Institut de Financement
du Développement du Maghreb Arabe
عهـــد تمويل التنميـــة للمغرب العربي

End of Studies Project

Topic :

Impact of Bank Competition on Financial Stability: A Study on Tunisian Banks

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ACKNOWLEDGEMENTS

SUMMARY

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
AMF	Arab Monetary Fund
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CBE	Central Bank of Europe
CBT	Central Bank of Tunisia
CCB	Capital Conservation Buffer
CCyB	Countercyclical Capital Buffer
CEMAC	Economic and Monetary Community of Central Africa
CRD	Capital Requirements Directive
DSIB	Domestic Systemically Important Bank
DSTI	Debt-Service-to-Income ratio
E.g	exempli gratia
ESRB	European Systemic Risk Board
FE	Fixed effect
FED	Federal Reserve
FSB	Financial Stability Board
FV	Franchise value
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
H	H-statistics
HCFS	High Council For financial syability
HHI	Herfindahl-Hirschman Index
IMF	International Monetary Fund
LCR	Liquidity Coverage Ratio
LLP	Loan Loss Provision
LTD	loan To Deposit
LTI	Loan-to-Income ratio
LTV	Loan-to-Value ratio
MENA	Middle East and North Africa
NPL	Non-Performing Loan
NSFR	Net Stable Funding Ratio
OLS	Ordinary Least Squares
RE	Random effect
ROA	Return on Assets
ROE	Return on Equity
SRP	Supervisory Review Process
VIF	Variance Inflation Factor
WDI	World Development Indicators

GENERAL INTRODUCTION

During the seventies and eighties, the financial landscape underwent significant deregulation, marked by financial innovations, advances in information technology and the globalization of financial markets. These changes led banks to take on more aggressive and competitive policies. Many attribute the 2007-09 crisis to excessive risk-taking by financial institutions.

The crisis showed the vulnerability of economic systems, revealing the heavy cost of such instability. Whether manifested in unemployment or public debt, addressing the repercussions of the global banking that was a verge of collapse necessitated several years of concerted efforts. The financial crisis prompted a revaluation of risk assessment practices and financial system regulations, thus, shifting attention from assessing the risk of individual financial institutions to evaluating a bank's contribution to the overall risk of the entire financial system The international organizations such as Basel gained significant importance in managing and preventing global economic crises as they have put in place preventive mechanisms and strengthened supervision of financial markets. They also developed new standards and encouraged the adoption of more robust financial practices to build a more resilient system.

Furthermore, financial stability became a main concern for central banks globally too. These institutions recognized that financial stability is fundamental to preventing systemic crises that can shake the global economy. By anticipating potential risks and intervening proactively, central banks help maintain global financial balance and minimize the impacts of potential crises, thus demonstrating their essential role in preserving economic stability internationally. There are several instruments that central banks have developed in order to monitor the financial system including constructing a composite financial index.

Regarding Tunisia, the central bank of Tunisia has implemented the new banking law n°2016-35 of April 25 2016. This legislation defined the objectives of the CBT with the primary focus on maintaining financial stability.

Simultaneously, the global financial crisis, heightened public policy interest in understanding the competition. This concern revolves around whether increased competition triggers crisis. In the post-financial crisis, significant banking mergers were undertaken with the expectation that increased concentration would lead to greater financial stability and reduced competition. While

enhanced competition in the banking sector has undeniably fostered innovation and efficiency, banking authorities often assumed that in order to enhance financial stability, markets are opt to be more concentrated. However, there is no consensus within the academic community regarding the impact of competition on financial stability. Theoretical predictions are conflicting and empirical findings are mixed.

There are three mainstream that present the relationship between competetion and stability. First, the competition-fragility perspective suggests that competition within the banking sector can increase fragility by incentivizing banks to take excessive risks to maximize their profitability. The quest for competitive positioning can lead to risky behaviour that could compromise financial stability (Keeley, 1990). The second perspective, known as competition-stability emphazises that competition has a stabilizing effect because in the presence of competition, interest rates decline, thereby reducing borrowers' default risk and promoting financial stability (Boyd and De Nicoló, 2005). A third school has recently emerged suggesting that both hypotheses may coexist and that the relationship between banking competition and financial stability is non-linear (Martinez-Miera and Repullo, 2010).

Despite the extensive literature on the relationship between competition and stability, there is a limited body of literature addressing this particular subject for banks in Tunisia.

In fact, previous studies predominantly focused on developed countries with high and uniform competition levels, possibly explaining the prevalence of the competition-fragility hypothesis.

We aim to investigate the relationship between bank competition and stability in Tunisia. The significance of this study arises by the context in which Tunisian banks operate, traversing through in an environment that experienced turbulence in the preceding years. This instability significantly influences the behaviour of both banks and regulatory authorities. We will seek to understand how competition can contribute to strengthening or weakening the stability of national financial systems by examining the underlying factors and with a particular emphasis on the influence of size on banking stability. On one hand, large banks can benefit from economies of scale and have more diversified portfolios, thereby reducing their exposure to risk. However, excessive size can also pose risks, as banks that are too large could become "too big to fail" which create incentives for excessive risk-taking. Thus, the relationship between bank size and financial stability is complex and requires in-depth assessment.

In this context, our study is conducted with the objective of addressing the following central question:

"What is the impact of banking competition on financial stability in Tunisia?"

To address this question, our study will revolve around two research inquiries:

- Does the stability of banks increase or decrease when the competition is lower?
- What additional factors contribute to influencing the stability of these banks?

In order to answer these questions, our research is structured into two distinct parts: a theoretical part and an empirical one. The theoretical part is subdivided into four sections: the first examines the overall notion of financial stability, encompassing its definition and its measures. The second section examines the regulatory framework of financial stability at the international and national level. The third section examines the notion of banking competition, exploring its measurement indicators. The final section in the theoretical part studies the literature dealing with the relationship between banking competition and financial stability.

As for the empirical component, it offers an analysis of the relationship between banking competition and financial stability in Tunisia and is divided into five distinct sections. The first section provides an overall overview of the Tunisian banking sector. The second section examines the competition in Tunisian market as well as the stability by constructing a financial stability index. The third section presents our sample and variables, while the fourth section focuses on the analysis of the variables, including preliminary tests to select the appropriate estimation method. Finally, the last section summarizes our results and interpretations.

CHAPTER I: BANK COMPETITION AND FINANCIAL STABILITY

INTRODUCTION

Financial stability is essential both globally and domestically. By having confidence that the financial system is stable, individuals are be more likely to invest and save which will help create jobs and contribute to productivity. By having a sound financial market and banking system, resources will be transferred in an optimal way and it will allow public authorities to raise investment capital, to have financial safety nets and to better manage financial risks. Financial stability is thus a key element for ensuring a strong economy and maintaining price stability.

The constant financial crises and crashes have brought the attention of public authorities of the vulnerabilities and fragilities of the financial system as a whole and the banking system especially, which may have seemed over the years to be stable and robust, in particular before the occurrence of the subprime crisis. These crises have compelled financial authorities to put major emphasis on financial stability by drawing and updating new laws and regulations.

Financial instability results in substantial losses for the economy, due to the increased risk that financial institutions face of going bankrupt. Moreover, during these periods, economic growth may be restrained due to the fact that economic agents will be hesitant to place their money in financial market or to invest. Most countries worldwide have been stressing about the importance of maintaining financial stability when putting in place their policies. The presence of competition among banks is a pivotal element in influencing financial stability.

At the end of the twentieth century was characterized by financial deregulation which contributed to an increase in competition within the banking sector. Analysing this competition through various indicators becomes crucial in comprehending the robustness of the banking industry. This is because the level of competition significantly influences production efficiency, the quality of financial services and the extent of innovation within the sector. Regulators play a crucial role in monitoring and regulating banking competition to ensure a fair, transparent and secure environment.

In this theoretical chapter, we will be addressing the concept of financial stability in a first section: its definition and its measures. In the second section, we will examine the regulatory framework of financial stability internationally and nationally. In the third section, we will define banking competition and its measures. A final section will present the theoretical relationship between banking competition and financial stability.

SECTION I: FINANCIAL STABILITY

Financial stability is a widely discussed topic in contemporary economic literature. The relevance of studying financial stability was first acknowledged late in 1990s, and it grew further more significant due to the emergence of the financial crisis of 2007. In light of this global financial crisis, financial stability has drawn more attention from central banks and other governmental authorities since the since the resilience of financial institutions and their survival is highly correlated to financial stability. These events promoted the necessity of continuously offering the professional public an update and a reliable assessment of the solidity of the financial sector at any given country.

In order to be able to fully understand the concept of financial stability, in this section, we will first present the different definitions of financial instability and financial stability. The second part will be dedicated to presenting the different measures for financial stability.

1. Definition of financial instability and financial stability

There have been approaches that have chosen to start from the definition of financial instability in order to deal with what exists in the financial system and not what should be. We are no longer talking about an effort to maintain financial stability but an effort to prevent bank fragility and financial crises, Shinasi (2005). To deepen our understanding of financial stability, it is imperative to first define financial instability.

1.1 Financial instability

Financial instability seems to be most effectively explained by Minsky's financial hypothesis theory. Minsky hypothesis is a theory that studies the impact of debt on the economic systems' behaviour. There are three distinct income-debt relationships which are the following:

- Hedge financing units: The borrowers have enough cash-flow to pay-off all their payment obligations;
- Speculative financing units: Borrowers are able to meet their payment obligations even though they're unable to repay the principle through their income cash flow (e.g. issue a new debt in order to meet payment obligations on maturing debt);
- Ponzi financing units: Borrowers do not have sufficient cash flow to repay neither the principle nor the interests so they are obliged to sell their assets or to borrow in order to pay the interest.

