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The Influence of Liquidity Risk on Financial Performance: A Study of the UK's Largest Commercial Banks

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Abstract: The Basel III regulations turned the banking industry around worldwide and created new challenges for banks' financial stability, particularly in liquidity management. As the demand for compliance with the rules started to grow, the inability of banks worldwide to meet the Basel III requirements about liquidity shifted the way they work. This paper highlights the complex relationship between liquidity and bank profitability in the post-Basel III era. Based on market presence and influence, 10 publicly traded UK commercial banks were selected for 2015–2021. Panel data, using FGLS regression models, were tested to elaborate in detail how the liquidity risk indicators determine banks' performance, as measured by different profitability indicators. The findings were diversified: some showed that the relationship between liquidity risk indicators and bank profitability is contingent upon the interaction of several dimensions that range from the internal aspects of the banks themselves to general macroeconomic factors. This study provides vital insights into the current literature on risk management, especially about liquidity risks and their effect on bank performance. The findings of this study contribute meaningfully to the knowledge base for banks, regulators, and policymakers. This will contribute to better decision-making, financial stability, and long-term development within the UK's banking industry.

Keywords: Basel III; UK commercial banks; regulatory compliance; liquidity risk; financial performance

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1. Introduction

The performance of the banking industry consistently and efficiently works as an indicator of the financial stability of a country. Wamalwa et al. (2020) highlighted that this mainly depends on several aspects, such as different types of risks that banks usually face; these involve the possibility of losses because of certain events. In this context, above all, the liquidity risks are considered prevalent. Hereby, the essence of risk management will be crucial. It involves recognition, assessment, and strategies to mitigate risks and optimize the balance between risks and returns accordingly (Ghosh 2014). This will aid the banks in identifying the type of risk, its sources, and the strategies that would work best in moderating it.

The role and importance of such risk management became evident during the global financial crisis of 2007 and 2008. Such turmoil in financial markets has demonstrated significant weaknesses in the practices employed by an individual bank in dealing with liquidity risk (Cardoso and Cardoso 2024). Over time, the effects of this crisis underpinned the importance of banks pragmatically ensuring that their liquidity management policies are thorough and robust to see them through times of uncertainty with ease (Alkhazaleh 2017).

During the post-crisis period, regulators and policymakers realized that heightened liquidity risk management would be required to maintain the performance and stability of the banking industry. Most importantly, the Basel Committee on Banking Supervision

proposed Basel III to respond to the crisis. Basel III introduced many liquidity risk measures, such as liquidity coverage and net stable funding ratios.

If one looks at the journey of the UK over the last decade, one can see that it has been a landscape filled with significant hurdles and game-changing events. The macroeconomic environment has faced several challenges that, in a way, have helped it evolve a story. The history of the UK is developing in the context of a multifaceted Brexit. In contrast, in the international arena, unprecedented economic instability was brought about by the far-reaching consequences of the COVID-19 epidemic. In addition to the inherent difficulty of the task, the long-lasting repercussions from historically low interest rates in response to the financial crisis of 2007–2008 had a significant impact on the banking sector.

Due to all of these changes, there was also a significant change in the regulatory context. The Basel III accord imposed itself as an essential reference, while the role of other regulatory frameworks became more critical. In such a multifaceted context, the situation becomes extremely complex and poses significant pressures on the liquidity management and performance evaluation of banking institutions. Within this context, one can ask,

> *"To what extent have commercial banks in the UK successfully managed liquidity risk and its influence on their overall performance during this transformative decade, taking into account shifting regulatory dynamics and evolving macroeconomic variables?"*

Many previous studies have examined bank performance determinants, including the introduction of the measures of liquidity risk. However, measures in some research studies have often been controlled parameters (Athanasoglou et al. 2008; Kosmidou et al. 2017; Bhatt et al. 2023; Harb et al. 2023). In terms of other scholarly deductions as to how the element of liquidity risk relates to the profitability level of banks, some produce positive effects (Abu Khalaf and Awad 2024), while other studies depict adverse effects (Demirgüç-Kunt and Huizinga 2013; Kosmidou et al. 2017).

Hence, the ambiguous nature of the relationship between liquidity risk and bank performance remains vague, and there is a need for an extended and decisive study. Earlier studies typically use liquidity ratios, i.e., liquid assets over total assets, as a micro-prudential benchmark to quasi-assess the bank's liquidity adequacy. Poorman and Blake (2005), however, explained that one should not rely exclusively on liquidity ratios to determine the underlying level of liquidity because of their low level of sensitivity.

According to Matz and Neu (2007), financial institutions can measure liquidity risk using balance sheet liquidity, cash capital buffers, and a maturity mismatch technique. However, the current research approach is unique in explaining key performance indicators by embracing a multidimensional approach to facilitate multiple liquidity measures such as non-performing loans, loan-to-deposit ratio, and liquidity coverage ratio. The aim is to contribute to the current debate, thereby improving knowledge about the complex relationship between liquidity risk and bank performance.

In that respect, a significant number of scholarly works, from Nouraldeen (2024), Alshatti (2015), Boahene et al. (2012), and Abiola and Olausi (2014) to Poudel (2012), have suggested that research into integrated measures of liquidity and its impact on banks' performance should be carried out. These recommendations emerge from a collectiveness in approaching a better understanding of the determinants of bank performance.

Therefore, the main focus of this study is to explain the performance using an integrated measure of liquidity of the largest commercial listed banks found in the United Kingdom between 2015 and 2021. In so doing, this research fills a variety of significant lacunae in the current body of the literature. It is an uncommonly used temporal framework that allows for a close look at the recent present, marked by several important events such as Brexit and the COVID-19 pandemic. While the duration of the sample coincided with these events, it should also be emphasized that the factors related to them were not actively sought; the present research is inherently bound to involve this period characterized by those events.

It is also significant to note that most of the current literature focuses on developing nations like Malaysia, India, and Bangladesh. This study, therefore, bridges the geograph-

ical gap left by the existing literature as it focuses on the UK banking sector. Thus, this research lens allows us to examine how bank operational efficiencies function in a more mature financial framework, thus offering a complementary perception that will add to the existing body of literature.

This investigation also studied macroeconomic factors and bank-specific variables simultaneously. Such a dual focus by the researcher enables him to develop a far more complex and even superior understanding of the external economic conditions and their interaction with the internal banking indicators. Most of the mainstream body of literature, as provided in the works of Jamel and Mansour (2018) and Horváth et al. (2014), has failed to consider this interaction and combination. This study intends to fill and enhance the understanding of bank performance measures based on the theoretical underpinnings of financial intermediation theory and Capital Adequacy Theory. Finally, this study attempts to shift the limited examination of one or two financial metrics like ROA and ROE prevalent in the existing research. By including net interest margin (NIM) as the financial performance indicator, this research aims to offer a broad view of factors governing bank performance (Hudin and Hamid 2014; Ashraf et al. 2023).

The study thus employs several measures of liquidity that study the association of liquidity risk with bank performance. By focusing on a vast array of measures, this research tries to contribute to the extant literature concerning ways in which effective liquidity risk management strategies influence the shortage in the overall well-being and stability of publicly traded banks in the UK. The results of this research invaluably add to the knowledge base for banks, regulators, and policymakers by providing valuable input that can be utilized to arrive at more judicious decisions that facilitate financial stability and long-term development of the UK banking industry.

The rest of the paper is organized as follows: Section 2 presents the literature review and hypotheses development. Section 3 explains the research design and methodology, followed by the results in Section 4. Section 5 presents the findings and a discussion of the study. Finally, the conclusion is in Section 6.

