

Risk Management and Bank Performance: Evidence from the MENA Region

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by
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ABSTRACT

Purpose: This paper investigates the impact of liquidity risk management and credit risk management on the accounting and market performances of banks operating in the MENA region. It also studies the effect of the interaction between both types of risk management, mentioned above, on the accounting and market performances of the same sample of commercial banks.

Design/methodology/approach: Panel Data regression analysis is performed on a sample of 51 commercial banks in the countries of MENA region during the period 2010-2018. Data is retrieved from Thomson Reuters Eikon data stream and annual reports of our sample's commercial banks.

Findings: Our empirical results reveal that risk management significantly affects accounting and market performances of commercial banks operating in the MENA region. Credit risk management doesn't affect the accounting performance of banks, but rather has a significant impact on the market performance. Non-performing loans ratio, as a proxy for credit risk management, is found to have an inverse non-linear U-shaped relationship with the market performance indicating that the higher the credit risk management efforts, the lower the profitability of banks and vice versa. Surprisingly, liquidity risk management is not significant on both performances of MENA region banks. However, when a bank combines credit risk and liquidity risk management efforts, the latter (when measured by the financial gap) returns a significant impact on both performances, illustrated by a U-shaped relationship. Also other factors seem to influence bank performance when banks manage both credit risk and liquidity risk, as shown by our regression models testing for interaction between both risk management types. On one hand, the effect of the interaction between loan loss provision ratio and financial gap ratio is found to be negative and highly significant on both the return on assets and return on stock, showing that banks with lower credit risk management have higher accounting performance as far as their liquidity risk management is low. On the other hand, the combined risk management effort focusing on the loan loss provision ratio and the liquid assets to total assets shows a positive and highly significant relationship with the accounting performance as well as the market performance. The latter stipulates that for high levels of liquid assets to total

assets representing an increased effort of liquidity risk management, combined to high levels of loan loss provision ratios, the interaction improves the accounting performance as well as the market performance. Hence, the accounting and market performances are differently affected by joint risk management efforts, and the impact depends on the combination of risk management types the bank opts for or focuses its efforts on.

Research limitations/Implications: The sample of the study suffers from missing data. It was particularly reduced due to the unavailability of data in some countries of the MENA region where the stock market is under-developed or for political instability or war. As a result, we have unbalanced panel data, which might reduce the scope of our findings but do not impair their quality.

Practical implications: Our results may be of great help for investors and policy makers in the decision-making process. From policy-making perspective, this research proposes that policymakers must be aware of the trade-off between immunity to liquidity disturbances and the opportunity cost of keeping low-yielding liquid assets. Therefore, our findings reinforce the importance of the regulatory measures like Basel III accord and Dodd-Frank Act. From the investor's perspective, our results are relevant for investors to guide them in their investment decision-making. We show that they mostly have to observe the combined risk management efforts deployed by banks since the impact of interaction between these types of risk management is proved to be significant on bank performance, and mainly market performance.

Originality/value: Despite the considerable number of studies that addressed the impact of risk management on bank performance, very few examined this impact on banks operating in the MENA region. Moreover, to the best of our knowledge, there are no studies that examine the joint impact of credit risk management and liquidity risk management on bank performance. Additionally, while most of the studies use typical liquidity ratios for measuring liquidity risk, we are the first to examine the impact of liquidity risk management on bank performance in the MENA region using the financial gap, in line with Poorman and Blake (2005) recommendations. Finally, we classify countries into two types of financial systems: bank-based and market-based financial systems, in order to account for the difference in risk management between countries belonging to these two different financial systems.

Keywords: Credit risk, liquidity risk, bank performance, interaction, MENA countries.

Chapter One: Introduction

1.1.Introduction

This chapter introduces our research work and focuses on its originality and contributions. Section two states the general background of the relationship between credit risk management and liquidity risk management and both the accounting and market performances of banks operating in the MENA region. Section three presents the purpose of the study and the research questions we aim at answering in this thesis. In section four, we emphasize the originality of the research work we are conducting. Section five presents our major findings and section 6 states the managerial implications of the study. Finally, we provide, in section 7, an outline that describes the structure of the following chapters.

1.2.General Background

Bank performance is a key indicator in assessing the ability of a country to achieve continuous economic growth, especially in emerging countries like the MENA region where banks are a vital source of capital for businesses and real economy. However, banks are exposed to various kinds of risks such as credit risk, liquidity risk, operational risk, market risk and many others. Therefore, a better understanding of the management of these risks would contribute to the performance of the banking industry as a whole.

The US subprime crisis that emerged in 2007 critically affected financial markets worldwide and revealed the importance of a sound liquidity risk management as well as a thorough credit risk management. In fact, the financial crisis that started as a credit crisis was converted into a liquidity crisis. A study performed by The Basel Committee on Banking Supervision (BCBS) in the year 1997 defined liquidity risk as the inability of a bank to put up with declines in liabilities or to fund the growth in assets. On the other hand, in its report in 2001, BCBS (2001) describes the credit risk (or default risk) as the likelihood of a partial or complete default on the loans by the customers due to multiple credit events. In addition, microeconomics of the banking industry support the theory that liquidity and credit risk are immediately tied. Official reports of the Federal Deposit Insurance Corporation (FDIC) and Office of the Comptroller of the Currency (OCC) addressing the crash of financial systems (so called “material loss reports”) clearly declare that most of commercial banks’ collapses were partly due to the dual existence of both liquidity and credit risk

at the same time (Imbierowicz and Rauch, 2014). Dermine (1986) explains that the interaction of both risks as follows: whereas liquidity risk alone is perceived as a negative influence on performance and profitability, the credit risk measured by the default on loans' payments will decrease the cash inflow, and therefore triggers a further decline in liquidity. Hence, when associated with liquidity uncertainty, risky assets are a catalyst for performance declines and banks' collapses (Samartin, 2003).

Our study was initially motivated by the scarcity of studies that address the impact of credit and liquidity risk management on bank performance, in the MENA region. Moreover, the MENA countries are worth to be studied for many reasons. First, according to Bitar et al. (2016), the credit expansion in these countries has been moderate and bears low risk. Yet, lately, MENA region countries have experienced unprecedented and rapid credit growth levels, which raises a red flag to the stability of the financial economy as a whole. In fact, a high credit expansion is usually linked to a high probability of financial crises occurrences (Crowley, 2008). Second, the MENA region is considered to be a bridge between developing and developed countries in three continents, in addition to containing many important trade canals. This makes it more attractive to foreign investors but more vulnerable to political instability and therefore financial susceptibility. Consequently, many of these countries have adopted financial regulations and international guidelines in the late 1990's to ensure better performance and more stability. Yet, they are still ranking low for industrialized countries (Creane et al., 2004)

Hence, it is worth noting that it is of great importance that banks adopt effective risk management practices to safeguard the investors' profits to remain attractive to foreign investors and ensure sustainability. Since banks have to deal with significant challenges due to awareness about increasing sources of risk in the post-financial crisis period, this has drawn the attention of banks' risk managers and investors to the growing importance of handling risk management and the rarely investigated impact of the interaction between the risks faced by banks.

1.3.Purpose of the Study

This study addresses the impact of credit risk and liquidity risk on the accounting and market performance of banks operating in the MENA region. Mindful of the importance of this topic, the objectives of our research are twofold. First, we explore the effect of liquidity and credit risk management on both accounting and market performance of the banks in the MENA region. Second, we examine the interaction between both risk management and its impact on banks' performance.

This research will answer the following questions:

- 1- What is the impact of credit risk management factors on banks' market and accounting performances?
- 2- What is the impact of liquidity risk management factors on banks' market and accounting performance?
- 3- What is the combined impact of both credit and liquidity risk on banks' market and accounting performances?

1.4.Originality of the Study

Although there is a large body of literature addressing the impact of either credit risk or liquidity risk on performance of banks, very few had examined the impact of liquidity and credit risk management on the performance of banks operating in the MENA region. Moreover, to the best of our knowledge, there are no studies that examine the joint impact of credit risk management and liquidity risk management on bank's performance. Our study explores further the interaction between both risks and its effect on bank's performance, through using four factors of credit risk and liquidity risk (loan loss provision ratio, non-performing loans ratio, financial gap ratio, and liquid assets to total assets ratio) and testing the interaction between each two variables.

Additionally, most of the studies use typical liquidity ratios for calculating liquidity risk. Following Poorman and Blake (2005) who stated that liquidity ratios lack the sensitivity in capturing liquidity exposure of banks, we opted for the financing gap ratio as a proxy for liquidity risk management. To the best of our knowledge, we are the first to examine the impact of liquidity risk management on bank performance using the financing gap as a measure of liquidity risk management in the countries of the MENA region. Finally, this study classifies countries into two types of financial

systems: bank-based and market-based financial systems, in order to account for the difference in risk management between countries belonging to these two different financial systems.

1.5. Major Findings of the Study

This study examines the impact of credit and liquidity risk management, both separately and jointly, on the performance of banks of the MENA region, for a period ranging between 2010 and 2018. First, we investigate, separately, the impact of each risk management on both accounting performance (return on assets (ROA)) and market performance (return on stock (YTD)). Our empirical results show that credit risk management doesn't affect the accounting performance of the bank, but rather has a significant impact on the market performance. Non-performing loans ratio, as a proxy for credit risk management, is found to have an inverse non-linear U-shaped relationship with the market performance. We show that low levels of non-performing loans, which reflect significant credit risk management efforts, affect negatively the market performance down to a certain level. However, beyond this level, high levels of non-performing loans, which reflect the non-existent or weak credit risk management affect positively the market performance. In other words, the higher the credit risk management efforts, the lower the profitability of banks and vice versa.

Regarding liquidity risk management, our findings show that the impact of liquidity risk management proxies is not significant on both performances of MENA region banks. However, when a bank combines credit risk and liquidity risk management efforts, interesting results are generated depending on the type of risk management tools used by the bank.

More specifically, when testing for an interaction between loan loss provision ratio as a proxy for credit risk management and financial gap ratio as a proxy for liquidity risk management, the financial gap ratio returns a significant impact on accounting performance while it was never significant when liquidity risk management variables were considered alone without a combination with credit risk variables. The financial gap ratio seems to have a U-shape relationship with the accounting performance, which can be interpreted as follows: the higher the financial gap, the higher the return on assets, up to an optimum level of financial gap, after which the ROA starts to decline. In fact, a high financial gap ratio indicates a large gap between loans and deposits, so a poorer liquidity risk management. The latter stipulates that a poor liquidity risk management positively impacts the return on assets: a bank with reduced risk due to high liquidity risk

management efforts is a bank that does not perform well since higher risk yields higher return and because it incurs higher liquidity risk management costs that squeeze its profitability. Thus, a poor risk management represented by a high financial gap ratio, may positively impact the return on assets. However, when the gap widens and loans are much higher than deposits, then the cost of external lending to cover this gap could hurt the profitability of the bank.

Additionally, the effect of the interaction between loan loss provision ratio and financial gap ratio is found to be negative and highly significant on both the return on assets and return on stock. Our results reveal that for high levels of loan loss provision ratio and financial gap ratio, the interaction term representing the combined risk management effort returns a negative impact on the return on assets, so it appears to be harmful to the accounting performance of the bank. In other words, banks with lower credit risk management have higher accounting performance as far as their liquidity risk management is low.

On the other hand, the combined risk management effort focusing on the loan loss provision ratio as a proxy for credit risk management and the liquid assets to total assets as a proxy for liquidity risk management shows a positive and highly significant relationship with the accounting performance as well as the market performance. For low levels of both variables, their interaction does not influence neither the accounting performance nor the market performance of the bank. For high levels of liquid assets to total assets (representing an increased effort of liquidity risk management) combined to high levels of loan loss provision ratios, the interaction improves the accounting performance as well as the market performance. Our findings reveal that when liquid assets are high along with sufficiently high level of loan loss provisions, then investors find it best to invest in a bank that satisfies their liquidity needs and keep their investment secure, through increasing the buffer on any possible defaults. Then, higher investments boost the stock return.

To put it simply, accounting and market performances are affected by the combination of risk management types adopted by the bank. When loan loss provision ratio is kept in check along with the financial gap ratio, a poorer management boosts the accounting and market performances so the bank's risk managers must relax their management activities to achieve higher returns. However, when the loan loss provision ratio is controlled along with liquid assets to total assets ratio, then greater management efforts yield higher accounting and market performances; hence, risk managers must tighten their risk management activity by keeping these ratios always high to maintain a good performance.

To conclude, the joint impact of credit risk management and liquidity risk management on a bank's accounting and market performances depends on the combination of risk management variables the bank is focusing its efforts on.

1.6. Managerial Implications

This research has several significant managerial implications and provide recommendations for risk managers. Our results show that the joint management of both risks can substantially improve performance. Hence, our interaction results encourage future research studies to further investigate the cause effect relationship between types of risk management other than credit risk and liquidity risk management to assess how beneficial is the combination of risk management efforts in terms of a bank's performance. Additionally, our findings may be of great help for investors and policy makers in the decision-making process. First, it shows for policymakers the importance of reinforcing regulatory measures like Basel III accord and Dodd-Frank Act which stress the significance of credit quality management combined to liquidity risk management. Besides, it is an utmost priority to the bank to pay careful attention to problems of liquidity and credit risk, in order to determine the required level of the bank's intervention. Additionally, our study helps investors in the banking sector in identifying important risk factors that affect the market performance of banks. It is noteworthy to mention that market performance, measured by the return on stock, is the best indicator for investors. Our study can improve the perception of risk and profit maximization by investors. In fact, investors must be attentive to the credit and liquidity risk variables that may impact their investments' decisions.

1.7. Structure of the Study

The following chapters are organized as follows. Chapter two covers the literature review related to the topic of our study. The first section of this chapter provides an overview of the role of the banking sector, the different risks that it may encounter, and the most important evidence of these risks: the financial crisis of 2008 which costs are still being paid by financial institutions and many players of the global economy. Section two addresses the credit risk and its different management techniques, in addition to the empirical studies addressing the effect of credit risk management on

banks' performance. Similarly, the third section tackles liquidity risk, and presents the theoretical framework and empirical evidence of the impact of liquidity risk management on banks' performance. Section four describes the effect of the combined management effort of both risks. Section five concludes and highlights the contribution of our study to the existing literature.

Chapter three emphasizes the methodology employed in studying the impact of credit and liquidity risk on banks' performance. The second section discusses the philosophical dimension of the study. Section three introduces the research orientation, while the research strategy is pinpointed in section four. The research questions and hypotheses are developed in section five. Section six defines the variables of our model and their measurements. Section seven portrays the sampling procedure and data sources. In section eight, we consider the methodology, regression analysis model, and procedures we followed. Section nine concludes.

Chapter four presents the empirical results of the study. Section two displays the descriptive statistics of the explanatory variables. Section three presents all the diagnostic tests which ensure the satisfaction of multiple linear regression assumptions. Section four reports the empirical results, which are discussed in section five. Section six concludes.

Chapter five provides a conclusion for the study. The second section summarizes the findings while section three tackles the limitations of the research. The theoretical and practical implications are discussed in section four. Section five paves the way for future researches.

Chapter Two: Literature review

1.1 Introduction

This chapter aims at explaining the major role of the banking sector in the real economy. It also provides an overview of main risks banks encounter in performing their financial activities. In tackling these financial risks, we cannot but address the financial crisis of 2008 called “The Crisis of Credit” which is a pure evidence of the danger of credit risk and liquidity risk on the real economy and the necessity for banks to manage them, and adhere to the requirements of the new Basel III accord. The second section addresses the credit risk through defining it, presenting its management techniques and the body of theory behind it, and finally examining the empirical studies that discussed the impact of its management on bank performance. Section three discusses liquidity risk starting by defining it, then considering the theoretical framework and the empirical evidence on the effect of credit risk managing on bank performance. Section four focuses on the effect of the combined management of both risks. Section five concludes and stresses the originality of our study and highlights its contribution to the existing literature.

2.1.1. Role of the bank in an economy

Banks are financial institutions playing an essential role in the development of the real economy. Banks basically accept money from depositors with excess funds, and grant loans for borrowers who need funds. Therefore, they derive a profit from the difference (or spread) between the interest rates charged to borrowers and those paid to depositors. This whole process of taking deposits and lending funds is known as the financial intermediation (Abel, 2013). Without banks’ intermediation, the financial transactions of economic agents become more costly and less efficient. Financial intermediaries guarantee price discovery and provide liquidity to demanders and suppliers of loanable funds.

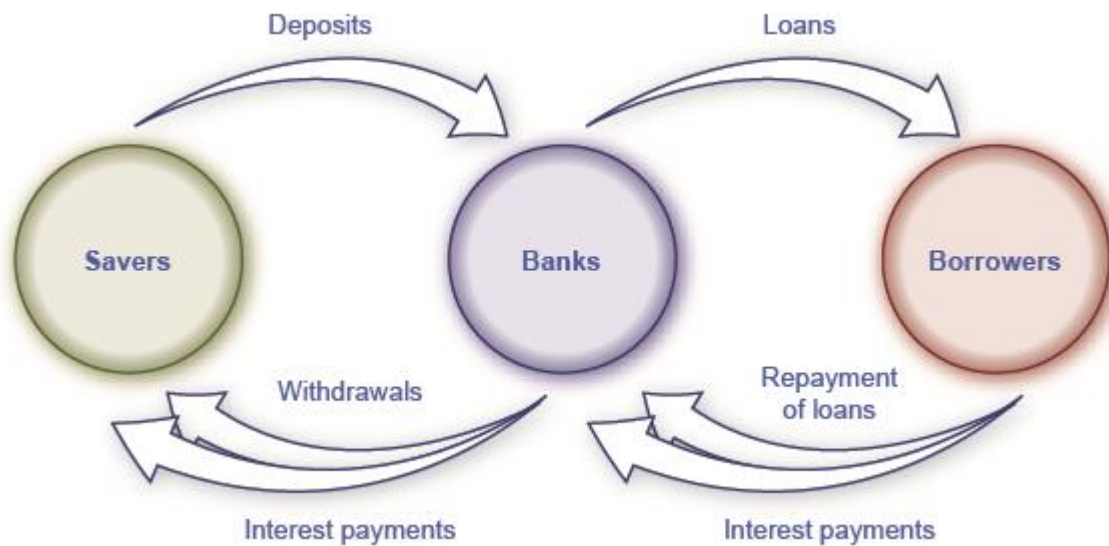


Figure 2. 1. Banking Operations

The function of banks is very important in a country, particularly in the MENA region since there is no developed stock exchanges to provide options to investors to borrow funds outside the banking sector. The main banking activities are described in the table below:

Table 2. 1: Role of Banks

Banking operations and functions	
Credit provision	Banks provide credit fuel to the economy through allowing businesses to invest in projects that are beyond their cash holdings, and people to buy homes and other things they need without saving the whole cost in advance.
Liquidity provision	Individuals and businesses want to feel protected against any sudden need of cash. That's where banks emerge as the main source of liquidity in an economy, either through offering demand deposits that are always ready to be withdrawn, or through offering credit lines whenever needed.

Remittance of money and provision of payment services	With the help of a bank, cash is easily transferred between different countries or parties. It has eased the transactions between remote places which, as a result, expanded trade internally and externally. Besides, the credit instruments issued by banks (cheques, credit cards...) have freed people from carrying cash and made the transfer of money smoother.
Economic Development	Banks offer loans to companies of various industries for production and trade. They provide them with the needed help to make direct investments and therefore boost the economic growth.
Promotion of Entrepreneurship	Banks can increase the engagement of the private sector in the development of the economy through lending loans at a specific interest rate. It is obvious that the private sector plays an essential role in economic growth, therefore banks play a key role in encouraging entrepreneurs to invest and undertake new projects.

2.1.2. Risks of banking operations

The banking risks are defined as a phenomenon that threatens the banking operations and causes negative consequences in their activities resulting in the deterioration in asset quality and profitability, which influence the banking system as a whole (Apatachioae, 2015).

In the banking sector, the risk is mainly represented by the negative deviations from the anticipated outcome and refers to the probability of a loss from any operation or decision, which is simply known as uncertainty of results. Risk is realized as from the probability that certain situations may occur, such that the decision maker is able to specify the potential events and their probability of occurrence, but they can't presume which event will occur for real.

Risks and performance are inter-related, hence a good definition of the two concepts is necessary for an adequate and effective risk management. The financial instability that shook financial institutions during the 2008 crisis led authorities and central banks to thoroughly investigate the major weaknesses of the banking system (Apatachioae, 2015).

It is needless to say that financial risks to which a bank is exposed should be well apprehended in order to better manage them and identify contingency plans in order to deal with them. Therefore, we mainly cite two categories of banking risks which are permanent risks caused by a long-term

source, and unique or event risks emanating from a discontinuous factor. Campbell (2007) believes that there are many sources from where these risks originate, such as the default of the customers on their loans, the changes in interest rates, the change in an existing market state, etc. He recognized at least 15 origins of risk in the banking operations which pool down into 6 categories:

- Credit risk is defined as the inability of a customer to meet his or her obligations in a timely manner or in other words, to repay the loan (principal or interest) on time.
- Market risk includes critical changes in interest rates, exchange rates, and market prices of financial instruments held in banks' trading portfolios.
- Liquidity risk represents the inability of the bank to meet the necessary short-term debt demands without suffering from large losses. It usually occurs when the bank is unable to convert its current assets into cash without incurring substantial losses.
- Legal risk comprises losses stemming from changes in regulations and procedures.
- Operational risk results in losses due to poor internal processes (such as internal fraud, physical risk like infrastructure shutdown, data entry errors, etc...) or external events (such as external thefts, environmental risks, political risk and wars, hacking systems security, etc...)
- Strategic risk is the risk that rises from a stiff competition in the banking sector leading to significantly squeeze a bank's profitability.



Figure 2. 2. Risks of Banks

Since 1988, regulatory authorities require from the banks to hold capital against the possible losses that might be incurred from those risks. International standards have evolved for banks to establish

and maintain capital adequacy ratios. In fact, banks are required to hold capital against three kinds of risks: credit risk, operational risk, and market risk (Hull, 2015).

Those standards started by the 1988 Basel I accord which was the first attempt to set international regulatory risk-based guidelines for capital adequacy. The accord demanded banks to maintain a minimum capital of 8% of the risk-weighted assets. Its main transformation was the “Cooke ratio” which is a measure of the bank’s total credit risk exposure. This ratio is based on the risk-weighted assets of the bank presented in Table 2.2.

Table 2. 2: Risk weights of assets

Risk Weight (%)	Asset Category
0	Cash, gold bullion, claims on OECD governments such as Treasury bonds or insured residential mortgages
20	Claims on OECD banks and OECD public sector entities such as securities issued by U.S. government agencies or claims on municipalities
50	Uninsured residential mortgage loans
100	All other claims such as corporate bonds and less-developed country debt, claims on non-OECD banks

The total risk weights would be the sum of the principle amounts of the assets (L_i) multiplied by its risk weight (ω_i), or in other words $\sum_i^n L\omega$.

Although Basel I accord enhanced the determination of capital, but it had a remarkable weakness. It treated all loans of a bank the same in terms of capital requirements and a risk weight of 100%. This means that the loan given by a bank to a company with a credit rating of AAA have the same risk weight of a loan given to a company with a B credit rating. For the purpose of improving the previous mentioned defects, Basel II Accord was introduced and published in 2004. It was built on three basic pillars:

- Minimum Capital Requirements: the capital requirement is still maintained at 8% of risk-weighted assets, but a new capital charge is added for operational risk costs, and a new way of calculating credit risk is applied. The overall capital became:

$$\text{Total Capital} = 0.08 \times (\text{credit risk RWA} + \text{market risk RWA} + \text{operational risk RWA})$$

- Supervisory Review: Supervisors have a mission of ensuring that the capital levels are properly met. This pillar also emphasizes the importance of intervention when a problem appears.
- Market Discipline: entails banks to have more risk disclosure about information of capital allocation.

Prior to Basel Accords, the large banks in most major countries appeared to have inadequate capital compared to the risks taken, specifically considering the aggressive competition in the international market shares area. The initial purpose of the Accord was to cease the decrease in capital ratios and to systemize the levels of approaches to capital in the G-10 countries. Basel II acknowledges the crucial element of capital as the common equity which needs to be publicly disclosed to safeguard the preservation of integrity (Federal Reserve Release, 2002).

This accord would improve the safety of the financial economy as a whole by adhering to the aforementioned pillars especially the refinement of the measurement of the minimum capital requirements that were set in 1988 accord. These pillars seek to yield uniformity in the banking systems around the world which in turn sustain security of the financial economy (Conford, 2000). Banks abided by the requirements of the latest Basel II regulations above until the credit crunch of 2007. The Basel Committee then realized that a serious repair of Basel II is needed, which is described in the next section.

2.1.3. Crisis and Basel III

The financial crisis of 2007-2008 was a drastic global economic disaster viewed by many economists as the most severe crisis since the Great Depression in the 1930's. It emerged in 2007 with a bubble in the US subprime mortgage market and expanded into a full-scale worldwide banking catastrophe when the Lehman brothers collapsed in 2008. It also spread fast from financial markets into real economies. A brief summary of the crisis shows that the crash occurred because of many years of careless relaxed lending standards that inflated a big debt bubble as people took cheap money and plunged it into property. This type of real estate loans with relaxed credit standards was called "sub-prime" mortgage relative to the high standard real estate loans called prime mortgage. In the US particularly, subprime mortgages were doubtful loans since sold in billions of dollars to people with no income, job, or assets (called ninja borrowers). Besides, subprime mortgages are considered to be riskier than average. More lending meant better profits

and the rising prices of houses meant that the lending is safely covered by a good underlying collateral.

The interest rate applied on mortgage loans was a floating rate called Adjustable-Rate Mortgage ARM. In 2006, the Fed increased its rates to curb the housing bubble, this led to an increase in ARMs. Mortgage borrowers began failing to pay their installments and properties were seized by banks and offered for sale. House prices dropped in major US metropolitan areas; banks were left with illiquid loans assets with collateral not covering the loan value. This disturbance pushed depository institutions to re-package the subprime home loans into structured instruments yielding high yields to investors. These products were called Asset-Backed Securities (ABS), their payoffs are derived from the cash flows of assets such as loans, bonds, and mortgages. The process of creating products for investors from the portfolio of mortgages is called securitization. It is an important and convenient technique that was used to transfer risk in financial markets from agents that want to get rid of it to agents willing to take it. A portfolio of assets would be sold to Special Purpose Vehicles (SPV) that allocate the cash flow from assets to three tranches: Senior tranche, Mezzanine tranche, and Equity tranche by specifying what is known as waterfall. Interest cash flows from the assets are allocated to the senior tranche until the senior tranche has received its promised return on its principal. Interest cash flows are then allocated to the mezzanine tranche until promised interest is received on its outstanding principal. If interest cash flows are left over, they are received by Equity tranche holders. The below figure shows a simplified approximation of how ABSs are created from a portfolio of assets. (Hull, 2015).

