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The relationship between credit ratings and asset liquidity: Evidence from Western European banks

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Abstract

This study examines the role of asset liquidity in Western European banks' credit rating downgrades and upgrades over the 2005–2017 period. The results suggest that changes in bank credit ratings have been more favorable for banks that have a liquid asset portfolio. Furthermore, asset liquidity has a stronger effect on the credit rating of banks that already have an illiquid asset portfolio. In contrast, the effect is significantly smaller or nonexistent for the most liquid banks. These results imply that the new liquidity regulation introduced by the Basel III requirements will improve the stability and hence decrease the fragility of the European banking sector. Furthermore, the benefits are highest for the most illiquid banks. In addition, the sovereign credit rating pass-through effect is strongest for illiquid banks.

Keywords: Banks, liquidity, credit ratings, sovereign effect

JEL classifications: G18, G21, G24, G32

1. Introduction

As noted by the Basel Committee (BIS, 2013), some banks failed during the early liquidity stress phase of the latest financial crisis despite having robust equity levels. According to the Committee, one reason for such failures seems to have been that the banks did not manage their *liquidity* in a prudent manner. As one prominent remedy of the liquidity problems in the banking sector ignited by the 2008–2009 financial crisis, the Basel III framework introduces two regulatory improvements: the net stable funding ratio (NSFR) and the liquidity coverage ratio (LCR). The LCR aims to ensure that banks have an adequate stock of liquid assets to meet their *short-term liquidity needs*. The NSFR, in turn, is a structural liquidity ratio that addresses *maturity mismatches* between assets and liabilities. The new regulation aims at reducing the risks in these functions by setting minimum requirements for the two ratios. The regulation attempts to prevent problems that may occur because of shocks in liquidity.

As recently pointed out, e.g., by DeYoung et al. (2018), most of the previous literature has analyzed the topics of bank credit risk and bank liquidity separately. However, as a reaction to the global financial crisis, more research is now focusing on the issue of bank insolvency and illiquidity as interrelated phenomena. This is motivated by Basel III's ideas for the joint regulation of the two. DeYoung et al. (2018) find in their sample of small (balance sheet below $1 billion) U.S. banks that the banks have actually historically self-managed their liquidity positions in a manner consistent with both the postcrisis concerns of bank regulators and the spirit of the new Basel III liquidity regulations. However, these small banks pose very little if any systemic risks to the U.S. economy. Furthermore, these researchers find no evidence of any linkages between capital shocks and liquidity management at larger banks. Hence, from a practical point of view, the authors suggest that imposing the NSFR and the LCR constraints on small banking companies is likely to be redundant and costly for the overall banking sector and economies in general.

In other previous studies, Caporale et al. (2012) used a sample of international banks from 2000–2007 to show that liquidity has no significant effect on bank credit ratings. Furthermore, Hong et al. (2014) focused specifically on the LCR and its effect on a bank's likelihood of failure. They suggested that the LCR has no significant effect on bank failures. In contrast, Du (2017) used data on the U.S. banks from the period of 2002–2015 to show that the LCR can positively contribute to an individual bank's systemic risk. This author suggests that the LCR can be used to predict *ex ante* which banks are most exposed to a crisis.

Vazquez and Federico (2015) showed that banks with weaker structural liquidity (i.e., lower NSFRs) are more likely to fail. Likewise, Bologna (2015) has argued that structural funding liquidity significantly affects a bank's likelihood of default. Similarly, Chiaramonte and Casu (2017) show that the NSFR is a significant determinant of bank failure using a sample of banks in the 28 EU countries over the 2004–2013 period. These authors argue that banks that ran into difficulties almost always had low structural liquidity, i.e., high maturity mismatch between assets and liabilities. Moreover, Sclip et al. (2019) show that the NSFR is a significant determinant of bank CDS spread changes. However, the relation is significant only when the ratio falls below the regulatory threshold.

Motivated by this somewhat small number of previous studies, we examine the relationship between a bank's asset liquidity and its credit rating. Furthermore, based especially on the assumed role of liquidity requirements in a bank's creditworthiness, we specifically focus on the direction of causality from bank asset liquidity to bank credit rating. In the empirical analysis, we use data on Western European banks before, during and after the global crisis of 2007–2009. Hence, we investigate whether banks' previous liquidity buffers will affect the default risk of a bank, which is described by its credit rating in the near future. In contrast to DeYoung et al. (2018), Hong et al. (2014) and Du (2017), we examine the relationship between a bank's default risk and its liquidity position. Furthermore, unlike, e.g., Vazquez and Federico (2015) and Bologna (2015), this study investigates the actual liquidity of banks' assets rather than the structural liquidity ratio (the NSFR).

The objective of the LCR is to promote the short-term resilience of a bank's liquidity risk profile. This is achieved by ensuring that the bank has a sufficient stock of high-quality liquid assets to survive a 30-day stress scenario. BIS (2013) suggests that the scenario would result in consequences such as, e.g., run-off of a proportion of retail deposits, a loss of unsecured wholesale funding capacity or unscheduled draws on committed but unused credit facilities. BIS (2013) argues that the specified scenario incorporates many of the shocks experienced during the financial crisis that started in 2007.

Consequently, we use credit ratings to investigate the role of asset liquidity in bank default risk. Since the LCR was developed to improve the banking sector's ability to absorb shocks, we examine whether asset liquidity affects a bank's assessed creditworthiness. Provided that asset liquidity improves the resiliency and ability of the bank to absorb financial shocks, there should be a positive relation between the two variables. This is because a liquid asset portfolio gives banks a buffer for adverse liquidity shocks such as, e.g., loss of wholesale funding capacity. In this respect, the credit rating, i.e., the perceived default risk, should reflect the liquidity profile of a bank.

In addition to the direct connection between the bank credit rating and its liquidity position, we also examine the role of sovereign credit ratings in this context, because many recent studies (see, e.g., Afonso et al., 2018 and the references therein) noted that bank credit ratings (or default probability) and sovereign credit ratings are strongly connected to each other. For example, Adelino and Ferreira (2016) have suggested that the sovereign asset markets play the role of emergency liquidity provider to domestic banks. Therefore, in our analyses, we also assume that bank credit ratings are dependent on the sovereign credit ratings of the countries where the banks mainly operate or are domiciled. Consequently, whenever there is a downgrade in the sovereign rating, domestic banks' credit ratings might also decrease.

This argumentation is also based on, for example, Acharya et al. (2014), who have argued that there exists a two-way feedback loop between sovereign and bank credit risks. Using data on European sovereign and bank CDSs from 2007–2011, they showed that financial sector bailouts were a significant factor in igniting the Eurozone crisis; costly bailout packages induced by a financial sector in distress also increased sovereign credit risks. This, in turn, weakened the financial sector, because the value of its government guarantees and bond holdings eroded. As a result, postbailout changes in sovereign CDSs explained changes in bank CDS values. Based on these earlier findings, since the sovereign credit markets might provide support for banks that are experiencing a liquidity shortage, we hypothesize that the sovereign effect is also less profound in the case of more-liquid banks.

While analyzing the relationship between the asset liquidity and credit ratings of Western European banks, we acknowledge that our empirical analyses now basically combine short-term and long-term concepts into the same setting. In doing so, we add significantly to previous studies on the role of imposing *legal restrictions* on bank portfolios for the purposes of decreasing *financial and economic fragility*. For example, previous studies by Peck and Shell (2010), Drago and Gallo (2017), Bech and Keister (2017), and Keister (2019) have analyzed similar types of questions. Peck and Shell (2010) proposed that putting actual restrictions on the most liquid part of bank asset portfolios could actually create an incentive for liquidity-based runs. According to their theoretical model, imposing requirements on the most liquid assets would reduce welfare at the aggregate level due to overinvestment in liquid assets even when a run does not occur. These authors base their analyses on the Diamond and Dybvig (1983) model but introduce the different role of checking accounts and debit cards in facilitating transactions.

Drago and Gallo (2017) focused on the role of sovereign credit ratings in bank activities concerning, for instance, liquidity management. They find that sovereign rating downgrades have a role primarily in capital ratios and lending supply. Moreover, sovereign rating upgrades do not significantly affect banks. Accordingly, the effect of sovereign rating changes on bank asset liquidity might not be very strong. Bech and Keister (2017) propose that imposing the new Basel III regulations might differently affect short-term and long-term interbank interest rates. They use a theoretical model to show that when banks are likely to face an LCR shortfall, the overnight interest rate tends to decrease. This is because banks have stronger incentives to utilize funding that receives favorable regulatory treatment. This again lowers the demand for overnight market funding. Conversely, a regulatory premium in longer-term interest rates might arise that would reflect each type of loan's value in satisfying the new regulation. Therefore, the spread between short-term and long-term interbank interest rates might increase. However, these authors also note that it might still be too early to reliably measure the empirical effects of the LCR requirement on interbank interest rates. In addition, banks in many jurisdictions are currently holding very large quantities of central bank liquidity resulting from unconventional monetary policy actions.

By using the liquidity ratio values reported in the Western European banking data, we aim to shed new light on the relationship between the LCR and the bank credit rating, which is obviously connected to the pricing of the long-term funding of an individual bank. At the moment, this is a highly relevant research question because the strong quantitative easing programs introduced by the European Central Bank (ECB) in recent years and again in the autumn of 2019 indicate that the ECB is still willing to strongly engage in the pricing of interest-yielding assets both at the very long end of the maturity spectrum and in the trading of assets at very short-term money market maturities.

In this respect, e.g., a very recent paper by Keister (2019) argues that the LCR requirement will impact short-term interest rates. Hence, it will likely also affect the process of monetary policy implementation. Thus, due to the possibility that this new framework introduces a regulatory premium on some longer-term market interest rates, Keister (2019) argues that the LCR might create a new wedge in the monetary policy transmission mechanism. From this point of view, it is necessary to find new results on whether and how a clearly long-term concept of bank credit ratings is connected to the very short-term, strongly LCR-related concept of the liquidity ratio of banks. Our study seeks to address this issue.

To our knowledge, this is the first study to examine the direct relationship between bank asset liquidity and bank credit ratings[1]. Hence, we strongly contribute the literature on bank ratings and bank liquidity management. Moreover, we contribute by discussing the fragility of the current financial and economic systems mentioned above and in the literature review. Moreover, instead of using data on U.S. banks (as for example in DeYoung et al. 2018, Hong et al., 2014, and Du 2017), we use a large dataset on Western European banks, including both the commercial banks and the large stakeholder banking sector of Western Europe. Likewise, the sample period from 2005–2017 extends that of Caporale et al. (2012), who used a sample covering the 2000–2007 period.