2. Literature Review and Hypotheses Development

2.1. The Concept of Liquidity Risk

The concept of liquidity risk, as defined by Drehmann and Nikolaou (2013), includes potential problems in promptly liquidating a position at a reasonable price. This is closely associated with a bank's capability to meet all its obligations and repay depositors (Jenkinson 2008). Liquidity risk then becomes very apparent when a bank is in a period where it faces problems regarding the meeting of the demands for liquidity, whether due to firm-specific, industry-wide, or general market liquidity stress. Effective liquidity risk management helps a bank finance excess assets and meet its commitments promptly (Basel Committee on Banking Supervision 2008). It includes the ability and willingness to fund assets and pay obligations as they come due.

2.2. Theoretical Foundation

Theoretically, the relationship between liquidity risk variables and bank performance can be described using the interaction between risk management frameworks and measures of profitability. For instance, inflation rates (INFs) and interest rates (INTRs) are critical macroeconomic indicators influencing banking profitability (Hidayat et al. 2020). In line with the financial intermediation theory, banks intermediate between borrowers and savers. Thus, according to Katırcıoglu et al. (2020), their reaction to inflationary pressures leads them to adjust their lending and deposit rates upward. According to Heider et al. (2021), an upward increase in the rate of inflation is always followed by a corresponding upward increase in the rate of lending by banks to improve NIMs. However, excessive inflation could also increase credit defaults, negatively impacting NPLs. Similarly, while higher interest rates incentivize loan reallocation, they may decrease liquidity. Such is the balance that banks must strike to optimize the return on assets and equity (Martins 2024).

At the institutional level, some other significant metrics are LDR (loan-to-deposit ratio), LCR (liquidity coverage ratio), and CAR (capital adequacy ratio); such dimensions underscore the trade-offs found in liquidity management (Kumalo 2023). The Capital Adequacy Theory postulates that higher buffers of capital enhance the ability to absorb shocks, improving ROA while probably reducing the NIM due to the opportunity cost of holding idle capital (Ali 2019). By contrast, a high LCR might avoid liquidity crises but at the expense of constraining profitability by tying resources up in low-yielding liquid assets (Buschmann and Schmaltz 2017). These interactions underline the complex mechanisms whereby banks manage liquidity risks to sustain profitability while observing regulatory requirements like Basel III (Sumi 2024). The research in this paper develops these interrelationships into a holistic explanation of how macroeconomic and bank-specific variables interact in influencing financial performance.

2.3. Empirical Review and Hypotheses

This section seeks to discuss the central empirical studies relating to the factors of liquidity risk and their impact on the financial performance of banks. This sets the baseline for the development of hypotheses. Our literature review focuses on banks' main liquidity risk factors, including inflation rates, interest rates, non-performing loans, loan-to-deposit ratios, liquid coverage ratios, cash-to-deposit ratios, capital adequacy ratios, and bank size.

2.3.1. Inflation Rates and Bank Performance

Various studies have attempted to investigate the relationship between inflation rates and bank performance, thereby enlightening the researchers about the influences of inflation on most of the dimensions of bank performance. Hence, the effect of inflation on banks' profitability has remained an issue that has yet not been resolved, since different studies yield different results.

For example, Tan and Floros (2012) report that, in a sample of Chinese banks, the higher the inflationary environment—often in conjunction with high interest rates—the better bank earnings. Along this line, the studies of Aspachs et al. (2005) regarding UK banks also corroborate this assertion by elaborating on the benefits accrued from sufficiently designed procedures in combating inflation effectively. One work examines inflation's effects on performance indicators related to Greek commercial banks. Using data from Greek commercial banks between 1988 and 2002, Athanasoglou et al. (2008) found that positive attributes resulted from accurate inflation forecasts and well-calibrated interest rate adjustments by regulatory agencies.

Grigorian and Manole (2006) also found that inflation is a positive determinant of net interest margins for banks. They concluded that inflation facilitates price inefficiencies within the banking sector, hence being a driver of interest margins. This has one implication: the banking sector can be fraught with problems or inefficiencies that could hurt the overall performance of the banking industry. Bunda and Desquilbet (2008) added that inflation tends to increase banks' vulnerability concerning the nominal value of loans extended to customers. Vodova (2011) found that inflation hurt bank performance by negatively affecting banks' liquidity. Moussa (2015) proposed that high and constructive inflation levels somehow affect short-term financial obligations, which reduce overall performance. From this discussion of earlier studies, the following hypothesis has been developed in this study:

H1. *There is a significant positive association between inflation (INF) and the bank's financial performance metrics (ROA, ROE, NIM).*

2.3.2. Interest Rates and Bank Performance

Interest rates are one of the most potent tools applied in monetary policy and are highly significant as a determinant under macroeconomic analysis. Conventionally, interest rates have widely been used to determine the soundness of banks.

Some studies have been conducted on the relationship between interest rates and bank performance; however, various studies have come up with either a positive or negative relationship. However, from the results of Yakubu and Musah (2024), it was noted that interest rates have no significant influence on the general performance of banks.

Davies and Vaught's research in 2010 was therefore aimed at explaining how interest rates influence the financial capability of banks. Their findings indicate that banks have maintained the same high level of profitability represented by ROA. Likewise, the multi-country study developed by Abu Khalaf and Awad (2024) reported a statistically significant and positive bank profitability, measured by ROE, regardless of interest rates.

In contrast, the research finding of Lucchetta (2007) showed that an increase in the monetary policy interest rate makes lending more attractive for banks. These factors, therefore, incentivize banks to allocate more of their funds into loans while reducing their liquidity holdings. This reallocation, thus reduces the level of liquidity and, correspondingly, is likely to have negative implications on the profitability and quality of loans. A study conducted in Pakistan by Rathnayake et al. (2022) showed that interest rates are inversely related to the ROA of commercial banks. Similarly, Horváth et al. (2014) found that a decline in interest rates tended to occur with increased liquidity. Conversely, a decline in interest rates was found by Bikker and Vervliet (2018) to negatively affect the financial performance of banks, showcasing a negative effect on the net interest margins of banks.

Therefore, from this perspective, a fall in interest rates provides access to and, at the same time, the affordability of borrowing, thus triggering liquidity within the economy. This, in turn, contributes to larger loan volumes, improving asset quality and enhancing banks' performance. Therefore, the following hypothesis was proposed based on the previous studies:

H2. *There is a positive significant association between interest rate (INTR) and the bank's financial performance metrics (ROA, ROE, NIM).*

2.3.3. Non-Performing Loans and Bank Performance

One of the significant challenges of liquidity management is the focus that many banks put on corporate or wholesale lending (Akhtar 2023). The parties involved in long-term loans contribute to the emergence of such issues as far as liquidity can be concerned, especially when available resources render repayments problematic during periods of economic downturn. In this regard, Nabeel and Hussain (2017) analyzed the multidimensional facets of liquidity risks and their impact on the financial performance of both large and small-scale banks in Pakistan. Likewise, Musyoki and Kadubo (2012) and Singh (2015) also found that bank performance and non-performing loans are negatively correlated. Their results show that an increase in non-performing loans hurts banks' profitability. Furthermore, Poudel (2012) reported that the relationship between non-performing loans and bank performance was inversely significant.

However, Abiola and Olausi (2014) revealed a significant positive relationship between non-performing loans and the ROA and the ROE of commercial banks operating in Nigeria. These findings are supported by Afriyie and Akotey (2013), who also found that non-performing loans positively influenced the financial performance of banks in Ghana. This positive relationship could be justified by the high rates of interest on loans and the income received from interest on non-performing loans.

