MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

ECOLE SUPERIEURE DE COMMERCE

-KOLEA-

End-of-cycle dissertation for the purpose of obtaining a Master's Degree in Financial Sciences and Accounting

Major: Corporate Finance

Topic:

The impact of liquidity risk on the performance of Algerian banks

Submitted by: **Supervised by:**

Imene SLIMANE   **Dr. Billel BENILLES**

                                                          Dr. Abdelkrim KRIMI

Location of the internship: BNP PARIBAS El DJAZAIR Bank, Quartier d'Affaires Bab Ezzouar, Algiers

Duration of the internship: From 12/02/2023 to 31/05/2023

2022-2023

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Acknowledgment

Dedication

I dedicate this work

To **my parents**, the two extraordinary souls who have been my guiding light, a constant source of joy and courage, and the dearest individuals in my life. Your prayers and blessings have been my armor, shielding me from life's challenges and leading me to success. I devote my life's accomplishments, delights, and successes to both of you today and every day. I am eternally grateful for your presence in my life.

To my siblings **Abdelmalek**, **Lilia**, and **Dina**, you are more than just a family; you are my closest allies and my greatest blessings. I value the bond we have and, I am grateful for the endless connection we share.

To my beloved aunt **Hakima**, for always being willing to share her knowledge. I sincerely appreciate everything you've done for me.

To every pure soul I know

To me, for believing in me, for being strong at times of weakness and finding the courage to endure, and for always remaining devoted, determined, and confident in my abilities. I am excited to see what the future holds for me.

"Genius is one percent inspiration, ninety-nine percent perspiration."
— Thomas A. Edison

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Abbreviation	Signification
BAD	Banque Algérienne de Développement
BCBS	Basel Committee on Banking Supervision
BCIA	Banque Commerciale et Industrielle d'Algérie
CAMEL	Capital adequacy; Asset quality; Management quality; Earrings; Liquidity
CBA	Central Bank of Algeria
CFP	Contingency Funding Plan
CNES	Centre National d'Etudes Spatiales
CNRC	Centre National du Registre du Commerce
DEA	Data Envelopment Analysis
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortization
ECB	European Central Bank
EF	Efficient Structure
FDH	Free Disposal Hull
FNI	Fonds National d'Investissement
FSI	Financial Stability Institute
GLS	Generalized Least Squares
HQLA	High Quality Liquid Assets
IMF	International Monetary Fund
LMC	Law on Money and Credit
MENA	Middle East and North Africa
OLS	Ordinary Least Squares
PAA	Prudential Allocations of Assets
PCSE	Panel-Corrected Standard Errors
SCP	Structure-Conduit Performance
SOCB	State-Owned Commercial Banks
SOE	State-Owned Enterprises
VIF	Variance Inflation Factor

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Abstract

This research aims to examine the impact of liquidity risk on the performance of Algerian banks. The study utilizes a sample of all functioning banks in Algeria, comprising twenty (20) banks, over a period of ten (10) years from 2010 to 2019. To achieve this objective, the panel data regression method is employed, considering both individual and temporal dimensions. We investigated the influence of several variables on the performance of banks, measured by the return on assets (ROA) ratio. The latter represents the variable to be explained in the model. Three of the explanatory variables are liquidity risk indicators, while the remaining four are other determinants of the performance of banks. The result of the multivariate analysis revealed that liquidity risk, measured by the liquid assets, financing gap, and transformation ratios, has a significant and positive impact on the performance of Algerian banks. As for the other determinants, the findings showed a significant positive relationship between ownership structure, diversification, gross domestic product growth, and the performance of Algerian banks, along with a significant negative relationship between the variable operational expenses and Algerian banks' performance.

Keywords: Liquidity risk; Banking performance; Panel data; Algerian banks.

Résumé

Cette recherche vise à examiner l'impact du risque de liquidité sur la performance des banques algériennes. L'étude utilise un échantillon de toutes les banques fonctionnant en Algérie, comprenant vingt (20) banques, sur une période de dix (10) ans de 2010 à 2019. Pour atteindre cet objectif, la méthode de régression sur données de panel est employée, en tenant compte à la fois des dimensions individuelles et temporelles. Nous avons examiné l'influence de plusieurs variables sur la performance des banques, mesurée par le ratio de rendement des actifs (ROA). Ce dernier représente la variable à expliquer dans le modèle. Trois des variables explicatives sont des indicateurs de risque de liquidité, tandis que les quatre autres sont d'autres déterminants de la performance des banques. Les résultats de l'analyse multivariée ont révélé que le risque de liquidité, mesuré par les ratios des actifs liquides, de l'écart de financement et de transformation, a un impact significatif et positif sur la performance des banques algériennes. En ce qui concerne les autres déterminants, les résultats ont montré une relation significativement positive entre la structure de propriété, la diversification, la croissance du produit intérieur brut et la performance des banques algériennes, ainsi qu'une relation négative significative entre la variable des dépenses opérationnelles et la performance des banques algériennes.

Mots-clés: Risque de liquidité; Performance bancaire; Données de panel; Banques algériennes.

GENERAL INTRODUCTION

GENERAL INTRODUCTION

The banking sector is critical for the financial system's stabilization, and it is one of the most substantial sectors due to its significant role in sustaining and stimulating the economy. It supports economic development and progress by facilitating the flow of funds and ensuring that financial resources are allocated effectively.

Banks emerged as one of the most essential providers of funds for businesses. As a result, the banking system serves a crucial role in society, and its performance is a severe determinant of a country's financial health. A bank's primary function is to enable the movement of funds between its lenders and depositors. However, their intermediation status exposes them to an array of risks referred to as "banking risks," such as credit risk, market risk, and liquidity risk.

Banks are inherently exposed to liquidity risk due to the maturity transformation of short-term deposits (liquid liabilities) into long-term loans (illiquid assets). Hence, they face the tradeoff between maintaining liquid assets to reduce their exposure to liquidity risk and investing in illiquid assets that generate greater returns. Consequently, the issue in liquidity management is striking a balance between liquidity and profitability.

The 2007 financial crisis put considerable strain on the banking system, emphasizing the necessity of liquidity to ensure the functioning of financial markets and the banking sector. The change in market circumstances demonstrated how quickly liquidity may drain and how long illiquidity can continue (BCBS, 2008, p. 01). As a result of this turmoil, financial bodies such as the Basel Committee on Banking Supervision have developed a series of international standards for bank regulation, most notably its landmark publications of the capital adequacy accords known as Basel I, Basel II, and most recently, Basel III, which displayed for an international framework for liquidity risk measurement, standards, and monitoring.

According to Basel Committee on effective banking supervision, liquidity risk arises from the inability of a bank to accommodate decreases in liabilities or to fund increases in assets. When a bank has inadequate liquidity, it can obtain sufficient funds, either by increasing liabilities or by converting assets promptly, at a reasonable cost, thereby affecting profitability. In extreme cases, insufficient liquidity can lead to the insolvency of a bank.

Since the subprime mortgage crisis, liquidity risk and its influence on banks' performance have been an increasingly prominent topic in the financial literature. Therefore, several studies on the subject have been conducted, including a recent study by Thi Xuan Huong et al. (2021) for banks in 9 Southeast Asian countries from 2004 to 2016, Chen et al. (2018) for commercial banks in 12 advanced economies from 1994 to 2006, Marozva (2015) for South African banks between 1998 and 2014, Ruziqa's (2013) study for Indonesian conventional banks from 2007 to 2011, and Arif and Anees (2012) for Pakistani banks from 2004 to 2009. All of these researchers have found that liquidity risk influences banks' performance.

The liquidity problem in both developed and developing countries has become a severe concern; it appears that the concept of liquidity is more widespread than ever. Algeria, as a developing country with 20 banks, requires an alert system to foresee the impact of this sort of risk on the financial health of Algerian banks.

GENERAL INTRODUCTION

Although there have been several studies on the issue in other countries throughout the world, there are only a few studies on the influence of liquidity risk on the performance of Algerian banks. In this sense, the consequences of this risk in Algeria remain unclear. As a result, the need to investigate this topic as the focus of our dissertation appears crucial.

The purpose of this research is to examine the effect of liquidity risk on the performance of Algerian banks from 2010 to 2019.

In this context, we present our research problem, which is centered on the question:

« What effect does liquidity risk have on the performance of Algerian banks? »

This main question prompts the following sub-questions:

- How does liquidity risk influence the performance of Algerian banks?
- Are there any other factors that impact the performance of Algerian banks?
- Are the characteristics of Algerian public banks different from those of Algerian private banks?

To address the issue, a set of hypotheses can be formulated as follows[*]:

- H1: Liquidity risk has a detrimental influence on the performance of Algerian banks.
- H2: There are other determinants that can explain the performance of Algerian banks.
- H3: Algerian public banks' characteristics differ from those of Algerian private banks.

The choice of this topic was made for both personal and objective reasons. These are summed up as follows:

- The appropriateness of the research theme to my specialty;
- Enhancing econometric knowledge;
- The importance of Algeria's banking sector to the country's development;
- Its value and the lack of research on it in Algeria.

Two approaches will be utilized to solve the fundamental problem, each of the secondary questions, and examine the validity of the hypotheses: the descriptive approach and the analytical approach. We conducted documentary research in which we were able to consult and investigate many works such as publications, books, and websites to get as much information as possible on this work. The empirical element of the study will be based on an analysis of a sample of the Algerian banking sector comprising 20 banks, 14 private banks, and 06 public banks from 2010 to 2019[**], using a linear regression model on panel data.

This dissertation will be divided into two parts. The first part will consist of two theoretical chapters. The initial chapter will introduce general concepts on banks' performance, liquidity, and liquidity risk, as well as international liquidity prudential regulation (Basel III) and

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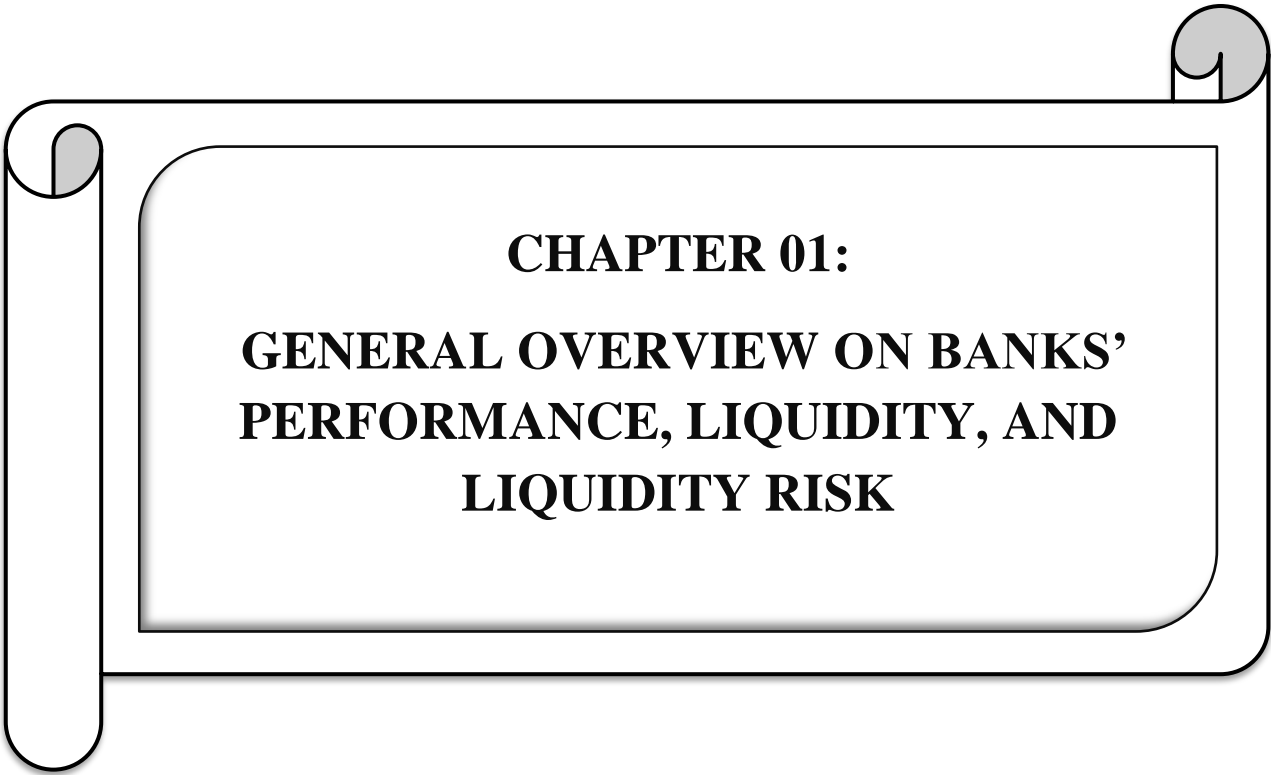
[*] Hypotheses H1 and H2 will be further elaborated in the second section of the third chapter.

[**] In 2021, the Algerian banking market consisted of nineteen (19) banks after the withdrawal of accreditation No. 07-02 issued to Banque Calyon Algérie- Spa on May 9, 2007. In 2022, the banking sector witnessed the establishment of a new bank specializing in housing finance.

GENERAL INTRODUCTION

Algerian prudential regulation. The second chapter will present a theoretical and empirical literature review on the impact of liquidity risk on the performance of banks. Subsequently, a discussion of other variables that can affect the performance of banks will take place. This chapter will also feature some findings from prior research on the issue.

The third chapter will be devoted to empirical validation of the influence of liquidity risk on the performance of banks, which will be conducted on a sample of twenty Algerian banks from 2010 to 2019. The first section of this chapter will focus on presenting and analyzing the Algerian banking sector. The second section will be dedicated to the methodological approach and the presentation of the chosen variables. Finally, the third section will be relied on to estimate the model and interpret the results.

CHAPTER 01:

GENERAL OVERVIEW ON BANKS' PERFORMANCE, LIQUIDITY, AND LIQUIDITY RISK

CHAPTER 01: GENERAL OVERVIEW ON BANKS' PERFORMANCE, LIQUIDITY, AND LIQUIDITY RISK

Introduction

Banks are the most crucial component of any financial sector, performing critical roles on both sides of the balance sheet. On the asset side, they increase the flow of funds by lending to cash-strapped users of funds, while on the liability side; they provide liquidity to savers (Diamond and Rajan, 2001).

Banks face a variety of risks as financial intermediaries, including credit risk, liquidity risk, capital risk, and interest rate risk. Several banks encountered difficulties during the recent global financial crisis due to their failure to manage liquidity prudently. As a result, the crisis highlighted the importance of liquidity to the proper operation of financial markets and the banking performance (BCBS, 2013).

In this chapter, we will attempt to clarify the fundamental concepts required to comprehend banking performance, liquidity, and liquidity risk. It is organized in the following manner:

➢ **Section 01:** General concepts on the performance of banks
➢ **Section 02:** General concepts on bank liquidity
➢ **Section 03:** General concepts on bank liquidity risk

CHAPTER 01: GENERAL OVERVIEW ON BANKS' PERFORMANCE, LIQUIDITY, AND LIQUIDITY RISK

Section 01: General concepts on the performance of banks

To study the effect of liquidity risk on the performance of banks, we must first explain and define the notion of performance in general. The target of this section will be to clarify the concepts required to complete our study; therefore, it will include theoretical notices on performance, and its various types, followed by a discussion of performance measurement.

1. Definition of performance

According to Krause (2006, p. 20), the term "performance" refers to the degree of achievement of objectives or the potential achievement of important characteristics of an organization for the relevant stakeholders. As a result, performance is primarily defined by a multidimensional set of criteria. The actions of participants in business processes are the source of performance.

Bourguignon (1995, p. 62) categorized the meaning of the word performance into three primary meanings, namely:

- Performance is a success: performance is a function of representations of success, which vary according to enterprises and actors.

- Performance is the result of the action: there is no value judgment in this sense, in which performance assessment is defined as the ex-post evaluation of results.

- Performance is action: performance is a process rather than a result that appears in a moment in time.

Samsonowa (2012, p. 25) found that, according to Grüning (2002), performance is dependent on both outcomes (over or underperformance) and goal setting.

Figure No. 01: Performance as goal attainment
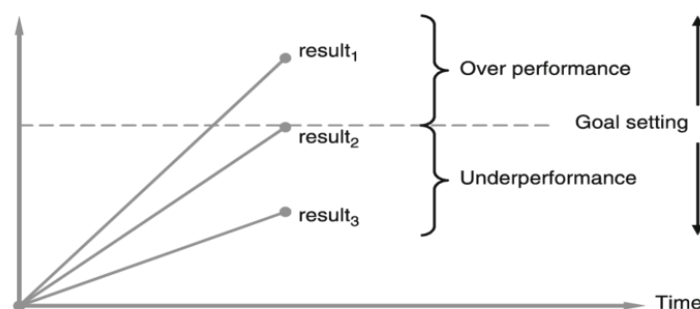
Source: Grüning (2002) extracted from (Samsonow, 2012, p. 25)

Level (-1): this is the level of underperformance. The company goes through a process to achieve its intended goals and strives to achieve them.

Level (0): the performance level, in other words, the degree to which the goal is achieved. This is the stage where the company successfully achieves the set goals.

Level (1): the over performance level, also known as the excellence level. At this level, the company has exceeded its expectations of simply achieving its goals and has achieved even better results.

Bouquin (2004, p. 63) represents the general problem of performance in the following way:

Figure No. 02: The general problem of performance
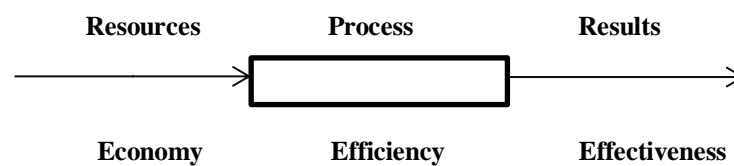
Source: Bouquin (2004, p. 63)

Economy: provides data on the price of the resources used to achieve the goal. Resources must be obtained at the lowest possible cost.

Efficiency: means minimizing the resources used to achieve a given result. In other words, it is a matter of achieving the goals at the lowest possible cost. By efficiency, we mean the absence of waste in the effective use of resources (human, technical, financial, and other).

Effectiveness: concentrates on identifying and completing the appropriate tasks promptly as possible. A highly effective organization pays particular attention to its strategy and goals to ensure that the firm's long-term and tactical goals are met. The effectiveness of a process or installation is determined by comparing what it can produce with what it produces.

2. Types of performance

According to Lallé (1992) there are five types of performance, namely economic, technical, managerial, commercial, and social performance.

- **Economic performance:**

Economic performance provides data on the company's current situation, such as turnover, added value, operating result, and net result. This performance reflects the company's ability to create wealth and value over time by establishing clear, realistic, and quantifiable goals. There are two components to assess this type of performance (Lallé, 1992, p. 15):

  o A short-term component: based on immediate results indicators specifically chosen to reflect the company's activity.
  o A medium- and long-term component: related to the goals of creating actions that will have a positive effect in the future: staff training, integration of new techniques, or product innovation.

- **Technical performance:**

Technical performance refers to how effectively a company uses its available resources, the degree of innovation in its management system, and the products and services it produces. As a result of the technical performance, two factors have been highlighted: the human factor and the technical factor, in which, the corporation must maximize its performance, profitability, and productivity while utilizing its human and technical resources to the greatest extent possible. Banks are now required to implement a variety of innovative methods to preserve their competitiveness in a market characterized by massive financial and technological developments.

- **Managerial performance:**

Managerial performance can be defined as the ability of the manager to manage time allocation and coordinate the three key elements: the spirit of design, execution skills, and the conciliation and management of contradictions (Frioui, 2001). This performance may also be a reflection of the management team's success in attaining its objectives. In the banking industry, there are a variety of hierarchical relationships, and teams with a significant number of individuals typically work together to complete tasks. To manage a team and guide it toward the accomplishment of the established goals, the manager must possess the traits of a leader. The bank's ability to operate effectively and profitably is a direct result of the effectiveness of its human resources.

- **Social performance:**

Bayed (1992, p. 381) defines social performance as the level of satisfaction attained by the individual participating in the life of the organization. Several indicators and criteria can be used to evaluate this performance:

- Staff satisfaction, assessed by surveys and opinion polls;
- The recurrence of social crises within the bank, such as strikes, absenteeism, and internal conflicts;
- The nature of social relationships and the effectiveness of collective decision-making.

Human resources are a critical pillar in a bank, from which it integrates departments dedicated to career management and recruitment of its human resources to attract and retain competent individuals.

- **Commercial performance:**

Commercial performance can be defined as a company's capacity to satisfy its customers' needs by offering products and services that meet consumer expectations while keeping in mind the competition. According to Venkatraman and Ramanujam (1986), to measure this type of performance, we need to use several indicators, such as market share, sales growth, marketing effectiveness, and profitability by: a customer, a product, market, etc.

- **Organizational performance:**

According to Kalika (1988, p. 340), organizational performance is defined as "measures that relate directly to organizational structure and not to its potential social or economic consequences." Within this framework, this author explained organizational effectiveness using four factors:

- o Respect the formal structure: failure to adhere to the previously defined structure by the company can lead to organizational dysfunction and problems;
- o Relations between departments: the company must focus on minimizing conflicts and their triggers to facilitate coordination between its various departments;
- o The quality of the information flow: the development of efficient and effective information systems allows an optimal flow of information within the organization;
- o The flexibility of the structure: the company must be able to adapt and respond to various constraints.

Within a bank, to properly carry out its missions, the bank must be diligent, and the tasks of each department must be evident, understandable, and recognized by all so that the bank's operations are regular and per the objectives and expectations set previously.

3. Measurement of performance

According to Barr (2014, p. 16), performance measurement is "a process, not an event. It is a series of steps in which we choose what to measure, define how we'll calculate our measures, get the data, analyze the data to produce our performance measure values, graph and report our measures to highlight signals of performance changes, interpret these signals, and use this information to take meaningful action to improve organizational performance."

A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions (Neely, 2005).

3.1 Performance measurement principles

Maskell (1991, p. 19) provides seven performance measurement system design principles:

- Non-financial measures should be embraced;
- It should be acknowledged that measures differ by location; one measure is not appropriate for all departments or sites;
- It should be recognized that measures change as circumstances change;
- The measures should be simple and easy to use;
- The measures should provide quick feedback;
- The measures should encourage continuous improvement rather than simply monitoring.

3.2 Performance measurement criteria

According to studies, the most well-known performance measurement framework is Kaplan and Norton's (1992) "balanced scorecard[*] " (Figure No. 03). It is based on the principle that a performance measurement system should provide managers with sufficient data about (Neely, 2002, p. 147):

- Financial perspective: concentrate on financial performance;
- Customer perspective: consider customers' satisfaction and needs;
- Internal business perspective: search for efficiency and a source of competitive advantages;
- Innovation and learning perspective: the organization's performance and workforce management.

Figure No. 03: Kaplan and Norton's balanced scorecard
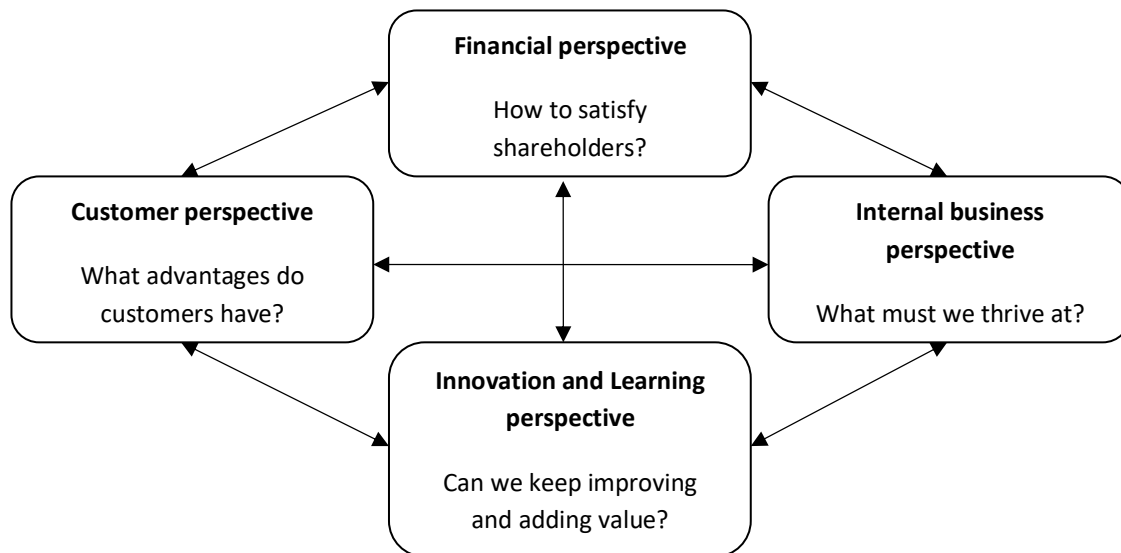
Source: Kaplan and Norton (1992), extracted from (Neely et al., 2005, p. 1244)

According to Neely's et al's (2005) article, the balanced scorecard has a critical flaw in that if a manager implemented a set of measures based strictly on it, he would be unable to answer one of the most fundamental questions of all: what are our competitors doing (the competitor's perspective)?

Other authors, rather than proposing frameworks, prefer to provide criteria for performance measurement system design. Globerson (1985, p. 640), for example, presents the following guidelines for selecting a preferred set of performance criteria:

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[*] A balanced scorecard is a strategic dashboard whose goal is to translate a company's strategic objectives into a coherent set of performance measures; it complements the financial measures with operational measures (Kaplan and Norton, 1992).

- Performance criteria must be drawn from the company's goals;
- Performance criteria must allow for the comparison of organizations in the same industry;
- Each performance criterion must have a clear purpose;
- The methods for collecting data and calculating the performance criterion must be clearly defined;
- Absolute numbers are preferred to ratio-based performance criteria;
- The evaluated organizational unit should have control over the performance criteria;
- Performance criteria should be chosen in consultation with the individuals engaged (customers, employees, and managers);
- Subjective performance criteria are preferable to objective performance criteria.

3.3 Performance measurement purposes

A performance measure quantifies a significant outcome that can impact an organization's success or achievement of its strategic goals. These measures are typically tracked regularly over time so that changes can be detected and addressed quickly (Barr, 2014, p. 98). According to Neely (2002, p. 176), performance measures were required for the following purposes:

- To monitor and control;
- To drive improvement;
- To maximize the effectiveness of the improvement effort;
- To achieve alignment with organizational goals and objectives;
- To reward and discipline (to a lesser extent).

Furthermore, an integrated performance measurement system should include the following features:

- Indicate stakeholder requirements to maximize stakeholder satisfaction;
- Concentrate on the competitive standards of the organization's markets and implement strategies and actions that enhance the organization's competitive position;
- Encourage intelligent and logical performance planning based on constraint management;
- Accommodate both quantitative and qualitative measures;
- Guarantee that measures are used at the appropriate levels;
- Facilitate simple reporting - demonstrating patterns where possible;
- Be dynamic and adapt to changes in the organization's internal and external environments.