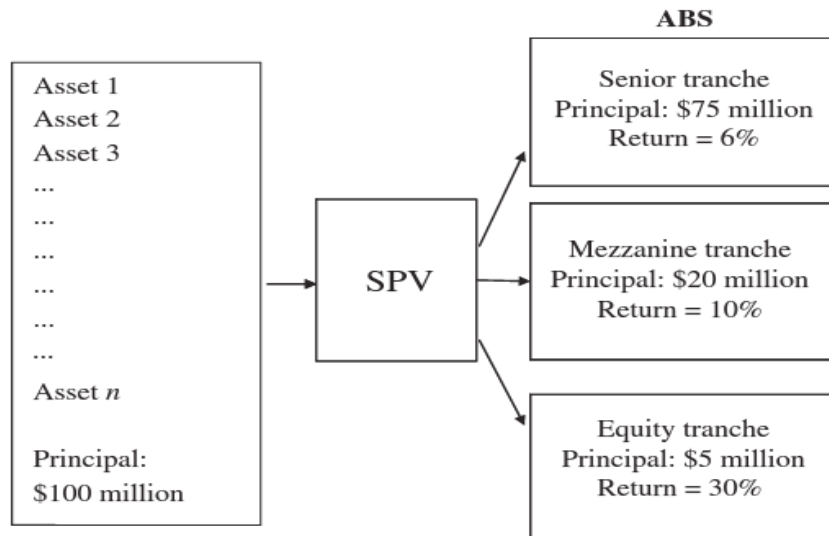


Figure 2. 3: Creation of an asset-backed security from a portfolio of assets

However, the more the borrowers default on their mortgage payments, the more the value of the investments plummet. As fear grown everywhere, these investments became almost impossible to sell and the financial gap widened. Banks and other financial institutions incurred huge losses that many of them filed for chapter 7 and few were bailed out by the Fed’s intervention.

The subprime crisis extremely influenced the global financial markets and economies around the world, and imposed changes with regard to risk management, solvency requirements of banks, the interference of monetary authorities, and the functioning of the financial markets in case of a crisis.

As a response for the aforementioned 2007-2008 financial crisis, an international agreed series of actions known as Basel III accord was taken by the Basel Committee on Banking Supervision in December 2010. These measures focus on building up supervision and risk management practices of banks. The new Basel III accord highlights the relation between risk and capital and aims at strengthening the bank’s capability of coping with a potential crisis or bubble. This Basel agreement targets a total protection of the banking sector through fighting the errors that was previously recognized, improving the quality and quantity of liquidity and capital requirements, and establishing a sound and adequate risk management system. The Basel II.5 that was issued in 2011 aimed at increasing the capital requirements for market risk, while Basel III accord came to increase the requirements for credit risk.

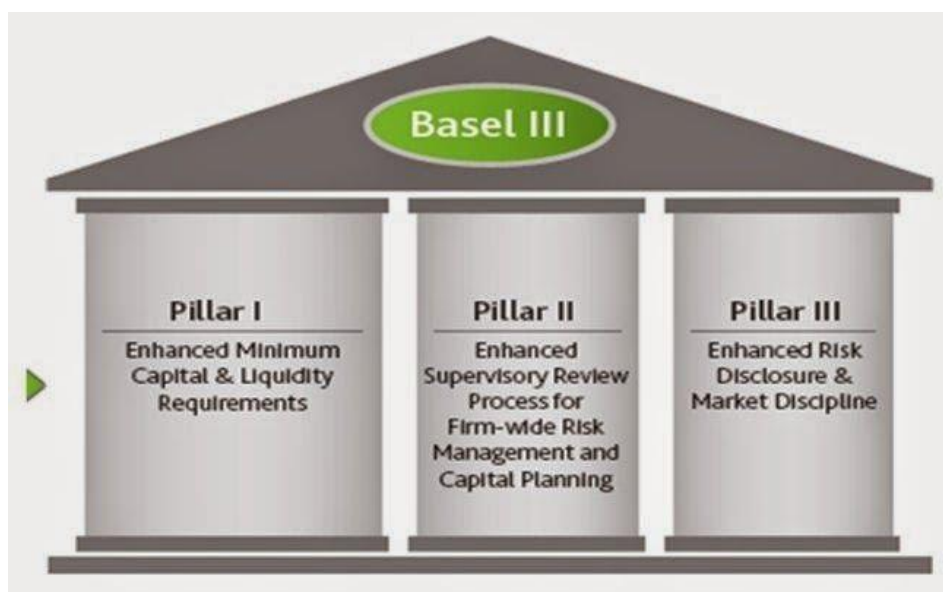


Figure 2. 4: The Three Pillars of Basel III

Accordingly, under Basel III, the bank’s total capital must consist of Tier 1 (shareholder’s equity and retained earnings), Additional Tier 1 (non-cumulative preferred stock, high contingent convertible securities), and Tier 2 (revaluation reserves, undisclosed reserves, hybrid instruments, and subordinated term debt).

The capital requirements under Basel III set Tier 1 capital to be at least 4.5% of RWA, Total Tier 1 (Tier 1 plus additional Tier 1 capital) to be at least 6% of RWA, and the total capital (Total Tier 1+ Tier 2) is minimum 8% of RWA (Hull, 2015).

Besides, Basel III required banks to hold a capital conservation buffer of Tier 1 equal to 2.5% of risk weighted assets, to ensure that banks build up capital in normal times that would downsize losses in turbulent times. Furthermore, Basel III requires from a bank to have a minimum of 3% leverage ratio. A leverage ratio is the ratio of capital measure to exposure measure, or $(\text{Total tier 1 capital}) / (\text{derivative exposure} + \text{securities financing transaction exposure} + \text{on-balance sheet exposure} + \text{off-balance sheet items})$.

A large portion of the Basel III regulations was tailored also to mitigate liquidity risk as well. The liquidity risk stems from the likelihood of banks to finance long-term needs with short-term deposits, or what is known as the “maturity mismatch”. Therefore, the Basel Committee introduced

two new liquidity ratios which are outlined to make sure that banks are able to survive any liquidity shortage (Hull, 2015);

- Liquidity Coverage Ratio (LCR): this ratio ensures the ability of the bank to survive a 30-day interval of liquidity disturbance. It is defined as

$$\frac{\text{High – Quality Liquid Assets}}{\text{Net Cash Outflows in a 30 – Day Period}}$$

This ratio must be greater than 100% to indicate that the liquid assets of a bank are adequate to survive the liquidity pressure.

- Net Stable Funding Ratio (NSFR): this ratio is for liquidity management for a 1-year interval of time. It is defined as:

$$\frac{\text{Amount of Stable Funding}}{\text{Required Amount of Stable Funding}}$$

The amount of stable funding (ASF) is calculated by multiplying each funding category by an ASF factor which reflects its stability. The required stable funding (RSF) is calculated by multiplying the items required funding by RSF factor which also reflects stability of funding. Both factors are shown in the Tables 2.3 and 2.4. This ratio must be greater than 100% to reflect the presence of a stability in the funding in a bank

Table 2. 3: ASF Factors for Net Stable Funding Ratio

ASF Factor	Category
100%	Tier 1 and Tier 2 capital Preferred stock and borrowing with a remaining maturity greater than one year
90%	“Stable” demand deposits and term deposits with remaining maturity less than one year provided by retail or small business customers
80%	“Less Stable” demand deposits and term deposits with remaining maturity less than one year provided by retail or small business customers
50%	Wholesale demand deposits and term deposits with remaining maturity less than one year provided by non-financial corporates, sovereigns, central banks, multilateral development banks, and public sector entities
0%	All other liability and equity categories

Table 2. 4: RSF Factors for Net Stable Funding Ratio

RSF Factor	Category
0%	Cash Short-term instruments, securities, loans to financial entities if they have a residual maturity of less than one year
5%	Marketable securities with a residual maturity greater than one year if they are claims on sovereign governments or similar bodies with a 0% risk weight
20%	Corporate bonds with a rating of AA– or higher and a residual maturity greater than one year Claims on sovereign governments or similar bodies with a risk weight of 20%
50%	Gold, equity securities, bonds rated A+ to A–
65%	Residential mortgages
85%	Loans to retail and small business customers with a remaining maturity less than one year
100%	All other assets

In this thesis, we mainly focus on liquidity risk and credit risk and the impact on their management on bank performance. In the following sections, we will discuss each one of them in depth.

2.2. Credit Risk and Bank Performance

2.2.1. Definition

Credit risk as defined by the Basel Committee is a probability that a bank's counterparty fails in the fulfillment of its agreed terms (Basel Committee on Banking Supervision, 1999).

Although there are many causes that can lead the financial institutions to face troubles and the banking industry to suffer from losses, but it is mainly due to careless standards of credit for borrowers and irrational management of risks generated from investments portfolios (Basel, 1999). The major activity in the banking industry is lending, which is directly associated with credit risk, thus this risk can drastically affect the profitability of commercial banks (Kaaya and Pastory, 2013).

Credit risk can be of many types including (Altman and Saunders, 1998):

- Default risk: the risk of loss resulting from the inability of the borrower to fulfill the loan payment in full or is 90 days past due on any loan obligation.
- Counterparty risk: the risk that a counterparty will not pay his/her obligation on a bond, insurance policy, derivative or other types of contracts.

- Concentration risk: the risk linked to a certain exposure in a portfolio of a bank (due to very little diversity in concentrated portfolios of a single counterparty or sector) that can incur huge losses which threaten the bank's operations.
- Country risk: this risk is associated with economic stability and political factors (such as devaluation, regulatory changes, war...) and it arises from the risk of investing or lending in a country, which may occur due to different changes in the business environment.

Credit risk occurs due to many reasons as per Kithinji (2010):

- Poor management of the bank
- Low capital and liquidity positions
- Volatile interest rates
- Laxity in credit assessment
- Weak lending practices
- Poor supervision of the central bank
- Extensive licensing of banks
- Inappropriate laws.

2.2.2. Theoretical Background of Credit Risk Management

Credit risk management is the technique of alleviating losses by examining the adequacy of bank's loan loss reserves and capital at any instant, which has proved to be a difficult task in the modern world (Singh, 2013). As stated by Lindergren (1987), the crucial theory of credit risk management procedure is a series of the following steps; foundation of an explicit structure, assignment of responsibility, prioritization of processes, and a clear communication of the assigned responsibilities.

Usually, risk management processes follow a common pathway for any type of risk, as presented in figure 2.5. It starts by identifying the risk that could possibly affect the business and analyzing its nature. Then the risk manager examines the different options of risk management techniques before selecting the most suitable one for the specific case. The next step is implementing the chosen technique and risk treatment measures. At the end, the risk manager track, review, and monitor the results.



Figure 2. 5: Steps of Risk Management

Demirgüç-Kunt and Huzinga (1999) state that there is a dual concern on bank credit risk management. The first is the reaction in case of bank losses, the recognition that losses are unmanageable once they occur. The second is the latest development in the domain of securitization, financing commercial papers, and other methods that pushed banks to search for more suitable borrowers.

The rise in the series of non-performing loans forced the Basel Committee to stress the necessity of credit risk management in the Basel II Accord actions. The abidance by the practices of the Accord allow to better deal with credit risk and automatically improve the performance of the bank. The effectual management of credit risk would not only reinforce the profitability and effectiveness of a bank, but it would largely contribute to the systemic stability of the economy worldwide (Psillaki, Tsolas, and Margaritis, 2010).

Credit risk management comprise three components: Credit Portfolio Modeling (CPM), Credit Risk Transfer (CRT), and Advanced Risk Management (ARM). CPM is a general model to mitigate credit risk by assessing the effect of loans on the overall portfolio risk, through estimating credit losses generated from a deterioration in credit-risky portfolios. CRT are securities created to transfer a part of the risk related to credit losses within pools of mortgages loans to the private sector and investors. However, the Basel Committee on Banking Supervision (2009) sent out

doubtful thoughts about the use of these models. They believe that they must be used with caution especially due to their major role as a driver of the financial crisis of 2007 (Bulbul et al, 2019). ARM is a combination of the previous two methods.

Another tool that helps in credit risk management is capturing the credit ratings of the companies and even individuals, which discuss in the next section.

2.2.2.1. Credit Rating

Credit rating is a powerful tool which help measures the qualitative and quantitative risks of companies, individuals, and even a sovereign government. This technique allows banks to make wiser decisions by gaining an advantage from the skills of experts in risk assessment.

For individuals, banks usually use the FICO score for credit rating. FICO is created by Fair Isaac Corporation to give borrowers scores that help banks determine whether to extend a credit line or not by allocating points to each of the characteristics of the borrower then compare the sum of the points (the score) to a given cutoff point. It is based on five factors to assess the creditworthiness of borrowers: types of credit used, payment history, length of credit history, current level of indebtedness, and new credit accounts.

For companies, there are special rating agencies (such as Moody's, S&P, and Fitch) that describe the creditworthiness of bonds of a company, and attributes in providing information about their credit quality through giving each a certain rating. Some agencies can also provide the probability of default (PD) of a company based on its equity price and other variables. Furthermore, this rating will assist the bank in determining the risk premium that will be charged on loans and corporate bonds. Besides, it increases transparency in the market by helping investors better understand credit risk of every participant.

Many banks follow internal procedures for rating the creditworthiness of their clients. Since the published ratings of the agencies are only available for companies that are publicly traded, small and medium companies don't have credit ratings. Therefore, Basel II introduced an internal rating-based approach (IRB) for banks to use in calculating the probability of default (Hull, 2015).

Before figuring out the right model for managing credit risk, the bank must initially calculate the required capital to be allocated for this matter. Prior to that, one needs to understand the determinants of credit risk modeling like probability of default (PD), recovery rates, loss given

default (LGD), and exposure at default (EAD). These elements will be defined and explained in the following sections.

2.2.2.2. *Recovery Rates*

When a company goes bankrupt, creditors of the company claim their money back. So the recovery rate of a bond is its traded price 30 days after the bankruptcy as a percentage of its face value. In other words, recovery rate is the amount of a loan that is recovered from its whole outstanding amount. Those rates are negatively correlated with default rates, which signifies that if default rates are high then recovery rates are going to be low. Another factor that affect the recovery rates is poor macroeconomic conditions, where a recession deeply lower those rates. Recovery rates influence the risk appetite of a bank towards a bond or company which depends on the exposure degree, as well as the expected amount to be lost on a default, since a high secured loan have a high recovery rate (Hull, 2015).

The calculation of the recovery rate as per Basel II is expressed in terms of loss given default (LGD). The latter refers to the amount of money lost by the bank when a borrower fails to repay a given loan. Therefore, % recovery rate = 100 - % LGD. In general, recovery rates are assumed to be 60% with a 40% LGD.

2.2.2.3. *Exposure at default (EAD)*

Exposure at Default is the total value of loss that the bank is exposed to when a loan default. Banks often calculates the EAD for every loan they have, and then use these values to figure out the total default risk. They use internal risk-management default models to calculate EAD, which is a basic component in calculating the Value at Risk for the IRB approach. Banks use information such as characteristics of borrowers and the type of the products offered, to base them in their internal analysis.

Following the credit crisis of 2007-2008, banks tried to build internal regulations to reduce their exposure at default. The Basel Committee's Accords also aimed at improving transparency and risk management techniques to steer clear of the domino effect that would occur in case of collapse.

2.2.2.4. Probability of Default (PD)

Probability of default (PD) is an approximation of the likelihood that a default of the counterparty will happen, and the borrower will fail to repay scheduled payments. PD is conditional to two categories of information:

- Specific borrower characteristics: which are determined with the help of FICO scores for individuals and credit agencies for businesses, as described in the previous section.
- Macroeconomic conditions: include data such as GDP growth rate, unemployment rate, house pricing index...

PDs can be also calculated through the use of historical data and statistical inferences. Normally, the higher the PD, the higher the interest rate charged on the loan, since the bank consider high interest rate to compensate for the default risk. Besides, there are two types of default probabilities: unstressed PD and stressed PD. The former refers to the estimate that the loan will default over a specific time period taking into consideration the present economic and specific information, in way that if the economic conditions worsen, PD tend to increase. Whereas the stressed PD refers to the estimate that the loan will default over a specific time period taking into consideration specific information and a “stressed” economic factor, regardless of the actual state of the economy (BIS, 2005).

2.2.2.5. Estimating default probabilities

An estimation of the default probabilities and recovery rates is one of the important theories to be applied by risk managers to predict the intensity of credit risk in a bank and assess it accordingly.

- Altman z-score:

Edward Altman has invented the Z-score model that estimates default using five accounting ratios: working capital/TA, Retained earnings/TA, Earnings before interest and taxes/TA, Market value of equity/Book value of total liabilities, and Sales/TA (Hull, 2015).

Table 2. 5: Z-score indicators for default probability

Altman's Z-score value	Indicates
≥ 3	Company unlikely to default
Between 2.7 and 3	Company must be alert
Between 1.8 and 2.7	Company have a chance to default
≤ 1.8	Company have high chance of financial embarrassment

Aside from the z-score model, there are other models that estimate default probabilities including credit metrics and credit risk plus.

- Credit risk plus:

The credit risk plus is a methodology proposed by the Credit Suisse Financial Products for the purpose of calculating the credit default risk. This approach takes into consideration information about the size and maturity of an exposure. This technique is widely used as well in the insurance industry to calculate the probability of a sudden default of an obligor.

If a financial institution has n number of loans with a q default probability for each, then the probability of m defaults is approximated by:

$$Prob(m) = \frac{e^{-qn}}{m!}$$

In reality, the loss from a default is uncertain and the bank has different default rates for different categories of exposures.

- Credit metrics:

The previous mentioned models estimate the probability of losses arising from possible defaults, without considering the effect of downgrades. The credit metrics is a model proposed by JP Morgan which considers both downgrades as well as defaults. It is based on a rating transition matrix where the ratings can be published by agencies or by internal calculations of the bank.

If we suppose that the probability of default is q during an i^{th} time interval, v is the present value of an exposure, q^* is the probability of default in a particular simulation trial, and R is the recovery rate, then the credit loss is:

$$\sum (1 - R)(q^* - q)v_i$$

If the credit rating improves during the year, then the credit loss is most likely to be negative.

2.2.2.6. Use of Credit Default Swaps

A considerable credit risk management technique is the use of derivatives, mainly the credit default swap (CDS), a financial instrument that provides insurance against the risk of default by a particular company. The company is known as the reference entity and a default by this company is called a credit event. The buyer of this protection has the right to sell bonds issued by the reference entity when a default occurs, and the seller of the protection agrees to buy them at their face value known as the CDS's notional principal. The buyer of the CDS (or in this case the bank that is trying to hedge its credit risk) pays a regular fee to the protection seller through the life of the CDS or until a default event occurs (Hull, 2015). The valuation of a CDS involves calculating and equating the present value of its two legs, the fee or premium leg (regular fee payments made by the protection buyer) and the contingent leg (the payment at the time of default made by the protection seller in case of a credit event).

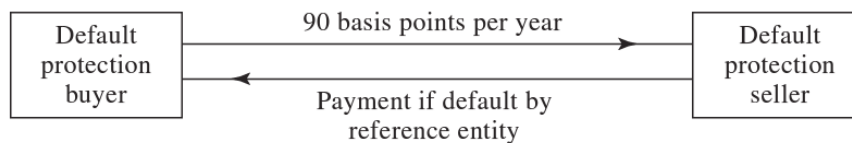


Figure 2. 6: Credit Default Swap

2.2.2.7. Calculating the Credit Value at Risk

A measure widely adopted by many risk managers in credit risk management and performed internally by almost all banks and financial institutions is the calculation of the credit VaR. The latter can be defined as the loss from credit risk for a specific duration that will not be exceeded within a defined confidence level. Value at Risk is a measure that comprises scenario analyses. The time horizon of credit risk VaR is usually a one-year span (longer than that of market risk VaR which is usually one-day span). Basel regulations suggest that the credit VaR must be calculated for the trading book (items held for trading) and the banking book (items held till maturity). One

of the methods to calculate credit risk VaR is Vasicek's Gaussian copula¹ model which calculates the percentiles of distribution of the default rate for a portfolio of loans. Its formula consists of the probability of default of a loan and the credit correlation between the banks (Hull, 2015).

2.2.3. Credit risk and Bank Performance in the Existing Literature

After having described the body of theories addressing credit risk, we focus now on the existing literature that dealt with credit risk and its management impact on banks performance.

Ahmad and Ariff (2007) study the determinants of credit risk in the commercial banks of emerging countries and developed countries. They infer a higher credit risk in the emerging countries and a greater need for management quality. Therefore, it is vital to divide the literature into developed and emerging countries.

2.2.3.1. *The effect of credit risk on performance in developed countries*

Felix and Claudine (2008) examine the interconnection between credit risk and bank performance in Sweden. They find an inverse relation between both ROA and ROE with the ratio of non-performing loans to total loans of banks.

A study performed by Paroush and Schrieber (2018) tackles the relationship between three important bank variables: risk, profitability, and capital. Their main sample is the US banks for the period between 1995 and 2015. This paper examined the relation between each two pairs separately, then compared the result with a three-variable equation that tested for the trilateral effect of the variables. They find that credit risk (measured by loan loss provision to gross loans) is negatively related to profitability or performance (measure by ROA), capital (CAR) and risk are negatively related, and capital and profitability are positively related.

Ekinci and Poyraz (2019) aim in their study to analyze the effect of credit risk on the performance of Turkish banks. Their dataset constituted of 26 banks between 2005 and 2017. They use ROA and ROE as indicators of performance, while NPL is the indicator of credit risk. The results show that there is a significant negative relation between credit risk and performance.

¹ It is a statistical tool that captures the dependence between variables without necessarily considering a linear correlation like the linear correlation coefficient. It also allows variables to have different distributions.

2.2.3.2. The effect of credit risk on performance in emerging countries

Another study conducted by Islam et al (2012) on 23 commercial banks listed in Dhaka Stock exchange between 2006 and 2015 cover the implications of credit risk management. They used three measures for performance as the dependent variable: ROA, ROE, and MBR (market to book ratio). A fixed effect model was diagnosed to be most suitable model for all three models. Besides, five indicators were used to measure credit risk along with two control variables (the bank size and management quality). The first indicator was CAR (capital adequacy ratio) and it proved a significant positive relation with bank performance. Also, LDR (loan to deposit ratio) is found to positively affect performances. Another indicator is NPLR (non-performing loans ratio) which shows a negative inverse relation with all three measures. The third indicator, LLPR (loan loss provision ratio) is considered to be negatively associated with ROE and ROA but affects MBR positively. As for the GFI (Geographic focus index or Sum of squares of loan proportions in Index different divisions), the study shows that it has a significant positive influence on MBR.

The paper suggests credit management practices based on the above results, including reducing extending risky loans, maintaining the minimum level of regulatory capital to absorb loan losses, having an internal strong credit evaluation system to select quality good loans, maintaining a provision against non-performing loans from operating profits, and striving to find a recovery loan emergency plan and loan rescheduling.

A study conducted by Musyoki and Kadubo (2012) use different parameters to assess credit risk management and its effect on banks performance in Kenya for a period ranging between 2000 till 2006. ROA is assigned to the performance as the dependent variable, while the independent X's parameters are: default rate which is non-performing loans to total loans, bad debt cost which is bad debt cost to total cost, and cost per loan asset which is total operating cost to total loans. Secondary data is used in the study and the ratios for each year and every bank are analyzed through a regression statistical tool run using SPSS program. They find that credit risk has an inverse impact on performance, and the management indicators are crucial and constitute about 36% of the bank's performance. Default rate is the most significant predictor of bank performance since it constitutes around 54% of the total credit risk influences on performance.

Similarly, Kaaya and Pastory (2013) investigate the relation between credit risk and performance as measured by ROA in Tanzania. The credit risk indicators used were loan loss to gross loan,

Non-Performing loan, loan loss to net loan, and impaired loan to gross loan. The control variables are deposit and bank size. They develop a regression model between performance and credit risk indicators which produce a negative correlation that reveals that the higher the measured risk the lower the performance. They finally recommend banks to strengthen their management techniques especially by increasing capital reserves in order to shield the bank from possible losses.

Ogbol and Okallo (2013) analyze the effect of credit risk management on the performance of banks in Nigeria. The relationship between ROA and credit risk management indicators is examined by a panel data using LLP, loans and advances, and capital adequacy as credit risk proxies. They observe a positive relation between a good management of risk and a bank's performance.

When it comes to the measurement of a bank's lending risk, existing studies use different proxies to measure credit risk. Samad (2014) uses non-performing loan to gross loan as a proxy for calculating credit risk. This indicator measures the percentage of doubtful gross loans in a loan portfolio and is considered one of the most remarkable indicators of credit risk of a bank where a lower ratio indicates a better asset quality. Other studies such as Kolapo et al (2012) uses the loan loss reserve ratio to calculate credit risk through the percentage of gross loans that are set aside to protect from losses of problematic loans. The higher the risk on loans, the higher the provision on potential loan losses, hence a high ratio is known to be a sign of a weak loan portfolio and a high risk of credit lending. Both Samad et al (2014) and Kolapo et al (2012) use the combination of both indicators in a new ratio called loan loss reserve to non-performing loan ratio (LLRNPL). This indicator measures the segmented reserves that are held only against the damaged loans or the non-performing loans, therefore a high ratio reveals a better credit risk management of asset qualities.

Bitar et al (2016) investigate the impact of capital requirements and regulatory capital ratio on performance of banks in the MENA region. They find out that banks that mostly comply to the Basel capital requirements are more protected against risk and have better performance.

Serwadda (2018) studies the effect of credit risk management on the financial performance of commercial banks in Uganda. The study considers the return on assets (ROA) as the dependent variable, and non-performing loans (NPL), Growth in interest earnings (GIE), and loan loss provision/total loans as the independent variables. The independent variables seem to be negatively significant and credit risk management seem to directly impact the performance of a bank.

Based on the above-mentioned literature, we realize that there exist many studies that focused on the relationship between credit risk and the performance of banks. Very few studies found a positive interaction (Ogbol and Okallo (2013)), and many others supported the negative relationship (Felix and Claudine (2008), Paroush and Schrieber (2018), Ekinici and Poyraz (2019), Musyoki and Kadubo (2012), Serwadda (2018)).

2.3. Liquidity Risk and Bank Performance

2.3.1. Definition

Given the significant role of liquidity in the banking activities, it is important to define, understand, and manage liquidity risk, since the latter can threaten banks' stability and affect banks' performance and reputation.

Liquidity risk is defined as the bank not being able to meet depositors' request, to supply cash payments and to meet financial obligations when they become due. According to Muranaga and Ohsawa (2002), liquidity risk is defined as banks being unable to liquidate their position in a timely fashion and at a reasonable price. Thus, banks, to be considered liquid, should have access to immediately spendable funds at a reasonable cost, and/or should liquidate their assets when required and at a fair market value. Basel Committee on Banking Supervision (1997) showed that liquidity risk results from the inability of a bank to handle any decrease in liabilities or to finance any increase in assets. Thus, an illiquid bank cannot obtain enough funds, by increasing its liabilities, or by converting its assets, quickly, and at a reasonable cost.

Faced with liquidity risk, banks might be forced to borrow at excessive cost or sell their assets at a loss, which result in a significant reduction in earnings. Furthermore, the insufficient liquidity does not only affect banks' earning but can cause erosion in depositors' confidence. Thus, a financial firm might be closed if it cannot raise sufficient liquidity, even though, it is still solvent. Here, it is vital to differentiate liquidity risk from solvency risk. Bank is considered insolvent when its assets are lower than liabilities, which makes the value of equity negative. Thus, banks that are solvent may- and sometimes - fail due to illiquidity.

Decker (2000) split liquidity risk into two parts: market liquidity risk and funding liquidity risk. While market liquidity risk refers to the situation when banks cannot easily handle any exposure without significantly lowering market prices, funding liquidity risk refers to the situation when banks are unable to meet their obligations as they are not able to obtain funding or sell their assets.