Despite this, the study by Kidane (2020) psychometrically determined insignificant statistical significance in the relationship between non-performing loans and the profitability of banks in Ethiopia. The implication is that for these loans to reduce their impact on the performance of banks, banks must adopt a practical risk management approach that will help lower the impact of these loans against bank performance.

Hoang et al. (2022) present an all-encompassing framework in financial intermediation theory applicable to any economy. Their study outlines that the most critical activity lies in sharing information to reduce the asymmetry between the lender and the borrower for

better banking system stability. Information sharing provides enormous benefits through the insight it can yield regarding the debt obligations of the borrowing firms and their actual financial position. As a result, there should be a substantial rise in information sharing between lenders and borrowers. It is assumed that information sharing would lower the negative impacts of non-performing loans on economic growth. Drawing upon the discussion of prior studies, the following hypothesis has been proposed for this study:

H3. *A significant negative relationship exists between non-performing loans (NPLs) and the bank's financial performance metrics (ROA, ROE, NIM).*

2.3.4. Loan-to-Deposit Ratio and Bank Performance

A ratio of loans to deposits is the most important single metric in any evaluation of liquidity position. It acts as a benchmark against which banks would be to perform their primary motivation of being effective intermediaries in facilitating between surplus liquidity holders and liquidity users. According to Alzorqan (2014), the loan-to-deposit ratio is significantly relied on in evaluating the liquidity status of banks. In a case where the level of the loan-to-deposit ratio is not highly sufficient, banks are failing to make the best out of their profitability in lending activity. In contrast, if the ratio is too high, financial bodies may face problems with liquidity because they may not have enough funds to meet unforeseen obligations. Because of this, banks must strike a balance for them to ensure liquidity balances are maintained and stable. Salim and Bilal (2016) conducted a study, testing the loan-to-deposit ratio against banks' profitability. Their findings showed that the loan-to-deposit ratio proved positive and statistically significant. However, the realm of their work is localized to an emerging market, comparable to Oman, thus no doubt limiting its immediate application to markets like the UK.

Nevertheless, the study conducted by Hacini et al. (2021) on Saudi Arabia concluded a negative and statistical significance in the relationship between the ratio and bank performance. It therefore concluded that bank management should consider the optimal loan-to-deposit ratio to reduce the risk of shortages. In a related context, results obtained from Sathyamoorthi et al. (2020) indicate that the coefficient of the loan-to-deposit ratio depicts a statistically significant and negative impact on ROA and ROE. In this line, the study by Hussain et al. (2016) compared significant and minor banks in Pakistan. The result showed that the ROA of major commercial banks is inversely related to their loan-to-deposit ratio.

Based on the review of related literature, the following hypothesis was generated by the research:

H4. *There is a significant negative relationship between the loan-to-deposit ratio (LDR) and the bank's financial performance metrics (ROA, ROE, NIM).*

2.3.5. Liquidity Coverage Ratio and Bank Performance

Liquidity coverage aims to make the banks capable of handling liquidity risks and, hence, operating more effectively. The best way to reach this resistance is to adopt a policy under which banks hold sufficient high-quality liquid assets that can quickly be transformed into cash.

Based on their study of US commercial banks, Rathnayake et al. (2022) concluded that a rise in the banks' level of liquidity coverage ratio decreased bank costs regarding interest rate payments. The cost declines were due to fund suppliers providing funding at cheaper rates that drifted the NIM upwards. In this respect, a study by Kalai and Toukabri (2024) considered the impact of liquidity constraints on the efficiency of banks in emerging economies. Regulatory policies, especially those excluding the requirement for the liquidity coverage ratio, tuned out to positively affect bank profitability performance. The above findings thus support the arguments by Harb et al. (2023) that the effective management of stable sources of funds and the liquidity of assets is a way to enhance bank

performance. The study conducted by Berger and Bouwman (2009) also provided evidence that an increase in the liquidity coverage ratio can be related to a rise in net surpluses, positively affecting a bank's valuation.

Using low-frequency data, Le et al. (2020), in their study of a sample of US commercial banks, aimed to examine the relationship between liquidity and profitability; the trend appeared, from their findings, in a U-pattern. Low-frequency data are typically collected over a more extended period, enabling the observation of the long-term pattern. In this case, the data reveal a U-shaped relationship between the liquidity coverage ratio and banks' profitability. Initially, increased liquidity brought about higher profitability. However, after a point, it reached a critical level where the cost of holding new liquid assets, therefore incurring higher costs, outweighed their meager revenues. Subsequently, the result became a falling profitability.

This affirmation aligns with the findings of Bordeleau and Graham (2010) and Tran et al. (2016), which emphasized how ill-controlled, highly liquid assets bear negative implications for a bank's ability to amply absorb shocks and remain profitable. The increased level of liquid assets improves the profitability of banks. Beyond the optimum limit, a bank continuing to hold higher levels of liquid assets is dysfunctional for the bank's overall performance. The fundamental reason for this is an excess of liquidity in the system that tends to downward profitability. Although this is a limitation that the research acknowledges, the studies above may not be able to consider comprehensively the benefits associated with keeping the liquid asset level below a threshold, as argued by Le et al. (2020). Based on the above discussions regarding the related studies, among others, this study hypothesized the following:

H5. *A significant positive association exists between the liquidity coverage ratio (LCR) and the bank's financial performance metrics (ROA, ROE, NIM).*

2.3.6. Cash-to-Deposit Ratio and Bank Performance

The cash-to-deposit ratio has been referred to as the bank's total amount of cash (Warrad 2017). It therefore gives a bank borrowing power. Goel and Kumar (2016) and Abdullah and Jahan (2014) discussed the effect of liquidity management on profitability. Both studies gave the same result, namely no statistically significant association between these two variables. However, both studies have limitations, such as narrow regional focuses, small sample sizes, and unsophisticated statistical methods. These might affect the generalizability of their results. Similarly, Mishra and Pradhan (2019) showed a non-significant negative relationship between the two measures in the Indian context. The reason for such an observation may be explained by the opportunity cost lost by keeping redundant capital instead of investing it into more profitable avenues.

In contrast, the research by Bansal et al. (2018) revealed a positive relationship between the cash-to-deposit ratio and profitability. However, Thiagarajan (2018) illustrated that the cash-to-deposit ratio inversely relates to banks' financial performance. Likewise, in the study of Hacini et al. (2021), a significant negative relationship indicates that a higher cash-to-deposit ratio results in opportunity cost and deposit interest imposition, thereby negatively affecting bank performance. Based on the above discussion, this study developed the following hypothesis:

H6. *There is no significant relationship between the cash-to-deposit ratio (CDR) and the bank's financial performance metrics (ROA, ROE, NIM).*

2.3.7. Capital Adequacy Ratio and Bank Performance

The Bank sets the capital adequacy requirement for International Settlements (BIS), which has immense implications for banks worldwide. This requirement has touched the banking systems of the Group of Ten (G10) countries, including the UK. Many studies have been conducted on the standard (Canton 2021).

The general rule dictates that capital levels should be sufficiently high to avoid bank failure and bankruptcy. Culpeper (2012) drives this point home by pointing out the importance of a sound capital structure that would make banks more resilient to financial crises, at least within developing economies such as Bangladesh. However, the narrow scope of the study, which centers on Bangladeshi banks, would limit its applicability to other banking systems and the economic contexts of developed economies.

