.008	0.311	0.074	0.103	0.074
Sweden	2.347	0.199	0.141	0.051	0.046	0.006	0.318	0.084	0.059	0.027
Denmark	2.874	0.215	0.157	0.032	0.052	0.007	0.334	0.050	0.022	0.016
Europe	1.240	0.495	0.141	0.044	0.078	0.034	0.510	0.152	0.071	0.059

Figure 3.3 provides a more detailed description of the correlations between the LDR, capital adequacy and liquidity ratios for Scandinavian countries. We observe negative correlations for Denmark and Sweden. Finland on the other hand shows marginally positive correlations. These graphs indicate that the trade-off is not evident from the descriptive statistics. We will explore this further in the empirical section, chapter 5.

Figure 3.3 LDR in function of the risk-based capital ratio, unweighted capital ratio and liquid assets for Scandinavian countries.



3.2.1.2 Net interest margin and return on assets

The net interest margin (NIM) and return on assets (ROA) are ratios used to measure banking performance. The latter is used as a proxy for the NIM in our robustness checks and is therefore only briefly discussed. The NIM is calculated as ratio of net interest income (NII), the difference between interest revenues and expenses, to total assets. The ROA is defined as net income over total assets, it indicates the income generated per euro of assets and signals banking profitability. Net income consists of interest income and non-interest income such as fees and commissions.

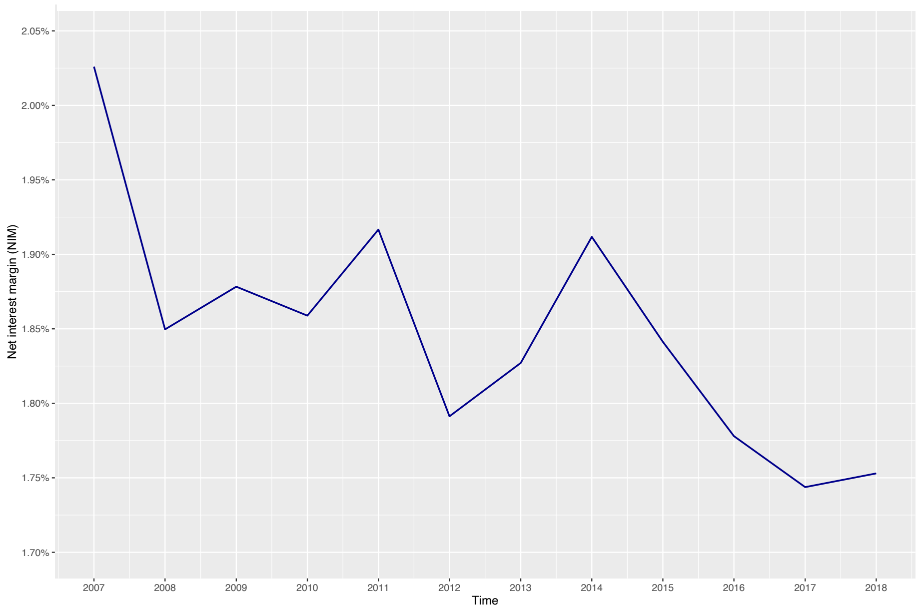
$$NIM = \frac{Net\ interest\ income}{Total\ assets} \qquad (3.2)$$

$$ROA = \frac{Net\ income}{Total\ assets} \qquad (3.3)$$

The low interest rate environment created by the ECB causes a protracted period of low banking profitability (ECB, 2019) (Jochnick, Banking performance, competition and financial stability: a supervisory review (Speech), 2019). This is reflected by the declining NIM in figure 3.4 which shows the average European NIM from 2008 until 2018. During this period the NIM declined 0.32 p.p. This depressed in the NIM is a byproduct of the low policy rates set by the monetary authorities (ECB, 2019) and subject to heavy competition. The European average ROA follows the same trend as the NIM, in 2018 the European average ROA in 2018 was 0.3765 %. Considering that the benchmark ROA is around 1 % (Casu, Girardone, & Molyneux, 2006) this is fairly low.

The simultaneous downward movement of the LDR and NIM (figure 3.1 and 3.4) could be a first indication that they move in tandem, which could cause concerns for financial stability (cfr. chapter 2). The correlation will be discussed in detail in the empirical section.

Figure 3.4 The net interest margin of European countries



3.2.2 Independent variables

3.2.2.1 Liquid assets

Banks have an account at the NCB on which they can deposit surplus amounts of liquidity. Banks receive interest on these deposits. The rate is set by the ECB and is called the deposit facility rate (cfr. 3.2.2.4). As part of their macro-prudential policy the ECB requires credit institutions established in the Euro-area to hold a minimum amount of reserves on these accounts (ECB, 2020). The minimum reserve requirements are a monetary policy tool for monetary policy. If the requirements are increased banks have less funds available to give out loans. Lower reserve requirements provide banks with more funds to supply loans. It is a way for the ECB to control the money supply (Casu, Girardone, & Molyneux, 2006).

In addition to cash some securities are generally considered liquid assets. Government bonds are rather liquid since they can be sold and converted to money very quickly (Darvas & Pichler, 2018). Banks' liquid assets are subject to Basel III regulation by means of the liquidity-coverage-ratio (LCR). The LCR stipulates that banks must hold high-quality-liquid-assets (HQLA) to be able to withstand a liquidity shock for a period of at least 30 calendar days (BIS, 2013). HQLA include cash and reserves held with the ECB as well as several types of bonds (Grandia, Hänling, Russo, & Åberg, 2019). All European banks are well above the minimum required LCR of 100 % with 149 % (EBA, 2019).

The SDW provides data on banks' liquid assets and the LCR, however, it does not cover the desired time period. Therefore, we opt to use cash, cash balances and other demand deposits at central banks as a proxy for liquid assets and normalize it by total assets (TA).

$$Liquid\ assets = \frac{Cash}{Total\ assets} \tag{3.4}$$

3.2.2.2 Capital ratios

Bank capital functions as a buffer for unexpected losses. Capital regulation has always been at the center of the Basel accords. In order to improve banking resilience by reducing the probability of default, Basel III imposes higher capital buffers thus strengthening on the previous regulation (BIS, 2010).

A bank's equity consists of core equity Tier 1, additional Tier 1 and Tier 2 capital. Basel III strengthens the quality and consistency of the capital held by defining common equity Tier 1 capital (CET1). CET1 comprises of common shares and retained earnings (ECB, 2010).

Risk-weighted assets (RWA) are calculated as the sum of credit-, market- and operational risk (BIS, 2017). Credit risk makes up 80 % of total RWA (EBA, 2019). The ratio of RWA over TA is defined as the risk density function and describes the risk profile of bank (Gambacorta & Shin, BIS Working Papers No 558. Why bank capital matters for monetary policy, 2016). The European average RWA of the past 11 years is around 50 % (table 3.4).

CET1 is weighted by a bank's risk weighted assets (RWA) which is not allowed to fall below the threshold of 7 % (BIS, 2019) . Basel III imposes additional capital requirements on top of the CET1/RWA ratio, these additional buffers are not taken into account in this analysis. Because RWA has certain drawbacks the leverage ratio is defined as a backstop. It is defined as total bank equity over total assets and should be larger than or equal to 3 % (BIS, 2010). This ratio is called the leverage ratio by the BIS, whereas the financial industry defines the leverage ratio as the inverse as the leverage ratio. To avoid confusion, we will refer to the Basel III leverage ratio as the unweighted capital ratio.

The data on the CET1 provided by the SDW does not meet our required time frame. To proxy for CET1 we use Tier 1 capital and then weigh it by RWA. We compute the unweighted capital ratio (Basel III leverage) by equity over TA.

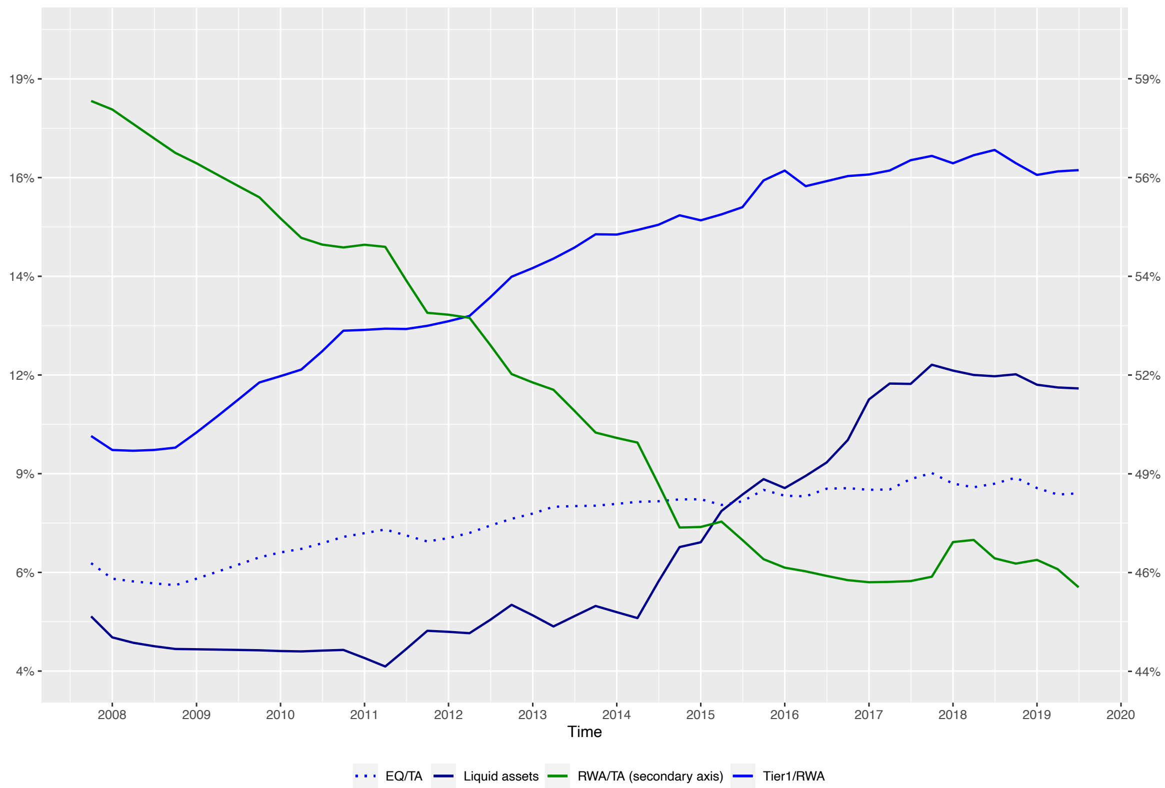
$$Risk\ based\ capital\ ratio = \frac{Tier\ 1}{Risk\ weighted\ assets\ (RWA)} \tag{3.5}$$

$$Unweigthed\ capital\ ratio = \frac{Equity\ (EQ)}{Total\ assets\ (TA)} \tag{3.6}$$

Figure 3.5 features the risk density function, liquid assets (3.4) and both capital ratios (3.5-6). We observe an increase in Tier1/RWA from 9,95 % in the 4th quarter of 2007 up to 16,7 % in Q3 2019. EQ/TA increased by 1,77-p.p. over the same period. An 12,3-p.p. decrease in RWA/TA suggest that banks increased the risk-based capital ratio through deleveraging. From table 3.4 we indeed observe differences between the risk-based and unweighted capital ratios. The variation between countries suggests that some retain more capital than others. The European average for the T1/RWA (14,1 %) and EQ/TA (7.8 %) in any case imply that banks are above the required ratios set by Basel III.

We note that from the second half of 2014 to 2018 liquid assets holdings increased, indicating high levels of liquidity in the Euro system. The amount of reserves above the minimum requirements of the ECB are considered excess liquidity. There has been a steady increase in excess liquidity since early 2015 likely driven by the quantitative easing measures of the ECB (Darvas & Pichler, 2018) (ECB, 2017).