3.4 Performance measurement difficulties

According to Barr (2014, p. 43), well-designed measurements provide the organization with precise and current data about how things are performing. As a result, they are much more likely to reach the target with decisions and actions to improve things. As an organization becomes better at measuring performance, performance improvement occurs more quickly and easily, and the organization accelerates toward performance excellence, fulfilling its mission and achieving its vision. This author provided a sample of some common symptoms of a broken performance measurement process:

- There are too many performance indicators;
- The emphasis is on financial measures rather than non-financial measures.
- Existing metrics are incompatible with the strategic direction, team goals, or purpose;
- Manual data collection is time-consuming;
- The collected performance data is inconsistent, incomplete, or not gathered in a timely enough manner to be used in decision-making;
- There are insufficient resources to collect data for new performance measures;
- Too much time is spent gathering data, and not enough time is spent analyzing it;
- Performance data is difficult to extract from data repositories such as database systems, spreadsheets, and paper-based records;
- Because disparate data sources do not communicate with one another, data merging is not possible;
- Inconsistency exists in how and when measures are reported;
- Producing performance reports takes time;
- Targets are established before the definition of performance measures or the measurement of the performance baseline;
- Performance conclusions are drawn by comparing this month to the previous month, the same month last year, or a target;
- Performance measures are ignored when determining which performance improvement actions or initiatives to invest in;
- Decision makers are unable to agree on (or disagree on) the appropriate actions taken in response to performance data.

3.5 Performance metrics

Banks' performance can be measured using a variety of instruments; a distinction can be made between the intermediate management balances (Nouy, 1993, p. 467), financial and economic measures of performance (ECB, 2010, p. 08).

3.5.1 The intermediate management balances

These balances are derived from the bank's income statement, which includes its revenues and expenses:

- **Net banking income (NBI):**

Net banking income is the difference between a bank's operating revenues and expenses. It considers all aspects of banking activity in terms of services and financial intermediation. Operating revenues are made up of interest and commissions, excluding interest on doubtful debts but including provisions and recoveries for depreciation of investment securities as well as gains or losses on securities. Net banking income is used to fund the bank's various overheads and risks and to determine bank value.

- **Gross operating income (GOI):**

This balance represents the margin derived from the bank's current activity after deducting operating costs. The latter are frequently referred to as "general costs." They are composed of staff costs, other general costs, and depreciation charges. It depicts the wealth that the bank generated solely through its operating cycle.

- **Operating income (OI):**

It is also called "Earnings before interest and taxes (EBIT)". The total profit earned from a bank's ongoing operations except for interest and income tax expenses is reported as operating income. It is calculated by subtracting depreciation, amortization, and other operating expenses from gross operating income.

- **Net result (NR):**

Net result (income) or net profit/loss refers to the bank's total gain or loss after deducting taxes and other expenses (financial and exceptional). It measures a bank's profitability after accounting for all costs and expenses for a given period. This profit can be distributed to shareholders as dividends or kept in the bank's reserves to be reinvested in more profitable future projects.

3.5.2 Financial measures of performance

- **Return on assets (ROA):**

Return on assets is a profit ratio that shows how much profit a bank can make from its assets. In other words, ROA assesses how efficacious a bank's management is at profiting from its economic resources or assets on its balance sheet. Banks with a low ROA typically have more assets involved in profit generation, whereas banks with a high ROA usually have fewer assets. According to Rivard and Thomas (1997), return on assets is the best measure of profitability since it is not impacted by high equity multipliers. It is the net income for the year divided by total assets (ECB, 2010). Numerous authors used this metric as a bank profitability proxy, such as Staikouras and Wood (2004), Saeed and Rahman (2015), and Toufaili (2019).

$$ROA = \frac{\text{Net Income}}{\text{Total Assets}}$$

- **Return on equity (ROE) :**

Return on equity is an internal performance measure of shareholder value; it is by far the most popular measure of performance because it proposes a direct assessment of the financial return on a shareholder's investment, is easily accessible to analysts, relies solely on public information, and allows for comparison between different banks or sectors of the economy (ECB, 2010). The higher a bank's ROE, the better it is at converting equity financing into profits. Among the researchers who employed ROE as a profitability measure are: Anbar and Alper (2011), Muriithi and Waweru (2017), Golubeva et al. (2019), etc.

$$ROE = \frac{\text{Net Income}}{\text{Total Equity}}$$

- **Net interest margin (NIM):**

Net interest margin is a proxy for the ability of banks' intermediation functions to generate income (ECB, 2010). It is a metric that compares the net interest income generated by a bank from credit products such as loans and mortgages to the interest paid to holders of savings accounts and certificates of deposit. Thus, NIM concentrates on the bank's typical borrowing and lending operations. A positive NIM indicates that an entity is profitable, whereas a negative figure indicates inefficient investment. Kosmidou et al. (2005), Lee and Hsieh (2013), Chen et al. (2018), and others have used NIM as a profitability indicator.

$$NIM = \frac{Interest\ Income\ -\ Interest\ Expenses}{Total\ Assets}$$

- **Cost-to-income ratio:**

The cost-to-income ratio illustrates the institution's ability to generate profits from a specific revenue stream. The numerator does not include any charges for impairment (ECB, 2010).

$$Cost - To - Income\ ratio = \frac{\text{Operating Expenses}}{\text{Operating Revenues}}$$

- **Return on investment (ROI):**

Return on investment (ROI) is the primary metric for calculating profit from any investment. It helps determine the current or potential return on investment, whether you are assessing the stock portfolio's performance, considering a business investment, or deciding whether to embark on a new project. It is calculated by dividing net income by total assets invested in the business (Satish and RAO, 2010, p. 76).

$$ROI = \frac{\text{Net Income}}{\text{Total Assets Invested In The Business}}$$

3.5.3 Economic (Non-financial) measures of performance

In economics, performance is measured using efficiency scores, which show the gap between a given bank's position and the best practice bank. According to Briki (2017, p. 207) efficiency frontier estimation methods are classified into two broad categories:

- **Non-parametric methods:**

The non-parametric approach has been extensively utilized through two main methods: data envelopment analysis (DEA) and free disposal hull (FDH) to evaluate banking efficiency. They require the nature of the returns to scale (constant or variable) and the orientation of the linear problem (input or output). The model optimization produces a virtual efficiency frontier representing the best possible practice. It provides information about the lowest quantity of input that can be used (given outputs) or the highest quantity of output that can be produced (given inputs) (Berger and Humphrey, 1997). The main disadvantage of these methods is the assumption of no random error in the efficiency measure, whereas parametric methods separate the inefficiency term from the random error. Guillen et al. (2014) and Balcerzak et al. (2017) are among the writers who employed this method.

- **Parametric methods:**

In contrast to non-parametric methods, parametric methods necessitate the specification of the cost and profit functions, which represents the existing relationship between the inputs, outputs, and environmental variables (Berger and Humphrey 1997). According to Berger and Mester (1997, p. 897), three concepts provide the best economic foundation for analyzing financial institution efficiency: cost efficiency, standard profit efficiency and alternative profit efficiency.

Section 02: General concepts on bank liquidity

What are the roots causes of economic downturns? What causes financial markets to crash? Why do banking panics occur? What factors contribute to currency crises? All of these are intriguing and important questions that have received a lot of attention. Each of these crises has been linked to liquidity issues in some way and shares many similarities.

This section will focus on the concept of bank liquidity, its factors, and its relation to solvency and profitability, pursued by the liquidity regulatory framework.

1. Definition of bank liquidity

Liquidity is an essential aspect of the smooth operation of banking activities. In fact, liquidity is critical to a bank's growth, development, and survival. The Basel Committee (2008, p. 01) defined bank liquidity as "the ability of a bank to fund increases in assets and meet its liabilities as they fall due without incurring unacceptable losses." In other words, a bank's liquidity is determined by its assets and liabilities.

Liquidity emerges from a variety of economic perspectives. It can be defined as how easy it is to sell a security and how easy it is to obtain financing to trade a security. The former is known as market liquidity, while the latter is known as funding liquidity (Godfrey, 2015). Indeed, the research distinguishes three types of liquidity (Nikolaou, 2009, p. 11):

1.1 Central Bank liquidity:

Central Bank liquidity reflects its ability to supply the liquidity required by the financial system, i.e., the flow of monetary base from the Central Bank to the financial system. It ensures the stability of the level of liquidity in the interbank market through its monetary policy: it is the lender of last resort.

1.2 Market liquidity:

Market liquidity reflects a bank's ability to meet its immediate commitments in a way that allows it to adjust its portfolio (sells or buy financial assets) and risks without significantly impacting the bank's financial position (Crockett, 2008). In other words, this refers to banks' ability to liquidate a non-monetary asset. For example, investment security is purchased to be held to maturity as part of a last-resort action to raise funds in central bank money.

The absence of market liquidity can cause not only inefficient markets but also the collapse of the banking system.

1.3 Funding liquidity:

The term funding liquidity mainly refers to cash and assets that can be quickly converted into cash, which are intended to meet short-term withdrawal demands (Valla, 2006).

The ability of banks to obtain external funding, i.e., deposits or draws on credit lines against illiquid assets, in this case, traditional bank loans, is also known as funding liquidity. This

liquidity dimension allows us to understand financial institutions' ability to perform their traditional function of maturity transformation, which is the process of converting illiquid assets into liquid liabilities or simply creating liquidity.

The concept of liquidity encompasses several aspects that should be distinguished:

- **Liquidity for an asset :**

The ease with which assets can be converted into cash within a short period of time and under normal conditions of use is defined as their "liquidity" (Cohen, 1991, p. 110). Liquidity is assessed based on three elements that are directly related to the asset's marketability, as stated by Vernimmen (1981, p. 186): the capital loss incurred on its sale, the time needed to complete the sale, and the significance of brokerage fees: the asset must be sold at a relatively low transaction cost.

- **Liquidity for a bank:**

Being liquid for a bank means being able to quickly find the cash it requires to meet demands. Direct cash holdings in currency or on account at the Federal Reserve or another bank can provide liquidity; besides, it is more commonly caused by holding securities that can be sold quickly and with little loss (Elliott, 2014).

- **Liquidity from a monetary perspective :**

Banks conduct monetary operations on both sides of the balance sheet. On the asset side, they boost the flow of funds by lending needed funds to users, while on the liability side; they accumulate liquidity from savers (Diamond and Rajan, 2001).

2. Functions of the bank liquidity

Banks have historically acted as financial intermediaries and collection centers for various groups in society (Muttalib, 2015). According to Greenberg and Koutete (2020, p. 12), the following are the essential functions of liquidity:

2.1 Reassuring creditors:

Liquidity's first function is to reassure that the bank will be able to repay its debts as they come due without having to renew them. Lenders are more concerned with the certainty of repayment than with the return. As long as a bank is perceived to have adequate liquidity, these lenders will not be afraid to lend to or deposit funds with that bank.

2.2 Ensuring the ability to lend:

The bank must maintain a certain level of liquidity to finance unexpected credit requests within the framework of the lines it grants to its customers. To do so, it must ensure that its current market borrowings and good reputation allow the bank to re-enter the market and acquire funds without difficulty and as per its needs.

2.3 Avoiding the forced sale of assets:

If a bank becomes severely illiquid and is unable to roll over its loans as they mature, one solution is to sell securities or loans at market prices far below their current prices, resulting in significant losses for the bank.

2.4 Preventing high-interest payments:

A bank that frequently appears in the market as a borrower, especially when interest rates are at their highest, will be perceived as illiquid. Therefore, having enough liquidity allows a bank to avoid having to pay high interest rates.

2.5 Avoiding recourse to the Central Bank:

The use of the Central Bank's advance has many disadvantages, not only because of its high cost but also because the Central Bank intervenes in the management of the illiquid institution. As a result, having enough liquidity allows banks to avoid going to the Central Bank.

3. Sources of bank liquidity

Bank liquidity can come from a variety of sources, which can be classified into two categories, according to Demey et al. (2003, p. 16):

3.1 Forecast sources
3.1.1 Quasi-mature assets:

These are bank assets that are about to mature, they are classified according to the size of the bank as follows:

- The principal on particular maturing, non-renewable loans;
- The loan portfolio, which provides liquidity to the bank as maturities come due via loan repayments (principal and accrued interest);
- Regular repayment of a portion of the principal;
- Securities and money market instruments: treasury bills, certificates of deposit from other banks, and surplus reserve loans that have matured and are thus liquid.

3.1.2 Short-term assets:

These are readily liquidable assets that can easily converted into cash without losing value. For example, consider we use customer loans, which can be sold directly on the market or through securitization operations. These securities are significant assets on the bank's balance sheet and drain significant liquidity when they mature. As a result, the liquidity generated by asset sales is determined by three factors:

- The amount of assets held;
- The flexibility and yield of interest rates;
- The ability to absorb potential losses (risk management).

3.2 Immediate or quasi-immediate sources

3.2.1 Borrowings:

It refers to the bank's ability to raise funds in the market and its ease of access to various capital markets. It is determined by its reputation, size, and profitability, as well as the quality of its shareholder base.

3.2.2 New savings:

We are referring to the capacity of business units to attract new savings in the form of deposits, which is a very beneficial source since it's free (with the exception of management fees and the mechanisms put in place to attract them).

3.2.3 Interbank credit lines:

A bank can demand standby credit from other banks (called a standby credit line). Banks frequently request and grant these lines of credit to one another to meet their liquidity needs.

3.2.4 Central Bank:

It is a loan from the Central Bank, which serves as a lender of last resort.

4. Factors affecting bank liquidity

The liquidity factors comprise macroeconomic (external) and bank-specific (internal) factors. The external factors are unrelated to bank management but reflect the economic and legal environment affecting institutions' operations and liquidity positions, while the internal factors are those that banks can control.

4.1 Bank-specific factors

- **Size:**

The impact of size on bank liquidity is unclear. On the one hand, according to the "too big to fail" hypothesis, large banks are less liquid. If large banks believe they are too big to fail, they will be less motivated to hold liquid assets. According to Lucchetta, 2007, large banks tend to invest in riskier assets and hold less liquid assets since they benefit from an implicit guarantee (rely on liquidity assistance from lenders of last resort). Small banks, on the other hand, are more likely to engage in traditional intermediation activities and hold small liquid assets (Rauch et al., 2010; Bunda and Desquilbet, 2008).

- **Capital adequacy:**

This factor is an important source of capital that demonstrates the degree of autonomy in the field. The higher the capital adequacy ratio (CAP), the less the bank relies on other sources of funding, lowering the cost of capital. Furthermore, it aids the bank in establishing trust and attracting customers in all aspects of its operations. Bunda and Desquilbet (2008) found that CAP has a positive relationship with liquidity, whereas, Mohamed (2015) found a negative

one. A bank with a high equity-to-total-asset ratio will have fewer time differences due to active capital. A high proportion of equity results in an increase in the bank's liquidity.

- **Return on total assets:**

Return on total assets (ROA) is one of the financial indicators used to assess a bank's performance (profitability). With a high ROA, the bank builds a good reputation and attracts depositors and borrowers, reducing early withdrawals and increasing working capital from retained earnings. As a result, increasing the ROA increases liquidity (El-Chaarani, 2019).

- **Loan growth:**

Banks regard loans as their primary activity due to their primary source of revenue. They are, however, illiquid. Therefore, an increase in loan demand will result in less liquid assets, resulting in a negative relationship between loan growth and bank liquidity. Banks specializing in lending have a higher exposure to liquidity risk, resulting in a lower liquidity ratio (Valla et al., 2006).

- **Cost of funding:**

The cost of funding is defined as the reimbursement of borrowers for the use of their funds. It is a critical input cost for banks because lower costs result in higher borrowing earnings. According to Munteanu (2012), banks with sufficient liquid assets are less reliant on external funds because their ability to meet frequent withdrawals by depositors prevents them from accessing funds through interbank borrowings or, as a last resort, from the Central Bank.

4.2 Macroeconomic factors

- **Gross domestic product:**

GDP is defined as an index that measures a country's overall condition and can be used as a business cycle indicator. It shows that investment is growing, and the need for loans to expand production and investment increases bank credit growth, as do liquidity risks. Chen et al. (2018) confirmed the above argument that economic growth has a negative relationship with bank liquidity.

- **Inflation:**

Inflation makes the economy unstable by affecting savings and reducing bank-mobilized capital. It raises the cost of using loans, thereby limiting the need for loans, decreasing intermediary activity, and increasing the amount of liquid assets held by banks. As a result, a positive relationship between the inflation rate and liquidity is expected, as demonstrated by Mazreku et al., (2019) research.

- **Liquidity premium:**

Liquidity premium, which is defined as the difference between loans and deposit interest rates is expected to have a negative impact on bank liquidity. Increased interest rate margins will encourage banks to lend more and hold fewer liquid assets (Aspach et al., 2005).

5. The relation of bank liquidity to solvency and profitability
5.1 Solvency and liquidity

An institution's solvency refers to its ability to pay its debts over all time horizons (short, medium, and long term). It denotes that the institution's assets exceed its liabilities, implying that its capital is positive or exceeds a minimum threshold; it is a type of stock or balance sheet measure (Olivier et al., 2020).

Liquidity and solvency are the two pillars of the banking industry, and it is often difficult to tell one from the other. An illiquid bank can quickly become insolvent, and vice versa (Goodhart, 2008). The figure below summarizes their interactions. It explains how, in times of crisis, a problem that appears to affect only a bank's liquidity can instantly turn into a severe solvency problem, leading to the institution's failure (Olivier et al., 2020).

Figure No. 04: Bank liquidity and solvency interactions
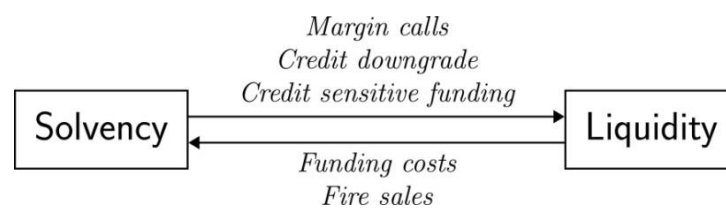
Source: Cont et al. (2020, p. 03)

These mechanisms result in (Cont et al., 2020):

- Endogenous liquidity shocks caused by solvency shocks;
- Amplification of solvency shocks due to funding costs caused by liquidity constraints.

According to Olivier et al. (2020), a higher capital ratio implies a higher proportion of stable funding, which should enhance liquidity. In contrast, a bank may have difficulty obtaining funding during a liquidity crisis. This increase in financing costs reduces its profits, implying that less income can be set aside to supplement its capital. A liquidity crisis may also lead a bank to sell assets to raise cash, which may result in losses if they are labeled to market and jeopardize the bank's solvency.

5.2 Profitability and liquidity

According to Tulsian (2014), profitability is a combination of the words profit and ability. Profit is an institution's ultimate output, while the term ability refers to its capability to generate profits. Profitability can be defined as a given investment's ability to earn a return on its use.

Revenue and expenses are shown on the income statement, which refers to the bank's earnings, whereas cash inflow and outflow are shown on the cash flow statement, which refers to the bank's liquidity (Das et al., 2015).

The words "liquidity" and "profitability" repeatedly appear in the context of a bank. According to Niranjan et al. (2010), they are complementary to one another. However, these two are also adversaries. If a bank has a high level of liquidity, it cannot profit. Since the vast bulk of the liquidity is held in the bank, it will not be able to invest the funds. Profitability cannot be expected without investment. In theory, a bank must maintain a level of liquidity that is not detrimental to its profitability. Although empirical evidence suggests a negative relationship between liquidity and profitability, a bank cannot operate with zero liquidity in order to maximize profits. Figure No. 05 illustrates this relationship.

Figure No. 05: Relationship between liquidity and profitability
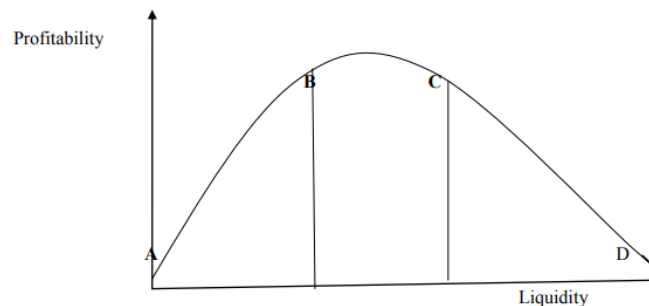
Source: Niranjan et al. (2010, p. 31)

Enhanced liquidity leads to increased profitability (A to B) up to a point where any further increase in liquidity causes profitability to remain constant (B to C). Any further increase in liquidity will lead to a decline in profitability (C to D) (Niranjan et al., 2010).

6. The liquidity regulatory framework

The issue of extreme risk is incredibly significant since the losses that financial institutions may suffer can be disastrous. It is of public interest because it postures a threat to the financial system's stability.

6.1 International prudential regulation

According to Hennani (2016), the subprime mortgage crisis, which began in the summer of 2007, is one of the most significant events in financial history. Its uniqueness can be attributed not only to the factors that contributed to the rapid decline in stock prices but also to the consequences in various areas.

The primary political response to this crisis, formulated at the G20 summit in London in April 2009, consists of the Basel Committee strengthening banking supervision (Hennani, 2016). According to BCBS (2013, p. 01), during the early "liquidity phase" of the financial crisis, which began in 2007, many banks faced difficulties despite adequate capital levels because

they did not manage their liquidity prudently. The turmoil demonstrated the crucial significance of liquidity to the proper operation of financial markets and the banking sector. The abrupt change in market conditions proved how quickly liquidity can evaporate and how long illiquidity can last.

The BIS published "Basel III: A global regulatory framework for more resilient banks and banking systems" in December 2010. This version was updated in June 2011. By the end of 2011, in December, all G20 financial centers had committed to adopting Basel III.

To address the market failures exposed by the crisis, the Committee implemented a fundamental reform to the international regulatory framework (BCBS, 2010, p. 02):

6.1.1 Introducing a global liquidity standard:

Some banks' difficulties were caused by lapses in basic liquidity risk management principles. In response, the Committee published Principles for Sound Liquidity Risk Management and Supervision in 2008 as the foundation of its liquidity framework. It provides detailed guidance on risk management and funding liquidity risk supervision. In addition to these principles, the Committee has strengthened its liquidity framework by developing two minimum funding liquidity standards. These standards were created to achieve two distinct but complementary goals.

- **Liquidity coverage ratio (LCR)**

According to BCBS (2010, p. 09), "the LCR is intended to promote resilience to potential liquidity disruptions over a thirty-day horizon. It will help ensure that global banks have sufficient unencumbered, high-quality liquid assets to offset the net cash outflows they could encounter under an acute short-term stress scenario."

$$LCR = \frac{High-Quality\ Liquid\ Assets}{Total\ Net\ Cash\ Outflows\ over\ a\ 30\ day\ period} \geq 100\%$$

HQLA are cash or assets that can be quickly converted into cash through sales (or pledged as collateral) with no significant loss of value. Level 1 asset can be included indefinitely, while Level 2 assets cannot exceed 40% of the liquidity reserve. Level 2 assets are further subdivided into Level 2A assets, the value of which is subject to a 15% haircut, and Level 2B assets, the value of which are subject to higher haircuts but cannot exceed 15% of HQLA stock (FSI, 2018).

Total net cash outflows are calculated by subtracting the total expected cash outflows from the total expected cash inflows resulting from the stress scenario. The total expected outflows are determined by multiplying the outstanding balances of various categories of liabilities and off-balance sheet commitments by the supervisory rates at which they are expected to run off or be drawn down. Total expected cash inflows are estimated by applying inflow rates to the outstanding balances of various contractual receivables. The difference between the stressed outflows and inflows is the minimum size of the HQLA stock (FSI, 2018).

- **Net stable funding ratio (NSFR)**

According to BCBS (2010, p. 09), "The NSFR aims to limit over-reliance on short-term wholesale funding during times of buoyant market liquidity and encourage better assessment of liquidity risk across all on- and off-balance sheet items."

$$NSFR = \frac{Available\ Amount\ of\ Stable\ Funding}{Required\ Amount\ of\ Stable\ Sunding} \geq 100\%$$

The amount of available stable funding is measured based on the broad characteristics of the relative stability of an institution's funding sources, including the contractual maturity of its liabilities and the differences in the propensity of different types of funding providers to withdraw their funding (BCBS, 2014).

The amount of required stable funding is measured based on the broad characteristics of the liquidity risk profile of an institution's assets and off-balance sheet exposures (BCBS, 2014).

6.2 National prudential regulation

Since independence, national authorities have worked tirelessly to ensure the soundness and stability of the banking system. They were able to implement quantitative and qualitative rules based on and referring to Basel Committee resolutions under the Bank of Algeria regulation No. 2011-08 of November 28, 2011, on the internal control of banks and financial institutions, which aims to align the Algerian system on the prudential procedures and supervision of activity enacted by the Basel Committee on Banking Supervision.

6.2.1   Liquidity ratio

Article 3 of Regulation No. 2011-04 of May 24, 2011, on the identification, measurement, management, and control of liquidity risk, requires banks and financial institutions to present a liquidity ratio of at least 100%.

$$Liquidity\ ratio = \frac{Short-Term\ Liquid\ Assets}{Short-Term\ Liabilites} \geq 100\%$$

According to Article 4 of the said regulation, at the end of each quarter, banks and financial institutions communicate to the Bank of Algeria:

- The minimum liquidity coefficient of the coming month and those of the two (2) last months of the previous quarter;
- A liquidity coefficient of observation for the three (3) months following the closing date.

In light of the impact of the COVID-19 pandemic on the global economy and all sectors at the national level, Instruction No. 05-2020 of April 6, 2020, on exceptional measures to alleviate certain prudential provisions applicable to banks and financial institutions, reduces the minimum threshold for the liquidity ratio to 60%. This provision went into effect on March 1, 2020, and lasted until September 30, 2020.

6.2.2 Reserve requirements

It is a monetary policy instrument established by the Bank of Algeria, intending to control bank liquidity and regulate their loanable fund capacity as well as the inherent credit risks.

According to Instruction No. 02-2004 of May 13, 2004, on the system of mandatory reserves, Article 2, the base of the reserve requirements includes deposits in dinars of all kinds, namely demand deposits, term deposits, deposits prior to import, savings books and bonds, cash bonds, and other deposits. The reserve requirement rate is set at 6.5% (Article 2).

According to the Instruction No. 02-2021 of February 7, 2021, modifying and completing Instruction No. 02-2004 of May 13, 2004, relating to the compulsory reserve system, the reserve requirement rate is set at 2% (Article 2).