According to Roman and Şargu (2014), an added dimension is the fact that the profitability of a bank directly depends upon the quality and strength of its capital. In addition, lower capital ratios and higher leverage in banks can relate to increased borrowing costs and related risks, as evidenced by Flamini et al. (2009). The text then states that banks with sufficient capitalization factors might provide a positive indicator in the market. This makes the study by Flamini et al. (2009) remarkable, given the lean country financial records it was supported with regarding its wide geographical area and an unbalanced panel of 41 commercial banks operating in Sub-Saharan Africa. An unbalanced panel raises questions about whether their data are comparable and whether the results can be generalized across other countries and over time.

In contrast, the investigation by Mardiana and Purnamasari (2018) examined how risk management impacts financial performance regarding the capital adequacy ratio as one of the variables considered. Their study found that the statistically insignificant and negative relationship between the ROA of a bank and capital adequacy persists. This finding corresponds to a survey conducted in Indonesia by Hersugondo et al. (2021), somehow doubting capital adequacy. The study provides evidence from Indonesian banks that increased capital adequacy negatively influences performance. Such a study thus questions the general applicability of the practices recommended by global norms such as the Bank for International Settlements. Such a study gives a different perspective, but its research nature into Indonesian banks also raises some questions about the generalizability of such findings to other geographical and economic environments. Based on the aforementioned above studies, this research hypothesized the following:

H7. *A significant positive association exists between capital adequacy and the bank's financial performance metrics (ROA, ROE, and NIM).*

2.3.8. Bank Size and Bank Performance

Various academic studies underline how seriously external and internal factors affect banks' functioning. The size of the bank has been the subject of extensive scholarly research, considering bank size as an important internal factor.

According to a study by Siddique et al. (2022), bank size and financial performance are positively related. The study also failed to establish any cause of financial soundness in moderating the relationship between bank size and economic performance. It simply means that when the scale of a bank business is likely to affect its profitability, it does not relate to the general financial health of the bank.

In this regard, Moyo and Obadire (2024) employed the machine learning approach to gauge bank size and its effect on the net interest margin in U.S. banks. The findings proved that bank size was positively related to banks' NIMs, thus supporting the hypothesis that the bank size factor is paramount in determining certain facets of financial performance. However, this, in turn, raises questions about the interpretability and theoretical validity of findings through machine learning approaches.

Synthesizing all these different views, the scenario for factors influencing bank performance is complex, with internal variables such as bank size influencing performance significantly. Moreover, Zhao et al. (2022) consider larger financial institutions to possess advantages of economies of scale and better risk management practices, respectively. Economies of scale are apart, and larger banks' advantages include strong resource mobilization capabilities, active deposit-gathering practices, and reduced equity-to-asset ratios. All these features collectively lead to enhanced profitability. Both studies focus on

testing economies of scale leading to profitability; a marked strength is that they test a well-recognized economic principle.

In contrast, Akhtar et al. (2011) fail to present a positive and significant relationship between bank size and performance for the two models investigated. This is explained by the fact that many banks have faced financial losses during the last couple of years. This thereby infers that, larger-sized banks are not intrinsically better equipped to deal with a general economic decline or sector-specific shocks. It defies the conventional wisdom of overwhelming advantages of scale. It is indicative that other factors, such as different economic conditions or shifts in the regulatory environment, strongly influence the nexus between size and performance. Other studies confirm these unexpected results, such as Almumani (2013), Hasan and Du (2023), and Nouraldeen (2024). After this discussion, the following hypothesis was formulated:

H8. *There is a significant positive relationship between bank size (BS) bank's financial performance metrics (ROA, ROE, NIM).*

3. Research Design and Methodology

3.1. Sampling

The sample of the study includes the 10 largest UK-based commercial banks publicly listed on the London Stock Exchange as shown in Table 1, ensuring that the chosen banks have consistent financial data availability for the study period of 2015–2021. The selection criteria included the following:

- Public Listing: Only banks listed on the London Stock Exchange were included to ensure that accurate and consistent data were available;
- Data Completeness: Only those banks whose financial reports were complete and publicly available throughout the study were selected;
- Regulatory Context Relevance: The sample would include banks to which the Basel III regulations applied, among other UK-specific regulations.

Table 1. List of selected commercial banks.

Bank Name	Ticker Symbol
HSBC Holdings PLC	HSBA LN Equity
Barclays PLC	BARC LN Equity
NatWest Group PLC	NWG LN Equity
Metro Bank PLC	MTRO LN Equity
Lloyds Banking Group PLC	LLOY LN Equity
Virgin Money UK PLC	VMUK LN Equity
Standard Chartered PLC	STAN LN Equity
Bank of Ireland Group PLC	BIRG LN Equity
Santander UK PLC	ANL LN Equity
TBC Bank Group PLC	TBCG LN Equity

Source: Authors.

The data range from 2015 to 2021 was selected to ensure a focused analysis of the period marked by significant regulatory, economic, and industry changes. This timeframe includes the implementation of Basel III regulations starting in 2015 and the impacts of important events such as Brexit and the COVID-19 pandemic, which profoundly affected the UK banking sector. These years provide a robust dataset for examining the interplay between macroeconomic factors, regulatory compliance, and bank performance during a transformative decade.

The exclusion of data beyond 2021 is primarily due to the availability and consistency of published financial data for the selected sample of banks. Financial data for later years were either incomplete or not publicly available during analysis. Furthermore, including post-2021 data might introduce confounding variables related to the recovery phase of the pandemic and the evolving macroeconomic environment, which could dilute the study's

focus on the regulatory and economic shifts during the 2015–2021 period. This specific range was thus deemed most appropriate for addressing the research objectives.

Considering the former requirements and given the specific focus on UK-listed commercial banks, this sample including leading commercial banks such as the following:

3.2. Data

The data were collected over seven years, from 2015 to 2021, and this was done to find out how liquidity management affects the financial performance of banks. This period encompasses significant events, such as Brexit and the widespread impacts of the COVID-19 pandemic. This paper does not consider these two events as separate factors within the study. Still, it must be recognized that their effect would be reflected in the gathered data across this timeline.

The data for this study were collected from two key sources, the Bloomberg data terminal and the manual extraction of information from the bank's annual reports. The annual reports were accessed from the official websites of the corresponding banks. This dataset contains 70 observations, each bearing factors of the performance and liquidity indicators of the banks.

The provided sample of data allows one to identify meaningful patterns and correlations, enlarging our understanding of the involved dynamics. Contributing significantly to the broadening of the scope and depth of this dataset is the substantial knowledge gained from the macroeconomic indicators of inflation and interest rates. These informational sources are the Bank of England's official website and the Office for National Statistics.

The most important contribution of the research is that some key measures like LCR have only now been implemented officially under Basel III, effective 1 January 2015. Inclusion thus becomes critical for explaining the results and validating the accuracy of the conclusions drawn from this study.

3.3. Variables and Measurement

The section below introduces the variables selected for the two critical variables under consideration: liquidity risk and bank performance.

3.3.1. Bank Performance

Some of the accounting measures targeted in this research are return on assets, return on equity, and net interest margin, which must be measured carefully (Choiriyah et al. 2020). These measures are beneficial in considering the trend differences yearly and provide size-adjusted information compared to the returns in the stock market (Demsetz and Lehn 1985; Waggle and Agrrawal 2015).