Goodhart (2008) mention that there are two features of liquidity risk: maturity transformation and inherent liquidity of banks' assets. First, banks face a maturity mismatch between assets and liabilities. The majority of the assets are long term in nature, and are funded with deposits most of which are current with a possibility to be due at any time. However, banks do not need to be worried about the maturity transformation if they have enough assets that can be sold without any loss. Thus, these two features are intertwined. Moreover, liquidity risk might be driven by a recessionary economic condition, which increase the demand for depositor's withdrawals.

According to Hull (2015), liquidity problems in a bank can be caused by:

1. Liquidity stress in an economy similar to what happened in 2007
2. Aggressive financial decisions where there is too much mismatch between assets and liabilities durations.
3. Poor financial performance that causes absence of confidence and may lead to a loss of deposits.

BCBS (2008) introduced 16 liquidity guidelines for the bank's stability and soundness that are divided into five broad categories: Management and supervision of liquidity (Principle 1), Governance of liquidity risk management (Principles 2-4), Measurement and management of liquidity risk (Principles 5-12), Public disclosure (Principle 13), and The role of supervisors (Principles 14-17). All these guidelines rotate around establishing a robust liquidity management framework that can resist a series of stress events. For instance, under governance of liquidity risk management, the Basel guidelines ensure that a senior risk manager must exist to continuously review the strategies and practices and frequently report to the board of directors. Under measurement and management of liquidity risk, a bank must build a strategy of well-diversified sources of funding. Additionally, the bank must control its collateral position and recognize the encumbered and unencumbered assets. Another principle ensures that the bank must conduct stress tests regularly for a multiple of scenarios to guarantee that existing exposures stay consistent with the bank's liquidity tolerance. Moreover, the bank must undergo a formal contingency plan (CFP) which provides certain actions for tackling a liquidity shortfall. Under disclosure regulations, Basel committee requires public disclosure of information to help investors make good judgements about the liquidity position. Under the role of supervisor's measures, it is vital to have communication between supervisors and public authorities like central banks, to ensure a successful oversight of liquidity risk management.

Therefore, it is increasingly important to study liquidity risk for banks, yet empirical studies covering the matter are still few and far between. According to Landskroner and Paroush (2008), extensive academic and regulatory discussion were tackling different major banking risks, such as credit risk, market risk, and operational risk, with little attention paid to liquidity risk. However, the crisis of 2007 evidently highlighted the importance of liquidity risk.

2.3.2. Theoretical Background of Liquidity Risk Management

Liquidity risk management is extremely important because any liquidity shortfall at one financial institution can have system-wide consequences. Liquidity risk management, also known as “water of life”, is one of the origins for the formation of surplus at a bank; its main objective is to ensure that the financial institution is in a position to address its liquidity obligations, to survive a period of liquidity stress, and to stay away from financial problems or bankruptcy. A bank should have a well-defined mechanism for identifying, measuring, monitoring, and mitigating liquidity risk, which is integrated into the bank risk management process. Banks can manage liquidity risk using various measures. For example, they may seek a better diversification of the funding sources. They may try to reduce the maturity mismatch between assets and liabilities. Banks might hold highly liquid assets that can be sold or pledged as collateral, or might increase its cash reserves, or uphold a liquidity buffer consisting of cash and liquid assets that can be used to withstand any liquidity stress (Ana Matis and Alina Matis, 2015).

Ratnovski (2013) establish a model where banks can manage their liquidity risk through two procedures: higher liquidity buffer which shields banks from liquidity shocks, and increased transparency about their solvency which could reduce the probability of large shocks as well. The government can force banks to hold a liquidity buffer but cannot force them to be transparent, so banks would hold high buffers but might not make an effort to be transparent. Hence, government regulations would reduce the level of dynamic liquidity management, such that banks would adhere to one risk management technique that is only forced by regulations and remains neglectful of other ways to reduce risk.

A paper by Delechat et al (2012) examines the determinant of liquidity buffers, defined as liquid assets to deposit ratio, in Central America, Panama, and the Dominican Republic over a period of four years. They stated that there are 4 determinants of the bank’s liquidity buffers as distinguished

by previous empirical literature: macroeconomic fundamentals, characteristics of the bank, moral hazard motives, and shocks to funding.

- **Macroeconomic Fundamentals:** The demand for liquidity is countercyclical and increases during recessions. Thus, banks store liquid assets in times of recessions and reduce them during good times to have more lending opportunities. Liquidity buffer is inversely related to real GDP growth and credit cycles.
- **Banks' Characteristics:** Some characteristics of the bank may influence its ability to raise money through non-deposit and affect the preventative demand for liquidity buffers. For instance, the size of the bank can be a barrier where small banks find it more difficult to access capital markets. Moreover, the higher the bank profitability is, the more it is ready to raise capital and therefore it would be less liquidity constrained.
- **Moral Hazard and safety nets:** The strength of the financial safety net would decrease the need of banks to hold more liquidity buffers (Repullo, 2003). An example of the safety nets is the lender of last resort (LOLR) which is an institution that provides liquidity for banks that find it difficult to obtain liquidity from the interbank lending market.
- **Shocks to funding:** The cost of holding liquid assets, with relatively low return, is weighed against the benefits of reducing the risk of not having enough liquidity (Santomero, 1984). This model predicts that the size of the liquidity buffers must mirror the cost of holding liquid assets instead of loans. It must also be associated with the distribution of liquidity shocks that the bank is exposed to and particularly to the volatility of the funding basis and the cost of raising additional funds.

Furthermore, holding enough reserve requirements is a step of liquidity risk management. This technique requires banks to have a percentage of their deposits aside either in the bank's own vault or with the central bank. In addition to the reserve requirements, it is important to maintain the liquidity risk ratios introduced by Basel III and previously discussed in section 2.1.3

2.3.3. Empirical Studies about Liquidity Measures

Various liquidity measures are commonly used to assess liquidity and /or liquidity risk and are divided into two different categories. The first definition uses liquidity ratio measured by liquid assets to total assets ratio (such as Bourke, 1989; Barth et al, 2003; Molyneux and Thornton, 1992), liquid assets to deposit ratio (Shen et al, 2001), and liquid assets to customer and short-term

funding (Kosmidou et al, 2008). In this group, the higher the liquidity ratio, the better the liquidity position and consequently the lower the probability of failure.

The second definition examines loans to total assets ratio (Demirgüç-Kunt and Huizinga, 1999 and Athanasoglou et al, 2006) and net loans to customer and short-term funding ratio (Pasiouras and Kosmidou, 2007; Naceur and Kandil, 2009). A higher value indicates less liquidity and a higher vulnerability to risk and failure.

In addition to the liquidity ratios aforementioned, there are alternatives to measure liquidity risk. Basel Committee on Banking Supervision (2000) introduces a method for testing liquidity risk called maturity laddering method, which compares the bank's future cash inflows to its outflows. Up until now, there is no common standard measure for liquidity risk. Therefore, banks use diverse methods to calculate liquidity since there is no single measure that yields a comprehensive view. Besides, banks must construct a new sight of liquidity measurements in addition to the traditional liquidity ratios. Poorman and Blake (2005) mentioned that liquidity ratios that are previously used are not sensitive measures to assess liquidity risk and should be not be used alone For example, a large regional bank in the US (Southeast Bank) measures its liquidity using more than 30 liquidity ratio, but still failed due to liquidity risk. Thus, banks are developing new measures of liquidity (Saunders and Cornett, 2006; DeYoung and Jang, 2016). Saunders and Cornett (2006) declare that banks' liquidity risk exposure is determined through measuring the financing gap. Managers usually consider core deposits as a stable source of funds, and therefore they can continuously fund bank loans. The financing gap can be defined as the difference between bank's average loans and average core deposits. If this value is positive, the bank should raise additional fund for the loans either by cash, selling liquid assets, or borrowing funds from the money market. When banks receive fewer deposits and liquid assets while lending out more loans, they have higher exposure to liquidity risk. DeYoung and Jang (2016) state that the financing gap is similar to the net stable funding ratio requirement of Basel III, where the bank is required to maintain enough stable funding (such as core deposits which are considered as lower cost funding source) to finance their illiquid assets (such as loans).

2.3.4. Liquidity risk and Bank Performance in the existing literature

The impact of liquidity risk on bank performance is ambiguous. On one hand, liquidity problems (illiquidity) may negatively affect banks' earning since banks need to borrow from the market at

an exceptionally high rate during a liquidity crisis. Moreover, an illiquid bank may refuse lending to customers, representing an opportunity loss for the bank. A bank with liquidity problem might lose a number of business opportunities, which puts the bank at a competitive disadvantage. Thus, a positive link is expected between liquidity and performance. On the other hand, even if banks try to keep enough liquid assets to meet unexpected demand from depositors, maintaining cash is expensive. From one side, liquid assets generate zero or low return, thus maintaining large cash reserve will lead to a loss of a number of opportunities in the market. Thus, the more resources are tied up in meeting demands for liquidity, the lower is the financial firm's expected profitability. On the other side, banks with a high level of liquidity are more willing to finance risky projects that are yielding high return, but with a low probability of success. Thus, a negative link is expected between liquidity and bank performance, while a positive link is expected between liquidity and bank stability.

There are several empirical studies investigating the impact of liquidity and/or liquidity risk on bank performance. While some studies support the positive link between liquidity and performance (Barth et al., 2003, Usama and Umair, 2018), other studies defend the opposite view and support the negative link (Kosmidou et al., 2008, Ly, 2015). These studies will be presented in chronological order.

2.3.4.1. The effect of liquidity risk on bank performance in developed countries

Bordeleau and Graham (2010) investigate the relationship between liquid assets holding and profitability in the Canadian and US banks between 1997 and 2009. Holding liquid assets is a way to decrease liquidity risk, but it has the drawback of having a comparatively low-yielding assets on the balance sheet. They regressed profitability (the dependent variable) against the liquid assets ratio, with a set of control variables. Their results show that there is a non-linear relationship between holding liquid assets and profitability. Profitability increase as banks hold some liquid assets until a level, where holding a higher level of liquid assets decreases banks' profitability. This relationship depends as well on the model used by the bank and the market funding risks.

Ly (2015) studies the relationship between liquidity risk and European bank performance during 2001-2011 by using a panel data of 27 European Union countries. They use the net interest margin (NIM) as the dependent variable, while the dependent variables include liquidity ratio (liquid assets to total assets) as a proxy of liquidity, a vector of bank specific variables (such as size,

deposit to total asset ratio, equity to total assets ratio, loans to total assets ratio...), industry specific control variables (such as capital regulatory index, official supervisor power index, degree of regulatory restrictiveness...), and macroeconomic control variables (such as annual GDP growth, foreign ownership...). The result supports the presence of a negative relationship between liquidity risk and bank performance.

Chen et al (2018) use a panel data of commercial banks of 12 developed economies over the period 1996-2006. They employ the financial gap method as an alternative for measuring liquidity risk and measure its effect on bank's performance. They divide the determinants of liquidity risk into bank specific, supervisory, and macroeconomic factors. Their results show that liquidity risk is an endogenous factor of banks' performance, and it constitutes a risk discount on the performance. Liquidity risk reduces profitability as measured by ROA and ROE, while it increases the bank's NIM. This means that banks with a high level of illiquid assets in loans could be compensated by having higher net interest incomes.

2.3.4.2. The effect of liquidity risk on bank performance in emerging countries

Farrouhi (2014) aims in his paper to identify the relation between performance and liquidity risk and to define the determinants of bank's performance in Moroccan banks between 2001 and 2012. A panel data regression is applied using four performance ratios (ROA-ROAA-ROE-NIM) and six liquidity ratios presented as follows:

1. Liquid assets/ total assets: this ratio measures the ability of the bank to absorb shocks
2. Liquid assets/ short term liabilities: this ratio measures the ability of the bank to stand the high demand of short-term liquidity
3. Liquid assets/ deposits: it measures the liquidity when the bank is unable to borrow from other banks.
4. Loans/ total assets: it measures the amount of assets associated with illiquid loans.
5. Loans/ (deposits + short-term liabilities): this shows the relationship between illiquid assets and liquid liabilities.
6. (Loans-customer deposits)/ total assets: it is known as the financial gap and it measures the liquidity risk exposure.

However, the author mentions that using solely liquidity ratios in measuring the risk is not enough since some banks that have positive ratios can go bankrupt, as supported by Poorman and Blake

(2005). Therefore, the author proposes the financing gap measure as the most suitable way to assess liquidity risk exposure. Furthermore, the results of the regression show that there are seven determinants for bank performance: liquidity ratio, size of the bank, log of total assets squared, external funding to total liabilities, foreign direct investments, share of own bank's capital from the total assets, and the unemployment rate. The results stated that the relation between liquidity risk and bank performance depends on the model of liquidity ratio used, as well as on all 7 determinants and their relationship with performance.

Usama and Umair (2018) examine the effectiveness of liquidity risk management practices on the performance of both Islamic and conventional banks of Pakistan, Malaysia, and Indonesia. They measure liquidity risk through two proxies: loan to deposit ratio (LTD) and cash to total asset ratio (CTA). ROA and ROE are the proxy measures for performance. A regression is run on a panel data extracted from the financial statements of banks between the years 2011-2015. The outcomes turn to be a positive relation between LTD and performance and between CTA and performance. The authors conclude that an increase in loans to deposit ratio will boost the overall profitability and performance of the bank.

Said (2014) examines the effect of the net stable funding ratio (NSFR) as the liquidity management technique presented by Basel II framework on bank's performance. With the introduction of NSFR, banks are expected to have a more stable source of funding and focus on high-quality assets. Said (2014) uses a panel data of 8 banks in Malaysia for the years 2005-2011. He measures performance with three commonly used variables: ROA, ROE, and NIM. With respect to the independent variables, he uses bank specific determinants which are: NSFR, operating efficiency, size, asset quality, and equity. Another set of environment-based measures are used which are GDP and inflation. There appears to be a positive relation between NSFR and all indicators of performance. This shows that liquidity risk management increases profitability and performance of commercial banks.

Arif and Anees (2012) test the effect of liquidity risk on bank's profitability in 22 Pakistani banks between 2004 and 2009. They calculate profitability from the "loss and profit statement" of banks, while the independent variables used are deposits, NLP, cash, and liquidity gap. The results of the paper show a significant negative relationship between liquidity risk and profitability. The authors conclude that there is a need for an utmost priority of liquidity risk management through keeping sufficient cash reserves, lowering the liquidity gap and NLP, and increasing the deposit base.

Additional literature reviews in both developed and developing countries are summarized in the below table:

Previous Studies	Developed or Developing	Liquidity Risk measures	Empirical Results
Bourke (1989)	Developed	The ratio of liquid assets to total assets	The liquidity ratio is positively related to return on assets (ROA).
Molyneux and Thornton (1992)	Developed		The liquidity ratio is negatively related to ROA.
Demirgüç-Kunt and Huizinga (1999)	Both	The ratio of loans to total assets	The liquidity ratio is negatively related to ROA and positively related to NIMs.
Shen et al. (2001)	Developed	The ratio of liquid assets to deposits	Banks with a high fraction of liquid assets have lower NIMs.
Demirgüç-Kunt et al. (2003)	Both	The ratio of liquid assets to total assets	Banks that hold a high fraction of liquid assets have lower NIMs. This is consistent with banks receiving lower returns on holding cash or securities, but facing a competitive market for deposits.
Barth et al. (2003)	Developed		The liquidity ratio is negatively related to ROA.
Athanasoglou et al. (2006)	Developed	The ratio of loans to total assets	The liquidity ratio has no effect on ROA and return on equity (ROE).
Pasiouras and Kosmidou (2007)	Developed	The ratio of net loans to customer and short-term funding	The liquidity ratio is positively related to ROAA of domestic banks operating in the 15 European Union countries. It is negatively related to ROAA of foreign banks.
Kosmidou (2008)	Developed		The liquidity ratio is negatively related to ROAA.
Kosmidou et al. (2008)	Developed	The ratio of liquid assets to customer and short-term funding	The ratio of liquid assets to customer and short-term funding has a positive effect on ROAA. It has a negative effect on NIMs, but is only significant in the presence of external factors
Naceur and Kandil (2009)	Developing	The ratio of net loans to customer and short-term funding	The liquidity ratio is positively and significantly related to NIMs of domestic banks, indicating a negative relationship between NIMs and the level of liquid assets held by the bank. However, banks'

			liquidity risk does not determine returns on assets or equity (ROA or ROE) significantly.
Sharma et al. (2015)	Developing	The ratio of liquid assets to total Assets	The liquidity ratio is negatively but not significantly related to bank efficiency.
Masood and Javaria (2017)	Both	The liquid to asset ratio, quick ratio, current ratio, investment to asset ratio, investment to deposit ratio, cash deposit ratio, cash and due from bank to asset ratio, cash and due from bank to deposit ratio	Positive effect of liquidity on performance. However holding further liquidity can have an inverse impact on performance
Usama and Umair (2018)	Developing	The ratio of loans to assets and the ratio of cash to deposit	There is a positive and significant impact on ROA and ROE

Table 2.6: Summary of literature

2.4. Credit risk and liquidity risk

According to the classic theories in banking over the past 50-60 years, credit risk and liquidity risk are closely associated. The way banks work with their risks is explained through two major research lines: the classic financial intermediation theory most commonly studied by Bryant (1980) and Diamond and Dybvig (1983), and the industrial organization approach highlighted by the Monti-Klein model of banking. Both models demonstrate that there is a relationship between credit and liquidity risk. The theory of financial intermediation builds on the notion that financial intermediaries (such as banks) work for reducing transaction costs and asymmetry of information. The role of these financial intermediaries is to channel funds from depositors to borrowers by intermediating between them. This creates liquidity in the market through financing projects from the deposits of the balance sheets, or through off-balance sheets items such as credit lines. The theory is based on the case that demanding deposits and reserves is directly connected to the cost of illiquidity and incomplete information. Therefore, the theory of financial intermediation is based on minimizing the cost of information which in turn help solve the problems between borrowers and lenders and reduce the probability of credit risk and liquidity risk as well. Moreover, the Monti-Klein framework of the industrial organization approach considers that both borrower defaults and instant withdrawal of funds reduce bank’s profitability. As liquidity risk is known to be a profit-

lowering cost, the loan default increases the liquidity risk since it triggers lower cash inflows and depreciations (Dermine, 1986). Dermine (1986) considers liquidity risk as a “profit-lowering cost”. A default on a loan multiplies the risk of liquidity due to a reduction in the inflow of cash. Based on that, it is obvious that bank shocks are triggered by risky assets, and the bank would be affected by the jointly contribution of both risks to its performance.

Diamond and Rajan (2005) reveal that credit and liquidity risks are positively related. They show that if many economic projects are financed with loans, the bank cannot provide the depositors with their needed demand. Therefore, if these assets' value decline, the depositors will demand their money bank. Besides, at the time of a crisis, banks are exposed to the risk of excessive withdrawal by depositors reaching a risk of drainage of funding origins, especially interbank market. Thus, liquidity and credit risk move simultaneously.

He and Xiong (2012) demonstrate the interaction between credit risk and liquidity risk in a constructed model that can be applied to both financial and non-financial institutions. They show that the decline in market liquidity leads to credit risk. They believe that credit risk can stem from the debt rollover. Therefore, when liquidity decreases, the bank should pay more cost for rolling over its maturing debt. This conflict can cause a higher default threshold for banks. Consequently, the authors highlight the relation between short-term debt and rollover risk and conclude that the interaction between both credit and liquidity risk intensifies the risk of business failure.

Imbierowicz and Rauch (2014) investigate the relationship between credit risk and liquidity risk, in all U.S commercial banks for a period ranging between 1998 and 2010. Their results show that both risks do not interrelate in an economic reciprocal way, but they affect the probability of default of the bank. This effect is binary where both risks influence the bank's default separately, but the influence of their interaction is conditional to the level of the bank's general risk and could either provoke default risk or alleviate it.

A study done by Ghenimi et al (2017) tackles the relationship between liquidity and credit risk and their effect on the banks' stability in the MENA region. They use a sample of 49 banks over a period of eight years. They calculate the credit risk and liquidity risk separately as internal factors taking into account bank specific and macroeconomic factors. Credit risk is measured by impaired loans divided by gross loans, while liquidity risk is defined as liquid assets to total assets ratio. They use the Z-score as a measure of bank's stability. They find that both risks affect stability when tested separately and their interaction contributes to the instability of the bank.

Chapter 3: Procedures and Methodology

3.1. Introduction

Chapter three emphasizes the methodology employed in studying the prevalence of different financial risks and the impact of their management on the performance of banks in the MENA region during the period extending from 2014 to 2018. This chapter starts by pinpointing the philosophical dimension in Section two. Section three highlights the research orientation of the study. Section four introduces the research strategy followed in this thesis. Research questions and hypotheses are developed in section five. Section six defines the variables, while the data source and the sampling procedure are discussed in section seven. Section eight discusses the methodology used, the regression analysis model and the procedures followed. Finally, section nine concludes.

3.2. Philosophical Dimensions

A research philosophy is a viewpoint of the way a data is approached to be gathered and analyzed. Advocates of research methods have relied on certain assumptions about the nature of knowledge. The main two approaches are ontology and epistemology.

The first approach, ontology, refers to the nature of reality, where the researcher's perspective of reality is the keystone to all other assumptions (Burrell and Morgan, 1979). Continuum polar opposites for ontological perspective are objectivism and subjectivism. Objective realism states that there is a reality that exists outside the human mind and independent of imagination, while subjective realism recognizes reality only as a projection of the human thoughts and beliefs (Morgan and Smircich, 1980). It claims to eliminate contextual factors and achieve observations free from bias which by itself leads to discovery of knowledge (Crotty, 1998).

Given that this research aims at detecting the impact of the management of various financial risks, namely the credit and the liquidity risks on the bank's accounting and market performances in the MENA region, it is assumed that the role of financial risks and the way they are managed are an independent reality that could be studied through collection of data and measurement of variables. Hence, this research leans towards objective realism.

The second approach is epistemology, which is concerned with the nature of knowledge, validity of information, and limits of inquiry (Rosenau, 1992). Epistemology has two extreme positions: positivism and interpretivism. Positivists believe that reality is stable and can be discovered from an objective stand through applying direct experiences and measures. On the other hand, interpretivists contend that reality can be entirely understood only through the subjective intervention of humans and their personal perceptions rather than by scientific theories.

Our study tackles research questions by adopting the positivist epistemological approach. Given that the research aims at studying the impact of the management of credit and liquidity risks on bank performance in the MENA region, it is required to gather empirical data in order to measure the risk as well as to calculate the metrics of bank performance. This process can only be achieved through collection of observations from trusted databases to be later analyzed and studied through statistical tools. These fundamental characteristics of empirical knowledge, direct measurements, and meaningful outcomes make our approach purely scientific and fall under the paradigm of positivism.

3.3. Research Orientation

Generally, the research has two main pillars: the deductive and the inductive reasoning. The deductive reasoning, or the “top-down approach”, begins with the theory of the topic, moves further into a specific hypothesis, narrows it more when collecting observations, and ends up with a logical conclusion. The inductive reasoning, or the “bottom-up approach”, works in the other way around such that it starts with the observations, identifies patterns, constructs hypotheses and ends up with the theory (Trochim, 2006).

In this research, a deductive approach of reasoning is adopted. It will start by examining the different types of risks that can be a main source of banking fragility. The risks will be narrowed down to address two of the most important types of risks which are credit risk and liquidity risk. Generalization of the results is the main pillar of deductive reasoning approach such that the findings obtained from an acceptable sample can be accurate enough to be generalized; this generalization can be applied in our sample research since it is conducted on an acceptable sample of banks in the MENA region which are all publicly listed banks in every country’s stock exchange.

3.4. Research Strategy

A research strategy is the way through which a researcher follows a plan to handle the object of inquiry and utilize it (Sarantakos, 2012). In social research, there are 6 types of strategies that can be used depending on the research's aim: survey, case study, action research, experiments, ethnography, and archival. This research will follow the archival strategy which uses secondary data as its data source. Therefore, the observations collected from DataStream will help calculating the risk metrics and performance measures for our sample of listed banks in the tested sample period.

Research methodologies are mainly four kinds, which depend on the type of research and the strategy used: questionnaire, interviews, observation, and content analysis. This study adopts the content analysis method which helps the researcher makes use of large amounts of texts and makes valid inferences to their context (Trochim, 2006). Therefore, the content analysis is needed to transform the raw data into outcomes, and to assess the observations extracted from the data stream to best serve the aim of the study. Quantitative methods will be used to analyze patterns of content in a non-invasive feature, unlike simulating social experiences or gathering answers from surveys. The study uses quantitative approach in assessing and interpreting the data which makes the objectivity a fixed pillar in the study. The quantitative method is 'objective' in nature and deals always with numerical data that are assessed using statistical approaches and mathematical modeling. Otherwise, the research would be qualitative in nature. This research proves to be quantitative where the data will be collected from a reliable data base and tested empirically within a context of statistical tools.

Furthermore, it is noteworthy that this research is an exploratory study as the tested effect of the management of both credit and liquidity risk on the performance of banks in the MENA region is assessed in a new combination. This is achieved by testing the separate effect of both risks on bank performance, and then testing for their combined effect and their interaction on the performance. This characteristic is a key fact of exploratory studies which require a new insight in assessing a phenomenon (Robson, 2002).

3.5. Research questions and hypotheses

A research question is the basic essence of a research project or a study. It directs the study in a more focused path, specifies the methodology, and leads all stages of analysis.

The research question helps determine the kind of research that the writer searches for along with the objectives that the study tackles. It presents the research problem which is considered worth solving for the reader (Creswell, 2014). This step is the first methodological one that the researcher has to take, which shapes the theoretical assumptions in an explicit way, where the investigator makes sure that it is defined in a clear and accurate form.

Our main objective in this research is to pinpoint the possible effect of credit and liquidity risk management on bank performance, then we should identify a research question that addresses clearly the relation between each of the risks mentioned above and the performances of banks.

It is widely known that banks all around the world are prone to several financial risks. These risks can be severe and are directly associated with banks' failure. Risks include the probability of borrowers defaulting on their loans (credit risk), depositors withdrawing their deposits unexpectedly (liquidity risk), sudden changes in interest rates (interest rate risk), and banks disrupt in their system internally and externally (operational risk). However, between these risks, credit and liquidity risks are the main threats for the bank and the financial economy as a whole (Cecchetti and Scoenholtz, 2011). The subprime crisis that erupted in 2008 and affected drastically the economies and financial markets worldwide illustrates the danger of these risks and the importance of managing them effectively. The Basel Committee on Banking Supervision (BSBS) specified that the liquidity shortage was one of the main drivers of the crisis (BCBS, 2008). At the time, banks relying extensively on short-term money market to finance their assets have suffered a shortage of liquidity. Illiquidity arose from the weakness of a bank to adjust to a fall down in liabilities or a rise in assets. The crisis was initially triggered by a sudden default of counterparties on banks' loans which dried up lending to business and consumers. Therefore, both credit risk and liquidity risk shaped the downfall of the financial system and caused a severe crisis in many countries around the world (Chen et al, 2018).

This research attempts to fill a gap in the literature, by investigating the impact of the management of credit risk and liquidity risk on bank performance in the MENA region. Each research question will be translated into a hypothesis that would give insight into the phenomenon studied and will be tested by the proposed measurements.

In this study, we develop the following research questions:

Research Question 1: What is the impact of credit risk management factors on a bank's market and accounting performances?

In order to answer this research question, the following hypotheses are developed:

H_{1.0}: Credit risk management does not have an impact on bank performance.

H_{1.a}: Credit risk management has an impact on bank performance.

Research Question 2: What is the impact of liquidity risk management factors on a bank's market and accounting performance?