Our main results suggest that banks with more liquid asset portfolios have better credit rating changes compared to banks whose assets are less liquid. Therefore, liquid banks' default risk (and hence, the longer-term risk premium) increases less during financial turmoil than that of banks with less-liquid assets. This suggests that these banks are more resilient during economic crises than banks with illiquid assets. Furthermore, liquid banks are less affected by sovereign rating downgrades than are less-liquid banks. This is a new finding compared to, e.g., the results of Drago and Gallo (2017). We find that these results support the introduction of the LCR because this liquidity ratio aims at collecting a stock of liquid assets to improve the shock absorption ability of the banking sector. In other words, somewhat in contrast to the results of Bech and Keister (2017), DeYoung et al (2018) and Caporale et al. (2012), we find that the newly introduced LCR requirement might actually decrease the fragility of the banking sector. However, we are obviously not able to say anything precise about, e.g., the LCR's effects on the functioning of the monetary policy channel. Nevertheless, we argue that a well-functioning liquidity regulation has the potential to break the vicious circle between sovereign ratings and bank ratings.

The structure of our study is as follows. In section 2, we discuss the LCR, Fitch ratings and the most closely related previous studies on the role of liquidity requirements in the banking sector. Section 3 details the data and the main regression equations utilized in the empirical analyses for the relationship between bank liquidity and credit ratings. Section 4 provides a thorough discussion of the empirical results, and section 5 provides conclusions and suggestions for further research.

[1]Gibson, Hall and Tavlas (2017) show that net interbank position positively affects bank credit ratings using data on euro area banks over the 1998–2013 period.

2. Previous literature on bank liquidity requirements and credit ratings

2.1. Description of the LCR and Fitch ratings

Rating agencies (RAs) report information on the credit risk of fixed income securities (Bongaerts et al., 2012). Investors utilize RAs' creditworthiness assessments because acquiring information is costly for them (Hau et al., 2013). Regarding the importance of credit ratings for banks, Adelino and Ferreira (2016) argue that bank credit ratings affect a bank's access to funding. For instance, institutional investors may have restrictions on investing in debt securities with a poor credit rating. Furthermore, credit ratings affect capital requirements for holding securities on balance sheets. For example, Bongaerts et al. (2012) suggest that regulations may mandate that entities keep higher reserve capital for junk bonds than for investment grade bonds. Moreover, Adelino and Ferreira (2016) suggest that credit ratings are used in interbank markets to assess the creditworthiness of the counterparty. Therefore, rating downgrades may lead to impaired access to markets and higher funding costs. Hau et al. (2013) argue that bank credit ratings are a particularly important determinant of the issuance cost of senior unsecured debt.

Fitch (2018) suggests that an issuer default rating (IDR) expresses Fitch's opinion on an entity's relative vulnerability to default on its financial obligations. Typically, IDRs express an opinion on the risk of default on senior obligations to third-party, nongovernmental creditors. Fitch (2018) argues that their nonperformance best reflects the uncured failure of the entity. Furthermore, Fitch assigns separate ratings to capture a bank's intrinsic creditworthiness (the viability rating, VR) and the likelihood of it receiving external support in case of need. Such support can be received from shareholders (support rating) and/or sovereigns (support rating floor). A bank's IDR is then derived from the VR and support ratings.

Regarding the VR, Fitch (2018) argues that it considers five key factors: the operating environment, company profile, management and strategy, risk appetite and financial profile. The latter includes metrics for asset quality, earnings and profitability and capital and leverage. In addition, the VR includes metrics for funding and liquidity; the core metric in this category is the loans-to-deposits ratio. In addition, complementary metrics for funding and liquidity include the liquidity coverage ratio.

By definition, the liquidity coverage ratio (LCR) is given as

$$\text{LCR}=\frac{\text{Stock of HQLA}}{\text{Total net cash outflows over the next 30 calendar days}}\geq 100\% \qquad (1)$$

In other words, the LCR is the ratio of high-quality liquid assets (HQLA) to total net cash outflows over the next month (see also BIS, 2013), and in the Basel III requirements, this ratio is required to be at least 100%. Based on this, banks are required to hold a stock of unencumbered liquid assets to cover the total net cash outflows under a 30-day stress test scenario. High-quality liquid assets are assets that can be liquidated easily and immediately with no or little loss in value. In principle, the definition of high-quality liquid assets is close to the definition of liquid assets by Berger and Bouwman (2009). They define asset liquidity in terms of the ease, cost and time it takes banks to dispose of their obligations in order to meet these liquidity demands. Furthermore, the assets are divided into Level 1 (e.g., cash) and Level 2 (e.g., short-term corporate bonds) categories, which are given certain weights in the calculation of the LCR. The total net cash outflows are calculated by multiplying the balances of several categories of liabilities by the rates at which they are expected to be run off or to be drawn (for details, see BIS, 2013).

2.2. Literature review

Previously, both bank liquidity and bank credit ratings have been studied from several perspectives but always somewhat separately. For instance, Diamond and Dybwig (1983) have argued that sudden, large-scale withdrawals of deposits, i.e., bank runs, may force a bank to liquidate its assets at a loss and eventually fail. However, Gatev et al. (2009) showed that an increasing degree of customer deposit funding decreases a bank's liquidity risk that arises from unused loan commitments.

Even if modern deposit guarantee systems have made traditional bank runs more or less obsolete, Du (2017) proposed that the financial crisis of 2007–2008 was actually a bank run in a more modern sense of the concept because modern financial institutions currently rely heavily on short-term funding. Huang and Ratnovski (2011) also showed that in an environment with a costless but noisy signal, short-term wholesale financiers may suddenly withdraw heavily, i.e., run, hence triggering liquidation. In addition, López-Espinosa et al. (2013) showed that short-term funding is the main determinant of systemic risk. Diamond and Rajan (2001) argue that after having made the loan, a lender may need money for a new business project or consumption. However, she may not be able to raise money elsewhere for this need. Therefore, to raise money, she needs to sell the loan or use it as collateral. The amount raised will be low if her ability to collect future loan payments from the debtor is lost when she undertakes the opportunity. Therefore, a loan's low sale price makes it a risky asset for a lender with potential liquidity needs. This is the case even if the loan is riskless when held to maturity.

In other recent studies, de Haan and van den End (2013) used a dataset of 62 Dutch banks to examine the functioning of the Dutch liquidity regulation (i.e., the 'Liquidity Balance'), which is conceptually similar to the LCR. These authors suggested that banks should keep liquid assets as a buffer against liquid liabilities (mostly demand deposits) and net cash outflows and proposed that banks take into account more carefully the prospects for their future cash flows when deciding how much to hold in liquid assets. Furthermore, Banerjee and Mio (2018) showed that banks in the United Kingdom responded to the tightened liquidity regulation ('Individual Liquidity Balance'), which is analogous to the LCR, by increasing the share of their liquid assets. In addition, banks decreased funding based on interbank markets and other short-term sources. Moreover, Bonner et al. (2015) argued that a liquidity regulation neutralizes incentives to hold liquid assets and that without a liquidity regulation, banks' liquidity buffers can be explained by a combination of bank-specific and country-specific factors.

Furthermore, Wagner (2007) suggests that asset liquidity paradoxically increases banking instability. Wagner (2007) argues that improved liquidation possibilities due to financial innovations are offset by greater risk taking; since banks have improved possibilities for selling and hedging loans, they take new risks that lead to a higher probability of default.

Another branch of the liquidity literature studies the NSFR and structural liquidity, i.e., the maturity mismatch of bank assets and liabilities. Typically, these studies have found that improving the NSFR will have a stabilizing effect on the financial sector. In addition to the studies of Vazquez and Federico (2015) and Bologna (2015), López-Espinosa et al. (2012) showed that short-term wholesale funding was the most relevant systemic risk factor for the data from 18 countries over the 2001–2009 period. They argued that this supports the introduction of the NSFR as a regulatory tool because it limits excessive exposure to liquidity risk. Furthermore, Hong et al. (2014) used a sample of U.S. commercial banks over the 2001–2011 period to show that rising values of NSFR have a negative connection to bank failures.

Similar to bank liquidity, credit ratings have also been analyzed from several angles. For example, Gabbi and Sironi (2005) showed that credit ratings are the most important determinant of the yield spreads between corporate bonds and Treasury securities. Furthermore, they suggest that bond investors' reliance on rating agencies' judgment has increased over the 1991–2001 period. However, the accuracy of ratings has also been questioned after the 2008–2009 financial crisis. For instance, Hau et al. (2013) showed that large banks are given better credit ratings relative to their expected credit risks compared to smaller banks. Moreover, these authors suggest that bank credit ratings in the upper investment grade range bear no substantial ordinal relationship to expected default probabilities two years later.

Poon et al. (1999) showed using a bank data sample from 30 countries that loan loss provisions, risk and profitability are important factors that determine bank credit ratings. On the other hand, Caporale et al. (2012) have shown that large banks have better credit ratings. Moreover, a higher equity ratio seems to be positively related to credit ratings. However, these authors do not find any evidence that bank liquidity affects credit ratings, although banks in some countries seem to have systemically higher credit ratings than do banks in other countries. Furthermore, Ferri et al. (2014) showed that credit ratings decrease during recessions in general, but compared to other banks, stakeholder banks' ratings decrease less during crisis years. In addition, shareholder banks' ratings were higher during the lead-up to the crisis than were stakeholder banks' ratings.

Salvador et al. (2018) showed using data from Japan, the U.S. and Europe from 2004–2013 that there was a general fall in banks' credit ratings over the 2008–2013 period. Furthermore, these authors argued that the decline might have been caused partially by the worsening asset position and partially by the tightening of rating policies. Moreover, D'Apice et al. (2016) showed that banks whose share of traditional income (measured by the share in operating income of net interest income and fees and commissions minus dividend income) in total income is higher had better rating performances during the 2008–2009 financial crisis than did other banks.

In regard to the government's role, Iannotta et al. (2013) used data on large European banks from 2000–2009 to show that government-owned banks have better credit ratings than do their private counterparts. However, the better ratings are based on governmental support rather than on lower operating risk. Moreover, Huang and Shen (2015) showed that the sovereign credit rating affects a bank's credit rating. This "sovereign effect" is stronger in rating downgrades than in upgrades. Likewise, Alsakka et al. (2014) showed that sovereign rating downgrades have a strong effect on bank rating downgrades. The effect is stronger for multiple-notch sovereign rating downgrades. Moreover, Li and Zinna (2018) used CDS data of 54 European banks over the 2008–2015 period to show that sovereign risk accounts for approximately one-third of the credit risk.