Figure 3.5 Capital adequacy ratios, liquid assets and the risk density function of European banks



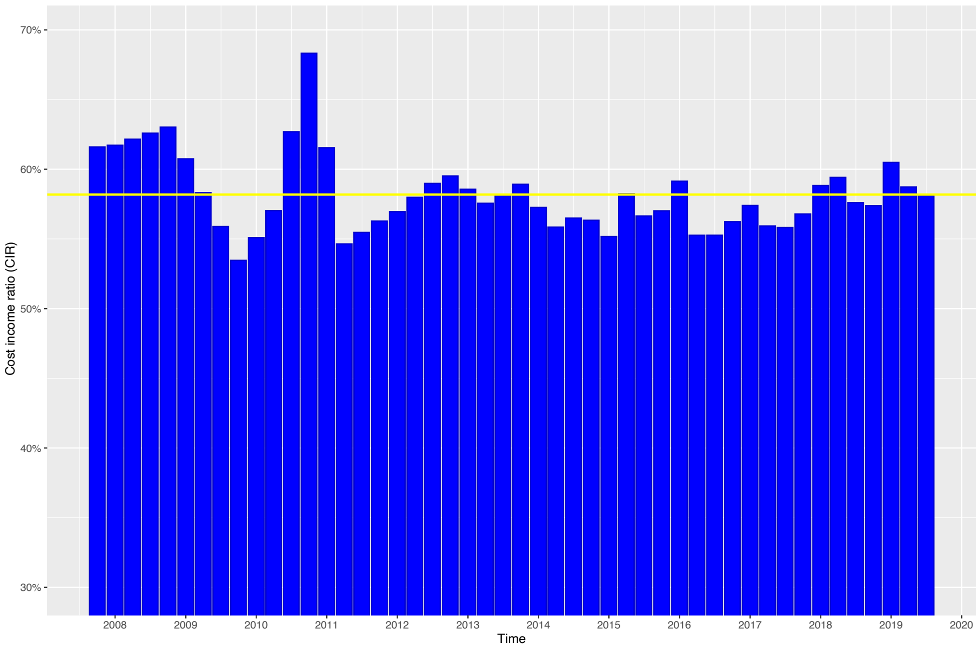
3.2.2.3 Cost-income ratio

The cost-efficiency of a bank can be measured by computing the cost relative to income which is called the cost income ratio (CIR). When the ratio increases the bank's costs go up relative to their income. The number falls if income increases relative to the costs. A high cost income ratio thus is an indicator of low cost-efficiency. The average CIR of European banks over the past 11 years was 58,2 %. Considering a healthy CIR is 50 % (Casu, Girardone, & Molyneux, 2006) this suggests high cost inefficiencies.

$$Cost\ income\ ratio = \frac{Costs}{Income} \tag{3.7}$$

Presented by figure 3.6 is the average European CIR over time. We note that in 2019 the ratio has been above the 11 years European average indicating almost no improvement in cost-efficiency.

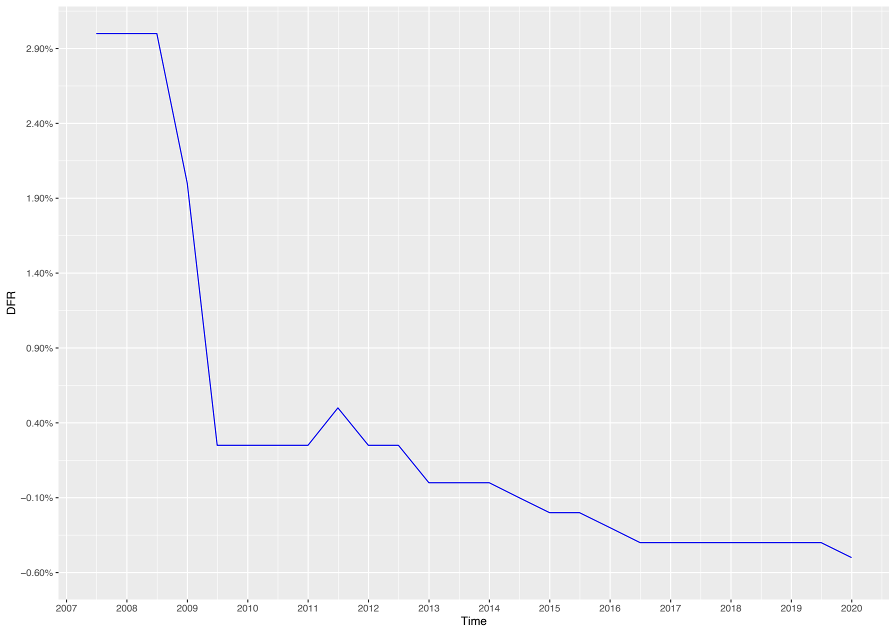
Figure 3.6 Cost income ratio of European banks. Yellow line indicates the 11-year European average



3.2.2.4 The deposit facility rate

The deposit facility rate (DFR) is the interest rate banks receive on their accounts at NCBs. In 'normal' times a lower (positive) DFR transfers to a lower rate on customer deposits (Deutsche Bundesbank, 2019) thus lowering the cost of funding for banks (Heider, Saidi, & Schepens, 2018). Since June 2014 the ECB lowered the DFR into negative territory. Together with easing measures and forward guidance this caused banks to cut lending rates (Deutsche Bundesbank, 2019). However, banks appear to be reluctant to reduce their interest rates on customer deposits squeezing the margin they earn as we saw in the section on the NIM. Since the DFR signals the policy stance of the monetary authorities we adopt it as a proxy for monetary policy.

Figure 3.7 Deposit facility rate set by the ECB



3.2.2.5 Hirschman-Herfindahl index

The Hirschman-Herfindahl index (HHI) measures market concentration in industries. It is defined as the sum of squares of firms' market share on a country level based on the assumption that competition takes place on national level (Angori, Aristei, & Gallo, 2019). An HHI of 1 indicates that there is only one supplier on the market. An HHI close to 0 suggest perfect competition and no market power. We use this variable as a proxy for market power and argue high concentration coincides with low levels of competition. The higher this ratio, the higher a firm's market power. The European average HHI in the past 11 years was 11.4 % indicating very high competition (table 3.4)

Table 3.3 Summary table of the variables used in this study

Variables	**Description**	**Period**	**Range**
Dependent			
LDR	Loan-to-deposit ratio	1999 - 2019	Quarterly
NIM	Net interest margin	2007 - 2019	Quarterly*
ROA	Return on assets	2007 - 2019	Quarterly*
Independent	**Description**	**Period**	**Range**
Cash	Cash, cash balances and other demand deposits at central banks	2007 - 2019	Quarterly*
CIR	Cost income ratio	2007 - 2019	Quarterly*
DFR	Deposit facility rate at the ECB	1999 - 2020	Daily
HHI	Herfindahl-Hirschman index to measure bank concentration	1997 - 2018	Annual
Tier 1	Tier 1 capital	2007 - 2019	Quarterly*
TA	Total assets	2007 - 2019	Quarterly*
EQ	Total equity	2007 - 2019	Quarterly*
Computed variables	**Description**	**Period**	**Range**
Cash / TA	Proxy for liquid assets	2007 - 2019	Quarterly*
Tier1 / RWA	Risk-based capital ratio	2007 - 2019	Quarterly*
EQ / TA	Unweighted capital ratio	2007 - 2019	Quarterly*

*Interpolated variables. Data only exists annually from 2007 Q4 until 2009 Q4, biannual from 2010 Q2 until 2014 Q4. From 2014 Q4 to 2019 Q3 the data are quarterly. HHI is interpolated as well.

Table 3.4 Descriptive statistics

	LDR		Liquid assets		T1/RWA		EQ/TA		NIM		ROA		RWA/TA		CIR		HHI	
Country	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**	**Mean**	**Std.Dev**
Austria	1.194	0.069	0.039	0.021	0.117	0.025	0.073	0.010	0.014	0.005	0.003	0.002	0.535	0.037	0.680	0.058	0.048	0.024
Belgium	0.687	0.072	0.050	0.035	0.153	0.019	0.058	0.013	0.011	0.003	0.002	0.005	0.346	0.016	0.664	0.074	0.120	0.026
Bulgaria	0.992	0.224	0.135	0.042	0.171	0.031	0.128	0.007	0.029	0.011	0.010	0.005	0.672	0.090	0.488	0.028	0.086	0.009
Croatia	0.893	0.134	0.078	0.035	0.184	0.009	0.136	0.003	0.022	0.006	0.005	0.004	0.668	0.034	0.543	0.025	0.131	0.012
Cyprus	1.059	0.176	0.115	0.067	0.115	0.034	0.073	0.017	0.018	0.007	-0.005	0.015	0.574	0.061	0.511	0.075	0.143	0.038
Czech Republic	0.810	0.026	0.104	0.036	0.134	0.023	0.084	0.008	0.021	0.008	0.010	0.004	0.493	0.062	0.472	0.027	0.104	0.005
Denmark	2.874	0.215	0.022	0.016	0.157	0.032	0.052	0.007	0.009	0.003	0.002	0.002	0.334	0.050	0.600	0.067	0.125	0.032
Estonia	1.308	0.295	0.159	0.030	0.181	0.076	0.119	0.029	0.018	0.006	0.010	0.013	0.588	0.132	0.447	0.031	0.268	0.028
Finland	1.591	0.047	0.103	0.074	0.156	0.027	0.049	0.008	0.007	0.003	0.004	0.002	0.311	0.074	0.532	0.048	0.299	0.077
France	1.238	0.113	0.049	0.023	0.128	0.020	0.053	0.008	0.008	0.003	0.003	0.001	0.337	0.017	0.700	0.034	0.058	0.008
Germany	1.092	0.110	0.028	0.032	0.137	0.024	0.000	0.000	0.008	0.002	0.001	0.001	0.355	0.026	0.739	0.057	0.032	0.015
Greece	1.113	0.209	0.040	0.007	0.111	0.047	0.071	0.025	0.020	0.007	-0.005	0.009	0.642	0.040	0.580	0.065	0.178	0.048
Hungary	0.763	0.050	0.046	0.024	0.124	0.014	0.087	0.013	0.031	0.012	0.004	0.009	0.631	0.047	0.671	0.196	0.082	0.005
Ireland	1.434	0.291	0.059	0.050	0.179	0.051	0.090	0.041	0.009	0.004	-0.002	0.010	0.454	0.077	0.769	0.634	0.064	0.007
Italy	1.229	0.162	0.021	0.014	0.110	0.023	0.074	0.004	0.013	0.005	0.002	0.003	0.523	0.055	0.632	0.030	0.047	0.017
Latvia	0.914	0.269	0.139	0.088	0.136	0.037	0.095	0.016	0.016	0.006	0.002	0.013	0.658	0.110	0.566	0.071	0.117	0.022
Lithuania	1.254	0.311	0.112	0.066	0.131	0.047	0.086	0.016	0.014	0.005	0.005	0.011	0.648	0.166	0.518	0.049	0.181	0.027
Luxembourg	1.077	0.128	0.094	0.077	0.168	0.044	0.063	0.011	0.006	0.002	0.004	0.002	0.294	0.037	0.529	0.049	0.037	0.015
Malta	0.941	0.297	0.052	0.045	0.181	0.091	0.115	0.052	0.014	0.005	0.008	0.004	0.551	0.045	0.368	0.095	0.146	0.022
Netherlands	1.211	0.062	0.058	0.030	0.139	0.028	0.048	0.009	0.010	0.003	0.002	0.002	0.342	0.033	0.783	0.411	0.201	0.024
Poland	1.019	0.082	0.036	0.005	0.138	0.016	0.104	0.005	0.022	0.007	0.009	0.004	0.660	0.041	0.557	0.031	0.065	0.010
Portugal	1.335	0.276	0.030	0.015	0.104	0.025	0.071	0.014	0.013	0.004	0.000	0.004	0.617	0.060	0.591	0.044	0.117	0.005
Romania	1.037	0.188	0.172	0.035	0.136	0.015	0.101	0.007	0.029	0.011	0.006	0.007	0.620	0.054	0.546	0.031	0.090	0.008
Slovakia	0.977	0.068	0.026	0.016	0.133	0.014	0.103	0.012	0.024	0.009	0.008	0.003	0.578	0.051	0.555	0.029	0.127	0.005
Slovenia	1.287	0.411	0.060	0.028	0.130	0.040	0.096	0.020	0.018	0.006	-0.001	0.016	0.691	0.098	0.579	0.042	0.109	0.014
Spain	1.499	0.326	0.041	0.015	0.108	0.017	0.065	0.008	0.015	0.005	0.003	0.004	0.507	0.060	0.495	0.028	0.078	0.021
Sweden	2.347	0.199	0.059	0.027	0.141	0.051	0.046	0.006	0.008	0.003	0.004	0.001	0.318	0.084	0.545	0.017	0.084	0.009
United Kingdom	0.907	0.059	0.051	0.019	0.143	0.026	0.054	0.009	0.008	0.003	0.001	0.002	0.336	0.023	0.633	0.034	0.046	0.006
Europe	1.240	0.495	0.071	0.059	0.141	0.044	0.078	0.034	0.016	0.009	0.003	0.008	0.510	0.152	0.582	0.181	0.114	0.069

4 Methodology

This section discusses the equations and the estimators used to answer our questions. Furthermore, we address some econometric issues important to the analysis.

