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Regulatory capital: Implications on credit creation and profitability

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Abstract: The level of liquidity in banking determines the extent to which a bank can meet its financial intermediation role. Liquidity and regulatory capital requirements have gained momentum after the 2008 global financial crisis. Meeting the shareholder's need (i.e profitability) and regulatory requirements (liquidity and capital) is a delicate balance that banks strive to achieve. Applying a pooled fixed-effects model on a complete panel of 179 banks from 2008 to 2019 in the European Union, the results show how banks in Europe strive to achieve profitability requirements at the same time meeting the regulatory hurdles. The results indicate, better-capitalised banks lend much more, which in turn enhances profitability. Also, the findings indicate that higher capital requirements for banks significantly positively influence liquidity. Furthermore, there is an inverse relationship between growth in loans and total regulatory capital. The results imply banks should ensure that the quality of the capital base and the buffers above the regulatory minimum are built up during periods of strong earnings growth. The results also indicate that profitability is significant in influencing the liquidity of the bank. The results emphasise the need to regulate not only the minimum capital requirement but also the liquidity level.

ABOUT THE AUTHOR

Isaiah Oino is a Senior Accounting Lecturer at Coventry University. Dr Oino completed his PhD in 2013 examining the minimum capital requirements of banks and the speed of adjustment to the optimum level. Since his graduation, he continues to research on prudential regulations and other areas of behavioural finance. Apart from academia, Dr Oino is the current Chairman of the medium sized Saving and Credit institution in Kenya.

PUBLIC INTEREST STATEMENT

Banks are the most regulated firms across the world. The regulations range from provision of licence, minimum capital requirements, corporate governance, financial reporting and disclosure requirements, minimum reserve requirements and activity and large exposure restrictions and the latest being liquidity requirements. The level of liquidity in banking determines the extent to which a bank can meet its financial intermediation role such as provision of credit to the borrowers. Liquidity and regulatory capital requirements have gained momentum after the 2008 global financial crisis. The results from 179 banks from 2008 to 2019 in the European Union indicate that banks in Europe strive to achieve profitability requirements at the same time meeting the regulatory hurdles. The results indicate that better capitalised banks lend much more which enhances profitability. In addition, higher capital requirements positively influence liquidity. The results imply banks should ensure that the quality of the capital base and the buffers above the regulatory minimum are built up during periods of strong earnings growth.

Subjects: Economics; Finance; Business, Management and Accounting; Industry & Industrial Studies

Keywords: Liquidity; capital; requirements; profitability; assets

1. Introduction

Banking is one of the most important sectors in the economy because of the intermediation role that banks play. To perform such a role effectively, apart from being efficient, it is paramount that the banks are liquid enough to meet the financial commitments. According to the Basel Committee, one of the main objectives of recent financial reforms to strengthen global capital and liquidity rules is to build a foundation for sustainable economic growth with a strong and resilient banking system (Basel Committee on Banking Supervision, 2011). In line with this, several pieces of research have examined the effects of financial shocks on real economic activity and the procyclical nature of risk-based capital ratios Gilchrist and Zakrajšek (2012), Lopez-Salido et al. (2015), Gertler and Karadi (2015), and Caldara and Herbst (2016). The relationship between capital levels and credit supply has been identified by Berrospide and Edge (2010) as one of the most fundamental research issues that require resolution in verifying the link between the financial sector and real activity. Also, Gambacorta and Paolo Emilio Mistrulli (2004), and Meh (2011) emphasise the importance of the bank-capital channel, through which monetary policy and shocks to bank capital affect bank lending.

Liquidity may be impacted as a result of sudden, unexpected cash outflows by way of large deposit withdrawals, large credit disbursements, unexpected market movements, or crystallisation of contingent obligations. The other cause may be because of some other events causing counterparties to avoid trading with or lending to the bank. A number of studies have emphasised the importance of banks' liquidity as well as its effects on the banks. For example, DeYoung and Jang (2016) stated that the Basel III standard is tantamount to the Tirole (2011) analysis for bank liquidity that centres on three main areas: maintaining liquid assets to aid short-term financing runs; issuing stable deposits that may not run; and holding significant levels of equity financing to indicate long-term solvency and thus minimise the possibility of runs.

Considering banks differ significantly from non-financial firms by the fact that the bulk of the bank's liabilities are subject to payment on call, it is paramount that at all times the resources of the bank provide the means for meeting demands for cash as they are made. It might appear that this would require banks to hold against these liabilities resources, which are also payable on call.