Given the significant increase in bank liquidity and the Treasury's current account at the Bank of Algeria at the end of March 2023, the Monetary Policy Operations Committee has agreed to raise the reserve requirement rate by 1% to 3% on April 15th, 2023.

6.2.3 Equity and permanent resources ratio

It is defined by regulation No. 2004-04 of July 19, 2004, which sets the ratio of equity and permanent resources.

The purpose is to minimize medium- and long-term transformation while maintaining the balance between resources and long-term uses (Article 1 of the said regulation).

$$EPR = \frac{\text{Equity and Similar Funds } + \text{ Long−Term Resources (Duration>5 } years)}{\text{Long−Term Uses (Duration >5 } years)} \geq 60\%$$

Article 2 of the said regulation explains the numerator of the ratio, while Article 7 describes the denominator.

Section 03: General concepts on bank liquidity risk

The ability of a bank to effectively manage its risks determines its survival and success in the banking industry. Although all risks are essential to banks, our focus will be on liquidity risk as it represents the cumulative effect of other risks and has gained prominence due to the ongoing global financial crisis.

During this section, we will concentrate on the concept of bank liquidity risk, its causes, mitigation techniques, and its measurements.

1. Definition of bank liquidity risk

When the probability of not being liquid equals one (i.e., the possibility becomes a certainty), liquidity risk peaks and illiquidity occurs. In that sense, there is an inverse relationship between liquidity and liquidity risk because the higher the liquidity risk, the greater the likelihood of becoming illiquid, and thus the lower the liquidity (Nikolaou, 2009).

According to Greenbaum and Thakor (2007, p. 151), liquidity risk can manifest in two ways. The first is when financial security is sold for less than its fair value. This price difference is the result of either a discount or a lack of opportunity to sell. The second is that liquidity risk is the inability to meet cash flow obligations at a particular time due to a lack of liquid assets, a financial crisis, or a lack of investor confidence in the institution.

Accordingly, liquidity risk is the risk of incurring losses as a result of failing to meet payment obligations on time (or unexpected withdrawals) or at a reasonable cost.

In the second section, we distinguished three types of liquidity. Therefore, it is appropriate to present the risks associated with each category (Nikolaou, 2009, p. 16):

1.1 Central Bank liquidity risk:

Central bank can only be illiquid to the extent that there is no demand for domestic currency, and thus the supply of base money from the Central Bank cannot materialize. This could occur in the event of hyperinflation or an exchange rate crisis. Nevertheless, based on conventional wisdom, such a scenario could be safely regarded as unlikely, at least in developed, industrialized countries.

1.2 Market liquidity risk:

Market liquidity risk is the inability to trade at a fair price in real-time. It is determined by the type of assets to liquidate, the number of traders willing to buy at current market prices, and the speed at which assets can be traded. As a result, this risk can be mitigated by investing in high-quality liquid assets that are marketable at fair value.

1.3 Funding liquidity risk:

It refers to a financial intermediary's inability to fulfill its liabilities as they become due. Typically, funding liquidity risk is determined by the availability of the four liquidity sources:

depositors, the market, the interbank market, and the Central Bank, as well as the ability to satisfy the budget constraint over the respective period.

2. Sources of bank liquidity risk

According to Matz and Neu (2007, p. 17), we can classify the sources of bank liquidity risk as follows:

- **Maturity transformation:**

Banking activities entail financial intermediation and maturity transformation, which is the collection of callable on-demand deposits with short-term maturities for financing contracts with relatively long-term maturities (Muttalib, 2015). As banks try to provide liquidity insurance to depositors, the maturity transformation in the form of cash inflows and outflows exposes them to liquidity risk.

- **Contreparties and customer behavior:**

Redemption or early withdrawal options entitle the holder to exercise them on the contractually agreed-upon dates. It allows bank clients to repay loans early or withdraw loaned funds before maturity. It gives short-term money market financing providers the right not to roll over those funds at the conclusion of the contract. These implicit options destabilize the bank's balance sheet, i.e., liquidity inflows and outflows that will not be realized at the agreed maturity date.

- **Trading portfolios:**

High losses in trading portfolios cause unsecured funding from other banks to become unavailable. Furthermore, a decrease in the market value of a derivative trading position causes extra collateral to be provided to the counterparty or causes the trade to be liquidated under unfavorable terms. Additionally, disclosing high losses from credit portfolios or high losses owing to operational risks might result in a downgrade of a bank's external rating, which will almost certainly result in a bank's liquidity crisis. These risks are frequently interconnected, and their revelation can significantly influence a bank's image and, as a result, its liquidity status.

- **Capital markets in a stressed condition:**

Although the behavior of capital markets in a stressed state is beyond a bank's control, it has repercussions for the bank's liquidity. For starters, adverse capital market movements affect the bank's ability to raise funds if it decides to do so through them. Second, banks' increased dependence on wholesale markets rather than small depositors influences the proportion of market-risk-averse depositors in the total number of bank depositors. These depositors are ready to withdraw funds from the bank at the first hint of peril, raising the possibility of a bank "run" or a liquidity crisis. As a result, banks must improve their brand image to profit from favorable market circumstances and, thus, decrease their liquidity risk.

- **Systemic crisis**

Dubernet (1997, p. 72) has discussed the causes of such a crisis. Tight regulatory constraints prevent investors from participating in all market segments. These segments will be almost closed for a longer or shorter period under these conditions, reducing liquidity in these financial markets. The most well-known example is the 2008 bankruptcy of Lehman Brothers, which was caused by the 2007 subprime mortgage crisis.

3. Asset-Liability imbalance, maturity mismatch and liquidity risk

According to Choudhry (2018), the two most common causes of liquidity risk are asset-liability imbalance and maturity mismatch, both of which can occur as a result of two conditions:

- **Liquidity gap**: liquid assets are available in larger quantities than volatile liabilities.
- **Liquidity need**: the predicted amount of funds needed on the asset side is greater than the expected amount of funds available on the liability side.

According to Greenbaum and Thakor (2007, p. 140), matching the maturities of assets and liabilities is one way to balance the asset and liability sides. Thereby, bank deposits should be allocated in well-organized maturities, where, the liquidity demand from matured deposits could be matched by the liquidity of matured assets. Therefore, neither a liquidity gap nor a liquidity need exists.

In this part, we will discuss the factors that cause asset-liability imbalance and maturity mismatch risks, as well as their related risks (Ismal, 2010, p. 47).

3.1 Factors triggering asset-liability imbalance and maturity mismatch risks
- **Short-term deposits:**

The first factor is when depositors prefer to place their cash in short-term deposits. Some of the funds are then used to finance long-term investment projects by banks. The asset-liability imbalance may occur because short-term deposits are liquid while long-term investments are illiquid. When depositors execute their short-term deposits, banks may be forced to terminate long-term investments in order to free up liquidity to satisfy immediate demand. Indeed, banks are vulnerable to financial distress due to their overreliance on short-term debts.

- **Combination of high deposit and credit rates:**

The second factor is the combination of a high deposit rate to entice depositors and a high credit rate imposed on entrepreneurs. When a business experiences a downturn, the high credit rate reduces the entrepreneurs' ability to repay debt interest and principal, leaving banks in a difficult situation to reimburse depositors' deposits. If banks proceed to be unable to access funds from the money market, this asset-liability imbalance could lead to a liquidity run.

- **Big companies' behavior**:

The third factor occurs when large corporations become the dominant depositors and invest funds in short-term deposits. Banks would require immediate liquidity if large companies' liquidity behavior is uncertain and unpredictable, and these companies redeem their deposits without prior notice or all at once.

- **Asymmetric information**:

The fourth factor is an asymmetric or unequal distribution of information among depositors, banks, borrowers, and regulators (Greenbaum and Thakor, 2007, p. 153). For instance, when there is hidden information among parties involved in the bank's financing activities or unorganized liquidity behaviors between depositors and banks.

- **Business cycle**:

The final factor is the business cycle, which plays a significant role in causing an asset-liability imbalance (Allen and Gale, 1998). Unfavorable business and/or economic conditions, for example, may disrupt asset performance, affecting the balance of assets and liabilities.

3.2 Related risks following asset-liability imbalance and maturity mismatch risks
- **Insolvency risk:**

Insolvency risk, defined as a bank's inability to meet its obligations to depositors, arises when banks fail to manage liquidity risk by not having adequate liquidity reserves, selling liquid assets, or borrowing from the money market. In particular, insolvency risk is referred to as the state in which a bank's liabilities exceed its assets, resulting in a negative net worth on the balance sheet (Greenbaum and Thakor, 2007, p. 151).

- **Government takeover (bailout) risk:**

Governments frequently act as the lender of last resort for banks, as evidenced by the global financial crisis of 2008 and other similar large-scale economic conditions such as the Asian economic crisis of 1997. They provide emergency liquidity to banks in distress or even take over defaulting banks to protect the entire economy from the negative impact of bank failures.

- **Reputation risk :**

Failures by banks to balance their asset and liability sides, manage liquidity demand, and mitigate unexpected liquidity pressures can damage their reputation in the eyes of depositors and stakeholders. In extreme cases where the bank is a major engine behind the economy, a poor banking reputation may not only degrade the function of banks as financial intermediaries but also impact the economy's performance.

4. Techniques to mitigate liquidity risk

To manage the predictable irregular demand for liquidity, banks should have an estimate of the short-term demand for liquidity based on their past experiences (patterns of liquidity

needs). As a result, unless there is an error condition, it should be possible to identify the predictable irregular demand for liquidity. To enhance the precision of their estimation, banks should obtain information from their clients about the timing of their intended deposit withdrawals.

The most difficult to predict is the unpredictable irregular demand for liquidity due to unfavorable economic and/or business conditions. There are several proactive actions that banks can take in response to this type of liquidity demand (Ismal, 2010, p. 49)

4.1 Contingency Funding Plan (CFP):

CFP are policies, strategies, and procedures that serve as a framework for a bank to address liquidity shortfalls in emergencies at a reasonable cost (BCBC, 2008, p. 04), depending on the size, nature, and complexity of the business, risk exposures, and organizational structure. It anticipates liquidity needs through three treatments:

- CFP identifies, quantifies, and ranks all funding sources based on their preferences;
- The second is to match potential cash flow sources and fund usage;
- The final strategy entails creating indicators to notify bank management when a predetermined level of potential liquidity risk problems is reached.

4.2 Combination of cash flow matching and liquid assets (mixed approach):

Banks use this mixed approach to seek out matching cash outflows in each period with a mix of contractual cash inflows from asset sales, repurchase agreements, or other secured borrowing. The most liquid assets are counted first, followed by the lowest liquid assets.

4.3 Prudential Allocations of Assets (PAA):

This technique may reduce the risk of refinancing, redeeming, or repurchasing the bank's borrowing before its contractual maturities. Some requirements need to be fulfilled to use the method; they are as follows:

- Allocate a significant portion of deposits to secured and short-term investment alternatives that are highly liquid and can be repurchased before maturity dates;
- Require collateral from debtors to guarantee long-term investments;
- Join syndication loans to share credit risk among involved parties;
- Avoid credit concentration on specific types of placements (debtors).

4.4 Integrated structure of banking organizations:

The presence of a bank holding company and bank subsidiaries indicates a modern banking organization. Thus, there are two types of liquidity concerning liquidity management:

- The liquidity of the bank holding company as the owner of bank subsidiaries;
- The liquidity of the bank subsidiaries.

CHAPTER 01: GENERAL OVERVIEW ON BANKS' PERFORMANCE, LIQUIDITY, AND LIQUIDITY RISK

The holding company frequently expects its subsidiaries to handle liquidity risk issues on their own in the first instance, though it may provide the necessary funds and management assistance if the liquidity risk exceeds a certain level of tolerance (BCBS, 2006, p. 04).

The bank holding company sets a standard regulation for the capital amount required by all its subsidiaries. Consequently, the holding company may release emergency liquidity to its subsidiaries not only to meet the demand for instant liquidity but also to meet the capital requirement. By doing so, the holding company exerts control over its subsidiaries, which can quickly meet their liquidity needs through the holding company rather than seeking funds from other companies, the money market, or selling marketable securities.

4.5 Deposit insurance:

"Deposit insurance insures depositors' deposits up to a fixed limit in case their bank fails" writes Freixas and Rochet (2008, p. 313). Meanwhile, the current deposit insurance reduces the banks' liquidity risk exposures due to the existence of an external entity (the deposit insurance company) that covers the failure of deposit repayment.

According to Zhu (2001) deposit insurance is another technique for mitigating liquidity risk, though it may introduce moral hazard issues to some extent. Since banks have less liability exposure, bank financing is less cautious. Deposit insurance requires prudent banking supervision and market discipline to be effective.

5. Liquidity risk metrics

In general, liquidity risk measures can be assessed using balance sheet positions. In the past, best practices for measuring liquidity risk focused on using liquidity ratios. Nevertheless, Poorman and Blake (2005) stated that measuring liquidity solely through liquidity ratios was insufficient and not the solution. Banks must develop a new perspective on liquidity measurement that exceeds standard liquidity ratios. Aside from traditional liquidity ratios, many new methods have recently been developed to assess bank liquidity risk.

BCBS (2006, p. 04) stated that banks assess liquidity risk according to three basic approaches:
- Under the liquid assets approach:

The bank keeps liquid instruments on its balance sheet that can be relied on when needed. Additionally, it can retain a pool of unencumbered assets (often government securities) that may be utilized to receive secured finance through repurchase agreements and other secured facilities. Ratios are the appropriate metrics in this method.
- Under the cash flow matching approach:

According to this approach, the core of liquidity risk is cash flow. Banks control their liquidity primarily by managing the maturity structure of their assets and liabilities to generate adequate net cash flows (Matz and Neu, 2007, p.23). A bank assesses its liquidity risk by matching cash outflows against contractual cash inflows over an array of near-term maturity buckets.

- The mixed approach:

It incorporates aspects of the cash flow matching and liquid assets approaches. A bank attempts to match expected and unexpected cash outflows in each time bucket against a combination of contractual cash inflows and inflows generated by asset sales, repurchase agreements, or other secured borrowing. The most liquid assets are normally counted in the earlier time buckets, whereas the least liquid assets are counted in the later time buckets.

According to Chen et al. (2018) liquidity risk is usually measured by the liquidity ratio, operationally defined in two directions in the literature (in the form of cash flow items). The first type of definition uses the liquidity assets adjusted by size as the measure of the liquidity ratio, which includes: The liquid assets-to total-assets ratio (Bourke, 1989; Molyneux and Thornton, 1992; Anbar and Alper, 2011; Balaj and Rudhani, 2019), liquid assets-to-deposits ratio (Shen et al., 2001; Bace, 2016; Vodova, 2013), and liquid assets-to-customer and short term funding ratio (Kosmidou et al., 2005; Vodova, 2013; Ayaydin and Karakaya, 2014). A higher liquidity ratio value indicates more liquidity and, thus, less liquidity risk.
The second type of definition takes into account loan size, such as: loans-to-total assets ratio (Athanasoglou et al., 2006; Ferrouhi, 2014; Lee et al., 2015), net loans-to-total assets ratio (Ayaydin and Karakaya, 2014; Marozva, 2015; Terraza, 2015), and net loans-to-customers and short-term funding ratio (Chen et al., 2018; Pasiouras and Kosmidou, 2007; Naceur and Kandil, 2009; Munteanu, 2012). A higher value of these ratios indicates that the banks will face greater liquidity risk.

However, there are alternatives to traditional liquidity ratios for assessing bank liquidity risk, which are classified as quantitative and qualitative measurements. The Basel Committee on Banking Supervision (2000) proposed the maturity laddering method for measuring liquidity risk in the context of quantitative measurement.

According to Saunders and Cornett (2017, p. 365), banks can measure their liquidity risk exposure by using sources and uses of liquidity, peer group ratio comparisons, a liquidity index, the financing gap (FGAP) (Bunda and Desquilbet, 2008; Chen et al., 2018; Ferrouhi, 2014; Marozva, 2015; Lucchetta, 2007), and liquidity planning. DeYoung and Jang (2016) stated that the financing gap is in line with the purpose of Basel III's net stable funding ratio (NSFR) requirement, which states that banks must keep enough stable funding (e.g., core deposits, which are considered lower-cost funding sources) to fund their illiquid assets completely (e.g., loans).

According to Chen et al. (2018) the financing gap is defined as the difference between loans and deposits. If the FGAP is positive, the bank must fill it with cash, liquid assets, or money market funds. As a result, the financial gap can be established by subtracting borrowed funds from liquid assets. It represents the bank's financing needs after selling its liquid assets. Banks may be more exposed to liquidity risk when they make more loans with fewer liquid assets.
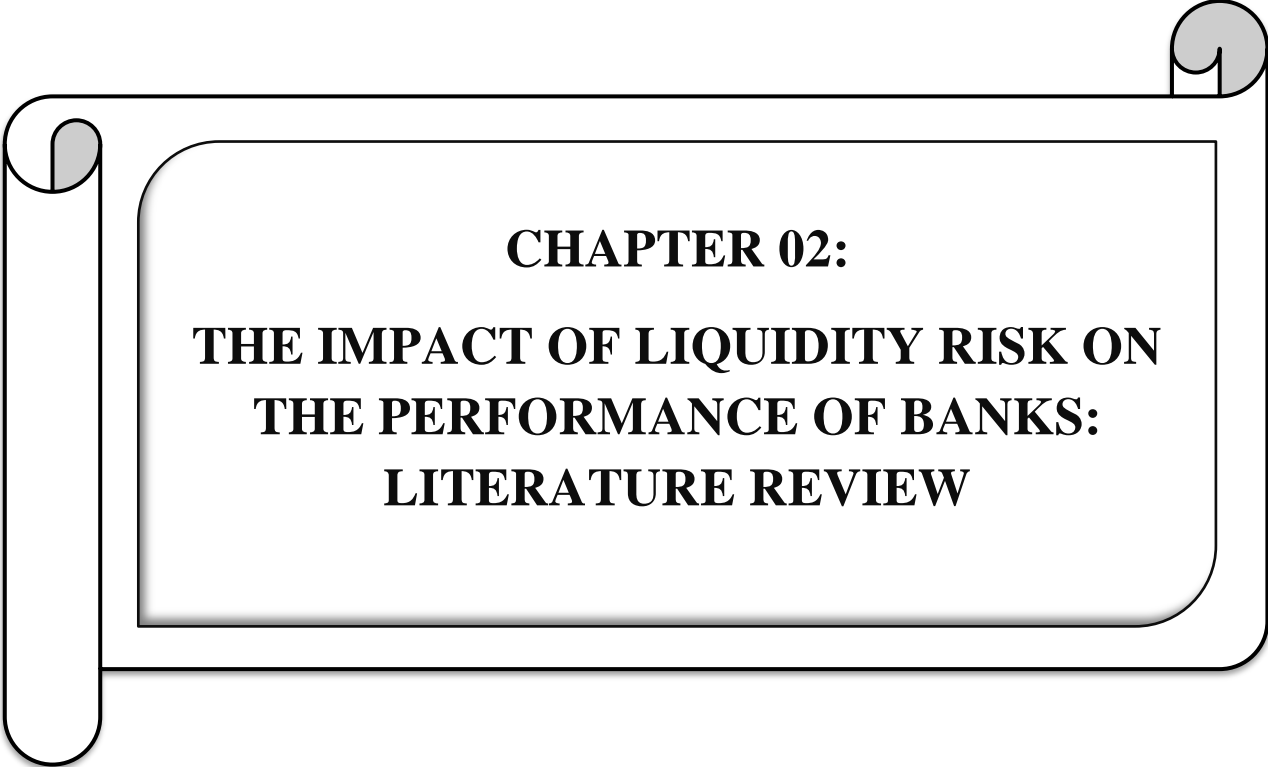
Conclusion

This chapter presented a theoretical overview of banks' performance and illustrated its various types. Following that, we concentrated on performance measurement, whereby the metrics used to assess banks' performance were reviewed, which include intermediate management balances and financial and non-financial measures.

Since banks operate as financial intermediaries, they need to maintain sufficient liquidity to carry out their daily commitments efficiently or risk being deemed illiquid. Hence, international prudential regulation was necessary to improve financial stability by enhancing global banks' supervisory standards. It was achieved through the establishment of three sets of regulatory standards (Basel I, Basel II, and Basel III). Yet we concentrated on the Basel III regulations since they provide specific guidance on risk management and financing liquidity risk monitoring. Additionally, we highlighted the national prudential regulation concerning the liquidity framework.

Furthermore, this chapter addressed the concept of liquidity risk, its sources, and its fundamental cause "maturity transformation." Afterward, we presented methods for reducing liquidity risk and the measures of this risk, which fall under the liquid assets approach, the cash flow matching approach, and the mixed approach.

The next chapter will discuss the link between liquidity risk and banks' performance, studies on the issue, and other factors influencing banks' performance.

CHAPTER 02:

THE IMPACT OF LIQUIDITY RISK ON THE PERFORMANCE OF BANKS: LITERATURE REVIEW

CHAPTER 02: THE IMPACT OF LIQUIDITY RISK ON THE PERFORMANCE OF BANKS: LITERATURE REVIEW

Introduction

One of the most significant features of any financial system is the availability of liquidity. As a result, financial intermediaries must constantly manage their liquidity positions to fulfill this critical role. Banks are converting short-term deposits into long-term and illiquid assets, exposing themselves to the bank's most dangerous risk: liquidity. It not only jeopardizes the safety of each bank, but it also endangers the security of the entire banking system (Eichberger and Summer, 2005).

Liquidity issues can impact a bank's earnings and capital, and in extreme cases, they can cause the bank to underperform (Central Bank of Barbados, 2008). During a liquidity crisis, banks may be forced to borrow from the market at unusually high-interest rates. Hence, the banks' earnings fall. Furthermore, Diamond and Rajan (2005) emphasize that a mismatch between depositor demand and resource production forces a bank to generate resources at a higher cost.

Banks strive to achieve objectives that allow them to survive, balance profitability and liquidity, avoid bankruptcy, and maximize their possible return. Management must define a policy to measure and control liquidity management, with internal factors concentrating on bank-specific characteristics and external factors focusing on macroeconomic and market variables. It will help prevent a liquidity crisis.

This chapter will focus on the relationship between liquidity risk and banks' performance, as well as other determinants of banks' performance. It is organized as follows:

- ➢ **Section 01:** Theoretical literature review of liquidity risk impact on banks' performance
- ➢ **Section 02:** Empirical literature review of liquidity risk impact on banks' performance
- ➢ **Section 03:** Other determinants of the performance of banks

Section 01: The impact of liquidity risk on the performance of banks: Theoretical literature review

While liquidity creation is a fundamental function of banks, it carries significant risk for them. Diamond and Rajan (2001) proposed that banks may face a critical liquidity situation if depositors withdraw funds at inconvenient times, particularly if the banks have illiquid loans. A bank with good assets, solid earnings, and adequate capital may fail if liquidity is insufficient. Hence, liquidity is regarded as the primary pillar influencing banks' performance and survival.

This section will focus on bank liquidity theories as well as theories that can explain the relationship between liquidity risk and the performance of banks.

1. Bank liquidity
1.1 Liquidity preference theory

"Liquidity preference," a term espoused by John Maynard Keynes in his masterwork "The General Theory of Employment Interest and Money, 1936," portrays individuals' preference for liquid cash since it is the most liquid asset rather than securities or long-term interest-bearing investments. John Maynard Keynes stated that the interest rate is the price of money, demonstrating the relationship between the interest rate and the amount of money the public wishes to hold.

Keynes (1936, p. 170), defined the liquidity preference model as having three motivations:

1.1.1 Transactional motive: divided into two incentives:
- The income motive: a primary reason for keeping money is to bridge the gap between income receipt and its disbursement, which is determined primarily by its amount, and the gap's normal duration.
- The business motive: similarly, money is kept to bridge the gap between professional expenses and sale proceeds; money kept by traders between purchases and realizations falls into this category. The intensity of this type of demand is primarily determined by the value of current production (i.e., current income).

1.1.2 Precautionary motive:

The concern for contingencies that require unexpected expenditures, the hope of taking advantage of unforeseen opportunities to make advantageous purchases, and lastly, the desire to retain the wealth of immutable monetary value to meet a future obligation stipulated in money are all reasons to preserve cash. The greater the income, the more cash is required for this purpose.

1.1.3 Speculative motive:

This motive necessitates a more in-depth investigation, first because it is less well understood than the others and second because it plays a significant part in transmitting the effects of a

change in the quantity of money. A decrease in interest rates increases the amount of money demanded by individuals until interest rates rise.

Under normal conditions, the amount of money required to satisfy both the transactional and precautionary motives is determined primarily by the general activity of the economic system and the amount of nominal income. Nevertheless, it is only by introducing speculative intent into the formula that the authorities in charge of the direction of money, or, in the absence of such a path, the fortuitous variations in the value of money, can make a difference.

1.2 Shiftability theory:

Moulton (1918) developed this theory, which is based on the proportion of a bank's liquidity that can be transferred or sold to other lenders or investors for cash. Furthermore, rather than relying on maturities to solve their liquidity problems, these assets could be transferred to the Central Bank for cash with no material loss if necessary. Hence, a bank's liquidity can be improved if it always has assets to sell, which the Central Bank and discount market are willing to purchase. Thereby, this theory recognizes and asserts that a bank's assets' shiftability, marketability, or transferability is a foundation for ensuring liquidity; for example, highly marketable securities held by a bank are an excellent source of liquidity that can decrease liquidity risk.

This theory contends that banks could effectively protect themselves against massive deposit withdrawals by holding credit instruments on a prepared secondary market as a form of liquidity reserve.

1.3 Commercial loan theory:

This theory is also called the "real bills doctrine," which was proposed by Adam Smith (1776) in his book entitled "Wealth of Nations." It states that a commercial bank should only make short-term, self-liquidating[*], productive loans to business organizations, which the central bank should lend to banks on the security of such short-term loans (Sargent and Wallace, 1982).

However, this theory has some limitations. First, it ignores the concept that a bank's liquidity is heavily dependent on the transferability of its assets. Furthermore, because loan repayment is only made when the products produced are sold, during an economic downturn, traders' business activities suffer, leading to debtors' failure to meet their debt obligations when they become due. The theory also focuses on short-term loans while ignoring long-term loans, which are critical in financing development projects.

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[*] A self-liquidating loan is a form of debt in which the repayment is intended to correspond to the cash flows generated by the assets purchased with the loan capital. The loan's repayment schedule and maturity are usually arranged to coincide with the anticipated profits or cash inflows from the underlying property.

1.4 Anticipated income theory:

This theory was developed by Prochanow (1944), who contends that banks' liquidity can be estimated and met if scheduled payments are based on the borrower's income. It emphasizes the importance of banks tying loan repayment to revenue rather than relying heavily on collateral (Oladapo et al. 2017). Furthermore, the maturity pattern of loans through customer installments rather than those secured by real estate can affect banks' liquidity.

