Liquidity Risk and Bank Financial Performance

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Abstract

In recent decades, businesses and academics in the field of financial management have developed an increasing interest in banks' liquidity. It has been recognized that banks' liquidity may impact banks' financial performance. Contemporary research shows that optimal liquidity reserves could enhance banks' financial performance across several countries. Though, the question of "how liquidity dynamics impact banks' financial performance" has not been thoroughly conducted and studied in Egypt. This research intends to investigate the impact of liquidity risk on Egyptian banks' performance. This research also examines how nonperforming loans and liquidity risk interact to affect the performance of Egyptian banks. The empirical data is drawn from a sample of 396 observations for the period 2013-2021 for Egyptian banks listed on the Egyptian Stock Exchange. Mixed-effects models were used as the statistical tools to analyze the collected data. The return on asset, return on equity, and banks' stock price are used as measures of banks' performance. According to the empirical findings, there is a significant inverse impact of liquidity risk on bank financial performance as measured by ROA. Furthermore, there is a negative and significant association between nonperforming loans and bank performance as indicated by ROE. Moreover, for the stock price model, it is concluded that the interaction effect of liquidity risk and nonperforming loans on bank performance is significantly negative. This demonstrates how procedures for managing liquidity risk are crucial in establishing banks' profitability and preventing banks' failure. Consequently, banks must practice prudent risk management strategies to protect the interests of investors.

Keywords: Liquidity Risk, Non-Performing Loans, Bank Performance, Egypt

1. Introduction

To guarantee long-term economic prosperity, an effective banking system is necessary. Both scholars and policymakers were primarily concerned with how the financial systems' volatility during the 2007–2009 financial crisis led to liquidity problems. Numerous nations all over the world were impacted by this issue. According to Aldalsteinsson (2014) liquidity risk is considered as the most serious sort of risk that any country might suffer. The financial system of a whole country could be destroyed by liquidity risk. Banks are vulnerable to liquidity risk since one of their primary responsibilities is benefit transfer, or the capacity to secure funding from short-term deposits in order to refinance long-term loans. Liquidity risk emerges when the bank struggles to fulfil its financial commitments without incurring expenses. Liquidity risk occurs when depositors remove huge sums of money all at once, and at the same time the demand for loans increases (Iqbal, 2012).

Sustaining a liquidity reserve by banks is thought to be an effective strategy for managing liquidity risk and protecting minor liquidity disruptions (Drehmann & Nikolaou, 2013). According to European Central Bank (2017), the capacity to adhere to a budget for a specific period of time has a significant effect on preserving liquidity. Liquidity sources include the sale of properties, acquiring cash through the central banking system or the interbank market, creating liquidity or depositors entrusting funds to the bank through stock exchange, or refinancing credit syndicated.

Liquidity risk management within the banking industry has been considered as a critical concern for financial institutions. Standards and regulations must be established in banks to manage and assess banks' liquidity position consistently and effectively. Since then, poor asset quality has been the fundamental cause of numerous financial crises, which have impacted both developing and developed countries. (Nikolaidou & Vogiazas, 2017). Policymakers have implemented a series of initiatives aimed at improving bank liquidity in an attempt to avoid a repetition of the financial crisis. These new reforms are being implemented, to maintain the overall soundness and safety of the banking system (Hamdi & Hakimi, 2019).

Previous research (Khursheed et al., 2016; Purbaningsih and Fatimah, 2014; Rasul, 2013) have shown that the liquidity risk had a significant impact on the performance of banks. The question of whether liquidity risk has a positive or negative impact on bank financial performance is not fully addressed in the prior studies. In an attempt to fill this literature gap, the current research examines how bank liquidity risk affects its' financial performance in the context of Egypt. A limited amount of research has been conducted to determine this impact in Egypt (Ghenimi, Chaibi, & Omri, 2017). The majority of empirical research were focused on American contexts (De Nicolo et al., 2012; Imbierowicz & Rauch, 2014), European contexts (Chortareas, Girardone, & Ventouri, 2011; Kim, 2015; Thorsten, Heiko, Thomas, & Natalja, 2009), and Asian nations (Arif & Anees, 2012; Sohaimi, 2013; Tan et al., 2017; Zolkifli, Abdul Hamid, & Hawati Janor, 2015).

This research is motivated by the continued issues encountered by the Egyptian banks which largely attributed to liquidity risk. Since 2011, Egypt has witnessed numerous revolutions, which were followed by more protests in 2013. The Egyptian economy was significantly impacted negatively by these revolutions. Additionally, the flotation of the Egyptian currency in 2016 was one of the main issues that was considered as a significant challenge faced by the Egyptian economy. The Central Bank of Egypt (CBE), on the other hand, joined the alliance for financial inclusion in July 2013 and since then has embarked on the challenge of promoting a culture of financial inclusion in Egypt. The global initiative of financial inclusion seeks to promote banking services accessibility for individuals who aren't currently a member of the official banking industry, in addition to creating enhanced regulations for financial innovation (Alex Bank, 2017). In order to help banks, achieve the crucial financial inclusion aims, banks urgently need to maintain effective liquidity management practices in the new financial inclusion environment in Egypt. Nevertheless, Egypt has achieved progress under numerous metrics since 2015 and is dedicated to attaining the Sustainable Development Goals (SDGs) by 2030. Egypt achieved an SDG Index Score of 68.6% and is ranked eighty-second out of 165 countries according to the sustainable development report 2021.

The objective of this research is to investigate the impact of liquidity risk on the financial performance of banks in Egypt. To achieve that purpose, this research used quarterly data from 11 banks that were listed between 2013 and 2021 on stock exchange of Egypt. This research employs mixed-effects models. Return on assets, return on equity and stock price are the financial performance proxies for banks. According to the empirical findings, there is a significant negative impact of liquidity risk on bank financial performance as assessed by ROA. Furthermore, there is an inverse and significant effect of the nonperforming loans on banks' financial performance as indicated by ROE. Moreover, based on the stock price model, it is concluded that the interaction effect of liquidity risk and nonperforming loans had significant negative impact on banks' performance.