4.1 The fixed-effects estimator (FE)

The fixed-effects estimator allows for individual heterogeneity of countries by letting the intercept α_i vary over countries. Individual heterogeneity may be due to particular features of countries that are constant over time and are not taken into account by the explanatory variables in our model.

$$Fixed\ effects\ model \qquad y_{it} = \alpha_i + x_{it}'\beta + \epsilon_{it} \ , \quad \epsilon_{it} \sim iid(0, \sigma_\epsilon^2) \tag{4.1}$$

$$Mean\ equation \qquad \bar{y}_i = \alpha_i + \bar{x}_i\beta + \bar{\epsilon} \tag{4.2}$$

$$Within\ estimator \qquad y_{it} - \bar{y}_i = (x_{it} - \bar{x})'\beta + (\epsilon_{it} - \bar{\epsilon}) \tag{4.3}$$

We estimate this model by subtracting the mean equation (4.2) from the original equation (4.1). This yields the within estimator (4.3) and is mathematically equivalent to (4.1) (see appendix D.1 for proof). By running the regression in deviations from individual means we can obtain our β coefficients. In doing so, we exploit the within dimension of the data i.e. the difference within countries. Appendix D.2 shows that there is ample amount of variation in countries' LDR to exploit.

The fixed-effects estimator is unbiased if the explanatory variables are independent of the error terms and consistent under the assumption that the deviations from individual means are uncorrelated with the explanatory variables (4.4).

$$E[(x_{it} - \bar{x}_i)\epsilon_{it}] = 0 \tag{4.4}$$

Under the assumption of $\epsilon_{it} \sim N$ we state that the estimator is normal distributed. The fixed effects model allows for the α_i to be correlated with the error terms since the latter is removed from the equation by demeaning (Verbeek, Models based on panel data, 2004).

4.3 The random-effects estimator (RE)

The random-effects estimator exploits both the within and between dimension of the data i.e. the difference within and between countries is used in obtaining coefficient estimates. This results in a more efficient estimator than FE. The difference with FE is that the intercept α_i is treated as part of the error term. Because of this the error term ϵ_{it} should be uncorrelated with the explanatory variables. Otherwise this would lead to an inconsistent estimator.

$$y_{it} = \alpha + x_{it}'\beta + \mu_{it} \tag{4.5}$$

$$\mu_{it} = \alpha_i + \epsilon_{it}, \qquad \epsilon_{It} \sim iid(0, \sigma_\epsilon^2), \qquad \alpha_i \sim iid(0, \sigma_\alpha^2) \tag{4.6}$$

4.4 Hausman tests

Using only the within variation makes FE less efficient than the RE estimator (Verbeek, Models based on panel data, 2004). To probe which estimator to use we performed Hausman tests. The null hypothesis states that x_{it} and a_i are uncorrelated. The fixed-effects estimator is consistent under both the null and alternative hypotheses. The random-effects estimator is consistent (and efficient) under the null hypothesis. Not being able to reject the null hypothesis indicates that RE is consistent and should be used as it increases estimation efficiency.

Dependent on the variables used in the models the Hausman test for estimator consistency yielded differing outcomes. With the regard to consistency in comparing results we opted to estimate the models using country fixed effects over the random effects estimator. The results of RE did not differ from FE in a way that it affected our conclusions (appendix D.3 & D.4).

4.5 Specifications

The models estimated to address our research questions are specified below.

Q1: *Is there a trade-off at play between high loan-to-deposit ratios versus capital adequacy and liquid asset ratios of European banks?*

To address the first question, we regressed the LDR on capital adequacy and liquidity asset holdings (4.7) and then expanded the model by adding the control variables (4.8). The models displayed here are the fixed effects models. Note that we use the notation with the intercept to emphasize that we take into account country individual effects.

$$LDR_{it} = \alpha_i + \beta_1 CAP_{it} + \beta_2 LIQ_{it} + \epsilon_{it} \tag{4.7}$$

$$LDR_{it} = \alpha_i + \beta_1 CAP_{it} + \beta_2 LIQ_{it} + \beta_3 DFR_t + \beta_4 HHI_{it} + \epsilon_{it} \tag{4.8}$$

The LDR_{it} denotes the loan-to-deposit ratio. The subscript i indicates the country and t the time dimension. The intercept α_i denotes country level individual effects . CAP_{it} represents a capital ratio (risk-based or unweighted) and LIQ_{it} expresses the liquid asset holdings. The DFR_t is the deposit facility rate set by the ECB, HHI_{it} is the Herfindahl-index used to describe market concentration.

Q2: *What is the correlation between the loan-to-deposit-ratio and the net interest margin of European banks?*

We explored the correlation between the LDR and NIM by first estimating a baseline equation (4.9) and expanding it by adding control variables (4.10).

$$NIM_{it} = \alpha_i + \beta_1 LDR_{it} + \beta_2 CIR_{it} + \beta_3 CAP_{it} + \beta_4 LIQ_{it} + \epsilon_{it} \tag{4.9}$$

$$NIM_{it} = \alpha_i + \beta_1 LDR_{it} + \beta_2 CIR_{it} + \beta_3 CAP_{it} + \beta_4 LIQ_{it} + \beta_5 DFR_t + \beta_6 HHI_{it} + \epsilon_{it} \tag{4.10}$$

The NIM_{it} depicts the net interest margin. The subscripts i and t denote the country, and time dimension respectively. LDR_{it} represents the loan-to-deposit ratio. The intercept α_i denotes country level individual effects . CAP_{it} represents a capital ratio (risk-based or unweighted) and LIQ_{it} expresses the liquid assets holdings. The DFR_t is the deposit facility rate set by the ECB, HHI_{it} is the Herfindahl-index used to describe market concentration.

4.6 Robust standard errors

The fixed effects estimator assumes that all correlation between unobservable bank characteristics is captured by α_i in different time periods. This implies that the ϵ_{it} is assumed to be uncorrelated over individuals and over time. Supposed there was autocorrelation in the ϵ_{it} given that the x_{it} variables are strictly exogenous; this doesn't result in inconsistency of the standard estimators. However, this invalidates the standard errors and inference (Verbeek, Models based on panel data, 2004). In order to draw inference, the standard errors in the models are adjusted for general forms of heteroskedasticity and autocorrelation. Arellano robust standard errors are applied in every model as is custom for macro-econometric panels (Millo, 2017).

4.7 Endogeneity issues

A challenge in observational research is to establish causality. For example, increased credit extension, implying a high LDR, can be the result of a higher capital base (Gambacorta & Shin, BIS Working Papers No 558. Why bank capital matters for monetary policy, 2016). On the other hand, does increased lending provides profits which could be used to increase the capital base through retained earnings (Cohen & Scatigna, 2016). The same goes for the LDR and NIM. A high LDR can result in a higher NIM because of increased interest income. Conversely, if the NIM is too low banks can opt to extend more credit, thus increasing the LDR. These examples show that our explanatory variables might not be strictly exogenous thus resulting in an endogeneity issue (Gujarati & Porter, 2009). We try to mitigate this issue with the use of control. By not fully addressing this endogeneity issue our regressions only measure correlations instead of causations.

5 Empirical results

In this section we discuss the results of the regressions. While addressing our first research question we regressed the LDR on two capital ratios, a liquidity ratio and added a monetary and competition control variable (cfr. chapter 4) . The correlation between the LDR and the NIM are explored by regressing the NIM on the LDR, bank characteristics and the same controls used previously (cfr. chapter 4).

5.1 The trade-off

Q1: *Is there a trade-off at play between high loan-to-deposit ratios versus capital adequacy and liquid asset ratios of European banks?*

Columns (1) to (4) of table 5.1 show the results of the first regressions. Column (1) and (3) refer to the baseline specifications using the risk-based and unweighted capital ratio. Column (2) and (4) present the specifications complemented with control variables.

All specifications are highly significant. It immediately stands out that the capital ratios in every specification exert a negative influence on the LDR, speaking against the trade-off. The capital ratios in model (1) to (3) are significant at the 1 % and 5 % level. Liquid assets follow the capital ratio in their influence on the LDR. Model (1) and (2) do not show significant effects whereas liquid assets in (3) and (4) are significant at the 5 % level. The DFR is significantly positive associated with the LDR, at least at the 10 % level. We report no significant effects of the HHI on the LDR.

Table 5.1 Regression results from full sample using country fixed effects with LDR as dependent variable

	Dependent variable: LDR			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-2.401***	-1.862**		
	(0.832)	(0.862)		
EQ/TA			-3.619**	-2.578
			(1.780)	(1.631)
Liquid assets	-1.076	-0.928	-1.571**	-1.178**
	(0.703)	(0.597)	(0.713)	(0.598)
DFR		4.064*		5.909***
		(2.203)		(1.811)
HHI		-0.248		-0.281
		(1.059)		(1.057)
Observations	1,264	1,264	1,264	1,264
R^2	0.312	0.339	0.241	0.306
Adjusted R^2	0.296	0.322	0.223	0.288
F Statistic	280.125*** (p = 0.000)	157.959*** (p = 0.000)	195.628*** (p = 0.000)	135.769*** (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks of 28 countries using quarterly interpolated data from 2007 Q4 until 2019 Q3.

Some observations were omitted due to missing datapoints in the dependent variable LDR.

This applies to Croatia, Hungary, Latvia and the United Kingdom. A total of 80 from 1344 observations were omitted.

Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Model (2) shows that an increase of 1 p.p. capital ratio is associated with a 1.862 decrease in LDR on average. This result appears to be driven by Tier1 capital rather than RWA. Although the RWA and LDR are positively correlated (appendix E.1), an increase in the unweighted capital ratio in (3) relates to a decrease in the LDR (-3.619) as well. Gambacorta & Shin (2016), Norden & Weber (2010), Polizzi, Scannala & Suárez (2020) report positive relations between credit supply and capital ratios. Equity and debt funding become more attractive as additional capital reduces its costs; through improvement of the risk profile of a bank. The data suggest that increased lending must be compensated by an even larger increase in deposit taking, resulting in the negative sign on the coefficients. This finding argues against our first hypothesis. It cannot be confirmed by these models that the liquidity risks and credit risks of a high LDR are compensated by retaining more capital.

If liquid assets increase by 1 p.p., on average, models (3) and (4) state that the LDR significantly decreases by -1.571 p.p. and -1.178 p.p. respectively. This is another argument against our hypothesis that liquid asset holdings act as a hedge for a high LDR. This finding serves the argument that banks prefer liquid asset holdings over low yielding, riskier loans (Naceur & Roulet, 2017). Van den End (2013) also suggests that a low LDR is associated with liquidity hoarding.

The DFR, our proxy for the monetary environment, is positively associated with the LDR. A 1.p.p. increase in the DFR relates to an average 4.064 p.p. and 5.909 p.p. increase in (3) and (4) respectively. This indicates that the LDR and DFR move in the same direction. In light of the current economic environment, where the DFR stands at -50 basis points (ECB, 2019), our result implies that banks on average provide less credit or have more deposits. This is in accordance with the findings of Heider, Saidi and Schepens (2018) who demonstrate that banks with a higher dependence on deposit funding relative to low-deposit banks tend to extend less credit. Although insignificant, the sign of the HHI does not align with the observations of Harrison, Klocanas & Sigee (2016) who suggested that increased market competition drives down the LDR.