Similarly, and to answer research question 2, the following hypotheses are developed:

H_{2.0}: Liquidity risk management does not have an impact on bank performance.

H_{2.a}: Liquidity risk management has an impact on bank performance.

Research Question 3: What is the combined impact of both credit and liquidity risk on a bank's market and accounting performances?

The following hypotheses are developed to answer the third research question as follows:

H_{3.0}: Credit risk management and liquidity risk management together have a combined impact on bank performance.

H_{3.a}: Credit risk management and liquidity risk management together don't have a combined impact on bank performance.

The above hypothesis will be narrowed down and divided into sub-hypotheses which are developed in section 3.6.

Performance can be reflected by the soundness of the bank which is quantitatively measured through assessment of asset quality, capital, liquidity and sensitivity to the market. Performance can be measured using accounting measures or using market measures, which assess various economic constructs.

First, accounting performance shows how a bank is performing through financial analysis and is used by investors to compare the profitability of the bank over time and with the industry average (Lee, 1999). Second, market performance is the main concern of investors who are interested with

higher stock return. To check how well a firm is performing or growing, shareholders simply look over its stock returns and some other indicators based on stock prices. Thus, the change in the price would be an ideal standard of company's performance (Charles, 2013). Hence, stock market return is another principal measure for performance.

While accounting measures are responsible for presenting an economic history of company's performance, market measures are driven ultimately by alterations in the market anticipations of future profits (Charles, 2013). Thus, it is important to consider both types of performance in order to obtain a more comprehensible picture of the relationships between credit and liquidity risk management on bank performance.

Accordingly, we will test the effect of credit and liquidity risks on the accounting and the market performance measures.

3.6. Variables

Variables are divided into three types: dependent, independent, and control variables. While the dependent variable is called the response or outcome, the independent variables are called the cause, effect, or predictor. In another words, independent variables are those stimulus or inputs that cause changes in the dependent variable or the output (Patten and Newhart, 2018).

Each variable will be carefully evaluated and discussed in this section.

3.6.1. Dependent Variables

The performance of the banking industry has been a large topic discussed in the previous studies. The importance of the banking sector in the economy was demonstrated in the last financial crisis. Moreover, Athanasoglou, Brissimis and Delis (2005) mentioned that the stability of the financial system is dependent on a profitable banking sector. Thus, performance of banks is particularly important. The dependent variable in this thesis is bank performance, which will be proxied using both accounting performance and market performance. Each measure looks at a different aspect of performance and has its own advantages and disadvantages. The main disadvantages of accounting measures are their historical nature and being affected by accounting systems, while the main disadvantage of market measures is being sensitive to systematic risk. According to Hax (2003), accounting based measurement and market-based measurement are complementary measures of performance.

More specifically, this study will use Return on Assets (ROA) as the accounting measure and stock return (YTD) as the market measure.

3.6.1.1. Accounting performance

The two proxy indicators for bank's accounting performance commonly used by previous researchers are return on assets (ROA) and return on equity (ROE). However, according to International Monetary fund (IMF, 2002), ROA is considered as the most informative indicator for bank profitability. This statement is supported by Hassan and Bashir (2003) who stated that ROA is preferred by most regulators. In this thesis, return on assets will be used to measure the accounting performance of the commercial banks in the MENA region, which is our first dependent variable.

Return on Assets (ROA) is computed as the net profit or net income divided by total assets (NI/TA), reflecting banks' ability to generate profits given the amount of assets they have. ROA represents the percentage of income a bank attains relative to the overall resources or the profit the bank can generate from utilizing the assets. Therefore, a higher ROA means a better asset management. Although both ROA and ROE measure the performance of a company, this research will use ROA as its dependent variable since it takes into consideration all of the bank's assets including those which stem out of liabilities to creditors.

ROA is used by many previous studies such as Altarawneh and Shafie (2018), Gizaw, Kebede, and Selvaraj (2015), Serwadda (2018), and Chen (2018). For example, Alterawneh and Shafie (2018) tested the effect of credit risk, liquidity risk, and operational risk on bank performance using ROA as a dependent variable. Our research differs from theirs by the choice of the independent variables such that they used total debt/total assets for credit risk, net loans/deposits for liquidity, and total expenses/total revenue for operational risk. They identified a negative relationship between both credit risk and operational risk and ROA, and an insignificant relation between liquidity risk and ROA.

3.6.1.2. Market performance

Since accounting-based measures can be biased, market-based measures are needed. Thus, in this study, the market performance of the banking sector is measured as the stock return of the bank,

similar to many prior studies such as Ekinci (2016) and Kasman et al (2011). Ekinci (2016) conducted a research to assess the effects of market risk and credit risk on the market performance of the Turkish banking sector. The study returned a significant positive effect of both risks on the stock return of banks. Similarly, Kasman et al (2011) investigated the effect of interest rate risk on the market performance of Turkish banks using return on the stock as the dependent variable. However, their work was focused on only one type of risk and did not include any other possible risks that may affect the stock returns.

Stock return is calculated as

$$R = 100 \times (LnP_t - LnP_{t-1})$$

where P_t is the stock price at time t and P_{t-1} is the stock price at time $t-1$.

The return of a stock is simply described as the change of the stock's price representing investor's gain or loss over a specified period of time.

4. Independent Variables:

The independent variables, also known as explanatory variables, are those variables who are causing the change in the dependent variable. Since our objective is to investigate the link between risk and bank performance, the independent variables are the two types of bank risk, mainly credit risk and liquidity risk, defined below.

3.6.2.1. Credit Risk

To answer Research Question 1, our first independent variable is Credit risk. Due to the unavailability of data, researchers used a variety of variables to measure credit risk. There are many indicators used in the literature to measure credit risk including stress tests (increase the probabilities of default (PD) and loss given default (LGD) for each asset or increase the default correlation between different assets), expected default frequencies (EDF) (a measure of the probability that a firm will default over a specified period of time), loss given default (the amount of money a bank or other financial institution loses when a borrower defaults on a loan), and many others (Ekinci, 2016). Credit risk, in this thesis, will be measured by taking into consideration the percentage of loans from the total assets as well as the percentage of the low-quality loans from the total loans.

In line with Serwadda (2018), Iftikhar (2016), Serwa (2013), and Ekinci (2016), credit risk factors will be proxied using non-performing loans ratio (NPLR), loan loss provision to total loans (LLPR), and capital adequacy ratio (CAR).

- **Non- Performing Loan to Total Loan Ratio (NPLR):** First, the most accurate and widely used credit risk measure is non-performing loans ratio defined as non-performing loans divided by total loans since it directly incorporates loan losses. Non-performing loans are those of which interest payments or principle repayments have not been fulfilled for a certain period of time, mainly 90 days. In fact, according to the International Monetary Fund (IMF, 2005), banks are considered in default or close to default and loans are classified as non-performing loans if payments have not been made in at least 90 days. The ratio of non-performing loans to total outstanding loans is widely applied in banks to evaluate the financial performance and quality of the loan portfolios (Serwa, 2013; Meeker and gray, 1987; Jin et al, 2011). This ratio indicates how effective the management is in managing credit risk in banks because it determines the ratio of loans that have defaulted or are close to being default to the total loans. Furthermore, according to Noman, Pervin and Chowdhury (2015), a lower NPL ratio signifies a lower amount of loans being doubtful which in turn is translated into a lower credit risk. Thus, NPLR can be used as a credit risk management proxy. A common assumption in literature is that non-performing loans will decrease the profit generated from returns on the total loans and hence decrease the return on assets (Serwadda, 2018). Therefore, in this research we will assume that a high NPL ratio indicates a high percentage of loans that are in default which will have a negative impact on a bank's performance.

H_a: NPL has a negative impact on bank performance.

- **Loan Loss Provision to Total Loans Ratio (LLPR):** In case the data for nonperforming loans is not available, researchers often use loan loss provision ratio defined as loan loss provision divided by total loans. Loan loss provision (LLP) is an indicator of how protected a bank is against future losses. It is an expense calculated for uncollected loan payments and used to cover risks associated with loan defaults. It is a standard accounting adjustment included in the financial statements of banks to assess for bank's loan loss reserves. Banks use loan loss provisions to create reserves in order to cover the expected losses resulting from bad loans. It is expected that a bank is likely to create higher loan loss provisions

when loan portfolio is riskier. Therefore, this variable is a rough indicator of the overall quality of the loan portfolio and an efficient indicator of credit risk where it is predicted to have a negative impact on the performance of the bank as concluded by Miller and Noulas (1997) and Ramlall (2009). If a bank operates in a risky environment in which it has a high-risk portfolio of loans, or if it lacks the proficiency to control for lending activities, it will devote higher reserves to cover this risk, resulting in a high LLP ratio. Increasing reserves to cover the risk will decrease profits and returns on the assets (Mustafa et al, 2019). Hence, the ratio is expected to have a negative relationship with the performance of the bank.

H_b: LLP has a negative impact on bank performance.

- **Capital Adequacy Ratio (CAR):** Finally, capital adequacy ratio is our last credit risk variable. Capital adequacy ratio is calculated as the capital divided by the risk-weighted assets (RWA). Capital represents the value of equity or the net worth of the bank to investors. It is divided into Tier 1 and Tier 2 as specified by Basel II and Basel III Accords. Tier 1 is the basic source of funding for the bank which consists of shareholders' equity and retained earnings while Tier 2 is the supplementary capital composed of unsecured debt and reserves as announced in the Basel Committee October 1998 press release "Instruments eligible for inclusion in Tier 1 capital" (BIS, 2004). Risk-weighted asset is a bank's assets or off-balance-sheet exposures, weighted according to risk. The risk weighting process takes into account the relative riskiness of various types of credit exposures that banks have and incorporates the effect of off-balance sheet contracts on credit risk. Different risk weights are assigned to several classes of assets, and the calculation of the weights is dependent on the type of approach the bank is using under Basel II Framework, whether it is the Standardized approach or the IRB approach. For example, the government debt is given a 0% risk weighting, therefore when calculating risk weighted assets, the government debt assets is multiplied by zero which in turn nullify its presence. Bhavani and Bhanumurthy (2012) used this ratio to determine the soundness of the banking system.

Equity is considered as a buffer since it absorbs all the losses in case of loan defaults. However, a bank with high risk portfolio must hold more buffer against it. Higher CAR indicates higher asset quality which in turn means lower credit risk for a bank and a better return on the assets.

H_c: CAR has a positive impact on bank performance.

3.6.2.2.Liquidity Risk

To answer Research Question 2, our second independent variable is Liquidity risk, which can be measured in many different ways including liquidity ratio, maturity mismatch, and cash capital position. In the existing literature, the effect of liquidity risk management on bank performance is mixed and has been proved in both negative and positive directions. Studies such as Molyneux and Thornton (1992) and Barth et al. (2003) show a positive relation between liquidity risk and performance. Yet many others support a negative relationship such as Bourke (1989) and Kosmidou (2008).

- **Financial Gap Ratio (FG):** Saunders and Cornett (2006) believe that the most efficient way to measure liquidity risk is by computing the financial gap, which is the difference between borrowed funds and liquid assets. This gap needs to be divided by total assets to standardize it, so that we get a ratio that is comparable between different banks of different sizes. The financing gap is compatible with the spirit of the Basel III's net stable funding ratio requirements as designated by Deyoung and Jang (2016). It is consistent with the requirement that banks should have enough stable funding to totally finance their illiquid assets. If banks lend out more loans with less liquid assets and collect fewer deposits, then they would be more exposed to liquidity risk. In theory, a high financing gap ratio would indicate that banks must fund it by using its cash and borrowed funds from the money market. Banks with higher liquidity risk tend to engage in higher risk by selecting more interest incomes to compensate for higher funding costs. This is expected to lower ROA and therefore we will assume that there is a negative effect of liquidity risk on bank performance, as stated by a recent study of Chen et al (2018). Then;

H_d: Financial gap has a negative impact on bank performance.

- **Liquid Assets to total Assets Ratio (LATA):** Another measure for liquidity risk is the ratio of liquid assets to total assets. Liquid assets are assets that can be easily converted into cash with little or no substantial loss of its value. They include cash, central bank reserves, and some marketable securities. The proportion of liquid assets to total assets designates the overall liquidity position of a bank and measures its ability to absorb liquidity shocks. Liquidity ratios have opposite opinions in literature when it comes to determining its effect on bank performance. In theory, the higher the liquid assets, the more

immune is the bank to liquidity crisis and run outs. This theory is supported by Ferrouhi (2014) where he finds a positive relation between liquidity ratio and return on assets. However, high liquidity ratio can also indicate that the bank is inefficiently holding too much assets which can be utilized in more profitable investments. This was shown by Molyneux and Thornton (1992) who proved a negative relation between the ratio of liquid assets to total assets and ROA. Hence, we develop the following hypothesis:

H_e: Liquidity ratio has a negative effect on bank performance.

3.6.2.3.Squared Variables

To control the presence of a non-linear relation between the main independent variables and the dependent variable in each model, quadratic term x^2 which is the square of each credit risk and liquidity risk factor is included in the regression. The purpose of this step is to capture if a risk factor affects performance in a non-linear way where a U-curve indicates which way the curve is bending. In other words, there are three cases that the X variable can impact the Y variable:

- If a credit or liquidity risk variable is significant but its square is non-significant, then the relationship is linear, and its sign is constant over time.
- If a credit or liquidity risk variable is positively significant but its square is negatively significant, then there is a non-linear polynomial relationship, having a U-shaped curve that is concave and facing downward. This implies that this independent variable will continue to impact the dependent variable positively up to the highest point of the curve, where every further increase in the same independent variable will start to decrease the dependent variable.
- If a credit or liquidity risk variable is negatively significant but its square is positively significant, then there is a non-linear polynomial relationship, having a U-shaped curve that is convex and facing upward. This implies that this independent variable will continue to impact the dependent variable negatively down to the lowest point of the curve, where every further increase in the same independent variable will start to increase the dependent variable.

3.6.2.4. Interactive Terms

In order to examine the joint impact of both credit risk management and liquidity risk management on the market and accounting performances of the bank (Research Question 3), we included interaction terms between the risk variables, one of every risk category. This method was used by Imbierowicz and Rauch (2014) by multiplying the proxy of credit risk with the proxy of liquidity risk. In our case there will be 4 interaction terms:

- NPLR*FG: the interaction between non-performing loan ratio and financial gap ratio
- LLPR*FG: the interaction between loan loss provision ratio and financial gap ratio
- NPLR*LATA: the interaction between non-performing loan ratio and liquid asset to total asset ratio.
- LLPR*LATA: the interaction between loan loss provision ratio and liquid asset to total asset ratio.

Therefore, four models will test for the possible effect of an interaction between credit and liquidity risk factors on the accounting performance of the bank, as measured by return on assets. Additional four models will test the effect of the same interactions on the market performance of the bank, as measured by the return on stock YTD.

3.6.2.5. Control Variables

Control variables are variables that are held constant in a model, and thus any change in them will invalidate the correlation between the independent variables and the dependent variables. Control variables provide a baseline for measurements in the model and reduce the effect of confounding variables. In this thesis, control variables are divided into two types: bank specific or internal factors and macroeconomic or external factors. Internal factors are those that management can control and that can be affected by management' actions, while external factors are the ones that management has no control over such as economic growth and interest rate level. According to Kosmidou, Tanna and Pasiouras (2005), although internal factors explain banks' profitability, external factors are needed since they contribute to profitability as well.

Bank Specific Factors

There are certain bank specific aspects that might affect profitability, such as operational risk or efficiency of management, size of banks, capital strength, and age (Staikouras & Wood, 2011; Kosmidou et al. 2005; Petria, Capraru and Ihnatov, 2015).

- **Operational Risk (OR)** defined as cost to income ratio: It is the likelihood of loss resulting from an interruption in business process. When losses and expenditures are managed by the bank through minimizing costs of operational losses, then future cash flows would be maximized which would increase bank performance (Froot, 2007). More specifically, he cost to income ratio is the ratio of non-interest (operating) costs excluding bad and doubtful debt to the net interest income plus non-interest income of the bank. Non-interest costs are perceived as those costs which are most amenable to management decisions and are considered to be part the costs which can be controlled. The use of the net interest income term in the denominator will reduce the volatility that could arise from fluctuations in the general level of interest rates (Correa and Raju, 2008). A reduction in costs will lead to increased profits, and increased profits will result in a higher ROA and an increase in the share price. Thus, this ratio is expected to have a negative impact on bank performance.
- **Size (SIZE):** The size of the bank is used as our second control variable. It is measured as the natural logarithm of bank's total assets similar to Chen et al (2018). Larger size may result in economies of scale, which could reduce the cost of gathering information, increasing their financial performance. Some studies identify economies of scale for large banks (Berger and Humphrey, 1997) while others reveal diseconomies for larger banks (Pasiouras and Kosmidou, 2007). However, the effect of a growing size for a bank could have a positive effect on performance, or a negative one due to bureaucracy (Chen et al, 2018). Therefore, the relation between size and bank performance might be non-linear. Hence, $Size^2$ is introduced as another control variable to capture the nonlinear relationship, which is defined as the square of the size of the bank (Iannotta et al, 2007).
- **Age (AGE),** defined as the number of years since the bank started incorporation. The older the bank, the more experienced it is, the more advanced the ability of its management, and consequently, the more performant it is.

Capital strength, as one of the aforementioned factors, is already included in the regression under capital adequacy ratio. Therefore, there is no need to control for capital strength of banks twice.

Macroeconomic Factors

Although Kosmidou, Tanna and Pasiouras (2005) found that internal factors are more explanatory in explaining bank performance, some macroeconomic variables are still significant in explaining their performance. Therefore, this thesis includes also some external factors which capture the effect of the macroeconomic environment on the whole system, given that our sample includes more than one country operating in a different environment.

- **Real GDP Growth Rate (GDP):** In line with Staikouras and Wood (2011) and Petria, Capraru and Ihnatov (2015), real GDP annual growth rate of the economy is used as a macroeconomic control variable. Real GDP is the measure of the pure growth of the total economic activities of the economy. Kosmidou et al. (2008) found that GDP affects performance positively since a high GDP indicates a higher growth which motivates banks to lend more and increase charges, thus enhancing the quality of the assets. Hence, it is expected that GDP growth rate will have a positive effect on performance.
- **Prime Lending Rate (LENDRATE):** In addition to real GDP growth rate, prime lending rate is our second macroeconomic control variable. It stands for the interest rate charged by commercial banks to their most creditworthy customers. It is often used as an underlying base index for almost all other interest rates including mortgages, personal loans and business loans. Prime rate is mainly set according to federal fund rates (or overnight rates). It is directly linked to interest rates, so when it increases, the demand for loans would decrease, because people are less willing to borrow at a higher rate. Therefore, it is expected that lending rates have a negative impact on performance.

It is noteworthy to mention that we included a dummy variable named ‘financial system’ to control for the different financial structure of the economies. Demirgüç-Kunt and Levine (1999) built an index for financial structure giving rise to a pair of categories: market-based and bank-based. The division reflects the reliance of the financing behavior on stock market or bank finance in an economy. A group of literature studied the effect of financial structure on economic growth and returns (Demirgüç- Kunt and Maksimovic, 2002; Schmukler and Vesperoni, 2004). Yet, Demirgüç-Kunt and Huizinga (2000) concluded that after introducing the type of financial structure of a bank, there is no significant change in banks’ returns or profit margins between the two types of systems.

All variables, their calculations and expected signs are summarized in Table 3.1 below. This serves as a better overall view on what to expect from the analysis of this thesis.

It must be noted that we use a 1-year lag for all variables, except Age and Lending Rate.

Table 3. 1: Summary of variables: definition and units of measurements.

	Variable		Description	Measurement
Dependent Variables	Accounting performance variable	ROA	Return on assets	Net income/ total assets
	Market performance variable	YTD	Return on stock	$100*(Ln p_t - Ln p_{t-1})$
Independent Variables	Credit risk Variables	NPLR	Non-performing loans	Non-performing loans / Total Loans
		NPLR²	Square of non-performing loans	$(\text{Non-performing loans} / \text{Total Loans})^2$
		LLPR	Loan loss provision	Loan loss provision / Total loans
		LLPR²	Square of the loan loss provision	$(\text{Loan loss provision} / \text{Total loans})^2$
		CAR	Capital adequacy ratio	$(\text{Tier 1} + \text{Tier 2}) / \text{Risk Weighted Assets}$
		CAR²	Square of capital adequacy ratio	$((\text{Tier 1} + \text{Tier 2}) / \text{Risk Weighted Assets})^2$
	Liquidity variables	FG	Financial Gap ratio	$(\text{Total loans} - \text{Total assets}) / \text{Total assets}$
		FG²	Square of financial gap ratio	$((\text{Total loans} - \text{Total assets}) / \text{Total assets})^2$
		LATA	Liquidity ratio	Liquid assets/ Total assets
		LATA²	Square of liquidity ratio	$(\text{Liquid assets} / \text{Total assets})^2$
Control Variables	Control Variables	Size	Firm size	Log of total assets
		Size²	Square of the size of the firm	$(\text{Log of total assets})^2$
		AGE	The age of the bank	Number of years since the firm started incorporation
		OR	Operational Risk	Non-interest expenses/ Net income
		GDP	Change in real GDP growth	$\Delta (\text{Real GDP})$
		LENDRATE	Prime lending rate	Interest rate charged by banks to customers with good credit
		BANKSYSTEM	Financial system structure	Dummy variable which takes 1 if bank-based, and 0 if market-based

3.7. Data and Sample

Data collection is an important character of statistical analysis. There are different practices in research to collect information, all of which fall into two classes: primary data and secondary data. (Trochim, 2006). Primary data is when the researcher collects for the first time all needed information through interviews, questionnaires, and experiments. On the other hand, secondary data is information already gathered by others for a certain purpose and is available in several sources like reports, journals, and websites. In this research, we will be using secondary data collected from financial reports of banks and a financial software (Thomson Reuters Eikon).

In an attempt to examine the various risks that influence bank performance, our research covers the area of the MENA region for a period extending from 2010 till 2018. We opt for this sample period to assess the impact of the management of financial risks on bank performance in the MENA region in the most recent years, assuming that a period of 8 years is a reasonable span to allow for changes in the risk profile of a bank.

More specifically, the study is conducted only on the commercial banks of the MENA region countries listed on their stock exchanges. We stick to the World Bank's records for MENA definition, which includes Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, UAE, West Bank and Ghaza, and Yemen.

In addition, we imposed the following conditions to be included in our sample:

- 1- Only commercial Banks will be selected, thus Islamic, development, investment and special purpose banks will be excluded to maintain homogeneity.
- 2- Only publicly listed banks on local stock exchanges of MENA countries will be selected in order to have full access to historical data for stock prices.
- 3- Only banks with a minimum of three consecutive available data will be selected

Due to economic and political disturbance in Syria and Ghaza, these two countries will be excluded from our sample. Political instability can highly increase inflation and decrease investments, which make it directly interconnected with the economy. Including them in our sample is not suitable since it would generate biased results. Therefore, to ensure the validity and credibility of the research, those two countries have to be removed.

Furthermore, Yemen and Djibouti have no stock exchanges and thus no listed banks. Algeria has a very small stock exchange and none of its banks are listed. Besides, Iran and Libya have no data

of listed banks on Thomson Reuters Eikon. Accordingly, ten countries of the MENA region will be excluded from the sample as shown in Table 3.2.

Table 3. 2: Countries excluded from our sample

Country	Reason of exclusion from the sample
Syria	Political issues and war
Ghaza	Political issues and war
Djibouti	No stock market
Yemen	No stock market
Algeria	No listed banks
Libya	No data on Thomson Reuters Eikon
Iran	No data on Thomson Reuters Eikon
Tunisia	Too many missing data
Morocco	Too many missing data
Iraq	Too many missing data

Therefore, and after applying the filters above, our sample is reduced to ten countries. After extracting the publicly listed banks in the stock exchanges of the concerned countries from Thomson Reuters Eikon, our sample is made of 51 banks as shown in Table 3.3

A detailed list of banks' names in each country is presented in the Appendix.

Table 3. 3: Number of publicly listed banks in countries of the MENA region

Country	Number of listed banks
Lebanon	5
Saudi Arabia	7
Kuwait	4
Malta	3
Qatar	2
United Arab Emirates	7
Oman	3
Jordan	9
Bahrain	4
Egypt	7
Total	51

3.8. Methodology

Now that all the variables have been explained and analyzed, the methodology used to test our research questions can be presented. In order to test the hypothesis with the dependent and independent variables presented in the previous section, regression is used to statistically prove any relationship between variables.

Regression is one of the most important models used by econometricians to evaluate the relationship between one variable and another or a set of other variables (Brooks, 2008).

The primary objective of the regression is to obtain estimators that find the best fitted line of the data. More specifically, taking a linear regression model of the form $y = \alpha + \beta x + \hat{\varepsilon}$, the estimators are α and β which are supposed to bring the line of regression close to all values.

The best way to achieve this purpose according to Brooks (2008) is through the Ordinary Least Square method (OLS). The main aim of this method is to decrease the distance between the data of the sample and the best fitted line, and thus minimize the sum square of errors ($\hat{\varepsilon} = y - \hat{y}$).

3.8.1. Properties of OLS

The OLS regression has certain assumptions to fulfill the requirements of being BLUE (Best Linear Unbiased Estimators):

- Linear: the model constitutes of linear parameters.
- Unbiased: the expected parameters are equal to the actual values.
- Efficient: the best unbiased estimators have the lowest variance.
- Consistent: the estimators indicate real values of the original parameters (Brooks, 2008).

3.8.2. Multiple Linear Regression Model

A multiple linear regression model is one that has one dependent variable and more than one independent variable, or in other words N number of regressors (Brooks, 2008). Since the aim of the study is to find the relationship between credit and liquidity risk management and the performance of banks, a multiple linear regression model is adopted using OLS method.

The panel regression equation will be written as follows:

$$Y_{it} = \alpha + \sum \beta_n X_{nit} + \varepsilon_{it}$$

Where:

Y_{it} – the dependent variable

X_{nit} - independent variables

α - the intercept

β_n - coefficients of the regressors

ε_{it} - the residuals

Subscript “i” represents cross-sectional unit $i = 1, 2, \dots, N$, while subscript “t” denotes time periods with $t = 1, 2, \dots, T$ (Baltagi, 2011).

The first research question will test if credit risk management positively affects profitability of MENA commercial banks. The second research question will test if liquidity risk management positively affects profitability of MENA commercial banks. The third research question will test if credit risk management combined with liquidity risk management affects profitability of MENA commercial banks.

The first and second equations test the impact of credit risk on bank’s accounting performance (Equation 1) and bank’s market performance (Equation 2), while controlling for bank specific and macroeconomic factors (Research Question 1). All variables of the models are previously defined and explained in section 3.6.

Equation one includes the aforementioned credit risk variables with the control variables to find their impact on the accounting performance measured by ROA of each publicly listed bank in the MENA region.

Equation 1:

$$ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLLPR + \beta_5 LLLPR^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation two presents the same variables of credit risk with a different dependent variable (YTD) which reflects the market performance of banks in the MENA region.

Equation 2:

$$YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLLPR + \beta_5 LLLPR^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation three and Equation four account for the effect of liquidity risk on bank’s accounting performance and market performance respectively using the previously defined liquidity risk variable (Research Question 2).