Furthermore, Adelino and Ferreira (2016) showed that banks with a rating at the sovereign bound, i.e., equal to the sovereign rating, reduce lending more than do banks that have a lower rating in the case of a sovereign downgrade. In addition, these banks reduce ratings-sensitive funding, such as wholesale funding, more than do similar banks whose ratings are not at the sovereign bound. Finally, Correa et al. (2014) used data on banks from 37 countries from 1995–2011 to show that sovereign rating downgrades have a large negative effect on bank stock returns for those banks that are expected to receive stronger support from their governments.

3. Data and econometric specifications

3.1. Data

The data on bank-specific variables were obtained from Bankscope[2], which is the most frequently utilized international database in studies concerning banking. It is offered by the Bureau Van Dijk, and it consists of bank income statement and balance sheet data. The sample period in our study is from 2005–2017 for the consolidated-only observations, so it covers bank observations at the group level. The dataset includes commercial banks, cooperative banks and private and publicly owned savings banks, together with the bank holding companies. The latter group is included because for some of the banks, the data are available only for the bank holding companies. We use the data from Western European countries that belong to the EU15[3], as well as Norway, Iceland and Switzerland. Eastern European transition economies are excluded from the study because we aim to keep the sample homogeneous. Shen et al. (2012) show using data on banks from 89 countries over the 2002–2008 period that rating agencies give higher weight to financial ratios in countries where information asymmetries are smaller, i.e., in high-income countries. Since the main dependent variable in this study

[2]Precisely, Bureau Van Dijk's Bankscope is used for the years from 2005–2015. Data for the years from 2016–2017 are downloaded from Orbis BankFocus database, which is the successor of Bankscope. Mergeability of the data was manually confirmed to ensure the reliability of the analysis.
[3]The EU15 is Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

is the liquidity ratio, the sample excludes Eastern European countries even if they are members of the euro area.

The sample period includes the 2008–2009 financial crisis, the sovereign debt crisis and the recovery years following these two crises. Furthermore, the period includes the economic upswing preceding the crisis periods. The liquidity regulation was first announced in 2010 (a consultative document from 2009). Therefore, the sample years include a period during which the liquidity requirements were not already discussed. BIS (2013) argues that during the early 'liquidity phase' of the financial crisis, many banks experienced difficulties because they were not able to prudently manage liquidity. Therefore, the years 2005–2009 are included in the sample because our objective is to investigate whether a liquidity buffer affects a bank's perceived default risk.

To improve the quality of the data, the dataset was revised to remove any overlapping ownership structures of the banks. There were several subsidiary banks that had their own data entries in the dataset, although their parent companies were also included. Moreover, in the cases of some cooperative and savings banks, there were entries from several levels regarding the same bank, i.e., from the parent organization and from the regional group members. In these cases, the regional group members were preferred to the group parents because the ownership in these banks is typically at the regional level. In some cases, the data for the regional members were unavailable, so the data for the parent organization were used. After these revisions, the dataset did not have any overlapping ownership structures.

The overall dataset was strongly affected by the availability of the credit rating variable for the individual banks, restricting the final dataset to 169 banks. The credit ratings used in this study are the Fitch ratings (similar to, e.g., Caporale et al, 2012) for the long-term issuer default risk. The source for the ratings variable is Bankscope/BankFocus. Fitch ratings are preferred to S&P's and Moody's ratings because the sample coverage is better. Rating outlooks are not used because the data are annual. Kaminsky and Schmukler (2002) suggest that the time interval between changes in outlook and changes in ratings is typically not more than two months. Therefore, investigating both outlooks and ratings using annual data would usually lead to similar results[4].

Iannotta et al. (2013) argue that the ex post statistics on defaults confirm that credit ratings are an accurate measure of default risk. In our data, the range of the ratings is from the lowest, D (default), to the highest, AAA. On a scale in numbers, this corresponds to a range of 1–20. However, it should be noted that credit ratings are not a cardinal measure of credit risk (as Ferri et al., 2014, suggest), but rather they represent an ordinal measure and should be interpreted as relative measures.

FIG. 1. HERE

Fig. 1 shows the mean liquid assets to total assets ratio (in percentage) and the mean credit rating in 169 Western European banks over the 2005–2017 period. The graphs show that the liquidity ratio was, on

[4]Furthermore, Kaminsky and Schmukler (2002) use daily data to examine changes in ratings and outlooks, and we focus on yearly observations.

average, high at the beginning of the sample period. It decreased during the 2008–2009 financial crisis and rose slightly during the sovereign debt crisis. In the meantime, the average credit rating decreased from 15.5 (between A and A+) to 13 (BBB+). Therefore, the figure suggests that these two variables might have a positive relationship. However, liquidity already began to increase in the middle of the sample period when the mean credit rating was still decreasing. Moreover, liquidity increased more at the end of the sample period, whereas the mean credit rating stagnated.

Many items in the variable for liquid assets overlap with Basel III's definition of HQLAs. First, the liquidity variable includes cash, which is classified as a Level 1 asset in the LCR. In addition, the liquidity variable includes balances in central banks. In the LCR, these balances are classified as Level 1 assets under certain conditions. Furthermore, the liquidity variable includes financial assets measured at fair value through profit and loss and financial assets held for trading. These are included in Level 1 assets of the LCR only if marketable securities represent claims on sovereigns, central banks, etc. and satisfy several conditions (for details, see BIS, 2013). For corporate debt securities, they can be included in Level 2 assets under certain restrictions unless they are issued by financial institutions. In addition, reverse repos are included in the liquid assets variable; they are either Level 1 or Level 2 assets in the LCR. In contrast to the LCR, liquid assets here include loans and advances to banks. These items are not included in the LCR. Therefore, the two variables differ from each other in this matter.

In the regression analyses, we use seven bank-specific variables. The data on all bank-specific variables and ratio measures have been filtered by removing the values below the 1st percentile and above the 99th percentile, because most of the data series seemed to contain outliers in the form of reporting errors. Finally, data on GDP growth rates were obtained from the OECD. The exact details of all variable definitions are given in Table A1 in appendix A.

3.2. Descriptive statistics

Table 1a shows the descriptive statistics for the analyzed variables. In addition to the full sample values, the reporting of statistics is divided into two subsamples based on the median value of the liquid assets to total assets ratio (*L-ratio*). From Table 1a, we see that, on average, the numerical credit rating is 14.52, which equals a letter class rating between A- and A. The standard deviation is over 2.5, which implies that there is high variation in the credit rating observations. The mean of the first difference of credit ratings is negative, which indicates that the mean rating decreased during the sample period. The median is zero. This is because typically a bank rating remains unchanged for several periods in time, and thus the difference is often zero. The average value of the liquid to total assets ratio is 19%, whereas the equity ratio is 6.9%, on average. As expected, the sovereign credit ratings are, on average, much higher than the banks' credit ratings; the mean value is 18, which equals a rating of AA. However, the standard deviation is even higher than that of banks' credit ratings, namely, 3.83. Furthermore, the range of this variable is from 4 to 20 (from CCC to AAA), so it is much more dispersed compared to the bank credit ratings.

Regarding the differences between the two groups, one can see from the reported statistics that all the differences between the means of the two groups are statistically significant. Furthermore, the mean rating is lower in banks that have less-liquid assets. Banks in the higher half of the distribution have, on average, a rating of A (i.e., 15), whereas the mean rating of banks in the lower half of the sample is between BBB+ and A- (i.e., 13.6). Moreover, there is a significant difference in the mean rating change; it is close to -0.5 for the less-liquid banks, whereas the mean change is -0.16 among the more-liquid banks. Furthermore, we can also see that assets are much more liquid in banks that have an above-the-median value for the liquidity ratio. Banks in the lower half of the distribution seem to have more equity. In addition, loan loss provisions are over twice as high in banks that have less-liquid assets. This may result from the fact that banks with high losses are more liquidity-constrained than are healthy banks.

The customer deposit funding ratio (*D-ratio*) seems to be higher in banks that have less-liquid assets. Furthermore, banks in the lower half of the distribution are less profitable than banks with more-liquid asset compositions. Moreover, banks that have more-liquid assets are larger than banks in the lower half of the distribution; the mean size for banks in the upper half of the distribution is almost four times as large as the mean for the lower half of the distribution. Furthermore, the sovereign rating is higher for the bank-years above the median value. Finally, GDP growth is higher for the bank-years above the median value of the liquidity ratio. This suggests that, in general, banks' asset portfolios are more liquid when the economy is booming.

TABLE 1A HERE

Turning to the descriptive statistics based on classifying the data by the median value of the credit rating (that is, 15), we obtain a somewhat different picture of the data. From Table 1b, we see that the mean rating change is close to zero in banks with high credit ratings. Again, all the means, except those of the deposit ratios, are statistically significantly different between the two groups at least at the 5% significance level. We also see that banks with better credit ratings have more-liquid assets than banks with lower credit ratings. This was already implied by the descriptive statistics in Table 1a. Moreover, banks with a lower credit rating have more equity than other banks, potentially implying a higher risk profile. Unsurprisingly, loan quality is inferior in banks that have a poor credit rating. At the 5% risk level, there are no significant differences between the two groups in terms of the customer deposit ratio. Moreover, as can be expected, banks with higher credit ratings are also more profitable. Furthermore, they seem to be much larger than banks with poor credit ratings. This is a similar finding to Hau et al. (2013), who proposed that large banks obtain better credit ratings than smaller banks.

Regarding the role of the sovereign credit rating, banks with higher credit ratings seem to be located in countries where the sovereign credit ratings are better on average. However, only a handful of banks have a better credit rating than the sovereign rating in the country where they are domiciled. The share of these bank-years is 2.6% of all observations. Moreover, all except two of these banks are actually in GIIPS[5] countries. The share is similar to Alsakka et al. (2014), who show that approximately 2.1% of banks have a credit rating that surpasses the "sovereign rating ceiling". Finally, GDP growth is higher for the bank-years that have better credit ratings. This also matches the a priori expectations.

TABLE 1B HERE

Fig. 2 shows the distribution of credit ratings during 2005–2017. The figure illustrates that most of the observations are at the higher end of the distribution, and the observed unimodal distribution seems to have a peak around the "A+" level of credit ratings. To the left, we see a long tail of observations that indicate the lower credit ratings. To the right from the peak, the values are higher than the mean, and we can see that the mean value (solid line) is close to the median (dashed line). However, the distribution is somewhat negatively skewed, and the mean value is between A- and A.'

FIG. 2 HERE

Our descriptive empirical analyses will mainly focus on the level values of credit ratings and bank liquidity, but in Table 2, we also report some descriptive statistics on credit rating upgrades and downgrades. From Table 2, we see that the rating remains unchanged for 74% of bank-years in the sample, and there are many more rating downgrades (255) than upgrades (68). This is because the 2008–2009 financial crisis and the subsequent sovereign debt crisis dominate our sample period. Hence, the mean for the rating changes is also below zero. Moreover, most of the rating downgrades occurred in the period of 2008–2013, whereas the rating changes during the lead-up to the crisis typically were upgrades. Unsurprisingly, the number of rating upgrades is low during the crisis years from 2008 onwards. However, the number increases in the last sample year, i.e., from 2015.