Apart from the demand deposit and its effects on liquidity, many studies have examined the effect of changes in bank capital on lending (Berrospide & Edge, 2010; Brei et al., 2013; Carlson et al., 2011). Conversely, some scholars focus on other factors that have slowed down bank lending during the recent financial crisis. For example, Cornett et al. (2011) highlight the negative effect of bank liquidity on lending during the recent crisis.

The overarching objective of this paper is to assess host factors that may influence liquidity in the selected banking sector using a host of estimation methods to draw a comparison. The article also analyses how the regulatory capital not only influences liquidity but also how it impacts the profitability of the banks. Also, the procyclical nature of regulatory capital is assessed in the context of 179 banks in the European Union economies. This study extends the debate on the Dodd–Frank Act of 2010 and Basel's capital requirements on liquidity creation and bank profitability and a recent study by Tran et al. (2016) that examined the inter-relationships between liquidity creation, regulatory capital and profitability using US banks from 1996 to 2013. Higher capital requirements may drive up funding costs and reduce liquidity creation, which would lead to lower lending and investment activities in the economy. Banks are therefore likely to experience lower profitability since a higher capital requirement shifts funding from liquid deposits to less liquid capital. For example, Goddard et al. (2010) argue that an increase in capital requirements

has a negative impact on bank profitability. Also, Andreou et al. (2016) point out that during the financial crisis, banks are likely to reduce liquidity creation and hence reduced profitability.

Conversely, Admati et al. (2013) noted that higher capital requirements tend to reduce excessive risk-taking activities. Consequently, banks tend to perform better due to fewer distortions in lending decisions and lower moral hazards. Other studies have indicated a positive association between higher capital requirements and performance (Demirgüç-Kunt & Huizinga, 2000; Iannotta et al., 2007; Lee & Hsieh, 2013).

This study also contributes to the current literature, which focuses on the effect of either capital or liquidity creation on bank profitability without considering both effects together. For instance, A. N. Berger and Bouwman (2009) assessed the impact of capital on liquidity creation and the association between liquidity creation and bank value separately. This study examines the effect of liquidity creation when regulatory capital changes.

To the best of my knowledge, this is the first study that investigates the dynamic interrelationships among liquidity creation, regulatory capital, and bank performance using banks in Europe. This paper builds upon studies on the effect of regulations on bank soundness (Barth et al., 2004; Delis & Staikouras, 2011) and Tran et al. (2016) nexus between regulatory capital, liquidity and profitability among the US banks.

The results also show that banks do not strengthen their regulatory capital buffer when they face higher illiquidity as defined in the Basel III accords or when they create more liquidity. The results support the need to implement minimum liquidity ratios as recommended by the Basel Committee. Therefore, the results provide insights into the design of prudential regulation and supervision of banks. That is, regulatory capital interventions do have a positive consequence of liquidity creation that is paramount to a well-functioning banking system. In terms of contribution to the literature, this paper points out that there is a significant interaction effect of bank capital and liquidity on credit supply. That is an increasing regulatory capital significantly positively influences liquidity ratios. In terms of policy implications, the results point out that policy actions such as revised minimum capital requirements and liquidity requirements such as liquidity coverage ratio (LCR) ensure sustainable lending and the two should be harmoniously implemented.

2. Related studies

Managing liquidity in banking is one of the most important elements that bank supervisors or regulators keep a close eye on.

A bank should maintain sufficient liquidity to withstand all kinds of stress events that it will be faced. Constant assessment of liquidity risk management framework and liquidity position is an important supervisory action that will ensure the proper functioning of the bank. Literature on the determinants of liquidity risk relatively scarce. However, liquidity risk is mainly considered as a determinant of other risks, such as credit risk (Bissoondoyal-Bheenick & Treepongkaruna, 2011) or influence of bank financial performance (Arif & Anees, 2012; Pasiouras & Kosmidou, 2007). In terms of determinants of liquidity risk, Rauch, Steffen, Hackethal, & Tyrrel (2010) highlight that the most important determinants are macroeconomic variables and monetary policies. Also, Bunda and Desquilbet (2008), in their study on 1107 commercial banks in 36 emerging economies and noted that capitalisation has a significant and positive relationship with all liquidity measures considered in their study and a significant relationship with the inflation rate and growth rate.