This research is distinct from prior research and contributes to the current literature in various domains. First, Egypt is regarded to be a suitable region for research because the banks are viewed as the prime source of financing the country. Therefore, it is essential for regulators to concentrate on strategies to guarantee the progress and stability of the banking sector. Second, in contrast to previous research that examined how liquidity risk affected bank performance, the current research assessed how nonperforming loans and liquidity risk interaction affected bank financial performance. Third, this research included institutional variables to the econometric model to assess the impact of banks' liquidity risk on banks' performance.

The remaining research sections are categorized as follows: Review of the literature is discussed in Section 2. Section 3 offers an explanation of the theoretical frame work and hypotheses development. The methodology is demonstrated in section 4. The data analysis results, discussion and conclusion are presented in sections 5,6,7 respectively.

2. Literature Review

A considerable amount of research has investigated liquidity management; the following section highlights the macro and micro determinants of liquidity risk, the theories related with banks liquidity, the nature of the banking sector in Egypt and the findings from

empirical research of the effect of liquidity risk on the financial performance of banks applied in previous research.

2.1. Liquidity Risk

Liquidity, according to the Basel Committee on Banking Supervision (2004), is the capability of banks to finance the growth of their assets and fulfill all obligations as soon as they become overdue before suffering unpredictable deficits. Liquidity risk is the incapability of a bank to control rising funds or lowering liabilities (BCBS, 2014). Liquidity risk occurs when assets and liabilities have differing maturities (Hacini, Boulenfad & Dahou, 2021). There are two possibilities in which liquidity risk can occur. Initially, depositors may attempt to redeem cash as soon as possible. Under this instance, the bank may have to borrow cash or liquidate assets to settle these claims. On the other hand, the second instance is if borrowers elect to take out their loan commitment and it must be financed right away.

Evaluation and control of net financing requirements, access to markets, and contingency planning are the three components of liquidity risk management. Estimating anticipated future outcomes is a significant aspect of managing liquidity risk. The maturity ladder must be created and the determination of the cumulative surplus or deficiency of funding sources on specified date are required for the study of net subsidizing prerequisites. Banks need to regularly assess the potential cash flow projected in the future. Focusing on the future cash flow oppose focusing solely on textual agreements, which allow forward or backward scrolling. Evaluating a bank's liquidity depends on how cash flow under various conditions.

The factors that influence bank liquidity are covered in detail in this section. The reviewed literature asserts that both macro and micro factors influence bank liquidity. Macro determinants are external factors that have an impact on bank liquidity. Conversely, micro indicators comprise bank-specific liquidity drivers.

2.1.1. Micro Determinants (Bank Specific drivers)

According to Ghenimi et al., (2017), a loan default increases liquidity concerns due to the decreased cash inflows. The majority of loans are long-term, which frequently results in liquidity issues. When the

economy faces insufficient resources for production, the process of repaying loans is adversely affected. This leads to the raise of the rate of nonperforming loans. When a bank faces a sharp rise in nonperforming loans, liquidity issues become inevitable. Banks may have a substantial liquidity imbalance, because of poor lending quality of the banking system.

The banking industry depends on deposits to survive. The majority of banking activities are funded by deposits. If depositors begin to withdraw their cash, the bank will fall into a liquidity trap and be forced to borrow money at higher rates from the central bank or the interbank market (Jeanne & Svensson, 2007; Engelhardt & Kumar, 2008; Diamond & Rajan, 2001). In contrast, a bank with plenty deposits in its accounts won't have the aforementioned issues. A bank must immediately expand its deposits in order to increase its profitability.

The amount of capital that is available for banks has a substantial impact on banks' liquidity risk. Banks might engage in more liquidity risk exposure if their capital are used in granting excess amount of loans. Achaya & Naqvi (2011) examined the association between bank capital regulations and banks' liquidity. The results showed that banks' increased focus on maintaining liquidity lowers their requirement for minimum capital requirements and lowers their net stable funding ratio (NSFR). According to Bhati et al., (2015), there is a weak and negative relationship between bank liquidity and capital adequacy. High-capitalized banks can generate more revenue through maintaining their level of risk.

The bank size also has an effect on liquidity. Karim (2013) investigated Saudi banks' liquidity risk between 2011 and 2017. The analysis showed an inverse relationship between liquidity risk and the size of banks in Saudi Arabia. On the contrary, Choon et al., (2019) showed that the bank size and liquidity risk are positively associated. Similarly, comparing the liquidity risk of international banks and Pakistani domestic banks during 2001 and 2011, Abdullah and Khan (2012) found significantly positive relationship between bank size and liquidity risk in retail banks. Generally, the literature findings revealed that larger banks are less affected by financing liquidity risk due to their higher risk tolerance.

2.1.2 Macro Determinants drivers

Macroeconomic factors have an adverse impact on banks' liquidity. Prior research focused on comparisons in an international setting and linked finance to the real economy. According to Aspachs et al. (2005), banks in UK maintain less liquidity when the GDP is growing (GDP). According to Berger & Sedunov (2017), there is a significant positive association between the growth of liquidity and the real economy production. Correspondingly, Choon et al., (2019) asserted that GDP has a positive impact on liquidity risk. Alternatively, when analyzing Islamic banks in Malaysia, Bakoush et al., (2018) revealed a negative relationship between liquidity risk and GDP.

Previous research has also investigated the relationship between banks' liquidity risk and inflation. Yacoob et al., (2016) argued that banks often increase liquid assets in the hyperinflation context to protect depositors. In contrast, previous studies (Abdul-Rahman et al., 2018; Mohamad et al., 2013) concluded that inflation and liquidity risk are positively associated. The findings also indicated that banks minimization to their liquidity position due to the increase in expenses accrued that indirectly subjected the bank to an increase in the liquidity risk.