1. Return on Assets (ROA): ROA measures the bank's profitability relative to its total assets. A high ROA means higher profitability and efficiency since it reflects the capacity of the bank to earn profits from the aggregate base of its asset portfolio. It has been a widely applied proxy variable for assessing bank performance in several works, including those of Chen et al. (2021); Nguyen (2020); Nurfitria et al. (2023); and Moyo and Obadire (2024);
2. Return on Equity (ROE): ROE refers to the returns emanating from the bank's equity capital. A higher ROE postulates better profitability and efficiency because it reflects the bank's ability to generate profits from its shareholders' investments. It is widely regarded as the proxy variable used in measuring a bank's profitability and efficiency, such as in Chen et al. (2021); Nguyen et al. (2023); Rakshit (2023); Moyo and Obadire (2024);
3. Net Interest Margin (NIM): NIM represents the appropriateness or ability of the bank to earn net interest income from its interest-earning activities. A higher NIM reflects a greater profitability because the bank enjoys earnings from its interest-earning assets. Many studies have used it as a proxy for bank performance (Chen et al. 2021; Nguyen et al. 2023).

3.3.2. Liquidity Risk

Next, we will consider the proxy liquidity risk variables: macroeconomic and bank-specific and summary of variables, acronyms, and formulas as presented in Table 2.

Table 2. Summary of variables, acronyms, and formulas.

Variables	Acronyms	Formulas
	Bank performance	
Return on Assets	ROA	Net Income/μ∑ Assets
Return on Equity	ROE	Net Income/μ Shareholder Equity
Net Interest Margin	NIM	Net Interest Income/μ Earning Assets
	Liquidity risk	
	Macroeconomic factors	
Inflation Rates	INF	Annual Consumer Price Index %
Interest Rates	INTR	Annual μ Interest Rate %
	Bank-specific factors	
Non-Performing Loans	NPLs	∑ Non-Performing Loans/∑ Loans
Loan-to-Deposit Ratio	LDR	∑ Loans/∑ Deposits
Liquidity Coverage Ratio	LCR	(HQLA/Net Cash Outflows over 30 days) × 100
Cash-to-Deposit Ratio	CDR	(Cash + Balance with RBI)/∑ Deposits
Capital Adequacy Ratio	CAR	∑ Capital/Risk Weighted Assets
Bank Size	BS	Log (∑ Assets)

Source: Authors.

1. Inflation Rate (INF): Inflation reflects changes in the prices of goods and services and thus can be used to estimate liquidity risk (Vodova 2011; Mariscal-Cáceres et al. 2024). Business and individual purchasing power could be affected by inflation, therefore lowering their capability to meet various financial liabilities and maintain liquidity. It also explains that inflation influences interest rates, the aptitude to lend and borrow, and hence, liquidity (Negash and Veni 2019; Acharya and Rajan 2024);
2. Interest Rate (INTR): Some earlier studies that estimated liquidity risk using INTRs include Lucchetta (2007), Vodova (2011), and Horváth et al. (2014). Changes in INTR might influence either borrowing or borrowing costs and, therefore, alter bank liquidity. Acharya and Rajan 2024 posit that increased interest rates may enhance the cost of borrowing and dampen liquidity. On the contrary, a decrease in the INTR boosts borrowing and liquidity (Mariscal-Cáceres et al. 2024);
3. Non-Performing Loans (NPLs): NPLs could be considered a proof of liquidity risk since they refer to loans not repaid by borrowers. As seen by Alaoui Mdaghri (2022) and Akhter (2023), high NPLs could have impending liquidity effects because banks will face problems retrieving money from non-income-generating assets. NPLS can hinder the capital allocation process and limit a bank's ability to meet its liquidity needs (Alaoui Mdaghri 2022);
4. Loan-to-Deposit Ratio (LDR): The LDR could be adopted as part of the liquidity risk measures because, according to Fadare (2011) and Jamshed and Siddiqui (2023), a high level of LDR is evidence that a financial organization assigns more cash to a loan: this could be incorporated into the auspicious liquidity buffer (Mariscal-Cáceres et al. 2024). According to Negash and Veni (2019), a low LDR represents a higher level of liquidity because it indicates that the available fraction of deposits for meeting urgent needs is higher;
5. Liquidity Coverage Ratio (LCR): The LCR is a regulatory requirement that stands for a bank's capability to meet its liquidity needs during a generated stress period over a month. Compliance with the LCR can be used as a proxy for liquidity risk management, as argued by Brůna and Blahová (2016) and Cucinelli (2013), since a higher LCR means a more powerful liquidity position and more negligible probability of a liquidity squeeze, which Demirgüç-Kunt and Huizinga (2013) have supported;
6. Cash-to-Deposit Ratio (CDR): The CDR can be used as a proxy for liquidity risk (Warrad 2017; Siddiqui 2008; Haralayya and Aithal 2021; Sathyamoorthi et al. 2020).

In this context, CDR refers to the bank's cash reserve compared to its deposit level. Negash and Veni (2019) noted that a higher cash-to-deposit ratio means a better liquidity position for any bank, given its cash supply when withdrawals arise;

7. Capital Adequacy Ratio (CAR): According to Zaghdoudi and Hakimi (2017), CAR can be considered an appropriate proxy for liquidity risk because it refers to the bank's capital in terms of risk-weighted assets. A higher CAR means a better capital position, which might improve the ability of banks to absorb losses and maintain liquidity in times of financial stress (Gorton and Rosen 1995);
8. Bank Size (BS): BS may represent a proxy for liquidity risk (Ahamed 2021; Delechat et al. 2012). Larger banks are likely to be more vulnerable to liquidity risks, given the scale and complexity of their operations. Larger banks face more significant varieties of funding sources with more extensive clientele, increasing liquidity risk exposure (Tran and Nguyen 2024).

3.3.3. Feasible Generalized Least Squares Regression (FGLS) Models

Accordingly, FGLS regression was applied to test the impact of independent variables jointly on dependent variables along with controlling entity-specific, time-specific, and random errors. To be specific, the generic econometric model can be specified as follows:
Model 1: FGLS Regression Model.

$$Yit = \beta 0 + \beta 1\ (X1)i,t + \beta 2\ (X2)i,t + \ldots + \beta k\ (Xk)i,t + \varepsilon i,t$$

where *Yit:* the dependent variable;

*X*1, . . ., *Xk:* independent variables;
*β*0, *β*1, . . ., *βk:* regression model coefficients;
i: the number of observations or (the cross-sectional dimension of the data);
t: the number of periods or the time or longitudinal dimensions of the data;
ε: the error term.
Source: Authors.

The study designed three research models based on the foundation of the general regression equations, which are presented as follows:
Model 2: Return on Assets (ROA)

$$ROAi,t = \beta 0 + \beta 1 NPLSi,t + \beta 2 LDRi,t + \beta 3 LCRi,t + \beta 4 CDRi,t + \beta 5 CARi,t + \beta 6 BSi,t + \beta 7 INFi,t + \beta 8\ INTRi,t + \varepsilon i,t$$

Model 3: Return on Equity (ROE)

$$ROEi,t = \beta 0 + \beta 1 NPLSi,t + \beta 2 LDRi,t + \beta 3 LCRi,t + \beta 4 CDRi,t + \beta 5 CARi,t + \beta 6 BSi,t + \beta 7 INFi,t + \beta 8 INTRi,t + \varepsilon i,t$$

Model 4: Net Interest Margin (NIM)

$$NIMi,t = \beta 0 + \beta 1 NPLSi,t + \beta 2 LDRi,t + \beta 3 LCRi,t + \beta 4 CDRi,t + \beta 5 CARi,t + \beta 6 BSi,t + \beta 7 INFi,t + \beta 8 INTRi,t + \varepsilon i,t$$

Source: Authors.