Similarly, A.N. Berger and Bouwman (2009) noted that banks with a lower level of equity capital are more likely to commit to monitoring their borrowers and hence allow them to grant loans and to create more liquidity. That is, a higher level of capital increases liquidity creation because

a higher level of capital improves an institution's ability to absorb and diversify risk and hence creates more liquidity. Pana et al. (2011) also find the positive relationship between capital and liquidity creation for large banks, but find no evidence for small banks. However, Mukherjee and Pana (2010) report the negative relationship between capital and liquidity creation for credit unions. Other studies have noted that different levels of liquidity can be created by changing the funding mix on the liabilities (Diamond & Rajan, 2001; Gorton & Winton, 2000), and the amount of equity capital impacts the level of lending and the asset portfolio composition, and thus affects liquidity transformation (Thakor, 1996).

In analysing the impact of liquidity, Kumbirai and Webb (2010) investigated the relationship between the liquidity, profitability, and credit quality performance of South Africa's commercial banks for the period of 2005–2009. The study concluded that the global financial crisis had an adverse effect on South African banks, which had resulted in falling profitability, low liquidity, and deteriorating credit quality of the banking sector. Also, Bordelean and Graham (2010) analysed the association between liquidity and profitability for a panel of Canadian and U.S. banks from 1997 to 2009. Their study indicated that there is a non-linear relationship between liquid assets and profitability. However, Molyneux and Thorton (1992) and Goddard et al. (2010) document a negative effect of liquidity on bank performance across European countries for the periods of 1986–1989 and the mid-1990s, respectively. Interesting results were noted also by Altunbas et al. (2007) that inefficient European banks appear to be highly capitalized banks. Goddard et al. (2010) find that well-capitalised banks appear to have lower profitability in eight European Union member countries from 1992 to 2007.

Other studies have analysed the impact of macroeconomic variables on liquidity. Regarding GDP, Valla et al. (2006) noted that appetite for higher creation of liquidity increases with better economic conditions than at a time of economic downturn. Also, Cucinelli (2013) noted similar results that liquidity is increased during the economic boom. Conversely, Aspachs et al. (2005), Vodová (2011a), and Moussa (2015) document higher liquidity holdings in a period of economic downturn, when holding is motivated by the principle of precaution from banks, but also by less demand for loans from clients. This demonstrates a lack of consensus in terms of the impact of economic growth on banking liquidity.

There are also studies that analysed the impact of bank liquidity on credit growth (Ivashina and Scharfstein, 2010; Berrospide, 2013; Cornett et al., 2011). Cornett et al. (2011) concluded that there is a negative association between an increase in liquidity and credit growth.

Ivashina and Scharfstein (2010) and Berrospide (2013) noted that during the financial crisis of 2007–08, US banks were holding more liquid assets during the 2007/08 financial crisis. This is because the banks were anticipating to make significant losses in loans/advances.

Therefore, the hypothesis of this study includes:

H1. There is a positive association between liquidity and profitability.

H2. There is a positive association between profitability and regulatory capital.

H3. There is a negative association between regulatory capital and liquidity.

3. Data and methodology

For bank-level data, this research makes use of the Fitch connect database to extract unconsolidated statements of financial position and income statements data, for a panel of banks within eight biggest economies in the European Union area. Only retail and consumer banks with complete data and rated A and above were included. Table A1 shows the countries from which

the data was extracted for the 179 private banks. We excluded government-controlled banks and concentrated on privately owned banks. Our population covers only European area only because uniformity of regulation. In considering foreign-owned banks, because they operate within the European Union, there will be no difference with domestic banks because the regulations do not discriminate the two categories. Annual data was used from 2008 to 2019. Country-specific data, i.e., real gross domestic product growth was extracted from the World Bank database.

The capital requirement regulation (CRR) was implemented across Europe in January 2014. This was because of stringent reforms post the recent global financial crisis. Such reform may bring structural break in the data. Structural break test was imposed on the data to assess whether there is a need to split the data into two. That is 2008–2013 and 2014–2019. To test for the known point, Chow test was used and for unknown point, recursive regressive. Both tests indicated that there were no significant breaks that can warrant splitting the data.