In recap, we cannot provide evidence for the hypothesized trade-off. Funding and credit risk reflected by high LDRs do not appear to be hedged by more liquid assets and higher capital ratios. Higher capital ratios are associated with a lower LDR on average, indicating that banks have more funding relative to the amount of lending. The coefficient on the liquid asset ratio suggests that increased liquid asset holdings prevent banks from lending.

5.2 LDR and the NIM

Rising competition in the European banking sector and the monetary environment are pressuring the NIM (Klein, 2020) (Harrison, Klocanas, & Sigee, 2016). In Japan, the monetary environment and competitive landscape pushed the LDR trajectory down (Harrison, Klocanas, & Sigee, 2016) resulting in a loss of pricing power for banks.

Q2: *What is the correlation between the loan-to-deposit-ratio and the net interest margin of European banks?*

In this section we explore whether the link between the LDR and NIM is also present in Europe by regressing the NIM on the LDR, bank characteristics and the aforementioned controls. The results are presented in table 5.2.

Model (1) through (4) are highly significant. The LDR exerts a significant positive impact on the NIM in every model. Specification (2) tells us that a 1 p.p. increase in LDR is associated with a 0.005 p.p. increase in the NIM on average. The coefficient on the CIR tells us that the correlation with the NIM is negative supporting the findings of Angori, Aristei & Gallo (2019) and Dietrich & Wanzenried (2011).

Table 5.2 Regression results from full sample using country fixed effects and the NIM as dependent variable

	Dependent variable: NIM			
	Fixed effects			
	(1)	(2)	(3)	(4)
LDR	0.006**	0.005*	0.008**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)
CIR	-0.004***	-0.004**	-0.003**	-0.004**
	(0.002)	(0.002)	(0.001)	(0.002)
Tier1/RWA	-0.029*	-0.019*		
	(0.016)	(0.010)		
EQ/TA			0.003	0.018
			(0.029)	(0.026)
Liquid assets	-0.020*	-0.018*	-0.026***	-0.021**
	(0.011)	(0.010)	(0.010)	(0.009)
DFR		0.093***		0.127***
		(0.029)		(0.035)
HHI		-0.024**		-0.024*
		(0.011)		(0.013)
Observations	1,264	1,264	1,264	1,264
R^2	0.176	0.204	0.153	0.198
Adjusted R^2	0.155	0.183	0.131	0.177
F Statistic	65.866*** (p = 0.000)	52.698*** (p = 0.000)	55.488*** (p = 0.000)	50.721*** (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks from 28 countries using quarterly interpolated data from 2007 Q4 until 2019 Q3.

Some observations were omitted due to missing datapoints in the dependent variable LDR.

This applies to Croatia, Hungary, Latvia and the United Kingdom. A total of 80 from 1344 observations were omitted.

Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Contrasting with the results of Abreu & Mendes (2002), Menicucci & Paolucci (2016), and Angori, Aristei & Gallo (2019) the Tier1/RWA is negatively associated with the NIM at the 10 % significance level (1 & 2). Although statistically insignificant EQ/TA and the NIM are positively associated in (3) and (4). This indicates that the negative correlation with the NIM and Tier1/RWA is motivated by RWA. RWAs consist, for most part, of loans which determine a share of the interest income. In that sense a decline in RWAs could be associated with a lower NIM.

Liquid assets holdings negatively impact the NIM. An increase in liquid assets by 1 p.p. is associated with a -0.018 change in the NIM on average (model 2). This result emphasizes the opportunity cost of holding more liquid assets. The NIM and DFR are positively correlated. An increase of the DFR by 1.p.p. is associated to an average increase of 0.093 p.p. in the NIM which suggests they move in tandem. Since June 2014 the NIRP of the ECB is squeezing the margins of European banks (ECB, 2019) supporting the positive correlation reported here.

The HHI and NIM are positively linked in both (3) and (4) at the 5 % or 10 % significance level. A 1 p.p. increase of the HHI produces a -0.024 change in the NIM. This does not support the observations by the ECB (2019), Harrison, Klocanas & Sigee (2016) that competition puts pressure on the NIM. Our data indicates the contrary. When markets are more concentrated (less competition) the NIM declines on average, suggesting that more competition is positive for the NIM.

All in all, we find a positive correlation between the LDR and the NIM. The declining in LDR of European banks (figure 3.1) resembles the Japanese situation where the LDR dropped from 1.3. in 1990 to 0.65 in 2015 indicating a loss of pricing power (Harrison, Klocanas, & Sigee, 2016). The positive correlations between the LDR and NIM could point in the same the direction for Europe. The significant negative coefficient on the HHI, however ,does not support the idea that increased competition pressurizes the NIM.

5.3 Robustness checks

In order to gauge whether our results remain unchanged we conduct several robustness checks by running the same specifications on a number of subsamples.

5.3.1 Robustness checks of the trade-off

5.3.1.1 Cross-sectional analysis, alternative variables and subsample analyses

In order to control for time effects, we reran our regressions (appendix E.2) on time cross-sections using OLS. This resulted in 10 cross-sectional datasets, one for each full year, ranging from 2008 to 2018 with annual data. We proxied the DFR with the deposit rate to deal with the low yearly variation. The constant in the regressions is in line with the declining LDR we documented earlier. We observe sign changes on the capital ratio albeit that these results were insignificant due to a low number of observations. We decide that this cross-sectional analysis does not yield another conclusion with regard to the previous outcomes.

To measure whether the use of a different ratio for liquid assets leads to different conclusions we ran the regressions using models including liquid assets as percentage of total assets, including liquid assets other than cash, provided by the SDW. This led to a drop of observations as this variable is only available within a limited time frame. Our results remained unchanged by this (appendix E.3).

Because the average LDRs across European member states show quite some variation (figure 2.1) perhaps the trade-off is just a phenomenon at countries' banks with high average LDRs. We did not find graphical evidence before (cfr. 3.2.2.1) but still find it worthwhile to explore this. Therefore, we divide our original dataset in two parts based on the highest[1] and lowest[2] average LDRs consisting each of 5 countries. We repeated this exercise by splitting the sample in two. However, the results were similar to those of the full sample (regressions not shown). The results for the 5 countries with the lowest average LDR do not differ much from the initial regressions signaling that no trade-offs take place on banks' balance sheets. Something to note is that the coefficient of unweighted capital ratio in (4) is positive but insignificant (appendix E.4).

[1] Denmark, Sweden, Finland, Ireland and Spain
[2] Belgium, Croatia, Czech Republic, Hungary and the United Kingdom

5.3.1.2 Countries with highest average LDRs

The results from the countries with the highest average LDR are somewhat different (table 5.3). We do not find proof of the trade-off. In fact, the correlation between the capital ratios and the LDR seem to have become even stronger. Moreover, the explanatory power of these regressions has increased considerably compared to the full sample. In addition, liquid assets have a positive sign and become significant in (3) and (4). This result, however, appears to be driven by the inclusion of the DFR. The coefficient on the HHI in model 2 is significant at the 5 % level implicating that increased market concentration affects the LDR negatively. The significance disappears in the regression with the unweighted capital ratio (4).

Table 5.3 Regression results from subsample of 5 countries with highest average LDRs using country fixed effects and the LDR as dependent variable

	Dependent variable: LDR			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-4.697***	-4.640***		
	(0.960)	(0.789)		
EQ/TA			-8.393***	-7.890***
			(1.970)	(1.588)
Liquid assets	0.040	0.217**	0.079	0.470***
	(0.025)	(0.085)	(0.087)	(0.131)
DFR		2.442***		4.620***
		(0.903)		(0.974)
HHI		-1.837**		-1.547
		(0.811)		(1.014)
Observations	240	240	240	240
R^2	0.571	0.668	0.482	0.573
Adjusted R^2	0.560	0.657	0.468	0.558
F Statistic	154.984*** (p = 0.000)	116.196*** (p = 0.000)	108.282*** (p = 0.000)	77.520*** (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks from 5 countries with highest average LDR using quarterly interpolated data from 2007 Q4 until 2019 Q3.

Countries included in the analysis are Denmark, Finland, Ireland, Spain and Sweden.

Some observations were omitted due to missing datapoints in the dependent variable LDR.

Coefficients are adjusted with Arellano robust standard errors (in parentheses).

5.3.1.3 The influence of different ways of mortgage pricing

The credit market in the euro area is very heterogeneous when it comes to fixed or variable rate mortgages (Albartazzi, Fringuellotti, & Ongena, 2019). We additionally explore whether differentiating between countries with predominant adjustable rate mortgages (ARM[1]) or fixed rate mortgages (FRM[2]) will affect our results. Countries with a high LDR in an FRM-environment are exposed to more risk in case of interest rates going up whereas banks are more able to adjust their rates when pricing their mortgages with variable rates.

The results from the ARM subsample (table 5.4) resemble the outcome of our prior analysis (table 5.1). Capital and liquidity ratios remain to be negatively associated to the LDR. Liquid asset holdings are significant in (1) and (3) but this disappears in (2) and (4). The DFR has the same sign as in table 5.1 the HHI has a positive sign but is insignificant.

Table 5.4 Regression results from subsample of countries with predominant ARM using country fixed effects and LDR as dependent variable

	Dependent variable: LDR			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-2.755***	-2.603**		
	(1.038)	(1.022)		
EQ/TA			-4.001	-3.707
			(2.721)	(2.578)
Liquid assets	-0.396*	-0.147	-0.504**	-0.118
	(0.235)	(0.139)	(0.229)	(0.133)
DFR		3.025**		4.569***
		(1.519)		(1.401)
HHI		0.074		0.070
		(1.205)		(1.136)
Observations	792	792	792	792
R^2	0.247	0.262	0.114	0.148
Adjusted R^2	0.230	0.243	0.094	0.126
F Statistic	127.095*** (p = 0.000)	68.350*** (p = 0.000)	49.918*** (p = 0.000)	33.507*** (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks from 17 countries with variable rate mortgage pricing using quarterly interpolated data from 2007 Q4 until 2019 Q3.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
Countries include Finland, Poland, Sweden, Portugal, Romania, Spain, Austria
Greece, Bulgaria, Croatia, Slovakia, Estonia, Lativa, Slovenia, Lithuania, Malta and Cyprus
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

[1] ARM: Austria, Bulgaria, Croatia, Cyprus, Estonia, Finland, Greece, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden (Albartazzi, Fringuellotti, & Ongena, 2019)**Invalid source specified.**.

[2] FRM: Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Luxembourg and the United Kingdom (Albartazzi, Fringuellotti, & Ongena, 2019)**Invalid source specified.**.

Table 5.5 Regression results from subsample of countries with predominant FRM using country fixed effects and LDR as dependent variable

	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-3.477***	-3.390**		
	(1.111)	(1.420)		
EQ/TA			-6.951***	-6.614***
			(0.890)	(0.929)
Liquid assets	0.514	0.537	0.763	1.113**
	(0.391)	(0.507)	(0.634)	(0.534)
DFR		0.669		4.326***
		(1.974)		(1.636)
HHI		-1.596**		-2.355***
		(0.700)		(0.819)
Observations	472	472	472	472
R^2	0.431	0.470	0.397	0.542
Adjusted R^2	0.416	0.454	0.382	0.528
F Statistic	174.073*** (p = 0.000)	101.297*** (p = 0.000)	151.289*** (p = 0.000)	134.967*** (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks from 11 countries with fixed rate mortgage pricing using quarterly interpolated data from 2007 Q4 until 2019 Q3.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
Countries include Czech Republic, Denmark, United Kingdom, Belgium, Germany, Hungary, Ireland, Netherlands, France, Luxembourg and Italy.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

The FRM subsample shows highly significant negative capital ratios. Liquid assets have a positive sign in the FRM specifications (table 5.5) though only significant in the last one, which appears to be the result of the DFR. Again, we find no proof for the trade-off.