The financial instability hypothesis is based on two tenets: The first one stipulates the economy has a financing regime that is stable and another which in unstable. The latter that dictates that in case of prolonged prosperity, a shift will be seen from stable financing to unstable financing. In an inflationary state, authorities will rise the interest rates and the speculative units will turn into Ponzi units. The net worth of the prior Ponzi units will swiftly deteriorate. As such, individuals with cash flow shortage will be obliged to sell their assets leading to a sharp decline of asset values and leading to a financial instability. The Minsky financial hypothesis is explained by the following figure (1.1):

Figure 1: Minsky financial hypothesis
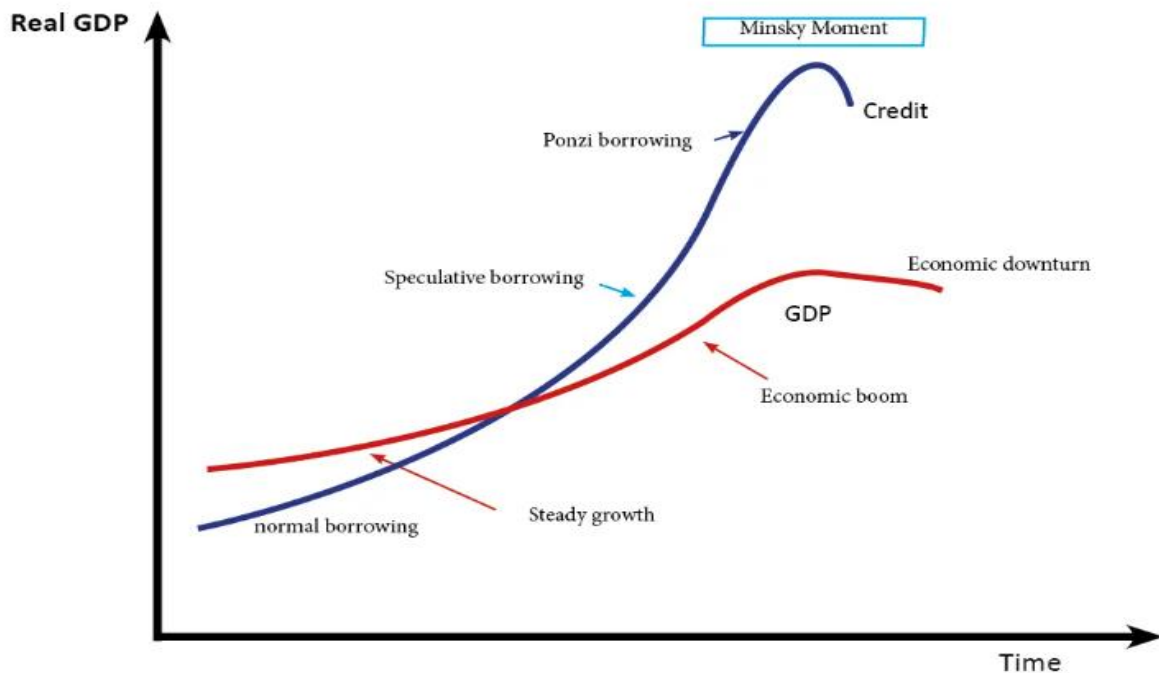
According to Mishkin (1999), asymmetric information can lead to the inefficiency of financial system by which one party has more accurate information than the other party. Asymmetric information can cause two major problems in the financial systems which are:

➢ Adverse selection: It is an asymmetric information issue that takes places before the occurrence of the transaction when possible bad risk borrowers are the ones that are actively requesting loans, Thereby, the parties selected are the bad credit risks at the expense of the good ones;

➢ Moral hazard: It takes place after the transaction when the borrower is inclined to take part in activities that are unacceptable from the creditor's point of view.

Financial instability occurs when financial system shocks interfere with the flow of information, which prevent the financial system from channelling funds to successful investment opportunities. There are several factors that can aggravate information asymmetry and cause financial instability. Among these factors:

➢ Increase in interest rates: Probability of credit risk increases when there are higher interest rates;

➢ increase in uncertainty: In case of uncertainty, lenders find it hard to distinguish bad risk credits from good ones;

➢ Asset market effects on balance sheets: Adverse selection and moral hazard worsens when there is a deterioration in the balance sheets;

➢ Problems in the banking sector: Investment and economic growth will decrease if banks are unable to provide financial intermediation and make loans.

In extreme circumstances, these factors may create a financial crisis when interacting potentially causing the financial system to cease functioning.

1.2 Financial stability

Researchers have widely discussed the concept of financial stability due to it is complexity. The study of financial stability is difficult because the definitions are numerous. Scholars and central bankers have yet reach to a consensus regarding the term "financial stability". They generally agree that financial stability indicates that the components of the financial system operate efficiently, but the more precise definitions vary. We will list some of these different definitions.

Financial stability can be defined as the state in which financial market's prices are affected by based on supply and demand. Mishkin (1991) states that financial stability can be established when financial systems have the capacity to allocate savings in a consistent and effective manner.

According to Crockett (1997), financial stability requires the financial system to function normally without the help of regulatory authorities. He also points out that the stability of markets and financial intermediaries are two factors that determine financial stability. The stability of financial institutions resides in the fact that economic agents have confidence in financial institutions and the latter are able to honour their financial commitments without intervention from the authorities, As for market stability, it is materialized by the capacity of the participants to carry out transactions safely and at prices that reflect the reality of the fundamentals of the assets traded. These prices must not vary excessively over short periods.

The stability of all parts of the system does not necessarily equate to financial stability. Rather, it equates to the absence of stresses or crises that can cause measurable economic losses. Therefore, occasional small institutions failures or occasional large institutions losses are not considered financial instability.

Michael foot (2003) states that financial stability is obtained when certain conditions are met: "We have financial stability where there is: monetary stability; employment levels close to the economy's natural rate; confidence in the operation of the generality of key financial institutions and markets in the economy; and where there are no relative price movements of either real or financial assets within the economy that will undermine monetary stability or employment levels".

Others like Padoa-Schioppa (2003) considers that financial system is stable when it is able to be resilient to shocks that might otherwise impair the allocation of resources from savings to investments, without disturbing the payment process within the economy. To have a better understanding of financial stability, it is crucial to determine the components of the financial system which is all of financial intermediaries, organized and informal markets, payments and settlement circuits, technical infrastructures supporting financial activity and supervisory agencies. This comprehensive definition permits to have a full perspective of how savings are used for investment opportunities, information is disseminated and processed, risk is shared among economic agents and payments are facilitated across the economy.

Some scholars have chosen a narrow definition which stipulates that a financial system can be considered stable when there is no excessive volatility, stress and crises. However, this claim is not enough because it fails to understand the positive impact that an efficient financial system has on performance. Additionally, defining a crisis is difficult due to the wide variety of crisis types over time (banking crises, debt crises, equity crises, etc.) as well as the variety of ways to define crisis (using binary variables, more quantifiable variables, etc.) and the time horizon over which it is measured.

Traditionally, central banks have focused on managing financial crises, but they also play a pivotal part in preventing them by ensuring an efficient payment system, supervision and monitoring. In fact, globalization, deregulation, the rise of innovation, and various other trends have enhanced the roles of central banks. Many central banks have realized that ensuring financial stability should be one of their main objectives. They adopt specific definitions of financial stability in order to provide guidance in this respect. Some of these definitions are grouped in the table below:

Table 1 :Central banks 'defitnions of financial stability

CBE	*"Financial stability can be defined as a condition in which the financial system – which comprises financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and the unravelling of financial imbalances."*[1]
Bank of England	*"A stable financial system is one that can provide crucial services to households and businesses in both good times and bad."*[2]
FED	*"Financial stability is a financial system that meets the needs of average families and businesses to borrow money to buy a house or a car, or to save for retirement or an education. Likewise, businesses need to borrow money to expand, build factories, hire new workers, and make payroll."*[3]
Swiss National bank	*"A financial system is stable if its individual components - banks, financial markets and financial market infrastructures - fulfil their individual functions and are resilient to potential shocks. Financial stability is an important prerequisite for economic development."*[4]
Bank of Japan	*"Financial system stability refers to a state in which the financial system functions properly, and participants, such as firms and individuals, have confidence in the system."*[5]

2. Measures of financial stability

In the wake of the global financial crisis, several studies focused on indicators of financial stability. The measurement of financial stability is essential for regulators and supervisory

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[1] https://www.ecb.europa.eu/ecb/html/index.fr.html consulted on 21/07/2022 at 11:00 AM

[2] https://www.bankofengland.co.uk/financial-stability consulted on 21/07/2022 at 11:10 AM

[3] https://www.federalreserve.gov/faqs/what-is-financial-stability.htm consulted on 21/07/2022 at 11:18 AM

[4] https://www.snb.ch/fr/iabout/finstab consulted on 21/07/2022 at 11:26 AM

[5] https://www.boj.or.jp/en/finsys/outline/index.htm consulted on 21/07/2022 at 11:37 AM

institutions to analyse and assess the sources of stress that can impede the functioning of the financial system. It is possible to better control the extent of financial stability by putting in place the most effective preventive measures and policies. In light of the diversity of definitions of financial stability, a variety of measurement methods have been used.

In the literature, two primary methodologies are employed for assessing the financial stability of a system: those reliant on crisis prevention and those centred around composite indicators. The first approach involves the use of simulation approach or individual indicators, which function as early warnings for financial vulnerabilities. The second approach revolves around composite indicators or indices, offering a comprehensive measure of financial stability. In contrast to the crisis prevention indicator method, which predicts the likelihood of a financial crisis, this method provides an actual measure of financial stability.

2.1 Crisis Prevention based approach

Before the financial system enters a phase of instability and becomes exposed to systemic risk, there are warning events. Indicators designed for crisis prevention have the objective of identifying the potential occurrence of a financial crisis, enabling proactive measures to prevent it. In the subsequent part, we will provide a more detailed explanation of the two categories of prevention indicators: those grounded in crisis simulations and those relying on individual indicators.

2.1.1   Crisis simulation approach

 It is defined by Colletti et al. (2008) as the employment of a tool to evaluate the resilience of a segment within the financial system when confronted with infrequent yet plausible events that have previously given rise to vulnerabilities or could potentially do so in the future. Crisis simulations function as controlled tests to assess the financial system's ability to withstand the occurrence of one or more macroeconomic incidents. During the simulation of a macroeconomic crisis, adverse events with potential impacts on financial stability are introduced. These events, which can harm the economy, are often linked using an econometric model to generate a macroeconomic scenario. The primary objective of the financial stability measurement approach based on crisis simulation is to evaluate the system's resilience in the face of a specific, unfavorable, yet probable scenario.

Two fundamental methods are employed for conducting macroeconomic crisis simulations:

➢ Bottom-up method: In this approach, all relevant financial institutions conduct an analysis of the scenario's impact on their portfolios. They then communicate the results to the authorities, who are responsible for collecting and analyzing the conclusions provided by the institutions;

➢ Top-down method: The authorities take charge of studying the impact of the scenario on various financial institutions. They utilize the results obtained in their analyses and incorporate them into discussions with the concerned institution.