To test the relationship between the bank liquidity and the bank-specific factors and macro-economic determinants, I used the econometric model used by Brei et al. (2013) with some adjustments which take the form:

$$Liq = \alpha + \sum_{J=}^{j} \beta x_{it-1}^{j} + \sum_{M=1}^{M} Bx_{t-1}^{M} + \varepsilon_{its}$$

where $\varepsilon_{its} = \nu_i + \mu_{its}$

Following the literature (e.g., Berrospide & Edge, 2010; Brei et al., 2013; Gambacorta & Paolo Emilio Mistrulli, 2004), we use the growth rate of the dependent variable (Liq) instead of the variable in levels to mitigate spurious correlation.

In addition, $\sum_{j=1}^{j} \beta X_{it-1}^{j} i$ is a vector of bank-specific variables like the loans to deposit ratio. Also, $\sum_{m=1}^{M} \beta X_{t-1}^{M}$is the country's macroeconomic variable. In estimating the regression, a number of methods have been proposed, with some known to produce biased estimators. For example, Montgomery and Peck (1992) noted that stepwise regression tends to produce unsatisfactory results. Roodman (2006), recommends fixed-effects estimators as better alternatives to GMM under a large time dimension because under such a condition, dynamic panel bias becomes nonsignificant and number of instruments tends to considerably increase as time dimension increases. Judson and Owen (1999) also noted that fixed-effects estimators perform well or better when the time dimension of panel data is greater than 30. Judson and Owen (1999) also argue that fixed-effects estimators may be chosen even when the time dimension is 20 for balanced panel data. The fixed-effects method has been extensively used in the literature (for example, Berrospide & Edge, 2010; Cornett et al., 2011; Francis & Osborne, 2009).

Before running a regression, I assess the stationarity of the variables in the model, using panel unit root test, which is applicable to balanced panel data (Fisher-type tests based on augmented Dickey–Fuller). Stationarity means that the mean, variance and autocorrelation of a variable do not change with time. The results indicate that all the variables are stationary. However, some outliers were identified because of the timeframe that was considered in this research. Without data cleaning to remove or smooth off the outliers, the Robust regression method was used. Robust regression methods are designed to be not overly affected by violations of assumptions by the underlying data-generating process.

Assessing the drivers of bank liquidity could be affected by an endogenous character of certain variables. For instance, the more profitable a bank is, the more likely it is to increase its equity capital. This problem of causality could even move in the opposite direction; for example, higher

bank profitability could lead to more employees and less efficiency (García-Herrero et al., 2009). In addition, some characteristics of banks that affect their liquidity are difficult to measure or identify in an equation (the so-called unobserved heterogeneity); if the influence of such characteristics is not taken into account, there could be correlations between some of the coefficients of the explanatory variables and the error terms that bias these coefficients.

The dependent variable liquidity is as described in Kashyap and Stein (2000). Liquid assets are composed of cash, reverse Repos, bills and commercial papers and comprise in addition to all types of investment securities, such as equities and bonds. This research measure liquidity as a ratio of liquid assets to total assets. This measure is interesting since it informs on the split between liquid and illiquid assets (such as loans) on the bank's balance sheet.

The liquidity estimation model was captured using Robust least square, random effects and pooled fixed effects (FE) after testing for heteroskedasticity and serial correlation using the Breusch Pagan with White test procedure as a possible remedy. The Akaike information criterion for FE is smaller than any other estimation method. Therefore, the FE is a better estimator. Using the Hausman test between the fixed effects and the random effects, the result indicates that the fixed effects is more appropriate, implying that the differences between the banks do not vary greatly from period to period. However, the results from the three estimation methods are reported for meaningful comparison.

All bank-specific variables and macroeconomic control variables are lagged one period to mitigate possible endogeneity bias. This method, though it partially alleviates the simultaneity issue, does not correct bias due to omitted variables. To deal with the issue of omitted/unobserved variables, we follow Graham et al. (2010) and Coles and Li (2013) and use fixed-effects model. The unobservable year effects (μt), and potentially captures temporal aggregate shocks from various market forces that affect both the liquidity and bank profitability. The fixed-effects model extracts these unobservable bank-specific characteristics from the error term, making the error term uncorrelated or less correlated with the liquidity, and providing an unbiased or less biased estimate Table 1.