Equation 3:

$$ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LFG + \beta_3 LFG^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 4:

$$YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LFG + \beta_3 LFG^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

The last equations are the combinations of both credit risk and liquidity risk to test for their combined effect on the accounting performance (Equations 5.A, 5.B, 5.C, and 5.D) and market performance of the bank (Equation 6.A, 6.B, 6.C, 6.D), and how can they have a possible new effect when they are jointly tested (Research Question 3).

Equation 5.A:

$$ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LNPLR * LFG + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 5.B:

$$\beta_0 + \beta_1 LROA + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LLLPR * LFG + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 5.C:

$$ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LNPLR * LLATA + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 5.D:

$$ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LLLPR * LLATA + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 6.A:

$$YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LNPLR * LFG + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 6.B

$$YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LLLPR * LFG + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 6.C:

$$YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LNPLR * LLATA + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

Equation 6.D:

$$YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LLLPR * LLATA + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$$

3.8.3. Multiple Linear Regression Assumptions

Five assumptions need to be tested to maintain validity of outcomes from the regression analysis through identifying multicollinearity, normality, heteroscedasticity, autocorrelation, and stationarity (Hair et al, 2006). These assumptions need to be respected to ensure a well-defined model and unbiased results. It is worthy to mention that heteroscedasticity and normality tests are performed post-regression.

3.8.3.1. Presence of Stationarity

Stationarity means that the statistical features of a process generating time series do not change overtime. A time series is considered having stationarity if a movement in time does not change the shape of the distribution. Stationarity verifies the property that the mean, variance and autocorrelation are constant overtime. Most forecasting procedures are based on the assumption that a non-stationary time series can be transformed to be stationary, through using mathematical

transformations or a process called differencing (Priestley and Rao, 1969). There are many ways to test for stationarity including the unit root tests (ex: Augmented Dickey-Fuller (ADF) test) and Kwiatkowski–Phillips–Schmidt–Shin test (KPSS) test. In this thesis, we will be testing for the presence of stationarity using the Augmented Dickey-Fuller test. This test’s null hypothesis is the presence of unit root (i.e. non-stationary) thus, H_0 should be rejected in order to be able to proceed.

3.8.3.2. Absence of Multicollinearity

Multicollinearity exists when two or more independent variables are strongly associated with each other. According to Gloede et al (2013), in case of multicollinearity, it will be very confusing to specify the effect of any single variable on the dependent variable due to their interrelationship. Thus, when independent variables are multi-collinear, there will be an overlap in the predicted power. Multicollinearity is a utilization method to identify the presence of unstable relationship between the independent variables (Mullner et al, 1998). If it is present in the data, the statistical inferences may not be reliable.

Multicollinearity between the explanatory variables (i.e. independent and control variables) will be tested pre-regression using the Pearson correlation matrix. Any correlation coefficient with an absolute value below 0.8 signals no collinearity problem (Brooks, 2008).

3.8.3.3. Absence of Autocorrelation or Serial correlation

Autocorrelation is a representation of whether the sample data set is created from a random procedure over successive time intervals. It exists where the residuals are not independent. It is commonly tested by Durbin-Watson statistical test. Durbin-Watson value is always between 0 and 4. A value of 2 shows no autocorrelation in the tested sample. A value between 0 and 2 reveals positive autocorrelation while a value between 2 and 4 reflects a negative autocorrelation (White, 1992). However, correlation in a linear panel data model biases the errors and affects the results. Therefore, an attractive method proposed by Wooldridge (2002) will be used to test for serial autocorrelation in the panel data model which is easy to implement and requires relatively fewer assumptions (Drukker, 2003). The null hypothesis H_0 is the absence of serial correlation, while H_1 is the presence of serial correlation.

3.8.3.4. Absence of Heteroscedasticity

Heteroscedasticity is when the variance of residuals (error term) is not constant across all values of the independent variables. In order to satisfy the OLS regression assumptions of being unbiased, the residuals must have a constant variance and should be identically distributed (homoscedastic). Violations of this assumptions lead to heteroscedasticity and may result in the estimators no longer being the Best Linear Unbiased Estimators (BLUE). Several tests can be used to test for heteroscedasticity including White, Breusch-Pagan test and F-test. However, in the case of panel data and fixed effect, Modified Wald test is used to verify this assumption, where the null hypothesis is that residuals are homoscedastic. This test runs the squared error terms from the regression against the independent and control variables. In case of OLS regression models, Breusch-Pagan / Cook-Weisberg test is used. The null hypothesis is rejected if p-value is less than 0.05 implying the presence of heteroscedasticity. Under this case, the regression should be run with robust standard errors to correct for this violation (Garson, 2012).

3.8.3.5. Normality

Normality of variables is conducted to determine whether the data set has a normal distribution for further statistical tests. This normality test is applied through D'Agostino-Pearson normality test which examines the values of kurtosis and skewness. Kurtosis is the sharpness of the peak of the distribution curve, while skewness is the measure of asymmetry of the probability of distribution about the mean of a real-valued random variable. The data is normally distributed when skewness is around 0 and kurtosis is around 3 (Klein, 1998). Furthermore, following the standard assumption of linear regression, the residuals should be independent and normally distributed. Hence, normality of residuals will be tested as well using Shapiro Wilk Test.

3.8.4. Choice of Model

Since this study uses variables across many years in time, the methodology proposed in this study suggests using a panel data, where it is a multidimensional data including measurements over a period of time. It is composed of observations of multiple occurrences extracted over multiple time series for the same companies or people. “Also, by combining time series of cross-section observation, panel data provides more informative data, more variability, less co-linearity among the variables, and more degree of freedom and efficiency” (Gujarati and Sangeetha, 2007).

There will be three panel data methods used: pooled regression, fixed effect and random effect.

Pooled regression has a major downside since it does not distinguish between the various banks thus denying the heterogeneity that may and should exist among them. Thus, Forssbäck (2015) mentioned that there are two different types of models that allow for cross-sectional heterogeneity: random effects model and fixed effects model. These two models have been used widely in social researches when observations are assumed to be grouped. Grouping can cause unobserved heterogeneity where the distribution of the outcome can change for unobserved causes. When modeling this kind of data, researchers face a problem with the way they shall account for this cluster effect (Setodji and Shwartz, 2013).

A fixed effect model is a regression model where the model parameters are fixed or non-random numbers. The fixed effects model assumes that the unobserved variables can have any association with observed variables, while the random effects model expects that the unobserved variables are statistically independent of the observed variables. In other words, we assume under the fixed-effect model that the true effect size of all studies is the same, and the only cause that can vary the effect size is the sampling error. On the other hand, under the random effect model we aim to reach for the mean of distribution of effects rather than a one true effect (Borenstein et al, 2011).

Hausman test is used to help a researcher decide between fixed effects model or random effects model (Hausman, 1978). The null hypothesis would be that the model is random effect model, while the alternate hypothesis would be that the model is fixed effect and the endogenous regressors' influence on the estimates is meaningful. When performing the Hausman test, the Hausman statistic is compared to the critical value from its sample distribution. A P-value of Hausman- Test which is greater than the critical value suggests rejecting the null hypothesis and concluding that the fixed-effects model shall be used. Otherwise, the random-effects model will be used.

3.9. Conclusion

In brief, our research questions will be answered with a positivist philosophical perspective since it depends on empirical observations to produce valid conclusions. It will also follow the deductive reasoning approach where it will start by mentioning the general risks of banks and narrow them down into credit and liquidity risks that are presented in clear hypotheses. Besides, an archival research strategy will be used since preceding data of banks in the MENA region will be acquired from archives to be studied and analyzed accordingly. Furthermore, objectivity is maintained by

the use of quantitative techniques in the statistical measures and mathematical models. To detect the effect of the risks studied, three proxies are used to measure the impact of credit risk and two proxies for liquidity risk, then both risk proxies are combined in regression models with interaction terms to measure the impact on a bank's performances (market and accounting performances). The financial data needed to calculate the variables and proxies are obtained from Thomson Reuters Eikon. Besides, statistical tests are applied to test for the conditions of multiple linear regression model. With respect to testing the significance of the results, it is applied on our data sample that consists of 51 banks of the MENA region, which are publicly listed in each country's stock exchange market.

Chapter 4: Results

4.1. Introduction

This chapter presents the empirical results of our research study. The second section shows the descriptive statistics of the explanatory variables. Section three exposes the diagnostic tests of classical linear regression assumptions which guide the regression model selection (fixed effect versus random effect). While stationarity, multicollinearity, serial correlation are tested pre-regression, heteroscedasticity, cross-sectional dependence and normality of residuals are tested post-regression. Subsequently, the empirical results are reported in section four and discussed in section five with their relevance to the research hypothesis. Section six concludes.

4.2. Descriptive Statistics

This section presents the descriptive statistics of the data set. Descriptive statistics help understand and describe the characteristics of a given information through providing summaries about the tested sample and data measures. They are considered the basis of a simple quantitative data analysis and definitions of variables. Additionally, descriptive statistics extend a modest summary of large data collections for the purpose of making conclusions about the distributions.

Descriptive statistics are broken into three measures (Trochim, 2008): (i) distribution or frequency of each variable; (ii) central tendency measures such as the mean, median, and mode, and (iii) dispersion measures such as standard deviation or variance, minimum, and maximum variables.

Table 4.1 represents the descriptive statistics of the whole sample for the period 2010 till 2018.

The dependent variable for the accounting performance (ROA) has a mean of 1.44% with a minimum of -9.51% and maximum of 5.42%. A number of banks had a negative net income in few of the sample years which resulted in negative returns on assets. The return on the stock (YTD) has a mean of 7.24% and a high standard deviation of 28.31, reflecting different banks' size that are operating in different countries as well as the fact that return on stocks is highly volatile.

Table 4. 1: Summary of Descriptive Statistics

	MEAN	STD DEV	MIN	MAX	P-value (SKEWNESS)	P-value (KURTOSIS)	Joint P- value
Return On Assets (ROA) (%)	1.44	1.11	-9.51	5.42	0.000	0.000	0.000
Return on stock (YTD) (%)	7.237	28.31	-70.26	186.1	0.000	0.000	0.000
Lagged return on assets (LROA) (%)	1.46	1	-2.94	5.42	0.911	0.000	0.000
Lagged return on stock (LYTD) (%)	7.922	29.11	-70.26	186.1	0.000	0.000	0.000
Lagged non-performing loan ratio (LNPLR) (%)	3.75	4.6	0.022	47.5	0.000	0.000	0.000
Lagged loan loss provision ratio (LLPR) (%)	0.52	0.61	-0.56	7.42	0.000	0.000	0.000
Lagged financial gap ratio (LFG) (decimal)	0.27	0.332	-0.86	0.86	0.0002	0.2486	0.0013
Lagged liquid assets to total assets ratio (LLATA) (%)	36.4	13.1	5.53	72.75	0.000	0.6178	0.0002
Lagged capital adequacy ratio (LCAR) (%)	17.43	4.51	9.79	36.28	0.000	0.000	0.000
Lagged size of the bank (LSIZE)	10.42	1.166	8.84	13.82	0.000	0.0001	0.000
Lagged square of the size (LSIZE²)	110.10	26.18	78.2	191.11	0.000	0.000	0.000
Lagged lending rate (LENDRATE) (%)	6.52	3.11	0.7	13.6	0.9782	0.5872	0.8626
Lagged operational risk (LOR) (decimals)	1.62	4.17	-22.47	58.35	0.000	0.000	0.000
Lagged change in growth domestic product (LGDP) (%)	6.84	8.83	-25.51	36.06	0.0153	0.000	0.000
Age of the bank (AGE) (years)	43.55	27.26	3	153	0.000	0.000	0.000

The lagged non-performing loans ratio has a mean of 3.75%, ranging between a minimum of 0.022% and a maximum of 47.57%. The lagged loan loss provision ratio varies between a minimum of -0.56% and a maximum of 7.42%. Negative ratios are due to the negative provisions where estimates of the allowances are low. The lagged capital adequacy ratio has a mean of 17.43% with a minimum CAR is 9.79% and a maximum of 36.28%, well above the minimum ratio of capital to risk weighted assets under Basel III requirements (which is 8%). The lagged financial gap has a mean of 0.27. The minimum is -0.86 where the negative sign is due to having more deposits than loans. However, the maximum is +0.86 which indicates that banks have more loans

than deposits. The lagged liquid assets to total assets ratio has a minimum value of 5.53% and a maximum of 72.75%. The lagged operational risk has a minimum ratio of -22.47 and a maximum of 58.35. The negative sign is due to the negative net income for some banks in few years of the sample.

With respect to age, the standard deviation is equal to 27.26, which is due to having in our sample newly incorporated banks (minimum age 3 years) and ancient banks (maximum age 153 years). The lag of the size of the bank also varies depending on the total assets of each bank, where size has a minimum of 8.84 and maximum of 13.82. Lagged GDP growth has a minimum of -25.51% and maximum of 36.06% while lending rate has a minimum of 0.7% and a maximum of 13.6%. Furthermore, normality test is essential to check the distribution of the variables. In this matter, our main concern is to check the symmetry of distribution (skewness) and peakedness of distribution (kurtosis). As shown in Table 4.1, all the variables (except lending rate) have a problem of non-normality where their joint p-values are less than 5%, therefore rejecting H_0 indicating that no normal distribution.

There are different methods to deal with non-normal data and handle the issue of spurious outliers in the distribution of data such as winsorization and trimming. In contrast to the method of trimming which simply excludes the extreme values, winsorizing converts the extreme values to the value of the highest data which is not considered to be an outlier. Similarly, the outliers at the lowest end of the distribution would be replaced by the lowest values that are not outliers. Winsorization has an advantage of giving robustness to the statistical data and protecting it from harmful outliers while maintaining the highest or lowest values of information (Dixon and Yuen, 1974). Based on this logic, our variables were winsorized at 1% cuts to remove the outliers from the data that could harm the outcome of the regression.

4.3. Diagnostic Tests

Diagnostic tests comprise a series of statistical tests that are performed for the main purpose of maintaining validity of the regression analysis and achieving unbiased results. These tests aim at satisfying the classical linear regression assumptions discussed previously in Section 3.8.3, through a process of identifying and correcting the model of any possible problem that may arise. The common assumptions are stationarity, multicollinearity, serial correlation, heteroscedasticity, cross-sectional dependence and normality of residuals (Hair et al, 2006). The tests are presented

in the below section and discussed thoroughly. While the first three assumptions are tested pre-regression, the last three assumptions are tested after the regression model is chosen.

4.3.1. Stationarity: Augmented Dickey-Fuller unit root test

Stationarity, in the most intuitive sense, means that the statistical features of a process generating time series remain constant over time. Section 3.8.3.1 discusses the concept of stationarity and the method of testing it. Using Fisher type unit root tested based on Augmented Dickey-Fuller tests (ADF), results are presented in Table 4.2.

Table 4. 2: Fisher-type unit-root test, Based on augmented Dickey-Fuller tests

Variable	Inverse chi-squared P-value (lag 0)	Inverse chi-squared P-value (lag 1)	Inverse chi-squared P-value (lag 2)
ROA	0.0001***	-	-
YTD	0.0000***	-	-
NPLR	0.0005***	-	-
LLPR	0.0000***	-	-
LATA	0.0000***	-	-
CAR	0.0187**	-	-
FG	0.0000***	-	-
SIZE	0.0000***	-	-
SIZE2	0.0000***	-	-
AGE	1	1	1
Operational risk	0.0000***	-	-
GDP	0.0000***	-	-
LENDRATE	0.7319	0.7037	0.0000***

Note: H_0 =All panels contain unit roots and H_1 =At least one panel is stationary
 *** denotes significance at the 1%,

The results show that all variables, except the lending rate, have a p-value less than 5%, which is statistically significant, therefore we reject H_0 and accept H_1 which stipulates that at least one panel is stationary. The stationarity presence allows us to proceed with the regression. However, the prime lending rate has a p-value of 0.7319 which is higher than 0.05, therefore the null hypothesis that all panel contain unit roots is not rejected. Based on this result, we lag the time-series on the first level and still get a p-value of 0.7037. The second lag gives a p-value of 0.00, which implies that stationarity exists for lending rate at the second level difference.

However, it is important to mention that all other variables were lagged to a one-year period (except age of the bank) to capture the impact of the risk management techniques of the last year on the performance of the bank in the current year. Many previous studies considered that it is more efficient to test the effect of the risk factors of the preceding year on the current performance of banks. Athanasoglou, et al. (2006) and Godfrey et al (2017) consider that any positive improvement in risk management will appear in the performance of the next year. Others believe that lags would instrument the endogenous variables and remove any possible order autocorrelation from predetermined variables (Tan, 2015). Therefore, ROA, YTD, NPLR, LLPR, CAR, SIZE, SIZE², OR, and GDPG are lagged to a one-year period despite their stationarity at level zero for the purpose of regression improvement. Lending rate is lagged to a two-year period to ensure its stationarity, while age does not need to be changed.

4.3.2. Multicollinearity

Table 4.3 presents the Pearson-correlation coefficients between all the independent variables and control variables of our regression model.

Table 4. 3: Pearson-Correlation Coefficients

	LROA	LYTD	LNPLR	LLLPR	LCAR	LFG	LLATA	LSIZE	LSIZE ²	AGE	LLENDRA TE	LOR	LGDPG	LNPLR ²	LLLPR ²	LCAR ²
LROA	1															
LYTD	0.3047	1														
LNPLR	-0.243	0.054	1													
LLLPR	-0.257	-0.045	0.3568	1												
LCAR	0.3973	0.0071	-0.0357	-0.0235	1											
LFG	0.1668	-0.061	-0.1668	0.1265	0.1366	1										
LLATA	-0.109	0.0441	0.065	-0.2009	-0.085	-0.7646	1									
LSIZE	0.1258	0.0408	-0.1882	-0.1204	-0.1344	-0.3568	0.2421	1								
LSIZE ²	0.1012	0.0308	-0.1819	-0.1244	-0.1409	-0.3824	0.2592	0.9978	1							
AGE	-0.071	0.0162	0.1883	-0.019	-0.1319	0.0183	0.1414	0.1313	0.1309	1						
LLENDRA ATE	-0.008	0.1564	0.3491	0.1164	-0.124	-0.5243	0.4098	-0.091	-0.0725	-0.1086	1					
LOR	-0.195	-0.132	0.0759	-0.0994	-0.0944	-0.0074	0.0461	-0.1249	-0.1128	0.1154	0.1253	1				
LGDPG	0.188	0.1885	0.2023	-0.0531	0.0499	-0.1937	0.2041	-0.1253	-0.1327	-0.0416	0.4411	0.0008	1			
LNPLR ²	-0.191	0.0525	0.8759	0.1679	-0.0897	-0.1513	0.0464	-0.0923	-0.0923	0.2005	0.2213	-0.0175	0.1928	1		
LLLPR ²	-0.324	-0.1065	0.2207	0.8999	-0.0377	0.1443	-0.1805	-0.0791	-0.0826	-0.0495	0.0368	-0.1173	-0.1056	0.0955	1	
LCAR ²	0.368	0.0125	-0.0069	-0.019	0.9846	0.1046	-0.0612	-0.14	-0.1445	-0.1095	-0.0876	-0.0891	0.043	-0.0622	-0.036	1
LFG ²	0.1851	-0.0224	-0.1676	0.1035	0.1752	0.8043	-0.5202	-0.0935	-0.1084	0.1326	-0.4149	-0.0462	-0.1969	-0.1387	0.1507	0.158
LLATA ²	-0.093	0.0339	0.0498	-0.1796	-0.0464	-0.7569	0.982	0.2679	0.2866	0.135	0.3959	0.026	0.1782	0.031	-0.158	-0.0232
BANKIN GSYS TE M	0.1455	0.149	0.2358	0.213	0.1197	-0.3672	0.234	0.3859	0.3834	-0.1151	0.4717	-0.1283	0.1671	0.1827	0.1572	0.162

The presence of multicollinearity in a regression can be of two types: structural multicollinearity and data multicollinearity. The former is normal, and it usually does not affect the regression results severely. It occurs when we create a model term using other terms. It is not existent in the nature of the data itself but rather a byproduct in the specification of our model. In our case, there is a structural multicollinearity between some of the variables and their squares, since when we square the variable to model the curvature, there will exist a correlation between these two variables. Therefore, structural multicollinearity exists between Lsize and Lsize² (0.9978), Lcar and Lcar² (0.9846), Lnplr and Lnplr² (0.8759), Lllpr and Lllpr² (0.8999), Lfg and Lfg² (0.8043) and Llata and lata²(0.9820).

Data multicollinearity exists in the data itself and is not a remainder from the model construction, which occurs when creating a new variable from an original variable. This means that the data suffers from a high linear correlation between the predictor variables which can lead to distorted results in the regression models. Consequently, a correlation coefficient higher than 0.8 indicates the presence of multicollinearity; hence, highly correlated variables must not be included together in the same model, as per Gujarati and Sangeetha (2007).

Results in Table 4.3 show that the correlation among the variables is relatively low (being less than 0.8), suggesting no multicollinearity problem. Consistent with Ibrahim et al. (2011), these correlation coefficients will have no impact on subsequent empirical analysis.

4.3.3. Serial Autocorrelation Test:

Serial autocorrelation test is used to answer the question of whether or not the given data set is created from a random procedure. Serial autocorrelation also known as autocorrelation can exist when the residuals are not independent, and it is tested using Wooldridge test as explained in Section 3.8.3.3.

Table 4. 4: Wooldridge test for autocorrelation in panel data

Model	Dependent variable	Independent variables	P-value	Result
1	ROA	LROA, LNPLR, LLLPR, LCAR, LNPLR ² , LLLPR ² , LCAR ² , LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
2	YTD	LYTD, LNPLR, LLLPR, LCAR, LNPLR ² , LLLPR ² , LCAR ² , LSIZE,	0.0000***	we reject H ₀ => There is first order autocorrelation

		LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM		
3	ROA	LROA, LFG, LLATA, LCAR, LFG ² , LLATA ² , LCAR ² , LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000*	we reject H ₀ => There is first order autocorrelation
4	YTD	LYTD, LFG, LLATA, LCAR, LFG ² , LLATA ² , LCAR ² , LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
5.A	ROA	LROA, LFG, LNPLR, LCAR, LFG ² , LNPLR ² , LNPLR*LFG, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
5.B	ROA	LROA, LFG, LLLPR, LCAR, LFG ² , LLLPR ² , LLLPR*LFG, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0001***	we reject H ₀ => There is first order autocorrelation
5.C	ROA	LROA, LLATA, LNPLR, LCAR, LLATA ² , LNPLR ² , LNPLR*LLATA, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
5.D	ROA	LROA, LLATA, LLLPR, LCAR, LLATA ² , LLLPR ² , LLLPR*LLATA, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0002***	we reject H ₀ => There is first order autocorrelation
6.A	YTD	LYTD, LFG, LNPLR, LCAR, LFG ² , LNPLR ² , LNPLR*LFG, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
6.B	YTD	LYTD, LFG, LLLPR, LCAR, LFG ² , LLLPR ² , LLLPR*LFG, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
6.C	YTD	LYTD, LLATA, LNPLR, LCAR, LLATA ² , LNPLR ² , LNPLR*LLATA, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation
6.D	YTD	LYTD, LLATA, LLLPR, LCAR, LLATA ² , LLLPR ² , LLLPR*LLATA, LSIZE, LSIZE ² , LOR, LLENDRATE, LGDPG, AGE, BANKINGSYSTEM	0.0000***	we reject H ₀ => There is first order autocorrelation

Note: H₀: no first order autocorrelation.

***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

The results of Table 4.4 show that the null hypothesis of no autocorrelation is rejected for all models since the p-values are 0.0000. Hence, there exists autocorrelation between variables of credit and liquidity risk and the performance indicators in the commercial banks of the MENA region.

Although the results are violating the classical linear regression model assumptions, this issue will be dealt with later on in the regression model. Furthermore, it is important to mention that the serial correlation is considered a problem for panel data with time dimension spanning for 20 years or more (Brooks, 2008), which is not our case given a time span of only 8 years (2010-2018).

For the remainder of the assumptions, they will be tested post-regressions, especially that the errors terms are needed to be able run these tests. Thus, the next step is to choose the regression estimator model.

4.3.4. Choice of the Model

This subsection determines the type of the regression model that will be used to study the impact of credit risk management and liquidity risk management on ROA and YTD, while controlling for bank specific variables and macroeconomic variables. First, we apply Hausman test in order to choose between fixed effect and random effect models. The principal of Hausman test is discussed in Section 3.8.4 with the null hypothesis that the random effect is the best approach.

Results presented in Table 4.5 show that Models 2, 3, 4, 5.A, 5.C, 6.A, and 6.C should be estimated using the fixed effect because the p-values are less than 0.05, leading to the rejection of the null hypothesis. However, Models 1, 5.B, 5.D, 6.B, and 6.D have a p-value greater than 5%, therefore accepting H_0 and suggesting that random effect model is chosen. To decide between random effect model and OLS regression, we perform Breusch and Pagan Lagrangian multiplier test. The p-value of 1 indicates that OLS is the chosen model.