These three-panel regression models deal with bank performance variables, including ROA, ROE, and NIM, each having a dependent variable related to performance metrics. Other factors considered are NPLs, LDR, LCR, CDR, CAR, BS, and macroeconomic variables such as inflation and interest rates. The respective coefficients (β) of each independent variable explain the effect of the same on the performance indicator. Error term: (ε), unobserved factors that influence the dependent variable but are not accounted for by the included variables, which will not be taken up in this research work.

4. Results

4.1. Descriptive Statistics

Table 3 below shows descriptive statistics of the research variables: maximum, minimum, mean, and standard deviation. A mean ROA of 1.60 indicates that profitability

from effective asset utilization within the sample is effective. The standard deviation is relatively moderate and stands at 0.49. The minimum value is 0.01, while the maximum is 2.93, indicating that some banks are barely profitable while others have a highly efficient asset-to-earning conversion. With an ROE mean of 22.88, it is much higher than the ROA and reflects strong equity returns. However, it also demonstrates considerable variation, with a standard deviation of 8.64. This ranges from 0.10 to 42.12, indicating significant differences in banks' financial performances. This range shows that the bottom limit illustrates some banks have hardly tried to create shareholder value, whereas the top one shows the outstanding performance of others.

Table 3. Descriptive statistics of dependent and independent variables.

	ROA	ROE	NIM	NPLs	LDR	LCR	CDR	CAR	BS	INF	INTR
mean	1.5974	22.8845	0.0061	2.2073	93.1087	128.2526	0.2147	0.7411	5.3388	1.5891	0.4113
std	0.4827	8.5780	0.5662	1.3713	18.1748	46.9492	0.1583	0.2048	0.9137	0.9089	0.2064
min	0.0100	0.1000	−2.7358	0.1116	61.8056	5.6745	0.0427	0.3686	1.9465	0.200	0.1125
25%	0.0853	0.7230	1.5081	1.3717	75.4140	130.2500	0.1262	0.5582	4.9513	0.600	0.2250
50%	0.2923	4.2403	1.7235	1.8502	93.2254	139.0500	0.1797	0.7531	5.6522	1.600	0.3958
75%	0.5105	7.7976	2.1238	2.7264	109.5624	153.7500	0.2461	0.9162	5.9166	3	0.6042
max	2.9344	42.1223	2.6221	6.3588	125.9981	197	0.8025	1.1192	6.4748	3	0.7500

The mean of the NPL is 2.21 with a standard deviation of 1.38, reflecting varying effectiveness in managing loan risk. While the minimum value of 0.11 may reflect very good credit risk performance for some banks, a high maximum value of 6.36 reflects difficulties with non-performing loans for some. The mean value is 93.11; the LDR has a standard deviation of 18.31, indicating an average level of utilization, as most banks use almost half of deposits to finance lending. The range from lowest to highest is 61.81 to 126.00, showing that most banks apply different levels of the LDR, hence very varied ways of managing liquidity or giving out credit.

The average LCR is at 128.25%, while the banks are found adequate in terms of liquidity buffers to, on average, fulfill short-term obligations. Correspondingly, the standard deviation is 47.29% and fluctuates in meeting the set liquidity threshold between the minimum and maximum values of 5.68% and 197.00%, respectively. The average CDR is 0.22, with a standard deviation of 0.16, indicating that banks operate under different lending strategies. However, this relatively small variation in the CDR level indicates consistent practices within more conservative liquidity lending frameworks. The average CAR of 0.74 indicates the banks generally have a decent capital buffer. From this, a standard deviation of 0.21 implies that risk appetite and structure variations cause the dispersion of observed values between 0.37 and 1.12.

The mean BS is 5.34 with a standard deviation of 0.92, reflecting the operational and financial scale dispersion of banks. Scores range from 1.95 to 6.48, reflecting diversity in the size of institutions. The general state of the economy where the banks operate is reflected in macroeconomic factors like INF inflation, whose average stands at 1.59 with variations between 0.20 and 3.00. The variation in INTR ranges between 0.11 and 0.75, with an average of 0.41, showing the dissimilarity in banking operations regarding monetary policy. Lastly, the mean of 0.01 means a small margin between the rates of lending and deposits. This would, therefore, indicate that the interest spread has increased pressure. The variation in NIM is considerable due to differences in income-to-expense management among banks, reflected by a high standard deviation of 0.57 that ranges from −2.74 to 2.62.

4.2. FGLS Regression

Regression diagnostics were deemed necessary for hypothesis testing to check on the strength of data and verify whether multiple regression assumptions hold. The diagnostic analyses included various tests and technical methods that involve identifying and treating outliers, checking for unit roots, assumptions of normality, multicollinearity, other forms of autocorrelation patterns, and heteroscedasticity.

No extreme observations were identified during the data analysis. The capping method has been applied to outliers to maintain the integrity of the dataset and, thus, ensure that the analysis is reliable. The data are balanced to check whether the dataset is in balance after the transformation of the outliers. The dataset is a balanced panel since each bank has 7 observations for all periods.

Indeed, any research study that applies non-stationary variables will always result in misleading results and wrong inferences (Granger and Newbold 1974). Therefore, this study used the Augmented Dickey–Fuller to establish varied patterns at a 5% significance. From this, it was established that NPLs, LDR, LCR, CAR, INF, and INTRs exhibit stationary behavior guided by their p-values < 0.05, which implies they were statistically significant.

The identification and control of multicollinearity determine the accuracy and reliability of the analysis. Tolerances and Variance Inflation Factors were used to check multicollinearity. According to Hair et al. (2014), tolerances above 0.1 and Variance Inflation Factors less than 10 were acceptable. The results indicate that VIF values fall between 1.13 and 1.72, while tolerance values range between 0.58 and 0.88. These results align with the fact that no multicollinearity problem exists among the independent variables.

The researcher considered the skewness and kurtosis scores to assess the normality of measures. It could be deduced from Hair et al. (2014) and Byrne (2013) that the normality distribution for the dataset is met if the value of skewness lies in the range between −2 to +2 and the kurtosis value lies in the range between −7 to +7. It indicates that most variables are typically distributed, excluding BS and NIM.

These skewness and kurtosis values do not entirely meet the criteria; however, slight violations of univariate normality are usually considered acceptable, provided they are not a result of outliers (Hair et al. 2014). The sample size used was 70, well above the minimum of 30 observations, as suggested by Hair et al. (2014). Hence, this assumption was also not violated in this case.

The Durbin–Watson test is widely used to check autocorrelation presence in the residuals obtained after a regression analysis. As observed here, the value of ROA is 2.44, which the DW-Stat presents. This figure gives a more significant deviation from 2 in the upper tail, showing a larger possibility of negative autocorrelation. The DW-Stat for the ROE is 2.51. The numerical value has a higher magnitude, indicating more substantial negative autocorrelation. The Feasible Generalized Least Squares (FGLS) methodology is applied through the regression method to resolve the autocorrelation problem.

Hair et al. (2014) assert that heteroscedasticity has a consistent effect of constantly underestimating coefficient estimates and unduly inflates the impact of those variables that are not significant. The Breusch–Pagan test for heteroscedasticity was conducted in this study to assess the homoscedasticity or independence of the error term. Through such an analysis, the p-value obtained was 0.55. This shows that heteroscedasticity does not exist in the variable NIM. By contrast, it can be proven that both ROA and ROE exhibit heteroscedasticity through their very low p-values of 0.0003 and 0.0007, respectively. The issue of heteroscedasticity will be addressed by applying Feasible Generalized Least Squares (FGLS) regression.