2.1.2 Individual indicators

These indicators serve as alert mechanisms for financial fragility, enabling the identification of the likelihood of a crisis and the extent to which the financial system is susceptible to systemic risk. This capability aids in proactively preventing the occurrence of a financial crisis. Drawing from the guidelines outlined by the International Monetary Fund (IMF, 2006) financial stability is assessed through multiple variables, each reflecting a distinct type of risk faced by institutional finances. We will present the most used indicators as well as the usefulness and meaning of each of these indicators.

a) *The Z-score*

In literature, the Z score is widely used as proxy to assess the stability of a bank (Berger et al., 2009; Fiordelisi and Mare, 2014). It measures the number of standard deviations by which a bank is likely to exceed its capital base. The Z-Index rises in tandem with increased profitability and higher levels of leverage or capitalization, while it declines with greater return volatility or unstable earnings. Consequently, a higher Z-Index value signifies a diminished risk profile for a bank and enhanced overall bank stability. A key reason for the Z-score's popularity as an indicator of financial stability is that it can be calculated for both listed and unlisted banks. To determine the Z score we use the following formula:

$$Z= \frac{ROA + E/A}{\sigma ROA} \qquad (1)$$

Where:

***ROA*:** Return on assets, which is the net profit divided by total assets

***E/A*:** Total equity divided by total assets

σ(ROA) : The standard deviation of return on assets

b) NPL

The non-performing loan (NPL) is another accounting indicator of stability which is used as a proxy (Schaeck and Cihák, 2014). NPLs are loans made by financial institutions that are significantly overdue or unlikely to be repaid in full.

The high presence of NPLs in the financial sector can have significant implications for financial stability. Elevated levels of NPL suggest an increased risk of insolvency, leading to higher bank fragility or diminished bank stability. In contrast to the Z-Index, which provides an assessment of overall bank risk, NPL serves as a measure of credit or loan portfolio risk, as highlighted by Beck (2008) and Berger et al. (2008). NPL ratio is determined as follow:

$$NPL = \frac{\text{Total amount of bad loans held by the bank}}{\text{net loan amount}} \qquad (2)$$

Regulators and financial institutions are implementing measures to identify, manage and reduce NPLs in the financial system. This may include initiatives to strengthen the quality of loans granted, establish more rigorous supervisory mechanisms and develop policies to resolve banking crises.

2.2 Approaches based on the composite financial stability index

The composite financial stability index is a quantification tool that measures the vulnerability of a financial system and thus allows to predict in real time the future level of financial stability. Initially, central banks developed partial measures in the aim of establishing an index making it possible to assess the solidity of a well-targeted sector, before deciding, to develop a single index that measures the overall financial stability. The creation of an aggregate financial stability index is a methodology that enables the measurement of a financial system's stability, considering its dynamic and evolving nature. Consequently, it provides analysts with a means to quantify and forecast the financial system's stability. The advantages of this measurement method include transparency in presenting results and accessibility to data. Additionally, it offers researchers the opportunity to compare the stability of financial systems across different countries. The Table (2) summarize the different approaches that have been used when constructing financial stability indices.

Table 2: Literature review of composite indices

Author	Country	Method
Central Bank of Czechia(1997)	Czechia	The banking stability index is obtained through a weighted average of sub-indicators assesing the strength of the banking sector. These sub-indicators include capital adequacy, profitability, balance sheet liquidity, asset quality and credit risk
Central bank of Turkey (1999)	Turkey	The financial strength index is determined through a weighted average of specific indicators measuring the financial strength of banks. This index include indicators across six key areas of financial strength: capital adequacy, profitability, liquidity, asset quality, interest rate risk, and foreign exchange risk.
Petrovska and Mihajlovska(2013)	Macedonia	The index is designed to measure the stability of the banking sector. This index is a weighted average of indicators reflecting various banking risks, including insolvency risk, credit risk, profitability, liquidity risk, and exchange considerations.
Van den End (2006)	Netherlands	The indicator takes into account monetary sub-indicators that include: the interest rate, the effective exchange rate, stock and real estate prices, the solvency of financial institutions and the volatility of the stock index of financial institutions.
Morris (2011)	Jamaica	This indicator brings together 19 microeconomic, macroeconomic and international standards representative of the performance and robustness of the financial system. Sub-indicators were also established to measure the impact of each of these areas on financial stability, namely the financial development index, which measures the level of development of the financial system and the financial vulnerability index, which reflects the robustness of the financial system to disruptions.
Jakubík and Slacˇík(2013)	Emerging Europe	The index measures the level of risk of financial markets, called the financial instability index. The variables, selected for creating this index, are indicators for markets risk, in particular money markets, foreign exchange markets and securities markets (stocks and bonds).

SECTION II: REGULATORY FRAMEWORK AND SUPERVISION OF FINANCIAL STABILITY

In order to ensure financial stability, financial authorities apply a very complex regulatory framework. This carefully designed framework aims to achieve one main objective: to supervise, regulate and monitor all participants in the financial sector, including financial institutions, markets and financial instruments. By improving the financial strength of market participants, prudential regulation contributes to creating a more resilient financial system, capable of coping with economic shocks and market turbulence and preserving economic stability over time on a national and international scale. In addition, international coordination is also crucial to ensure consistency of standards globally.

1. Regulatory framework of financial stability

Prudential regulation involves overseeing financial institutions through specific requirements, restrictions, and guidelines aimed at preserving the stability of the financial system. While the specifics may differ across countries, there are consistent general principles that guide this regulatory approach. This section explores the historical development of both international and Tunisian prudential regulations.

1.1 International prudential regulation

International prudential regulation plays a crucial role in preserving financial stability, notably through the Basel Accords which were formulated in response to the bankruptcy of the German bank Herstatt. The Basel Committee on Banking Supervision (BCBS), initially known as the "Cooke Committee", was established in 1975 by the central bank governors of the G10[6] countries. The committee's primary objective was to establish universally applicable prudential standards for credit institutions. Comprising 45 members from 28 jurisdictions, the BCBS aims to harmonize banking practices globally. Literature indicates that the committee's central role is to define norms and standards for banking supervision, thereby enhancing the security and reliability of the financial system. While lacking supranational authority, its recommendations are translated into directives within national financial systems. For instance, in the European

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[6] G10 is a group of 11 industrialized nations that have similar economic interests. The member countries are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States

Union, the Basel Accords are implemented through European directives known as Capital Requirements Directives (CRD).

Over the past few decades, the Basel Committee has established a series of agreements known as the "Basel Accords." Presently, there are three agreements in place: Basel I, Basel II, and Basel III. Simultaneously, a fourth agreement, Basel IV, is scheduled for gradual implementation and it refines aspects of Basel III, specifically addresses banks and financial institutions engaged in market activities.

In an effort to enhance the management of banking risks, the BCBS implemented reforms by transitioning from a microprudential approach, characterized by the standards and recommendations of Basel I and subsequently Basel II, to another macroprudential approach represented by Basel III.

Each Basel Accord serves a distinct purpose:

- Basel I introduced a minimum capital requirement to address credit risk;
- Basel II aimed at a more comprehensive integration of incurred risks;
- Basel III focused on enhancing the financial system in response to the subprime crisis;
- Basel IV is aimed towards improving risk coverage.

1.1.1 Basel I

The Basel Committee's initial efforts resulted in the creation of the "Basel I" agreement in 1988, also referred to as the "Cook ratio" in honor of the then-president of the Basel Committee. This agreement established a standardized framework for assessing and regulating the capital adequacy of banks. Its primary objective was to ensure that banks maintain an appropriate level of capital to cover potential losses arising from credit risk. The framework introduced minimum capital requirements based on the risk-weighted assets of banks. The Cook ratio stipulates a minimum threshold of 8% for the capital that banks must hold to safeguard against counterparty risk. It is expressed as such:

$$\text{Cooke ratio} = \frac{Own\ funds}{Credit\ risk} > 8\% \qquad (3)$$

Despite its implementation, Basel I has faced criticism from various authors and researchers who argue that its design primarily caters to G10 countries, rendering it unsuitable for emerging

markets. Rochet (2008) have noted that using weighting methods are overly simplistic in assessing the true level of credit risk. The Cook ratio, in particular, is criticized for not adequately reflecting the genuine risks associated with banking commitments. Notably, states are weighted at 0%, overlooking potential risks, while companies, even those with favorable ratings, bear a weight of 100%. Acknowledging these limitations, the Basel Committee initiated reforms in 1996 to address deficiencies and adapt to evolving financial market dynamics, including the incorporation of market risk and off-balance sheet risks.

1.1.2 Basel II

Basel II was created with the purpose of replacing the guidelines set by Basel I. This framework for prudential regulation seeks to enhance the oversight of banking risks by improving the approaches used to calculate risk weightings. Additionally, it strives to reduce systemic risk by improving supervision and fostering increased market discipline. Basel II is built upon three primary pillars Basel II which are:

- ➢ **Pillar 1 - Minimum Capital Requirements:** The first pillar concerns the rules for calculating the minimum capital requirement by defining a methodology specific to each type of risk and according to the nature of the assets. It takes into account consideration the quality of the borrower through the "Internal Ratings Based Approach". Unlike the Cooke ratio, this new ratio integrates operational risk in the capital requirements.

$$\text{McDonough ratio} = \frac{Own\ funds}{Credit\ risk + market\ risk + operational\ risk} > 8\% \quad (4)$$

- ➢ **Pillar 2 - Supervisory Review Process (SRP):** The second pillar focuses on prudential supervision, by putting in place mechanisms aimed at monitoring. It establishes a framework for communication between banking regulatory authorities and the financial institutions.

- ➢ **Pillar 3 - Market Discipline:** The objective of this pillar is to ensure transparency and discipline in the market. In fact, banks are required to disclose information on their risk management practices by disclosing the approaches used to assess various risks and by making sure that relevant information is available to the public.

However, this prudential system presented by Basel II is criticized by the literature. Rochet (2008) observes that Basel II does not take into account systemically important financial institution and does not address the risks associated with these entities. Furthermore, Basel II standards and recommendations do not give sufficient importance to liquidity risk. The 2001 Bank for International Settlements (BIS) report highlights another aspect not covered by the Basel II standards which is the correlation between economic cycles and the financial system. Periods of "economic euphoria" are generally characterized by underestimation of risks, excessive distribution of credit, significant increases in asset prices, large investments and excessive household consumption. The issue of cycles in financial systems is causing increasing concern, which is prompting authorities and central banks to examine the consequences of financial cycles, particularly with regard to the financial imbalances they generate.

The major financial crises, in particular Asian crisis of 1997, as well as the subprime crisis have highlighted the inadequacy of the microprudential system in overseeing systemic risks. The microprudential regulatory approach exhibits various limitations and shortcomings. This led to the need to add a macroprudential policy to a better risk management.

1.1.3   The macro prudential approach and the pillars of Basel III

The macroprudential framework is materialized by the pillars of Basel III.

a) *The macroprudential approach versus the microprudential approach*

The macroprudential system considers the banking system as a whole, including the interactions among its various components. Consequently, the macroprudential approach is designed to address the collective aspects of the banking system rather than treating each individual banks on its own.   Three characteristics differentiate the macroprudential approach from the microprudential approach which are namely the objectives, purposes and the characterization of risk.