2.2 Theories

Previous research employed various theories to clarify challenges of liquidity shortages in banks. Among these theories the trade-off theory, financial intermediation theory, shiftability theory, income anticipation theory, liquidity preference theory, and commercial loan theory. According to the commercial loan theory, also known as the traditional or real bills doctrine theory and developed by Adam Smith in 1776, banks must only fund business operations that have short term payback period. This theory is founded on the assumption that banks have debts that must be paid immediately and that they cannot be satisfied if their assets are held in reserve for an extended period (Mitchell, 1923; El-Chaarani, 2019).

Second, Harold Moulton's Shiftability hypothesis superseded the commercial loan idea in 1916. The main source of liquidity for banks, according to this theory, comes from their efficient capability to

transmit assets in a capital market without suffering significant delays or monetary losses (Alshatti, 2016). According to this perspective, a bank's liquidity will rise if it has assets to sell through transferring it to the central bank, this serves as the final resort of the lending institution. The cornerstone for a bank's ability to sustain liquidity, according to this theory, is the asset's transferability, marketability, or shiftability. Additionally, according to this theory, the liabilities side of the bank statement of financial position is the main focus since, a bank's liabilities may be utilized to obtain additional liquidity (Moses, Tobias, & Margaret, 2018).

Thirdly, Herbert Prochnow's 1949 income anticipation hypothesis proposes that banks should schedule the redemption of long-term loans depend on the projected future cash inflows from all of their clients, irrespective of the type of loans. Due to its high level of safety and liquidity assurance, this theory outperforms the others (El-Chaarani, 2019). This approach permits the bank to offer medium and long-term loans in addition to short-term loans, only if the payback of these loans is correlated to the consistency of the debtors' anticipated revenue.

Fourthly, Keynes (1936) introduced the liquidity preference theory, which asserts that speculative, precautionary, and transactional motives influence the need to retain cash and that interest rates represent what is paid as a charge for the withdrawal of cash. According to another assumption of the theory, interest rates are established by assessing anticipated cash requirements and the amount of cash on hand to meet those requirements. According to the banks' liquidity preference theory, banks should implement proactive cash flow tactics as opposed to passively meeting loan demand.

Fifth, the tradeoff theory states that because of the lengthy expected repayment periods of real estate, basic commodities, and investments in stocks and bonds, banks do not offer loans for any of these purposes. This approach is appropriate for traders who must rapidly fund specific trading deals.

Finally, the interactions between loan lenders and loan borrowers are explained by the financial intermediation theory. The risk transformation theory is another name for the theory. According to the

theory, banks can generate liquidity out of illiquid assets when they are needed. Illiquid assets, such as long-term loans, are transferred into liquid liabilities, such as transaction deposits, to maintain liquidity Illiquid assets and liquid liabilities are given equal weight. Parallel to this, as banks are eliminating liquidity during the conversion of liquid assets (such as securities) into illiquid liabilities (such as subordinated debt), liquid assets and illiquid liabilities are given negative weight (Berger et al., 2016). By transforming their illiquid assets into cash, banks may generate liquidity. Banks can be competitive if two key milestones have been be accomplished: risk transformation and liquidity production (Bhattacharya & Thakor, 1993). According to the theory of financial intermediation, banks' risky financial loans are created by transforming their risk-free deposits (Diamond, 1984; Ramakrishnan & Thakor, 1984). The hypothesis might clarify how banks control their leverage to impact overall banks' performance.

2.3. Banking Sector in the Egypt

Hala El-Said, the minister of planning and economic development, declared in August (2022) that the Egyptian economy had raised by 4.2% during the previous fiscal year (FY), as opposed to roughly 3.3% in FY2020/21. Despite the increase of population, the gross domestic product (GDP) per person grew from $2,700 to about $4,000 in 2021. The World Bank Group (WBG) in its most recent update, predicted that Egypt would achieve the ultimate economic growth rate (4.8%) among the major economies in the Middle East and Africa (MEA) region in FY 2022/2023.

The average yearly growth for some factors related to banking sector in Egypt is shown in Table 1. For instance, the analysis of the yearly growth of profitability in banks is demonstrated by the ROA and the ROE. Data was extracted from the Global Financial Development Database. In Table 1, it is demonstrated that the profits of Egyptian banks have grown through the years. However, there was tendency for downward direction from 2015 to 2017. The ROA ratio was 2.74 per cent in 2015 and reached 2.28 per cent in 2017. This is due to the devaluation of the Egyptian currency. Additionally, there was downtrend in 2020 and 2021 due to COVID pandemic. The ROE almost detected the same pattern.

With relation to how the liquidity risk has changed through years, Table 1 reveals that as measured by the bank lending-deposit spread, a rise in the ratio suggests that banks are highly subjected to liquidity. Any decline in this percentage, however, suggests inadequate liquidity. Liquidity levels in Egyptian banks have increased. In 2021, the loans to deposits ratio have increased from 4.60 percent in 2013 to 7 percent.

Table 1: Banking Sector in the Egypt

Years	ROA	ROE	Bank lending-deposit spread
2013	2.20997	27.19845	4.608333
2014	2.511718	30.24583	4.791667
2015	2.741397	33.74162	4.716667
2016	2.569911	34.41267	5.741667
2017	2.289193	30.92163	6.083334
2018	2.234701	27.43618	6
2019	2.735734	32.12038	5.166666
2020	2.225713	25.12401	3.583333
2021	2.356349	27.97391	7

Source: World Bank

2.4. The Relationship between Liquidity and Banks' financial performance

The debate of whether bank liquidity affects bank financial performance is continuing as some previous research (Ayunku, 2017; Ifeacho & Ngalawa, 2014; Kosmidou et al., 2005, Quarshie & Djimatey, 2020) indicated a positive realationship between liquidity and banks' performance; other research (Arif & Anees,2012; Adelopo, Lloydking, & Tauringana, 2018; Cuong Ly, 2015; Hakimi & Zaghdoudi,2017; Mamatzakis & Bermpei, 2014; Marozva, 2015; Mishra & Pradhan, 2019; Sahyouni & Wang, 2019) revealed a negative relationship. It's widely expected that liquidity can impact banks' performance. Table 2 summarizes earlier empirical studies that investigated the relationship between liquidity and banks' financial performance.