4. Analysis of the results

Table 2 indicates that on average the ratio between equity and total assets is 12.3 while that maximum is 164.00 and the minimum 0.01 with a huge standard deviation. This ratio represents the amount of debt and equity used to finance the bank assets. This is an important ratio as it indicates the potential financial risk. A relatively high ratio, i.e., 2 commonly indicates an aggressive growth strategy by a firm. However, one would expect that with the banks this ratio is quite high compared with non-financial institutions because of the nature of the business that makes use of deposits. In terms of profitability, the results indicate ROE is 2.9% on average while the maximum is 31.1% and the minimum is −151.82%. Interestingly, as shown in Table 3, there is a positive association between profitability and regulatory capital requirements. This confirms Berger (1995)'s study on U.S. commercial banks where he found a positive relationship between the level of capital and earnings in banks. Also, Goddard et al. (2010) found that the relationship between the capital–asset ratio and profitability is positive for banks in the Euro-area. Well-capitalised banks face lower bankruptcy costs, which reduces the cost of funding, thereby increasing the profitability and hence fail to reject hypothesis 2. Focusing on traditional intermediation role as loans and deposits, the average share of total loans to total deposit in total assets is 95.22%. As expected, there is a positive association between loans to deposit and ROE.

In terms of bank liquidity, the liquid assets-to-total assets ratio was employed. This ratio measures the maturity structure of the asset portfolio that can reflect excessive maturity unbalances (Cihak & Poghosyan, 2009). The higher is the ratio, the more liquid an institution is considered. As shown in Table 2, on average 18.1% of the total assets were classified as those that can be converted to cash quickly if needed to meet financial obligations; examples of liquid assets generally include cash, central bank reserves, and government debt. To remain viable, a financial institution must have enough liquid assets to meet its near-term obligations, such as withdrawals by depositors.Table 3

indicates that there is multicollinearity between liquid assets to tier 1 and total regulatory capital. To limit the impact of multicollinearity, subsequent analysis will consider only total regulatory capital. Table 3 also indicates that there is a positive relationship between liquidity and profitability. This implies that there is a need to strike a balance between liquidity and profitability.

Notes: EQ/TA, equity to total assets; GDPG, gross domestic product growth; G.LOANS, growth of loans; G.TA, growth of total assets; LIQ, liquid assets to total assets; LOANS/DEP, total loans-to-total deposits ratio; TIER 1, Regulatory Tier 1 Capital; ROE, return on equity; T.REG.CAP, Total Regulatory Capital, Tier 1 plus Tier 2.

As a proxy of bank capitalisation, the ratio of Tier 1 and total regulatory capital to total risk weighted assets were considered. A bank could be more vulnerable when its capital is weaker compared with the volume of its risky assets (Martin, 1977). In this context, a bank security buffer could be too weak to absorb losses from bad quality assets. As shown in Table 2 , tier 1 is 16.3% and total regulatory capital is 17.3%. Total regulatory capital is the sum of tier 1 and tier 2. Tier 2 capital consists of capital instruments and subordinated loans and their associated premium accounts. The claim on the instrument or loan must be wholly subordinated to the claims of all non-subordinated creditors, and should not be secured or subject to a guarantee that enhances the seniority of its claim. As of 2017, under Basel III, a bank's tier 1 and tier 2 capital must be at least 8% of its risk-weighted assets. The minimum capital adequacy ratio (including the capital conservation buffer) is 10.5%. The capital conservation buffer recommendation is designed to build up banks' capital, which they could use in periods of stress. Examining the relationship between regulatory capital requirements and lending, the results (Table 3) indicate that there is an inverse relationship between growth in loans and both tier 1 and total regulatory capital. This implies, when the banks are building their capital level, they are likely to reduce their lending. This is in line with Furfine (2000) who noted that a 1%-point increase in risk-based capital requirement results in a 5.5% reduction in loan growth. Similarly, Francis and Osborne (2009) find that a 1%-point increase in capital requirements would reduce lending in 2002 by 1.2%.

The status of the economy can play a significant role in building bank capital buffer. In terms of economic growth, on average, the major economies in Europe grew by 0.5% between 2008 and 2016. Unlike Djalilov and Piesse (2019) study that demonstrated that there is a negative association between economic growth and regulatory capital, as shown in Table 3 , there is a positive association between GDPG and both tier 1 and total regulatory capital. This implies that banks build up their capital during the economic growth. This encourages banks to strengthen their capital buffer. In addition, in line with Tran et al. (2016), there is a positive association between liquidity and capital requirements (both tier 1 and total regulatory capital). In other words, liquid banks are likely to meet the regulatory capital requirements.