➢ **Objective:** The primary aim of the macroprudential approach is to decrease the risk of a financial crisis that could adversely affect the entire system. Conversely, the objective of the microprudential approach is to address the risk of failure at the individual financial institution level;

➢ **Purpose:** The macroprudential system emphasizes shared exposures among various financial institutions that collectively form the system, contrasting with the

microprudential approach, which focuses on exposures within the portfolios of individual establishments;

➢ **Risk:** The macroprudential approach defines aggregate risk as dependent or "endogenous" to the collective behavior of banking establishments. Financial institutions collectively have the ability to influence the dynamism of the economy (Borio, 2009) and impact the prices. In contrast, the microprudential perspective neglects the interactions between distinct financial institutions, essentially treating risk as "exogenous".

To summarize, Borio (2003) presents these differences in the comparative table (3) of macroprudential and microprudential approaches.

Table 3: The microprudential and macro-perspectives compared

Approach	Macroprudential	Microprudential
Proximate Objective	Limit situations of system instability	Limit insolvency of an individual institution
Ultimate Goal	Avoid macroeconomic costs related to financial instability	Protect consumers (depositors and investors)
Risk Characterization	Endogenous (depend on collective behaviour)	Exogenous (independent of individual behaviour)
Correlation and common exposures of financial institutions	Significant	Not relevant
Prudential control calibration	In terms of systemic risk: Top-down	In terms of risk specific to each institution: Bottom-up

Source: Borio (2003)

b) *Basel III*

Basel III takes into consideration of liquidity risk and addresses deficiencies in the financial system across various dimensions by:

Introducing new liquidity ratios:

- *Liquidity Coverage Ratio (LCR):* This short-term ratio mandates banks to maintain a reserve of high-quality liquid assets to endure a 30-day crisis, such as a substantial withdrawal by depositors.
- *Net Stable Funding Ratio (NSFR):* A long-term ratio serving a similar purpose as LCR but over a one-year horizon, ensuring stable assets match stable resources.

Appreciating the importance of systematically important banks domestic banks (SIDBs): SIDBs are banks that are identified as having a systemic importance within a specific country or domestic market which are subject to additional regulatory requirements and supervision.

Strengthening capital adequacy: Basel regulators identify specific types of capital that better absorb losses.

Implementing a leverage ratio: In addition to risk-weighted capital requirements, a new ratio is introduced to mitigate the accumulation of excessive leverage in the banking system which assesses the proportion of a bank's total assets funded by its capital.

Other recommendations: These recommendations aim to enhance the resilience of banks through the introduction of two capital buffers usable during crises to absorb losses:

- *Capital Conservation Buffer*: Ensures banks have an additional layer of usable capital in case of losses.
- *Countercyclical Capital Buffer:* Aims to shield the banking sector from periods of excessive overall credit growth, associated with the accumulation of systemic risks.

1.2 National prudential regulation

At the national level in Tunisia, the CBT serves as the authority responsible for control and supervision. It has undertaken a comprehensive series of reforms with dual objectives. Firstly, these reforms are aimed to establish a regulatory framework for risk management that aligns with the highest international standards, notably the Basel agreements. Secondly, the reforms are designed to uphold financial stability, ultimately aiming to safeguard depositors and strengthen public confidence in the banking system. The Table below provides a summary of the key developments in Tunisia in terms of prudential regulation.

Table 4: Tunisian prudential framework

Circular Number	Title	Purpose
CBT Circular No. 87-47	Granting and refinancing of credits	Establishes limits by type of credit by applying the Loan-to-value (LTV) ratio which represents the relationship between the amount of a loan and the appraised value of the asset.
CBT Circular No. 91-24	Risk Division, Coverage, and Monitoring	Establishes prudential rules for risk limits, capital adequacy, commitment monitoring, and asset classification and provisioning. For instance exposure to a single counterparty or a group must not exceed 25% of bank's equity
CBT Circular No. 2006-19	Internal Control	Mandate credit institutions to implement an internal control system and establish a permanent internal audit committee for risk management.
CBT Circular No. 2011-06	Governance Rules	Define governance rules for credit institutions to ensure sound management, protecting the interests of stakeholders.
CBT Circular No. 2014-14	Liquidity Ratio	Introduce a new liquidity ratio derived from the short-term Basel liquidity ratio. The LCR is obtained by devising the realizable assets by the payable liabilities. The minimum value of this ratio is 100%.
Banking law No. 2016-48	Banking and Financial Institutions Law	Regulates the conditions for conducting banking operations and the supervision of financial institutions to preserve their stability, protect depositors and users of banking services, and contribute to the proper functioning of the banking sector and financial stability.
CBT Circular No. 2018-06	Capital Adequacy Standards	Redefines capital adequacy standards for Tunisian banks, specifying solvency and Tier I ratio requirements to maintain financial stability and compliance. The solvency ratio cannot be less than 10% and the tier ratio cannot be less that 7%
CBT Circular No. 2018-10	Loans/Deposits Ratio	Establishes a "Loans/Deposits" ratio to ensure a better match between resources and liabilities and control maturity transformation risk, with a maximum level set at 120%.
CBT Circular No. 2022-01	NPL Prevention and Resolution	Aims to reduce non-performing loans in financial institutions' balance sheets by implementing a mechanism for the prevention and resolution of these non-performing loans.

Source: Author

Within the context of analysing prudential regulation in Tunisia, it is now opportune to formally asses the macroprudential tools used in Tunisia and compare it to other comparable countries.

Macroprudential tools are designed to enhance the resilience of the financial system and address systemic risk and the weaknesses of the banking sector. We have chosen the most commonly used macroprudential tools that can be classified into 5 categories as it is shown in table below:

Table 5: Macroprudential tools by selected countries

	Country	Algeria	Egypt	Jordan	Lebanon	Morocco	Tunisia	Türkiye
Capital	**Contracyclical capital buffer (CCyB)**			▪				▪
	Capital conservation buffer	▪	▪	▪		▪	▪	▪
	Levarge ratio		▪	▪		▪	▪	▪
Household	**Loan to value ratio (LTV)**					▪	▪	▪
	Loan to income ratio (LTI)							▪
	Debt service to income (DSTI)	▪			▪	▪	▪	
Corporate	**Sector capital**		▪					▪
	LTV				▪		▪	
Liquidity	**LCR**	▪	▪	▪	▪	▪	▪	▪
	NSFR	▪	▪					▪
	LTD	▪		n.a.			▪	
Systemic risks	**Domestic systemically important bank buffers (DSIB) buffer**		▪	▪				▪

Source: Author (based on IMF macroprudential survey, 2021)

Tunisia has implemented several tools in the liquidity category including the LCR and LTD as it was stipulated by the circulars n°2014-14 and n°2018-10. The same can be said about the household tools since Tunisia uses many tools including the LTV. Examples of LTV is that the mortgage loan amount should not exceed 80% of the total investment. Additionally, it encompasses the DSTI[7] as a tool. Although no explicit rule exists, there is an observed online

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[7] It assess a borrower's ability to manage debt. It is calculated by dividing the borrower's debt service (monthly loan payments) by their gross monthly income.

banking practice adhering to a ratio established in Tunisia since 1976 (Decree No. 76-54 of January 23, 1976) for mortgage loans. According to this regulation, the debt service amount should not surpass 40% of the annual gross salary of the loan recipient.

Unlike several countries with analogous banking systems, Tunisia has yet to implement capital tools such as the CCyB or the capital conservation buffer. Similarly, systemic risks tools, mainly the DSIB, have yet to be utilized.

2. Supervision of financial stability

One of the most effective and direct approaches to influencing financial stability is prudential supervision by specifically monitoring negative consequences resulting from the behaviour of individual institutions, which have effects on the entire system due to their direct and indirect interconnections. There are many entities that ensure supervision including:

2.1 Financial Stability Board (FSB)

The Financial Stability Board is responsible for ensuring financial stability internationally by facilitating cooperation between national financial authorities and international standard-setting bodies that aim to create robust policies to regulate and supervise. Its major role is to promote fairness in the competitive environment by encouraging consistent implementation of these policies across all financial areas and jurisdictions. The main mission of the FSB is to strengthen financial systems and to increase the stability of global financial markets**.**

2.2 European Systemic Risk Board (ESRB)

The board plays a key role in preventing and mitigating systemic risks by issuing warnings and recommendations to address major systemic risks that threaten financial stability in the European Union. Additionally, the ESRB monitors the implementation of its recommendations and assesses whether systemic risks have been reduced. The ESRB also supports the development of effective frameworks for macroprudential policy, both at the level of individual Member States and the European Union as a whole. This includes providing guidance on the application of macroprudential instruments used to address specific and general systemic risks.

2.3 High Council for Financial Stability (HCFS)

As the macroprudential authority in France, it is responsible for overseeing the entire financial system to ensure stability and promote a sustainable contribution of the financial sector to

economic growth. The HCSF also seeks to facilitate cooperation and information exchange among the institutions represented by its members.

2.4 Macroprudential Supervision and Financial Crisis Management Committee

The Macroprudential Supervision and Financial Crisis Management Committee is established within the CBT. It has multiple responsibilities including issuing recommendations to enhance the overall stability of the financial system. This involves reinforcing its resilience and preventing systemic risks.

In January 2023, the Macroprudential Surveillance Committee assessed the changes in macroeconomic and financial risks, emphasizing concerns related to the increase reliance of the treasure on domestic financing. The review noted that if external resources couldn't be mobilized and in case budget was funded by domestic debt, this would be heighten risks of liquidity pressures. This, in turn, might encourage individuals to shift investments, potentially disrupting activities in banking, financial, and insurance markets.

SECTION III: BANK COMPETITION

The notion of market competition was initially developed by Adam Smith in his book « The Wealth of Nations » (1776). The Smithian insight views the competition as being essential in ensuring innovation, market efficiency and a way to avoiding both oligopolies and monopolies since they were perceived as a potential risk to the functioning markets.

1. Competition theories

Inspired by Smith, other economists including McNulty (1967) and Blaug (2001) engaged in evaluating competition which resulted to two main theories. On one hand, competition can be defined as being static as oppose to the other theory that refers to it as a process of rivaly.

1.1 Static theories of competition

When referring to market competitive extremes, it's either perfect competition or monopoly. In either event, companies are not impacted by decisions taken by other firms. In the case of monopoly, other firms are non-existent. At the other end of the spectrum, markets which are perfectly competitive have numerous firms that operate in the same filed ,however, the actions of one company doesn't have any consequences on other companies . This is can be explained

by the fact , that each company has a small proportion market share and as such, the actions taken by one company has no impact on the other ones functioning in the market.

However, in reality, Most of the companies and firms don't operate in either perfectly competitive market nor in a monopolist one and they usually find themselves in a oligopolistic market, where they have to cooperate and connect in order to ensure their survival (Pepall et al., 2008). Mathematician Augustin Cournot (1838-1897) was the first to analyse the oligopolistic markets. He initially started studying monopolistic markets then examined highly competitive equilibrium. He came to a conclusion that there was middle ground between these two types of optics consisting in a market made up of more than a sole firm but at the same time not a huge number of them.