TABLE 2 HERE

Table 3 shows the mean rating and the mean change of the ratings by sample year and the median value of the liquid assets to total assets ratio (*L-ratio*). The statistics also show that the mean rating was generally statistically significantly higher in more-liquid banks for every sample year except 2005. Furthermore, many of the differences between the mean values are statistically significant. However, the means are statistically significantly different, especially in the latter half of the sample period, i.e., during the sovereign debt crisis. This can be interpreted in at least two ways. First, the default risk of less-liquid banks may have increased more during the sovereign debt crisis than that of more-liquid banks. This again would have materialized as a deterioration of the credit rating. Alternatively, it is possible that the role of liquidity in the assessment of the credit rating has changed during the crisis years, i.e., credit rating agencies give more emphasis to bank liquidity when determining the proper

[5]The GIIPS countries are Greece, Portugal, Iceland, Ireland and Spain.

credit rating during the years towards the end of our sample period. This is a similar conclusion to that of D'Apice et al. (2016) and Salvador et al. (2018), who suggest that there was a change in the rating agencies' rating policies during the economic crisis.

Moreover, the decrease in ratings from the beginning of the sample period towards the end of the period is not nearly as deep in banks that have more-liquid assets because more-liquid banks' ratings decrease, on average, by less than one notch, whereas the ratings of less-liquid banks decrease by four notches, i.e., from A to BBB-. In addition, the yearly differences in the ratings are much larger (i.e., more negative) for banks that have below-the-median values in the liquidity ratio than for banks at the higher end of the distribution. This obviously suggests that banks that have a liquid asset portfolio are more resilient in economic downturns than banks with less-liquid assets. Finally, most of the significant differences in credit ratings occur during the sovereign debt crisis.

TABLE 3 HERE

Table 4 below shows the correlation matrix of the analyzed variables. In general, we see that the correlation coefficients between the variables in our data are not very high. However, some of them are in the range of 0.4–0.5 in absolute values, indicating possibly stronger relationships between the variables. For example, bank credit rating changes and sovereign rating changes seem to be positively correlated. Unsurprisingly, loan loss provision ratio (*LLP-ratio*) and credit ratings seem to be strongly negatively correlated. Furthermore, LLPs and profitability (*ROA*) are negatively correlated, as are bank size and equity ratio.

TABLE 4 HERE

3.3. Econometric specifications

The main idea in our empirical analyses is to reveal the empirical connections between bank credit ratings and liquidity. Hence, assuming that the direction of causality goes from liquidity (*L-ratio*) to credit rating (*CR*), the general form of the main regression equation in this study is

$$\Delta\log(CR)_{it} = \alpha_i + \beta_1 \text{L-ratio}_{i,t-1} + \beta_2 \text{E-ratio}_{i,t-1} + \beta_3 \text{LLP-ratio}_{i,t-1} + \beta_4 \text{D-ratio}_{i,t-1} + \beta_5 ROA_{i,t-1} + \beta_6 \log(A)_{i,t-1} + \beta_7 \log(CR)_{i,t-1} + \beta_8 \Delta\log(SOVCR)_{i,j,t-1} + \beta_9 \text{GDP growth}_{i,j,t-1} + \sum_{k=1}^{12} \beta_k D_{Year} + \varepsilon_{i,t} \quad (2)$$

where in addition to the bank specific constant terms (α_i), we also control for the role of the amount of equity capital (*E-ratio*), loan loss provisions (*LLP-ratio*), deposit funding (*D-ratio*), profitability (*ROA*), and size (*A*) in terms of the amount of assets of each of the banks. In addition, we add to the main regression equation the effects of the lagged level of the bank credit rating, along with the effects of the sovereign credit rating (*SOVCR*) and overall economic growth (*GDP growth*) of each of the countries *j* where bank i is located. In addition, to control for the time fixed effect, we include year dummies for all except one year in the regression equation.

In Equation (2), we focus on the log changes in bank credit ratings because, as has been previously pointed out, e.g., by Ferri et al. (2014), a one-notch change at the lower end of the scale, e.g., a change from BB to BB-, corresponding to a change from 9 to 8 in numbers, implies a relatively larger change in default risk than a one-notch change at the higher end of the scale (e.g., a change from AA to AA-, i.e., from 18 to 17). This is because default risk increases exponentially at the lower end of the scale (see, e.g., Fitch, 2015)[6].

The main variable of interest in the set of explanatory variables is the liquid assets to total assets ratio (*L-ratio*). It measures a bank's liquidity position and serves as a proxy variable for the liquidity coverage ratio (LCR, described in section 2) in our analyses and discussions[7]. If the regression coefficient on the lagged values of this variable is significantly positive, on average, banks with a more-liquid asset portfolio previously have better credit ratings in the current period. Furthermore, the specification includes several control variables that, based on the previous literature, have been found to be related to credit ratings. First, the specification includes the equity ratio (as in, e.g., Caporale et al., 2012) and the loan loss provisions ratio (similar to Ferri et al., 2014). Furthermore, de Haan and van den End (2013) argue that banks hold liquid assets against their stock of liquid liabilities. Therefore, the customer deposit funding ratio is also included in our analysis. In addition, the pretax profit-to-total assets ratio, i.e., ROA, measures bank earnings (as, e.g., in Huang and Shen, 2013). Moreover, the specification includes the log of total assets to control for the effects of bank size (see also Ferri et al., 2014), along the lines of, e.g., Hau et al. (2013), who argue that large banks are given higher ratings than smaller banks. Finally, analogously to Ferri et al. (2014), in the set of bank-specific variables, we also include the lagged level of bank credit rating.

In addition, to control for country-specific effects, we include sovereign credit ratings (SCRs) and GDP growth rates in our analysis. As we discussed in the introduction, many studies have implied that the SCR affects banks' credit ratings (see also, e.g., Huang and Shen, 2015), and Iannotta et al. (2013) argue that it is essential to control for the role of country-specific real economic growth in these types of regressions. All the bank-specific control variables are lagged by one period because credit ratings may contain relevant information that was unknown when the ratings decision was made (see also Caporale et al., 2012). Consequently, all bank-specific control variables and sovereign ratings are the beginning-of-the-year values. We use OLS estimations with bank fixed effects in our regressions.

[6]Note however, that for the sake of robustness of our results, we also used the levels of the ratings, i.e., the numbers, in the regressions, but the results remained qualitatively the same.

[7] It is worth noting that these two measures are not exactly the same because our variable (*L-ratio*) misses completely the liability aspect of the LCR, i.e., the total net cash flows over the next 30 calendar days (see equation 1). However, in this study, we emphasize that as a short-term forward looking variable, this liability related measure in the LCR calculation might actually clearly be connected to the riskiness of the bank's overall businesses and, hence, perhaps in connection to the credit rating. Obviously, the best (and almost only) way a bank can react contemporaneously on the requirement of over 100% LCR imposed by the Basel III is by changing the amount of current liquid assets in its portfolio. Hence, based on this reasoning, it is also necessary to find out how much is the bank's credit rating dependent on the amount of liquid assets, that is, the other major determinant of the LCR.

Based on Iannotta et al. (2013), the bank fixed effects capture, for example, potential implicit or explicit governmental support, which may affect issuer credit ratings. In addition, since banks do not necessarily define liquid assets in a comparable way, within estimations are used throughout the analysis. Furthermore, an OLS regression model is used instead of a logit/probit model because our main interest is in ratings changes over the sample period. Using differences instead of levels allows us to examine ratings changes. All the test statistics are based on heteroscedasticity-consistent nonclustered robust standard errors from the estimation.

In the second stage, we perform the regression analyses based on using the first difference of the level of the credit rating as the dependent variable. In the case of a one-notch increase in the credit rating, this variable takes the value of 1, and analogously, a one-notch decrease is equal to -1. This is similar to Huang and Shen (2015). These regressions examine the role of asset liquidity in the nonrelative changes in the credit rating. Hence, in this case, e.g., a decrease from 5 to 4 (from B+ to B) is equal to a downgrade from 19 to 18 (from AA+ to AA). Accordingly, the sovereign credit ratings and the lagged bank ratings are used as levels instead of logs in these regressions. Otherwise, the specification is the same as in Equation 2.

Finally, possibilities for nonlinear relationships between the main analyzed variables (bank liquidity and credit rating) are examined by running regressions that include dummy variables to capture the bank-years above the median value in liquidity. In this case, we presume that the effect of liquidity on banks' credit ratings is stronger for banks that already have a low liquidity ratio. This is because these banks are likely to be the most liquidity-constrained. Furthermore, it is also possible that excess liquidity decreases a bank's credit rating. In other words, it may be the case that too much liquidity decreases a bank's assessed creditworthiness because it implies that the bank does not have enough long-term assets to generate returns. Furthermore, Wagner (2007) argues that higher liquidity induces greater risk-taking, which again increases bank instability. To capture the possibilities for all these effects, the final regression model has the form

$$\begin{aligned}\Delta\log(CR)_{it} = {} & \alpha_i + \beta_1 Median_{i,t}^{L\text{-}ratio} + \beta_2 L\text{-}ratio_{i,t-1} + \beta_3 Median_{i,t}^{L\text{-}ratio} \times L\text{-}ratio_{i,t-1} \\ & + \beta_4 E\text{-}ratio_{i,t-1} + \beta_5 LLP\text{-}ratio_{i,t-1} + \beta_6 D\text{-}ratio_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 \log(A)_{i,t-1} \\ & + \beta_9 \log(CR)_{i,t-1} + \beta_{10}\Delta\log(SOVCR)_{i,j,t-1} + \beta_{11} GDPgrowth_{i,j,t-1} + \sum_{k=1}^{12}\beta_k D_{Year} + \varepsilon_{i,t} \qquad (3)\end{aligned}$$

Hence, the two main hypotheses to be tested based on our regression analyses are the following:

(i) Does the bank's balance sheet liquidity have an effect on its credit rating upgrades during 2005–2017?

(ii) Is the effect of liquidity linear in terms of the level of the bank's liquidity position?