5.3.1.4 Still no evidence for the trade-off

To summarize, the results from the regressions ran on the full sample are very similar to the outcomes of the subsample analysis. Our results are robust to various subsamples. The cross-sectional analysis did yield sign changes on some of the coefficients but were not significant, due to the low sample size. The economic impact of the capital ratios on the LDR actually increased, relative to the full-sample analysis, in the top 5 LDR and FRM-sample. In both these subsamples we observed a sign change on the liquid asset coefficient. The significance of this seems to be driven by our monetary control variable. It is interesting though that the coefficient sign changes in these particular subsamples. On the one hand we could argue that the baseline regressions (1)(2) in table 5.4 and (3)(4) in table 5.5 which produced insignificant coefficients, do not provide enough proof for the trade-off taking place purely on a bank's balance sheet. On the other hand, the increased R^2 in the models with control variables do suggest a better fit of the data. Taken together with the fact that the descriptive statistics did not show higher than European average liquid assets holdings (figure 3.3) we, again, gather that this does not provide us with enough evidence to support the trade-off hypothesis. In addition, the negative sign on the HHI suggests that increased concentration, meaning lower competition, positively correlates with the LDR which is contrary to what the literature states.

5.3.2 Robustness checks of the LDR and the NIM

Just like in the previous section we reran the regressions on some of the subsamples to test whether our prior findings remain the same. Furthermore, we used an alternative measure for banking performance to examine whether the effects remain unchanged.

In the analysis of the cross-sectional regressions almost none of the coefficients were significant which we ascribe to the low sample size. We did not encounter significant coefficients in the subsamples organized according to high/low average LDRs either (regressions not shown).

5.3.2.1 The NIM and the influence of mortgage pricing

Banks' pricing power can be affected by the way banks price their mortgages. The predominance of ARM[1] can lead to a less pricing power relative to an FRM[2]-environment. Spain, for instance, prices mortgages at the 12m EURIBOR which is reset annually. Hence, banks are limited in their ability to widen mortgages spreads to compensate for a lower negative EURIBOR (Harrison, Klocanas, & Sigee, 2016). We now consider whether this affects the economic impact of the coefficients on the LDR on the NIM.

The LDR coefficients lose significance except in model (2) (table 5.6) which even has a negative sign. Compared to the full sample analysis (table 5.2) the coefficient on the HHI shows a decreased economic impact. The overall economic impact of the coefficients in the ARM-environment are smaller than in the full sample but show the same signs overall.

In the FRM-sample (table 5.7) there are almost no significant effects in models (1) and (2). Specifications (3) and (4) show significant coefficients on the LDR but not on the HHI. Compared to the ARM-context this suggest that a higher LDR is positive for the NIM only when mortgages are priced at a fixed rate. This is dependent on the level of interest rates. Increasingly negative rates in an FRM-environment imply a higher spread relative to banks which price their mortgages with adjustable rates. EQ/TA is positively significant in both models supporting the findings of Gambacorta & Shin (2016). However, the impact of CIR loses its significance in model (8). Moreover, the explanatory power of both models appears particularly low.

[1] ARM: Austria, Bulgaria, Croatia, Cyprus, Estonia, Finland, Greece, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden (Albartazzi, Fringuellotti, & Ongena, 2019)**Invalid source specified.**.

[2] FRM: Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Luxembourg and the United Kingdom (Albartazzi, Fringuellotti, & Ongena, 2019)**Invalid source specified.**.

Table 5.6 Regressions results from subsample of countries with predominantly ARM using country fixed effects and NIM as dependent variable

	Dependent variable: NIM			
	Fixed effects			
	(1)	(2)	(3)	(4)
LDR	0.0003	-0.001^{**}	0.001	-0.001
	(0.001)	(0.0004)	(0.001)	(0.0003)
CIR	-0.012	-0.012	-0.013	-0.012
	(0.009)	(0.008)	(0.009)	(0.008)
Tier1/RWA	-0.016^{**}	-0.010^{***}		
	(0.007)	(0.003)		
EQ/TA			-0.025^{*}	-0.019^{***}
			(0.015)	(0.007)
Liquid assets	-0.053^{***}	-0.038^{***}	-0.053^{***}	-0.038^{***}
	(0.014)	(0.013)	(0.014)	(0.013)
DFR		0.183^{***}		0.185^{***}
		(0.047)		(0.047)
HHI		-0.009^{**}		-0.009^{**}
		(0.004)		(0.004)
Observations	792	792	792	792
R^2	0.151	0.221	0.148	0.220
Adjusted R^2	0.129	0.198	0.126	0.198
F Statistic	34.359^{***} (p = 0.000)	36.258^{***} (p = 0.000)	33.491^{***} (p = 0.000)	36.197^{***} (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks from 17 countries with adjustable rate mortgage (ARM) pricing using quarterly interpolated data from 2007 Q4 until 2019 Q3.

Some observations were omitted due to missing datapoints in the dependent variable LDR.

Countries include Finland, Poland, Sweden, Portugal, Romania, Spain, Austria

Greece, Bulgaria, Croatia, Slovakia, Estonia, Lativa, Slovenia, Lithuania, Malta and Cyprus

Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Table 5.7 Regressions results from subsample of countries with predominantly FRM using country fixed effects and NIM as dependent variable

	Dependent variable: NIM			
	Fixed effects			
	(1)	(2)	(3)	(4)
LDR	0.002	0.001	0.011^{***}	0.008^{**}
	(0.004)	(0.004)	(0.004)	(0.003)
CIR	-0.003^{**}	-0.003^{**}	-0.002^{*}	-0.002^{*}
	(0.001)	(0.001)	(0.001)	(0.001)
Tier1/RWA	-0.043	-0.037		
	(0.028)	(0.027)		
EQ/TA			0.083^{**}	0.079^{**}
			(0.042)	(0.033)
Liquid assets	0.001	0.003	-0.026^{***}	-0.018^{*}
	(0.015)	(0.013)	(0.007)	(0.010)
DFR		0.052		0.102^{*}
		(0.045)		(0.057)
HHI		-0.035^{**}		-0.014
		(0.016)		(0.013)
Observations	472	472	472	472
R^2	0.110	0.134	0.107	0.141
Adjusted R^2	0.083	0.104	0.080	0.111
F Statistic	14.182^{***} (p = 0.000)	11.730^{***} (p = 0.000)	13.729^{***} (p = 0.000)	12.456^{***} (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks from 11 countries with fixed rate mortgate pricing (FRM) using quarterly interpolated data from 2007 Q4 until 2019 Q3.

Some observations where omitted due to missing datapoints in the dependent variable LDR

Countries include Czech Republic, Denmark, United Kingdom, Belgium, Germany, Hungary, Ireland, Netherlands, France, Luxembourg and Italy.

Coefficients are adjusted with Arellano robust standard errors (in parentheses).

5.3.2.2 An alternative variable for banking performance

Table 5.8 shows the regressions with an alternative measure for banking performance. Something that immediately stands out is that LDR significantly impacts the ROA in a negative way. A potential explanation is that as banks increase lending there is less room for non-interest income driving down the ROA. ROA measures the income earned per asset and reflects how effectively the banks resources are managed to produce profits (Menicucci & Paolucci, 2016). A high LDR implies a mismatch between deposits and lending and could, in a sense, indicate ineffective management of a banks' resources. The coefficients on the CIR align with the evidence from Menicucci & Paolucci (2016) Although not all are significant, the positive effect of the capital ratios on banking performance becomes clear in these regressions. A higher capital base leads to lower cost of funding (Gambacorta & Shin, Why bank capital matters for monetary policy, 2016) which results in a higher ROA (Menicucci & Paolucci, 2016). Models (3) and (4) report a significant positive impact from liquid assets holdings on ROA the reason for the significance appears to be the DFR. The HHI is insignificant in both regressions.

Table 5.8 Regression results from full sample using country fixed effects and ROA as dependent variable

	Dependent variable: ROA			
	Fixed effects			
	(1)	(2)	(3)	(4)
LDR	-0.006^{***}	-0.009^{***}	-0.004^{*}	-0.008^{***}
	(0.002)	(0.002)	(0.002)	(0.002)
CIR	-0.010^{***}	-0.011^{***}	-0.009^{***}	-0.009^{***}
	(0.002)	(0.002)	(0.002)	(0.002)
Tier1/RWA	0.002	0.031^{**}		
	(0.010)	(0.012)		
EQ/TA			0.089^{***}	0.121^{***}
			(0.025)	(0.039)
Liquid assets	0.014	0.021^{**}	0.010	0.022^{**}
	(0.010)	(0.010)	(0.009)	(0.010)
DFR		0.266^{***}		0.273^{***}
		(0.053)		(0.053)
HHI		-0.013		-0.011
		(0.012)		(0.010)
Observations	1,264	1,264	1,264	1,264
R^2	0.120	0.218	0.163	0.278
Adjusted R^2	0.098	0.197	0.142	0.259
F Statistic	42.024^{***} (p = 0.000)	57.287^{***} (p = 0.000)	59.973^{***} (p = 0.000)	78.989^{***} (p = 0.000)

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$
Domestic and foreign banks from 28 countries using quarterly interpolated data from 2007 Q4 until 2019 Q3.
Some observations were omitted due to missing datapoints in the dependent variable LDR. This applies to Croatia, Hungary, Latvia and the United Kingdom. A total of 80 from 1344 observations were omitted.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

5.3.2.3 Modest evidence of a positive correlation between the LDR and NIM

Our results lost economic impact and significance when performing the robustness checks, but our main conclusions remain largely unchanged. Gauging the effect between LDR and banking performance, measured by the ROA, leads to a reversed sign on the LDR coefficients. We do find a positive correlation between the LDR and NIM in the full sample analysis. However, the economic impact is quite small. All in all, this indicates that the correlation between the NIM and LDR might not be as clear cut as previously hypothesized and requires further enquiry. Furthermore, we do not find evidence for both the LDR and the NIM to be pressurized by competition.

6 Discussion

Table 6.1 presents an overview of our results as found in table 5.1-2. We gather that there is not enough evidence to support our trade-off hypothesis. European banks do not hedge credit and liquidity risk, brought by on higher LDRs, by retaining more capital or liquid assets. We did however find some evidence, although weak, of a positive correlation between the NIM and LDR. In this section we explain our results in a broader economic framework and provide grounds for our findings.

Table 6.1 Summary of regression results

Summary of results		
Dependent variables	**LDR**	**NIM**
LDR	n.a.	+*
CIR	n.a.	-*
T1/RWA	- *	-*
EQ/TA	-	+
Liquid assets	- *	-*
DFR	+*	+*
HHI	-	-*

Significant effects indicated with an asterix

A high LDR signals a mismatch and funding risk whereas a low LDR points to disintermediation. We investigated whether European banks strengthen their risk profile to cover risks from a high LDR by maintaining higher capital and liquidity buffers. We could not find evidence for this hypothesis. Since the implementation of the Basel III framework banks have been improving their capital and liquidity ratios (BIS, 2019). We found negative correlations between (risk-based) capital ratios and the LDR of European banks. While a higher capital base increases lending (Gambacorta & Shin, Why bank capital matters for monetary policy, 2016) this must be offset by an even greater growth in deposits. This increase in deposits is suggested by figure 3.2.

We reckon that this deposit growth has to do with the past and current economic environment. The deposit base of European banks is still increasing despite historically low interest rates in 2019 (EBA, 2019). Banks tend to increase their share of deposits and reduce short-term and money market funding (Brei, Borio, & Gambacorta, Bank intermediation activity in a low interest rate environment, 2019). On the other hand, does this environment also stimulate lending growth (Klein, 2020). Our results suggest that the former has the upper hand. It also fits the picture of the decreasing LDR we observed in figure 3.1.

What is more, we found that an increase in liquid assets negatively relates to the LDR. Liquid assets sit idle on banks' balance sheets as they are not converted to loans. The negative relation between liquid assets and the NIM emphasizes this phenomenon as they are not converted into interest earning assets. The European banking landscape is currently dealing with excess liquidity, brought on by the easing measures of the ECB (Darvas & Pichler, 2018) (ECB, 2017). This corresponds with figure 3.5 where we saw that liquid assets have been increasing since mid 2014. Together with the low interest rate environment the negative sign on the liquid asset ratio might be explained through preference for liquid asset holdings over riskier, low yielding loans (Naceur & Roulet, 2017).