In this model, the firm entering a monopolist market, produces similar products with a unit cost that is the same. The objective of the entrant firm is to maximize its profits. The monopolist, on the other hand, will adjust its output based on the output sold by the new rival firm. In this model, the equilibrium market price is less than that of a monopoly but at the same time more elevated than what would have been in a perfectly competitive market. The strategic variable in Carnout's model is the quantity of the output of each of the rival firms.

In 1883, French mathematician, Joseph Bertrand, voiced a critique related to Cournot's work, offering an alternative perspective. According to Bertrand, firms that operate in a oligopolistic market would eventually collude in order to achieve larger profits than what would have been obtained in Cournot's equilibrium. Even without the presence of collusion, Bertrand argued that firms' competition would be based on prices instead of quantities produced. In an oligopoly with identical output, consumers would opt for the cheapest source. As such, firms wouldn't be quantity choosers but rather price choosers. (Shapiro, 1989). This will incentivize firms to decrease their prices in order to gain the biggest market share.

In the mid-20th century, a new economic theory emerged called the "game theory" that is closely linked to the study of oligopoly. Game theory evaluates strategic decisions which were made in interactive settings. In game theory, companies are rational and try to maximize their profits while engaging in strategic reasoning and foreseeing other firms' behaviour. The equilibrium only occurs when companies have no incentive to bring changes into their strategies. This equilibrium therefore sustains, thus, making the game static.

The equilibrium concept of game theory was developed by John Nash and even though Cournot and Bertrand's oligopoly models were developed prior to the emergence of game theory, they incorporate some aspect of modern game theory oligopoly.

Oligopoly theory has had a major influence to the neoclassical notion of competition, which classifies market structures from perfectly competitive to collusive. This has promoted of new mechanisms to evaluate the degree of competitiveness. Nevertheless, criticisms inflicted to neoclassical and oligopoly theories emphasize the need to view competition as a dynamic approach instead of a static concept.

1.2 Dynamic theories of competition

The debate concerning the use of the neoclassical concept of competition raises questions in whether or not this concept can be applied in real-world markets, supporting the call for another perspective based on a dynamic outlook. Austrian School, such as Mises (1949) and several authors developed dynamic theories of competition. They criticized static competition theories for their incapacity to elucidate the market development and their disregard for the importance of entrepreneurial innovation. Austrian School assumes that the firms are constantly striving for innovation to achieve a competitive advantage. Temporary monopolies will ultimately be eroded by rivals who will imitate their products or will offer a better one.

 Austrian economist theories developed by Shackle and Kirzner harshly critique these assumptions. They've established that realistically, firms are always engaging in innovation in order to obtain a competitive advantage to surpass their rivals. Accomplished entrepreneurs with ground-breaking products may initially gain profits out of static market power, however this advantage is eventually destroyed by competitors who will replicate the product or develop one that has superior characteristics. Furthermore, the handful of barriers to both entry and exit may also contribute to preventing long lasting competitive leverage for successful companies. The potential of having substantial profits will prompt new firms to penetrate the market, causing economic profits reaching normal levels. (Rosen, 1997).

According to Austrian school, policymakers ought to not interfere and impose regulations of antitrust if the market exhibits minimal obstacles to entry. Economists dispute that such intervention that aim to lessen successful firms' profits would eventually diminish their willingness to innovate. The singular scenario in which competition authorities ought to enforce regulations and inhibit antitrust behaviour is when a leading firm has important monopoly power but shows limited levels of innovation. The concepts formulated by Austrian School

economists were revitalized by Chicago school figures. The principles of antitrust were developed by Aaron Director in the 1950s.

The Chicago School stresses the importance of not having regulations for markets. They reckon that market mechanisms will eventually eradicate any monopoly profits and market power. They argue that even though actions taken by firms to obtaining higher profits might be seen as damaging to competition, it actually enhance the consumer welfare and the economic efficiency. The competitive equilibrium will be reached without any regulation intervention.

The conclusions made by both Austrian School and Chicago School regarding competition have faced criticisms by many scholars. A major critique is questioning whether new entrants have the ability or capacity to effectively compete. Another element which was criticized is whether or not entrepreneurial innovation can actually enhance welfare.

2 Competition indicators

New industrial economics have emerged which puts the focus on firms' behaviour in terms of strategy and conduct rather than market structure (Pepall et al., 2008). In order to measure competition in the banking field, models and theories mentioned in literature can be categorized into two main groups: structural and non-structural.

2.1 Structural approaches

To determine the degree of competition, the structural approach studies the market and applies several concentration indicators (Bikker and Haaf, 2002). But, according to the literature, emphasis has only been placed on two main indicators, namely: the concentration ratio (CR) and the Herfindahl-Hirschman index (HHI), which will be detailed in what follows.

2.1.1 The Concentration Ratio

Given its simplicity and minimal data prerequisites, the concentration ratio is commonly used for concentration measures. It measures the concentration of the largest companies in the market and places equal importance for the largest banks, however, it overlooks the many small banks operating in the market. To distinguish large banks from small ones, we generally refer to the total value of assets. Although this ratio is generally calculated using total assets, it is also possible to use each bank's share of loans or deposits (Repkovà and Stavàrek, 2011). The concentration ration requires data on the number of companies and their respective market shares. There is no precise way to determine the value of N, the determination of the number

of banks to include is somewhat arbitrary. Commonly used values of N are C3, C5, and C10. By basing only on the market share of the top N companies, CR does not take into account the distribution of market shares of other companies. For example, CR5 represents the combined market share of the five largest companies, but does not distinguish between markets where there are only six companies and those where there is a long list of companies with significant market shares. The concentration ratio can be determined as follow:

$$CR=\sum_{i=1}^{n} S_i \quad (5)$$

Where:

S_i: The market share of bank "i" ranked by size, from the bank with the largest assets or total loans or total deposits to the one with the smallest.

n: Total number of banks

The values if this ratio ranges between zero and unity. Depending on the number of banks picked for the calculations, the value of the ratio will be zero if the number of banks selected is relatively small compared to the total bank's numbers. It will be equal to one if all banks are take into account when determining the concentration ratio. The following table gives the interpretation of the concentration ratio:

Table 6: Interpretation of the concentration ratio

CR4	Degree of concentration	Explantation
0%	**Perfect competition**	All companies operating in the market have the same market share.
0%- 40%	**Low concentration**	The banking sector has a great number of firms
40% – 60%	**Medium concentration**	Medium concentration concerns oligopoly where only a small number of companies has the majority of market shares
60% – 100%	**High concentration**	This can range from being an oligopoly to being a monopoly.

Source: Bikker and Haaf (2002)

2.1.2 The Herfindahl-Hirschman Index

The Herfindahl-Hirschman Index (HHI), which determines market concentration, is widely used. It underlines the significance of larger banks by placing greater weight on these institutions on the basis of their market share. It is calculated by summing the squares of bank sizes based on market shares. It can act as a benchmark when measuring other concentration indices. Since it contains information on the whole distribution of bank sizes, the HHI is also referenced as to s the full-information index. The HHI is determined as follow:

$$HHI=\sum_{i=1}^{n} S_i^2 \quad (6)$$

Where:

S_i: The firm "i"'is market share of assets or loans or deposits in the market

n: Represents the total number of banks

The HHI varies between 0 and 1, with lower values signifying more competition and higher values representing less competition.

The interpretation of the HHI is explained as follow:

Table 7: Interpretation of the Herfindahl-Hirschman Index

HHI	Degree of concentration
HHI<0.1	The market is non-concentrated
0.1<HHI<0.18	The market is moderately concentrate
HHI>0.18	The market is highly concentrated

Source : Krivka (2016)

HHI index has several advantages over the CR index, one of which, is that the larger firms' weight in the market are given more weight than the smaller ones. This means that HHI captures more accurately disparities in market power and influence among firms compared to CR, which treats all firms uniformly. Another advantage of HHI over CR is that it doesn't just take into account the largest firms in the market but rather all of them. In other words, it is able to reflect variations of competition, market structure and competition more accurately than CR, which neglects smaller firms.

Similar to the CR, HHI is simple to calculate and doesn't require large data. However, its main drawbacks arise from its simplicity, which prevents it from taking into account the complexities of different markets in a way that allows a truly accurate evaluation of monopolistic or competitive market conditions. It does not take into account that new companies might enter the market. Like the concentration ratio, it only gives an indication of the market power of already existing firms.

Since the structural approaches were heavily criticized, the none structural approaches have appeared to put in place new measures.

2.2 Non-structural measures of competition

A new method called the non-structural approach uses the behaviour of firms and banks to measure market power. This method draws its inspiration from measures of monopoly power created by (Lerner, 1934). It also includes measures of competition such as the adjusted lerner index (2012), the statistical H index (Panzar and Roose, 1987) and the Boone index (Boone, 2007). We will detail each of these measures in the following.

2.2.1 Lerner index

The Lerner Index was created by Lerner in 1934 is used to measure market power. It represents the elasticity of price in relation to demand and which is markup's percentage price over marginal cost. It is determined as the following:

$$Lerner_i = \frac{P_i - MC_i}{P_i} \qquad (7)$$

Where:

Pi: Represents the price of the good established by the firm "i"

MCi: Represents the marginal cost of the firm "i"

A low index indicates high competition, while a high index indicates a lack of competition. It ranges between 0 and 1, with 0 for perfect competition and 1 for pure monopoly. In the latter case, the firm has the ability to charge above its marginal cost. Lerner index can be interpreted as the follows:

Table 8: Interpretation of the Lerner index

Lerner index	Degree of competition
0-0.5	Perfect competition
0.5	Slightly to moderate competitive
0.5-1	Monopoly

Source : Coccorese (2014)

The literature has widely used this index (Bergeer et al. (2009), Beck et al., Leroy and Lucotte (2017)). The main advantages of the Lerner index are its simplicity from the fact it doesn't require much binding data and its straightforward interpretation. Additionally, this index doesn't require an accurate market definition which makes it easy to determine market power for all different banking markets (geographic and by product).

However, the Lerner index has certain shortcomings. In fact, it measures market power in pricing, not competition which may result in an increase of competition along with an increase of market power. According to Koetter et al. (2012) traditional Lerner index implicitly assumes the efficiency of both profit and cost, but fails to take into account the possibility that banks may not exploit price opportunities resulting from market power. It therefore does not measure correctly the power of the market. This prompted them to create a new measure, the adjusted Lerner index.