The theory also suggests that borrowers' financial activities should be restricted and that when granting the loan, considerable attention should be paid not only to the security presented by the borrower but also to the borrower's anticipated income to determine the borrower's ability to meet their financial commitments. Hence, it focuses on three primary goals of banks: liquidity, security, and profitability.

The theory's limitation is that it does not meet the lending bank's emergency cash needs because loans are repaid in installments.

2.   Liquidity risk and banks' performance relationship
2.1 The risk-return trade-off:

The risk-return tradeoff concept is used to explain the relationship between risks and return (Markowitz, 1952). This theory holds that the risk of a financial asset correlates with its return, and therefore, when the risk rises, so will the return. Liquid assets are less risky than other assets. As a result, their returns are not comparable to those of illiquid financial assets (Markowitz, 1999). From this vantage point, keeping more liquid assets to reduce liquidity risk may harm a bank's financial performance because, as a financial intermediary, interest income from lending is its primary source of income. As a result, while other factors remain constant, liquidity risk should positively impact bank financial performance.

According to the corporate finance hypothesis, a bank in equilibrium would prefer to maintain an optimal level of liquidity solely to offset its marginal costs and benefits (Miller and Bromiley, 1990). Because a bank's optimal liquidity level can change during the economic cycle, often increasing as expenditures are expected to rise, the relationship between liquidity and bank profitability is highly cyclical. Banks' optimal liquidity level rises during a financial sector crisis because bankruptcy costs increase under such conditions. According to Osborne et al. (2012), during a crisis, banks try to increase liquidity to improve profits; thus, the relationship between liquidity and short-term bank performance (positive or negative) depends on whether the bank is above or below the optimal level of liquidity. As a result, the relationship between bank liquidity and profitability is expected to be cyclical. It is because, in extreme conditions, banks tend to reserve less liquidity than is optimal. However, banks may or may not achieve their optimal level of liquidity under normal conditions, in which the relationship would be close to zero or vice versa. It implies that diminishing liquidity can improve bank performance. The reduction in the structure of liquidity assets raises the liquidity risk.

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Furthermore, according to Flannery and Rangan (2008), if banks could maintain an optimal level of liquidity, there would be no relationship between liquidity balance and bank performance. In the long run, however, when legal liquidity requirements are binding, ensuring high liquidity and lowering liquidity risk will reduce banks' profitability if they exceed their optimal liquidity due to regulatory requirements or unexpected shocks. Based on the hypothesis, as risk increases, so does profitability. In addition, most well-performing banks have high liquidity risk.

2.2 Free cash flow:

The free cash flow hypothesis (Jensen, 1986), consistent with agency costs theory, may also explain why banks with higher liquidity do not perform better financially. The increase in free cash flow raises the likelihood that managers will engage in activities that conflict with the interests of the shareholders, thereby increasing agent-principal conflicts and, as a result, agency costs. High liquidity allows managers to indulge in self-aggrandizement by pursuing low-benefit projects and other behaviors that inevitably lead to poor financial performance. Furthermore, Acharya and Naqvi (2012) contend that when banks are flush with liquidity, they relax lending standards, fueling credit growth and asset price bubbles. This situation could result in a financial crisis that would be disastrous for banks and other financial institutions (Adusei, 2021).

2.3 Transaction cost:

Another theory that could explain the effect of liquidity risk on banks' financial performance is the transaction cost theory. Transaction costs drive a chasm between an asset's buying and selling prices, for instance, brokerage commissions, exchange fees, transaction taxes, bid-ask spreads, and price impact (Vayanos and Wang, 2011). This theory proposes that organizations keep extra cash on hand to reduce transaction costs (Keynes, 1936). In the absence of sufficient cash to meet its obligations, a firm might have to borrow funds from outside sources until it can liquidate its noncash assets, incurring additional interest and transaction costs. It is due to the presence of capital market imperfections. Information asymmetry in imperfect financial markets exposes firms to an external finance cost premium. Thereby, the Pecking Order Theory suggests that firms prefer using internal finance like cash or retained earnings rather than external finance such as bank loans, debt, and equity to avoid such costs (Myers, 1984). Moreover, because internal finance is less expensive than external finance, it is reasonable to expect a bank to perform better when it accumulates more liquid funds, indicating low liquidity risk (Adusei, 2021).

Despite the above contradictory positions, the uniqueness of banks as lending institutions provides some basis for the study's contention that a bank's liquidity risk should be negatively related to its financial performance.

Section 02: The impact of liquidity risk on the performance of banks: Empirical literature review

This section aims to present some earlier research on the impact of liquidity risk on the performance of banks across the world.

The correlation between liquidity risk and bank performance can emerge when banks are forced to sell a large portion of their illiquid assets in order to satisfy the demand for funds, raising the fire sale risk. This situation may impact the bank's performance in one of two ways: it may force the bank to offer price discounts to attract buyers, or it may compel other banks to lower the values of their assets at a fire sale price (Goddard et al., 2004). Banks may refuse to lend funds to customers during periods of liquidity scarcity, which can be seen as an opportunity lost for the bank (Diamond and Rajan, 2005).

Studies are underway to investigate the connection between liquidity risk and bank performance, but previous studies have been controversial. Some research has found a positive correlation, while others have found a negative correlation or no correlation at all.

The study by Thi Xuan Huong et al. (2021) used unbalanced panel data from Bankscope from 171 banks in nine countries in Southeast Asia over the period 2004–2016 and the Generalized Method of Moments (SGMM) to analyze the impact of liquidity risk on bank performance in Southeast Asian countries. The results indicated that liquidity risk, as measured by FGAP and net loans-to-total assets (NLTA), has a positive statistical relationship with bank performance, as measured by ROA and NIM, which is consistent with previous research (Ayaydin and Karakaya, 2014; Sufian and Chong, 2008; Trujillo-Ponce, 2013). On the other hand, FGAP, NLTA, and net loans-to-customers funding and short-term funding (NLST) showed a negative correlation with ROE, which is consistent with previous research (Lee and Hsieh, 2013; Sufian and Chong, 2008). However, if there is a financial crisis, liquidity risk has a negative impact on bank performance. It means that during a crisis, banks will seek to increase liquidity assets to improve profitability, increasing financial costs and decreasing bank efficiency. In addition, this research investigated the effect of asset structure variables on the bank performance (liquid assets-to-total assets, liquid assets-to-total loans, and liquid assets-to-short-term customer deposits). The results demonstrated a positive effect in the model with ROA and a negative impact in the model with NIM, implying that bank performance is quite sensitive to changes in asset structure. If banks typically reserve liquid assets at an optimal level to ensure business operations, their performance can be monitored in the event of shocks. However, if banks hold too many liquid assets, banks' performance will suffer as financial expenses rise faster than revenue, which corresponds to previous research (Chen et al., 2018; Kosmidou et al., 2005; Lee and Hsieh, 2013).

Hacini et al. (2021) conducted a study to examine the effect of liquidity risk management on the financial performance of selected conventional banks in Saudi Arabia from 2002 to 2019, applying the panel data method (pool, fixed-effects, and random-effects). The loan-to-deposit ratio (LTD) and cash-to-deposit ratio (CTD) were used to assess liquidity risk, while ROE was used to evaluate financial performance. The findings revealed that CTD has a significant

negative effect on ROE. CTD rises when banks hold more cash than deposits. The increase in CTD gives the bank's customers confidence that it will be able to provide their deposits when they are requested. When CTD rises above a certain level, funds become idle, and the bank bears the opportunity costs and deposit interest, negatively impacting the bank's performance. As a result, Saudi banks may hold a large percentage of cash (liquidity surplus) to meet the demand for deposit withdrawals. The ratio LTD has a negative impact on the financial performance indicator, explaining that because the LTD ratio contributes to assessing the bank's liquidity and assists investors in determining whether the bank is adequately managing its liquidity; if the ratio is excessive, it means that the bank lacks sufficient liquidity to cover any financing needs, such as loan defaults or an economic recession, leading to a significant and negative impact on the bank's performance.

Ratri (2021) used multiple linear regressions to investigate the impact of liquidity on bank performance, alongside the moderating effects of size and board meetings, on conventional banks listed on the Indonesia Stock Exchange from 2014 to 2019. The loan-to-total assets ratio was used to assess bank liquidity, while the ROA was used to assess bank performance. The findings revealed that liquidity has a significant positive impact on bank performance. The greater the distribution of funds loaned, the higher the profits (interest income). Banks with sufficient liquidity can effectively perform their intermediation function, store and manage public deposits, and distribute them to other parties as grants. In addition, the study found that the size of the board significantly reduces the positive effect of liquidity on bank performance, outlining that a large board can have more difficulty expressing the opinions of its members due to the limited time available during board member meetings. Banks with a large board size struggle to communicate, coordinate, and make appropriate decisions regarding the optimal percentage of total loans disbursed, resulting in poor bank performance. Also, according to this study, the board meeting severely undermined the positive effect of liquidity on bank performance, implying that the positive impact of bank liquidity on bank performance is lower if a bank board of commissioners has a high intensity of meetings. When banks hold meetings on a regular or very high frequency, it demonstrates that the resulting meetings are inefficient and do not generate a determined and agreed-upon agreement. As a result, when the benefits derived from high-level board meetings are low, the bank's ability to complete all tasks suffers, resulting in a decline in the bank's performance. Thus, the large number of meetings significantly reduces the beneficial effect of liquidity on bank performance. Consequently, it is essential to consider the optimal number of board members to carry out their supervisory and advisory functions to the greatest extent possible to improve bank performance; likewise, the number of meetings held by banks must be considered in corporate governance management to achieve the goal of improving banks' performance.

Golubeva et al. (2019) investigated the impact of liquidity risk on bank profitability following the implementation of the Basel III regulations using a data set of 45 European banks with 180 observations between 2014 and 2017 and 37 observations in 2018, proposing a quantitative model based on ordinary least squares (OLS) techniques supplemented by weighted least squares (WLS) regression analysis. This research utilized three liquidity risk

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measures: FGAP, liquid coverage ratio (LCR), and loan-to-deposit (LTD), as well as traditional profitability measures: ROA, ROE, net profit margin (NPM), and EBITDA margin. The main reason they excluded 2018 was that the Basel III liquidity restrictions (LCR) went into effect at the start of that year, so they examined whether this new regulation for liquidity risk changed its impact on profitability. The research showed that the LTD ratio has a positive relationship with EBITDA margin and ROE but a negative relationship with ROA and NPM. These findings suggest that increasing the loans-to-deposits ratio increases liquidity risk while increasing profitability. The influence of FGAP on the EBITDA margin proxy is statistically significant with a positive sign, which primarily consists of interest income, explaining that banks with a high level of illiquid assets in loans may earn a higher interest income than banks with a lower level of illiquid assets. Therefore, an increase in illiquid assets may lead to higher interest income and, as a result, a higher EBITDA margin. FGAP, on the other hand, has a significant and negative impact on ROA, which can be explained by the fact that banks with a higher financing gap ratio lack stable and cheap funding and must eventually rely on costly external sources to meet their funding demands. Thus, the banks' profitability suffers. The authors revealed that LCR was a minor contributor to all return proxies, which warrants further investigation.

Toufaili (2019) used panel data (fixed and random-effect) to examine the impact of banks' internal and external determinants on banks' profitability in 13 Lebanon commercial banks from 2005 to 2017. Internal and external factors such as capital adequacy, credit risk, liquidity risk, bank size, inflation, and interest rates, were analyzed to determine their impact on banks' profitability. The research found that liquidity risk, as measured by the loan-to-customer deposit ratio, had a negative effect on banks' profitability (ROA and ROE). According to the author, this effect indicates that banks have a liquidity surplus and use minimal deposits to generate lending or give more loans without increasing deposits. Furthermore, this study found that liquidity risk positively impacts the net interest margin (NIM), implying that banks use deposits to make loans.

Chen et al. (2018) sought to investigate the causes of liquidity risk and the relationship between bank liquidity risk and performance in 12 advanced economies from 1994 to 2006. This research contributes by employing alternative liquidity risk measures rather than the liquidity ratio. The findings revealed that liquidity risk, as measured by FGAP, is both negatively and significantly related to banks' performance (ROAA and ROAE). It indicates that banks with a significant funding gap lack stable and cheap funds, forcing them to use liquid assets or more external funding to meet funding demand, which consequently increases their cost of funding and reduces profitability. On the other hand, liquidity risk (FGAP) is positively and significantly related to NIM. Banks with higher FGAPRs tend to make riskier loans to earn more NIMs. Indeed, market funding costs for the funding gap rise as banks take on risky loans. As a result, banks with higher liquidity risk have higher NIMs and lower average total asset and equity returns (ROAA and ROAE).

Muriithi and Waweru (2017) used panel data techniques of random effects estimation and the generalized method of moments (GMM) to conduct a study on liquidity risk and financial

performance of commercial banks in Kenya for 43 registered commercial banks from 2005 to 2014. LCR and NSFR were used to assess liquidity risk, while ROE was used to evaluate financial performance. The research reveals that NSFR is negatively associated with bank profitability in both the long and short run, whereas LCR has no significant influence on Kenyan commercial banks' financial performance in both the long and short run, explaining that Kenyan commercial banks are reliant on short-term investments and assets with low maturities, which have a negative impact on profitability. Moreover, competitive pressures will constrain banks if higher available stable funding, consisting of capital and retail deposits, is required, resulting in competition for loans, deposits, and even sources of equity and debt investments. This competition will raise business costs, resulting in instability.

The study by Saeed and Rahman (2015) applied data from 21 Malaysian commercial banks between 2005 and 2013 to examine the liquidity risk exposure of Malaysian banks and its effects on banks' performance. This study used three liquidity indicators to represent liquidity exposure from the asset and equity sides of a bank's balance sheet, namely the loans-to-deposits ratio, the liquid assets-to-total assets ratio, and the total equity-to-total assets ratio. ROA and ROE were used to measure the performance of banks. The findings revealed that the loan-to-deposit ratio has insignificant effects on changes in bank performance. This result could be attributed to the banks' lending policies, which have a moderate loan-to-deposit ratio of 63.8%. The result of the liquid assets-to-total assets ratio revealed a negative impact on both ROA and ROE, implying that banks have a disadvantage in holding high liquid assets. Because of their low return relative to other assets, high-liquid assets impose an opportunity cost on the bank, reducing profitability. Furthermore, the capital ratio has a significant positive impact on ROA but a significant negative impact on ROE. It shows that banks are well capitalized if they do not engage in excessive lending and have an adequate liquid asset-to-total asset ratio.

Liu and Pariyaprasert (2015) sought to investigate the impact of the CAMEL model independent variables (capital adequacy, asset quality, management, earnings, and liquidity) on bank performance in China's banking sector. The fixed effects multiple linear regression models were used to measure the relationship in this study, which used data from 13 Chinese banks listed on the Shanghai and Shenzhen stock exchanges between 2008 and 2011. The loan-to-deposit ratio was used to assess bank liquidity, while ROA and ROE were used to measure bank performance. The study's findings revealed a significant positive relationship between liquidity and bank performance, stating that a higher loan-to-deposit ratio indicates that the bank lends out more money to earn interest. As a result of the rising trend in outstanding loans, the bank's profitability should rise. Notwithstanding, when the loan-to-deposit ratio is too high, the bank may face liquidity risk, forcing it to borrow emergency capital at a higher cost and reducing its profitability.

Ruziqa (2013) investigated the impact of credit and liquidity risk on the financial performance of Indonesian conventional banks with total assets exceeding 10 trillion Rupiah from 2007 to 2011. ROA, ROE, and NIM were used to measure banks' financial performance, whereas the liquidity ratio (liquid assets-to-total liabilities) was used to measure liquidity risk. The results

showed that liquidity risk has a positive and significant relationship with ROA, implying that banks with low liquidity must use more external funding to meet their demand for funds, increasing the bank's cost of funding and thus decreasing their returns. Furthermore, liquidity risk has a significant positive relationship with ROE; the higher the liquidity ratio, the more liquid and less vulnerable the bank is to failure. Banks with low liquid assets may need to increase their cash reserves to reduce their liquidity risk. As a result, during a liquidity crisis, a bank may be forced to borrow from the market at unusually high rates, lowering its returns. Notwithstanding, there is a negative relationship between liquidity ratio and NIM; this result may occur because banks with a high level of liquid assets may receive lower interest income than banks with a lower level of liquid assets. The relationship between the liquidity ratio and NIM is insignificant; one possible explanation for this result is that the liquidity ratio is not an optimal variable that can affect NIM.

Poposka and Trpkoski (2013) presented a study on the secondary model for bank profitability management: A test on the case of the Macedonian banking sector from 2001 to 2012. An econometric model was developed to analyze the profitability of Macedonian banks, with ROA and ROE as dependent variables and nine independent variables. The highly liquid assets-to-total assets ratio was used as an indicator of liquidity. The analysis indicated that liquidity had a high positive statistical significance on both profitability indicators (ROA and ROE). An instant liquidity ratio is a crucial indicator that instills trust among banking service users. As a result, banks with such liquidity can borrow funds at lower costs, resulting in increased profitability.

The study by Arif and Anees (2012) aimed to investigate liquidity risk in Pakistani banks and evaluate the effect on bank profitability. They used data from 22 Pakistani bank balance sheets, income statements, and notes from 2004 to 2009; multiple regressions were applied to assess the impact of liquidity risk on bank profitability. The analysis indicated that liquidity risk impacts bank profitability significantly and negatively, with the liquidity gap serving as a measure of liquidity risk. The liquidity gap shows the maturity mismatch between assets and liabilities. They explained that in the event of a significant liquidity gap, banks may be forced to borrow from the repo market at higher rates, increasing their costs. This cost increase will eventually have an impact on banks' profitability. However, the findings of this study revealed that Pakistani banks do not rely on the repo market. They have enough cash to reduce their reliance on the repo market, which will assist banks in keeping the negative impact of the liquidity gap within an appropriate range. It can be deduced that the negative effects of liquidity can be avoided by maintaining adequate cash reserves.

Anbar and Alper (2011) used the panel (fixed effects model) data method to investigate the bank-specific and macroeconomic determinants of bank profitability in Turkey from 2002 to 2010. Return on assets (ROA) and return on equity (ROE) were used to calculate bank profitability as a function of bank-specific and macroeconomic determinants. Among the eleven independent variables, the ratio of liquid assets-to-total assets was used to measure liquidity. The findings revealed that banks' liquidity had no effect on the bank's performance.

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Bordeleau and Graham (2010) used a panel two-step GMM procedure with bank and time-fixed effects to present empirical evidence on the relationship between liquid asset holdings and profitability for a panel of 10 Canadian banks and 55 U.S. bank holding companies (BHC) from 1997 to 2009, with only the macroeconomic variables treated as exogenous. The ratio of cash, government-issued and government-guaranteed securities, and interbank deposits-to-total assets was used to assess liquid assets, whereas ROA and ROE were used as proxies for banks' performance. Furthermore, the liquid asset ratio was expressed as a nonlinear polynomial of order two, as a product of real GDP growth, and as a proxy for short-term funding. The results showed that banks with certain liquid assets have higher profitability; however, there is a point beyond which holding more liquid assets reduces a bank's profitability, which is consistent with the idea that funding markets reward a bank to a certain extent for holding liquid assets, reducing its liquidity risk. However, the opportunity cost of holding such comparatively low-yielding liquid assets on the balance sheet can eventually outweigh this benefit. Also, by adopting a more traditional (i.e., deposit- and loan-based) business model, a bank can maximize profits while maintaining a decrease in liquid assets. Likewise, when the likelihood of funding market difficulties is low (as measured by economic growth); banks must hold fewer liquid assets to maximize profits. According to this paper, banks should consider the tradeoff between resilience to liquidity shocks and the cost of retaining lower-yielding liquid assets. On the one hand, holding liquid assets strengthens banks' resilience to liquidity shocks, reducing the negative externalities they may impose on other economic agents. Holding too many, on the other hand, may incur a substantial cost in terms of diminished profitability. Indeed, because retained earnings are the primary source of organic capital generation, low profits may prevent banks from expanding and lending to the real economy.

The study by Sufian (2009) sought to investigate the performance of China's banking sector from 2000 to 2007, a period characterized by significant reform in the country's banking sector. The empirical study was limited to four state-owned commercial banks (SOCBs) and twelve joint-stock commercial banks (JSCBs). A total of 120 bank-year observations were included in the sample. The dependent variables are the return on assets (ROA) and net interest margin (NIM). The ratio of total loans-to-total assets represents bank liquidity among the eight bank-specific variables that comprise the regressions. The research results exhibited a negative relationship between bank profitability and the bank's liquid assets. A higher total loan-to-asset ratio indicates lower liquidity; the findings imply that more (or less) liquid banks have lower (or higher) profitability levels, demonstrating that the negativity is due to the increased cost of screening and monitoring necessitated by a higher proportion of loans in the bank's asset portfolio, as loans have the highest operational expenses in a bank portfolio. Additionally, the negative sign of total loans-to-total assets indicates that a higher level of liquidity is associated with a low-interest margin, as explained by the phenomenon that some large SOCBs have been aggressively expanding their credit business at low margins. Besides, it indicates that SOCBs with a higher level of liquidity are more profitable. The government can control the lending amount in the Chinese banking sector through quotas and other means. In this regard, SOCBs are well-known as the major lenders to SOEs (state-owned

enterprises). Loans to SOEs, on the other hand, are known to be riskier and are the primary component of the growing number of NPLs (non-performing loans). As a result, it is reasonable to expect that SOCBs that made fewer loans will be more profitable due to lower future NPLs.

Section 03: Other determinants of the performance of banks

This section seeks to highlight other factors that were included in earlier research that intended to explain the performance of banks.

Any bank must identify the factors that have a beneficial or detrimental impact on its performance in order to implement the appropriate strategies that will allow it to be competitive and efficient. They are divided into two categories: bank-specific (internal) factors and macroeconomic (external) factors.

1. Internal factors

Internal factors reflect the bank's various organizational and managerial policies and the implemented strategies. We will discuss the main internal determinants that have been identified in the literature as having an impact on banks' performance.

- **Capitalization (CAR) :**

The equity-to-total assets ratio is commonly used to calculate capitalization. This ratio is a crucial metric for determining the health of financial institutions (Kosmidou, 2008). It protects shareholders' interests, avoids banking collapse, and keeps banks alive overall (Nguyen, 2021). Banks with high capital-asset ratios tend to be less risky in the event of a loss or insolvency (Chen et al., 2018). Furthermore, a rise in capital may enhance anticipated earnings by lowering the costs of financial distress (Berger, 1995).

Several authors have concluded that the most powerful banks are those that can keep a high level of own capital in relation to their assets (Bourke, 1989; Abreu and Mendes, 2002; Goddard and al., 2004; Pasiouras and Kosmidou, 2007), presenting evidence to support the assertion that well-capitalized banks incur reduced expenses from going bankrupt, lowering their cost of funding, or that they have less demand for external financing, leading to better profitability. Additionally, a high level of stockholder equity sends a positive signal to the market about the bank's solvency and low credit risk.

- **Size :**

In the majority of empirical studies on the relationship between size and banks' performance, the logarithm of total assets is used as a measure of bank size. The impact is ambiguous. On the one hand, larger size may generate economies of scale, leading to a reduction in its costs and resulting in improved performance; among those arguing this relationship are Bikker and Hu (2002), Pasiouras and Kosmidou (2007), and Guillen et al. (2014). On the other hand, they are frequently affected by rigidities, inertia, and bureaucracy, which can reduce performance (Kosmidou, 2008; Athanasoglou et al., 2006; Dietrich and Wanzenried, 2011).

- **Credit risk (CR):**

The Basel Committee on Banking Supervision (2001) defined credit risk as "the possibility of losing the outstanding loan partially or totally due to credit events (default risk)". The loan

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loss provisions-to-loans ratio (LLPL) is a credit risk proxy. According to Thakor (1987), the level of loan loss provisions is an indicator of a bank's asset quality and signals a change in future performance.

Credit risk is one of the most crucial variables influencing banks' performance, as it constitutes the risk of loss due to the debtor's failure to fulfill its obligations to the bank (Nicolae et al., 2015). It is one of the primary causes of bank failure and can be viewed as a risk of not being repaid when the loan is due.

Miller and Noulas (1997) contend that the greater a bank's exposure to high-risk loans, the greater the accumulation of unpaid loans and the lower the profitability; additionally, the decline in loan loss provisions is, in many cases, the primary catalyst for increases in profit margins. Similarly, Chen et al. (2018) discovered a negative association between credit risk and banks' performance, indicating that banks should prioritize credit risk management, which is consistent with previous study like Athanasoglou et al., (2006) and Athanasoglou et al., (2008). Hence, the LLPL coefficient is expected to be negative.

- **Market share (MS):**

A bank's market share is determined by dividing the bank's deposits by the total deposits of all banks in a given country (Kulu and Darko, 2021). This indicator indicates a bank's market position to its competitors. According to Peria and Mody (2004), banks with a significant market share can use their market share and size to eliminate existing or potential competitors by lowering interest rate margins. In the short term, this will reduce interest income and the performance of these banks. However, Genchev (2012) found a positive association between market share and profitability in Bulgarian banks, indicating that banks can increase their market share to boost profitability. The result is similar to that of Mirzaei and Mirzaei (2011).

- **Deposits:**

Deposits, including demand deposits and term deposits, are regarded as the primary source of funding for banks. It is the ratio of total deposits to total assets. The greater the number of deposits converted into loans, the greater the interest margin and profit (Alper and Anba, 2011). Banks with a sizable branch network can attract more deposits, which are a less expensive source of funds. It enables cost savings, which boosts banking performance.

According to Chu and Lim (1998), large banks may attract more deposits and loan transactions, commanding greater interest rate spreads in the process. However, Randhawa and Lim (2005) suggested that smaller banks with smaller depositor bases may be compelled to purchase funds in the interbank market, which is more expensive. Deposits can thus have a negative impact on profitability if they are not effectively converted into investment opportunities. El-Ansary and Megahed (2016) discovered an inverse link between total deposits-to-total assets and banks' profitability.

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- **Operational expenses (OPEX):**

Operational expense (overhead) is a cost incurred by a business to carry out its operational activities. OPEX includes general and administrative expenses such as rent, salaries and wages, equipment leases, license fees, insurance, property taxes, and payroll. The overhead-to-total-assets ratio is used to provide information on the variation in bank costs across the banking system (Sufian and Habibullah, 2010).

Since efficient banks are expected to operate at lower prices, a high overhead ratio is most likely to have a negative impact on performance (Bourke 1989). Furthermore, using new electronic technology, such as ATMs (Automated Teller Machines) and other automated means of delivering services, has caused wage expenses to fall (as capital is substituted for labor). Hence, a lower overhead ratio may positively impact a bank's performance (Kabir and Bashir, 2005).