4. Results from the regression analyses

Table 5 shows the regression results for the specifications explaining the first difference of the log of credit rating. The results show that the coefficient for liquidity is significantly positive in every specification. This indicates that the more liquid the assets a bank held, the better were its credit rating changes for the 2005–2017 period. Furthermore, as can be expected, the parameter estimate on the loan loss provisions (asset quality) is significantly negative. Similarly, the rating changes are better for profitable banks with higher ROA values. The results for the equity ratio suggest that a high equity ratio leads to worse credit rating changes. This may be an indicator of a higher risk profile. Moreover, bank size has a negative effect, implying that large banks had worse rating changes during 2005–2017 than smaller banks. In addition, the effects of sovereign credit ratings are significant in this specification, albeit only at the 10% significance level. The coefficient on the SCR variable is positive, suggesting that there is a 'sovereign effect' in the credit ratings. Finally, in this specification, GDP growth does not seem to statistically significantly affect bank credit ratings.

TABLE 5 HERE

The specifications that explain the first difference of the level of credit rating (i.e., not the change in log values) give similar results. These results are available upon request. In these specifications, a one-notch change at the lower end is interpreted as equally large as is a one-notch change at the upper end of the distribution. Despite the slight change in the explained variable, many of the results are the same as those for the log values of the dependent variable. The effect of the liquidity ratio remains unchanged. Moreover, it is statistically significantly positive in every specification, which implies that the rating changes were more favorable for banks with a liquid asset portfolio. However, there are some differences in the results for the control variables. For example, bank size does not seem to play a role in this specification. Likewise, the effect of loan loss provisions on credit rating is now statistically insignificant, but GDP growth now positively affects credit rating[8].

Table 6 shows the results for the comparison of two subsamples that include only the bank-years below or, alternatively, above the median value of the liquid assets to total assets ratio. The regression equation is based on the largest specification involving all the control variables, i.e., column (5) reported in Table 5. The first two columns in Table 6 report the results from using the relative change in credit rating, i.e., the first difference of the log of ratings, as the dependent variables. The results

[8] As we observed from Fig. 1, on average, credit ratings started to decrease in 2008, and the decrease continued until the end of the sample period, i.e., 2017. These were also the years when most of the rating changes occurred. Therefore, the regressions were repeated for the subsample from 2008 to 2017 to analyze if asset liquidity improved rating changes, especially during and after the crisis years from 2008 onwards. However, the results remained the same from these regressions. Thus, they are not reported here but are available from the authors upon request. Furthermore, the regressions were repeated for the subsample consisting of only the commercial banks, based on the finding in Ferri et al. (2014) that cooperative banks and savings banks had better credit rating changes during the 2008–2009 financial crisis. The results again remained the same from this sampling exercise. These results are also available upon request.

show that the coefficient on the liquidity ratio is significant for both subsamples. However, the size of the coefficient is three times larger for banks in the below-the-median subsample compared to those in the upper half of the distribution. Therefore, the effect of asset liquidity on the change in credit rating seems to be clearly larger for banks that have less-liquid asset portfolios.

Furthermore, columns (3) and (4) in Table 6 report the results from the regressions where the change in the level of rating is the dependent variable. These results show that the magnitude of the liquidity effects for banks with a below-the-median value in liquidity is almost two times the size of the effect for banks that have a more liquid asset portfolio. Moreover, the parameter estimate for the sovereign rating change effect is significant in all these specifications, and the effects are larger in the specifications for the sample based on banks with a below-the-median value of the liquidity ratio. This implies that the sovereign credit rate effect is larger for less-liquid banks.

TABLE 6 HERE

Table 7 reports the results for the specifications that include an interaction term with a dummy variable indicating an above-the-median value in the liquidity ratio for the bank in question, capturing the nonlinear effects of the liquidity ratio on credit ratings. The parameter estimates connected to the direct liquidity ratio effect and the interaction term can be interpreted to reflect the difference between the banks with liquid and illiquid asset portfolios regarding the effects of liquidity on credit ratings. The coefficients on these terms show that an increase in asset liquidity increases credit ratings of illiquid banks in particular. This can be inferred based on simply viewing the coefficients for the liquidity ratio. However, the interaction term is statistically significantly negative, suggesting that the effect is smaller for banks with a liquid asset portfolio. Nevertheless, because in absolute terms the coefficient on the interaction term is smaller than that of the direct effect, the overall total effect is also positive for banks with a more liquid asset portfolio. Nonetheless, the combined result is quite close to zero, and therefore, its economic significance is rather negligible. In any case, the effect of liquidity is smaller for more-liquid banks' credit ratings. This confirms the results reported in Table 6 from our previous specifications based on sampling the data of banks with below- or above-the-median values of the liquidity ratio.

TABLE 7 HERE

Furthermore, we used specifications that use the quartiles of the liquidity ratio as the independent variables in the credit rating regression. These regressions examine whether a more accurate division of the liquidity ratio gives similar results to the specifications that use the median to divide the sample. The results are not reported to avoid repetition. However, they are available upon request. The results are very similar to those of the earlier specifications. Typically, the coefficients for the interaction terms with the dummies indicating the second and the third quartiles are significantly negative. Moreover, the combined effects of the direct and interaction terms are close to zero. This confirms the results of our earlier regressions. Furthermore, this shows that the relationship between asset liquidity and credit rating upgrades does not turn negative for most liquid banks. In other words, these results do not suggest that 'too much liquidity' is interpreted as a negative feature for banks by credit rating agencies. This is a different result from Wagner (2007). Furthermore, the relationship between credit ratings and liquidity seems to be linear for banks in the below-the-median group. Therefore, the cut-off point for the connection between these variables seems, in fact, to be the median value for the liquidity ratio.

The robustness of the results was tested by using different sample periods. The LCR and the NSFR were announced from 2010 (a consultative document from 2009). Therefore, liquidity regulations were not discussed during the early years of the 2005–2017 sample period. Thus, the regressions were repeated for two subsamples before and beginning in 2010 (and from 2009 and several other periods). The result of higher liquidity improving ratings is unaffected by the changes in sample periods. Similarly, the results are robust to changes in the specifications (as Table 5 suggests). Moreover, an instrumental variable approach is implemented to instrument the liquidity ratio with the total assets of the ECB. This variable is an instrument for the level of liquidity in the entire financial sector. The results remain unchanged, and they are left unreported.

In addition, we used a sample of Standard & Poor's (S&P) bank credit ratings to test the robustness of our results. These ratings are long-term issuer default credit ratings similar to the Fitch ratings used in the original sample. Often, rating agencies disagree on a bank's credit rating (split rating). Using a sample of European firms from 1993–2013, Iannotta (2006) shows that banks have split ratings less frequently (37% of issues) than nonbanking firms (46% of issues). In his analysis, the average absolute gap between Moody's and S&P ratings was 0.53 for banks. However, the result was reversed after controlling for risk and other characteristics. Similarly, Morgan (2002) used data on U.S. firms from 1983–1993 to show that Moody's and S&P disagree more often over financial intermediaries than over other firms. Loans and trading assets are a significant source of disagreement for banks.

In our study, the sample coverage substantially decreases when S&P ratings are used instead of Fitch ratings. Nonetheless, we were able to build a regression sample of 629 observations. Therefore, the sample size decreases to approximately half compared to the Fitch sample. Despite the shrinkage in coverage, the regression results typically remain similar. The main results for the relationship between liquidity and credit ratings are similar when the dependent variable is the first difference of the S&P rating. However, once the dependent variable is changed to the first difference of the log of the rating, the results lose their statistical significance due to the clearly smaller sample size. The results are not reported but they are available from the authors.

3.3. The role of sovereign credit rating downgrades

This section examines the role of sovereign rating downgrade pass-through in our analyses. For example, Adelino and Ferreira (2016) have argued that the economic rationale for the sovereign ceiling is the government's role as an emergency liquidity provider. Hence, it provides bailouts to domestic banks in distress. Consequently, if there is a decrease in the sovereign credit rating, banks' credit ratings also decrease, because ultimately, a decrease in a sovereign's rating implies a reduction in the government's (i.e., the central bank's, to be exact) ability to function as lender of last resort for banks. Furthermore, because sovereign entities serve as 'emergency lenders', it is possible that the sovereign credit rating effect, i.e., bank credit rating downgrades following a sovereign rating downgrade, is largest in banks that have the most severe shortage of liquidity. In contrast, the sovereign credit rating effect might be expected to be smallest for banks whose liquidity position is healthy.

Furthermore, Fitch (2018) assigns banks an operating environment score. If a bank operates mainly within a given country, the operating environment score is a country-specific score. On the other hand, when the bank operates in a larger area, the score may differ from a country score. Fitch (2018) argues that the country operating environment score is usually constrained by the sovereign rating because a sovereign default is typically accompanied by a deteriorating operating environment. Therefore, a downgrade in the sovereign rating is typically accompanied by a decrease in the operating environment score and ultimately by a decrease in the viability rating. However, an operating environment score may be rated above the sovereign credit rating when Fitch believes that the linkage between sovereign creditworthiness and the operating environment is weak or when the sovereign rating is very low, but there are specific sovereign rating drivers that do not affect banks.

Fitch (2018) states that a bank is rated above its sovereign when two conditions hold. First, following a sovereign default, a bank must retain its capacity to service its obligations. This may be because of external support (e.g., from shareholders) or the bank's very strong standalone credit profile. Fitch (2018) suggests that the former case is more common than the latter. Second, Fitch must believe that the defaulting sovereign would probably not impose any restrictions on the bank's ability to service its obligations.

FIG. 3 HERE

Fig. 3 shows a scatter plot of the sovereign credit ratings and bank credit ratings based on our data. The 45-degree line in the middle of the figure describes the 'sovereign ceiling', i.e., the locus where the sovereign credit rating equals the bank credit rating. Provided that the credit rating agencies use the sovereign ratings as the upper limit for the bank ratings, the scatter markers should be on or below this line. The figure shows that typically the markers are indeed below the sovereign ceiling. There are only 41 observations above the ceiling. In total, the dataset includes 1,566 ratings, so the figure suggests that the sovereign ceiling exists in our data and that banks very rarely (in only 2.6% of all cases) exceed the ceiling.

FIG. 4 HERE

Furthermore, Fig. 4 shows the graphs for the mean sovereign ratings and for the mean bank ratings for our sample period. From this figure, we see that the relationship between these variables is, on average, visibly linear, i.e., both ratings were relatively high at the beginning of the sample period. The mean ratings began to decrease from 2008 onwards, and they stagnated during the sovereign debt crisis. However, the mean bank rating decreased slightly at the end of the sample period. Moreover, the mean sovereign rating has been clearly above the mean bank rating for the full sample period, and the difference is approximately four notches. Hence, the banking sector has been in average terms clearly riskier than the sovereign credit market.