2.2.2 Adjusted Lerner index

This new method has been proposed by (Koetter et al., 2012) and it provides more accurate results than the traditional Lerner index. This index is measured by the mark-up of price and total cost over marginal cost multiplied by total output. The adjusted Lerner index is determined as follow:

$$Adjusted\ Lerner_i = \frac{\pi_i - tC_i - mC_i * q_i}{\pi_i + tC_i} \quad (8)$$

Where:

π_i: Profit of the firm "i";

tc_i: Total cost of firm i

mC_i: Marginal cost of firm "i";

q_i: Total output of firm "i "

The adjusted Lerner index, just like the conventional Lerner index, ranges from 0 to 1 where 0 indicates perfect competition and 1 indicates market power. To compare and ensure the effectiveness of this new approach, some authors have used both the adjusted Lerner index and the conventional Lerner index. Kouki and AL-Nasser (2017) first used the Lerner index then the adjusted Lerner index to get a more accurate result. They found that both measures have a positive and significant impact on stability, and it is only the degree of significance that changes.

2.2.3 H-statistics

This index studies how the changes in bank prices inputs can influence the bank's revenue. The H statistic is a measure of banking competition which was introduced by (Panzar and Roose, 1987). It can be defined as to the to the elasticities's sum of a bank's total revenue with respect to that bank's factor prices. The equation of the H-statistics is as follow:

$$H = \sum_{i=1}^{n} \frac{Wi * \partial R}{R * \partial Wi} \qquad (9)$$

Where

H: Competitivity index

W$_i$: Factor prices of bank « i »

R: Bank's revenues.

The value of the H statistic varies between $-\infty < H \leq 1$. The table below explains in detail the values of H.

Table 9 : Interpretation of H statistic ratio

CR4	Degree of concentration	Explantation
H<=0	Monopoly competition	Increase in cost leads to a decline in outputs, price rise and lower total revenue
0<H<1	Monopolistic competition	Cost increase leads to a revenue increase at a rate lower than the rate of the cost increase
H=1	Perfect competition	Proportional increase in factor input prices raises costs and revenues equi-proportionally

Source: Otero(2017)

This model makes it possible to obtain results using only a single equation requiring a limited number of variables and banking data. Therefore, it is possible to obtain it from a relatively small sample of observations. However, these advantages come with some disadvantages. The major drawback concerns the econometric identification and interpretation of the H statistic. Depending on market conditions, the H statistic can be positive or negative, which complicates its interpretation.

In summary, the first generation of non-structural measures studies banking competition based on the theory of classic oligopoly. These approaches offer the advantage of being able to distinguish between different possible situations: perfect competition, monopoly, oligopoly. However, they do not take into account market dynamics or strategies other than pricing. The second-generation measures incorporates these elements by using the Boone indicator.

2.2.4 Boone indicator

This indicator was proposed by (Boone, 2000) and then was readjusted by (Boone et al, 2007). The main idea behind the so-called Boone indicator is that competition improves the performance of efficient banks and hinders the performance of inefficient banks. The Boone indicator makes it possible to measure the degree of competition by analyzing the relationship between efficiency and profit. Boone (2000) shows that the more competitive the market is, the more the bank is punished for its inefficiency in terms of relative profit. This measure of the degree of competition is calculated as the elasticity of profits to marginal costs. This indicator is determined as follows:

$$MC \;=\; \mathrm{Ln}\,(\pi_{i,t}) = \alpha + \beta\,\ln\,(MC_{i,t}) \quad (10)$$

Where:

Ln ($\pi_{i,t}$)**:** Log of profits (measured by return on assets)

Ln ($MC_{i,t}$) : Marginal costs for the *ith* bank at time *t*, respectively.

β coefficient indicates the Boone indicator which may take a negative or positive sign.

A large negative *β* indicates high competition, because, a bank may earn more profit by lowering its marginal cost at the expense of inefficient banks in a more competitive environment.

The Boone indicator offers several advantages. Firstly, it requires relatively minimal data. Additionally, it assesses competition in terms of a bank's ability to translate cost efficiency into a higher market share. Moreover, it facilitates the measurement of competition over time. Finally, unlike the H-statistic, the Boone indicator does not necessitate long-term equilibrium.

The following table presents a summary for the different competition 'measures.

Table 10 : Competition measures' summary

	Index	Features	Advantages	Drawbacks	Refrences
Structural measures: These measures focus on the configuration and structure of the market	**The concentration index CR)**	Refers to the size of a specific group of banks in relation to the total size of the banking sector. It is employed to assess the extent of dominance exhibited by the leading n banks.	Simple and requires minimal data	Overlooks small banks. Doesn't provide information on the distribution of market share	Jiminèz el al, (2007)
	Herfindahl-Hirschman (HHI) index	Calculates the market shares of all the banks operating in the market	Captures disparities in market power Takes into account all the banks operating in the market	Does not take into account the specificities of each bank. May not adequately reflect competition in markets with many small firms	Berger et Al. (2004)
Non-structural measures: These measures assess competition based on variables other than market structure. They often focus on the observable behavior of companies in the market.	**Lerner index**	Uses the price elasticity of demand to measure market power.	Provides insights into market power	Assumes the efficiency of both profit and cost	Beck et al. (2013)
	Adjusted Lerner index	Measures competition by the mark-up of price and total cost over marginal cost multiplied by total output	Considers variations in marginal cost	Increased complexity of adjustment may make the adjusted Lerner index more difficult to interpret and apply	Koetter et al. (2012)
	H statistics	Level of competition in the banking industry are determined by summing the elasticities of gross banking revenues in relation to input factor prices.	Provides a more accurate assessment of market power	Can be positive or negative, which complicates its interpretation	Panzar et Rosse (1987)
	Boone	Measures the degree of competition, calculated as the elasticity of profits with respect to marginal costs	Allows an understanding of companies' behavior in response to cost variations	Assumes a linear relationship between market share and markups. Endogeniety Problems	Boone (2008)

Source: Author

SECTION IV: IMAPCT OF COMPETITION ON FINANCIAL STABILITY

The ongoing debate on the nature of the relationship between financial stability and bank competition has been the subject of many papers for the last two decades and it has grown even more after the last financial crisis. In fact, the intensification of competition due to the financial liberalization and to the US banking deregulation has contributed to the 2008 crisis, thus leading to an economic recession in many countries.

1. Financial stability and competition theories

Two main theories have been developed in the literature on the relationship between competition and banking stability, namely the theory of "competition-fragility" and that of "competition-stability". These last two are completely opposed, respectively, one claims that competition only aggravates banking fragility and the other demonstrates that competition stimulates stability.

1.1 Competition fragility

The first research on the relationship between competition and stability was initiated by (Keely, 1990) who introduced the theory of "competition fragility" and "franchise value". According to Demsetz et al. (1996) the value of franchise can be defined as "the present value of a firm's future profits—revenues in excess of all costs, including the cost of capital". Franchise value can be quantified by subtracting the firm's market value by its replacement cost, where the replacement cost refers to the amount it would take to rebuild the firm today:

$$\text{Franchise value (FV)} = \text{market value} - \text{replacement cost} \quad (11)$$

During 1950s, 1960s, 1970s, the banking sector has known deregulation and an increase of competition from financial institutions resulting in a drop in bank franchise value which Keely has reported. He documents that this fall in franchise value resulted in banks increasing their risk taking in the 80s, a decade known for its distress in the banking sector where a large number of U.S. banks have failed .This study demonstrated that increased competition in the system only destroyed the stability of the banking system in the 1980s..

Thus, Keeley found that the probability of bankruptcy increases when banks are faced with excessive competition. Besanko and Thakor (1993) viewed that intensified competition could lead to banks to take more excessive risk. In fact, it is argued that due to competition, banks

will be obliged to lower their credit price which may result in banks making riskier asset portfolio choices. Banks will usually try to maintain to long-term relationships with borrowers while the latters could easily change their banking activities to other banks when competition is heightened. On the deposit side, competition could also result to a certain instability due to the fact that banks will be obliged to raise their deposit rates resulting in a lower bank margins. Marquez (2002) supported this view and indicated that banking industry in an enhanced competitive environment would end being inefficient, with large banks having an informational leverage over smaller ones. However, banks operating in an oligopolistic market, take less risk and are more stable. Beck, Demirguc-Kunt, and Levine (2006) observed that in systems where access is limited and competition is low, banks have more opportunities to earn profits and maintain larger capital buffer. As a result, they have less incentive to engage in aggressive risk-taking strategies which positively contributes to financial stability.

Several authors have studied the relationship between competition and fragility through the risk-taking channel. Some studies tried to explain the origins of risk taking by banks and found that deposit insurance has been a main source of risk taking. In fact, bank managers were taking extra risk, given that the funds deposited were available to them and protected by the insurance deposit. Jensen and Meckling (1976) identified an agency problem, if the gamble taken ends being successful, the bank would reap the rewards however if it leads to losses, the cost would end being be covered by the deposit insurance fund. This additional risk taken by banks lead to a surge in bank failures during the years of 1980's. Marcus (1984) considers that that deregulation within the banking field, combined with a system of deposit insurance, contributes to competition that will eventually impact the bank' franchise value. In order to protect the franchise value, banks adopt high-risk strategies which may push them towards bankruptcy. As for Hellmann, Murdock, and Stiglitz (2000), their research showed that the Japanese and US banking sector's liberalisation had contributed to the increase of competition in way that can be held responsible for the failure of a large number of banks in both countries.

Market power is generally related to a lower probability of bank failure, and this negative relationship can be explained by numerous reasons. First, higher lending rates lead to lower levels of investment, which increases the expected return on investments and thus reduces the risk of bankruptcy. Second, when a bank's expected earnings are high, the opportunity cost of failure decreases, reducing the incentive to invest in excessively risky assets. Finally, on the deposit side, competition tends to raise deposit rates, which reduces the profit margin and increases the likelihood of bankruptcy. Some of the existing theoretical models confirm these

intuitions. Allen and Gale (2000) found that a concentrated banking system with a number of large institutions is more stable because banks are easier to monitor and supervise and therefore more resilient to shocks. Diamond (1984) and Williamson (1986) showed that the most concentrated banking systems are composed of larger banks and that large banks can benefit from scale economies and take advantage of a well-diversified portfolio of assets. If we reason in terms of competition, since the latter is the inverse function of concentration, we can conclude that competition only limits the capacity for diversification of banking portfolios.

1.2 Competition stability

Several theoretical researches have shown that competition in the banking field does not automatically cause financial fragility or excessive risk taking. Even though in a more concentrated banking market, banks could potentially earn higher profits since they would be able to charge higher interest rates to borrowers but the latters would have an incentive to invest in riskier projects to meet the demands of these higher interest rates. This situation could increase the probability of bank's default, suggesting that reduced competition could lead to financial instability in the banking sector (Boyd and De Nicolo, 2005). Competition, moreover, has the effect of eliminating weak banks from the market, thus contributing to strengthening financial stability (Beck et al., 2006). Furthermore, in banking systems dominated by a few large banks (or highly concentrated), large banks might have an incentive to take on more risk because of the idea that they are "too big to fail". During financial crises, governments tend to bail out big banks, creating a moral hazard problem (Kane, 2000). In fact, in a less competitive market, banks tend to take higher risk and since they're deemed to be very important to fail, they obtain implicit or explicit subsidies via government safety nets (Mishkin, 1999). Similarly Kane (2010) has suggested that large banks receive public guarantees that encourage taking more risk.