According to Ben Naceur's (2003) research, there is a positive and significant coefficient on the overhead-to-assets ratio variable in the NMI and ROA, explaining that banks tend to incur additional operating expenses to maximize their profits; this result is consistent with the study of Molyneux and Thornton (1992). Nevertheless, according to Nessibi's (2016) research, operating expenses have a negative impact on the bank's profitability. The higher the operating expenses, the more expenditure the bank will bear when carrying out its operations and the less profit the bank will generate; this result is consistent with the study of Sufian and Habibullah (2010) and Staikouras and Wood (2004).

- **Loan growth (LG):**

Loan growth is a bank's riskiness and future performance indicator; it is a scale of operating metrics known as the quarterly growth rate of loans and advances (Rebei, 2014). When banks aggressively provide loans to subprime customers with low creditworthiness, more loans may default, and the bank must increase the loan loss provision, resulting in lower profit (Pokharel, 2020).

Keeton (1999) reveals, using a dataset of US banks from 1982 to 1996, that loan growth leads to more loan loss provisions resulting in a negative performance. Another study was conducted in Australia by Hess et al. (2008) using bank data from 1980 to 2005. The findings show that current rapid loan growth results in more bank losses after 2-4 years, demonstrating that this impact is amplified in the context of macroeconomic instability or for large banks. Furthermore, Mirzaei and Mirzaei (2011) discovered that the link between loan growth and profitability in the Middle East is negative and insignificant; indicating that the probability of loan defaults in Middle Eastern banks is considerable. On the other hand, Tariq et al. (2014) found that loan growth has a positive impact on banks' profitability, explaining that loans are the primary source of income for banks; implying that the more money a bank lends, the more funds it earns from short- and long-term financing in various sectors of the economy. Subsequently, depending on the level of credit grade, the size of a bank's credit portfolio affects its profitability in either a positive or negative way.

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- **Diversification (DIV):**

Diversification entails becoming involved in more areas and/or services. It is a proxy of non-traditional activities. It is the ratio of non-interest income divided by operating income. Non-interest income consists of commission, service charges, and fees, guarantee fees, net profit from sale of investment securities, and foreign exchange profit (Sufian and Habibullah, 2010).

Banks may intend to diversify their credit portfolios in order to improve performance and reduce credit portfolio risk. According to modern portfolio theory, holding imperfectly correlated assets reduces risk within an asset portfolio and results in net positive returns (Markowitz, 1959). Another viewpoint asserts that diversification can lower the expected costs of financial distress by spreading activities across various industries and enhancing resource allocation through internal capital markets (Boot and Schmeits, 2000).

Lin et al. (2012) demonstrate that when banks implement diversification strategies, they focus on new business lines, lowering their idiosyncratic risk. Likewise, Sufian and Habibullah, (2010) found that non-interest sources tend to have a positive impact on banks' profitability. Conversely, Acharya et al. (2002) conducted a study on credit portfolio diversification in banks; analyzing Italian banks and revealing that both industrial and sectoral diversification reduce bank returns while producing riskier loans. Jensen (1986) contends that organizations should remain focused on their traditional activities in order to minimize potential agency problems. He points out that diversification can provide incentives for managers to grow their businesses beyond the optimal size, sacrificing organizational value in the process. It is because growth increases the resources under managers' control and the compensation they receive. Nguyen (2018) further states that diversification dilutes banks' comparative advantage by forcing managers to operate outside their areas of expertise.

Other detrimental effects of diversification include informational asymmetries between divisional managers and headquarters (Harris et al., 1982), increased exposure to new types of risks such as operational risk, liquidity risk, and market risk, and bank credit risk (Moudud-Ul-Huq et al., 2018).

- **Ownership structure (OWN):**

Since public banks render riskier loans, implying higher credit risk and lower asset quality, and have lower solvency ratios than private banks, the majority of authors concluded that public banks are less robust than private banks (Innotta et al., 2007; Barth et al., 2004; and Cornet et al., 2010).

According to Cornet et al. (2010), the performance gap between private and public banks is even more pronounced in countries where power is heavily involved in the banking system and political corruption exists (conflicts of interest). Micco et al. (2007) stated that bank control affects its performance, but this relationship is especially evident in developing countries where nationalized banks have poor performance, low margins, and high overheads. This relationship appears to be much less pronounced in developed countries.

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In the case of Switzerland, Dietrich and Wanzenried (2011) confirmed that public banks are less potent than private banks, except during financial crises, where private banks are regarded as safer and better managed than private institutions. According to Bourke (1989), public ownership has a negative impact on banks' profitability. It is because public banks do not always seek to maximize profits; instead, they generally use their resources to fund projects that benefit society, which are less profitable and riskier.

2.   External factors

External factors are those over which bank management has no control. These factors include the financial, economic, regulatory, and legal environments. They are classified into two types: the first category includes macroeconomic factors that reflect the country's economic situation; the second category includes all of the characteristics that provide information on market specifics (banking industry)

- **Gross domestic product growth (GDPG):**

The GDP is a prominent macroeconomic indicator for measuring total economic activity in a country. It is the total quantity of products and services that a nation generates by all business units through economic activities. An increase in regional GDP will benefit the country's economy (Barro, 1991; King and Levine, 1993). The GDP is expected to have an impact on a variety of factors related to the supply and demand for loans and deposits. When the economy performs well and expands, credit activity will increase, which shifts credit demand outward and causes interest rates to rise. Alternately, low or negative economic growth rates may weaken borrowers' debt serviceability, resulting in credit losses and increased bank provisions, affecting the bank margins; thereby its profitability. When economic activity falls, so does the demand for loans and deposits, which has a negative impact on profit margins (Sufian and Chong, 2008). It is reasonable to expect that favorable economic conditions affect positively the demand and supply of banking services.

Thi Xuan Huong et al. (2021) demonstrate that GDP has a positive impact on ROA, ROE, and NIM using unbalanced panel data from Bankscope from 171 banks in nine Southeast Asian countries from 2004 to 2016, which is consistent with previous research (Chen et al., 2018; Kosmidou et al., 2005; Lee and Hsieh, 2013; Trujillo-Ponce, 2013). It is because economic growth improves banks' performance by lowering interest rates, leading to increased demand for loans and allowing banks to charge higher fees for their services. In addition, Al-Smadi and Al-Wabel (2011) revealed the same result: economic growth positively and significantly affects banks' performance, explaining that bank performance is better during times of prosperity than during an economic recession. Economic activity, in general, decreases during the recession. As credit quality deteriorates, banks' provisions increase, lowering their return. However, other researchers concluded that GDPG and banks' performance are inversely related.

Bernanke and Gertler (1989) and Demirguc-Kunt et al. (2004) discover an inverse relationship, justifying that in periods of recession, the risk of borrower default rises and

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banks raise interest rates on loans to compensate for the increased risk, which improves their performance. Furthermore, Claeys and Vennet (2008), who study the situation in Europe, reveal a positive relationship in Western Europe but no impact on Eastern European banks.

- **Inflation (INFL):**

According to the IMF, inflation is the rate at which prices rise over a given period, which can be interpreted as a decline in purchasing power over time. The increase in prices, often expressed as a percentage, means that a unit of currency presently buys less than it did previously. Inflation differs from deflation, which occurs when prices fall while purchasing power rises. The inflation rate is another main economic factor that may impact both bank costs and revenues. According to Staikouras and Wood (2004), inflation can have both direct and indirect effects on bank profitability, such as rising labor costs and changes in interest rates and asset prices. The majority of studies use the consumer price index (CPI) as a proxy for inflation, such as Claeys and Vennet (2008) and Maudos and Solisa (2009). On the other hand, some authors prefer using the Gross Domestic Product (GDP) deflator as a proxy because it reflects changes in prices for all goods and services, whereas the CPI only reflects changes in a basket of goods and services (Demirgüç-Kunt and Huizinga, 1999; Mendes and Abreu, 2003; Gunter et al., 2013).

According to Staikouras and Wood (2004), Revell (1979) was the first author to address the issue of inflation. He demonstrated that the impact on performance depends on the growth rate of operational expenses; if these expenses rise faster than inflation, performance falls. But if the growth rate is lower, the impact is positive. According to Perry (1992), the effects of inflation on bank performance differ depending on the inflation expectation: in the expected case, interest rates are adjusted accordingly, causing revenues to grow faster than costs and, as a result, a beneficial effect on bank profitability. On the other hand, in the unexpected case, banks may be slow in adjusting their interest rates, resulting in a faster increase of bank costs than bank revenues and, consequently, having a detrimental effect on bank profitability. Fadzlan and Mohamad (2012) revealed that inflation is positively related to Indian bank profitability, implying that inflation levels were anticipated by banks operating in the Indian banking sector between 2000 and 2008. It allowed them to adjust interest rates accordingly, resulting in higher profits. Abreu and Mendes (2002) contend that the relationship between inflation and bank profitability is primarily determined by the rate at which the bank revenues adjust to its costs.

Several more authors, including Molyneux and Thornton (1992), Athanasoglou et al. (2006), Pasiouoras and Kosmidou (2007), and Dietrich and Wanzenried (2011), were curious about the influence of inflation on banking performance and concluded a positive and significant impact. However, the studies of Afanasieff et al. (2002) and Ben Naceur and Kandil (2009) found that inflation has a negative effect on interest margins. They provide the following rationale: trade banks' primary activity is credit granting. Therefore, the market depends on a supply of credit (provided by banks) and a demand for credit (that of individuals and firms). Inflation reduces credit demand because it raises uncertainty about the future. Nevertheless, it has been demonstrated that individuals and businesses are generally very lighthearted about

uncertainty (ambiguity aversion). This decrease in demand would result in a decrease in credits and, as a result, a decline in performance.

- **Interest rate (IR):**

The interest rate, which is the price a borrower pays for the use of money borrowed from a lender or financial institution, is one of the most important factors influencing a bank's financial performance (Crowley, 2007). When interest rates rise, banks generate more revenue by exploiting the difference between the interest rates they pay customers and the interest rates they can earn by investing. Since variations in interest rates are primarily caused by government economic policies and supply and demand market conditions, most research papers on the determinants of bank profitability present the interest rate as an external variable.

Interest rates are one of the most vital determinants of banks' performance in Nigeria, according to Olokoyo et al. (2019), and they conclude that higher interest rates impede bank performance. According to Genay and Podjasek (2014), low-interest rates have a negative impact on US banks over time due to a narrower spread. They also point out that the direct effects of low-interest rates are minor compared to the economic benefits, including improved asset quality support. Demirgüç-Kunt and Huizinga (1999) revealed, on the other hand, that higher interest rates are associated with higher net interest margins and profits, particularly in developing countries, because their interest rates on deposits are more likely controlled and below market rates. Claessens et al. (2016), as well as Molyneux and Thornton (1992), found a positive and significant relationship between interest rates and banks' profitability.

English (2002) found no evidence that changes in the levels of short-term and long-term rates influence contemporaneous banks' net interest margins in a study specifically investigating the effects of interest rates on banks' net interest margins, using aggregate data for ten industrial countries over 20 years. Similarly, Garcia and Guerreiro (2016) concluded from their research that interest rates do not affect banks' profitability.

- **Market concentration (CON) :**

The market concentration (CON), an industry-specific indicator, is defined as the percentage of total assets held by the k (usually 3 or 5) largest trade banks compared to the total assets of the sample's banks. In the context of the effect of concentration on banks' performance, two theories exist. The first, known as "structure-conduit performance" (SCP), asserts that increased market share and market structure result in monopoly powers. According to this thesis, an increase in market concentration leads to a weakening of competition and the generation of market power. Organizations will be allowed to set prices above competitive levels, freeing them from the burden of calculating high profitability due to monopoly profits. The second, "efficient structure" (ES), contradicts this notion, which states that the relationship of the proxy with margins can be a result of market power or bank efficiency.

According to Molyneux and Thornton (1992), the bank concentration ratio has a positive and statistically significant impact on banks' performance, supporting the SCP theory. A higher

concentration ratio is expected to give banks more negotiating power in pricing policies, increasing net interest margins and profitability. Conversely, other studies, such as those of Demirguc-Kunt and Huizinga (1999) and Staikouras and Wood (2004), yield the exact opposite result, which tends to support the theory of ES. This idea is explained by the fact that a concentrated sector has low deposit rates and high loan rates. As a result, customers will be hesitant to borrow from and deposit funds with banks, reducing their customer base and profitability.

- **Exchange rate (EXR):**

The exchange rate is the fee charged to exchange one currency for another, and it is determined by the international money market. Real currency exchange rates are determined by the price level of goods in domestic currency and the domestic currency's exchange rate against foreign currencies. When the real exchange rate of the domestic currency is high, the prices of goods sold abroad are relatively lower, while the prices of domestic goods are considerably higher. In contrast, if the domestic currency's real exchange rate is low, the prices of goods abroad are relatively higher, while the prices of domestic goods are relatively lower.

Nyabakora et al. (2020) discovered a negative and significant relationship between the exchange rate and bank profitability, explaining that an increase in the exchange rate makes it more difficult to sell overseas because relative prices rise. Reduced exportation leads to a lower level of bank loans because the product has no market outside of the country, resulting in a decrease in profit; even those with bank loans are unable to repay the installments and become bad loans, affecting liquidity and profitability. A decline in the currency value lowers the overall price level of goods and services, attracting foreign investors who invest and employ locals, contributing to profit-making.

- **Money supply growth (MSG):**

The money supply is the sum of a country's currency and other liquid assets at the time the money supply is determined. All cash in circulation and bank deposits that can be easily converted into currency by the account holder are included in the money supply. The money supply is monitored over time as a crucial component in analyzing the economy's health, identifying weak spots, and developing policies to address those weaknesses. A rise in the money supply usually lowers interest rates, resulting in more investment and more money in the hands of consumers, stimulating spending. In contrast, when the money supply falls or its rate of growth slows, banks lend less, and consumer demand for home mortgages and car loans falls.

Changes in the money supply, according to the quantity theory of money, result in changes in the nominal GDP and the price level. The money supply is primarily determined by Central Bank policy; however, it is influenced by households' actions that hold money and banks where funds are kept. Kosmidou (2008), Bourke (1989), and Molyneux and Thornton (1992) all found a significant and positive relationship between money supply and banks revenues.
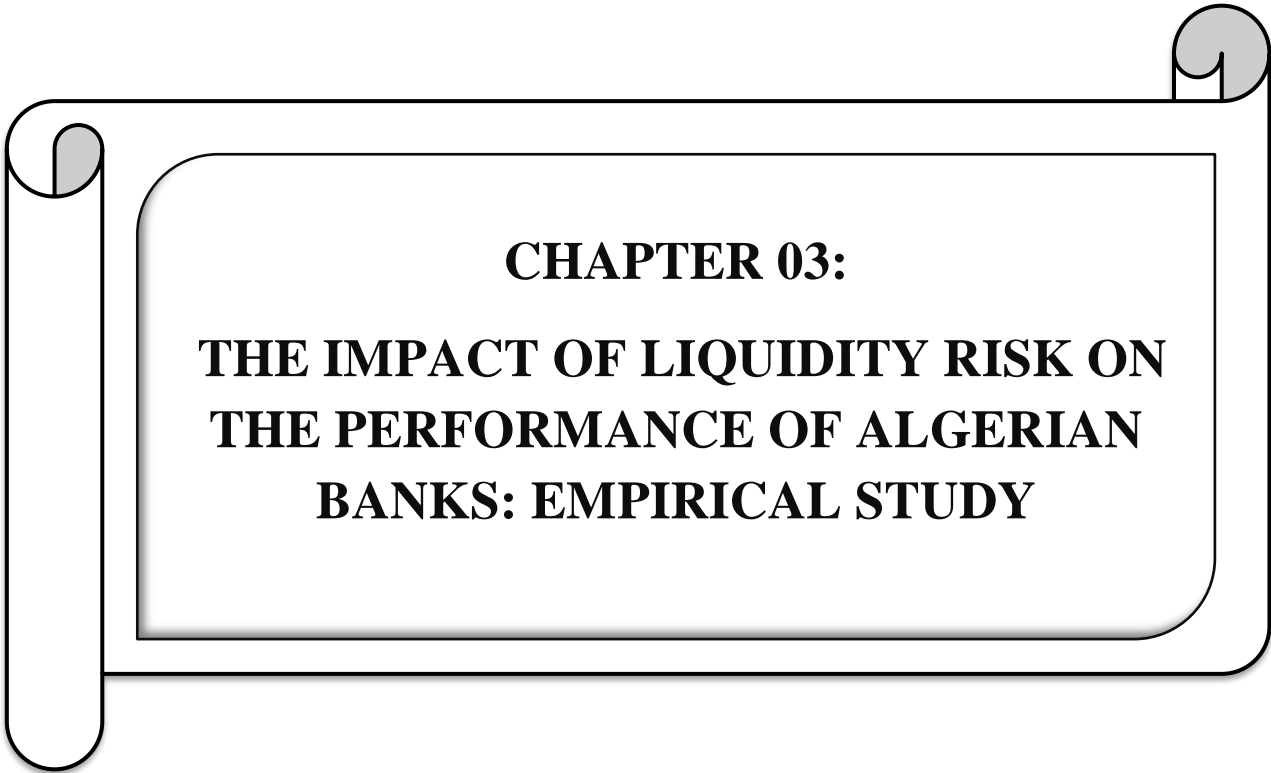
Other researchers like Sufian and Habibullah (2010) found a negative relationship between money supply growth and banks income. According to Lutf (2018), excessive growth in the money supply indicates an increase in inflation, which has an inverse effect on deposits. It means that as deposit levels fall, so does the income level of banks. Even though the state bank's policy determines the money supply, this can be influenced by individual and banks behavior.

Conclusion

In this chapter, we presented theories that explain the relationship between bank liquidity risk and the performance of banks, such as the risk-return trade-off theory. We found through our research that liquidity risk can have either a negative or positive impact, or both, on banks' performance. In previous studies, banking performance was primarily measured by ROA, ROE, and NIM, whereas liquidity risk was measured based on liquid assets and loan size.

Furthermore, this chapter addressed the different factors that can affect banks' performance, which are divided into two categories: internal factors such as size, capitalization, credit risk, and diversification, and external factors such as GDP growth, inflation, exchange rate, and interest rate.

Our work will not be limited to presenting a theoretical and empirical literature review on this subject but will also investigate the relationship using an Algerian bank sample, which will be the subject of the following chapter.

CHAPTER 03:

THE IMPACT OF LIQUIDITY RISK ON THE PERFORMANCE OF ALGERIAN BANKS: EMPIRICAL STUDY

Introduction

In recent years, liquidity risk has emerged as one of the most severe risks to banks and other financial institutions. It attracted the interest of researchers and professionals, who investigated its determinants and their impact on banks' performance.

Following the presentation of a theoretical and empirical literature review on the relationship between liquidity risk and banks' performance, along with other determinants of the performance of banks, this chapter is going to present the empirical element of the study, demonstrating the existence of a significant or insignificant impact of liquidity risk on the performance of Algerian banks using econometric modeling.

This chapter is organized as follows:

> ➢ **Section 01:** Algerian banking sector
> ➢ **Section 02:** Research methodology and descriptive study
> ➢ **Section 03:** Model estimation and results interpretation

Section 01: Algerian banking sector

Due to hydrocarbon revenues, Algeria's banking sector has seen a significant increase in intermediation and penetration rates. In response to the sharp decline in hydrocarbon receipts in late 2014, authorities have implemented reforms and announced new measures to empower the sector to finance economic development. In 2015, efforts were made to integrate the informal economy into the formal financial system (Banking and Financial Services, 2015). This section presents the Algerian banking sector's evolution, regulatory framework, and banking intermediation indicators.

1. Evolution of the Algerian banking sector

The Algerian banking sector has passed through many stages. It can be summarized in five phases (Hacini and Dahou, 2018).

- **Colonial phase**:

Algerian banks were an extension of the French banking system during this period. They were established to meet the financial needs of the colonial economy. The Algerian banking system was made up of the Bank of Algeria (1851), which was an annex of the Bank of France, whose role was to issue money, provide loans to finance colonial economic activities and ensure currency exchange services. French authorities founded the Algerian Council of Credit, whose mission was to set regulations and legal frameworks and provide proposals and consultations on the development of the banking system.

- **Sovereignty phase:**

Following independence in 1962, the Algerian government attempted to establish an economy separate from the colonial economy. The Algerian authorities were required to create an Algerian banking system to support and finance ambitious economic development programs. In this perspective, the Treasury was established in August 1962 to ensure financial resources for the execution of the state budget and monitor the financial and accounting organization of state-owned enterprises. The Central Bank of Algeria (CBA) was created in December of 1962, serving three functions: bank of banks, bank of the State, and bank of exchange. In order to build a core of Algerian commercial banks, the "Banque Algérienne de Développement" (BAD) was established in May 1963 as the CBA's first investment bank. The "Caisse Nationale d'Epargne et de Prévoyance-Banque" (CNEP-Banque) was created in August 1964 to collect savings and build housing.

- **Nationalization and socialization phase:**

As a result of the nationalization of the foreign banks that had operated in Algeria since the colonial period, the Algerian banking network expanded in 1966 with the establishment of three commercial banks. The "Banque Nationale d'Algérie" (BNA) was established as a national corporation to operate as a deposit bank in terms of resource collection and operations, as well as to ensure exchange operations and various credit transactions. Later

that year, the "Crédit Populaire d'Algérie" (CPA) was formed to provide all of the services of a bank, with its operations encompassing hotelier, tourism, fishing, and craft activities. Following that, in 1967, the "Banque Extérieure d'Algérie" (BEA) was founded with the primary goal of facilitating and developing all transactions between Algeria and foreign countries. The Treasury is the primary institution in the Algerian financial system during this period, managing the State's financial resources, while the banking sector is simply a channel that distributes capital according to state plans without regard for its objectives. Indeed, banks have been prohibited from managing their profits and revenues independently, requiring the approval of central authorities for all decisions, including those relating to the investment of their financial resources.

- **Restricting phase:**

During this period, the Algerian banking sector was strengthened by establishing two commercial banks: the "Banque de l'Agriculture et du Développement Rural" (BADR), which was founded in 1982 to take over the role of financing the agriculture sector from BNA, and the "Banque de Développement Local" (BDL), which was created in 1985 to replace the CPA in its activities of financing state-owned enterprises of an economic nature and funding local government investment plans. The Treasury intervened in the restructuring of state-owned enterprises to increase profitability, which benefited the enterprises by shedding their debts and improving their financial situation.

- **Liberalization phase:**

Algerians lived in what was dubbed "the golden age" during the 1970s, when socioeconomic indicators were favorable. Following that, the Algerian economy experienced a severe crisis in 1986 as a result of a precipitous drop in oil prices, which resulted in a decrease in export revenue and a negative economic growth rate. Moreover, the currency reserve collapsed, raising the cost of external debt and debt service. Therefore, the Bank and Credit Act of 1986 was enacted, granting bank management autonomy to determine their credit policies within the context of the national credit plan. However, this autonomy had little impact on the banking sector because state-owned enterprises were not autonomous and were still managed by a centralized system. Following that, the Law of 1988 was implemented to complete the process of providing autonomy to economic and public enterprises, including financial institutions. Thereby, economic and public enterprises were only required to follow the logic of performance and profitability. Algeria experienced a multidimensional crisis (political, social, and economic) at the end of the 1980s, characterized by a poor production system, high levels of external debt, a decline in exports, and a contraction of currency reserves, which led to a reduction in imports. Following International Monetary Fund (IMF) recommendations, Algeria has worked to rebuild the economy in order to sustain long-term growth by creating a favorable macroeconomic environment (Oufriha, 2008), attracting foreign direct investment, and promoting the private sector through privatization. To that end, the Law on Money and Credit (LMC) was enacted in 1990 to establish a modern banking system capable of meeting the requirements of the market economy system. The primary

objectives of this law were to transition from directed credit banks to market-determined credit banks as well as improve banking sector modernization and competition. The process of opening the banking sector to private and foreign investment has continued at a rapid pace; as of 2001, the Algerian banking system consisted of more than twenty banks and financial institutions of various types, including public, private, and foreign institutions.

The Algerian banking system has been subjected to a violent shake due to the failure of three national private banks: the "Banque Commerciale et Industrielle d'Algérie" (BCIA), EL-Khalifa Bank, and Union Bank. As a result, the Algerian authorities hastened to strengthen the legislative environment and regulations governing bank operations by issuing the banking ordinance in 2003.

2. Regulatory framework of the Algerian banking sector

A bank's core vocation is intermediation, and regulatory instruments have been put in place to ensure that banking activity, reporting, and supervision are conducted according to universal standards. Laws and ordinances have been enacted, the most important of which are listed below.

- **Law No. 90-10 of April 14, 1990, relating to money and credit:**

This law, promulgated in 1990, was intended to be a legislative mechanism to support the government's economic reforms begun in 1988. The goals of this law were to (CNES, p. 23, 2000): put an end to all administrative interference in the financial and banking sector; rehabilitate the role of the Central Bank in the management of money and credit; re-establish the value of the Algerian dinar by removing the various statuses conferred on the currency in different spheres of transactions; improve overall banking of the economy; encourage external investments; to improve the public sector's financial situation; to clarify the missions assigned to banks and financial institutions; and to diversify the sources of financing of economic agents, particularly businesses, through the establishment of a financial market.

- **Ordinance No. 01-01 of February 27, 2001, relating to money and credit:**

This ordinance came to modify and complete Law No. 90-10 through arrangements affecting primarily the Council of Currency and Credit, which has been divided into two bodies, the first of which is made up of the board of directors in charge of the management and administration of the Bank of Algeria, and the second of which is made up of the Council of Currency and Credit acting as a monetary authority.

- **Ordinance No. 03-11 of August 26, 2003, relating to money and credit:**

The government was urged to overhaul the money and credit law following the scandals surrounding the failure of three national private banks. This ordinance focused on toughening procedures for providing bank accreditation, strengthening conditions for the establishment of new institutions, modernizing bank management methods, and improving the operations of

supervision and control of bank activities. It also introduced new principles such as foreign exchange and capital movements, depositors' protection, and professional secrecy.

- **Ordinance No. 10-04 of August 26, 2010, relating to money and credit:**

This ordinance was promulgated to modify and complete specific articles of ordinance No. 03-11 of August 26, 2003, relating to money and credit. The Bank of Algeria's mission has been expanded, the Money and Credit Council's mission has been updated, and banks' and financial institutions' tasks have been expanded to include new related operations. Foreign participation in banks can only be permitted within the framework of a partnership (one or more partners) with at least 51% resident national shareholding. Moreover, the ordinance supported the establishment of an internal control and compliance system at the level of banks and financial institutions, with the obligation to consider all risks associated with banking activity. It also introduced several new articles to protect citizens' interests in the face of certain trade practices, such as Article 119ter, which requires banks to be more transparent in their credit operations, like keeping their customers informed about their banking situation and the banking conditions practiced.