Table 4. 5: Hausman test for the choice of model

Model	P-value	Result
Model 1: $ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLLPR + \beta_5 LLLPR^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$	0.4851	>5% therefore we accept H_0 ⇒ Fixed effect model is REJECTED
	(Breusch and Pagan Lagrangian multiplier test for random effects) Random effect test: P-value=1	>5% therefore the chosen model is OLS regression

<p>Model 2: $YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLLPR + \beta_5 LLLPR^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	0.0152**	<p><5% therefore we reject H_0 (significant at 5% and 10% confidence levels) \Rightarrow Fixed effect model is chosen</p>
<p>Model 3: $ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LFG + \beta_3 LFG^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	0.0000***	<p><1% therefore we reject H_0 (significant at 1%, 5%, and 10% confidence levels) \Rightarrow Fixed effect model is chosen</p>
<p>Model 4: $YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LFG + \beta_3 LFG^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	0.0086***	<p><1% therefore we reject H_0 (significant at 1%, 5%, and 10% confidence levels) \Rightarrow Fixed effect model is chosen</p>
<p>Model 5.A : $ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LNPLR * LFG + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	0.0000***	<p><1% therefore we reject H_0 (significant at 1%, 5%, and 10% confidence levels) Fixed effect model is chosen</p>
<p>Model 5.B : $ROA_{it} = \beta_0 + \beta_1 LROA + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LL$</p>	0.4871	<p>>5% therefore we accept H_0 Fixed effect model is REJECTED</p>
	(Breusch and Pagan Lagrangian multiplier	>5% therefore the chosen model is OLS regression

$\beta_8LOR + \beta_9LSIZE + \beta_{10}LSIZE^2 + \beta_{11}BANKAGE + \beta_{12}LGDPG + \beta_{13}LLENDINGRATE + \beta_{14}BANKINGSYSTEM + \varepsilon_{it}$	test for random effects) Random effect test: P-value=1	
Model 5.C : $ROA_{it} = \beta_0 + \beta_1LROA + \beta_2LNPLR + \beta_3LNPLR^2 + \beta_4LLATA + \beta_5LLATA^2 + \beta_6LCAR + \beta_7LNPLR * LLATA + \beta_8LOR + \beta_9LSIZE + \beta_{10}LSIZE^2 + \beta_{11}BANKAGE + \beta_{12}LGDPG + \beta_{13}LLENDINGRATE + \beta_{14}BANKINGSYSTEM + \varepsilon_{it}$	0.000***	<1% therefore we reject H ₀ (significant at 1%, 5%, and 10% confidence levels) Fixed effect model is chosen
Model 5.D : $ROA_{it} = \beta_0 + \beta_1LROA + \beta_2LLLPR + \beta_3LLLPR^2 + \beta_4LLATA + \beta_5LLATA^2 + \beta_6LCAR + \beta_7LLLPR * LLATA + \beta_8LOR + \beta_9LSIZE + \beta_{10}LSIZE^2 + \beta_{11}BANKAGE + \beta_{12}LGDPG + \beta_{13}LLENDINGRATE + \beta_{14}BANKINGSYSTEM + \varepsilon_{it}$	0.5731	>5% therefore we accept H ₀ Fixed effect model is REJECTED
Model 6.A: $YTD_{it} = \beta_0 + \beta_1LYTD + \beta_2LNPLR + \beta_3LNPLR^2 + \beta_4LFG + \beta_5LFG^2 + \beta_6LCAR + \beta_7LNPLR * LFG + \beta_8LOR + \beta_9LSIZE + \beta_{10}LSIZE^2 + \beta_{11}BANKAGE + \beta_{12}LGDPG + \beta_{13}LLENDINGRATE + \beta_{14}BANKINGSYSTEM + \varepsilon_{it}$	0.0000***	<1% therefore we reject H ₀ (significant at 1%, 5%, and 10% confidence levels)
	0.4401	>5% therefore we accept H ₀ Fixed effect model is REJECTED

<p>Model 6.B: $YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LFG + \beta_5 LFG^2 + \beta_6 LCAR + \beta_7 LLLPR * LFG + \beta_8 LOR + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	<p>(Breusch and Pagan Lagrangian multiplier test for random effects) Random effect test: P-value=1</p>	<p>>5% therefore the chosen model is OLS regression</p>
<p>Model 6.C: $YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LNPLR * LLATA + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	<p>0.0000***</p>	<p><1% therefore we reject H₀ (significant at 1%, 5%, and 10% confidence levels)</p>
<p>Model 6.D: $YTD_{it} = \beta_0 + \beta_1 LYTD + \beta_2 LLLPR + \beta_3 LLLPR^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LLLPR * LLATA + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it}$</p>	<p>0.5913 (Breusch and Pagan Lagrangian multiplier test for random effects) Random effect test: P-value=1</p>	<p>>5% therefore we accept H₀ Fixed effect model is REJECTED >5% therefore the chosen model is OLS regression</p>

Note: H₀: difference in coefficients not systematic (random effect)

***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

4.3.5. Heteroscedasticity Test

After deciding on the models, the next step is to test Heteroscedasticity to make sure that the residuals of the regression have a constant variance across the values of the independent variables, or in other words homoscedastic. Heteroscedasticity is tested using Modified Wald test for fixed-effect model regressions and using Breusch-Pagan / Cook-Weisberg test for OLS regression models. With a null hypothesis having homoscedastic residuals, rejecting the hypothesis suggests the presence of heteroscedasticity. The significance of this test is already defined in Section 3.8.3.4 and results are presented in Table 4.6.

Table 4. 6: Heteroscedasticity tests

Model	Test	P-value	Result
Model 1	Breusch-Pagan/ Cook-Weisberg test	0.0175**	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 2	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 3	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 4	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 5.A	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 5.B	Breusch-Pagan/ Cook-Weisberg test	0.0001***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 5.C	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 5.D	Breusch-Pagan/ Cook-Weisberg test	0.0001***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 6.A	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 6.B	Breusch-Pagan/ Cook-Weisberg test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 6.C	Modified Wald test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity
Model 6.D	Breusch-Pagan/ Cook-Weisberg test	0.0000***	We reject $H_0 \Rightarrow$ There exists heteroscedasticity

Note: For fixed effect models, Modified Wald test for groupwise heteroskedasticity was used with $H_0: \sigma(i)^2 = \sigma^2$ for all i . For OLS models, Breusch-Pagan/ Cook-Weisberg test for heteroskedasticity was used with H_0 : variables have constant variances, $V(\varepsilon_j) = \sigma^2$ for all j

***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

The results show that all models have a p-value of 0.000, rejecting H_0 , indicating the presence of heteroscedasticity. For fixed effect models (Models 2, 3, 4, 5.A, 5.C, 6.A, and 6.C), this problem should be corrected by using Driscoll-Kraay standard errors or by using robust standard errors. The choice depends on whether there is a cross sectional dependence. Thus, Pesaran test is used to test whether the residuals are correlated across entities. The null hypothesis is that residuals are not cross sectional dependent. The existence of cross-sectional dependence suggests the use of Driscoll-Kraay standard errors that correct for heteroscedasticity, serial correlation and cross-sectional dependence as suggested by Hoechle (2007), using the command of Xtscc in Stata. The absence of cross-sectional dependence suggests the use of robust standard errors. For OLS regression (Models 1, 5.B, 5.D, 6.B, and 6.D), heteroscedasticity problem will be corrected by using robust standard errors.

4.3.6. Cross-sectional dependence

Cross-sectional dependence is a diagnostic tool for panel-data analysis that investigates the presence of a pairwise correlation coefficient of the residuals of each individual unit. In this context,

the Pesaran test is used to test for cross-sectional dependence of Models 2, 4, 5.A, 5.C, 6.A. and 6.C we use.

Table 4.7 presents the results of this test indicating a strong cross-sectional dependence for models 2, 4, 6.A, and 6.C. Thus, these models will be run using Driscoll-Kraay standard errors (Xtscc command for Stata). Models 3, 5.A and 5.C will be run using robust standard errors.

Table 4. 7: Pesaran test for weak cross-sectional dependence

Model	p-value	Result
2	0.000***	We reject $H_0 \Rightarrow$ there is a strong cross-sectional dependence
3	0.743	We don't reject $H_0 \Rightarrow$ There is no cross-sectional dependence
4	0.000***	We reject $H_0 \Rightarrow$ there is a strong cross-sectional dependence
5.A	0.872	We don't reject $H_0 \Rightarrow$ There is no cross-sectional dependence
5.C	0.739	We don't reject $H_0 \Rightarrow$ There is no cross-sectional dependence
6.A	0.000***	We reject $H_0 \Rightarrow$ there is a strong cross-sectional dependence
6.C	0.000***	We reject $H_0 \Rightarrow$ there is a strong cross-sectional dependence

Note: H_0 : errors are weakly cross-sectional dependent.

***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

Table 4.8 below summarizes the regression used for each Model, based on the results of the above tests.

Table 4. 8: Summary of the regression used for each of our models

Model	Final Regression	Problems	Correction	Stata command
Model 1	OLS model	- Heteroskedasticity - Serial autocorrelation	Robust	Reg (variables), robust
Model 2	Fixed effect model	- Heteroskedasticity - Serial autocorrelation - Cross-sectional dependence	Regression with Driscoll-Kraay standard errors	Xtscc (variables), fe
Model 3	Fixed effect model	- Heteroskedasticity - Serial autocorrelation	Robust	Xtreg (variables), fe robust
Model 4	Fixed effect model	- Heteroskedasticity - Serial autocorrelation - Cross-sectional dependence	Regression with Driscoll-Kraay standard errors	Xtscc (variables), fe
Model 5.A	Fixed effect model	- Heteroskedasticity - Serial autocorrelation	Robust	Xtreg (variables), fe robust
Model 5.B	OLS model	- Heteroskedasticity - Serial autocorrelation	Robust	Reg (variables). Robust
Model 5.C	Fixed effect model	- Heteroskedasticity - Serial autocorrelation	Robust	Xtreg (variables), fe robust
Model 5.D	OLS model	- Heteroskedasticity - Serial autocorrelation	Robust	Reg (variables), robust

Model 6.A	Fixed effect model	- Heteroskedasticity - Serial autocorrelation - Cross-sectional dependence	Robust (Regression with Driscoll-Kraay standard errors is not applicable with models that contain interaction terms (nplr#fg))	Xtreg (variables), fe robust
Model 6.B	OLS model	- Heteroskedasticity - Serial autocorrelation	Robust	Reg (variables), robust
Model 6.C	Fixed effect model	- Heteroskedasticity - Serial autocorrelation - Cross-sectional dependence	Robust (Regression with Driscoll-Kraay standard errors is not applicable with models that contain interaction terms (nplr#lata))	Xtreg (variables), fe robust
Model 6.D	OLS model	- Heteroskedasticity - Serial autocorrelation	Robust	Reg (variables), robust

4.3.7. Normality

The final assumption is to test the normality of residuals using Shapiro Wilk test. The results of Table 4.9 shows that all models suffer from non-normality of the residuals' distribution. This issue can be corrected through applying robustness to the regressions, as well as removing outliers to improve the fit. Therefore, we have applied robust command at the end of every regression model. Therefore, this issue is solved and would not affect our results.

Table 4. 9: Shapiro-Wilk test for normal data

Model	p-value	Result
1	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
2	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
3	0.002***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
4	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
5.A	0.001***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
5.B	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
5.C	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
5.D	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
6.A	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
6.B	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
6.C	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed
6.D	0.000***	We reject $H_0 \Rightarrow$ residuals are not normally distributed

Note: H_0 : Residuals are normally distributed

***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

4.4. Presentation of Findings

This section describes the results of the empirical tests in terms of significance of the independent variables in each model, as well as the similarity of our results with earlier studies.

4.4.1. Credit Risk Management and Bank Performance

To answer the first research question, we explore the impact of credit risk management on banks' performance (ROA and YTD) using Models 1 and 2 respectively. Results are shown in Table 4.10.

4.4.1.1. Impact of credit risk management factors on the accounting performance of banks

Table 4.10 investigates the impact of credit risk management factors on the accounting performance, measured by the return on assets, of the commercial banks in the MENA region. Specifically, Model 1 aims at answering the first part of our first research question: What is the impact of credit risk management factors on a bank's **accounting** and market performances?

$$\begin{aligned} \text{Model 1: } ROA_{it} = & \beta_0 + \beta_1 LROA + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLLPR + \beta_5 LLLPR^2 + \beta_6 LCAR + \beta_7 LCAR^2 \\ & + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG + \beta_{13} LLENDINGRATE \\ & + \beta_{14} BANKINGSYSTEM + \varepsilon_{it} \end{aligned}$$

Model 1 shows that the lagged return on assets has a strong significant positive impact on the current return on assets, with a coefficient of 0.812 and a P-value of 0.000. The result shows that the profitability of banks in the MENA region tends to stay persistent to a certain level. Our finding is in line with Tan (2015) and Godfrey et al (2017).

Table 4. 10: Credit Risk Management and Bank Performance

Dependent variable	Sign	ROA (Model 1)	Sign	YTD (Model 2)
Independent variable				
LROA	+	+0.812 (0.000) ***		
LYTD			-	-0.083 (0.086) *
LNPLR	-	-1.43 (0.535)	-	-336.96 (0.045) **
LNPLR ²	+	+7.59 (0.396)	+	3243.8 (0.006) ***
LLLPR	+	+8.97	+	+788.03

		(0.617)		(0.553)
LLPR ²	-	+56.07 (0.952)	-	-32471.3 (0.276)
LCAR	-	-1.98 (0.638)	+	+309.79 (0.492)
LCAR ²	+	+8.49 (0.389)	-	-784.44 (0.393)
LOR	+	0.020 (0.272)	-	-1.10 (0.076) *
LSIZE	+	+ 1.06 (0.004) ***	+	168.47 (0.155)
LSIZE ²	-	-0.41 (0.007) ***	-	-8.83 (0.079) *
LGDPG	+	+0.63 (0.118)	-	-10.34 (0.825)
LLENDRATE	+	+0.023 (0.096) *	-	-4.14 (0.228)
AGE	-	-0.001 (0.263)	-	-0.92 (0.676)
F-test p-value		0.000***		0.000***
N		350		350
R-squared		0.7162		0.1391

The table represents the results of the regressions for the effect of lagged dependent variable, lagged non-performing loans ratio, lagged square of non-performing loans, lagged loan loss provision ratio, lagged square of loan loss provision, lagged capital adequacy ratio, lagged square of capital adequacy ratio, lagged operational risk, bank age, lagged size of the bank, lagged squared size of the bank, lagged GDP growth, two period lagged prime lending rate, and dummy variable of the financial system structure on the return of assets and return on the stock of commercial banks in the MENA region. While Model 1 is run using OLS robust regression, Model 2 is run using fixed effect with Driscoll-Kraay standard errors. P-values are reported in brackets and significant results are marked in bold. ***, **, * denote two-tailed significance at 1%, 5%, and 10% level respectively.

In Model 1, it is clear that credit risk management has no significant impact on the accounting performance of banks of the MENA region since LLPR and NPLR are both insignificant. This implies that the return on assets is not directly affected by the amount of non-performing loans or the loan loss reserves held for loan defaults. Our result is in line with Kithinji (2010) who finds that there is no relationship between profits, amount of credit, and the level of non-performing loans.

Moving to the control variables, SIZE is found to be positively significant with a coefficient of 1.06 and P-value of 0.004. This shows that the larger the bank, the higher the profitability. Yet, the square of the size of the bank is negatively significant with a P-value of 0.007 and a coefficient of -0.41 indicating a non-linear relationship between size and performance. Our results are consistent with Chen et al (2018) and Mwaurah et al (2017), supporting the presence of an optimal size for banks. Chen et al (2018) concluded that the larger the banks, the lower are their costs and the higher

the efficiency and their performance. However, the performance increases with size up to an optimal level after which it drops off.

The F-test scored a value of 0.0000 which implies that the regression is strongly significant. R-squared of the regression is 0.7162 while the adjusted R-squared is 0.7043 which implies that 70.43% of the variation in the return on assets is explained by the variables of the regression.

4.4.1.2. Impact of credit risk management factors on the market performance of banks

Model 2 aims to answer the second part of our first research question: What is the impact of credit risk management factors on a bank's accounting and **market** performances?

$$\begin{aligned} \text{Model 2: } YTD_{it} = & \beta_0 + \beta_1 LYTD + \beta_2 LNPLR + \beta_3 LNPLR^2 + \beta_4 LLLPR + \beta_5 LLLPR^2 + \beta_6 LCAR \\ & + \beta_7 LCAR^2 + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG \\ & + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it} \end{aligned}$$

The results of the regression summarized in Table 4.10 show a negative impact of the lag return of the stock on the current return of this year, but only significant at 10% (a coefficient of -0.083 and a P-value =0.086). Moving to credit risk management variables, results show that non-performing loans have a negative and significant effect on YTD, with a coefficient of -336.96 and a p-value of 0.045. This result stipulates that the higher the percentage of non-performing loans out of total loans of a bank (the lower the credit risk management), the weaker is the market performance. Our findings are in line with Mwaurah el al (2017) who found a negative relationship between non-performing loans and return of the stock. It is worth mentioning that literature is scarce when it comes to investigate the effect of risk management on banks' market return, which adds to the contributions of the present study. Furthermore, NPLR² is positively affecting market performance with a coefficient of 3243.8 and a P-value of 0.006, suggesting the presence of a non-linear relation with a U-shaped curve between non-performing loans and stock return.

As for the control variables, operational risk has a negative effect on YTD with a coefficient of -1.10 and a P-value of 0.076, in line with Altarawneh el al (2018) who also found a negative relationship with return and concluded that the higher the operational risk, the lower the bank performance. While SIZE appears to be not significant, SIZE² is significant with a negative impact, suggesting that there is a decline in returns for extremely large banks.

The F-test has a P-value of 0.000 which makes our regression statistically significant. The R-squared is 0.1391 implying that 13.91% of the changes in the stock return is affected by variables of the regression.

4.4.2. Liquidity Risk Management and Bank Performance

To answer the second research question, we explore the impact of liquidity risk management on bank performance (ROA and YTD) using Models 3 and 4 respectively. Results are shown in Table 4.11.

4.4.2.1. Impact of liquidity risk management factors on the accounting performance of banks

Model 3 addresses the first part of our second research question: What is the impact of liquidity risk management factors on a bank's **accounting** and market performances?

$$\begin{aligned} \text{Model 3: } ROA_{it} = & \beta_0 + \beta_1 LROA + \beta_2 LFG + \beta_3 LFG^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LCAR^2 \\ & + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG \\ & + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it} \end{aligned}$$

The results of the regression are presented in Table 4.11. The lagged ROA is positively and significant affecting the current ROA with a coefficient of 0.57 and a P-value of 0.000. This implies that when the profit of the previous year increases by 1%, the return on assets of this year will increase by 57%. This shows a strong impact of lagged performance on present accounting performance similar to Model 1.

The determinants of liquidity risk management (FG and LATA) are found insignificant to return on assets. Our findings are similar to Athanasoglou et al (2006) and Khaled el al (2019) who both studies found that liquidity risk has no significant impact on ROA. No other control variable has a significant impact on ROA as well, since all P-values are greater than 10%.

The regression has an F-test of 0.000 which means that the regression is statistically significant, and the R-squared is 0.3846, which indicates that 38.46% of the variation in the return on assets is explained by the variables of this regression.

4.4.2.2. Impact of liquidity risk management factors on the market performance of banks

Model 4 answers the second part of our second research question: What is the impact of liquidity risk management factors on a bank's accounting and market performances? Results are shown in Table 4.11 for the regression incorporating liquidity risk factors and market performance.

$$\begin{aligned} \text{Model 4: } YTD_{it} = & \beta_0 + \beta_1 LYTD + \beta_2 LFG + \beta_3 LFG^2 + \beta_4 LLATA + \beta_5 LLATA^2 + \beta_6 LCAR + \beta_7 LCAR^2 \\ & + \beta_8 LOR + \beta_9 LSIZE + \beta_{10} LSIZE^2 + \beta_{11} BANKAGE + \beta_{12} LGDPG \\ & + \beta_{13} LLENDINGRATE + \beta_{14} BANKINGSYSTEM + \varepsilon_{it} \end{aligned}$$

The lagged return on stock has a negative and significant impact on the market performance of the current year with a P-value of 0.061 and a coefficient of -0.109. This result was previously confirmed in Model 2 as well. Liquidity risk management variables (FG and LATA) are insignificant with respect to stock return, suggesting that liquidity risk management does not affect the market performance as well as accounting performance.

In terms of bank-specific variables, operational risk negatively affects stock return (coefficient -1.19 and P-value 0.055), which is also similar to the findings presented in Model 2. Additionally, size also showed a positive sign with stock return (coefficient of 147.59 and P-value of 0.09), and its square has a negative significant impact (P-value 0.048 and coefficient -7.68). This non-linear relationship was also proved in Model 1 with ROA as the dependent variable. Finally, the F-test is 0.000, which proves that the regression is statistically significant. Besides, R-squared is 0.0806 which means that only 8.06% of the changes in stock return is explained by the variables of the regression².

Table 4. 11: Liquidity Risk Management and Bank Performance

Dependent variable	Sign	ROA (Model 3)	Sign	YTD (Model 4)
Independent variable				
LROA	+	0.57 (0.000) ***		
LYTD			-	-0.109 (0.061) *
LFG	-	-0.89 (0.186)	+	+8.58 (0.710)
LFG ²	+	0.34	-	-37.64

² Low R-squared are not always problematic, particularly for panel data. In many cases, a fitted line plot shows a trend that indicates that predictors still provide information about the response, despite the fact that data points fall further from the regression line.

		(0.677)		(0.231)
LLATA	-	-1.65 (0.264)	-	-27.7 (0.457)
LLATA ²	+	1.35 (0.406)	+	39.23 (0.399)
LCAR	+	5.91 (0.394)	+	+317.89 (0.483)
LCAR ²	-	-11.33 (0.49)	-	-809.74 (0.383)
LOR	+	0.017 (0.309)	-	-1.19 (0.055) *
LSIZE	-	-3.29 (0.299)	+	147.59 (0.090) *
LSIZE ²	+	0.124 (0.38)	-	-7.68 (0.048) **
LGDPG	+	0.57 (0.271)	-	-7.6 (0.871)
LLENDRATE	-	-0.055 (0.304)	-	-4.004 (0.318)
AGE	+	0.009 (0.719)	-	-1.36 (0.474)
F-test p-value		0.0000***		0.0013***
N		350		350
R-squared		0.3846		0.0806

Note: The table represents the results of the regressions for the effect of lagged dependent variable, lagged financial gap ratio, lagged square of the financial gap, lagged liquid assets to total assets ratio, lagged square of liquid assets to total assets, lagged capital adequacy ratio, lagged square of capital adequacy ratio, lagged operational risk, bank age, lagged size of the bank, lagged squared size of the bank, lagged GDP growth, two period lagged prime lending rate, and dummy variable of the financial system structure on the return of assets and return on the stock of commercial banks in the MENA region. While Model 3 is run using fixed effect robust, Model 4 is run using with Driscoll-Kraay standard errors. P-values are reported in brackets and significant results are marked in bold. ***, **, * denote two-tailed significance at 1%, 5%, and 10% level respectively.

4.4.2.3. The joint Impact of credit and liquidity risk management factors on the accounting performance of banks

Table 4.12 presents the results of the regression analysis of the joint impact of both credit and liquidity risk management factors on the accounting performance of banks.

As we previously described in chapter 3, the model is divided into 4 parts to capture every interaction between the 4 tested variables.

Table 4. 12: Joint effect of credit and liquidity risk management on the accounting performance of banks.

MODEL	5.A	5.B	5.C	5.D
INDEPENDENT VARIABLES				
LROA	0.516 (0.000)***	0.822 (0.000)***	0.54 (0.000)***	0.806 (0.000)***
LNPLR	-0.63 (0.874)		-12.02 (0.168)	
LNPLR ²	7.29 (0.541)		17.74 (0.259)	
LLLPR		10.23 (0.544)		-61.84 (0.209)
LLLPR ²		1529.82 (0.176)		941.83 (0.412)
LFG	-0.307 (0.562)	0.535 (0.021)**		
LFG ²	0.209 (0.783)	-0.613 (0.037)**		
LLATA			-2.36 (0.183)	0.644 (0.527)
LLATA ²			2.02 (0.278)	-1.50 (0.212)
LCAR	1.83 (0.349)	1.93 (0.032)**	1.82 (0.387)	1.75 (0.050)**
<u>LNPLR*LFG</u>	-13.27 (0.14)			
<u>LLLPR*LFG</u>		-84.64 (0.008)***		
<u>LNPLR*LLATA</u>			22.41 (0.163)	
<u>LLLPR*LLATA</u>				164.78 (0.087)*
LOR	0.019 (0.282)	0.026 (0.174)	0.018 (0.281)	0.0211 (0.279)
AGE	0.013 (0.625)	-0.00009 (0.916)	0.0048 (0.865)	-0.0006 (0.445)
LSIZE	-3.18 (0.367)	0.82 (0.030)**	-2.18 (0.565)	0.835 (0.026)**
LSIZE2	0.117 (0.47)	-0.033 (0.048)**	0.08 (0.629)	-0.034 (0.037)**
LLENDRATE	-0.043 (0.421)	0.0092 (0.48)	-0.013 (0.802)	0.013 (0.281)
LGDPG	0.7 (0.16)	0.507 (0.172)	0.737 (0.157)	0.582 (0.139)
R-squared	0.125	0.7327	0.3546	0.7227
F-test p-value	0.000	0.000	0.000	0.000

The table represents the results of the regressions of the following models:

Model 5.A- Return on asset = a + β_1 (LROA) + β_2 (LFG) + β_3 (LFG²) + β_4 (LNPLR) + β_5 (LNPLR²) + β_6 (LCAR) + β_7 (LNPLR*LFG) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Model 5.B- Return on asset = a + β_1 (LROA) + β_2 (LFG) + β_3 (LFG²) + β_4 (LLLPR) + β_5 (LLLPR²) + β_6 (LCAR) + β_7 (LLLPR*LFG) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Model 5.C- Return on asset = a + β_1 (LROA) + β_2 (LLATA) + β_3 (LLATA²) + β_4 (LNPLR) + β_5 (LNPLR²) + β_6 (LCAR) + β_7 (LNPLR*LLATA) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Model 5.D- Return on asset = a + β_1 (LROA) + β_2 (LLATA) + β_3 (LLATA²) + β_4 (LLLPR) + β_5 (LLLPR²) + β_6 (LCAR) + β_7 (LLLPR*LLATA) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Where a is the intercept, and ϵ_t represents the residuals value. P-values are reported in brackets and significant results are marked in bold.

While Models 5.B and 5.D are run using OLS with robust standard errors, Models 5.A and 5.C are run using fixed effect robust

***, **, * denote two-tailed significance at 1%, 5%, and 10% level respectively.

Non-Performing Loan and Financial Gap Ratio Interaction

The results show that Model 5.A (which tests the interaction between non-performing loan ratio and financial gap ratio) has no significant variables in the equation. The only significant level is the lagged return on assets (coefficient 0.516 and P-value of 0.000).

Non-Performing Loan and Liquid Assets to Total Assets Ratio Interaction

Similar to Model 5.A, Model 5.C (which tests for the interaction between non-performing loan ratio and liquid assets to total assets ratio) has no significant variables in the equation. The only significant level is the lagged return on assets (coefficient 0.54 and P-value of 0.000).

Therefore, Models' 5.A and 5.C are not further analyzed since they cannot explain the interaction between credit and liquidity risk variables.

Loan Loss Provision and Financial Gap Interaction

Model 5.B presents the interaction between loan loss provision and financial gap ratio. The first significant variable is the return on assets of the previous year with a P-value of 0.000 and coefficient of 0.822. Also, financial gap ratio separately impacts return on assets positively with a P-value of 0.021 and coefficient of 0.535. This means that when financial gap ratio increases by 1%, ROA will increase by 53.5%. Additionally, the square of FG ratio has a significant negative impact on ROA with a p-value of 0.037 and a coefficient of -0.613. This proves that there exists a non-linear relationship such that after a certain turning point, every increase in financial gap, will decrease ROA. Besides, capital adequacy ratio has a significant positive impact on return on assets with a P-value of 0.032 (at 5% significance level) and coefficient of 1.93. Our results are consistent with Datta and Almahmud (2018) who found that capital adequacy ratio increases the profitability of banks.

With respect to size and size², they have the exact impact on ROA as model 1, such that size positively affects ROA (P-value of 0.03 and coefficient of 0.82) while size² has a negative impact on ROA (P-value=0.048 and coefficient= -0.033).

The variable term LLPR*LFG captures whether there is an interaction effect between the two variables. The P-value of 0.008 shows that there is a strong negative impact (at the 1% confidence level) of the interaction between loan loss provision ratio and financial gap ratio. Our findings are similar to Imbierowicz and Rauch (2014) who found a negative joint impact of the interaction between credit risk and liquidity risk on bank performance. However, the body of literature on the interaction terms' coefficient explains that the statistical meaning of the coefficient of interaction as well as its sign cannot be translated in the same way as a coefficient of any linear regression, especially that it varies across various observations (Imbierowicz and Rauch, 2014). Therefore, similarly to Norton et al (2004), we calculated the cross derivative of the values of the variables to find the direction and magnitude of the interaction's impact (using Margin command in Stata).

By looking at Table 4.13, we find the result of the effect of different values of lagged financial gap ratio on the relationship between lagged loan loss provision ratio and ROA at an interval of 0.2 for the values of LFG. The interval of 0.2 is chosen as half the median of LFG values (the median between the minimum and maximum is about 0.4). We notice that the effect of LLLPR on ROA depends on the level of LFG. When LFG is equal to -0.406, the effect of LFG on LLPR is an average increase of 44.60 points on ROA. The result is significant (P-value =0.016 with a t-value of 2.42). However, when LFG value increases to 0.794, the effect of LFG on LLPR becomes weakly and negatively significant (P-value=0.093), where the effect of LLLPR is an average decrease of almost 56.98 points in ROA. Furthermore, we can see that at high and negative values of LFG, LFG effect on LLPR is a positive and significant on ROA. For high and positive values of LFG, the effect of LFG on LLPR is a negative and significant on ROA. When LFG has a value between -0.006 and 0.594, LLPR has no significant impact on ROA.