Notes: EQ/TA, equity to total assets; GDPG, gross domestic product growth; G.LOANS, growth of loans; G.TA, growth of total assets; LIQ, liquid assets to total assets; LOANS/DEP, total loans-to-total deposits ratio; TIER 1, Regulatory Tier 1 Capital; ROE, return on equity; T.REG.CAP, Total Regulatory Capital, Tier 1 plus Tier 2.

As shown in Table 4, regression, the Akaike Information Criteria (AIC) for the pooled fixed-effect s model is lower than the rest. AIC estimates the quality of each model, relative to each of the other models. In this case, the pooled fixed-effects model gives the best fit. However, the three models are reported for the purpose of comparison. The results show that ROE has positive coefficients and significant at 1% across all models. This implies the more profitable the bank is, the less likely to be cash strained. Interestingly, apart from the significance level, the magnitude of the coefficient is quite big. That is a 1% increase in profitability will lead to 0.295 improvements in liquidity, hence fail to reject hypothesis 1.

The theory of financial intermediation highlights various channels through which capital and liquidity are interrelated. Table 4 indicates that total regulatory capital is significant at 1%. Thus,

Table 1. Variable measurements

Variable	Explanation	Computation
Dependent variable		
Liquidity ratio	The buffer of liquid assets as a share of the balance sheet. It is a measure of the maturity structure of the asset portfolio that can reflect excessive maturity unbalances (Cihak & Poghosyan, 2009).	Liquid assets/total assets
Liquidity ratio	The loan-to-deposit ratio is used to assess a bank's liquidity by comparing a bank's total loans to its total deposits for the same period. It is a measure of the illiquidity of the asset portfolio that can reflect excessive illiquidity and higher exposure to default risk (Arena, 2005).	Total loans/total deposit
Idiosyncratic factors		
Profitability	Profitability of the bank as a ready source of liquidity (analysed in the regression in level)	Net profit/Total equity
Loan growth	Financial constraints. Ability to raise new funds if loan business expands compared to the rest of the balance sheet	% of Loan growth
Economic growth	The status of the economy, Gross Domestic Product Growth. This measures the macroeconomic conditions of the country.	GDPG
Capital adequacy Tier 1	The minimum regulatory capital requirement as a ratio based on the risk-weighted assets. (RWCR). Tier 1 capital includes common equity plus other instruments that are subordinated to subordinated debt, have no fixed maturity and no embedded incentive for redemption, and for which a bank can cancel dividends or coupons at any time (Distinguin et al., 2013).	RWCR = Capital/Risk Weighted assets
Total regulatory capital.	This includes tier 1 and tier 2. Tier 2 consists of unsecured subordinated debt and its stock surplus with an original maturity of fewer than five years minus investments in non-consolidated financial institutions subsidiaries under certain circumstances.	The sum of Tier 1 and Tier 2 capital.
		Total Loans/Total Deposit
Growth in size of the bank	Changes in the bank size using the log of total assets.	Growth of total assets.
Equity/total assets	It represents the amount of assets on which shareholders have a residual claim.	Total shareholders' equity/ total assets

Table 2. Descriptive statistics

	Mean	Maximum	Minimum	Std. Dev.	Observations
EQ/TA	12.300	164.000	0.014	88.220	1450
GDPG	0.527	4.089	−5.618	2.091	1450
G.LOANS	2.496	212.500	−110	16.810	1450
G.TA	4.281	68.910	−57.9	12.501	1450
LIQ	18.120	80.801	0.010	18.491	1450
LOANS/DEP	95.220	465.100	0.618	60.500	1450
TIER 1	16.301	50.100	5.950	7.200	1450
ROE	2.920	31.100	−151.82	14.120	1450
T.REG. CAP	17.325	49.561	4.714	6.900	1450

the higher is the bank's capital ratio, the higher is its liquidity creation. In other words, higher capital incentivises banks to work harder, leading to more lending and liquidity creation. This is in line with Igan and Mirzaei (2020) who noted that banks that were liquid during the financial crisis performed better. Liquid banks can meet their financial intermediation role. This implies that forcing banks to hold a significantly higher capital not socially expensive in the long term. Better capitalised banks are expected to suffer fewer distortions in lending decisions and perform better confirming hypothesis 2. Moreover, regulatory capital positively impact profitability of banks significant at 5%. This is because the more capitalised the bank is, the more resources (liquid) it is and hence the more it can lend. This implies rejection of hypothesis 3 for the alternative. On the other hand, the high constraint bank in terms of capital, the less liquid it is and so less ability to lend.