4.3. Empirical Results

This section provides an overview of the findings from the multivariate analysis conducted in testing the study's hypotheses, which were H1 to H8. Given that heteroscedasticity and autocorrelation were identified within the ROA, ROE, and NIM models, this study used FGLS regression focusing on reducing heteroscedasticity and the problem of autocorrelation in the three models as shown in Table 4.

The R-squared of the model ROA is 0.864, while the Adjusted R-squared is 0.859. This would explain the 86.4% variance in ROA, to be explained by the determinants of liquidity risk. The model is statistically significant from the F-statistic magnitude of 205.0 with a p-value of 4.25×10^{-41}. That means that the evidence is adequate to consider that,

at least among the variables associated with liquidity risk, the determinant is relevant in predicting ROA.

Table 4. FGLS results—ROA model.

WLS Regression Results						
Dep. Variable:			ROA_diff	**R-squared:**		0.864
Model:			WLS	**Adj. R-squared:**		0.859
Method:			Least Squares	**F-statistic:**		205
Date:			Sat, 16 September 2024	**Prob (F-statistic):**		4.25×10^{-41}
Time:			00:12:08	**Log-likelihood:**		21.418
No. Observations:			70	**AIC:**		−24.84
Df Residuals:			61	**BIC:**		−4.600
Df Model:			8			
Covariance Type:			nonrobust			
	coef	std err	t	$p > \|t\|$	[0.025	0.975]
const	0.1558	0.158	0.988	0.327	−0.159	0.471
NPLs	−0.0476	0.005	−9.070	0.000	−0.058	−0.037
LDR	−0.0013	0.001	−1.544	0.128	−0.003	0.000
LCR	−0.0019	0.001	−2.677	0.010	−0.003	−0.000
CAR	0.2105	0.050	4.245	0.000	0.111	0.310
INF	0.0576	0.008	7.219	0.000	0.042	0.074
INTR	0.3315	0.071	4.660	0.000	0.189	0.474
CDR_diff	−0.4823	0.514	0.938	0.352	−0.545	1.510
BS_diff	−0.2547	0.313	−0.813	0.419	−0.881	0.372
Omnibus:			3.672	**Durbin–Watson:**		1.9230
Prob (Omnibus):			0.159	**Jarque–Bera (JB):**		3.218
Skew:			−0.260	**Prob (JB):**		0.200
Kurtosis:			3.913	**Cond. No.**		4.75×10^{4}

The R-Square value of 0.863 and Adjusted R-square of 0.858 for the model ROE indicate that around 85% of the variation in the ROE diff is explained by the determining factors affecting liquidity risk. Also, the F-statistic, as high as 200.1 with a p-value of 8.56×10^{-41}, supports the overall statistical significance of the model. This means that at least one variable in the determinants of liquidity risk is significant in predicting ROE as shown Table 5.

Table 5. FGLS results—ROE model.

WLS Regression Results						
Dep. Variable:			ROE_diff	**R-squared:**		0.863
Model:			WLS	**Adj. R-squared:**		0.858
Method:			Least Squares	**F-statistic:**		200.1
Date:			Sat, 16 September 2024	**Prob (F-statistic):**		8.56×10^{-41}
Time:			00:12:08	**Log-likelihood:**		−146.38
No. Observations:			70	**AIC:**		310.8
Df Residuals:			61	**BIC:**		331.0
Df Model:			8			
Covariance Type:			nonrobust			
	coef	**std err**	**t**	$p > \|t\|$	**[0.025**	**0.975]**
const	3.7552	1.803	2.082	0.042	0.149	7.361
NPLs	−0.2160	0.116	−1.859	0.068	−0.448	0.016
LDR	−0.0419	0.013	−3.291	0.002	−0.067	−0.016
LCR	−0.0283	0.011	−2.539	0.014	−0.051	−0.006
CAR	2.3743	1.280	1.855	0.068	−0.185	4.934
INF	1.4873	0.129	11.566	0.000	1.230	1.744
INTR	1.8345	1.189	1.543	0.128	−0.543	4.212
CDR_diff	8.9539	3.640	2.460	0.017	1.676	16.232
BS_diff	−1.6294	2.730	−0.597	0.553	−7.088	3.829
Omnibus:		3923.173		**Durbin–Watson:**		2.010
Prob (Omnibus):		0.000		**Jarque–Bera (JB):**		9.054
Skew:		−0.174		**Prob (JB):**		0.0108
Kurtosis:		1.273		**Cond. No.**		5.12×10^{4}

The R-squared value of 0.771 reveals that the NIM model explains about 77.1% of the variation in NIM. The model fit is suitable based on an Adjusted R-squared value of 0.74. The whole model is statistically significant, as evidenced by the F-statistic obtained, which is 25.63 with a p-value of 8.34×10^{-17}. This supports a relationship between at least one set of explanatory variables and NIM predictability as shown in Table 6.

Table 6. FGLS results—NIM_diff model.

WLS Regression Results						
Dep. Variable:			NIM_diff	**R-squared:**		0.771
Model:			WLS	**Adj. R-squared:**		0.741
Method:			Least Squares	**F-statistic:**		25.63
Date:			Sat, 16 September 2024	**Prob (F-statistic):**		8.34×10^{-17}
Time:			00:12:08	**Log-likelihood:**		81.149
No. Observations:			70	**AIC:**		−144.3
Df Residuals:			61	**BIC:**		−124.1
Df Model:			8			
Covariance Type:			nonrobust			
	coef	**std err**	**t**	**$p > \|t\|$**	**[0.025**	**0.975]**
const	−0.0316	0.063	−0.505	0.615	−0.157	0.093
NPLs	−0.0058	0.006	−0.966	0.338	−0.018	0.006
LDR	−0.0024	0.000	9.521	0.000	−0.002	−0.003
LCR	−0.0009	0.000	−3.242	0.002	−0.001	0.000
CAR	0.1288	0.022	−5.80	0.000	0.173	0.085
INF	0.0035	statistic	0.896	0.374	−0.004	0.011
INTR	0.0153	0.047	0.326	0.746	0.079	0.109
CDR_diff	0.6304	0.127	4.968	0.000	0.377	0.884
BS_diff	−0.7723	0.133	−5.824	0.000	−1.037	−0.507
Omnibus:			1101.918	**Durbin–Watson:**		1.997
Prob (Omnibus):			0.000	**Jarque–Bera (JB):**		9.975
Skew:			0.057	**Prob (JB):**		0.0068
Kurtosis:			1.154	**Cond. No.**		9.99×10^{3}

5. Findings and Discussion

This study explores the relationship between the key financial performance indicators, ROA, ROE, and NIM, and various macroeconomic factors affecting UK commercial banks, including inflation, interest rates, and bank-specific indicators, namely non-performing loans, loan-to-deposit ratio, the liquidity coverage ratio, cash-to-deposit ratio, capital adequacy ratio, and Bank Size. The results conform to financial intermediation theory, in that UK banks can handle whatever invisible risk factors, such as inflation and interest rate, occur. This evidence depicts that inflation positively influences ROA and ROE; hence, UK banks are adept at manipulating the lending and deposit rates to gain from inflationary pressures. This accumulation supports the works of Radovanov et al. (2023) and Ropele et al. (2024), who evidence that inflationary expectations positively influence bank profitability. However, the non-significant relationship between inflation and NIM may be justified based on effective monetary policies insulating the NIM against volatile inflation changes. Similarly, interest rates positively influenced ROA but showed weak influences on ROE and NIM. This partial influence indicates that the banks' adoption of effective risk management practices in hedging against the volatility of interest rates dampened the influence, as observed by Geng et al. (2016).