The risk of contagion can increase in a concentrated banking system with large banks, which contradicts the findings of Allen and Gale (2000). In fact, the more the bank grows, the more its organizational complexity increases and it becomes more difficult to manage, which increases its probability of bankruptcy. This will have repercussions on the entire banking system which explains what happened during the 2007-2008 crisis. In this sense, Beck et al (2006) indicated that monitoring a large bank is more difficult than monitoring a small one. Consequently, as the size of the bank increases, transparency can decrease and reduce the effectiveness of the management and increase operational risks. A study conducted by Arkins and al (2016) examined the impacts of competition based on the financial crisis of 2008, they

found that, with increased competition, banks tend to lower their interest margins and invest in projects with a lower level of risk. Moreover, the most competitive banks show lower profitability and hold less capital than other banks, which makes them less vulnerable to regulatory constraints and less likely to fail.

1.3 Non-linear relationship

According to Berger et al. (2009), the two streams of literature do not necessarily lead to contradictory predictions regarding stability and the influence of bank power market. Analysing data from nearly 9,000 banks, they concluded that while the hypothesis that competition leads to fragility was supported, the rise of loan portfolio was also consistent with the idea that competition enhances stability.

Supporting the same idea, Martinez-Miera and Repullo (2010) explain that competition has two major effects:

➢ Reduced loan rates and reduced loan default probability: When there is an increase of competition among banks, they tend to provide reduced interest rates on loans in order to attract customers. Consequently, leading borrowers do not have excessive repayment obligations, thus, resulting in a reduced likelihood of loan default. Banks have less probability to encounter loan defaults which makes them safer;

➢ The margin effect: It represents the revenues generated by banks from their loans. When facing intensive competition and in order to stay competitive, banks tend to lower their loan rates which reduce their income. When their revenues lessen from their profitable loans, their financial resources which they rely on to absorb potential losses regarding loan defaults decreases. This can affect the stability of banks.

Thus, the competition and the risk of bank failure's relationship is not linear. The pattern is rather a U-shaped one.

Leroy and Luoctte (2017) proved that the two theories can exist at the same time since they found that market power makes the bank benefit from a higher interest margin which reduces the franchise value and therefore reduce market risk at the individual level, however it also increases systematic risk.

2. Literature review

The impact of banking competition on stability has always been a subject of concern and discussion for researchers and policy makers. There is a significant empirical literature that aims to examine the impact of the structure of the banking system on its stability. We will shed light on the empirical studies that produced different results.

The main points of view include:

- ✓ "Competition-fragility": Argues that competition makes banks more likely to take excessive risks in order to increase their profitability, which leads to fragility (Keeley, 1990);
- ✓ "Competition-stability": Suggests that higher interest rates in less competitive environments can lead borrowers to take higher risks, leading to a higher likelihood of non-performing loans and a more fragile system (Boyd and De Nicoló, 2005);
- ✓ A non-linear relationship between competition and stability: This is explained by the existence of the two points of view simultaneously. Hence the relationship is non-linear. Competition can both improve and reduce stability (Martinez-Miera and Repullo, 2010).

2.1 Competition fragility

For the competition fragility view we can cite the studies carried out by Cubillas & González (2014) in the banking system from 1991 to 2003 with a case study of 83 countries. The obtained results show that higher levels of competition are associated with the growth of bank loans and an increase of bank risk. Similarly, Anginer et al. (2014) examined the relationship between competition and stability in 63 countries from 1997 to 2009. They found that competition deteriorates bank stability. During the study, the dependent variables used were the Z-score index and Merton's distance to default. To measure the level of competition they used the Lerner index and the HHI. Concerning the Tunisian banking sector, Zaghdoudi et al. (2016) conducted a study examining the relationship between bank competition and risk-taking. They utilized data spanning from 2005 to 2015, focusing on nine Tunisian banks. The Z-score and HHI served as proxies for stability and concentration, respectively. The outcome of their econometric analysis unveiled a positive correlation between competition and the levels of risks taken by banks. As for Albaity and al (2019), they demonstrated a negative association between competition and financial stability and it was shown that banks facing limited competition tended to undertake fewer insolvency and credit risks while enjoying greater profitability.

Similarly, in the Japanese banking system, Tongurai and Vithessonthi (2020) undertook a comprehensive investigation spanning the years 1993 to 2016, with a particular focus on 1461 financial institutions. Their findings demonstrated that heightened levels of competition within the Japanese banking sector were linked to an increase in bank loans and elevated banking risk. As for Moudud-Ul-Huq et al, they found that in a competitive market, credit risk increases, thereby rendering banks more susceptible to risk.

Table 11 : Empirical studies on competition – fragility view

Author	Sample	Period	Bank stability	Competition	Method
Moudud-Ul-Huq et al. (2021)	MENA	2000-20145	Z score, NPL	Lerner, HHI	GMM
Tongurai et vithessonthi (2020)	Japan	1993-2006	Z score, NPLS	HHI	GMM
Albaity (2019)	MENA	2006-2015	Zscore, ROA, ROE, NPL	Boone, Lerner	GMM
Zaghdoudi et al. (2016)	Tunisia	2005-2015	Zscore	HHI	GLS
Cubillas & González (2014)	83 countries	1991-2007	Z-score	Lerner	GMM
Anginer et al. (2014)	63 countries	1997-2009	Z-score, Marton's Distance to Default,	Lerner, H, HHI	FE

Source: Author

2.2 Competition stability

Unlike studies supporting the competition-fragility paradigm, some researchers have obtained results supporting the competition-stability paradigm. Mainly, the studies of Boyd and De Nicolo (2005) who developed a model challenging previous researchers based on the fact that there are fundamental risk incentive mechanisms that work in exactly the opposite direction, causing banks to become riskier as their markets become more concentrated. They suggest that greater market power in lending markets increases banks' risks, because higher interest rates charged to consumers are harder to repay.

Ben Ali and Sghaier (2013) investigated the relationship between competition and the efficiency of ten Tunisian banks over the period 1990-2009. The HHI and concentration ratio

were employed to assess banking competition. The findings disclosed that the Tunisian banking sector is competitive and that there is a positive relationship between competition and banking efficiency. Moreover, the study highlighted that private banks demonstrate higher efficiency compared to state-owned banks.Similarly, Schaeck & Čihák (2014) empirically examined the impact of competition on the European banking system using annual data of 26 commercial banks from 1995 to 2005. The concentration ratios Boone and H were used as a measure of competition while the Z-score NPL ratio were used as indicators of financial stability. The effects of macroeconomic factors and bank-specific indicators were also taken into account. The results reveal that there is a positive relationship between greater banking competition and financial stability in Europe, and that competition in the banking sector leads to reduced credit risk and contributes to financial stability..

Similarly, Surya Bahadur and Sharma (2016) conducted an empirical examination of how competition influences the Nepalese banking system. They utilized annual data from 26 commercial banks spanning the years 1999 to 2012, employing a fixed-effects panel data model. Competition was measured using concentration ratios such as HHI, CR3, and CR5, while financial stability was presented by the Z-score and the NPL ratio. The study also considered the impact of macroeconomic factors and bank-specific indicators.

The results uncovered a positive correlation between increased competition in the banking sector and enhanced financial stability in Nepal. This suggests that a competitive banking environment leads to a reduction in credit risk and contributes to overall financial stability. However, the study emphasized that, beyond the level of competition, the macroeconomic landscape of the country plays a pivotal role in determining the stability of the Nepalese banking system. In light of these findings, the study recommends that policymakers not only foster a competitive environment but also actively promote the consolidation of the Nepalese banking sector through a cautious approach to mergers and acquisitions.

Shifting focus to a different context, Kasman and Kasman (2015) delved into the impact of banking competition on financial stability within the Turkish banking sector. Their analysis involved data from 28 commercial banks spanning the years 2002 to 2012. Competition was assessed using indicators such as Boone's indicator and the Lerner index, while banking stability was measured through the NPL ratio. The study yielded results indicating a positive relationship between banking competition and financial stability. Mamadou Asngar, Ongo Nkoa, and Wirajing (2022) conducted a study on the impact of banking competition on financial stability within the Central African Economic and Monetary Community (CEMAC) during the

period from 2010 to 2020. Financial stability was assessed using banks' Z-scores and the non-performing loans ratio. The HHI served as an indicator of competition in both the loan and deposit markets. The study's results revealed that the banking sector in this region exhibits greater financial stability under conditions of competition compared to situations characterized by high concentration.

Table 12 : Empirical studies on competition – stability view

Author	Sample	Period	Bank stability	Competition	Method
Mamadou Asngar et al. (2022)	CEMAC	2010-2020	Z-score, NPL ratio	HHI	GLS
Surya Bahadur and sharma (2016	Nepal	1999-2012	Z-score, NPL	CR3, CR5, HHI	FE
Kasman and Kasman (2015)	Turkey	2002-2012	NPL	HHI, Lerner	GMM
Schaeck and Cihák (2014)	10 Europenan countries	1995-2005	Z-SCORE, NPLS ratio, ROA	H-statistic, Boone	FE
Ben Ali et Sghaier (2012)	Tunisia	1990-2009	ROA	H-statistic, HHI,CR3	FE, RE

Source:Author

2.3 Non-linear relationship

In this context, Martinez-Miera and Repullo (2010) align with the proposition by Boyd and De Nicolo (2005) that increased bank competition diminishes the probability of default in loans due to lower loan rates, known as the risk-shifting effect. However, they introduce the margin effect argument, positing that heightened competition may also decrease interest payments from performing loans, serving as a buffer to offset loan losses. Unlike prior models, the study shows a U-shaped relationship between competition and the risk of banks failing, where risk initially decreases before escalating in a highly competitive market. Tabak et al. (2012) explore the effects of bank competition on risk-taking behavior in 10 Latin American countries between 2003 and 2008. They specifically examine how size and capitalization alter the relationship between competition and stability. They found supporting evidence for how competition influences banks' risk-taking behavior in a non-linear manner. Both high and low competition levels enhance financial stability, with the opposite effect for average competition. The authors propose that the non-linearity of the effect supports both the concentration-stability and the concentration-fragility theories. They argue that banks facing both high and low competition

tend to be lower-level risk-takers than those experiencing average competition. Liu et al. (2013) similarly showed an inverted U-shaped relationship between regional bank competition and stability. Their study examines the combined impact of competition and regional economic conditions on the risk and stability of European banks from 2000-2008. By analyzing the relationship between regional economic conditions, competition, and their subsequent impact on bank risk in European banking, they affirm the prevalence of a U-shaped relationship between regional competition and banks. Notably, risk-shifting effects dominate in concentrated markets, while margin effects are prominent in competitive banking markets. In a related context, Fu et al. (2014) investigated the relationship between bank competition and financial stability from 2003-2010, using data from 14 Asia-Pacific economies. Their findings suggest a neutral perspective between competition and stability, indicating that competition-stability and competition-fragility can coexist simultaneously in Asia-Pacific banking markets. As for Otero et al. (2017) they found competition-stability and competition-fragility seem to coexist for MENA banks. In high-competition countries, particularly in the Gulf region, intensified competition elevates the probability of default. Conversely, in low-competition settings, such as non-Gulf countries, heightened rivalry can have positive implications for risk-shifting and efficiency. As for Krisova (2020), she found a nonlinear relationship between stability and competition which indicates that, around a specific turning point, heightened market power is likely to intensify individual risk-taking behavior, posing a potential detriment to the stability of the banking sector.