The specifications used for the analysis of the role of sovereign credit ratings are the same as we have been using previously, except that they include a dummy variable *DOWN* to indicate a sovereign credit rating downgrade. Analogously to Adelino and Ferreira (2016), our dummy variable takes a value of 1 if there is a downgrade in the sovereign rating and zero otherwise. Furthermore, the dummy is interacted with the liquidity ratio in our analyses. The results for these variables are interpreted as describing the role of liquidity for the effects of sovereign credit rating downgrades on bank credit ratings. Moreover, similar to our earlier specifications, the dependent variable is the first difference of the credit rating. In addition, the specifications are analyzed for the subsamples based on the bank-years below and above the median value of the liquidity ratio.

Moreover, the dummy *DOWN* is interacted with a dummy *BOUND*. The latter dummy indicates banks that are at the sovereign bound, i.e., their credit rating equals the sovereign rating. As in Adelino and Ferreira (2016), we assume that credit rating agencies' sovereign ceiling policies create exogenous variation to bank credit ratings. As a consequence, a sovereign downgrade causes a downgrade in credit ratings for banks that are at the sovereign bound. Interacting the dummies *DOWN* and *BOUND* ensures that a significant result for the sovereign rating is not caused by an overlapping general decrease in bank credit ratings. Because of the sovereign ceiling policies, credit ratings in banks with a credit rating at the sovereign ceiling decrease after a sovereign downgrade. If the effect is smaller for more-liquid banks, the result implies that asset liquidity dampens sovereign rating pass-through. The objective of these regressions is to eliminate the possibility that the linkage between bank rating and sovereign rating is caused by a third factor, such as a deteriorating macroeconomic environment.

Table 8 shows the results for the specifications that examine the role of sovereign credit rating downgrades. The results suggest that bank credit ratings decrease when a sovereign rating decreases. This can be seen from the negative and statistically significant coefficient on the dummy variable *DOWN*. However, the results for the interaction term consisting of the *DOWN* and the liquidity ratio show that the effect is smaller for banks that have a more liquid asset portfolio. Furthermore, the results are similar in the specifications that use the first difference of the ratings as the dependent variable instead of the first difference of the log of the rating. The parameter estimate on the dummy variable *DOWN* suggests that a decrease in a sovereign rating causes, on average, a 0.35 decrease in a bank rating.

TABLE 8 HERE

Table 9 shows the results for regressions that use an interaction between the dummies *DOWN* and *BOUND* and the liquidity variable *L-ratio*. The latter dummy variable takes the value of 1 if a bank's credit rating equals its sovereign rating. The results show that there is a rating decrease in banks whose credit rating equals their sovereign rating. This can be seen in the negative sum of the coefficient for the dummy *DOWN* and the interaction between the dummies *DOWN* and *BOUND*. However, the general term for the *L-ratio* and the triple interaction between the dummies *DOWN* and *BOUND* and the *L-ratio* has a significantly positive coefficient. This implies that asset liquidity dampens the decrease in a bank credit rating following a sovereign downgrade. The effect is even larger for banks at the sovereign bound.

The result is repeated in the regression that explains the first difference of the credit rating. In contrast to the first regression, the result for banks at the sovereign bound does not significantly differ from that of other banks. Nonetheless, the result for the *L-ratio* is significantly positive. To conclude, asset liquidity dampens the sovereign effect pass-through. This is confirmed by the results for banks at the sovereign ceiling. Since these banks are exogenously exposed to sovereign downgrades because of the 'sovereign effect', it can be concluded that asset liquidity decreases the pass-through effect of a sovereign downgrade.

TABLE 9 HERE

In addition, we ran regressions that use the subsamples obtained based on the classification of bank-years below and above the median value for the liquidity ratio. These results are not reported. The results are similar to our previously obtained results and show that less-liquid banks are clearly affected by sovereign credit downgrades. In contrast, more-liquid banks are unaffected by downgrades in sovereign ratings. Therefore, the results clearly suggest that a higher amount of liquid assets protects banks from the effects of sovereign rating downgrades on their own credit ratings. This confirms our hypothesis that the more liquidity-constrained banks are the ones that are affected the most by the sovereign rating downgrades. However, our results also suggest that the most liquid banks are not affected by sovereign credit rating downgrades at all[9,10].

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[9]Note that, similar to Adelino and Ferreira (2016), we also examined the role of sovereign credit rating upgrades. However, the results were mostly statistically insignificant and inconclusive, which suggests that the effect of sovereign rating upgrades on bank ratings is not as systematic as that of downgrades. These results are also available from the authors upon request. The relationship between bank ratings and sovereign rating upgrades seems not to be relevant, possibly because most of the upgrades take place during economic booms, when the liquidity constraints in the banking sector are not binding. Moreover, as Adelino and Ferreira (2016) argued, credit rating agencies' sovereign ceiling policies do not address the upgrades at all. Hence, the decision to upgrade a bank's rating is done on an individual basis rather than as a general rule.

[10]Note that a sample of S&P credit ratings was also used to test the robustness of these results. The regressions that examine the role of liquidity in the sovereign effect pass-through (Table A8) gave similar results when the dependent variable was the first difference of the S&P long-term issuer default rating. The results were also similar when the dependent variable was the first difference of the log of the credit rating. These results are available on request.

4. Conclusions

We have studied the role of bank asset liquidity for Western European banks' credit ratings over the 2005–2017 period. Based on our thorough empirical analyses, we are now also able to take a stand on the prominent role of the newly introduced liquidity coverage ratio (LCR) requirement for the stability of the banking sector. In our analyses, the main variable of interest and the proxy variable for the stock of unencumbered liquid assets was the ratio of liquid assets to total assets. The credit ratings used in this study were the Fitch credit ratings of long-term issuer default risk.

Our first research question addresses a significant gap in the literature by investigating the role of asset liquidity in bank credit ratings. Hence, our results add to the discussion of the results of, e.g., Hong et al. (2014), who studied the role of the LCR in bank failures. Moreover, this study complements the study of Caporale et al. (2012), who studied the determinants of bank credit ratings. The second research question examines how asset liquidity affects the linkage between sovereign ratings and bank ratings. Consequently, this study complements several studies in the literature that examine the sovereign effect. These include studies such as, e.g., Adelino and Ferreira (2016), Huang and Shen (2015), Acharya et al. (2014), Correa et al. (2014) and Alsakka et al. (2014) by showing that sovereign credit rating downgrades affect bank credit ratings significantly less for banks holding more liquid assets.

Our results show convincingly that banks with a large stock of liquid assets have obtained more favorable credit rating changes over the 2005–2017 period compared to banks with less liquid asset portfolios. Therefore, their perceived default risk decreased less from 2005–2017 than that of banks with less liquid asset portfolios. This result is contrary to that of Caporale et al. (2012), who suggested that bank asset liquidity has no effect on bank credit ratings. This may result from the chosen sample period that includes the years from 2005–2017. In comparison, the dataset used by Caporale et al. (2012) covers the years from 2000–2007. Moreover, this result is somewhat different from Hong et al. (2014), who propose that the LCR has no effect at all on the likelihood of bank failure. However, our different results may reflect the different natures of the explained variables, i.e., those of bank failure and of assessed default risk. Moreover, it is possible that our measure of liquidity gives different results than the precise LCR that was used by Hong et al. (2014).

However, according to our results, the relationship between the liquidity of bank assets and credit ratings is not completely linear. Instead, it seems that increasing asset liquidity positively affects bank credit rating upgrades up to a certain threshold. In our sample, this threshold is the median liquidity ratio. Furthermore, the relationship between the two main analyzed variables does not become negative for the most liquid banks either, i.e., our results do not suggest that banks that are 'too liquid' have worse credit rating upgrades than banks with a more 'normal' level of liquidity. This may be because these banks do not have enough income-generating illiquid assets. Alternatively, this may be an implication of the result shown by Wagner (2007), who argues that asset liquidity increases financial instability because asset liquidity gives banks incentives to take higher risks. However, our results do not suggest that higher asset liquidity leads to lower stability. Whether the nonlinear relationship between credit ratings and asset liquidity is explained by reduced performance that relates to a higher retention of liquid assets or by increased risk-taking is a good subject for further research.

Our results indicate that asset liquidity is an important determinant of a bank's resilience in economic turmoil. We argue that this supports the introduction of a minimum liquidity ratio such as the LCR, because the objective of the LCR (and Basel III) is to improve banks' ability to absorb financial shocks and hence decrease the overall fragility of the banking sector. This is an important implication for regulators of the financial sector, as it shows that a liquidity requirement, such as that of the LCR, is a valuable tool in building a more resilient banking sector. Furthermore, the role of liquidity in banks' credit ratings is stronger for banks that have a low liquidity ratio. This suggests that the benefits of the changed regulation are greatest for the segment of banks whose liquidity position is already vulnerable. Moreover, this implies that the newly introduced liquidity regulation will improve the stability of the banking sector in an efficient manner because the benefits are highest for the least liquid banks. Furthermore, Adelino and Ferreira (2016) showed that banks reduce lending after a downgrade in their credit rating. Therefore, an important implication of our results is that liquidity buffers will reduce the cyclicality of lending, because credit rating downgrades typically occur in economic recessions. Finally, as Huang and Shen (2013) suggest, because credit ratings affect banks' costs of debt, better ratings increase banks' cost efficiency during economic recessions, as higher liquidity implies better credit ratings during downswings. Better credit ratings again imply lower funding costs.

As the second main theme, this study examined the role of sovereign rating downgrades in bank credit ratings. Similarly to studies by Adelino and Ferreira (2016) and Alsakka et al. (2014), our empirical results suggest that a sovereign rating downgrade causes, on average, a decrease in bank credit ratings. However, asset liquidity significantly dampens the decrease in bank credit ratings following a sovereign rating downgrade. In other words, sovereign credit rating downgrades cause larger effects on credit ratings for the more liquidity-constrained banks. Therefore, one way to protect banks from the sovereign credit rating effect is to ensure that they have enough liquid assets in their balance sheets. Likewise, the banks most vulnerable to sovereign credit market effects are those that are short of liquidity. This result contributes to the studies of, e.g., Adelino and Ferraira (2016) and Alsakka et al. (2014). Furthermore, since this study is the first to examine the relation between asset liquidity and the sovereign effect, it opens a discussion on an important subject. In addition, we offer a useful result for the future design of financial regulation. This result can be explained by the sovereign creditor's role as an emergency liquidity provider because liquidity-constrained banks are the banks most likely to require a bailout. Therefore, a decrease in the assessed creditworthiness of the sovereign entity increases the probability of liquidity problems, especially in the least liquid banks. This, in turn, increases their costs of funding. Therefore, the new liquidity regulation may provide an opportunity to reduce the dependence between sovereign and bank credit ratings.