- **Law No. 17-10 of October 11, 2017, relating to money and credit:**

This ordinance was enacted to complete Article 45 of Ordinance No. 03-11 of August 26, 2003, relating to money and credit. For five years, as an exception, the Bank of Algeria proceeds to the direct purchase from the Treasury of securities issued by the latter for purposes related to the coverage of the Treasury's financing needs, the financing of the internal public debt, and the financing of the "Fonds National d'Investissement" (FNI). The goal of this ordinance is to implement economic and budgetary structural reforms to balance the state's Treasury and balance of payments.

- **Regulation No. 2018-02 of November 4, 2018, on the conditions of the exercise of banking operations under participatory finance by banks and financial institutions:**

The purpose of this regulation is to define the conditions for prior authorization by the Bank of Algeria for the operations of banks and financial institutions approved under participatory finance. These operations fall into the categories of receiving funds, investing, and financing and do not result in the collection or payment of interest. Furthermore, these operations pertain to the following product categories: Murabaha, Musharaka, Mudaraba, Ijara, Istisna'a, Salam, and deposits in investment accounts.

- **Regulation No. 2020-02 of March 15, 2020, defines the banking operations falling under Islamic finance and the conditions of their exercise by banks and financial institutions:**

The goal of this regulation is to repeal the 2018 regulation while clarifying some points. Its objective is to define the conditions for prior authorization of operations by the Bank of Algeria, the rules that apply to them, and the terms for their execution by banks and financial

institutions under Islamic finance. Any financial institution that practices Islamic finance is required to obtain a certificate of compliance with Sharia precepts issued by the National Sharia Authority of Fatwa for the Islamic Finance Industry and set up a specific window for Islamic finance operations in each bank that does so.

3. Figures on the Algerian banking sector

Algeria's banking sector consists of nineteen (19) banks: six (06) public banks and thirteen (13) private banks with foreign capital, including one (01) with mixed capital (the annual reports of the Bank of Algeria, 2021). The Algerian banking sector is dominated by public banks, which have a higher branch network than private banks (1 202 versus 401 branches in private banks in 2021). According to the annual reports of the Bank of Algeria, we will present the evolution of some indicators of the Algerian banking sector.

3.1 Collected resources (deposits):

Deposits are the primary source of income for banks; indeed, total deposits have slightly increased in recent years, indicating that banks have made efforts to collect deposits.

Table No. 01: Evolution of the collected resources by the Algerian banks from 2016 to 2020

In billions of Algerian dinars; end of period

Year	2016	2017	2018	2019	2020
Total Collected Resources	9 079.9	10 232.2	10 922.7	10 639.5	10 756.0
Public banks' share	87.06%	85.81%	86.24%	85.32%	84.71%
Private banks' share	12.94%	14.19%	13.76%	14.68%	1 5.29%

Source: Bank of Algeria Reports of 2020 and 2021

We notice that banks' demand and term deposits increased by 1.1% in 2020 after declining by 2.6% in 2019 and rising by 6.7% in 2018. Deposits pledged as collateral for signature commitments are included (documentary credits, endorsements, and guarantees).

Figure No. 06: Attractiveness of deposits
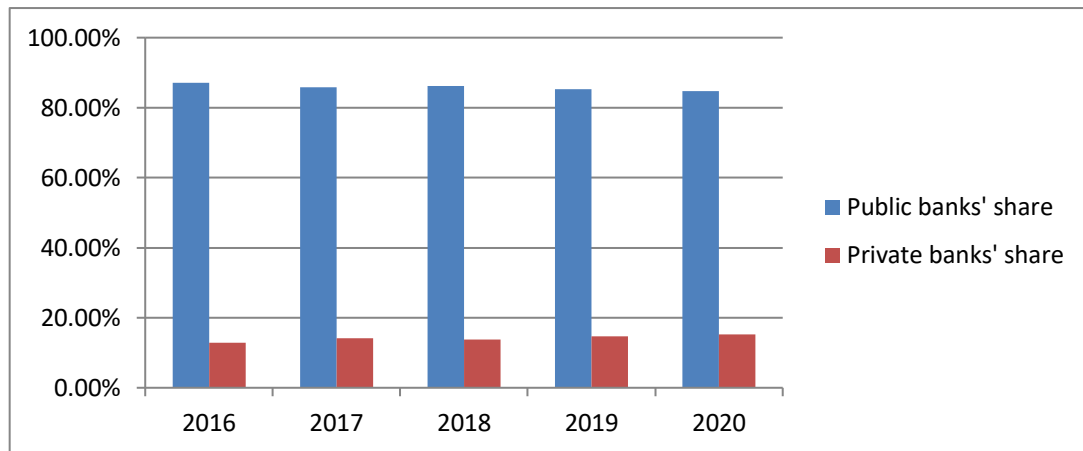
The deposits collected show the quasi-monopolization of the public sector, with a market share of 84.71% in 2020.

3.2 Distributed credits:

During an international economic and financial crisis linked to the coronavirus pandemic (2019 and 2020), the banking sector continues to provide for Algeria's economic financing while maintaining a strict risk management system.

Table No. 02: Evolution of the credits of the Algerian banks from 2016 to 2020

In billions of Algerian dinars; end of period

Year	2016	2017	2018	2019	2020
Total Credits Distributed	7 907.8	8 877.9	9 974.0	10 855.6	11 180.2
Public banks' share	87.58%	86.78%	86.59%	87.93%	88.30%
Private banks' share	12.42%	13.22%	13.41%	12.07%	11.70%

Overall, credit activity increased slightly in 2020, rising from 10,855.6 billion dinars at the end of December 2019 to 11,180.2 billion dinars at the end of 2020.

Figure No. 07: Attractiveness of the credits distributed
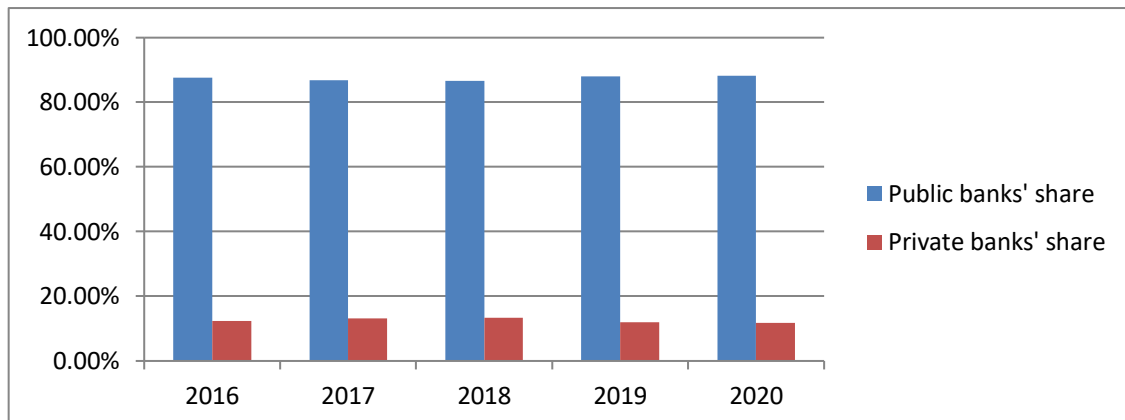
Credits allocated by public banks, which are steadfastly committed to financing big projects of public enterprises and organizations, accounted for 88.30% of total credits granted at the end of the fiscal year 2020, while private banks accounted for 11.70% of total credits granted. Banking institutions prefer medium- and long-term credits. These are frequently associated with financing investments in the water and energy sectors.

3.3 Solidity of the banking sector:

Despite the COVID-19 pandemic's shocks, the Algerian banking sector has proven resilient, thanks to the combined efforts of the public and monetary authorities to contain the effects of this health crisis. Four representative financial strength ratios will be addressed:

- **Solvency :**

Since the introduction of Regulation No. 2014-01 on solvency coefficients applicable to banks and financial institutions, the banking sector has always been solvent by adhering to the minimum standard of the solvency ratio, which is 9.5%.

Two solvency ratios will be presented: solvency in relation to core capital and solvency in relation to regulatory capital.

Table No. 03: Evolution of solvency ratio of the Algerian banks from 2016 to 2020

In billions of Algerian dinars; end of period

Year	2016	2017	2018	2019	2020
Solvency Ratio in relation to Regulatory Capital	18.75%	19.45%	19.05%	17.99%	19.17%
Solvency Ratio in relation to Core Capital	16.25%	15.03%	14.98%	14.26%	15.38%

Figure No. 08: Evolution of solvency ratio of the Algerian banks from 2016 to 2020
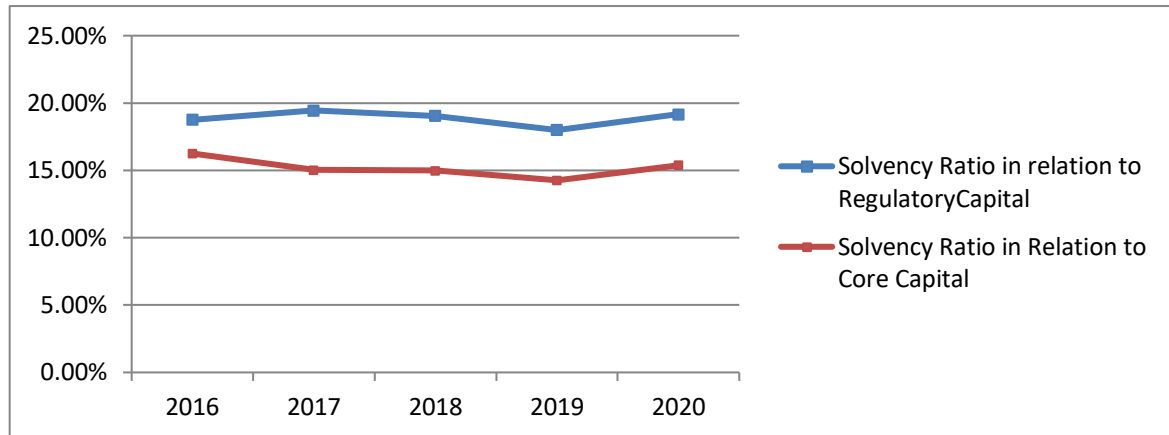
<div align="right">Source: Elaborated from table N. 03</div>

- **Liquidity (liquid assets):**

The size of the banking sector, as measured by total assets, is dominated by the public sector, whose total assets represent more than 86% of the banking system's total assets (Bank of Algeria, 2021). Despite an increase in non-conventional financing in 2017, the trend in the banking system's liquid assets has continued to fall over the last five years. It was confirmed by a 17.4% drop in liquid assets in 2020, compared to 14.4% in 2019.

Banks' liquid assets at the end of 2020 consist of 38.7% of assets in account with the Bank of Algeria and 46.5% of claims on the central government (bonds and Treasury bills).

Two liquidity ratios will be presented: the first is the liquid assets-to-total asset ratio, and the second is the liquid assets-to-short-term liabilities ratio.

Table No. 04: Evolution of liquidity ratio of the Algerian banks from 2016 to 2020

<div align="right">In billions of Algerian dinars; end of period</div>

Year	2016	2017	2018	2019	2020
Liquid Assets-To-Total Assets	23.52%	23.51%	19.84%	15.97%	13.11%
Liquid Assets-To-Short-Term Liabilities	58.39%	53.70%	47.45%	44.23%	37.14%

<div align="right">Source: Bank of Algeria Reports of 2020 and 2021</div>

The banking sector's short-term liquidity ratio for 2020 fell to 37.1% from 44.2% in 2019, as did the liquid assets-to-total assets ratio, which stood at 13.1% at the end of 2020, down (-2.8) percentage points from the previous year (15.97% at the end of 2019).

Figure No. 09: Evolution of liquidity ratio of the Algerian banks from 2016 to 2020

<div align="right">
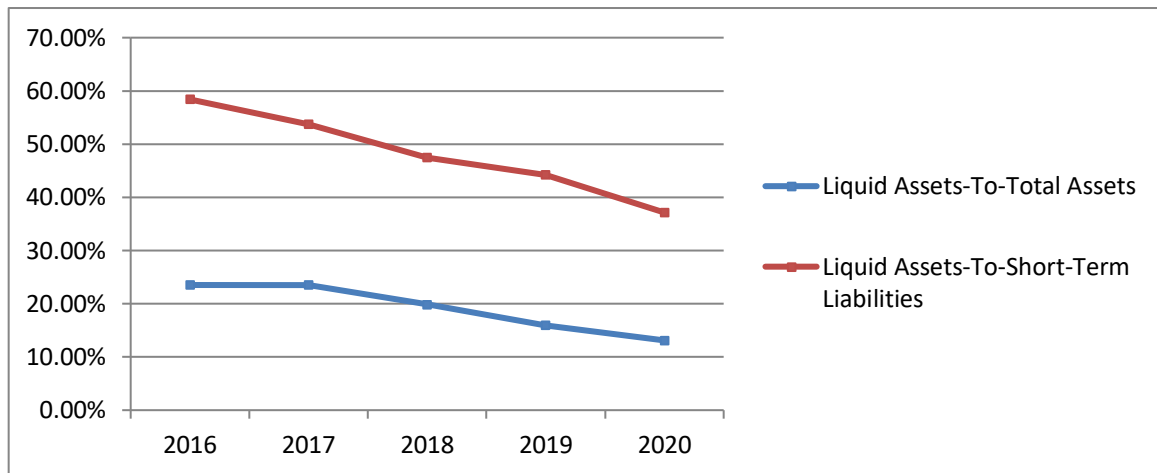
Source: Elaborated from table N. 04
</div>

- **Non-Performing loans and provisions:**

Bank-held non-performing loans continued to rise, with a 16.4% increase in outstanding loans in 2020 compared to a 30.8% increase in 2019. The slower growth of these loans is due to the Bank of Algeria's relief measures, particularly one that states that banks and financial institutions can postpone the payment of credit installments coming to maturity or proceed to the rescheduling of their customers' receivables without affecting the classification and provisioning of the said receivables (Article 4 of Instruction No. 05-2020 of April 6, 2020).

The ratio of classified loans to total loans has risen steadily over the last five years, reaching 16.36% at the end of 2020, up +1.6 percentage points from 2019. Banks provisioned 46.14% of their consolidated non-performing loans in 2020, compared to 46.69% in 2019. This decrease is due to classified loans increasing faster (+15.6%) than provisions (+12.4%).

Table No. 05: Evolution of non-performing loans and provisions of the Algerian banks from 2016 to 2020

<div align="right">

In billions of Algerian dinars; end of period
</div>

Year	2016	2017	2018	2019	2020
Classified Loans Rate	12.09%	12.96%	12.70%	14.76%	16.36%
Provisioning Rate	54.62%	52.28%	50.12%	46.69%	46.14%

<div align="right">

Source: Bank of Algeria Reports of 2020 and 2021
</div>

Figure No. 10: Evolution of non-performing loans and provisions of the Algerian banks from 2016 to 2020
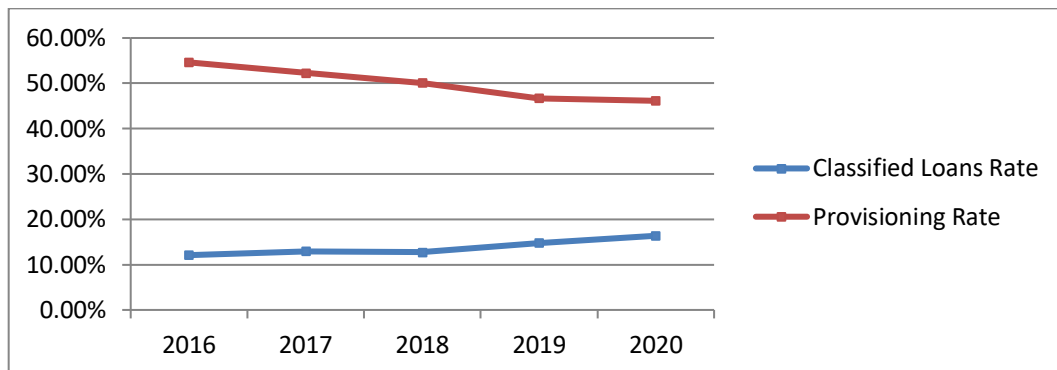
<div align="right">Source: Elaborated from table N. 05</div>

- **Profitability:**

The banking sector's return on equity (ROE) fell to (-8.31%) in 2020, down from (-14.08%) in 2019. This decline is the result of the bank's average equity increasing by 62.6% between 2020 and 2019 but not being accompanied by the same level of performance, with net income rising by only 6.7% during the same period. Similarly, the banking sector's return on assets (ROA) has fallen slightly from 1.51% in 2019 to 1.43% in 2020. As a result, banks' profitability remains low, endangering financial stability.

Table No. 06: Evolution of ROE and ROA from 2016 to 2020

<div align="right">In billions of Algerian dinars; end of period</div>

Year	2016	2017	2018	2019	2020
ROE	17.79%	18.85%	22.41%	14.08%	8.31%
ROA	1.83%	2.05%	2.42%	1.51%	1.43%

<div align="right">Source: Bank of Algeria Reports of 2020 and 2021</div>

Figure No. 11: Evolution of ROE and ROA from 2016 to 2020
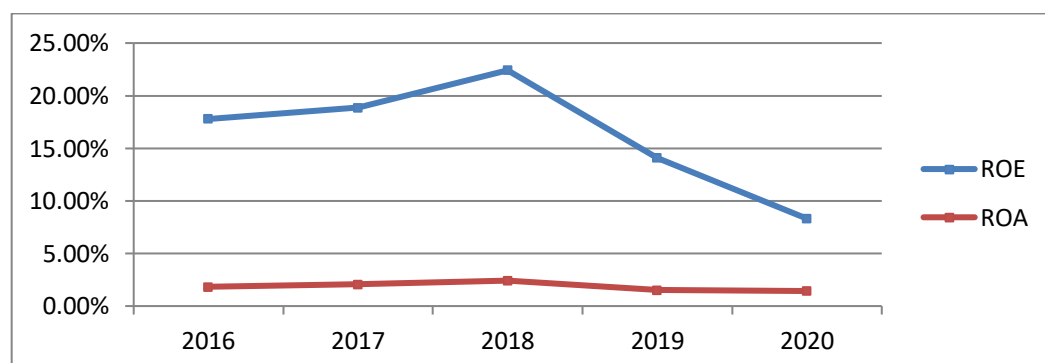
<div align="right">Source: Elaborated from table N. 06</div>

Section 02: Research methodology and descriptive study

This section will first provide the sample of our study, the sources of the data collected, and the presentation of the variables related to the model to be estimated. Following that, a descriptive analysis of the variables will be conducted.

1. Methodology and data description

The data utilized in this study stems from a database that we developed using accounting information from banks in the Algerian banking sector.

1.1 Sample presentation

This study will use a sample that includes a panel of 20 banks, composed of fourteen (14) private banks and six (06) public ones, operating in Algeria over the period 2010-2019, i.e. 10 years. This represents a set of 200 observations.

Table No. 07: The sample banks

	Bank	Abbreviation	Ownership
1	Société Générale Algérie	SGA	Private
2	Gulf Bank Algérie	AGB	Private
3	Arab Banking Corporation	ABC	Private
4	Trust Bank Algeria	TRUST	Private
5	Al Salam Bank Algeria	AL SALAM	Private
6	Banque Al Baraka d'Algérie	AL BARAKA	Private
7	The Housing Bank For Trade and Finance-Algeria	HOUSING	Private
8	Fransabank El-Djazair	FRANSABANK	Private
9	Arab Bank PLC-Algeria	AB PLC	Private
10	H.S.B.C-Algeria	HSBC	Private
11	Crédit Agricole Corporate et Investissement Bank-Algérie	CALYON	Private
12	BNP Paribas Al Djazair	BNP	Private
13	Natixis d'Algérie	NATIXIS	Private
14	Citibank N.A Algeria	CITIBANK	Private
15	Banque Nationale d'Algérie	BNA	Public
16	Banque Extérieure d'Algérie	BEA	Public
17	Banque de l'Agriculture et du Développement Rural	BADR	Public
18	Banque de Développement Local	BDL	Public
19	Crédit Populaire d'Algérie	CPA	Public
20	Caisse Nationale d'Epargne et de Prévoyance-Banque	CNEP-Banque	Public

Source: Elaborated by the student

1.2 Data collection and sources

The data used in the empirical study was gathered from the National Trade Register Center (CNRC), an independent administrative institution under the aegis of the Trade Minister from March 1997. The data were obtained by reviewing the balance sheets and income statements of the chosen sample from 2010 and 2019. Additionally, macroeconomic data were extracted from the World Bank's official website.

These data enabled the creation of a comprehensive database, which was used to estimate the linear regression model on panel data.

1.3 Model variables' determination

In order to present the variables of the model, it is necessary to distinguish the dependent variables from the independent variables.

1.3.1 The variable to be explained

The dependent variable chosen for this study is the return on assets ratio. The ROA is defined as net income divided by total assets. This ratio reveals how much each dinar invested in the bank returns. Hence, it reflects how well a bank manages its assets to generate profits. This ratio has been used to measure bank performance in most studies, such as Sufian (2009) and Liu and Pariyaprasert (2015).

1.3.2 Explanatory variables

In order to investigate the impact of liquidity risk on the performance of Algerian banks, which is assessed by the ratio ROA, the study relies on the liquidity risk variables and the control variables utilized by prior research, aiming to explain the banking performance of Algeria.

The variables that will be incorporated into the model to be estimated are determined by the following factors: the ability to compute based on the gathered data, the correlation between the variables, and their significance.

The following table illustrates the chosen variables, their measurements, and their assumptions on their influence on the performance of banks.

Table No. 08: List of explanatory variables

Variables	Abbreviations	Measurements	Sub-hypotheses[*]	Sources
Liquidity risk (Independent variables)	LATA	Liquid assets/Total assets	H1a : -	Saeed and Rahman (2015)
	FGAP	Loans-Deposits/Total assets	H1b : -	Golubeva et al. (2019)
	LTD	Loans/Deposits	H1c : +	Hacini et al. (2021)
Bank-specific (Control variables)				
Ownership	OWN	0: Public Bank 1: Private Bank	H3 : +	Micco et al. (2007)
Diversification	DIV	Non-interest income/Operating income	H2a : +	Moudud-Ul-Huq et al. (2018)
Operational expenses	OPEX	Overheads/Total assets	H2b : -	Staikouras and Wood (2004)
Macro-economic (Control variable)				
Gross domestic product growth	GDPG	Selected from the world bank database	H2c : +	Lee and Hsieh (2013)

Source: Elaborated by the student on the basis of the literature review

1.4 Analysis method

The study selected panel data analysis as a statistical tool to investigate the effect of liquidity risk metrics on banks' performance. Furthermore, this research spans many years and multiple banks, resulting in two dimensions: temporal (t) and individual (i).

1.4.1   Choice of the panel data method

The type of data to be processed necessitates the use of statistical tools to assess the relationship between variables. On the one hand, cross-sectional data demand a reasonably large sample size (typically more than 30 individuals), but Algeria has only 20 banks, preventing us from employing cross-sectional method. On the other hand, time series require a large time series; even though some banks in Algeria have been in operation for more than

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[*] Sub-hypotheses derived from the main hypotheses mentioned in the general introduction.

30 years, our sample also contained some newer institutions, preventing us from utilizing time series method.

Therefore, our research is based on panel data analysis, which allows us to consider both the individual effects of the banks and the periods studied. Panel data analysis is a cross-sectional and time-series statistical combination that employs more than one explanatory variable. The amalgamation of dimensions increases the number of observations and sample variability, resulting in more accurate findings.

1.4.2   Model specification

The purpose of this research is to examine the influence of the explanatory variables (LATA, FGAP, LTD, OWN, DIV, OPEX, and GDPG) on the profitability variable (ROA) of 20 banks from 2010 to 2019.

Before we estimate the parameters of every factor under consideration, we must first identify the model we intend to analyze and interpret. It is presented as follows:

$ROA_{it} = C + \alpha_0\ LATA_{it} + \alpha_1\ FGAP_{it} + \alpha_2\ LTD_{it} + \alpha_3\ OWN_{it} + \alpha_4\ DIV_{it} + \alpha_5\ OPEXC_{it} + \alpha_6\ GDPG_{it} + \varepsilon_{it}$

Where:

i: index of banks, where i = {1,20};

t: index of periods, where t = {1,10};

C: the intercept;

α_k: coefficient of the explanatory variables, where k = {1,7};

ε : term of error.

2.   Descriptive Analysis

Before estimating the parameters of the panel data regression model, we must first undertake a descriptive analysis of the explanatory variables and the variable to be explained.

2.1 Descriptive statistics of variables

Descriptive statistics provide an initial overview of the variables used in the regression model through summary statistics. The table below attempts to present the mean, standard deviation, and lowest and greatest observation of each variable in the sample.

Given the Algerian banking market's bifurcation between the public and private banks, this part of the research attempts to provide a descriptive analysis of the two banking sectors as well as a comparison of them. Since economic growth in both sectors is the same, the latter will have no effect on this bi-composition; hence, this variable will be considered independently.

CHAPTER 03: THE IMPACT OF LIQUIDITY RISK ON THE PERFORMANCE OF ALGERIAN BANKS: EMPIRICAL STUDY

To determine whether there are any differences in the chosen variables based on the bank's ownership, we proceeded with parametric means comparison tests (student t-tests) followed by non-parametric rank comparison tests (the Mann-Whitney test) (see appendix No. 02).

Table No. 09: Descriptive analysis of variables by the banking sector

OWN	Stats	ROA	LATA	FGAP	LTD	OPEX	DIV
Public banks	**Mean**	0.0100	0.4046	-0.1353	0.6651	0.0102	0.2148
	Sd	0.0061	0.1321	0.1173	0.1894	0.0039	0.1559
	Min	0.0002	0.1671	-0.4557	0.2153	0.0039	0.0155
	Max	0.0233	0.7537	0.0856	1.0166	0.0176	0.6850
Private banks	**Mean**	0.0238	0.4105	-0.0161	0.8752	0.0214	0.3762
	Sd	0.0106	0.1520	0.1980	0.3540	0.0073	0.1687
	Min	-0.0083	0.0912	-0.5839	0.2677	0.0080	0.0652
	Max	0.0658	0.8137	0.4244	3.0607	0.0520	0.7787
Total	**Mean**	0.0197	0.4088	-0.0519	0.8122	0.0180	0.3278
	Sd	0.0114	0.1460	0.1856	0.3279	0.0082	0.1805
	Min	-0.0083	0.0912	-0.5839	0.2153	0.0039	0.0155
	Max	0.0658	0.8137	0.4244	3.0607	0.0520	0.7787

Source: Output of the STATA 11.2 software

According to the descriptive statistics of the two banking sectors (see appendix No. 01); public banks generate a lower average return on assets than private banks (1% against 2.38%). Because this ratio reveals how much each dinar invested in the bank returns, the result reflects the effectiveness of private banks in terms of investment. Based on the Student test and the Mann-Whitney test, this result is statistically significant.