Theoretically, this is supported by a number of theories from earlier research. Yet, the empirical investigation into this relationship reveals a wide range of mixed results. These conflicting results can be attributed to a number of aspects. Including using data from several countries and different periods of time. As a result, it is not possible to compare the research results, and it may be challenging to establish the causality of a relationship in such research.

Table 2: Summary of Some Related Previous Studies:

Authors & Year	Sample	Time span	Results
Kosmidou et al., (2015)	Greek banks	1998–2001	+
Arif & Anees (2012)	Pakistani	2004–2009	-
Mamatzakis & Bermpei (2014)	G7 and the Switzerland	1997–2010	-
Ifeacho & Ngalawa (2014)	South African	1994-2011	+
Cuong Ly (2015)	European banks	2001–2011	-
Marozva (2015)	South African	1998–2014	-
Hakimi & Zaghdoudi (2017)	Tunisian	1990–2013	-
Ayunku (2017)	Nigeria	2005-2014	+
Adelopo, Lloydking, & Tauringana (2018)	Economic Community of West African States	1996–2013	-
Mishra & Pradhan (2019)	Nepalese		-
Sahyouni & Wang (2019)	Syrian	2004-2016	-
Quarshie & Djimatey (2020)	Ghana	2006-2015	+

3. Theoretical Framework and Hypothesis Development

The interactions between lenders and their clients or loan borrowers are explained by the financial intermediation theory. The contributions of Goldsmith (1969), Shaw (1973), and McKinnon (1973) were among the first to explicitly develop the theory of financial intermediation. The process that incorporates lenders and borrowers is known as financial intermediation, and it is vital for the growth and prosperity of every country. As a result, in the money markets, financial intermediaries like banks act as the crucial link between lenders and borrowers. According to the theory, banks can generate liquidity out of illiquid assets when they are needed by transforming their illiquid assets into cash. Consistent with the theory of financial intermediation, banks' risky financial loans are created by transforming their risk-free deposits (Diamond, 1984; Ramakrishnan & Thakor,1984). The theory might illustrate how banks maintain leverage to affect total the banking performance.

After the previous major banking crises, liquidity risk has drawn considerable attention from scholars and risk experts. Banks and regulatory agencies are paying more attention to the banks' liquidity positions. The banking industry depends on deposits to survive since the majority of banks' processes are funded by deposits. If depositors begin to withdraw their cash, the bank will suffer a liquidity crisis and will be forced to borrow money at higher rates from the central bank or the interbank market (Jeanne & Svensson, 2007; Engelhardt & Kumar, 2008; Diamond & Rajan, 2001). On the other hand, a bank with sufficient deposits in their accounts won't have the aforementioned issues. Hence, a bank must raise its deposits in order to increase its profitability.

Furthermore, a lot of banks concentrate on corporate or wholesale lending, which creates difficulties for executives to preserve the necessary liquidity stability (Akhtar, 2007). Since a majority of this lending is long-term, banks could suffer liquidity issues (Kashyap et al., 2002). The banks' loan retirement procedure slows down, when the economy is not producing enough resources. The above circumstance leads to increase in non-performing loans (NPLs). A liquidity crisis is unavoidable when NPLs rapidly rise.

In the light of the arguments offered above, the following hypotheses have been formulated:

H1. There is a significant negative relationship between liquidity risk and bank performance.

H2. There is a significant negative relationship between the interaction effect of liquidity risk and nonperforming loan on bank performance.

4. Methodology

4.1. Sample and Data Collection

Collis and Hussey (2013, p. 222) stated that "the population may refer to a body of people or to any other collection of items under consideration for research purpose". Therefore, the population targeted for this research must be aligned with the main research objectives. According to the Central Band of Egypt (CBE), the Egyptian banking system consists of 40 banks categorized as commercial, non-commercial public and private sector. Hence, the Egyptian banks are the targeted research population. Yet, all banks that had been publicly traded and were listed in the EGX 30 in 2021 had to be included in the sample in order to meet the eligibility requirements. The initial sample included 12 banks. Even though, Bank Du Caire has been excluded from the sample, as the bank has delayed the sale of its shares on the Egyptian Exchange (EGX), which was supposed to take place before the end of 2022. This delay was because of the current market conditions, low liquidity, and low trading values. In order to examine H1 and H2, the final sample was then downsized to 11 listed Egyptian banks covering nine years quarterly, between 2013 and 2021.Cross-sectional and time-series data will be integrated into panel data. The annual reports of the various banks as well as Thomson and Reuter's data stream served as the main sources for the data on banks' performance and banks'-specific statistics. The macroeconomic drivers were extracted from the World Bank Open Data source.

4.2. The Variables

4.2.1. Bank Performance

Financial performance refers to how well a bank accomplishes its objectives. In financial terms, monetary outcome would calculate a bank's results in order to gain competitive advantage over its rivals. The importance of banks' financial performance is due to the fact that it aims to evaluate banks' performance by identifying their merits and drawbacks. The managers are guided in their decision- and strategy-making by the performance evaluation. Additionally, the value of financial performance comes from the techniques of keeping tracks on the banks' circumstances, assessing its activities, guiding performance in the proper directions, and producing right decisions also contributes to the significance of the financial performance. Additionally, financial performance is crucial for the external competitive position drivers. As banks with high growth in their financial performance are better equipped to react to changing environmental issues and prospects and may also benefit from various financing options (Tahir & Wael, 2007).

Beyond the bank, investors also place a high value on financial success. Investors seek to maintain track on the financial and economic environment in which the bank operates as well as the operational activities of the banks, and assess the impact of financial performance indicators in terms of profitability, liquidity, operations, and other factors. Furthermore, the collecting, analyzing, assessing, and reviewing the financial statements enables the investors to evaluate banks' financial performance to make the right decision based on the bank's conditions (Mahmoud, 2010).