Our results complement the results of Acharya et al. (2014), who showed that there exists a two-way loop between sovereign and bank credit risk. Since banks with a more liquid asset portfolio are not as dependent on implicit or explicit government guarantees, these banks' credit risk is less affected by an increase in the sovereign credit risk. Likewise, since more-liquid banks are less likely to default in financial turmoil than less-liquid banks, they are also less likely to induce government bailouts. This again will ease the downward pressure on sovereign ratings during financial crises, because bailouts will be less costly. Furthermore, Gropp et al. (2010) have shown that bailout expectations cause competitive distortions within the banking sector. In particular, these distortions are caused by the protection of competitor banks. Consequently, they argue that bailout expectations should be reduced. Since asset liquidity lessens banks' reliance on sovereigns, liquidity regulation might prove useful in dampening these competitive distortions.

As an apparent suggestion for further research, we propose using Moody's and S&P ratings to examine the issues presented in this study in even more detail. Using a larger sample of S&P (or Moody's) ratings would offer more clarity on this subject. Furthermore, a prominent theme for further research is the role of asset liquidity in rating disagreements. This would further shed light on how rating agencies perceive bank asset liquidity. Finally, the role of the LCR in monetary policy transmission should be a subject for much closer scrutiny in future research.

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Appendix A

TABLE A1 HERE

Tables

Table 1a. Descriptive statistics of the analyzed variables, calculated by dividing the bank observations into two groups based on the median value of the liquidity ratio (L-ratio-median) for the whole period of 2005–2017.

Below L-ratio-median	Mean	S.D.	Min	Max	Median	n
CR	13.44***	3.17	1	19	14	713
ΔCR	-0.40***	1.07	-7	6	0	651
L-ratio	7.96***	3.57	0.92	14.38	7.97	858
E-ratio	7.13**	3.57	1.61	42.33	6.62	830
LLP-ratio	0.64***	0.76	-0.35	4.33	0.40	827
D-ratio	51.00***	17.35	0.55	90.42	50.95	836
ROA	0.34***	1.20	-6.78	4.62	0.47	844
Assets (A,MEUR)	79,201***	167,510	466	1,967,122	25,233	858
SCR	17.2***	3.8	4	20	19	858
GDP growth	0.6***	2.8	-9.1	25.6	1.1	858
Above L-ratio-median	**Mean**	**S.D.**	**Min**	**Max**	**Median**	**n**
CR	14.97***	2.25	5	19	15	737
ΔCR	-0.12***	0.69	-7	2	0	687
L-ratio	28.48***	13.61	14.39	84.23	24.16	855
E-ratio	6.75**	4.12	1.45	42.21	5.76	838
LLP-ratio	0.28***	0.42	-0.37	4.47	0.17	835
D-ratio	44.27***	20.88	1.35	91.23	43.02	839
ROA	0.50***	0.97	-6.76	5.76	0.54	841
Assets (A,MEUR)	311,070***	472,643	106	2,202,423	47,323	855
SCR	18.8***	2.2	10	20	20	855
GDP growth	1.5***	2.3	-5.6	25.6	1.8	855
Full sample	**Mean**	**S.D.**	**Min**	**Max**	**Median**	**n**
CR	14.22	2.84	1	19	15	1450
ΔCR	-0.26	0.91	-7	6	0	1338
L-ratio	18.21	14.29	0.92	84.23	14.37	1713
E-ratio	6.94	3.86	1.45	42.33	6.22	1668
LLP-ratio	0.46	0.64	-0.37	4.47	0.25	1662
D-ratio	47.63	19.49	0.55	91.23	47.96	1675
ROA	0.42	1.09	-6.78	5.76	0.51	1685
Assets (A,MEUR)	194,932	372,733	106	2,202,423	31,097	1713
SCR	18.0	3.2	4	20	20	1713
GDP growth	1.1	2.6	-9.1	25.6	1.5	1713

Notes: For exact definitions and descriptions of the variables, see Table A1 in Appendix A. All the ratios are given as percentage values. The asterisks show the significance of the t-test with a two-sided null hypothesis that the means in the groups are the same, and *, ** and *** refer to significant test statistics at the 10, 5 and 1% significance levels, respectively.

Table 1b. Descriptive statistics of the analyzed variables, calculated by dividing the bank observations into two groups based on the median value of the credit rating (CR-median) for the whole period of 2005–2017.

Below CR-median	Mean	S.D.	Min	Max	Median	n
CR	12.75***	2.70	1	15	14	943
ΔCR	-0.41***	1.07	-7	4	0	880
L-ratio	16.74***	14.02	0.96	77.87	12.43	907
E-ratio	7.46***	3.74	1.50	37.53	6.92	878
LLP-ratio	0.57***	0.72	-0.36	4.33	0.32	891
D-ratio	48.27*	18.59	1.07	89.66	49.90	896
ROA	0.34***	1.20	-6.05	5.04	0.47	895
Assets (A, MEUR)	128,674***	287,296	188	1,868,202	24,957	909
SCR	17.0***	3.8	4	20	18	943
GDP growth	0.8***	2.8	-9.1	25.6	1.3	943
Above CR-median	**Mean**	**S.D.**	**Min**	**Max**	**Median**	**n**
CR	16.53***	0.78	16	19	16	623
ΔCR	0.00***	0.54	-3	6	0	554
L-ratio	20.68***	13.18	0.94	84.23	17.52	543
E-ratio	5.86***	3.58	1.45	42.33	4.94	539
LLP-ratio	0.28***	0.46	-0.28	4.47	0.18	530
D-ratio	46.32*	19.93	2.78	91.00	43.12	541
ROA	0.59***	0.62	-3.61	4.62	0.57	546
Assets (A, MEUR)	358,296***	491,170	434	2,202,423	126,335	548
SCR	19.7***	0.7	17	20	20	623
GDP growth	1.3***	2.4	-8.3	8.4	1.9	623

Notes: See Table 1 above and Table A1 in Appendix A.

Table 2. Number of bank credit rating upgrades and downgrades in the sample (2005–2017).

	No change	Upgrade	Downgrade	Total
2005	67	3	1	71
2006	95	8	2	105
2007	101	21	2	124
2008	87	3	19	109
2009	70	2	42	114
2010	89	2	33	124
2011	76	2	44	122
2012	78	3	42	123
2013	78	4	37	119
2014	103	4	6	113
2015	66	15	27	108
2016	83	10	11	104
2017	82	10	6	98
Total	1,075	87	272	1,434
%-share	75.0	6.0	19.0	100.0

Notes: No change = bank credit rating remains unchanged, Upgrade = bank credit rating increases, Downgrade = bank credit rating decreases.

Table 3. The mean bank credit ratings and the mean changes in rating, calculated by dividing the bank observations into two groups based on the median value of the liquidity ratio (2005–2017).

	CR		*ΔCR*	
	Less liquid	More liquid	Less liquid	More liquid
2005	15.16	15.47	0	0.05
2006	15.24	15.51	0.08	0.09
2007	15.24*	15.75*	0.18	0.15
2008	15.14**	15.82**	-0.15	-0.22
2009	14.62	15.10	-0.70	-0.52
2010	14.21***	15.43***	-0.65***	-0.06***
2011	13.58***	15.03***	-0.78**	-0.31**
2012	12.67***	14.82***	-1.08***	-0.33***
2013	12.48***	14.20***	-0.43	-0.41
2014	12.39***	14.14***	-0.02	-0.06
2015	11.97***	14.06***	-0.53*	-0.21*
2016	10.81***	14.52***	-0.36***	0.09***
2017	11.18***	14.31***	0.08	0.06

Notes: See Table A3 for the notations. The sample is divided into two sub-samples by the median value of the liquid assets to total assets ratio (*L-ratio*). The asterisks indicate the significance of the t-test statistics with a one-sided hypothesis that the less liquid banks have lower credit ratings and more negative rating changes, and *, ** and *** denote significant test statistics at 10, 5 and 1 percent significance levels, respectively.

Table 4. Pairwise correlation matrix for the analyzed variables (2005–2017). For the variable definitions, see Table A1 in Appendix A.

	ΔCR	*CR*	*L-ratio*	*E-ratio*	*LLP-ratio*	*D-ratio*	*ROA*	*log(A)*	*SCR*	*ΔSCR*	*GDP growth*
ΔCR	1										
CR	0.38	1									
L-ratio	0.13	0.22	1								
E-ratio	0.06	-0.19	0.01	1							
LLP-ratio	-0.32	-0.50	-0.29	0.09	1						
D-ratio	0.02	-0.15	-0.26	0.01	0.07	1					
ROA	0.28	0.35	0.03	0.30	-0.51	-0.06	1				
log(A)	-0.07	0.21	0.05	-0.46	-0.05	-0.30	-0.09	1			
SCR	0.32	0.73	0.26	-0.06	-0.50	-0.14	0.31	-0.06	1		
ΔSCR	0.38	0.19	0.11	0.04	-0.25	0.02	0.21	-0.01	0.29	1	
GDP growth	0.29	0.17	0.13	0.05	-0.33	0.02	0.26	-0.01	0.23	0.35	1

Notes: The table shows the correlation matrix for the analyzed variables. *CR* = Fitch long-term issuer credit rating (on a scale of 1–20); *L-ratio* = liquid assets to total assets ratio; *E-ratio* = total equity to total assets ratio; *LLP-ratio* = loan loss provisions to total assets ratio; *D-ratio* = total customer deposits to total assets ratio; *ROA* = pretax profit to total assets ratio; *log(A)* = log of total assets; and *SCR* = long-term issuer sovereign credit rating.

Table 5. Empirical results when using the change in the log of bank credit rating (*Δlog(CR)*) as the dependent variable for the period of 2005–2017. All the independent variables are one period lagged values, and the model includes fixed effects and year dummies in every specification reported in columns (1)–(5).