The findings demonstrate that there is a negative significant relationship between NPLs and ROA. This refers to the findings of Nabeel and Hussain (2017), who indicated that increased NPLs reduce profitability by decreasing asset efficiency. Again, NPLs did not significantly affect ROE and NIM. In this situation, the banks' risk management practices could mitigate the effects of bad loans on equity returns and interest margins, as Kidane (2020) has proposed. This has pointed to the need for improving credit risk management

and decision-making in credit through the sharing of credit information and practical loan assessments.

These results illustrate that the LDR negatively influences ROE and underpin that the higher the LDR, the more liquidity risks or excessive leverage will reduce equity returns. However, the LDR's influence on the NIM was positive; thus, it is shown that banks with higher lending ratios can generate a higher interest income. Hence, these findings demonstrate that, although this ratio may raise interest margins, there is an accompanying trade-off concerning equity returns because of liquidity concerns. This complements the work of Hacini et al. (2021), which finds the optimal trade-off between risks and benefits from higher loan issuance for banks.

The negative influence of LCR on all performance measures tested by our empirical model, ROA, ROE, and NIM, means that this also reflects that the over-holding of liquid assets could clog capital in low-yielding assets and thus hamper profitability. This result is consistent with Bordeleau and Graham (2010) and Tran et al. (2016), testifying that excessive liquidity might function as an encumbrance rather than something beneficial if not optimized properly. These results show that banks must manage liquidity carefully, balancing liquidity regulatory demands with optimal investments.

It was observed that the CDR did not affect ROA significantly but was positively related to ROE and NIM. This could mean that higher cash holdings can give rise to higher equity returns and interest income, possibly due to the bank's ability to exploit favorable interest environments. This result is opposite to the previous study conducted by Goel and Kumar (2016), who found no significant effect of the CDR on bank efficiency. Hence, it may suggest that UK banks can utilize cash holdings to enhance profitability.

CAR has a positive influence on ROA. The fact that ROA was positively influenced by CAR shows that banks that are well capitalized tend to use their asset base more productively for profitability; this is because, with sound risk management, the efficiency of the assets increases. On the contrary, CAR exerts a negative influence on NIM. This indicates that the cost of sustaining huge capital buffers reduces the profit-making tendency of banks through interest income, as suggested by Duho (2023). These findings verify that the higher the capital adequacy, the more efficient the management of risks taken by assets will be, although this may only be achieved at the cost of reduced interest margins.

Whereas it is generally assumed that larger banks outperform their smaller peers, the multivariate analysis showed no significant relationship between bank size and ROA and ROE but a negative association between bank size and NIM. A large bank size implies increased operational inefficiency or competitive pricing pressure that reduces interest margin-generating capability. These findings are supported by consistent results from Akhtar et al. (2011) and Hasan and Du (2023), where a decreasing return to scale of large banks is reported.

6. Conclusions

The findings suggest that inflation has generated considerable gains in UK commercial banks' profitability indicators, such as ROA and ROE, due to good risk-managing strategies that enable banks to capitalize on upward inflationary trends effectively. Interest rate surges indicated an improvement in ROA but did not affect ROE and the NIM, an example of how a multifaceted interest rate risk exerts its influence on financial profitability measures. Of the bank-specific factors, NPLs strongly decreased ROA while having a limited impact on ROE and NIM, underlining the critical role of credit risk management. The LDR positively influenced NIM but reduced ROE, while the LCR negatively influenced all performance indicators, suggesting that maintaining high liquidity buffers while stabilizing constrains profitability. The CDR positively influenced ROE and NIM but did not significantly affect ROA. On the other hand, CAR positively influenced ROA but was negatively significant for NIM, with larger bank sizes negatively influencing the latter, indicating operational inefficiencies and competitive pressures.

The findings of the current study challenge some of the usual assumptions of banking theory, such as the fact that larger banks are intrinsically more profitable. The negative relationship between bank size and NIM reveals the specific operational problems related to large institutions. Similarly, while the LDR positively associates with NIM, its negative impact on ROE brings out the importance of balancing lending opportunities with liquidity risks for maximizing performance.

6.1. Practical and Managerial Implications

The value added by this study is the better light it offers on the interplay of liquidity risk and bank performance, with valuable implications for policy, bank management, and industry practitioners as follows. The findings reveal that there must be an optimal balance between liquidity coverage and loan-to-deposit ratios. Bank managers should strike a proper balance in the liquidity buffer to meet the regulatory requirements without compromising profitability. Though excessive liquidity holdings ensure stability, it is a case of diminishing returns. Hence, dynamic and flexible liquidity strategies are called for.

The inverse relation of NPLs with performance indicators underlines the importance of robust credit assessment and monitoring mechanisms. Managers must welcome sophisticated tools for credit evaluation, big data, and predictive analytics that will help them minimize the risks of credit defaults. They can benefit from the positive effects of inflation and interest rates simply by adapting their lending and investment policy to the prevailing macroeconomic environment. Banks can adopt pricing models by proactively forecasting inflation and interest rates to ensure optimized NIMs and other profitability indicators. Results on CAR indicate that banks have to balance regulatory compliance and efficiency in their operations. While high levels of capital bring strength in times of bad economic conditions, they also limit investing the same amount in other profitable operations. Managers should look for means of effective capital utilization within the limits set by BASEL III.

These findings also have important implications for policymakers, because they can be used to further refine regulatory frameworks in ways that ensure the compliance requirements for liquidity and capital do not inadvertently impede the profitability of banks. A more adaptive regulatory approach might better support banks in achieving financial stability and competitive performance. Stakeholder Insights: Investors and all other stakeholders involved in the banking industry may, therefore, find the results of this research helpful in judging the state of financial health and efficiency of risk management in banks. Greater transparency in reporting liquidity metrics and their effects on performance enhances investor confidence and decision-making.

This paper points in one clear direction: bridging the gap between regulatory requirements and operational profitability by offering actionable guidance for a responsible improvement in financial performance. The implications of such insights are of the highest order for the post-Basel III regulatory environment, which is mainly characterized by enhanced pressures on actively managing liquidity and capital.

6.2. Limitations and Future Research Directions

While this study provides meaningful insights, it suffers from several limitations. By focusing on UK-listed commercial banks, the results cannot be generalized to other groups of financial institutions, including investment banks, cooperative banks, and Islamic banks. Furthermore, the liquidity risk, examined independently, may lead to an incomplete picture since it is partially interconnected with other risks, such as credit and market risks. Thirdly, reliance on only publicly available financial data may, to some extent, prevent considering some nuanced and detailed aspects of risk management strategies. Moreover, exogenous shocks such as Brexit and the COVID-19 pandemic, which may have affected the banks' performance during the study period, have not been explicitly considered in the analysis.

Future research can extend the scope by covering more types of financial institutions and broader geographical regions to reflect the manifold factors that influence bank per-

formance in both developed and emerging markets. Indeed, incorporating other types of risk, such as credit and market risks, into the model would provide more a comprehensive insight into the complex interactions involved in bank performance. Qualitative approaches might complement the quantitative analysis by the in-depth interviewing of senior executives and risk managers, carving deeper insights into liquidity risk management. Finally, additional performance metrics like return on investment and Tobin's Q and control variables for board size, bank type, and GDP would enrich the analysis.

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