According to our data these liquid assets can affect the trajectory of the LDR as well as the NIM. Although the capital and funding positions of European banks have greatly improved, the amount of liquidity in the system as a whole could be driving down the LDR in tandem with the NIM. Moreover, our data pointed to a positive, but weak, correlation between the LDR and the NIM indicating that these forces could be mutually reinforcing. Our data showed a negative correlation between the NIM and risk-based capital ratio, which is contrary to what the literature finds. The same goes for competition and the NIM. Perhaps this is the result of the specifications used to measure the correlations.

Together with the low interest rate environment the European banking landscape is resembling the Japanese situation. While low interest rates are good for credit transmission, the effects only hold up to a certain point. Persistent low rates, like in Japan, could significantly impact margins over time (Lakhani, Reid, & Templeman, 2019). A loss of pricing power implied by the downward sloping LDR and pressurized NIM could further plateau loan yields. With deposit rates around zero bank margins are diminishing and banks are more prone to take more risk. Unless these concerns are addressed, the Eurozone-economy is likely to stagnate in the long run as the banking system and the economy in Europe are inseparable.

6.1 Scandinavian countries

The LDRs of Scandinavian countries are much higher than their European peers (figure 2.1, table 3.4). Denmark shows high lending relative to international standards (Danmarks Nationalbank, 2019). Danish banks, in addition, rely on mortgage bonds for funding and adopt additional policy measures in order to cover liquidity and credit risks (Danmarks Nationalbank, 2018). Swedish banks are taking greater structural liquidity risks compared to other European banks. This can be explained, to some extent, by the fact that Swedish banks obtain their funding on financial markets rather than through deposits (Sveriges Riksbank, 2019).

The Bank of Finland identifies exposure to market funding as a structural risk for the Finnish banking system as well as the high levels of indebtedness of households and NFCs (Finlands bank, 2019). All in all, the way of funding and the high levels of credit extension explain the high LDRs of Scandinavian countries. The risks are not covered by liquid assets and capital ratios. Especially in Finland and Sweden this calls for additional policy measures.

7 Conclusion

This study dealt with two hypotheses regarding the LDRs of European banks. The first hypothesis stated that European banks improve their risk profile, reflected by high LDRs, by retaining higher capital bases and liquidity asset holdings. The second hypothesis concerned the correlation between the NIM and LDR. We learned from Japan that these two might depend on each another which put the pricing power of European banks at risk, and ultimately endanger financial stability.

Using country fixed effects estimators with Arellano robust standard errors in a panel of 28 countries ranging from 2007 until 2019, we estimated static linear regressions to test our hypotheses.

We found that the LDR and capital ratios are negatively rather than positively correlated. An increase in lending, brought on by more capital, must be offset by a higher increase in deposits. The latter potentially being the result of the low interest rate environment. Liquid assets holdings are also negatively related to the LDR. Liquid asset holdings sit idle on banks' balance sheet and are not converted into loans. Against the backdrop of the low interest rate environment there is the additional possibility that banks prefer low yielding safe liquid assets instead of low yielding riskier loans. The results remained unchanged in several subsample analyses. Considering all, cannot provide evidence of a trade-off taking place on the balance sheet of European banks.

With regards to the second hypothesis we reported a positive significant correlation between the LDR and the NIM. The economic impact of the correlation, however, was quite low. Moreover, some of the correlations tipped over to the negative side in robustness checks implying a modest relation.

7.1 Limitations & future research

Although we showed that linear interpolation did not bias our results, we were still dealing with quite a few missing observations. Since the data we used resulted from aggregation this could also smooth out interesting observations. The use of a static linear model and not addressing potential endogeneity are likewise limitations of this study. The lack of availability of data for a longer time period could also be addressed in the future. Moreover, the cross-sectional robustness checks did not yield significant results but did show interesting coefficient signs. A further analysis with increased sample size, data at bank-level, dynamic models and addressing endogeneity are likely to provide a deeper understanding of the correlations we found and presented to you in this report

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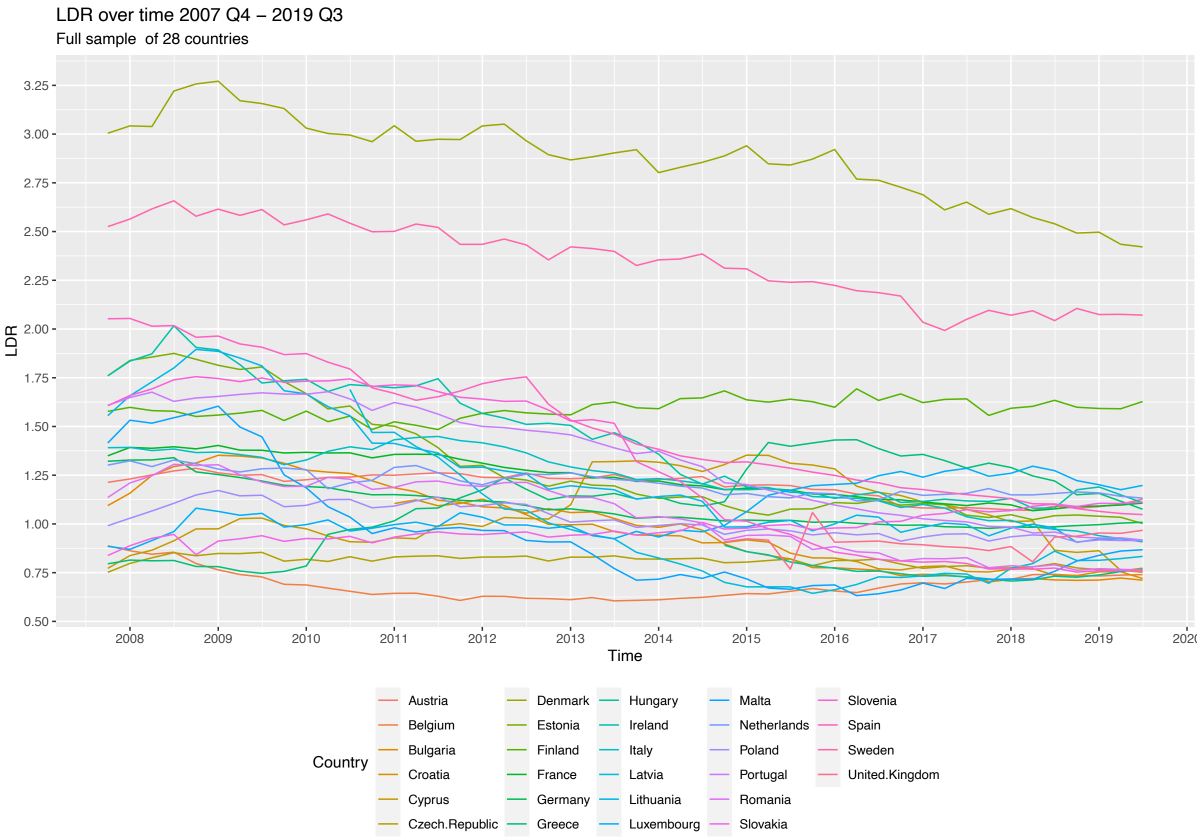
Appendices

Appendix B

B.1 LDR over time using the full sample of 28 European countries from 2007 Q4 – 2019 Q3.



Appendix C

C.1 Regressions results using bi-annual interpolated data and annual data

Table C.1.1 Regressions using biannual interpolated data with LDR as dependent variable

	Dependent variable: LDR			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-2.802^{***}	-2.580^{***}		
	(0.884)	(0.897)		
EQ/TA			-4.165^{**}	-3.690^{*}
			(2.082)	(1.974)
Liquid assets	-0.070	0.129	-0.357	-0.011
	(0.312)	(0.257)	(0.314)	(0.232)
DFR		2.760^{**}		4.284^{***}
		(1.239)		(1.228)
HHI		-0.181		-0.280
		(1.124)		(1.080)
Observations	631	631	631	631
R^2	0.272	0.289	0.147	0.190
Adjusted R^2	0.237	0.252	0.106	0.148
F Statistic	112.535^{***} (p = 0.000)	60.947^{***} (p = 0.000)	51.891^{***} (p = 0.000)	35.103^{***} (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks of 28 countries using biannual interpolated data from 2007 Q4 until 2019 Q2.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
This applies to Croatia, Hungary, Latvia and the United Kingdom.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Table C.1.2 Regressions using biannual interpolated data with NIM as dependent variable

	Dependent variable: NIM			
	Fixed effects			
	(1)	(2)	(3)	(4)
LDR	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}
	(0.0004)	(0.0004)	(0.0005)	(0.0004)
CIR	-0.006^{*}	-0.006^{*}	-0.006^{*}	-0.006^{*}
	(0.003)	(0.003)	(0.003)	(0.003)
Tier1/RWA	-0.011^{**}	-0.007		
	(0.005)	(0.005)		
EQ/TA			0.0004	0.005
			(0.006)	(0.007)
Liquid assets	-0.008	0.003	-0.008	0.004
	(0.013)	(0.014)	(0.014)	(0.014)
DFR		0.147^{***}		0.149^{***}
		(0.051)		(0.051)
HHI		-0.004^{**}		-0.005^{**}
		(0.002)		(0.002)
Observations	631	631	631	631
R^2	0.040	0.100	0.036	0.099
Adjusted R^2	-0.003	0.057	-0.007	0.056
F Statistic	6.331^{***} (p = 0.0001)	11.153^{***} (p = 0.000)	5.663^{***} (p = 0.0002)	11.025^{***} (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks from 28 countries using biannual interpolated data from 2007 Q4 until 2019 Q2.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
This applies to Croatia, Hungary, Latvia and the United Kingdom.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Table C.1.3 Regressions using annual (non-interpolated) data with LDR as dependent variable

	Dependent variable: LDR			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-2.178***	-1.496*		
	(0.777)	(0.796)		
EQ/TA			-3.250**	-2.182
			(1.585)	(1.480)
Liquid assets	-1.207*	-1.137*	-1.578**	-1.279*
	(0.733)	(0.681)	(0.755)	(0.689)
DFR		4.931**		6.150***
		(2.077)		(1.723)
HHI		0.222		0.069
		(1.398)		(1.428)
Observations	315	289	315	289
R^2	0.306	0.354	0.237	0.332
Adjusted R^2	0.236	0.276	0.159	0.252
F Statistic	62.898*** (p = 0.000)	35.235*** (p = 0.000)	44.288*** (p = 0.000)	31.982*** (p = 0.000)

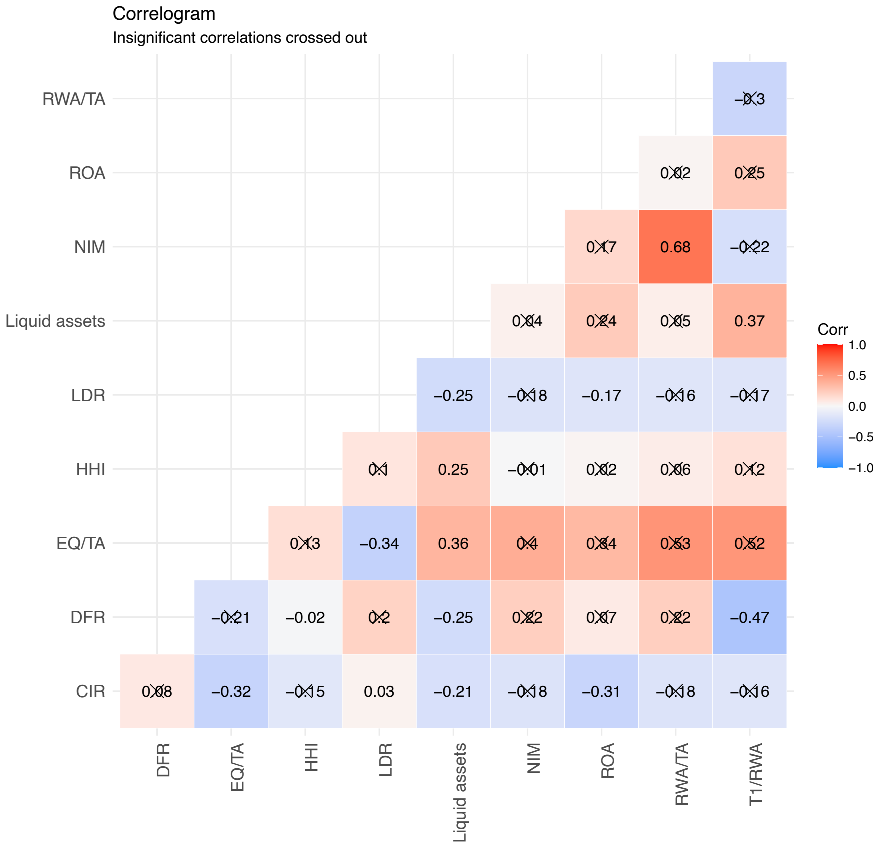
Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks of 28 countries using annual data from 2008 - 2018.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
This applies to Croatia, Hungary, Latvia and the United Kingdom.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Table C.1.4 Regressions using annual (non-interpolated) data with NIM as dependent variable