Notes: LIQ, liquid assets to total assets; EQ/TA, equity to total assets; GDPG, gross domestic product growth; G.LOANS, growth of loans; G.TA, growth of total assets; LOANS/DEP, total loans-to-total deposits ratio; ROE, return on equity; T.REG.CAP, Total Regulatory Capital, Tier 1 plus Tier 2.

The results imply that higher capital requirements for banks may provide incentives for the bank to reduce its probability of default by monitoring their borrowers and reduce moral hazard by incentivising banks to invest in less risky assets. This emphasises the need not only for regulatory capital but also the liquidity level. A key part of the new Basel III regulation is the introduction of a liquidity coverage ratio (LCR) from 2015 onwards. The LCR requires banks to hold a sufficient level of high-quality liquid-assets against expected net liquid outflows over a 30-day stress period. The introduction of the LCR is seen as one of the key reforms to promote a more resilient banking sector. The objective is to promote the short-term resilience of the liquidity risk profile of banks.

Examining the impact of loans-to-deposit ratio and increase in loans on liquidity indicates a negative coefficient but significant at 5%. This means increased lending may have a detrimental impact on liquidity. That is a 1%-point increase leads to 0.035 decrease in liquidity. As lending is a major source of revenue, there is a need to balance profitability and liquidity.

All models also indicate the impact of bank size on liquidity. The results indicate that an increase in total assets leads to improved liquidity. This implies that larger banks have lower liquidity exposure. This is because larger banks have a better reputation and so are less exposed to liquidity risk. Surprisingly, although a positive coefficient, GDPG indicates that it is not significant in influencing liquidity. This implies an increase in liquidity in response to stronger growth appears to be only marginally significantly different from zero.

Table 3. Correlation matrix

	EQ/TA	GDPG	G. LOANS	G.TA	LIQ	LOANS/ DEP	TIER 1	ROE	T.REG. CAP
EQ/TA	1								
GDPG	0.020	1							
G.LOANS	0.012	−0.029	1						
G.TA	0.018	−0.161	0.518	1					
LIQ	0.016	0.002	−0.023	0.114	1				
LOANS/ DEP	−0.019	−0.260	0.057	0.070	−0.128	1			
TIER 1	0.026	0.050	−0.043	−0.053	0.198	−0.004	1		
ROE	0.028	0.063	0.121	0.139	0.199	0.014	0.122	1	
T.REG. CAP	0.022	0.049	−0.075	−0.089	0.215	0.081	0.766	0.030	1

5. Robustness check

With the introduction of the capital requirement regulation (CRR) or Basil III across Europe in January 2014, I check whether there is a need to divide the panel into two periods. Some of the new measures that Basel III introduced are aimed at preventing future crises, creating a sound financial system in which financial problems are not spread to the real economy. This led to the introduction of a mandatory capital conservation buffer of 2.5% designed to enforce corrective action when a bank's capital ratio deteriorates. Then, although the minimum total

capital requirement remains at the current 8% level, yet the required total capital increases up to 10.5% when combined with the conservation buffer. In addition, from January 2014, banks are required to have a discretionary countercyclical seasonal buffer up to another 2.5% of capital. Therefore, I check whether, such stringent measures has a significant impact on liquidity and profitability using the fixedeffects model from 2015 to 2019 annual data. The results are reported in Table 5. The sign of the coefficients remains the same as before. However, there is slight change of the magnitude of the coefficients of limited time frame. I also note that the significance level of regulatory capital on liquidity does not change. Also, the impact of liquidity on profitability does not change. That is significant at 1% as before. Therefore, the effect of capital ratio on credit growth is positively associated with the level of liquidity ratio even after the period after the implementation of CRR. Lastly, we used nonperforming loans as a ratio of gross loan as a proxy for credit risk (Agoraki et al., 2011) to assess the impact of liquidity and profitability. As shown in Table 5 , we note non-performing loans significantly impacts both the liquidity and profitability of the company. In other words, NPL are seen as a drain of the company's liquidity and hence the need for banks to identify ways of enhancing responsibility and sustainable lending by paying greater attention to the needs and situations of borrowers and by finding appropriate financial products. This will enhance solvency and financial stability and resilience.