The average ROA of all banks during the ten years has been 1.97%, and the lowest value of return on assets belonged to private banks, with -0.83% in 2017, while the highest value was 6.58% in 2010. Both the public and private banks have relatively low standard deviations of ROA (1.06% and 1.14%, respectively). As a result, we may conclude that the banks are homogenous.

Among the three liquidity risk indicators, the loan-to-deposit ratio has the highest average, which is around 81.2%, with standard deviations of 32.79%. The outcome demonstrates the Algerian banks' reliance on deposits as a source of financing for their clients. The average LTD in public banks is 66.51%, while in private banks is 87.52%, indicating that the private banking sector's deposit-to-loan transformation rate is greater than that of the public one. According to the Student test and the Mann-Whitney test, this result is statistically significant.

For the LATA ratio, Algerian banks have an average of 40.88% liquid assets to total assets, indicating that liquid assets account for about half of the total assets, with standard deviations of 14.60%. This result shows that the Algerian banking sector was quasi-liquid from 2010 to

2019. According to the Student and Mann-Whitney tests, the difference between public and private banks is not statistically significant for this variable.

In contrast, the FGAP ratio has a negative mean (-5.16%). This finding reveals that deposits are higher than loans on average, which is consistent with the LTD ratio findings. Furthermore, FGAP has standard deviations above its mean (18.56%), showing a significant degree of variance among banks. The FGAP of private banks (-1.61%) is higher compared to the public banks (-13.53%), indicating that private banks face greater liquidity risk. According the Student and Mann-Whitney tests, this result is statistically significant.

In terms of operational expenses ratio (OPEX), the public banking sector averages 1.02%, whereas the private banking sector averages 2.1%. According to these findings, private banks have more overhead than public banks. Based on the Student and Mann-Whitney tests, this result is statistically significant. We also notice that the average OPEX of all banks is 1.80% with a standard deviation of 0.82%, implying differences in operational expenses management from one bank to another.

The final significant distinction is the degree of diversity. The statistics reveal that private banks (37.62%) are more diversified than the public ones (21.48%) on average, with the maximum value of DIV belonging to the private banks at 77.87% and the lowest value belonging to the public ones at 1.55%. According to the Student and Mann-Whitney tests, this result is statistically significant. We also observe that the average DIV of all banks over the ten years is 32.78% of operating income.

Regarding GDPG, considering that it is a macroeconomic measure and hence sector-independent, it gives the following figures (see appendix No. 01):

Table No. 10: Descriptive analysis of the variable GDP

Stats	GDPG
Mean	0.0269
Min	0.01
Max	0.038

Source: Output of the STATA 11.2 software

The highest reported value of gross domestic product growth (GDPG) from 2010 to 2019 is 3.8% whereas the minimum value is 1%.

2.2 Correlation matrix

The relevance of studying the correlation between the various variables stems from the requirement to know what types of associations may exist between the components to facilitate and guide the analysis and interpretations that will follow. The table below illustrates the correlations between the variable to be explained (ROA) and all of the other explanatory factors, along with the correlations between the explanatory variables (see appendix No. 03):

Table No. 11: Correlation matrix between model variables

	ROA	LATA	FGAP	LTD	OWN	OPEX	DIV	GDPG
ROA	1.0000							
LATA	-0.0642	1.0000						
FGAP	0.3859*	-0.3670*	1.0000					
LTD	0.3394*	-0.6082*	0.6446*	1.0000				
OWN	0.5569*	0.0188	0.2948*	0.2945*	1.0000			
OPEX	0.2295*	-0.3435*	0.4712*	0.5172*	0.6235*	1.0000		
DIV	0.4711*	0.4180*	0.1880*	-0.0672	0.4109*	0.1590*	1.0000	
GDPG	0.1860*	0.2640*	0.0485	-0.1135	0.0000	-0.0055	0.3044*	1.0000

(*) Significant at the 5% threshold

Source: Output of the STATA 11.2 software

This table indicates that return on assets (ROA) is positively and significantly correlated at the 5% threshold with two of the liquidity risk ratios (FGAP and LTD), ownership (OWN), operational expenses (OPEX), diversification (DIV), and gross domestic product growth (GDPG). Conversely, the third liquidity risk ratio (LATA) shows a negative and insignificant association with ROA.

We also observe a positive relationship between the liquidity risk ratio (LATA) and the control variables (OWN, DIV, and GDPG), but only significant with DIV and GDPG and negatively significant with OPEX. Furthermore, we notice that FGAP has a positive connection with the control variables (OWN, OPEX, DIV, and GDPG), yet, this association is insignificant with GDPG. The last liquidity risk (LTD) ratio is demonstrated to be positively significant with OWN and OPEX but negatively significant with DIV and GDPG.

The relationship between the explanatory variables reveals there is no concern with multicollinearity. Indeed, as suggested by Gujarati (2003) the lack of correlation values greater than 0.8 thresholds may indicate the absence of multicollinearity (Benilles, 2017, p. 242). Following this observation, we infer that no variable is correlated with another at a rate of more than (80%), which provides us a solid indicator of the relevance of the variable selection, but to be sure, we will perform a complementary examination of multicollinearity (VIF).

2.3 Multicollinearity test

Multicollinearity is an issue that occurs when some of the forecast variables in the model measure the same phenomenon. This problem may cause the variance of the regression coefficients to increase and render them unstable and difficult to comprehend. The preceding part showed that there is no multicollinearity. However, in order to corroborate this finding, the study proceeds to the VIF test (and tolerance).

The VIF test estimates how much a coefficient's variance has increased due to a linear relationship with other variables, reducing the model's reliability. According to Evrard et al. (2003), if the variable's VIF is more than ten and a tolerance (1/VIF) is lower than 0.1, the variable will have a higher influence, resulting in high multicollinearity (Benilles, 2017, p. 242). However, if the variable's VIF is close to one and a tolerance (1/VIF) higher than 0.1, the variables are not influenced by correlation with other variables, resulting in a more robust model. The test results are presented in the table below (see appendix No. 04).

Table No. 12: Result of the VIF test

Variable	VIF	1/VIF
LTD	2.57	0.389498
LATA	2.27	0.440619
OPEX	2.25	0.443653
OWN	2.09	0.478113
FGAP	1.97	0.507219
DIV	1.75	0.572159
GDPG	1.17	0.854963
Mean VIF	2.01	

Source: Output of the STATA 11.2 software

According to the test, the average VIF is 2.01, with a maximum VIF of 2.57, which is significantly below the threshold of ten (10) set by the authors. This result reveals weak collinearity between the variables utilized in this model, implying that each variable provides information that the others do not.

Section 03: Model estimation and results interpretation

The objective of this section is to present the multivariate analysis findings and evaluate the hypotheses using STATA 11.2 software. We will begin by outlining the various statistical tests and the panel data regression findings. Secondly, an interpretation of the results will take place to explain the impact of the liquidity risk on the performance of Algerian banks.

1. Presentation of the tests

The application of a panel data regression is required with an individual dimension of twenty (20) banks and a temporal dimension of ten (10) years while following a series of econometric processes to construct this particular approach. It should be noted that the multicollinearity test performed on the seven (7) explanatory variables (LATA, FGAP, LTD, OWN, OPEX, DIV, and GDPG) does not reveal any correlation issues; therefore, no variable is eliminated. The following are the tests run by the STATA 11.2 software and their interpretations:

1.1 Model specification test

The aim of this test is to distinguish between the individual and common effects of a model, or to assure the homogeneous or heterogeneous specification of the data-generating process.

Our model stands out by the presence of a dichotomous variable (OWN), which will result in its arbitrary removal from the collection of explanatory variables in a fixed-effects regression. This requirement necessitates the application of the "Breusch-Pagan Lagrangian Multiplier test for random effects" to determine whether to employ the GLS estimator if there are random individual effects or the OLS estimator if there aren't. In other words, this test indicates whether the random effects model or the pooled model will be employed.

We presume that our model has random effects. Once estimated, the Breusch-Pagan statistic will allow us to assess the model's significance. If the probability of the latter is less than the threshold, the random effects will be substantial.

The test's hypotheses are as follows:

> H0: Absence of random effects.
>
> H1: Presence of random effects.

The result of the test is as follows: (see appendix No. 05)

Table No. 13: Result of the Breusch-Pagan test

Breusch and Pagan Lagrangian multiplier test for random effects	
chi2(1)	8.01
Prob > chi2	0.0023

Source: Output of the STATA 11.2 software

The Chi-square statistic was found to be significant (Prob > chi2 = 0.0023). The latter is less than 5%, allowing us to reject the H0 hypothesis and confirm the presence of individual effects. As a result, we may infer that our model is a random effects model.

1.2 Autocorrelation test

The purpose of this test is to determine whether the errors are related across time. The Woodbridge test is the most often used econometric test for the error autocorrelation. It enables us to make a decision between the two hypotheses:

H0: Absence of autocorrelation.

H1: Presence of autocorrelation.

The result of the test is as follows: (see appendix No. 06)

Table No. 14: Result of the autocorrelation test

Wooldridge test for autocorrelation in panel data	
H0	No first-order autocorrelation
F(1, 19)	23.939
Prob > F	0.0001

Source: Output of the STATA 11.2 software

Since the probability p-value is equal to 0.0001, which is less than 5%, the initial hypothesis H0 is rejected, resulting in the presence of autocorrelation.

1.3 Heteroscedasticity test

The term heteroscedasticity refers to the statement that the variances of the residuals of the random variables in the model differ. To determine if our model has homoscedasticity or heteroscedasticity, we run the following test, which intends to examine the following hypotheses:

H0: Homoscedasticity of residuals ($Var\ [\varepsilon i] = \sigma^2\ \forall i$).

H1: Heteroscedasticity of residuals ($Var\ [\varepsilon i] = Var\ [\varepsilon j]$ regardless of ij).

The result of the test is as follows: (see appendix No. 07)

Table No. 15: Result of the heteroscedasticity test

Test for heteroskedasticity	
Likelihood-ratio test	LR chi2(19) = 79.64
(Assumption: homosk nested in hetero)	Prob > chi2 = 0.0000

Source: Output of the STATA 11.2 software

The probability p-value is equal to 0.0000, which is less than 5%; thus, we reject hypothesis H0, confirming the presence of heteroscedasticity.

According to the results of the preceding two tests, the estimated model has two flaws: autocorrelation and heteroscedasticity. We will utilize the PCSE (Panel-Corrected Standard Errors) approach to correct them and estimate the final model. This approach provides unbiased coefficients, which is very useful for micro panels (Beck et Katz, 1995). In what follows, we shall evaluate the outcomes of the regression model estimations after rectification.

2. Presentation and interpretation of estimation results

Following the estimation of the corrected model, we will evaluate and discuss the findings of the regression model estimates by examining the influence of the selected independent variables on the profitability ratio of Algerian banks. Afterward, we will attempt to interpret the coefficients of each explanatory variable.

The regression findings using the PCSE approach are as follows (see appendix No. 08):

Table No. 16: Results of the multivariate analysis of the model

Linear regression, correlated panels corrected standard errors (PCSEs)			
Variable	**Expectation**	**Coefficient**	**P-value**
LATA	-	-0.0188589	0.003***
FGAP	-	0.0078354	0.078*
LTD	+	0.0071796	0.015**
OWN	+	0.0150853	0.000***
OPEX	-	-0.6240842	0.000***
DIV	+	0.0211848	0.000***
GDPG	+	0.0017733	0.043**
_cons		0.0109383	0.012**
R-squared		0.5569	
Wald chi2		228.68	
Prob > chi2		0.0000***	
Number of obs		200	

(*) Significant at the 10% threshold
(**) Significant at the 5% threshold
(***) Significant at the 1% threshold

Source: Output of the STATA 11.2 software

In the table above, the relationship between the dependent and independent variables in the model studying the impact of liquidity risk on Algerian bank performance shows a total of 200 observations (20x10). We also notice that the R-squared value equals 0.5569. This figure indicates that the model's coefficient of explanation is 55.69%. It suggests that the explanatory factors chosen account for 55.69% of the variation in the profitability ratio. Furthermore, the Wald chi2 test of the model's overall significance is significant at the 1% level (Prob > chi2 = 0.0000), implying a solid general fit and sufficient potential for the explanation.

The following is an explanation of the impact of liquidity risk indicators and other variables on the profitability of Algerian banks:

CHAPTER 03: THE IMPACT OF LIQUIDITY RISK ON THE PERFORMANCE OF ALGERIAN BANKS: EMPIRICAL STUDY

2.1 Liquid assets ratio (LATA):

The research used this metric to quantify a bank's liquid assets-to-total assets ratio. It denotes a bank's capacity to pay its creditors using liquid assets. The greater the rate of this ratio, the more liquid the bank and the less sensitive it is to liquidity risk. As a result, the greater the amount of funds saved as cash, the greater the liquidity and the lower the liquidity risk. The regression results reveal a significant negative correlation at the threshold of 1% between this ratio and the return on assets ratio. This finding confirms the sub-hypothesis H1a.

The negative result of liquid assets-to-total assets indicates that banks have a disadvantage in retaining excessive liquid assets. When banks typically reserve liquid assets at an optimal level to guarantee business operations, bank performance can be controlled in the event of a shock. However, if banks hold too many liquid assets, bank performance would suffer as financial expenditures rise faster than revenue. Additionally, it imposes an opportunity cost on the bank due to its poor yield compared to other assets. As a result, banks should weigh the expense of keeping lower-yielding liquid assets against their resistance to liquidity shocks (Bordeleau and Graham, 2010).

In other words, while liquid assets are less risky than other assets, their returns do not compare to illiquid financial assets. This finding is consistent with Markowitz's (1952) risk-return trade-off theory, which contends that holding more liquid assets to decrease liquidity risk may hurt a bank's financial performance. This result corresponds with the findings of earlier studies, such as Saeed and Rahman (2015).

2.2 Financing gap ratio (FGAP):

The financing gap-to-total assets ratio (FGAP) is the second metric used as a proxy for liquidity risk in this study. Since the financing gap is the difference between loans and deposits, a higher FGAP indicates an increased liquidity risk. The regression findings show a significant positive relationship at the 10% threshold between this ratio and the return on assets ratio. This finding rejects the sub-hypothesis H1b.

This finding contradicts the findings of Chen et al. (2018). It can be explained by the nature of the gap, in which we find that 70% of the observations are negative values, indicating that the credits granted are less than the deposits collected. As a result, as the gap expands, so does the liquidity risk, forcing banks to obtain funding from the repo market at higher rates, rising their costs. This cost growth will eventually affect banks' profitability. However, the study's findings revealed that Algerian banks are not dependent on the repo market. They have sufficient cash to avoid their reliance on the repo market, resulting in a positive impact on banks' performance. It can also be explained by the deceleration in growth of deposits relative to credit and even negative growth in particular years, indicating a decline in deposits, which is due to non-renewing them, and a reduction in savings rates, resulting in a significant gap and thus a positive relationship with profitability.

This finding corresponds with the transaction cost hypothesis, which asserts that banks maintain additional cash on hand to lower transaction costs (Keynes, 1936), in other words, depending on internal rather than external sources (Myers, 1984).

2.3 Transformation ratio (LTD):

This ratio reflects the bank's transforming degree of deposits into loans. It gives a simplified overview of the extent to which a credit institution funds illiquid assets with liquid liabilities. The greater the loan-to-deposit ratio, the more the bank relies on its deposits to support its lending activities and, consequently, the lower its liquidity. It also denotes bank loan growth, where a higher ratio reflects excessive lending activity by banks, which may also imply an increased liquidity risk exposure (Saeed and Rahman, 2015). The regression findings show a significant positive relationship at the 5% threshold between this ratio and the return on assets ratio. This result validates the sub-hypothesis H1c.

A positive loan-to-deposit ratio indicates a positive association between liquidity risk and profitability; however, it also implies a negative relationship between bank profitability and the amount of liquid assets retained by the bank. It is explained by the fact that the more deposits the bank converts into loans, the more interest it earns. The bank's profitability should improve as a result of the growing trend in loans. This significant effect reveals Algerian banks' reliance on deposits to make loans that lead to profit.

The result aligns with Markowitz's (1952) risk-return trade-off theory, which asserts that a financial asset's risk corresponds with its return, so when the risk grows, so does the return. It indicates that an increase in loans provided (raising liquidity risk) inevitably boosts bank profitability. An adequate ratio, on the other hand, implies excellent control of the maturity transformation risk. This finding is consistent with those of Liu and Pariyaprasert (2015).

2.4 Ownership (OWN):

Algerian banks are classified as either private or public. The ownership variable is a binary variable that takes the value one (1) if the bank is private and zero (0) if it is public. The regression results demonstrate a significant positive correlation at the 1% threshold between the ownership and profitability ratio. This finding confirms the sub-hypothesis H3.

According to the findings, private banks have a higher profitability ratio than public banks. This result may be explained by the fact that public banks' primary goal is not usually maximizing their profit but rather the financing of vital sectors that benefit society, which exposes them to a relatively high level of risk. The result is consistent with the findings of Innotta et al., 2007.

2.5 Diversification (DIV):

In this study, income diversification was employed as a proxy for bank diversification. The regression findings show a significant positive correlation between diversification and profitability ratios at the 1% threshold. This result confirms the sub-hypothesis H2a.

A positive association implies that the more banks diversify and engage in non-interest activities or other activities that are external to their fundamental business, the higher their profit and the lower their risk. Hence, diversification positively impacts the bank's ROA by increasing its net income. Moreover, the greater the bank's diversification, the lower the predicted costs of financial distress will be by spreading activities across various industries (Boot and Schmeits, 2000). This result is consistent with the findings of Sufian and Habibullah (2010).

2.6 Operational expenses (OPEX):

This variable indicates the governing body's capacity to manage the bank's structural expenses. The regression results reveal a significant negative relationship at the 1% threshold between operational expenses and Algerian banks' performance. This result validates the sub-hypothesis H2b.

According to the findings, the greater the operational expenses, the more costs the bank would incur when performing its activities and the less profit it would make. In other words, operational expenses have a detrimental impact on a bank's profitability; increased overhead costs diminish the bank's net income, which in turn reduces its ROA. If a bank's expenses increase without a corresponding rise in revenue, its profitability suffers. This finding is aligned with those of Staikouras and Wood (2004).

2.7 Gross domestic product growth (GDPG):

GDPG is the macroeconomic variable utilized in this study to assess overall economic activity in Algeria. The regression results show a significant positive relationship at the 5% threshold between gross domestic product growth and banks' performance. This result validates the sub-hypothesis H2c.

The positive correlation indicates that economic expansion boosts banks' performance. This outcome could be explained by the fact that when the economy performs well and grows, it can lead to higher demand for loans from businesses seeking financing for expansion or investment. This increased loan demand can positively influence a bank's interest income, contributing to higher profitability (ROA). Likewise, when economic growth rates are low or negative, it may reduce borrowers' capacity for reimbursement, resulting in credit losses and increasing banks' provisions, leading to lower profitability. This result corresponds with the findings of earlier studies, such as Saeed and Rahman (2015).

Conclusion

The purpose of this study, which was conducted on a sample of 20 banks reflecting the entire population of Algerian banking institutions from 2010 to 2019, is to examine the influence of liquidity risk on the performance of Algerian banks.

The first section introduced the Algerian banking sector, which was the focus of our research. The second section emphasized the variables chosen as well as the statistical approach used to estimate our model, which subsequently allowed us to test the study hypotheses. In the final section, we presented and discussed the estimated model that explains the link between liquidity risk and the performance of Algerian banks.

The findings of this study reveal that all liquidity risk indicators have a significant impact on the performance of the Algerian banking sector. The profitability ratio (ROA) represented the performance variable to be explained. The model was estimated using panel data regression. All liquidity risk indicators, measured by the liquid assets, financing gap, and transformation ratios, were found to have a positive influence on the return on assets ratio, as were the three control variables, ownership, diversification, and GDP growth. However, one of the control variables (operational expenses) had a negative impact on the return on assets ratio.
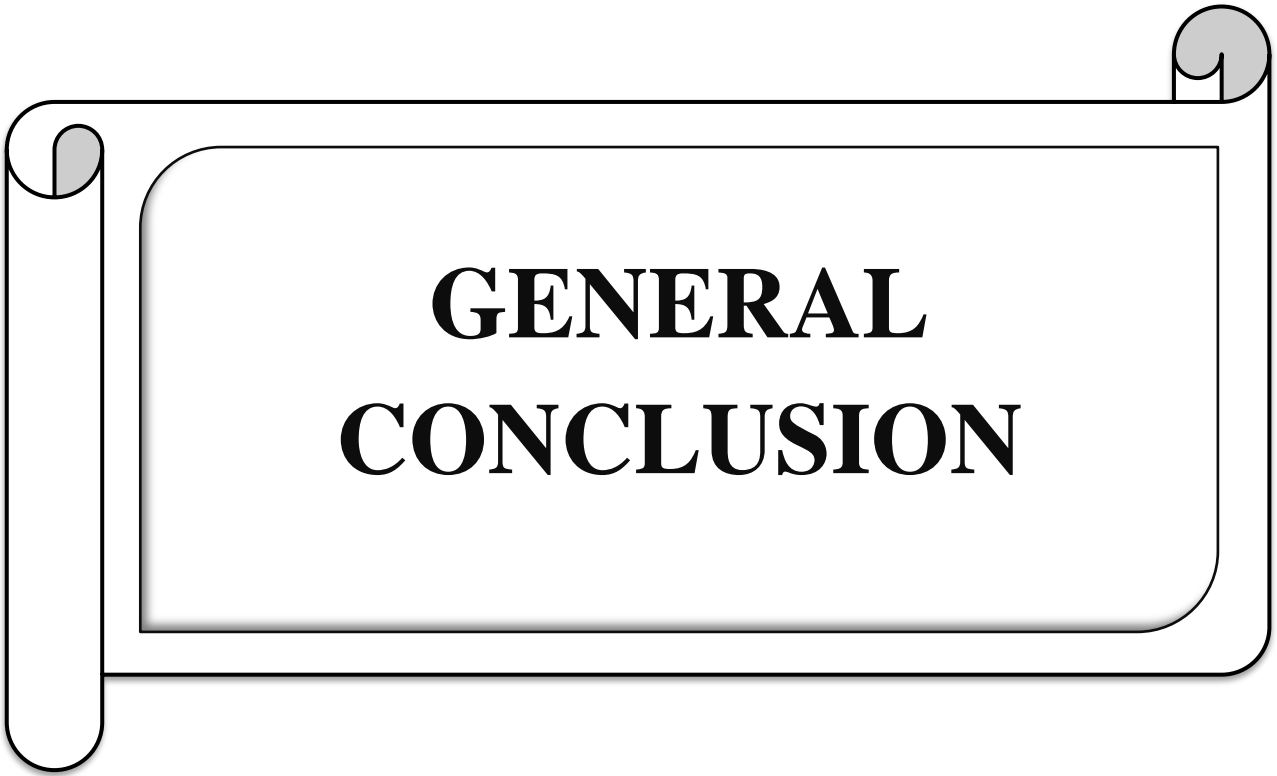
GENERAL CONCLUSION

GENERAL CONCLUSION

The primary objective of our research is to investigate the influence of liquidity risk on the performance of Algerian banks. To address this objective, we have employed the panel data regression approach, enabling us to examine data from twenty Algerian banks from 2010 to 2019. The significance of this study lies in its contribution to a better comprehension of the relationship between liquidity risk and banks' performance. Therefore, the research problem was formulated as follows:

« What effect does liquidity risk have on the performance of Algerian banks? »

By reviewing the relevant literature, utilizing specific liquidity risk ratios and other explanatory ratios, and employing the panel data approach, we were able to obtain answers to the issues outlined in the general introduction.

In the theoretical part, we provided a general overview of the concepts of banking performance, banking liquidity, and liquidity risk. The literature review enabled us to present theories that explain the link between liquidity risk and the banks' performance; additionally, prior studies on the issue have demonstrated that liquidity risk affects banks' performance. It was also found that the performance of banks can be influenced by other variables, which are classified as microeconomic and macroeconomic factors. However, depending on the sample and time period, the results demonstrating the impact of liquidity risk differs from one banking sector study to another. To be precise, any explanatory variable may have a positive association with one sample's performance while having a negative link with another. The same applies to the variables' significance.

Regarding the empirical component, our research addressed the influence of liquidity risk on the performance of Algerian banks. Through the empirical studies, we sought to model the relationship between liquidity risk, measured by three ratios (liquid assets, financing gap, and transformation ratios), control variables (ownership, diversification, operational expenses, and gross domestic product growth), and banks' performance measured by the profitability ratio (return on assets). It was achieved by utilizing an econometric model, specifically multiple linear regressions.

Based on the results obtained from the last chapter, in the empirical case, following the application of panel data regression, we identified a significant positive correlation between liquidity risk and Algerian banks' performance. This outcome invalidates the initial hypothesis H1 that liquidity risk has a detrimental influence on the performance of Algerian banks. In terms of the other factors, the results reveal that diversification (DIV) and gross domestic product growth (GDPG) have a significant positive association with the performance of Algerian banks while operating expenses (OPEX) exhibit a negative and significant impact. These findings confirm the second hypothesis H2 which posits the existence of other determinants that can explain the performance of Algerian banks.

Furthermore, the variable ownership (OWN) demonstrates a positive and significant relationship with the performance of Algerian banks; additionally, the statistical analysis revealed liquidity risk, diversification, and operational expenses differ between Algerian public and private banks. This result confirms the third hypothesis H3 which suggests that

there is a distinction between the characteristics of Algerian public banks and those of Algerian private banks.

This study provides contributions in three main axes: theoretical, methodological, and managerial.

On a theoretical level, this work presents significant theoretical contributions by enhancing our understanding of the fundamentals and principles of banking performance, banking liquidity, and liquidity risk. Moreover, the study advances our comprehension of the impact of liquidity risk on banks' performance by providing relevant theoretical frameworks that elucidate this relationship. Additionally, it provides a synthesis of various factors that can explain banks' performance based on previous studies. This study stands out as one of the first works to explore the influence of liquidity risk on the banks' performance within the Algerian context. As a result, it enriches the existing portfolio of banking research by shedding light on this specific context and contributing valuable insights to the field.

Regarding the methodological aspect, this study presents a robust methodology. The panel data approach application enables the exploitation of liquidity risk variables, and other factors, to better understand the impact of liquidity risk on the performance of banks operating in Algeria. This methodological choice provides a more thorough investigation of the relationships and enhances the validity of the findings.