Table 4. 13: The effect of LLLPR with different values of LFG on ROA with an interval of 0.2

Average marginal effects				Number of observations: 350		
Expression: Linear prediction, predict ()						
dy/dx w.r.t.: lllpr_w						
1._at: lfg_w = -.406						
2._at: lfg_w = -.206						
3._at: lfg_w = -.006						
4._at: lfg_w = .194						
5._at: lfg_w = .394						
6._at: lfg_w = .594						
7._at: lfg_w = .794						
LLLPR_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	44.60118	18.41171	2.42	0.016	8.384035	80.81832
2	27.67175	16.44107	1.68	0.093	-4.668996	60.01249
3	10.74232	16.81112	0.64	0.523	-22.32634	43.81097
4	-6.187112	19.38829	-0.32	0.750	-44.32525	31.95103
5	-23.11654	23.45603	-0.99	0.325	-69.25622	23.02314
6	-40.04597	28.3805	-1.41	0.159	-95.87241	15.78047
7	-56.9754	33.78915	-1.69	0.093	-123.4411	9.490249

On the other hand, Table 4.14 shows the reciprocal impact, i.e. the effect of different values of lagged loan loss provision ratio on the relationship between lagged financial gap ratio and ROA for an interval of 0.005. The results show that at LLLPR equals to -0.001, LFG’s impact is an average increase of 0.62 points on ROA. The result is significant with a p-value of 0.015 and t-value of 2.44. This significance persists but changes its sign, such that there becomes a negative effect of LFG by an average decrease of 0.649 points of ROA (P-value=0.051) at the value of LLLPR= 0.014, an average decrease of 1.072 points (P-value=0.025) at the value of 0.019, an average decrease of 1.496 points (P-value=0.018) at the value of 0.024, and an average decrease of 1.919 points (P-value=0.015) at the value of 0.029.

The R-squared of the whole regression is 0.7327 and the adjusted R-squared is 0.7215 which implies that 72.15% of the variations in return on assets is explained by the variables of this

regression. Besides, F-test is 0.000 which denotes that the regression as a whole is highly significant.

Table 4. 14: The effect of LFG with different values of LLLPR on ROA at the interval of 0.005

Average marginal effects Expression: Linear prediction, predict ()					Number of observations: 350	
dy/dx w.r.t.: lfg_w						
1._at: lllpr_w = -.001						
2._at: lllpr_w = .004						
3._at: lllpr_w = .009						
4._at: lllpr_w = .014						
5._at: lllpr_w = .019						
6._at: lllpr_w = .024						
7._at: lllpr_w = .029						
LFG_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	.6201376	.2543508	2.44	0.015	.1198116	1.120464
2	.1969018	.1705548	1.15	0.249	-.1385915	.532395
3	-.2263339	.2100015	-1.08	0.282	-.6394216	.1867538
4	-.6495697	.3312543	-1.96	0.051	-1.30117	.002031
5	-1.072805	.4753686	-2.26	0.025	-2.007889	-.1377218
6	-1.496041	.6267682	-2.39	0.018	-2.728938	-.2631439
7	-1.919277	.7812288	-2.46	0.015	-3.456009	-.3825447

Loan Loss Provision and Liquid Assets to Total Assets Ratio Interaction

Model 5.D presents the interaction between loan loss provision ratio and liquid assets to total asset ratio. Lagged return on assets is highly and positively significant to the current ROA with a P-value of 0.000 and coefficient of 0.806. This means that an increase of 1% in the return of the previous year will increase ROA by 80.6%.

Capital adequacy ratio is positively significant to ROA with a P-value of 0.05 and coefficient of 1.75. Our findings are similar to Udom and Onyekachi (2018) who found that capital adequacy ratio positively stimulates the financial performance of banks.

Additionally, size and size² have the same impact on ROA as in Model 1 and 5.A, such that size has a positive coefficient of 0.835 and P-value of 0.026, while size² has a negative coefficient of -0.034 and P-value 0.037.

Furthermore, the interaction term LLLPR*LLATA has a positive significant impact on ROA with a P-value of 0.087 and a coefficient of 164.78. To further interpret the meaning of this coefficient, we continue by finding the statistical significance of the interaction term through the estimated cross-partial derivative values of these independent variables.

The first part is presented in Table 4.15 which shows the effect of different values of lagged liquid assets to total assets ratio on the relationship between lagged loan loss provision ratio on ROA at an interval of 0.1 of LLATA. The results show that the effect of LLATA on LLLPR is an average increase of 38.807 points (at LLATA= 0.6108) and 55.285 points (at LLATA=0.7108) on ROA. The result is significant with P-values of 0.058 and 0.043 respectively. It is important to mention that at low levels of LLATA, LLLPR has no significant impact on ROA.

Table 4. 15: The effect of LLLPR with different values of LLATA on ROA at the interval of 0.1

Average marginal effects					Number of observations: 350	
Expression: Linear prediction, predict ()						
dy/dx w.r.t.: lllpr_w						
1._at: llata_w = .1108						
2._at: llata_w = .2108						
3._at: llata_w = .3108						
4._at: llata_w = .4108						
5._at: llata_w = .5108						
6._at: llata_w = .6108						
7._at: llata_w = .7108						
LLLPR_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	-43.58717	39.28193	-1.11	0.268	-120.8575	33.68316
2	-27.10833	30.8219	-0.88	0.380	-87.73718	33.52053
3	-10.62949	23.25542	-0.46	0.648	-56.37456	35.11557
4	5.849346	17.76359	0.33	0.742	-29.09289	40.79159
5	22.32818	16.55841	1.35	0.178	-10.24339	54.89975
6	38.80702	20.41378	1.9	0.058	-1.348317	78.96236
7	55.28585	27.26112	2.03	0.043	1.661305	108.9104

Table 4.16 shows the effect of different values of LLLPR on the relationship between LLATA and ROA at the interval of 0.005. The results show that there is a positive effect of LLATA on ROA at several different values of LLLPR (LLLPR is 0.014 or more). For instance, the effect of LLLPR on LLATA is an average increase of 5.423 points on ROA when LLLPR has a value of 0.029. The result is significant with a P-value of 0.066 and a t-value of 1.85. Again, at low levels of LLLPR, there is no significant impact of LLATA on ROA.

Table 4. 16: The effect of LLATA with different values of LLLPR on ROA at the interval of 0.005

Average marginal effects		Number of observations: 350				
Expression: Linear prediction, predict ()						
dy/dx w.r.t.: llata_w						
1._at: llpr_w = -.001						
2._at: llpr_w = .004						
3._at: llpr_w = .009						
4._at: llpr_w = .014						
5._at: llpr_w = .019						
6._at: llpr_w = .024						
7._at: llpr_w = .029						
LLATA_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	.4794573	1.023229	0.47	0.64	-1.533306	2.49222
2	1.303399	1.077048	1.21	0.227	-.8152303	3.422029
3	2.127341	1.31637	1.62	0.107	-.4620527	4.716735
4	2.951283	1.662947	1.77	0.077	-.3198517	6.222417
5	3.775225	2.063424	1.83	0.068	-.2836761	7.834125
6	4.599167	2.491949	1.85	0.066	-.3026722	9.501005
7	5.423108	2.936266	1.85	0.066	-.3527347	11.19895

The R-squared of this model is 0.7227 while the adjusted R-squared is 0.7111 which indicates that 71.11% of the variation in ROA is explained by the variables of this regression model. Additionally, F-test has a value of 0.00 which means that the regression is totally significant.

4.4.2.4. The joint Impact of credit and liquidity risk management factors on the market performance of banks

Table 4.17 presents the joint impact of credit and liquidity risk management factors on the market performance of the bank measured by the return of the stock.

Table 4. 17: Joint effect of credit and liquidity risk management on the market performance of banks

MODEL	6.A	6.B	6.C	6.D
INDEPENDENT VARIABLES				
LYTD	-0.0718 (0.253)	-0.070 (0.296)	-0.0771 (0.217)	-0.086 (0.201)
LNPLR	-412.09 (0.030)**		-345.53 (0.285)	
LNPLR²	3425.11 (0.000)***		3231.65 (0.000)**	
LLLPR		1011.99 (0.123)		-4392.32 (0.001)***
LLLPR²		20441.26 (0.491)		22971.43 (0.463)
LFG	-2.634 (0.874)	28.70 (0.005)***		
LFG²	-33.28 (0.215)	-23.48 (0.093)*		
LLATA			21.17 (0.804)	-62.03 (0.259)
LLATA²			-17.59 (0.848)	10.4 (0.861)
LCAR	5.42 (0.954)	22.04 (0.548)	5.09 (0.957)	5.71 (0.873)
<u>LNPLR*LFG</u>	252.28 (0.478)			
<u>LLLPR*LFG</u>		-3819.92 (0.003)***		
<u>LNPLR*LLATA</u>			24.92 (0.963)	
<u>LLLPR*LLATA</u>				12506.39 (0.000)***
LOR	-1.091 (0.058)*	-1.22 (0.057)*	-1.00 (0.065)*	-1.29 (0.035)**
AGE	-0.872 (0.374)	0.047 (0.49)	-0.901 (0.384)	0.042 (0.55)
LSIZE	102.1 (0.423)	45.02 (0.022)**	144.98 (0.296)	48.04 (0.006)***
LSIZE²	-5.58 (0.375)	-1.97 (0.024)**	-7.72 (0.269)	-2.15 (0.005)***

LLENDRATE	-4.64 (0.097)*	0.771 (0.283)	-4.23 (0.127)	0.606 (0.359)
LGDPG	-8.21 (0.655)	13.94 (0.363)	-7.4 (0.66)	17.67 (0.263)
R-squared	0.0023	0.1273	0.0022	0.1321
F-test p-value	0.0000	0.0019	0.000	0.0012

The table represents the results of the regressions of the following models:

Model 6.A- Return on stock = a + β_1 (LYTD) + β_2 (LFG) + β_3 (LFG²) + β_4 (LNPLR) + β_5 (LNPLR²) + β_6 (LCAR) + β_7 (LNPLR*LFG) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Model 6.B- Return on stock = a + β_1 (LYTD) + β_2 (LFG) + β_3 (LFG²) + β_4 (LLLPR) + β_5 (LLLPR²) + β_6 (LCAR) + β_7 (LLLPR*LFG) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Model 6.C- Return on stock = a + β_1 (LYTD) + β_2 (LLATA) + β_3 (LLATA²) + β_4 (LNPLR) + β_5 (LNPLR²) + β_6 (LCAR) + β_7 (LNPLR*LLATA) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Model 6.D- Return on stock = a + β_1 (LYTD) + β_2 (LLATA) + β_3 (LLATA²) + β_4 (LLLPR) + β_5 (LLLPR²) + β_6 (LCAR) + β_7 (LLLPR*LLATA) + β_8 (LOR) + β_9 (AGE) + β_{10} (LSIZE) + β_{11} (LSIZE²) + β_{12} (LGDPG) + β_{13} (LLENDRATE) + β_{14} (BANKSYS) + ϵ_t

Where a is the intercept, and ϵ_t represents the residuals value. P-values are reported in brackets and significant results are marked in bold.

While Models 6.B and 6.D are run using OLS with robust standard errors, Models 5.A and 5.C are run using fixed effect robust

***, **, * denote two-tailed significance at 1%, 5%, and 10% level respectively.

Non-Performing Loan and Financial Gap Ratio Interaction

Model 6.A shows that the interaction term of the independent variables (LNPLR*LFG) is insignificant which means that there is no interaction between these factors. Besides, the regression is statistically not significant such that its R-squared is questionably low (0.23%), which means that the change in YTD is not explained by the variables of this regression.

Non-Performing Loan and Liquid Assets to Total Assets Ratio Interaction

Similar to Model 6.A, Model 6.C shows that the interaction term of the independent variables (LNPLR*LLATA) is insignificant which means that there is no interaction between these factors. Besides, the R-squared is questionably low (0.22%), which means that the change in YTD is not explained by the variables of this regression.

Loan Loss Provision and Financial Gap Interaction

Model 6.B presents the regression model for the interaction between LLLPR and LFG. The lagged financial gap ratio has a positive significant impact on YTD such that it has a P-value of 0.005 and coefficient of 28.7. On the other hand, the U-shaped non-linear relationship is obvious in the negative significance of financial gap ratio squared (P-value=0.093 and coefficient=-23.48).

Operational risk has a negative significant effect on the stock return where its P-value is 0.057 and its coefficient is -1.22. This result is similar to Model 2 and Model 4. Additionally, the effect of size and size² on the return on the stock is similar to its effect on return on assets in Models 5.B and 5.D. Size positively affects stock return with a P-value of 0.022 while size² negatively impacts stock return with a P-value 0.024.

The interaction term LLLPR*LFG has a highly significant negative impact on return of the stock, with a coefficient of -3819.92 and P-value of 0.003. To further inspect this interaction term, we test the effect of every explanatory variable on YTD for different values of the other variable that it interacts with.

Table 4.18 presents the effect of different values of lagged financial gap ratio on lagged loan loss provision ratio for an interval of 0.2. The results show that at first the values of LFG affect LLLPR by an average increase of 2562.868 points (P-value of 0.012) and 1798.889 points (P-value of 0.028) on YTD, for values of LFG= -0.406 and -0.206 respectively. However, when LFG hits a value of 0.594, LLLPR effect on return becomes negatively significant. For instance, the effect of LFG on LLLPR is an average decrease of 2021.003 points on YTD. This result is significant with a P-value of 0.026 and t-value of -2.24.

Table 4. 18: The effect of LLLPR with different values of LFG on YTD at the interval of 0.2

Average marginal effects					Number of observations: 350	
Expression: Linear prediction, predict ()						
dy/dx w.r.t.: lllpr_w						
1._at: lfg_w = -.406						
2._at: lfg_w = -.206						
3._at: lfg_w = -.006						
4._at: lfg_w = .194						
5._at: lfg_w = .394						
6._at: lfg_w = .594						
7._at: lfg_w = .794						
LLLPR_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	2562.868	1009.234	2.54	0.012	577.6332	4548.102
2	1798.889	812.8999	2.21	0.028	199.8578	3397.921
3	1034.911	657.5468	1.57	0.116	-258.5301	2328.352
4	270.9325	577.2676	0.47	0.639	-864.5936	1406.459
5	-493.0459	602.8403	-0.82	0.414	-1678.875	692.7835

6	-1257.024	723.1206	-1.74	0.083	-2679.453	165.405
7	-2021.003	900.9433	-2.24	0.026	-3793.222	-248.7837

Table 4.19 presents the effect of different amounts of lagged loan loss provision ratio on lagged financial gap ratio for an interval of 0.005. The results show that the effect of LLLPR on LFG is an average increase of 32.523 points on YTD when LLLPR is equal to -0.001. This result is significant with a P-value of 0.002. This effect changes its sign at a higher value of LFG and starts to decrease YTD. For example, the effect of LFG on LLLPR is an average decrease on YTD of 43.874 pts, 62.973 pts, and 82.073 pts with different values of LFG of 0.019, 0.025, and 0.029 respectively. Their P-values are significant as well with values of 0.057, 0.030 and 0.019 respectively.

Table 4. 19. The effect of LFG with different values of LLLPR on YTD at the interval of 0.005

Average marginal effects					Number of observations: 350	
Expression: Linear prediction, predict ()						
dy/dx w.r.t: lfg_w						
1._at: lllpr_w = -.001						
2._at: lllpr_w = .004						
3._at: lllpr_w = .009						
4._at: lllpr_w = .014						
5._at: lllpr_w = .019						
6._at: lllpr_w = .024						
7._at: lllpr_w = .029						
LFG_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	32.52352	10.64766	3.05	0.002	11.57882	53.46823
2	13.42406	9.762688	1.38	0.170	-5.779835	32.62796
3	-5.675398	12.5724	-0.45	0.652	-30.40619	19.0554
4	-24.77486	17.36773	-1.43	0.155	-58.93842	9.388697
5	-43.87432	22.93532	-1.91	0.057	-88.98971	1.241074
6	-62.97378	28.83119	-2.18	0.030	-119.6868	-6.260797
7	-82.07324	34.88931	-2.35	0.019	-150.703	-13.44351

The R-squared of the regression is 0.1273 while the adjusted R-squared is 0.0908 which means that only 9.08% of the change in the return on the stock is explained by the variables of the regression

model. The F-test is 0.0019 which means that the regression is statistically significant at the 1% significance level.

Loan Loss Provision and Liquid Assets to Total Assets Ratio Interaction

Model 6.D presents the regression of the interaction between LLLPR and LLATA. Our findings show that loan loss provision has a negative significant impact on market performance of the bank. The result is significant with a P-value of 0.001 and a coefficient of -4392.32. Our result is similar to Mustafa el al (2012) who found that higher loan loss provision indicates less safety and thus lower returns. Besides, operational risk has a negative impact on YTD similar to its impact on the accounting performance of the bank (p-value= 0.035 and coefficient= -1.29).

Similar to Model 6.B, size and size² have the same significance on the market performance of the bank as its effect on the accounting performance. Size has a positive coefficient of 48.04 (P-value=0.006) indicating a positive impact on YTD, whereas size² has a negative coefficient of -2.15 (P-value= 0.005) revealing a non-linear relationship between size and stock return.

The interactive term LLLPR*LLATA has a positive and significant coefficient of 12,506.39 with a P-value of 0.000. The interaction coefficient is studied in tables 4.20 and 4.21.

Table 4.20 presents the effect of different values of lagged loan loss provision ratio on lagged liquid assets to total assets ratio in an interval of 0.005. The result shows that the effect of LLLPR on LLATA is an average increase of 238.116 points on YTD at the value of LLLPR=0.024, where the P-value is highly significant (0.003). Another example is when loan loss provision ratio has a value of 0.029, its effect on LLATA is an average increase of 300.648 points. Its P-value is highly significant (0.001) and the 95% confidence level of its effect is between 122.284 and 479.013. The same relationship is obtained when LLPR has a value of 0.014 or more.

Table 4.21 presents the effect of different values of lagged liquid assets to total assets ratio on lagged loan loss provision ratio with interval of 0.1. The effect of LLATA on LLLPR starts with an average decrease of YTD then starts to increase gradually with higher values of LLATA. For instance, the effect of LLATA at a value of 0.1108 on LLLPR is an average decrease of 3006.616 points on YTD. The result is highly significant with a t-value of -2.88 and a P-value of 0.004. However, when LLATA is 0.6108, its effect on LLLPR is an average increase of 3246.582 points on YTD. The result is highly significant with P-value of 0.00 and the 95% confidence level of this effect is between 1,501.819 and 4,991.344

Table 4. 20: The effect of LLATA with different values of LLLPR on YTD at the interval of 0.005

Average marginal effects					Number of observations: 350	
Expression: Linear prediction, predict ()						
dy/dx w.r.t.: llata_w						
1._at: llpr_w = -.001						
2._at: llpr_w = .004						
3._at: llpr_w = .009						
4._at: llpr_w = .014						
5._at: llpr_w = .019						
6._at: llpr_w = .024						
7._at: llpr_w = .029						
LLATA_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	-74.54293	55.88695	-1.33	0.183	-184.4765	35.39065
2	-12.01096	52.65874	-0.23	0.820	-115.5944	91.57251
3	50.52101	53.87587	0.94	0.349	-55.45663	156.4986
4	113.053	59.26507	1.91	0.057	-3.52559	229.6316
5	175.585	67.83923	2.59	0.010	42.14039	309.0295
6	238.1169	78.56239	3.03	0.003	83.57917	392.6547
7	300.6489	90.6753	3.32	0.001	122.2842	479.0136

Table 4. 21: The effect of LLLPR with different values of LLATA on YTD at the interval of 0.1

Average marginal effects					Number of observations: 350	
Expression: Linear prediction, predict ()						
dy/dx w.r.t.: llpr_w						
1._at: llata_w = .1108						
2._at: llata_w = .2108						
3._at: llata_w = .3108						
4._at: llata_w = .4108						
5._at: llata_w = .5108						
6._at: llata_w = .6108						
7._at: llata_w = .7108						
LLLPR_w at	Dy/Dx	Std. Error	T	P> t	95% confidence interval	
1	-3006.616	1045.611	-2.88	0.004	-5063.407	-949.8256
2	-1755.977	804.9417	-2.18	0.030	-3339.354	-172.5993

3	-505.3373	628.1638	-0.80	0.422	-1740.98	730.3052
4	745.3024	577.3021	1.29	0.198	-390.2916	1880.896
5	1995.942	681.172	2.93	0.004	656.0284	3335.855
6	3246.582	886.985	3.66	0.000	1501.819	4991.344
7	4497.221	1140.841	3.94	0.000	2253.105	6741.336

The R-squared of the regression model is 0.1321 while the adjusted R-squared is 0.0959 which means that just 9.59% of the changes in Return is explained by the variables of this regression. Additionally, the F-test is 0.0012 which means that the regression is statistically significant at the 1% significance level.

4.5. Discussion of the results and hypotheses

This section analyzes the results and establishes the relation between the hypotheses developed in chapter 3 and our empirical findings.

4.5.1. Impact of credit risk management factors on the accounting performance of banks

Our first significant variable is the one-year period lagged ROA which shows a positive significant impact on the current return on assets. Our result is consistent with Tan (2016) who found that one-period lag of the dependent variable ROA positively impacts the profitability of the bank in the present year. The author explains that profitability of the bank does persist, and the banking industry is competitive in the tested sample. Similarly, Godfrey et al (2017) obtain the same results such that previous year's performance of commercial banks will enhance the performance in the current year. In our first sub-hypothesis, we hypothesized a negative effect of non-performing loans, as one of the measures of credit risk management, on banks' ROA. Our results reject hypothesis 1a since our model shows an insignificant impact of the non-performing loans on ROA of banks in the MENA region. According to Kithingi (2010), Basel requirements might have authorized banks to better control their levels of non-performing loans, and therefore raise the quality of credit risk management. His findings show that banks' accounting performance is not directly affected by the amount of non-performing loans, and commercial banks must focus on other factors to boost their accounting performance. The Basel Committee on Banking Supervision established a task force to inspect the scope of practices concerning the definition and implications of credit risk management,

including non-performing loans, or what is referred to “problem assets” by Basel II (BIS, 2016). Banks are paying close attention to categorized customers that have high exposure and difficulties in settling their loans. The Basel Committee is more attentive to auditing practices, displayed by the committee’s examination of important documents and sound practices papers prepared by the bank (The World Bank, 2003). According to the World Bank, Basel accord is a suitable factor of change in terms of improved classification of risk systems, where banks are obliged to apply regimes that categorize loans according to their probability of default. This action tends to decrease the overall non-performing loans, since banks will have more homogeneity in their risk classification through adopting an objective quantitative factor judgment rather than a subjective one.

Our second sub-hypothesis 1b tests for a negative impact of loan loss provision on return on assets. Our results reject hypothesis 1b as loan loss provision ratio has no impact on the accounting performance. In principle and practice, managers of credit risk respect the risk that results from lending activities, and consequently hedge this unavoidable risk through incorporating high loan loss provision. Anandarajan et al (2005) says that the federal bank doesn’t classify loan loss provisions as an actual way to match the losses and it can involve a margin of defect.

Our third sub-hypothesis 1c predicts a positive impact of capital adequacy ratio on accounting performance. The results show no significance of this variable on return on assets. Our result is consistent with Alshatti (2015) and Abdelrahim (2013). Alshatti (2015) conducted a study on the Jordanian commercial banks to test the effect of credit risk management factors on their financial performance. His results revealed that capital adequacy ratio has no effect on the accounting performance of banks. He suggested that banks must shift their focus to variables other than the CAR to boost their profits and increase their performance while adopting the Basel III requirements. The size of the bank is found to have a positive impact on accounting performance in the MENA region. According to Iannotta et al (2007), larger banks are characterized with an indirect advantage of the too-big-to-fail reasoning. Large banks have less cost of funding which encourage them to invest in riskier assets, which is translated into higher performance. Additionally, size is usually included as a bank-specific variable to account for economies or diseconomies of scale in the industry (Molyneux and Thornton, 1992; Chen et al, 2018). The positive relationship of bank size with profitability can be due to the presence of economies of scale, which is translated into lower costs, better efficiency, and higher performance. However, the effect of the size of a bank is positive

up to a certain limit, considered as an optimal size level (Eichengreen and Gibson (2001)). Beyond this level, size has a negative effect on return on assets as reflected by the non-linear relationship between size and performance in Table 4.10.

Moving to the macroeconomic factors, prime lending rate has a weak but positive significant impact on the return on assets (only significant at 10%). Our result is similar to Okoye and Eze (2013) who found that bank lending rate has a positive significant effect on the performance of banks in Nigeria. This positive relation denotes that when macro-economic stability is achieved and good lending behavior is guaranteed, bank performance will increase.

4.5.2. Impact of credit risk management factors on the market performance of banks

The results of Model 2 reveal a negative and significant relationship between the stock return of the past year and the return of the current year (only significant at 10%). Investors are highly attentive to the performance of the stock in the most recent year, and hence their decision is based on the generated returns.

NPLR has a negative and significant impact on YTD while NPLR² has a positive and significant coefficient on market performance. This result reveals a non-linear U-shaped relationship between non-performing loans and the market performance where:

- low levels of NPLR, reflecting the significant credit risk management efforts put by banks, affect negatively the market performance down to a certain level;
- beyond this level, high levels of NPLR, reflecting the non-existent or weak credit risk management, affect positively the market performance.

In other words, if we express the regression results in terms of the relationship between credit risk management efforts and market performance, the U-shaped relationship between NPLR and market performance will turn to be an inverse U-shaped relationship between credit risk management and market performance, due to the inverse relationship between NPLR and credit risk management. The results of our Model 2 regression show then that the higher the credit risk management efforts, the lower the profitability of banks and vice versa. In fact, if the management of a bank decides to deploy efforts to keep NPLR at its lowest level, it leads the bank to grant loans to secure or high credit-score or credit-rating customers, on which banks obviously cannot charge a high premium (so they apply lower interest rates). On the other hand, if the management of a bank decides to take

more risks and allow for higher levels of NPLR (accepting potential losses on non-performing loans), banks will extend credit to lower credit-score or credit-rating customers, benefiting from higher interest rates due to the higher premiums they can apply to these loans.

Our results are compatible with the findings of Kolapo et al (2012), Kargi (2011), Kodithuwakku (2015), and Serwadda (2018) in the sense that a lower ratio suggests that the bank is exerting more efforts in credit risk management, which appeared to negatively affect the market performance. This can be due to the fact that extensive risk management is considered to be costly for a bank, thus decreasing its returns.

Additionally, size² has a negative impact on the market performance which indicates that the size of the bank below a certain level is insignificant, however, it starts to negatively affect the return on the stock, beyond a certain size. Operational risk is another specific factor that negatively affects stock return. As we hypothesized, the results show that operational risk can cause a decrease in the share price and lower returns. A low quality of operational risk management shows the inability of banks to perform their operational activities efficiently, which increases their costs and expenses, and decreases their returns.

4.5.3. Impact of liquidity risk management factors on the accounting performance of banks

The results in Table 4.11 reveal a positive impact of last year ROA on today's ROA. This indicates that previous profits boost the performance of the bank in the current period.