	(1) Δlog(CR)	(2) Δlog(CR)	(3) Δlog(CR)	(4) Δlog(CR)	(5) Δlog(CR)
L-ratio$_{t-1}$	0.0011**	0.0011***	0.0009**	0.0013***	0.0014***
	(2.183)	(2.850)	(2.412)	(2.795)	(2.843)
E-ratio$_{t-1}$	0.0014	-0.0097**	-0.0097**	-0.0115**	-0.0114**
	(0.855)	(-2.460)	(-2.484)	(-2.390)	(-2.401)
LLP-ratio$_{t-1}$		-0.0398**	-0.0318**	-0.0396**	-0.0402**
		(-2.584)	(-2.068)	(-2.281)	(-2.318)
D-ratio$_{t-1}$		0.0013	0.0009	0.0011	0.0011
		(1.478)	(1.323)	(1.363)	(1.356)
ROA$_{t-1}$		0.0337***	0.0293***	0.0335***	0.0338***
		(3.507)	(3.433)	(3.336)	(3.354)
log(A)$_{t-1}$		-0.0503***	-0.0490***	-0.0473***	-0.0502***
		(-3.404)	(-3.191)	(-2.695)	(-2.737)
Δlog(SCR)$_{t-1}$			0.4723*	0.4527*	0.4873*
			(1.973)	(1.968)	(1.915)
log(CR) $_{t-1}$				-0.0777***	-0.0812***
				(-3.150)	(-3.494)
GDP growth$_{t-1}$					-0.0035
					(-1.046)
Constant	0.0031	0.4976***	0.5045***	0.6946***	0.7431***
	(0.209)	(2.910)	(2.788)	(2.878)	(3.067)
Observations	1296	1236	1201	1201	1201
R^2	0.07	0.20	0.24	0.25	0.26
Banks	168	164	164	164	164

Notes: *CR* = Fitch long-term issuer credit rating (on a scale 1–20); *L-ratio* = liquid assets to total assets ratio; *E-ratio* = total equity to total assets ratio; *LLP-ratio* = loan loss provisions to total assets ratio; *D-ratio* = total customer deposits to total assets ratio; *ROA* = pretax profit to total assets ratio; *log(A)* = log of total assets; and *SCR* = long-term issuer sovereign credit rating. *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$ denote significance at the 10, 5, and 1% levels, respectively.

Table 6. Empirical results when dividing the sample based on the median value of the liquid assets-to-total assets ratio and using the change in the log of bank credit rating (*Δlog(CR)*) as the dependent variable in columns (1) and (2) and the absolute change in the level of ratings in columns (3) and (4) for the period of 2005–2017. All the independent variables are one period lagged values, and the model includes fixed effects and year dummies in all specifications.

	(1) Δlog(CR)	(2) Δlog(CR)	(3) ΔCR	(4) ΔCR
L-ratio$_{t-1}$	0.0025*	0.0007**	0.0182*	0.0107**
	(1.959)	(2.007)	(1.813)	(2.395)
E-ratio$_{t-1}$	-0.0281***	0.0005	-0.0626	-0.0028
	(-2.904)	(0.278)	(-1.215)	(-0.125)
LLP-ratio$_{t-1}$	-0.0461**	-0.0187**	-0.0988	-0.2209*
	(-2.378)	(-2.128)	(-0.771)	(-1.966)
D-ratio$_{t-1}$	0.0034**	-0.0002	0.0073	0.0005
	(2.074)	(-0.498)	(0.903)	(0.076)
ROA$_{t-1}$	0.0420**	0.0185**	0.1113	0.2097***
	(2.502)	(2.339)	(1.392)	(2.903)
log(A)$_{t-1}$	0.0006	0.0124	0.0072	0.0725
	(0.019)	(1.097)	(0.031)	(0.464)
log(CR)$_{t-1}$	-0.1472***	-0.2725***		
	(-3.635)	(-8.081)		
Δlog(SCR)$_{t-1}$	0.5408*	0.1717***		
	(1.836)	(2.880)		
GDP growth$_{t-1}$	-0.0042	-0.0033	0.0220	-0.0338
	(-0.897)	(-1.008)	(0.484)	(-0.868)
CR$_{t-1}$			-0.1637***	-0.2637***
			(-5.907)	(-7.219)
ΔSCR$_{t-1}$			0.2671***	0.1595***
			(3.284)	(2.778)
Constant	0.3774	0.6056***	2.3140	3.1929*
	(0.984)	(4.361)	(0.921)	(1.745)
Sample	Below-the-median	Above-the-median	Below-the-median	Above-the-median
Observations	569	606	569	606
R^2	0.35	0.21	0.31	0.23
Banks	112	115	112	115

Notes: See Table 3.

Table 7. Empirical results for the analysis of nonlinear effects of the liquidity ratio. The dummy variable *Median* takes the value of one for banks with an above-median liquidity ratio and zero otherwise. All the independent variables are one period lagged values, and the model includes fixed effects and year dummies in all specifications.

	(1) Δlog(CR)	(2) ΔCR
$Median_t$	0.0411^{***}	0.2933^{**}
	(2.753)	(2.460)
$L\text{-}ratio_{t-1}$	0.0033^{***}	0.0248^{***}
	(3.391)	(3.189)
$Median_t \times L\text{-}ratio_{t-1}$	-0.0025^{***}	-0.0179^{**}
	(-2.889)	(-2.357)
$E\text{-}ratio_{t-1}$	-0.0120^{**}	-0.0341
	(-2.380)	(-1.453)
$LLP\text{-}ratio_{t-1}$	-0.0462^{***}	-0.1787^{*}
	(-2.719)	(-1.879)
$D\text{-}ratio_{t-1}$	0.0011	0.0006
	(1.375)	(0.133)
ROA_{t-1}	0.0309^{***}	0.1655^{***}
	(2.973)	(2.912)
$log(A)_{t-1}$	-0.0456^{**}	-0.2178^{*}
	(-2.602)	(-1.682)
$\Delta log(SCR)_{t-1}$	0.5010^{*}	
	(1.971)	
$log(CR)_{t-1}$	-0.0920^{***}	
	(-3.674)	
$GDP\ growth_{t-1}$	-0.0040	0.0066
	(-1.166)	(0.195)
SCR_{t-1}		0.2295^{***}
		(3.980)
CR_{t-1}		-0.1672^{***}
		(-7.003)
Constant	0.7114^{***}	4.7210^{***}
	(3.009)	(3.229)
Observations	1175	1175
R^2	0.27	0.25
Banks	160	160

Notes: See Table 3.

Table 8. Empirical results for the role of sovereign credit rating downgrades in the bank liquidity vs. credit rating relationship. The dummy variable *DOWN* refers to sovereign credit rating downgrades and takes the value of one when a downgrade occurs and zero otherwise.

	(1)	(2)	(3)	(4)
	Δlog(CR)	Δlog(CR)	ΔCR	ΔCR
$DOWN_{t-1}$	-0.0488**	-0.0873**	-0.3537***	-0.5803***
	(-2.475)	(-2.486)	(-3.268)	(-3.541)
$DOWN_{t-1}$ × $L\text{-}ratio_{t-1}$		0.0023**		0.0136***
		(2.224)		(2.619)
$L\text{-}ratio_{t-1}$	0.0014***	0.0012***	0.0109***	0.0101***
	(3.004)	(2.822)	(3.062)	(2.776)
$E\text{-}ratio_{t-1}$	-0.0125**	-0.0131**	-0.0332	-0.0369*
	(-2.392)	(-2.498)	(-1.488)	(-1.676)
$LLP\text{-}ratio_{t-1}$	-0.0482***	-0.0475***	-0.1638*	-0.1602*
	(-2.803)	(-2.819)	(-1.731)	(-1.685)
$D\text{-}ratio_{t-1}$	0.0013	0.0013	-0.0005	-0.0002
	(1.372)	(1.426)	(-0.103)	(-0.051)
ROA_{t-1}	0.0363***	0.0354***	0.2039***	0.1988***
	(3.494)	(3.434)	(3.644)	(3.510)
$log(A)_{t-1}$	-0.0518***	-0.0506***	-0.2975**	-0.2893**
	(-2.944)	(-2.951)	(-2.155)	(-2.142)
$log(CR)_{t-1}$	-0.0799***	-0.0826***		
	(-3.812)	(-3.907)		
$GDP\ growth_{t-1}$	-0.0014	-0.0023	0.0235	0.0186
	(-0.533)	(-0.864)	(0.704)	(0.574)
CR_{t-1}			-0.1535***	-0.1555***
			(-7.047)	(-7.149)
Constant	0.7508***	0.7539***	5.6120***	5.6080***
	(3.235)	(3.269)	(3.672)	(3.726)
Observations	1236	1236	1236	1236
R^2	0.23	0.24	0.23	0.24
Banks	164	164	164	164

Notes: See Table 3.

Table 9. Empirical results for the role of sovereign credit rating downgrades in the bank liquidity vs. credit rating relationship. The dummy variable *DOWN* refers to sovereign credit rating downgrades and takes the value of one when a downgrade occurs and zero otherwise. The dummy variable *BOUND* refers to banks whose rating equals the sovereign rating.

	(1)	(2)
	Δlog(CR)	ΔCR
L.DOWN	-0.0620*	-0.5307***
	(-1.911)	(-3.258)
L.BOUND	0.0402	-0.1820
	(0.980)	(-1.049)
L.DOWN × L.BOUND	-0.3897**	-0.5259
	(-1.978)	(-1.037)
$L\text{-}ratio_{t-1}$	0.0012***	0.0097***
	(2.713)	(2.639)
L.DOWN × $L\text{-}ratio_{t-1}$	0.0014	0.0121**
	(1.533)	(2.372)
L.BOUND × $L\text{-}ratio_{t-1}$	-0.0015	0.0057
	(-0.983)	(0.569)
L.DOWN × L.BOUND × $L\text{-}ratio_{t-1}$	0.0228*	0.0121
	(1.773)	(0.219)
$E\text{-}ratio_{t-1}$	-0.0116**	-0.0341
	(-2.372)	(-1.584)
$LLP\text{-}ratio_{t-1}$	-0.0425***	-0.1428
	(-2.722)	(-1.498)
$D\text{-}ratio_{t-1}$	0.0011	-0.0007
	(1.362)	(-0.155)
ROA_{t-1}	0.0339***	0.2006***
	(3.608)	(3.537)
$log(A)_{t-1}$	-0.0498***	-0.2690**
	(-2.702)	(-1.996)
$log(CR)_{t-1}$	-0.0745***	
	(-3.567)	
$GDP\ growth_{t-1}$	-0.0029	0.0145
	(-1.059)	(0.472)
CR_{t-1}		-0.1555***
		(-7.049)
Constant	0.7277***	5.4084***
	(2.953)	(3.646)
Observations	1236	1236
R^2	0.27	0.24
Banks	164	164

Notes: See Table 3.

Table A1. Variable definitions

Variable	Definition
logCR	Log of Fitch long-term bank credit rating (on a scale 1–20)
Δ*logCR*	The first difference of the log of bank credit rating.
CR	Fitch long-term bank credit rating (on a scale 1–20)
Δ*CR*	The first difference of the bank credit rating.
L-ratio	Liquid assets to total assets ratio (%)
E-ratio	Total equity to total assets ratio (%)
D-ratio	Total customer deposits to total assets ratio (%)
ROA	Pretax return to total assets ratio (%)
log(A)	Log of total assets
LLP-ratio	Loan loss provisions to total assets ratio (%)
log(SCR)	Log of Fitch sovereign credit rating (SOVCR)
GDP growth	Growth rate of GDP (%) (Source: OECD)
D2005, D2006…D2016	Year dummies