	Dependent variable: NIM			
	Fixed effects			
	(1)	(2)	(3)	(4)
LDR	0.001	0.001	0.003	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
CIR	-0.002***	-0.002***	-0.002**	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
Tier1/RWA	-0.011**	-0.010*		
	(0.005)	(0.006)		
EQ/TA			0.016	0.018
			(0.026)	(0.029)
Liquid assets	0.008	0.006	0.005	0.004
	(0.006)	(0.005)	(0.006)	(0.005)
DFR		0.008		0.028
		(0.025)		(0.029)
HHI		-0.004		-0.004
		(0.007)		(0.009)
Observations	315	289	315	289
R^2	0.060	0.051	0.053	0.051
Adjusted R^2	-0.043	-0.072	-0.051	-0.072
F Statistic	4.514*** (p = 0.002)	2.288** (p = 0.037)	3.932*** (p = 0.005)	2.285** (p = 0.037)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks from 28 countries using annualdata from 2008 - 2018.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
This applies to Croatia, Hungary, Latvia and the United Kingdom.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

C.2 Correlogram



Appendix D

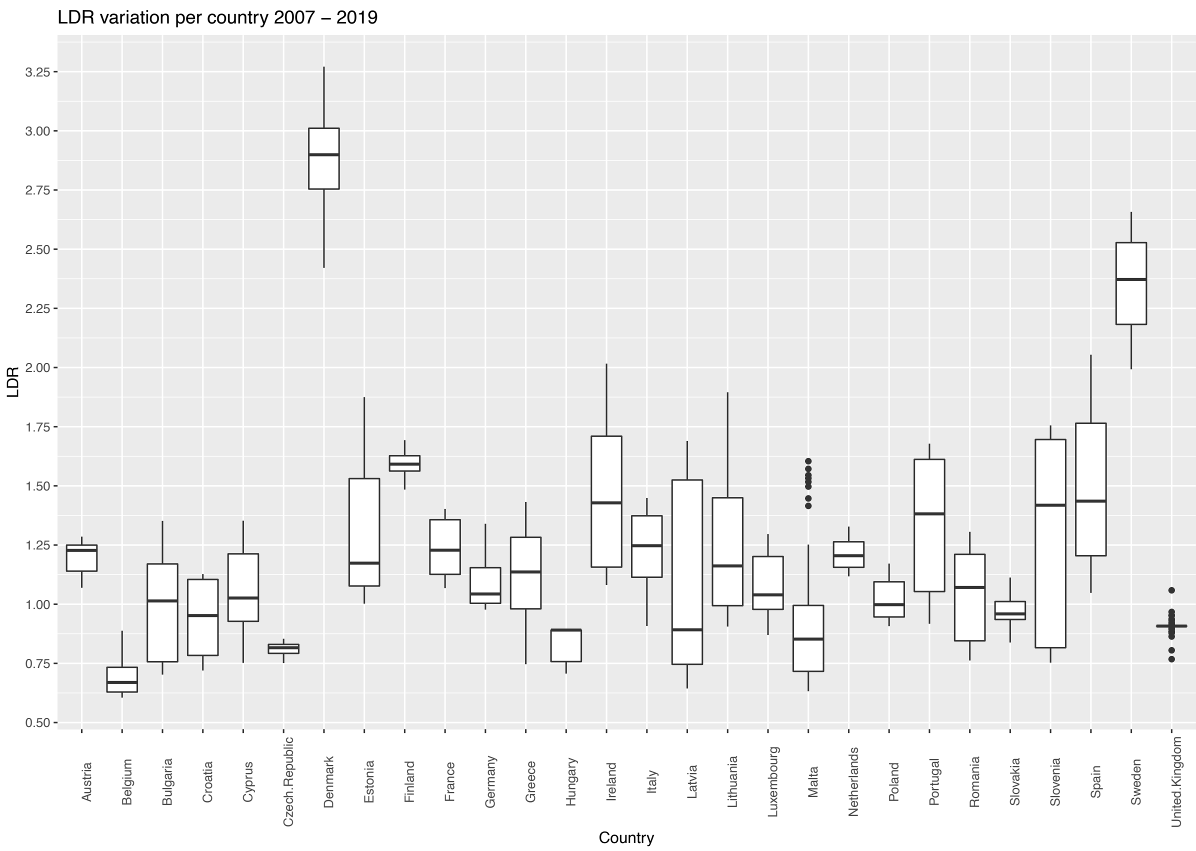
D.1 Mathematical proof for the fixed-effect estimator. Adding an intercept is the same as estimating regressions in deviations from the means.

$Sample\ regression\ function$
$$Y_i = \hat{\beta}_1 + \hat{\beta}_2 X_i + \hat{\epsilon}_i \qquad (1)$$

$OLS\ estimate\ for\ \hat{\beta}_1$
$$\hat{\beta}_1 = \bar{Y} - \hat{\beta}_2 \bar{X} \qquad (2)$$

$Substitute\ (2)\ in\ (1)\ and\ rewrite$
$$(Y_i - \bar{Y}) = (X_i - \bar{X})\hat{\beta}_2 + \hat{\epsilon}_i$$

D.2 LDR variation within countries



D.3 Hausman tests

Table D.3.1 Hausman test dependent variable LDR

```
        Hausman Test

data:  LDR ~ LIQ + T1_RWA
chisq = 0.72214, df = 2, p-value = 0.6969
alternative hypothesis: one model is inconsistent
```

```
        Hausman Test

data:  LDR ~ LIQ + T1_RWA + DEP + HHI_int
chisq = 2.5496, df = 4, p-value = 0.6358
alternative hypothesis: one model is inconsistent
```

```
        Hausman Test

data:  LDR ~ LIQ + EQ_TA
chisq = 0.14403, df = 2, p-value = 0.9305
alternative hypothesis: one model is inconsistent
```

```
        Hausman Test

data:  LDR ~ LIQ + EQ_TA + DEP + HHI_int
chisq = 2.0468, df = 4, p-value = 0.7271
alternative hypothesis: one model is inconsistent
```

Table D.3.2 Hausman test dependent variable NIM

```
        Hausman Test

data:  NIM ~ LDR + CI + T1_RWA + LIQ
chisq = 77.252, df = 4, p-value = 6.651e-16
alternative hypothesis: one model is inconsistent
```

```
        Hausman Test

data:  NIM ~ LDR + CI + T1_RWA + LIQ + DEP + HHI_int
chisq = 83.999, df = 6, p-value = 5.32e-16
alternative hypothesis: one model is inconsistent
```

```
        Hausman Test

data:  NIM ~ LDR + CI + EQ_TA + LIQ
chisq = 122.88, df = 4, p-value < 2.2e-16
alternative hypothesis: one model is inconsistent
```

```
        Hausman Test

data:  NIM ~ LDR + CI + EQ_TA + LIQ + DEP + HHI_int
chisq = 66.517, df = 6, p-value = 2.113e-12
alternative hypothesis: one model is inconsistent
```

D.4 Regressions with the random-effects estimator

Table D.4.1 Regressions with random-effects estimator with dependent variable LDR

	Dependent variable: LDR			
	Random effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-2.395***	-1.855**		
	(0.828)	(0.857)		
EQ/TA			-3.630**	-2.597
			(1.765)	(1.617)
Liquid assets	-1.082	-0.933	-1.569**	-1.177**
	(0.700)	(0.596)	(0.710)	(0.597)
DFR		4.084*		5.909***
		(2.202)		(1.817)
HHI		-0.220		-0.248
		(1.033)		(1.030)
Constant	1.638***	1.566***	1.620***	1.524***
	(0.150)	(0.205)	(0.176)	(0.218)
Observations	1,264	1,264	1,264	1,264
R^2	0.307	0.334	0.238	0.302
Adjusted R^2	0.306	0.332	0.237	0.300
F Statistic	558.971*** (p =)	630.453*** (p =)	393.355*** (p =)	544.767*** (p =)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks of 28 countries using quarterly interpolated data from 2007 Q4 until 2019 Q3.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
This applies to Croatia, Hungary, Latvia and the United Kingdom. A total of 80 from 1344 observations were omitted.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Table D.4.2 Regressions with random-effects estimator with dependent variable NIM

	Dependent variable: NIM			
	Random effects			
	(1)	(2)	(3)	(4)
LDR	0.004*	0.004	0.007**	0.005*
	(0.003)	(0.002)	(0.003)	(0.003)
CIR	-0.004***	-0.004**	-0.003**	-0.004**
	(0.002)	(0.002)	(0.001)	(0.002)
Tier1/RWA	-0.033**	-0.022**		
	(0.016)	(0.011)		
EQ/TA			0.012	0.029
			(0.026)	(0.025)
Liquid assets	-0.019	-0.017	-0.027**	-0.021**
	(0.012)	(0.011)	(0.011)	(0.009)
DFR		0.100***		0.147***
		(0.028)		(0.035)
HHI		-0.021**		-0.020**
		(0.009)		(0.010)
Constant	0.018***	0.020***	0.010*	0.012**
	(0.005)	(0.004)	(0.006)	(0.005)
Observations	1,264	1,264	1,264	1,264
R^2	0.162	0.191	0.125	0.180
Adjusted R^2	0.159	0.187	0.122	0.176
F Statistic	242.759*** (p =)	297.164*** (p =)	179.494*** (p =)	275.793*** (p =)

Note: *p<0.1; **p<0.05; ***p<0.01
Domestic and foreign banks from 28 countries using quarterly interpolated data from 2007 Q4 until 2019 Q3.
Some observations were omitted due to missing datapoints in the dependent variable LDR.
This applies to Croatia, Hungary, Latvia and the United Kingdom. A total of 80 from 1344 observations were omitted.
Coefficients are adjusted with Arellano robust standard errors (in parentheses).