Our second hypothesis assumed a negative effect of liquidity risk on accounting performance. Both liquidity risk determinants in Model 3 (FG and LATA) have non-significant coefficients. Therefore, the results of our regression does not confirm our hypothesis. Our findings are in line with Rashed el al (2019) who investigated the relationship between liquidity and financial performance of the bank. They concluded that liquidity risk has no significant positive or negative impact on ROA. Similarly, Athanasoglou et al. (2006) examined the relationship between liquidity risk and ROA for a dataset of European banks and found that liquidity risk has no impact on ROA.

Shen el al (2010) performed a study to find the determinants of liquidity risk and its effect on the performance of the bank. A common feature between their research and ours is the division of countries into market-based and bank-based financial systems. Results show a clear negative impact of liquidity risk on performance of banks that are located in market-based countries. However, liquidity risk is non-significant and has no relationship to performance of banks that are present in

bank-based financial systems. Consequently, banks in market-based financial systems are obliged to use excessive external funding from the market to fulfill their financial needs, and hence liquidity will be a threat to their activities, and their cost of funding would increase as well. However, in bank-based financial systems, banks are the major source in financing roles and therefore they would not be affected by liquidity risk.

Our sample is dominated by bank-based financial systems (6 out of 10 countries) as per the Financial Development and Structure Dataset of the World Bank (2019). Therefore, we conclude that the nature of the banking industries and financial systems in the MENA region had clearly safeguarded their liquidity practices and made them more solid upon facing liquidity shocks. Hence, liquidity risk is not a major problem for banks on its own, unless it is aggravated by other risks which will be demonstrated in section 4.5.5 and 4.5.6.

4.5.4. Impact of liquidity risk management factors on the market performance of banks

The regression results of Model 4 are presented in Table 4.11 and answer the second hypothesis of the study which tests for the impact of liquidity risk management on the market performance of the bank.

Stock return of the previous year seemed to have the same negative effect as the result in Model 2. As we previously discussed, this is reflected by the investor's reaction to the stock prices and returns. For instance, if the price of a stock decreases in the previous year, this may look appealing for investors to buy at a low price. An increase in the demand for the stock of a certain bank will boost its price eventually in the second year and increase its return.

Our second hypothesis was that liquidity risk management factors (FG and LATA) have a negative impact on performances. Results of Model 4 show that liquidity risk management variables have no significant impact on the market performance of the bank. Therefore, neither financial gap ratio nor liquid assets to total assets ratio are significant to both performances. This rejects our second hypothesis and denies the relationship between liquidity risk management and performance of banks in the MENA region.

The positive effect of size on stock return along with the negative impact of size² is similar to the result in Model 1. This indicates that the size of a bank impacts both accounting and market performance similarly, as well as its square which shows that there is an inverse linear relationship with stock return as well.

Also, operational risk has a negative significant impact on market performance as in Model 2. It is obvious that while operational risk does not affect accounting performance, it negatively affects the stock return. This shows that investors are very attentive to the increased expenses, raising a red flag to the bank that has a poor and ineffective management of this risk.

4.5.5. Joint impact of credit and liquidity risk management on the accounting performance of banks

In our third hypothesis, we stated that credit risk and liquidity risk combined together have a joint effect on the performance of banks. Table 4.12 presents the results of the effect of this interaction on the accounting performance of banks.

Models 5.A and 5.C tested the interaction between non-performing loans and financial gap ratio, and between non-performing loans and liquid assets to total assets ratio respectively. Both models showed non-significance in the singular variables, as well as in the interaction terms. This means that credit risk management represented by non-performing loans ratio has no effect on the accounting performance of the bank even when the bank is performing liquidity risk management. This is in line with our previous findings regarding Models 1 and 3 where NPLR has no impact on ROA.

Models 5.B and 5.D tested the interaction between loan loss provision ratio and financial gap ratio, and between loan loss provision ratio and liquid assets to total assets ratio respectively and both models show significant variables in the regressions. The first significant variable is the lagged ROA, which seems to be significant in all models, no matter the combination of variables we used. This reveals the importance of the last year's return on assets on the current year's profitability.

Capital adequacy ratio shows a positive impact on the performance of the bank in Models 5.B and 5.D. Our result is similar to Vyas et al (2008) who found that capital to risk weighted assets ratio increases the profitability of banks. However, this factor was insignificant in Models 1 and 3 where we studied solely the impact of credit risk management variables on accounting and market performances. It also shows non-significance when combined to the credit risk factor NPLR in Models 5.A and 5.C. We deduce that the capital adequacy ratio influences the performance of a bank, only when the regression model combines the loan loss provision ratio and liquidity risk exposure factors. In other words, the CAR improves bank performance when the bank is applying simultaneously liquidity risk management and credit risk management mainly through controlling

its loan loss provision ratio. Therefore, the capital serves as a good buffer for any expected losses that the bank may encounter resulting from loan defaults or liquidity runs.

In both models 5.B and 5.D, the size of the bank appeared to have a positive impact on accounting performance which is similar to Model 1. We previously concluded that large banks have a lower cost of funding, therefore, they can engage in riskier assets and generate higher returns. There is also the same non-linear relationship between the size and ROA, as in Model 1.

Additionally, the results of Model 5.B show that the financial gap ratio has a positive impact on ROA. This means that the higher the financial gap, the higher the return on assets, up to a certain value of FG, where the ROA starts to decline. This result indicates that the higher the financial gap ratio, the larger the gap between loans and deposits, the poorer is the liquidity risk management. Apparently, poor risk management impacts positively the return on assets. Logically, a bank that has no risk is a bank that does not perform well, since higher risk is linked with higher returns. On the other hand, if the bank is exposed to liquidity risk, then it should perform liquidity risk management, which represents an increased cost for the bank. This will obviously decrease its profitability. However, the square of the financial gap variable negatively impacts the ROA, which means that there is a non-linear relationship between FG and ROA. This means that a poor risk management may positively impact the return, provided FG reaches an optimal level. When the gap widens and loans are much higher than deposits, then the cost of external lending to cover this gap would be higher than the cost of managing the risk itself.

The effect of the interaction term ($LLPR*FG$) on the return on assets is found to be negative and highly significant at the 1% level. This term shows that both categories of risk jointly decrease return, but as we mentioned earlier, we must interpret this interaction based on the effect of each variable on the other, with respect to ROA. Tables 4.13 and 4.14 show the effect of the financial gap ratio on ROA, given its interaction with the loan loss provision ratio and vice versa.

From table 4.13, we can conclude that the financial gap ratio shows an effect on loan loss provision ratio of an average increase in ROA. This effect shifts when FG is around 0.194 where ROA starts to decrease. This is proved by the non-linear relation between FG and return on assets. Similarly, table 4.14 shows the reciprocal effect of loan loss provision on financial gap ratio and their interactions' impact on ROA. It reveals that the effect of loan loss provision ratio on financial gap ratio is an increase on ROA when LLP is low, whereas when the value of LLP increases, its effect on FG will become a decrease on ROA. The results of tables 4.13 and 4.14 indicate that the effect

of a high loan loss provision ratio is harmful to the return on assets of banks when financial gap ratio is high and vice versa. Their combined interaction moves together upwards and downwards such that banks with lower credit risk management have higher performance as far as their liquidity risk management is low.

In Model 5.D, the interaction term (LLPR*LATA) is found to be positive and highly significant with ROA. This interaction is taken further to assess every variable's impact on each other, which is presented by the results in tables 4.15 and 4.16. By looking at both tables, we notice that the joint effect of both variables are significant to one another only when their values are relatively high. This means that when the LATA is low, it has no effect on LLPR and their interaction does not influence the ROA and vice versa. In other words, a higher LATA indicates increased efforts deployed on liquidity risk management, and a high loan loss provision ratio indicates that the bank is taking more provisions to protect itself from possible defaults on loans. Therefore, high credit risk and liquidity risk managements in this specific case improve the accounting performance of the bank.

To conclude, the return on assets is influenced by the joint impact of risk variables for MENA region banks. However, the joint impact of credit risk management and liquidity risk management on bank performance depends on the combination of risk management variables the bank is focusing its efforts on. In other words, when loan loss provision ratio is kept in check by the bank along with the financial gap ratio, risk managers must relax their management activities to achieve higher returns. However, if they control the LLPR along with the liquid assets to total assets ratio, they must tighten their risk management activity by keeping these ratios always high to maintain a good performance.

4.5.6. Joint Impact of credit and liquidity risk management on the market performance of banks

The second part of the third hypothesis tests the combined effect of credit and liquidity risk management on the market performance of banks. The results are reported in Table 4.17 for the four tested models.

Models 6.A and 6.C tested the interaction between non-performing loans and financial gap ratio, and between non-performing loans and liquid assets to total assets ratio respectively and they both

have insignificant results, as we previously mentioned. Therefore, the non-performing loans ratio combined with other liquidity risk variables has no impact on the market performance of banks.

Models 6.B and 6.D tested the interaction between loan loss provision ratio and financial gap ratio, and between loan loss provision ratio and liquid assets to total assets ratio respectively and they show significant results for the interaction terms of credit and liquidity risk. First, the same control variables (size and size²) seem to impact market performance similar to Model 4, and also in the same way that they impact accounting performance in Models 1, 5.B, and 5.D. This means that size not only affects return in terms of higher risky investments but affects investors decisions to invest in bigger banks as well. Besides, operational risk also affect return negatively. This result is consistent with our previous finding in Models 2 and 4.

The financial gap ratio is found to impact the return of the stock positively up to a certain level, beyond which it shifts the return of the stock downward. The same non-linear relationship between FG and market performance is also obtained with accounting performance. To further inspect the effect of this variable when it interacts with loan loss provision ratio, we consider the interaction term (LLPR*FG). We notice that it is highly significant at the 1% confidence level and negatively impacts the return on the stock. This means that the interaction of both high-risk managements will drive the return of the stock downwards.

Tables 4.18 and 4.19 present the effect of the financial gap on the return on the stock or YTD, given its interaction with the loan loss provision ratio and vice versa. In table 4.18, it appears that as long as the financial gap ratio is low, its interaction with loan loss provision ratio has a positive impact on the YTD. When it increases and exceeds a certain value, its joint effect with LLPR decreases the market performance of the bank. Similarly, in table 4.19 the same result appears, but the other way around, such that the joint effect of low levels of LLPR with FG has a positive impact on YTD, while the impact of high levels of provisions on FG seems to negatively impact the stock return. Banks with high financial gap ratios want to chase higher returns, so they tend to lend out more risky loans to increase their net interest margins. Consequently, it would increase the market funding to cover the increase in FG ratio. Besides, riskier loans require higher provisions. This makes the relation between financial gap and loan loss provision inversely related to market performance.

The interaction term that captures the combination of loan loss provision and liquid assets to total assets ratio (LLPR*LATA) is in Model 6.D. Its coefficient is positive and highly significant to

market performance. Tables 4.20 and 4.21 present their interaction, based on different values given for each variable. Table 4.20 shows that the loan loss provision ratio, at low levels, has no impact on LATA relationship with the stock return. Yet, at higher levels, its interaction with the liquidity ratio causes the return of the stock to shift upward.

Table 4.21 shows that the joint effect of the LATA with LLPR decreases the stock return at low levels of liquid assets. At a higher level of liquid assets, the latter interaction positively affects market performance. It is worth mentioning that LATA did not affect the accounting or market performance in any of our previous models. However, it is clear that it has a non-linear impact on market performance, only when it is combined to loan loss provision ratio. Our findings reveal that when liquid assets are high along with sufficiently high level of loan loss provisions, then investors find it best to invest in a bank that satisfies their liquidity needs and keep their investment secure, through increasing the buffer on any possible defaults. Hence, higher investments boost the stock return.

To put it simply, market performance is affected by the type of risk management and combination of variables. When loan loss provision ratio is kept in check along with the financial gap ratio, the poorer the management, the higher the market performance. When the loan loss provision ratio is controlled along with liquid assets to total assets ratio, then the greater the management effort, the greater the market performance.

4.6. Conclusion

This chapter reports and discusses the empirical findings of our research. Our study investigates the relationship between both liquidity risk and credit risk with banks' market and accounting performances, in the MENA region over the period 2010-2018. First, we investigate, separately, the impact of each risk management on both accounting and market performances. Then, we examine the joint impact of credit risk and liquidity risk managements on the same dependent variables. The choice of the sample period aims at covering the most recent years after the financial crisis of 2008. The models are estimated through fixed effects regressions or OLS regressions. Models include not only credit and liquidity risk explanatory variables, but also bank-specific and macroeconomic factors. Descriptive statistics were performed with reported values of the mean and standard deviation of the whole tested sample. Diagnostic tests were carried to ensure satisfactory

multiple linear regression assumptions, such as stationarity, normality, serial autocorrelation, heteroscedasticity, and multicollinearity tests.

The main results achieved are mostly consistent with several existing studies. The regression outcome of the first credit risk test confirms partially our hypotheses, such that we did not find any significance of non-performing loans on accounting performance, but rather on market performance of banks. There exists a non-linear U-shape relationship between non-performing loans and return on stock. NPLR at low levels reflects significant credit risk management efforts, and impact negatively the market performance down to a certain level. After that, an increase in non-performing loans ratio, which reflects a weaker credit risk management would affect positively the market performance. In other words, the higher the credit risk management efforts, the lower the profitability of banks and vice versa.

Our second hypothesis assumed a negative impact of liquidity risk management on the accounting and market performances of the MENA region banks. Our results show that liquidity risk management variables (financial gap ratio and liquid asset to total asset ratio) have no significant impact on neither accounting performance nor market performance. However, when credit risk and liquidity risk management efforts are combined, significant and important findings are generated. Our third hypothesis aims at investigating the effect of the joint management of credit and liquidity risk factors on the performances of the bank. Our findings can be summarized as follows:

- The interaction of loan loss provision with financial gap ratio has a negative impact on both performances of the bank. Financial gap ratio shows a significant, concave or inverse U-shape relationship with both accounting and market performances, despite the fact that it has insignificant impact on both performances when tested alone. This non-linear relationship suggests that as far as FG increases, accounting and market performances increase at a decreasing rate, reaching a turning point after which the FG becomes inversely related with both performances. Similarly, the high levels of loan loss provision ratio (which was insignificant to ROA and YTD when tested alone) seems to return a significant negative impact on both accounting and market performances. Therefore, a relaxed credit risk and liquidity risk management represented by low levels of LLPR and FG is required to improve profitability.
- The interaction of loan loss provision with liquid assets ratio has a positive impact on both performance of the bank. In fact, for low levels of loan loss provision, the interaction does

not influence neither the accounting performance nor the market performance. When liquid assets to total assets is low, it decreases market performance. For high levels of liquid assets to total assets (representing an increased effort of liquidity risk management) combined to high levels of loan loss provision ratios, the interaction improves ROA (accounting performance) and YTD (market performance). This means that a higher risk management, when large provisions are associated with more liquid assets, contributes to improving the ROA and YTD.

Among the control variables, we found that the size of a bank, in general, positively impacts the accounting and market performance in a non-linear relationship. Large banks have less cost of funding which encourage them to invest in riskier assets, which is translated into higher performance. However, the effect of the size of a bank is positive up to a certain limit, considered as an optimal size level. Beyond this level, size² has a negative effect on performances as reflected by the non-linear relationship between size and performance. Additionally, operational risk has a negative impact on the market performance of the bank. This result suggests that investors hesitate to invest their wealth in banks that incur high expenses due to operational activities. As for macroeconomic factors, the only driver for a higher return on assets is the prime lending rate. This positive relation denotes that when macro-economic stability is achieved and appropriate lending policy is applied, bank performance will increase.

Chapter five: Conclusion

5.1. Introduction

This thesis aims at investigating the impact of liquidity and credit risk management on banks' market and accounting performances. Section two of the present chapter summarizes the result of the whole study, while section three exposes the limitations of the research. The theoretical and practical implications are discussed in section four. Finally, areas for future research are suggested in section five.

5.2. Summary of the Findings

This study examines the effect of liquidity and credit risk management on the performance of commercial banks operating in the MENA region for a period ranging from 2010 to 2018. The bank performance models divide the determinants of financial performance into credit and liquidity risk variables, bank-specific factors, and macroeconomic factors. The results of this study are both similar and dissimilar to previous literatures in the way how risk management affects banks' performance. In summary, the relationship depends on three criteria: (1) risk management measures; (2) financial performance measure; and (3) risk management interaction.

First, regarding the impact of credit risk management on accounting and market performances, it is important to distinguish between the impact of the non-performing loan ratio and the loan loss provision ratio as proxies for credit risk management. While there is no significant relationship between non-performing loans and accounting performance, there is a non-linear U-shape relationship between non-performing loans and market performance or return on stock. The latter suggests that low levels of non-performing loans, which reflect significant credit risk management efforts, impact negatively the market performance down to a certain level. Beyond this level, an increase in non-performing loans ratio reflecting a weaker credit risk management would affect positively the market performance. In other words, the higher the credit risk management efforts, the lower the profitability of banks and vice versa.

A part of our results (the downward-sloping part of the curve) support Serwadda (2018), Kaaya and Pastory (2013), Samad (2014), and Iftikhar (2016) who found negative relationship when testing the effect of non-performing loans on bank performance. With the convex relationship we identified

between NPLR and market performance, our models give more insights to Management with regard to the extent to which they should tight their credit risk management efforts.

Second, regarding the impact of liquidity risk management on both accounting and market performances of the MENA region banks, the contribution of this study is that it is the first to use the financial gap as a proxy for liquidity risk measure in studying its impact on banks' performance in the MENA region. Our results show that liquidity risk management variables have no significant impact on neither accounting performance nor market performance. However, when credit risk and liquidity risk management efforts are combined, significant and important findings are generated. The impact of risk management on bank performance depends on the type of risk management tools adopted by the bank.

In fact, we run different regression models with interaction terms that reflect the possible combinations of credit and liquidity risk management variables. Our results reveal that when combining credit and liquidity risk management efforts, many factors impact bank performance. In terms of bank-specific factors, the operational risk was found to negatively affect the market performance of the bank. Additionally, the size of the bank seems to impact both performances positively in a non-linear relationship, such that when banks' size increases beyond a certain level, it will cause the ROA and YTD to shift down. However, the size negatively impacts the ROA, only when it is regressed with liquidity risk factors. Regarding the macroeconomic environment variables, our regressions indicate that a high prime lending rate decreases the accounting performance or the return on assets of the bank.

Finally, regarding the joint effect of the interaction of credit risk and liquidity risk management on performances, the results show that there is a clear and significant interaction between both risks and the impact of the interaction depends on the type of risk management tools the bank adopts. First, the financial gap ratio shows a significant, concave or inverse U-shape relationship with both accounting and market performances. This suggests that as far as FG increases, accounting and market performances increase at a decreasing rate, reaching a turning point after which the FG becomes inversely related with both accounting and market performances. Logically, a bank that has no risk is a bank that does not perform well, since higher risk is linked with higher returns, and higher liquidity risk management costs squeeze its profitability. Our results contribute to the literature as to the best of our knowledge, there are no studies that used the FG to measure liquidity risk in assessing the bank performance in the MENA region. Furthermore, there are no studies that

investigated the impact of the interaction between credit risk and liquidity risk management on bank performance.

Similarly, the loan loss provision ratio also seems to return a significant impact on both accounting and market performances when we consider its interaction with both liquidity risk management variables. It is worth noting that when the LLPR was considered alone, it showed an insignificant impact on bank performances.

Likewise, the joint impact of loan loss provision ratio and financial gap ratio has a negative impact on both market and accounting performances. We show that for high values of loan loss provision and financial gap ratio reflecting a tightened credit and liquidity risk management, the interaction term yields a negative effect on both market and accounting performances. A relaxed credit risk and liquidity risk management represented by low levels of LLPR and FG would improve profitability.

On the other hand, when testing for an interaction between loan loss provision ratio as a proxy for credit risk management and liquid assets to total assets ratio as a proxy for liquidity risk management, it is found to be positive and highly significant with accounting and market performances. For low levels of both variables, their interaction does not influence neither the accounting performance nor the market performance of the bank. For high levels of liquid assets to total assets combined with high levels of loan loss provision ratios (representing an increased effort of liquidity and credit risk management), the interaction improves the accounting performance as well as the market performance. Hence, a tightened joint risk management improves banks' performance in this specific combination (i.e. LLPR and LATA).

To recapitulate, we reveal that the bank's performance depends on the combination of risk management tools that a bank choose to implement. When the bank adopts loan loss provision ratio as a credit risk management factor along with financial gap ratio as a liquidity risk management technique, they must relax their activities to achieve better performance. Nevertheless, if the bank controls loan loss provision ratio to the side of liquid asset to total asset ratio, they must keep their ratios high with tighter management practices to maintain high performances.

A summary of the findings associated with the hypotheses is presented in Table 5.1

Table 5. 1: Summary of findings

Hypotheses	Relationship Tested	Finding
Credit Risk and Accounting Performance	LLP→ ROA	Not Significant
	NPL→ ROA	Not Significant
Credit Risk and Market Performance	LLP→ YTD	Not Significant
	NPL→ YTD	Convex
Liquidity Risk and Accounting Performance	FG→ ROA	Not significant
	LATA→ ROA	Not significant
Liquidity Risk and Market Performance	FG→ YTD	Not Significant
	LATA→ YTD	Not Significant
Joint Impact of Credit and Liquidity risk on market and Accounting Performance	NPLR*FG→ROA	Not significant
	NPLR*FG→YTD	Not Significant
	NPLR*LATA→ROA	Not Significant
	NPLR*LATA→YTD	Not Significant
	LLLP*FG→ROA	Negatively significant
	LLLP*FG→YTD	Negatively significant
	LLLP*LATA→ROA	Positively significant
	LLLP*LATA→YTD	Positively significant

5.3. Limitations of the Research

The aim of our research is to contribute to the literature by giving insights to the upper management of banks, operating in the MENA region, about managing liquidity and credit risks and the extent to which these risk management efforts, whether applied separately or combined, can impact the accounting and market performances of banks. Unfortunately, our study, like any other research work, suffers from limitations. First, the tested sample was reduced due to the unavailability of data in some countries of the MENA region where the stock market is under-developed, hence, some banks were dropped from our initial list. The sample included 10 countries rather than 20 countries due to the inexistence or the very limited stock markets, political instability or war, and finally

considerable missing data. Second, this study focused only on the return on assets (ROA) as a bank accounting performance measure. Further research may involve a wider range of measures reflecting banks' accounting performance such as the return on equity, cost efficiency, or net interest margin (NIM). Third, the study does not incorporate bank-specific indicators that could affect the relationship between risk management and bank performance such as the ownership structure, overhead cost, market-to-book ratio, off-balance sheet activities, income diversification, and many others. Finally, due to some missing information, we have unbalanced panel data, which might reduce the scope of our findings but do not impair their quality.

5.4. Theoretical and Practical Implications

The results of this research have several significant theoretical and practical implications and provide recommendations for risk managers. As previously mentioned, recent trends of risk management activities drew attention to the need of specifying important variables that may capture changes in the quality of performance and protect the bank from liquidity and credit risks that may arise. The crisis of 2008 proved that a high credit risk in the portfolios of banks and the freeze in the market liquidity jointly contributed to the failures of large or too-big-to-fail financial institutions, leading to severe financial and economic crises. Our results show that the joint management of both risks can substantially improve performance. Hence, our interaction results encourage future research studies to further investigate the cause effect relationship between types of risk management other than credit risk and liquidity risk management to assess how beneficial is the combination of risk management efforts in terms of a bank's performance.

On a practical level, our findings may be of great help for investors and policy makers in the decision-making process. From policy-making perspective, this research proposes that policymakers must be aware of the trade-off between immunity to liquidity disturbances and the opportunity cost of keeping low-yielding liquid assets. Therefore, our findings reinforce the importance of the regulatory measures like Basel III accord and Dodd-Frank Act which stress the significance of credit quality management combined to liquidity risk management. Besides, monetary authorities have an obligation of reducing information asymmetry through controlling deposit insurance policies in order to decrease the risk of liquidity bank runs. It is an utmost priority to the bank to pay careful attention to problems of liquidity and credit risk, in order to determine the required level of the bank's intervention.

From the investor's perspective, this study is valuable due to insights it gives to investors who may have different perceptions of risk management efforts deployed by banks operating in the MENA region; therefore, our study provides them with a wider view of the credit risk and liquidity risk management tools and their impact on the market and accounting performances. Besides, investors' priority goes to magnifying their profits, which is possible if the stock return of the bank improves. Undeniably, the stock return is highly vulnerable to changes in credit and liquidity risk management efforts, as proved by our study. Therefore, investors must better understand the risk management techniques that determine the market performance of banks. They mostly have to observe the combined risk management efforts deployed by banks since the impact of interaction between these types of risk management is proved to be significant on banks' performance, and mainly market performance. Hence, our results are relevant for investors to guide them in their investment decision-making

5.5. Suggestions for Future Research

This study results in valuable empirical evidence for the significance of risk management implementation on banks' performance operating in MENA. It provides a basis for future research scenarios and avenues related to these issues. For instance, this study paves the way to extend the models through incorporating additional liquidity risk and credit risk variables. Moreover, the study focused on return on assets as a measure of performance. Further studies may include a broader view of performance (ex: return on equity, net interest margin). Also, other methods can be used to test for the interaction between credit and liquidity risk (ex: GMM method). Finally, future studies may focus on assessing other risk managements' impact on banks' performance such as market risk management, interest rate risk management, and operational risk management.

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Appendix

List of banks in each country of our sample.

Country	List of Banks
Lebanon	<ol style="list-style-type: none"> 1. Audi Bank 2. Blom Bank 3. Byblos Bank 4. Bank of Beirut 5. Bank Bemo
Saudi Arabia	<ol style="list-style-type: none"> 1. Saudi Fransi 2. Arab National Bank 3. Riyadh Bank 4. Samba Financial Bank 5. Saudi British Bank 6. Saudi Investment 7. Al Awal Bank
Kuwait	<ol style="list-style-type: none"> 1. Al Ahli Bank of Kuwait 2. Gulf Bank of Kuwait 3. National Bank of Kuwait 4. Burgan Bank
Malta	<ol style="list-style-type: none"> 1. Fimbank 2. HSBC Malta 3. Bank of Valleta
Jordan	<ol style="list-style-type: none"> 1. Arab Bank 2. Jordan Kuwait Bank 3. Bank of Jordan 4. Arab Banking Corporation Jordan 5. Cairo Amman Bank 6. Capital Bank of Jordan 7. Jordan Commercial Bank 8. The Hsg Bank for Trading and Finance 9. Jordan Ahli Bank
UAE	<ol style="list-style-type: none"> 1. Commercial Bank International 2. National Bank of Fujairah 3. National Bank of Ras Alkhaimah 4. Commercial Bank of Dubai 5. United Arab Bank 6. National Bank of Um Al Qawain 7. Invest Bank
Oman	<ol style="list-style-type: none"> 1. Bank Dhofar

	<ol style="list-style-type: none"> 2. Sohar International Bank 3. Hsbc Bank Oman
Egypt	<ol style="list-style-type: none"> 1. Union National Bank 2. Society Arab International De Banque 3. Credit Agricole Egypt 4. Suez Canal Bank 5. Qatar National Bank Al Ahli 6. National Bank of Kuwait 7. Commercial International Bank Egypt
Bahrain	<ol style="list-style-type: none"> 1. Ahli United Bank 2. Bbk 3. Ithmaar Bank 4. National Bank of Bahrain
Qatar	<ol style="list-style-type: none"> 1. Masraf Al Rayan 2. Al Khaleeji Commercial Bank