Notes: LIQ (Liquid assets to total assets); EQ/TA (Equity to total assets); GDPG (Gross Domestic Product growth); G.LOANS(Growth of Loans); G.TA (Growth of Total Assets); LOANS/DEP (Total loans to total deposits ratio); ROE (Return on Equity); T.REG.CAP (Total Regulatory Capital, Tier 1 plus Tier 2).

6. Conclusion and recommendations

The importance of liquid and well-functioning financial institution is undoubtably significant for the economic and social well-being. The study has demonstrated that there is a positive association between the profitability of the banks and economic growth. That is, when there is an economic boom, the profitability of the banks is likely to be enhanced. This is may influence the private credit to GDP which in turn could influence the employment level. Also, the study has shown that banks

Table 4. Regression results

Variables	Robust least square	Random effects	Pooled fixed effects	Robust least square	Random effects	Pooled fixed effects
	Dependent variable: Liquidity (Liquid assets to total assets)			Dependent variable: Profitability (ROE)		
C	11.403** (3.600)	13.820** (3.012)	14.931** 0.643)	0.813** (0.300)	12.484** (2.045)	12.710** (2.914)
EQ/TA	0.023 (0.312)	0.013 (0.001)	0.015* (0.004)	0.045** (0.020)	1.034** (0.400)	1.023** (0.312)
GDPG	0.045 (0.304)	0.279 (0.400)	0.015 (0.150)	0.289*** (0.523)	0.377** (0.599)	0.383*** (0.603)
G.LOANS	−0.019 (0.107)	−0.023 (0.012)	−0.345** (0.028)	0.787** (0.569)	0.787** (0.489)	0.862** (0.690)
G.TA	0.240* (0.018)	0.278* (0.089)	0.351*** (0.084)	0.591 (0.489)	0.897** (0.079)	0.592** (0.440)
LOANS/DEP	−0.089* (0.048)	−0.071* (0.019)	−0.057** (0.010)	0.130 (0.059)	0.139* (0.040)	0.147 (0.091)
ROE_	0.287*** (0.079)	0.301*** (0.079)	0.301*** (0.035)			
LIQ				0.013 (0.009)	0.099* (0.063)	0.091** (0.066)
T.REG.CAP	0.563*** (0.164)	0.509*** (0.151)	0.028*** (0.091)	0.160** (0.088)	0.180** (0.101)	0.182*** (0.098)
Adjusted R squared	0.306	0.311	0.423	0.435	0.761	0.778
AIC	404.60		7.61	270.10		4.70

Table 5. Regression results post CRR

Variables	Pooled fixed effects	Pooled fixed effects
Dependent variable	Liquidity	Profitability
C	8.102*	9.133*
	0.233)	(0.132)
EQ/TA	0.001*	1.041**
	(0.010)	(0.100)
GDPG	0.013	0.189**
	(0.001)	(0.291)
G.LOANS	−0.101**	0.272*
	(0.014)	(0.020)
G.TA	0.109**	0.196**
	(0.002)	(0.087)
LOANS/DEP	−0.021**	0.099
	(0.004)	(0.009)
ROE_	0.019***	
	(0.006)	
LIQ		0.098**
		(0.016)
T.REG.CAP	0.021***	0.039***
	(0.008)	(0.009)
NPL	−0.049***	−0.005***
	(0.005)	(0.006)
Adjusted R squared	0.491	0.578

tend to increase the regulatory capital during the economic growth which demonstrates the procyclical nature of the bank capital. Therefore, banks should ensure that the quality of the capital base and the buffers above the regulatory minimum are built up during periods of strong earnings growth during economic boom so that they are available to absorb greater losses in stressful environments.

The results also highlight that there is a positive significant relationship between growth in total assets and liquidity. This implies that large banks are likely to be more liquid. In other words, as banks grow, there is a need for them to develop a model that maps growth and liquidity. Further, a 1% increase in loans grants leads to 0.144%-point decrease in liquidity. However, as banks generate much of their income from loans, it is an activity that cannot be avoided. Therefore, there is a need to strike a balance between liquidity and profitability in addition to enhance credit evaluation of the borrowers. This study did not consider the impact of competition of lending and so future studies may consider this important nexus.

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Appendix

Table A1. Number of commercial and retail banks included in the sample

Country	Number of banks included in the sample
Germany	132
UK	9
France	32
Netherland	1
Denmark	2
Sweden	1
Spain	1
Norway	1
Total	179

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