Appendix E

E.1 Regression with RWA and the LDR

	Dependent variable: LDR
	Fixed effects
RWA/TA	1.934***
	(0.320)
	t = 6.044
	p = 0.000
Liquid assets	-0.023
	(0.091)
	t = -0.255
	p = 0.799
DFR	1.800*
	(0.942)
	t = 1.910
	p = 0.057
HHI	-0.095
	(0.745)
	t = -0.127
	p = 0.899
Observations	1,264
R^2	0.449
Adjusted R^2	0.435
F Statistic	250.543*** (p = 0.000)
Note:	*p<0.1; **p<0.05; ***p<0.01

E.2 Cross-sectional regressions with LDR as dependent variable

Table E.2.1 Cross-sectional baseline regressions with risk-based capital ratio

	Dependent variable: LDR										
	OLS										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Tier1/RWA	-1.585	-2.327	-1.868	-1.682	-1.302	-3.977	1.396	4.368*	4.171*	3.960	4.811
	(7.291)	(5.343)	(2.077)	(1.998)	(2.152)	(2.953)	(2.364)	(2.334)	(2.356)	(2.375)	(3.202)
Liquid assets	-1.649	-1.728	-1.503	-2.583	-1.546	-1.920	-2.177	-3.524**	-2.893**	-1.601	-1.885
	(2.254)	(2.564)	(2.216)	(2.371)	(2.425)	(1.997)	(1.821)	(1.466)	(1.382)	(1.170)	(1.119)
Constant	1.645**	1.745**	1.645***	1.732***	1.593***	1.969***	1.139***	0.718*	0.650*	0.596	0.443
	(0.682)	(0.617)	(0.309)	(0.317)	(0.338)	(0.472)	(0.364)	(0.351)	(0.358)	(0.385)	(0.503)
Observations	23	23	23	24	25	26	26	26	26	28	26
R^2	0.032	0.031	0.055	0.077	0.036	0.105	0.060	0.223	0.187	0.121	0.140
Adjusted R^2	-0.064	-0.066	-0.040	-0.010	-0.051	0.027	-0.021	0.155	0.117	0.051	0.065
Residual Std. Error	0.542	0.538	0.489	0.511	0.507	0.468	0.476	0.394	0.382	0.412	0.363
F Statistic	0.335 (p = 0.720)	0.320 (p = 0.730)	0.578 (p = 0.571)	0.882 (p = 0.429)	0.414 (p = 0.667)	1.345 (p = 0.281)	0.740 (p = 0.488)	3.296* (p = 0.056)	2.649* (p = 0.093)	1.725 (p = 0.199)	1.868 (p = 0.178)

Note: *p<0.1; **p<0.05; ***p<0.01

Each cross-section corresponds to a year and contains data on 28 countries. Some cases were omitted due to missing variables.

The data are not interpolated.

Table E.2.2 Cross-sectional regressions with controls and risk-based capital ratio

	Dependent variable: LDR										
	OLS										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Tier1/RWA	-10.939	-10.688**	-10.379**	-1.342	-0.302	-2.637	-0.731	0.698	1.624	2.895	-0.768
	(6.486)	(4.355)	(3.763)	(1.313)	(3.757)	(3.638)	(1.229)	(1.972)	(1.304)	(1.764)	(4.990)
Liquid assets	0.565	-1.514	-0.915	-0.142	-0.047	-0.309	-1.464	-1.906	-0.647	-1.176	-0.007
	(4.969)	(3.592)	(2.455)	(2.130)	(2.987)	(2.111)	(1.072)	(1.253)	(0.882)	(0.837)	(1.271)
Deposit rate	-18.216	-2.455	-4.791	6.379	7.940	6.461	3.458	3.979	10.946	5.594	-2.008
	(25.368)	(8.915)	(9.497)	(9.468)	(11.346)	(10.846)	(8.313)	(10.394)	(7.660)	(10.408)	(14.163)
HHI	1.315	1.651	1.123	0.498	0.675	0.916	1.602**	1.286	-0.705	-0.345	0.944
	(1.378)	(1.165)	(0.961)	(0.901)	(1.342)	(0.879)	(0.732)	(1.071)	(0.880)	(0.828)	(0.974)
Constant	3.025**	2.442***	2.457***	1.289***	1.090	1.417**	1.137***	0.988***	0.857***	0.681**	1.044
	(1.263)	(0.527)	(0.484)	(0.330)	(0.650)	(0.623)	(0.223)	(0.294)	(0.201)	(0.246)	(0.679)
Observations	17	17	16	18	17	17	17	16	16	16	16
R^2	0.238	0.387	0.440	0.142	0.135	0.301	0.398	0.291	0.243	0.239	0.085
Adjusted R^2	-0.016	0.183	0.236	-0.122	-0.154	0.069	0.197	0.034	-0.033	-0.037	-0.247
Residual Std. Error	0.375	0.318	0.296	0.315	0.301	0.241	0.207	0.230	0.175	0.194	0.250
F Statistic	0.936 (p = 0.476)	1.894 (p = 0.177)	2.158 (p = 0.142)	0.539 (p = 0.710)	0.467 (p = 0.759)	1.295 (p = 0.327)	1.981 (p = 0.162)	1.130 (p = 0.392)	0.881 (p = 0.507)	0.865 (p = 0.515)	0.256 (p = 0.900)

Note: *p<0.1; **p<0.05; ***p<0.01

Each cross-section corresponds to a year and contains data on 28 countries. The data are not interpolated.As a consequence some cases were omitted because of missing observations.

Subject to taking cross-sections the deposit facility is proxied by the deposit rate.

Table E.2.3 Cross-sectional baseline regressions with unweighted capital ratio

	Dependent variable: LDR										
						OLS					
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
EQ/TA	-1.171	-4.173	-3.228	-3.840	-4.358	-6.706**	-6.977*	-6.184	-6.380*	-6.138**	-5.036*
	(5.987)	(5.122)	(3.006)	(2.959)	(2.624)	(2.896)	(3.426)	(3.956)	(3.401)	(2.848)	(2.736)
Liquid assets	-1.464	-0.815	-0.716	-1.264	-0.308	-0.328	-0.113	-1.306	-0.822	-0.410	-0.456
	(2.636)	(2.768)	(2.254)	(2.480)	(2.436)	(1.983)	(1.813)	(1.714)	(1.468)	(1.079)	(1.037)
Constant	1.560***	1.734***	1.615***	1.731***	1.682***	1.842***	1.808***	1.805***	1.759***	1.699***	1.550***
	(0.337)	(0.344)	(0.246)	(0.237)	(0.230)	(0.248)	(0.275)	(0.308)	(0.295)	(0.279)	(0.247)
Observations	23	23	23	24	25	26	26	27	28	28	27
R^2	0.032	0.053	0.070	0.117	0.129	0.217	0.192	0.192	0.173	0.177	0.168
Adjusted R^2	-0.065	-0.041	-0.023	0.033	0.050	0.149	0.122	0.125	0.107	0.111	0.099
Residual Std. Error	0.542	0.532	0.485	0.500	0.482	0.437	0.441	0.445	0.434	0.399	0.350
F Statistic	0.330 (p = 0.723)	0.563 (p = 0.579)	0.754 (p = 0.484)	1.393 (p = 0.271)	1.635 (p = 0.218)	3.182* (p = 0.061)	2.732* (p = 0.087)	2.855* (p = 0.078)	2.622* (p = 0.093)	2.679* (p = 0.089)	2.423 (p = 0.111)

Note: *p<0.1; **p<0.05; ***p<0.01

Each cross-section corresponds to a year and contains data on 28 countries. The data are not interpolated. As a consequence some cases were omitted because of missing observations.

Table E.2.4 Cross-sectional regressions with controls and unweighted capital ratio

	Dependent variable: LDR										
						OLS					
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
EQ/TA	3.226	0.968	-0.894	-1.260	-0.474	-1.669	-0.265	-1.328	-2.763	0.234	-5.865**
	(6.002)	(5.356)	(6.897)	(2.097)	(3.137)	(2.721)	(2.153)	(2.714)	(2.521)	(3.277)	(2.367)
Liquid assets	1.740	2.207	1.533	0.588	0.156	0.509	-1.477	-1.498	0.007	-0.367	0.381
	(5.664)	(3.982)	(3.280)	(2.201)	(3.185)	(2.367)	(1.230)	(1.334)	(1.098)	(0.755)	(0.737)
Deposit rate	-10.549	2.904	3.047	8.145	8.254	11.006	5.232	1.396	0.874	5.589	-6.943
	(28.037)	(10.586)	(11.875)	(9.464)	(7.746)	(7.790)	(7.845)	(9.463)	(10.287)	(13.703)	(10.612)
HHI	0.238	0.305	0.224	0.401	0.626	0.743	1.469*	1.453	0.825	-0.122	1.329*
	(1.336)	(1.261)	(1.207)	(0.921)	(1.332)	(0.868)	(0.723)	(0.917)	(1.078)	(1.191)	(0.742)
Constant	1.611	1.180**	1.272**	1.149***	1.074***	1.091***	1.044***	1.177***	1.217***	1.022***	1.355***
	(1.249)	(0.406)	(0.496)	(0.289)	(0.296)	(0.237)	(0.195)	(0.231)	(0.230)	(0.260)	(0.195)
Observations	17	17	16	18	17	17	17	16	17	16	17
R^2	0.079	0.082	0.054	0.098	0.136	0.293	0.381	0.299	0.154	0.053	0.386
Adjusted R^2	-0.227	-0.224	-0.291	-0.179	-0.152	0.057	0.174	0.043	-0.128	-0.291	0.182
Residual Std. Error	0.413	0.389	0.384	0.323	0.301	0.243	0.210	0.229	0.236	0.216	0.196
F Statistic	0.259 (p = 0.899)	0.268 (p = 0.894)	0.156 (p = 0.957)	0.355 (p = 0.837)	0.472 (p = 0.756)	1.244 (p = 0.345)	1.844 (p = 0.186)	1.170 (p = 0.376)	0.547 (p = 0.705)	0.155 (p = 0.957)	1.887 (p = 0.178)

Note: *p<0.1; **p<0.05; ***p<0.01

Each cross-section corresponds to a year and contains data on 28 countries. The data are not interpolated. As a consequence some cases were omitted because of missing observations.

Subject to taking cross-sections the deposit facility is proxied by the deposit rate.

E.3 Robustness check using an alternative measure for liquid assets

	Dependent variable: LDR			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-0.295	-0.062		
	(0.402)	(0.391)		
EQ/TA			-0.121	0.818
			(1.483)	(1.366)
Liquid assets (alt)	-0.817**	-0.638*	-0.849**	-0.624*
	(0.393)	(0.357)	(0.396)	(0.329)
DFR		28.697***		30.331***
		(9.552)		(9.993)
HHI		-0.328		-0.328
		(0.376)		(0.360)
Observations	478	478	478	478
R^2	0.158	0.265	0.154	0.269
Adjusted R^2	0.112	0.221	0.107	0.225
F Statistic	42.481*** (p = 0.000)	40.579*** (p = 0.000)	41.179*** (p = 0.000)	41.420*** (p = 0.000)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks of 28 countries using quarterly interpolated data from 2007 Q4 until 2019 Q3.

Alternative measure for liquid asset holdings results in drop in sample size.

Coefficients are adjusted with Arellano robust standard errors (in parentheses).

E.4 Regressions on subsample 5 countries with lowest average LDRs

	Dependent variable: LDR (subsample of 5 countries with lowest average LDR)			
	Fixed effects			
	(1)	(2)	(3)	(4)
Tier1/RWA	-1.976**	-1.698*		
	(0.891)	(0.983)		
	t = -2.219	t = -1.727		
	p = 0.027	p = 0.085		
Equity/TA			-0.987	1.694
			(0.700)	(1.367)
			t = -1.410	t = 1.239
			p = 0.159	p = 0.216
Liquid assets	-0.243	-0.145	-0.162	0.153***
	(0.153)	(0.090)	(0.157)	(0.041)
	t = -1.582	t = -1.616	t = -1.031	t = 3.774
	p = 0.114	p = 0.107	p = 0.303	p = 0.0002
Deposit facility		0.731		2.156
		(1.280)		(1.569)
		t = 0.571		t = 1.374
		p = 0.568		p = 0.170
Herfindahl		0.380		1.904
		(0.955)		(1.226)
		t = 0.398		t = 1.554
		p = 0.691		p = 0.121
Observations	171	171	171	171
R^2	0.194	0.203	0.016	0.126
Adjusted R^2	0.165	0.163	-0.020	0.083
F Statistic	19.766*** (p = 0.00000)	10.296*** (p = 0.00000)	1.306 (p = 0.274)	5.848*** (p = 0.0003)

Note: *p<0.1; **p<0.05; ***p<0.01

Domestic and foreign banks from 5 countries with lowest average LDR using quarterly interpolated data from 2007 Q4 untill 2019 Q3.

Countries included in the analysis are the United Kingdom, Croatia, Czech Republic, Hungary and Belgium respectively

Some observations were omitted due to missing datapoints in the dependent variable LDR.

Coefficient are adjusted with Arellano robust standard errors (in parentheses).