Finally, for the managerial axis, this research brings attention to the measurement of liquidity risk and its influence on the performance of Algerian banks. It also considers other determinants that contribute to explaining banks' performance. By identifying these factors, banks' managers can leverage them as actionable strategies to enhance the performance of banks, particularly in terms of profitability.

Despite the aforementioned contributions, it is critical to acknowledge the limitations and obstacles that may restrict broader expansion and dissemination of this research. These limitations include:

- The research process duration was deemed too short, which limited the extent to which the work could be optimized and expanded.
- Difficulties in obtaining certain confidential information prohibited the utilization of other liquidity risk metrics. This limitation could have potentially provided a more complete analysis.
- Due to the difficulties in acquiring specific bank information, we were limited to extending our study period to include data from 2022, preventing us from capturing recent effects of the relationship between liquidity risk and bank performance.
- The sample used in the study, along with the selected explanatory variables, did not allow for the examination of financial profitability measured by return on equity (ROE) for the banks.

GENERAL CONCLUSION

For future research, we recommend incorporating additional liquidity risks indicators, such as the liquidity coverage ratio (LCR) and the nets funding ratio (NSFR). Likewise, it would be beneficial to include other relevant microeconomic variables in the analysis, such as bank size, non-performing loans, and capital adequacy ratios, alongside macroeconomic variables, such as the inflation rate. Moreover, we suggest incorporating additional measures of banking performance, such as return on equity (ROE) and net interest margin (NIM).

Based on the previous results, in response to the research problem, we can conclude that liquidity risk significantly impacts the performance of Algerian banks. This finding emphasizes the importance of effective liquidity risk management strategies in the banking sector to enhance performance and ensure financial stability.

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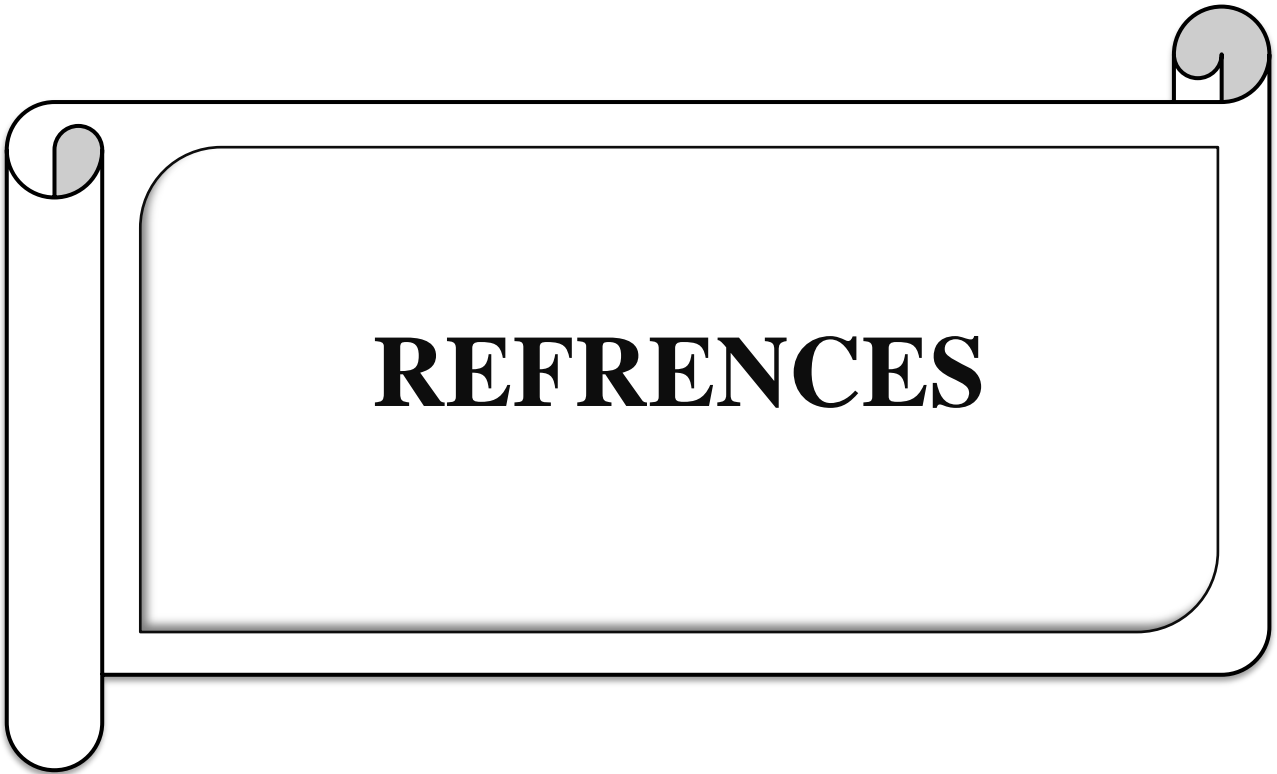
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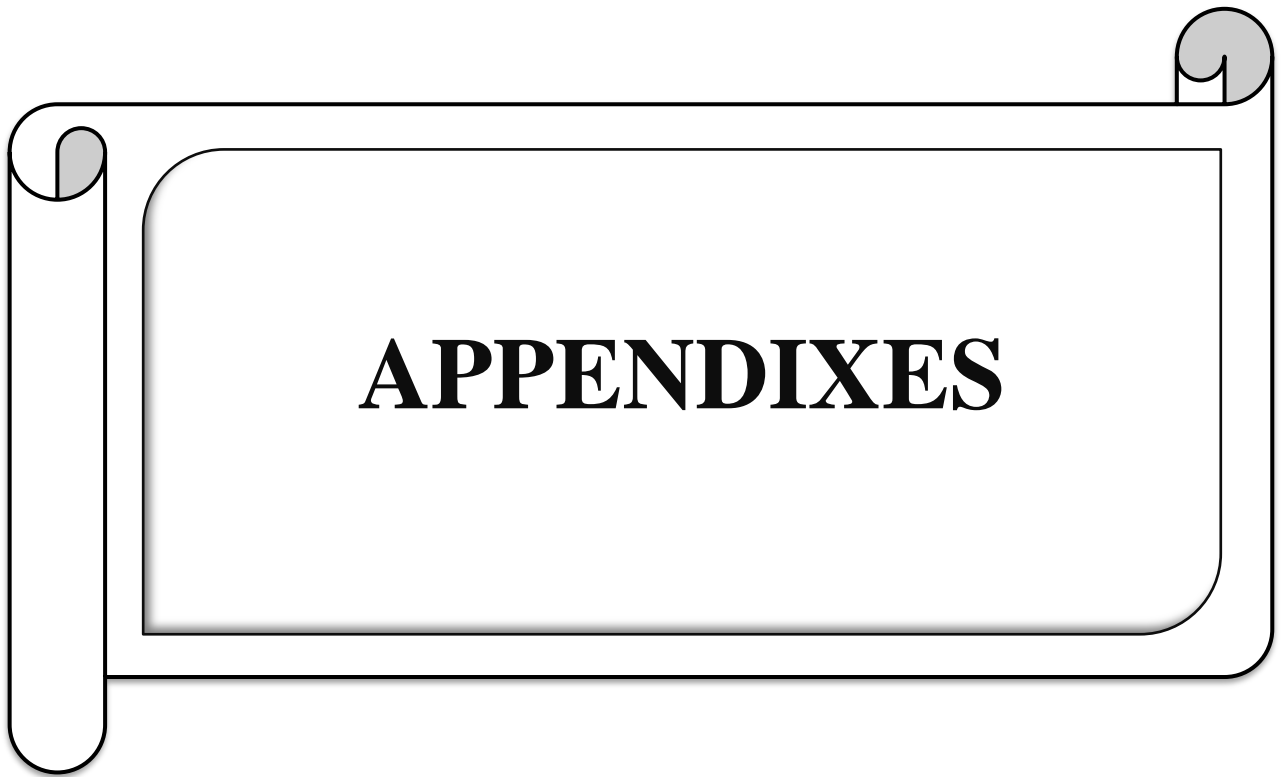
APPENDIXES

APPENDIXES

➢ **Appendix No. 01: Descriptive analysis of variables by the banking sector**

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. tabstat ROA  LATA FGAP LTD OPEX DIV, statistics (mean sd min max) by (OWN) columns (variables)

Summary statistics: mean, sd, min, max
  by categories of: OWN (OWN)
```

OWN	ROA	LATA	FGAP	LTD	OPEX	DIV
0	.0099901	.4045774	-.1352729	.6650969	.0101804	.2147563
	.0060598	.1321088	.1173319	.1894125	.0039061	.1559143
	.0002189	.167063	-.45567	.2153489	.0039485	.0155457
	.0232842	.7537139	.0856443	1.016616	.0175566	.685033
1	.0238409	.4105394	-.0161458	.8752381	.0213723	.376218
	.0106463	.1520207	.1979736	.3540005	.0072818	.1687034
	-.0082509	.0912236	-.5838769	.2677309	.008028	.0652339
	.0658311	.8137137	.4244086	3.060727	.0520356	.7786825
Total	.0196857	.4087508	-.051884	.8121957	.0180147	.3277795
	.0114257	.1460284	.1856156	.327856	.008246	.1805246
	-.0082509	.0912236	-.5838769	.2153489	.0039485	.0155457
	.0658311	.8137137	.4244086	3.060727	.0520356	.7786825

```
. tabstat  GDPG, statistics (mean sd min max)
```

variable	mean	sd	min	max
GDPG	2.69	1.047083	1	3.8

➢ **Appendix No. 02: Results of the parametric and non-parametric test**

```
. ttest ROA, by (OWN)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	60	.0099901	.0007823	.0060598	.0084247	.0115555
1	140	.0238409	.0008998	.0106463	.0220619	.02562
combined	200	.0196857	.0008079	.0114257	.0180925	.0212789
diff		-.0138508	.001468		-.0167457	-.0109559

```
    diff = mean(0) - mean(1)                                         t =  -9.4351
Ho: diff = 0                                    degrees of freedom =      198

   Ha: diff < 0                   Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000         Pr(T > t) = 1.0000
```

APPENDIXES

```
. ttest LATA, by (OWN)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	60	.4045774	.0170552	.1321088	.3704501	.4387047
1	140	.4105394	.0128481	.1520207	.3851365	.4359424
combined	200	.4087508	.0103258	.1460284	.3883889	.4291128
diff		-.005962	.0225855		-.0505011	.038577

```
    diff = mean(0) - mean(1)                              t =  -0.2640
Ho: diff = 0                             degrees of freedom =      198

    Ha: diff < 0              Ha: diff != 0              Ha: diff > 0
 Pr(T < t) = 0.3960      Pr(|T| > |t|) = 0.7921      Pr(T > t) = 0.6040
```

```
. ttest     FGAP, by (OWN)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	60	-.1352729	.0151475	.1173319	-.1655829	-.1049629
1	140	-.0161458	.0167318	.1979736	-.0492276	.0169359
combined	200	-.051884	.013125	.1856156	-.0777659	-.026002
diff		-.119127	.0274369		-.1732331	-.065021

```
    diff = mean(0) - mean(1)                              t =  -4.3419
Ho: diff = 0                             degrees of freedom =      198

    Ha: diff < 0              Ha: diff != 0              Ha: diff > 0
 Pr(T < t) = 0.0000      Pr(|T| > |t|) = 0.0000      Pr(T > t) = 1.0000
```

```
. ttest     LTD, by (OWN)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	60	.6650969	.024453	.1894125	.6161664	.7140273
1	140	.8752381	.0299185	.3540005	.8160839	.9343923
combined	200	.8121957	.0231829	.327856	.76648	.8579114
diff		-.2101412	.0484683		-.3057215	-.1145609

```
    diff = mean(0) - mean(1)                              t =  -4.3356
Ho: diff = 0                             degrees of freedom =      198

    Ha: diff < 0              Ha: diff != 0              Ha: diff > 0
 Pr(T < t) = 0.0000      Pr(|T| > |t|) = 0.0000      Pr(T > t) = 1.0000
```

APPENDIXES

```
. ttest        OPEX, by (OWN)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	60	.0101804	.0005043	.0039061	.0091713	.0111894
1	140	.0213723	.0006154	.0072818	.0201555	.0225891
combined	200	.0180147	.0005831	.008246	.0168649	.0191645
diff		-.0111919	.0009973		-.0131585	-.0092253

```
    diff = mean(0) - mean(1)                              t =  -11.2226
Ho: diff = 0                             degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000       Pr(|T| > |t|) = 0.0000        Pr(T > t) = 1.0000
```

```
. ttest        DIV, by (OWN)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	60	.2147563	.0201284	.1559143	.1744794	.2550332
1	140	.376218	.014258	.1687034	.3480273	.4044087
combined	200	.3277795	.012765	.1805246	.3026074	.3529516
diff		-.1614617	.0254595		-.2116683	-.1112552

```
    diff = mean(0) - mean(1)                              t =   -6.3419
Ho: diff = 0                             degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000       Pr(|T| > |t|) = 0.0000        Pr(T > t) = 1.0000
```

```
. ranksum ROA, by(OWN)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

        OWN |     obs    rank sum    expected
------------+---------------------------------
          0 |      60        2702        6030
          1 |     140       17398       14070
------------+---------------------------------
   combined |     200       20100       20100

unadjusted variance    140700.00
adjustment for ties         0.00
                       ----------
adjusted variance      140700.00

Ho: ROA(OWN==0) = ROA(OWN==1)
           z =  -8.872
    Prob > |z| =   0.0000

. ranksum  LATA, by(OWN)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

        OWN |     obs    rank sum    expected
------------+---------------------------------
          0 |      60        5900        6030
          1 |     140       14200       14070
------------+---------------------------------
   combined |     200       20100       20100

unadjusted variance    140700.00
adjustment for ties         0.00
                       ----------
adjusted variance      140700.00

Ho: LATA(OWN==0) = LATA(OWN==1)
           z =  -0.347
    Prob > |z| =   0.7289

. ranksum  FGAP, by(OWN)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

        OWN |     obs    rank sum    expected
------------+---------------------------------
          0 |      60        4285        6030
          1 |     140       15815       14070
------------+---------------------------------
   combined |     200       20100       20100

unadjusted variance    140700.00
adjustment for ties         0.00
                       ----------
adjusted variance      140700.00

Ho: FGAP(OWN==0) = FGAP(OWN==1)
           z =  -4.652
    Prob > |z| =   0.0000
```

```
. ranksum    LTD, by(OWN)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

        OWN |      obs    rank sum     expected
------------+---------------------------------
          0 |       60        4403         6030
          1 |      140       15697        14070
------------+---------------------------------
   combined |      200       20100        20100

unadjusted variance     140700.00
adjustment for ties          0.00
                        ----------
adjusted variance       140700.00

Ho: LTD(OWN==0) = LTD(OWN==1)
           z =  -4.338
    Prob > |z| =   0.0000

. ranksum    OPEX, by(OWN)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

        OWN |      obs    rank sum     expected
------------+---------------------------------
          0 |       60        2557         6030
          1 |      140       17543        14070
------------+---------------------------------
   combined |      200       20100        20100

unadjusted variance     140700.00
adjustment for ties          0.00
                        ----------
adjusted variance       140700.00

Ho: OPEX(OWN==0) = OPEX(OWN==1)
           z =  -9.259
    Prob > |z| =   0.0000

. ranksum    DIV, by(OWN)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

        OWN |      obs    rank sum     expected
------------+---------------------------------
          0 |       60        3740         6030
          1 |      140       16360        14070
------------+---------------------------------
   combined |      200       20100        20100

unadjusted variance     140700.00
adjustment for ties          0.00
                        ----------
adjusted variance       140700.00

Ho: DIV(OWN==0) = DIV(OWN==1)
           z =  -6.105
    Prob > |z| =   0.0000
```

> ➢ **Appendix No. 03: Correlation matrix between model variables**

. pwcorr ROA LATA FGAP LTD OWN OPEX DIV GDPG, star(5)

	ROA	LATA	FGAP	LTD	OWN	OPEX	DIV
ROA	1.0000						
LATA	-0.0642	1.0000					
FGAP	0.3859*	-0.3670*	1.0000				
LTD	0.3394*	-0.6082*	0.6446*	1.0000			
OWN	0.5569*	0.0188	0.2948*	0.2945*	1.0000		
OPEX	0.2295*	-0.3435*	0.4712*	0.5172*	0.6235*	1.0000	
DIV	0.4711*	0.4180*	0.1880*	-0.0672	0.4109*	0.1590*	1.0000
GDPG	0.1860*	0.2640*	0.0485	-0.1135	0.0000	-0.0055	0.3044*

	GDPG
GDPG	1.0000

> ➢ **Appendix No. 04: Result of the VIF test**

. regress ROA LATA FGAP LTD OWN OPEX DIV GDPG

Source	SS	df	MS
Model	.014467084	7	.002066726
Residual	.011511734	192	.000059957
Total	.025978818	199	.000130547

Number of obs = 200
F(7, 192) = 34.47
Prob > F = 0.0000
R-squared = 0.5569
Adj R-squared = 0.5407
Root MSE = .00774

ROA	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
LATA	-.0188589	.0056627	-3.33	0.001	-.030028	-.0076898
FGAP	.0078354	.0041522	1.89	0.061	-.0003544	.0160252
LTD	.0071796	.0026826	2.68	0.008	.0018884	.0124707
OWN	.0150853	.0017279	8.73	0.000	.0116771	.0184935
OPEX	-.6240842	.099937	-6.24	0.000	-.8211995	-.4269689
DIV	.0211848	.0040197	5.27	0.000	.0132563	.0291134
GDPG	.0017733	.0005669	3.13	0.002	.0006551	.0028916
_cons	.0109383	.0040134	2.73	0.007	.0030224	.0188543

. vif

Variable	VIF	1/VIF
LTD	2.57	0.389498
LATA	2.27	0.440619
OPEX	2.25	0.443653
OWN	2.09	0.478113
FGAP	1.97	0.507219
DIV	1.75	0.572159
GDPG	1.17	0.854963
Mean VIF	2.01	

➢ Appendix No. 05: Result of the Breusch-Pagan test

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        ROA[code,t] = Xb + u[code] + e[code,t]

        Estimated results:
                          |      Var        sd = sqrt(Var)
                 ─────────┼───────────────────────────────
                     ROA  |   .0001305         .0114257
                       e  |   .0000521         .0072172
                       u  |   8.36e-06         .0028908

        Test:   Var(u) = 0
                              chi2(1) =       8.01
                          Prob > chi2 =       0.0023
```

➢ Appendix No. 06: Result of the autocorrelation test

```
. xtserial ROA LATA FGAP LTD OWN OPEX DIV GDPG

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
     F(  1,       19) =      23.939
             Prob > F =       0.0001
```

➢ Appendix No. 07: Result of the heteroscedasticity test

```
. . xtgls ROA LATA FGAP LTD OWN OPEX DIV GDPG , igls panels (heteroskedastic)
Iteration 1: tolerance = .0243765
Iteration 2: tolerance = .01132454
Iteration 3: tolerance = .00597936
Iteration 4: tolerance = .00369023
Iteration 5: tolerance = .00250667
Iteration 6: tolerance = .00179528
Iteration 7: tolerance = .00133036
Iteration 8: tolerance = .00101289
Iteration 9: tolerance = .00079024
Iteration 10: tolerance = .00063087
Iteration 11: tolerance = .00051467
Iteration 12: tolerance = .0004284
Iteration 13: tolerance = .00036319
Iteration 14: tolerance = .000313
Iteration 15: tolerance = .00027371
Iteration 16: tolerance = .00024243
Iteration 17: tolerance = .00021713
Iteration 18: tolerance = .00019638
Iteration 19: tolerance = .00017914
Iteration 20: tolerance = .00016464
Iteration 21: tolerance = .00015233
Iteration 22: tolerance = .00014177
Iteration 23: tolerance = .00013264
Iteration 24: tolerance = .00012469
Iteration 25: tolerance = .00011773
Iteration 26: tolerance = .00011161
Iteration 27: tolerance = .00010619
```

APPENDIXES

Cross-sectional time-series FGLS regression

Coefficients: generalized least squares
Panels: heteroskedastic
Correlation: no autocorrelation

Estimated covariances	=	20		Number of obs	=	200
Estimated autocorrelations	=	0		Number of groups	=	20
Estimated coefficients	=	8		Time periods	=	10
				Wald chi2(7)	=	1038.65
Log likelihood	=	732.305		Prob > chi2	=	0.0000

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LATA	.0103721	.0048181	2.15	0.031	.0009287	.0198154
FGAP	.0153324	.0026971	5.68	0.000	.0100463	.0206185
LTD	.0104227	.0031625	3.30	0.001	.0042242	.0166212
OWN	.0142652	.0010995	12.97	0.000	.0121103	.0164202
OPEX	-.4621323	.0684398	-6.75	0.000	-.5962718	-.3279928
DIV	.0141372	.0028581	4.95	0.000	.0085354	.019739
GDPG	.0003412	.0003395	1.00	0.315	-.0003243	.0010066
_cons	.0000851	.0038516	0.02	0.982	-.0074639	.0076341

. estimates store hetero

. . xtgls ROA LATA FGAP LTD OWN OPEX DIV GDPG

Cross-sectional time-series FGLS regression

Coefficients: generalized least squares
Panels: homoskedastic
Correlation: no autocorrelation

Estimated covariances	=	1		Number of obs	=	200
Estimated autocorrelations	=	0		Number of groups	=	20
Estimated coefficients	=	8		Time periods	=	10
				Wald chi2(7)	=	251.34
Log likelihood	=	692.4829		Prob > chi2	=	0.0000

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LATA	-.0188589	.0055483	-3.40	0.001	-.0297334	-.0079844
FGAP	.0078354	.0040683	1.93	0.054	-.0001384	.0158092
LTD	.0071796	.0026284	2.73	0.006	.002028	.0123311
OWN	.0150853	.001693	8.91	0.000	.011767	.0184036
OPEX	-.6240842	.0979178	-6.37	0.000	-.8159996	-.4321688
DIV	.0211848	.0039385	5.38	0.000	.0134655	.0289042
GDPG	.0017733	.0005555	3.19	0.001	.0006846	.0028621
_cons	.0109383	.0039323	2.78	0.005	.0032312	.0186455

. estimates store homosk

. local df = e(N_g) - 1

. lrtest hetero homosk, df (19)

| Likelihood-ratio test | LR chi2(19) = | 79.64 |
| (Assumption: homosk nested in hetero) | Prob > chi2 = | 0.0000 |
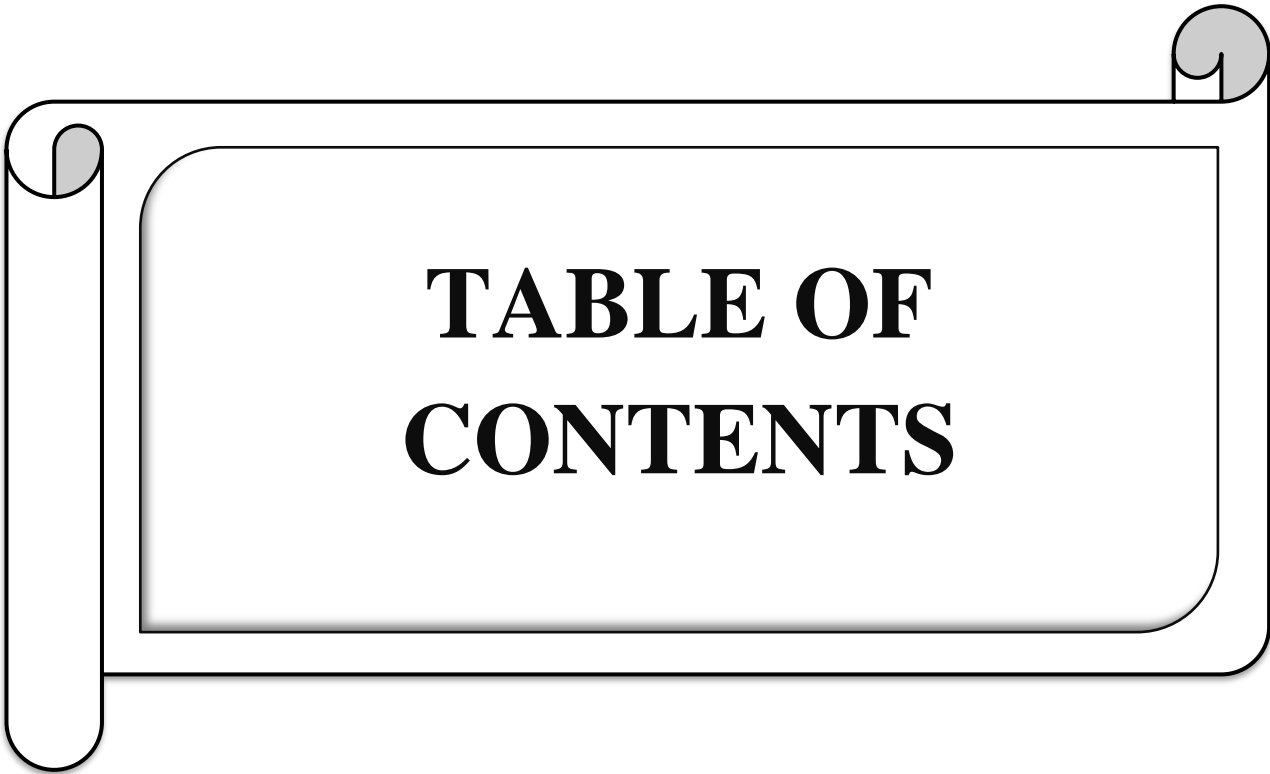
➢ **Appendix No. 08: Results of the multivariate analysis of the model**

```
. xtpcse ROA LATA FGAP LTD OWN OPEX DIV GDPG

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:    code                   Number of obs     =        200
Time variable:     year                   Number of groups  =         20
Panels:            correlated (balanced)  Obs per group: min =        10
Autocorrelation:   no autocorrelation                    avg =        10
                                                         max =        10
Estimated covariances      =      210     R-squared         =     0.5569
Estimated autocorrelations =        0     Wald chi2(7)      =     228.68
Estimated coefficients     =        8     Prob > chi2       =     0.0000
```

ROA	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
LATA	-.0188589	.0062712	-3.01	0.003	-.0311501	-.0065676
FGAP	.0078354	.0044432	1.76	0.078	-.0008731	.0165439
LTD	.0071796	.002938	2.44	0.015	.0014212	.0129379
OWN	.0150853	.0018064	8.35	0.000	.0115449	.0186257
OPEX	-.6240842	.06953	-8.98	0.000	-.7603605	-.4878079
DIV	.0211848	.0040101	5.28	0.000	.0133252	.0290445
GDPG	.0017733	.0008756	2.03	0.043	.0000572	.0034895
_cons	.0109383	.0043436	2.52	0.012	.002425	.0194517

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