The research's dependent variable is banks' performance. The return on assets (ROA) and return on equity (ROE) are the accounting-based indicators for the banks' performance. Banks with high ROA indicate that their financial position is stable and that they are not interested in engaging in riskier loans as there is less urgent need to earn risky profits. ROA is measured by dividing banks net profit to the banks' total assets. ROE is a crucial indicator of banks' financial performance as it shows whether a bank can succeed in using its resources (Farhi & Hacini, 2021) ROE is measured by dividing the

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banks' net profit to bank' total equity. Last but not least, the change in share price which acts as a benchmark for financial performance depending on the market. These metrics are often used in the literature (Chen et al., 2004; Frieder and Martell, 2006; Lesmond et al., 2008; Udomsirikul et al., 2011) to measure banks' financial performance.

4.2.2. Banks Liquidity:

Liquidity risk (LQR), is the key independent variable of interest and is calculated as the ratio of total loans to total deposits. It is generally accepted that the two main reasons for bank collapse; poor asset quality and insufficient liquidity. As stated by Molyneux and Thornton (1992), it's reasonable to expect a negative relation between profitability and liquidity because having highly liquid assets makes it harder for banks to make profit and meet unforeseen financial needs. On the contrary hand, a positive association between bank profitability and liquidity is also anticipated as a high level of liquidity lowers transaction fees and enables the fulfilment of commitments without unacceptably high losses (Bourke, 1989; Saleh, 2014).

4.2.3. Banks' specific variables:

The multi regression model, attempt to account for bank-specific factors, utilizes variety of control proxies to illustrate the impact of liquidity on banks' financial performance. Bank specific variables incorporated in the model are deposit ratio (DEP); capital adequacy ratio (CAR); bank size (BSZ); finally, the nonperforming loans (NPL).

The CAR assesses the banks' level of stability. It is a monetary driver that is utilized to assess the stockholders' commitment to maintain ownership of the bank. The ratio evaluates the bank's capacity to fund its assets (Fahrul & Buyung, 2018). It illustrates the banks' willingness to endure unusual losses and demonstrates their resilience and dependability during adverse circumstances. Banks must maintain a minimal CAR to achieve long term survival. It is calculated using the ratio of total equity to total assets (Makri et al., 2014).

The nonperforming loans (NPL) are referred to as loans that have not been repaid. According to the International Monetary Fund (IMF), a loan is deemed to be non-performing if the principal and interest have not been accrued for at least 90 days. Loans are classified as non-

performing assets (NPL) by Alton & Hazen (2001) when the full principal and interest payment is not made by the due date and is no longer expected to be made. The NPL were calculated in this research as the proportion of NPLs to all loans.

Deposits are a key source of finance for banks. Increased conversion of deposits into loans also boosts the banks' profitability (Deger & Adem, 2011). The deposit ratio (DEP) which is calculated by the ratio of total deposit to total asset.

The bank size is calculated by the logarithm of bank's total assets (De Haan and Poghosyan, 2012; DeMiguel et al., 2013). A bank's profitability may be impacted by economies of scale since it is associated with risk diversification, market opportunities, and readily available equity. (Bougatef and Mgadmi,2016; Distinguin et al., 2013).

4.2.4. Macro-Economic Variables:

The macroeconomic factors used are Gross domestic product (GDP) and inflation (INF). GDP is the most often used economic factors, since it measures the whole level of economic activity inside a country. Gross domestic product growth (GDP) is calculated as the mid-year population divided by the amount of the gross value produced by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output. GDP is supposed to have impact on several aspects that is related to the supply and demand for loans and deposits.

Inflation is another crucial macroeconomic factor that could have an impact on banks' expenses and income. As Staikouras & Wood (2003) emphasized, inflation may have both direct effects on the profitability of the banks (such as a rise in the cost of labour) and indirect effects (such as fluctuations in interest rates and asset values). According to Perry (1992), the impact of inflation on bank performance will depend on whether it is expected or not. When the former scenario (i.e., predicted inflation) occurs, interest rates are changed to reflect this. As a result, revenues rise faster than costs do, improving profitability. In the latter scenario (i.e., unexpected inflation), banks may delay changing interest rates, which causes bank costs to rise more quickly

than bank revenues and, as a result, has an adverse effect on bank profitability. INF is measured by yearly consumer price index.

4.3. Statistical Model:

This research incorporated various statistical techniques; first, descriptive statistics are employed to highlight the main characteristics of the data. Second, correlation analysis measures the strength and direction of the linear relationship between the main variables. Furthermore, the mixed model is used in this research to assess the data and investigate the hypotheses. The linear mixed model is used since it allows for a wide variety of correlation patterns, which is in accordance with earlier research (Groening et al., 2016; Jayachandran, 2013). Also, the analysis of the mixed model takes into account correlated data, which frequently appear in statistical research, and provides a broad, flexible method in these situations. A mixed-effects model incorporates both random and fixed effects, in contrast to a normal linear regression model which only includes fixed effects. Fixed effects are comparable to linear predictors from traditional Ordinary Least Squares (OLS). On the other hand, an empirically determined probability density function considers the "random" effects to be dispersed. The estimation model below tries to investigate how liquidity risk affects banks' financial performance:

$$FP = \beta LQR + \gamma + \varepsilon$$

where $FP(t)i$ is the accounting and market based financial performance of bank i at time span t, $LQR(t)i$ is the liquidity ratio for bank i at time t, γ represents control proxies (bank specific and macro-economic variables) and εi is the error.

The following models are employed to evaluate and assess the association between liquidity and banks' financial performance:

$$ROA_{it} = \beta_0 + \beta_1 LQR_{it} + \beta_2 CAR_{it} + \beta_3 DEP_{it} + \beta_4 NPL_{it} + \beta_5 BSZ_{it} + \beta_6 LQRNPL_{it} + \beta_7 INF_{it} + \beta_8 GDP_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 LQR_{it} + \beta_2 CAR_{it} + \beta_3 DEP_{it} + \beta_4 NPL_{it} + \beta_5 BSZ_{it} + \beta_6 LQRNPL_{it} + \beta_7 INF_{it} + \beta_8 GDP_{it} + \varepsilon_{it}$$

$$SP_{it} = \beta_0 + \beta_1 LQR_{it} + \beta_2 CAR_{it} + \beta_3 DEP_{it} + \beta_4 NPL_{it} + \beta_5 BSZ_{it} + \beta_6 LQRNPL_{it} + \beta_7 INF_{it} + \beta_8 GDP_{it} + \varepsilon_{it}$$

where the return on assets ratio (ROA) measures the accounting-based banks' financial performance. The return on equity ratio (ROE) is the second proxy of banks' accounting based financial performance; whereas the change in stock price per share (STP) measures banks' market performance; LQR is Banks' total loans to total deposits. The DEP is Banks total deposits to total assets for bank; CAR is the Banks total equity to total assets for bank; BSZ is the natural log of the total assets to calculate bank size; NPL is Banks nonperforming loans to total loans for bank; INF is the inflation which is the first macroeconomic variable and it measured by the annual consumer price index. GDP is the second macroeconomic variable which measured by the annual growth in GDP. LQRNPL is an interaction of liquidity and non-performing loans, dummy (i) and dummy (t) represent the bank and time effect, respectively in the model and εj is the random error term.

5. Data Analysis and Results:

5.1. Descriptive Statistics:

The descriptive data for the proxies used to assess banks' performance, liquidity, bank-specific variables, and macroeconomic indicators are summarized in Table 3. These data are provided more details regarding the characteristics of the banking sector in Egypt. Data from 396 years of observations are included in the distribution. The mean, standard deviation, minimum value, maximum value, and other descriptive statistics can be used to identify the features of the sample. Also, to check for any violations of the underlying presumptions of the mixed models.

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAit	396	0.0164867	0.0093388	-0.004517	0.047816
ROEit	396	0.1419618	0.1311382	-0.788681	1.229306
SPit	396	0.0209412	0.2263821	-0.73470	1.018518
LQRit	396	0.6224807	0.1779055	0.089539	1.264229
DEPit	396	0.812485	0.0872953	0.353032	0.947317
CARit	396	0.1406954	0.0885568	-0.40536	0.465022
BSZit	396	7.776901	0.3598074	6.994899	8.697037
NPLit	396	0.0662576	0.0765116	0	0.402129
INFit	396	11.93062	6.8919633	5.044933	29.50661
GDPit	396	3.974386	1.031137	2.185466	5.557684

The distribution includes a total of 396-years' observations. The dependent variable proxies are three: Initially, the ROA, which has a mean value of 0.0164867 and widely disperses from a minimum value of -.004517 in Societe Arabe Internationale De Banque (SAIB) in (Q2 2019) when SAIB provided the facility with 500 million EGP to Samcrete Egypt Engineers and Contractors as a result of an agreement that it will receive an EGP 3.1 billion ($180 million) from a group of six banks. Credit Agricole Egypt's (Q3 2019) reached a maximum value of ROA (0.0478166) as its net profit increased by 11.5%, translating to a continuous momentum of commercial development and operational efficiency.

Second ROE, having an average value of 0.1419618. It has fluctuated greatly, from a minimum value of -0.7886881in Housing & Development Bank in (Q2 2016). Since the board of directors approved opening nine new branches in different governorates. The maximum value of 1.229306 was in Egyptian Gulf Bank in (Q3 2020). This is due to the fact that stock dividends were declared and the net profit of the bank increased by 15%.

Finally, SP which has a mean value of 0.02094. It has dispersed from minimum value of -0.73471 in Abu Dhabi Islamic Bank (Q4 2017) as its profits crimped by 3.5% due to the costs linked to its recent merger with first Gulf bank; to maximum value of 1.01852 in Societe Arabe Internationale De Banque (SAIB) (Q4 2019) as the bank has reported 10% increase in its deposits and raise by 4% in its loans compared to 2018.

The financial performance indicators for banks demonstrate that Egyptian banks effectively generate profit and increase shareholders value. As the mean value of the banks' financial performance is significantly positive, it is clear that the overall profitability of the Egyptian banking sector is substantial. These findings also demonstrate the existence of a significant discrepancy between Egyptian listed banks' market-based financial performance and accounting-based measures throughout this time.

LQR holds a mean value of 0.6224807. The average value of CAR is 0.1406954. The mean values of the bank specific variables, which

also include DEP, NPL, and BSZ, are, 0.812485,0.0662576, and 7.776901 respectively. INF and GDP are the two macroeconomic indicators whose average values are 11.93062 and 3.974386, respectively.

5.2 Correlation Matrix:

Table 4 displays the Pearson correlation matrix; it evaluates the relationships between the variables used in the mixed models. It examines the direction of correlation (positive or negative) as well as its strength. According to the results, there is no evidence that the correlations between the explanatory factors seem to be problematic. The ROA and ROE have the moderate positive correlation, with 0.459. Additionally, The ROA and SP have the no correlation. Moreover, ROE and SP has moderate negative correlation, with 1.00; which suggests that there is no multicollinearity issue.

ROA has weak and positive correlation with LQR and GDP. However, ROA has weak and negative correlation with DEP, NPL and LQRNPL. Lastly, ROA has moderate and positive correlation with BSZ.

ROE has weak and positive correlation with SP and BSZ. However, ROE has moderate and negative correlation with CAR.

It is crucial to understand that all of the correlation coefficients are weak to moderate and that the predictor variables are not perfectly correlated. The assessed variables are not highly correlated because there is no correlation value equal to or higher than 0.7, which many authors in the literature (Brooks, 2008; Haniffa & Cooke, 2005) regard as a cutoff point.

Table 4: The Pearson Correlation Matrix

	(1) ROAijt	(2) ROEijt	(3) Spijt	(4) LQR_{iit}	(5) DEP_{iit}	(6) CAR_{iit}	(7) BSZ_{iit}	(8) NPL_{iit}	(9) $LQRNPL_{iit}$	(10) INF_{it}	(11) GDP_{it}
(1) ROA	1										
(2) ROE	.459**	1									
(3) SP	.-.062	-.100*	1								
(4) LQR_{iit}	.169**	.028	-.018	1							
(5) DEP_{iit}	-.155**	.083	-.014	-.451**	1						
(6) CAR_{iit}	.095	-.301**	.082	.052	-.041	1					
(7) BSZ_{iit}	.374**	.150**	-.025	-.081	.147**	.038	1				
(8) NPL_{iit}	-.200**	-.086	-.017	.292**	-.139**	.108*	-.418**	1			
(9) $LQRNPL_{iit}$	-.183**	-.091	-.010	.377**	-.199**	.122*	-.385**	.980**	1		
(10) INF_{it}	-.008	.027	-.087	.122*	-.034	.097	-.014	.223**	.218**	1	
(11) GDP_{it}	.134**	.047	-.062	.265**	.001	.093	.303**	-.068	-.011	.250**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

5.3. Regression Model Results:

A linear mixed model is used following prior similar studies (Groening et al., 2016; Jayachandran, 2013). In statistical analyses; correlated data are typically present, linear mixed models account for dependence within banks and heterogeneity across banks, respectively, by dividing the overall error variance into within- banks and between-banks variance components. Especially, the modelling of fixed effects associated to the marginal mean firm response is made possible by the use of linear mixed models (Fitzmaurice et al., 2011).

Table 5: Mixed Models:

Parameter	Model 1 ROA Estimate	t	Model 2 ROE Estimate	t	Model 3 SP Estimate	t
Intercept	.139811	8.658**	.100143	.995	-.143701	-.944
LQR_{it}	-.005791	-3.189**	-.038582	-1.354	.014208	.397
DEP_{it}	-.003408	-.939	.098004	2.425*	-.063567	-1.023
CAR_{it}	.002647	1.533	-.586418	-17.289**	.039046	.755
BSZ_{it}	-.016672	-8.017**	.005023	.392	.045647	2.611**
NPL_{it}	.005536	.398	-.880986	-3.874**	.000138	.000
INF_{it}	-.000152	-1.113	.001792	3.031**	.000322	.131
GDP_{it}	.003466	3.800**	.005013	1.497	-.039292	-2.764**
$LQRNPL_{it}$	-.005189	-.293	-1.082355	3.651**	-.284436	-2.771**

**Significant at the 0.01 level (2-tailed).
* Significant at the 0.05 level (2-tailed).

Table 5 displays the results of the linear mixed models. The results showed that liquidity, as calculated by the LQR ratio, has negative and significant impacts on accounting (ROA) financial performance. The results of Model 1 show that for each unit increase in the total LQR ratio, the ROA would significantly decrease by 0.0057 at the 99 percent confidence level. This conclusion is consistent with (Ghenimi et al.,2017; Ippolito et al., 2016; Yahaya et al., 2022). Moreover, the ROE would not change if the LQR ratio increased by one unit. Yet, the liquidity risk has a negative effect on the Egyptian banks' financial performance from (Q1 2013 to Q1 2021).

DEP significantly improved banks' financial performance. Since for every unit rise in DEP, ROE increase by 0.098. This result is in line with (Abbadi & Abu-Rub 2012). CAR significantly and negatively affected banks' financial performance as it lowered ROE by 0.586 for every unit increase in CAR. This result is consistent with (Awan, et al., 2020).

BSZ has a significant negative effect on ROA, as one unit increase in BSZ reduce ROA by 0.0166 in line with (Luo et al.,2016). However, BSZ had significant positive impact with SP since increase in BSZ boost SP by .045647. This finding implies that the larger the bank, the more profitable it will be in attracting more investors and raising prices (Rjoub, Civcir, & Resatoglu 2017).

NPL has a significant negative effect on ROE; as one unit increase in NPL reduce ROE by 0.880 (Zhang et al., 2016).

The three models used in this investigation accounts for the LQR and NPL interactions. The results showed that the interaction terms in the SP and ROE models were significant. With the SP, the interaction term (LQRNPL) is negative and significant at 99% confidence level. However, the relationship between the ROE and the interaction term (LQRNPL) is significantly positive.

INF and GDP are the macroeconomic factors employed in the model. INF is significant and has a positive relationship with the banks' ROE. Similarly, GDP has a positive relationship with the banks' ROA and SP. This finding is consistent with (Berglund and Mäkinen 2019; Saif-

Alyousfi & Saha, 2021). This indicates that higher GDP, inflation, or both will significantly improve Egyptian banks' performance.

6. Discussion:

This research examines the impact of liquidity risk on the financial performance of Egyptian banks. The key variable of interest, liquidity risk, is significant and inversely associated with the performance of Egyptian banks. This specifies that a rise in the rate of liquidity risk has a negative effect on the financial performance of Egyptian banks. This finding is parallel to (Altunbas and Marques ,2008; Ghenimi et al.,2017b; Ippolito et al., 2016; Yahaya et al., 2022)

The findings also demonstrated that the deposit ratio significantly improves banks' financial performance (ROE). Since banks will likely be more profitable if they have higher levels of assets funded by deposit obligations (Stanek, 2015). Yet, the cost of mobilizing and maintaining bank liabilities is anticipated to be relatively low since the interest rates on deposits have historically been low in Egypt.

The findings also demonstrated that the capital adequacy ratio significantly undermines the banks' performance (ROE). Modigliani & Miller's Capital Structure Irrelevance Theory (1958), supports the idea that there is a negative association between capital adequacy and profitability. The logic beyond that is since the debt-to-equity ratio is increased, risk is reduced, and as a result, the market rate of return on securities will fall.

The findings also indicated a significant positive association between bank size and stock price. This result is in line with the conclusions reached by Limam (2003), who showed that a larger bank could have a greater possibility of remaining solvent and prosper in the context of fierce rivalry and capture more investors. The size of the bank, however, significantly reduces ROA. The results showed that Egypt's larger banks are less profitable than its smaller banks. These findings are also consistent with those of Margaritis & Psillaki (2010). The argument that follows from this is that the research's time scope includes two crucial intervals when COVID and currency devaluation which affected Egyptian society negatively. Large banks have a lot of

pressure to act in a socially responsible way because of severe economic conditions which Egypt passed by. So, large bank executives believe that the only way to achieve long-term sustainability in terms of economic, social, and environmental perception is to continuously commit to executing the CSR pillars, which increases costs for the businesses and reduces earnings.

The findings demonstrated that the non-performing loans had a significant negative effect on ROE. According to the research, an increase in non-performing loans is associated with a decline in ROE. The cause of these consequences is that the exposure of banks to credit risk, as measured by NPLs, is typically linked to a rise in operational expenses and a decline in profitability. Bank management should thoroughly review client data and information across the credit analysis phase in order to lessen information asymmetry. Additionally, banks' mangers must make significant investments in reliable credit information systems in order to narrow informational gaps and enhance access to thorough, accurate, and reliable information about borrowers. Finally, bank management should also use cost-effective methods to manage their loan portfolio efficiently. On the other hand, policymakers should pay closer attention to changes in cost-to-income ratios and the capital position of banks, in order to effectively manage bank operational efficiency ratios and capital adequacy. Policymakers should establish guidelines and monitoring systems that would offer alerts before possible bank collapses resulting from the accumulation of NPL.

LQRNPL has a 1% significance level and is inversely related to the stock price of Egyptian banks. This demonstrates that the profitability of Egyptian banks declines when the rate of interaction between liquidity risk and nonperforming loans rises. This emphasizes the primary contribution, which is to fill a gap in the literature because there aren't many studies that focus on the indirect relationships and because the research's main focus is on Egypt, which hasn't attracted much attention from scholars and practitioners.

The findings indicated a significant positive impact of inflation on banks' financial performance based on the ROE model. According to Athanasoglou, Brissimis, & Delis (2008), if inflation is expected, exaggerated profit can be accomplished due to the asymmetric

information that exists between banks and their customers. As a result, banks will be able to effectively modify interest rates for loans and deposits to achieve a higher interest gap.

The findings indicated that ROA and SP are significantly & positively impacted by GDP. This occurs because firm's profitability rises during an economic upswing and falls during a recession. Consequently, increased GDP growth results in increasing companies' loans and deposits as well as higher net interest revenue and lower loan losses for banks. Moreover, increased economic growth translates into more disposable income, lower unemployment, and fewer consumer credit defaults.

7. Conclusion:

This research examines the significance of managing liquidity risk of the banking sector in Egypt. The research investigates the impact of liquidity risk on the overall banks' financial performance using a sample of 11 listed banks on the Egyptian stock exchange constituting 396 observations from 2013 till 2021 quarterly. The annual financial reports of the various banks, the Thomson Reuters data stream, and the World Bank Open Data Source for the macroeconomics factors were the main sources of the data used in this research.

The research's conclusions demonstrated a significant inverse association between the liquidity risk and Egyptian banks' financial performance. An increase in liquidity risk has a negative impact on banks' performance. Also, this research indicates that non-performing loans have a negative impact on bank performance in the ROE model. This indicates both a high level of credit commitment in anticipation of higher yields and that a substantial portion of nonperforming loans reduces bank profitability. The interaction effect of liquidity risk and nonperforming loans, which demonstrated a significant inverse association with bank performance in Egypt, is the key contribution to the research.

This research suggested a variety of political recommendations for bank practitioners, legislators, researchers, etc. This research highlighted the baking sector requirements for efficient liquidity risk

management. The policy makers are supposed to develop constructive strategies for managing liquidity risk issues in the Egyptian banks. Additionally, this research would also be informative to bank practitioners. The managers will be more capable to identify and respond rapidly to liquidity issues as a consequence of the different indicators and drivers of liquidity risk that are emphasized in this research. Several actions might be implemented by bank executives to enhance bank performance in Egypt by developing new policies and modifying existing ones. Moreover, this research provides significant insights to society and consumers since it informs them of the current state of the banking industry's efforts to address liquidity risk issues and guide their decision-making when comparing competing banks. Furthermore, new banking sector regulations impose an enormous burden on the regulators to ensure compliance. All deviant banks that might not follow the sector's capital and liquidity standards must be forced to do so by the regulators. The regulators should also enforce the execution of the Basel III regulation. Finally, other key stakeholders in the banking sector are the government and investors. The government must fulfill its obligations and increase the sustainability of the banks; through implementing effective policies and adjusting interest rates positively. In a similar vein, investors can improve the banks capitalization; in an attempt to attract in additional investors and maintain a safer banking environment.

This research contributes to the current knowledge and will act as a guide for academics in future. However, the focus of this research is restricted to examining how liquidity risk affects the performance of Egyptian banks. Future research may concentrate on emerging economies (MENA countries) or other developing or developed countries for comparative analysis. However, the results for developed economies may vary due to variations in the banking infrastructures. Also, depending on the data available, this research was restricted to the ROA, ROE, and stock price of Egyptian banks between 2013 and 2021 as well as the loan to deposit proxy of liquidity risk. Yet, future research may focus on liquidity coverage ratio and net stable funding ratio (NSFR) in Basel III as liquidity risk proxies. Future research may also take into account additional bank performance metrics such as earning

per share and Tobin's q. Additionally, it would be insightful to investigate the impact of bank liquidity on banks' financial performance through a comparison of the variations pre- and post-Egyptian revolution 2011 to investigate how this revolution may have impacted this relationship. Furthermore, this research was restricted to using GDP and inflation as the macroeconomic variables influencing the association between liquidity risk and bank performance. Further investigation is required to include other variables, such as declining depositor confidence in the monetary system, the unemployment rate, the financial crisis, and the interbank rate, which may affect banks' liquidity. Last but not least, this research emphasized the positive role of bank liquidity management in promoting Egyptian banks performance. As a result, the following inspiring question diffuses as follows: how does bank liquidity management effect on banks' performance differ across Islamic and conventional banks?

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