Table 13 : Empirical studies on non-linear view

Author	Sample	Period	Bank stability	Competition	Method
Kocisova (2020)	Europe	2008-2017	Zscore,LLP	Lerner	GMM
Otero and al. (2017)	MENA	2005-2012	Zscore	H-HHI	GMM,FE,RE
Fu et al.(2014)	Asia pacific	2003-2010	Zscore, Merton's	Lerner, CR3	GMM
Lui and Wilson (2013)	Japan	2000-2009	Z score	Lerner	GMM
Tabak et al, (2012)	Latin America	2003-2008	Z score	Boone , Lerner	GMM

Source:Author

CONCLUSION

In the theoretical part of our study we detailed the fundamental concepts of financial stability and instability, as well as the different measures used to assess stability. We examined regulatory framework both internationally and domestically, highlighting their crucial role in preserving financial stability. It is essential to maintain the stability of the financial system by preventing excessive risks, protecting consumers and investors, and providing constant supervision of financial institutions. Particular attention was paid to the essential role of macroprudential tools in maintaining robust financial stability. These instruments play a preventative role by identifying and mitigating potential systemic risks, thereby helping to strengthen the resilience of the financial system.

It is imperative to emphasize the crucial importance of financial stability in the economy. Strong financial stability is not only essential to ensure investor confidence and savers protection, but is also a fundamental pillar for fostering sustainable economic growth.

The influence of banking competition on financial stability is an aspect that deserves in-depth analysis. Our paper studied the various measures used to assess this complex relationship. We sought to quantify and understand the competitive dynamics within the banking industry. These measures provide crucial information on competitiveness and its potential impact on financial stability.

The literature review offers multiple perspectives on the relationship between financial stability and competition. In order to explore in depth the impact of competition on financial stability, we plan to collect relevant data and apply rigorous analytical models.

CHAPTER II: RELATIONSHIP BETWEEN BANK COMPETITION AND FINANCIAL STABILITY IN TUNISIA

INTRODUCTION

The question of competition in the banking sector has been an important topic and a widely debated one in the economic literature .The banking sector has specific characteristics that distinguish it from other sectors since any instability in this sector can eventually lead to a financial and economic crisis. Therefore, its efficiency is considered the cornerstone of a market economy.

Financial stability has become a paramount policy concern for central bankers, particularly in the aftermath of the global financial crisis. Recent discussions have revolved around examining the relationship between banking competition since it impacts the overall stability of the financial system.   Economic theory and empirical research yield conflicting predictions regarding the relationship between market competition and financial stability within the banking system. The mainstream perspective aligns with the competition-fragility hypothesis. Conversely, proponents of the competition-stability hypothesis emphasises that competition enhances financial stability.

The question of competition in the banking sector in Tunisia remains unsettled. Some consider that competition between banks is undesirable, while others support the existence of competition between Tunisian banks.

In this paper we will examine the relationship between financial stability and bank competition In Tunisia. It will organized as follow: First, we will provide a general presentation of the sector. The second section will examine both financial stability and competition. We will study stability in Tunisia through solidity indicators and by constructing our own financial stability index .An analysis of the banking competition will be presented using the HHI and CR4. A third section will be devoted to the presentation of the sample and the selected variables. As for the fourth section, it will focus on a descriptive analysis of the variables retained, as well as on the preliminary tests aimed at guiding us the appropriate regression methodology to adopt.

Finally, the last section will present the results of our estimations and their interpretations.4

SECTION I: PRESENATATION OF TUNISIAN BANKING SECTOR

Like many emerging countries, Tunisia remains largely dependent on debt to finance its economy. The banking system plays a central role in this dynamic, both as an essential component of economic growth and as a reflection of the general health of the economy. In this first section, we will begin the examination of the Tunisian banking sector by presenting its history and its current structure.

1. History of Tunisian banking sector

After the independence, Tunisia worked to free its economy and to mobilize resources for its economic development. In 1958, the Tunisian state took the initiative to establish a national financial system with the aim of financing the economy. The first stage of this creation of the Tunisian banking system was marked by the adoption of law N° 58-90 of September 19, 1958, which established the creation of the Central Bank of Tunisia.

In accordance with this law, the CBT was given legal personality and financial autonomy. Its main responsibilities, as defined in article 33 of the law of September 19, 1958, included the monitoring of the stability of the financial system, the development and implementation of monetary policy, as well as the supervision of financial institutions. The Tunisian dinar was introduced as the national currency. After its creation and until the 1980s, the Tunisian financial system was characterized by a strong state presence due to the absence of a developed private financial sector, rigid banking legislation and a low level of savings. However, significant changes subsequently took place, with the adoption of a policy of liberalization and a relaxation of banking regulations. The objective of these reforms was to stimulate the economy, reform the banking system and make it more efficient. In 2001, the banking sector experienced more substantial liberalization thanks to the adoption of law N° 2001-65. This law abolished the principle of legal compartmentalization of banks and transformed them into universal banking institutions. Subsequently, another banking legislation was enacted, namely banking law N° 2016-48. Its main objective was to strengthen regulatory and supervisory mechanisms, with the aim of strengthening the resilience of financial institutions, in particular, and the financial system as a whole.

Currently, the banking sector in Tunisia continues to implement reforms which have significant consequences and which mainly aim to comply with international standards to ensure financial stability.

2. Macro-prudential supervision by the Central Bank of Tunisia

Financial stability is central to the role of central banks. They play a crucial role in preventing financial crises by monitoring the financial system, regulating financial institutions and taking preventive measures. In the event of a financial crisis, central banks intervene to mitigate the negative effects.

As such , the CBT's mission, in accordance with article 8 of law No. 2016-35 is to contribute to financial stability, a responsibility which has been entrusted to it " to contribute to the implementation of macro-prudential policy with a view to prevent and mitigate systemic risk." Article 18 of Chapter 4 of the law in question, which deals with the preservation of financial stability states "Detection and monitoring of different factors and developments likely to affect the stability of the financial system, particularly those constituting an attack on its solidity or an accumulation of systemic risks".

3. Structure of Tunisian financial system

The total number of financial institutions is 43 as distributed as follows: 22 resident banks, 7 non-resident banks, 8 leasing institutions, 2 factoring companies, 2 investment banks and 2 financial institutions payment. It is important to note that BFT was liquidated in April 2022, reducing the number of resident banks licensed in Tunisia from 23 to 22.

Depending on their economic model, the 22 resident banks are divided into 17 universal banks, 2 banks specializing in the financing of micro-projects, and 3 banks specializing in banking services compliant with Islamic law.

In 2021, there have been some significant changes in the shareholder structure in the Tunisian banking sector, marked by the withdrawal of certain prominent foreign shareholders[8]. The share of foreign shareholders in the capital of resident banks has dropped from 37.7% in 2020 to 32.7% in 2021. The share of Tunisian private shareholders increased thus from 28.5% in 2020 to 32.9% in 2021. The State's shares reached 34.5% in 2021.

According to classification of reference shareholders, the distribution of resident banks is as follows:

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[8] Following the Exit of BNP Paribas IRB Participations (BNPP) by selling 39% of its capital in UBCI to the CARTE group. And the Exit of BPCE International et Outre-Mer (BPCE International) by selling its 60% stake in the capital of BTK and its indirect stake of 95% in the capital of AIL to the company ESTABLISSEMENT MT ELLOUMI

➢ The Tunisian state holds a stake in 6 banks[9];

➢ Foreign shareholders have shares in 9 banks[10];

➢ Industrial and commercial business groups are present in 5 banks[11];

➢ In the 3 other banks, the reference shareholding is mixed, with an equal distribution between the Tunisian State and an Arab country[12].

Table 14 : Evolution of the number of banks according to the status of shareholding

	2018	**2019**	**2020**	**2021**
Public banks	7	6[13]	6	6
Foreign-banks	10	11	11	9[14]
Tunisian private capital banks	3	3	3	5
Mixed banks	3	3	3	3
Total	23	23	23	23

Source: CBT annual supervision report (2021)

SECTION II: FINANCIAL STABILITY AND COMPETITION IN TUNISIA

The interplay between financial stability and competition holds paramount significance in the economic landscape of Tunisia. As the nation strives for sustained growth and development, the assurance of a resilient financial system becomes imperative.

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[9] STB, BNA, BH, BTS, BFPME et BFT.

[10] ATB, ATTIJARI, UIB, Citibank, Bank ABC, QNB, Al Baraka, BT et BZ

[11] Amen Bank, BIAT, BTK, UBCI et WIB.

[12] TSB, BTE et BTL

[13] Following the sale of the State's stake in the capital of BZ to the Qatari group "Al Majda"

[14] Following the sale of BNP Paribas' share in the capital of UBCI to the CARTE group and the stake of BPCE in the capital of BTK to the company ESTABLISSEMENT MT ELLOUMI.

1. Financial stability

Measuring financial stability is critically important for several reasons. First of all, it makes it possible to assess the robustness and resilience of a financial system, by identifying possible risks and vulnerabilities. This provides regulators and policymakers with a basis for putting in place risk management policies and mechanisms to prevent financial crises. Strong financial stability encourages lending and facilitates economic growth. Conversely, financial instability can lead to economic crises, job losses and difficulties for households and businesses. As such, we chose several methods to measure financial stability.

1.1 Macro-financial risks

When reflecting the risks weighing on the stability of the financial system, the CBT uses an approach which is essentially based on the assessment of macro-financial risks based on six factors which are the following: macroeconomic conditions, bank liquidity, solvency, profitability, asset quality and excessive credit growth.

During 2022, there was a reduction in macro-financial risk factors linked to credit expansion, solvency, profitability, and asset quality. Nevertheless, risks associated with macroeconomic conditions and bank liquidity rose compared to the prior year, attributable to substantial twin deficits and elevated inflation.

Figure 2 : Trends in macro-financial risks
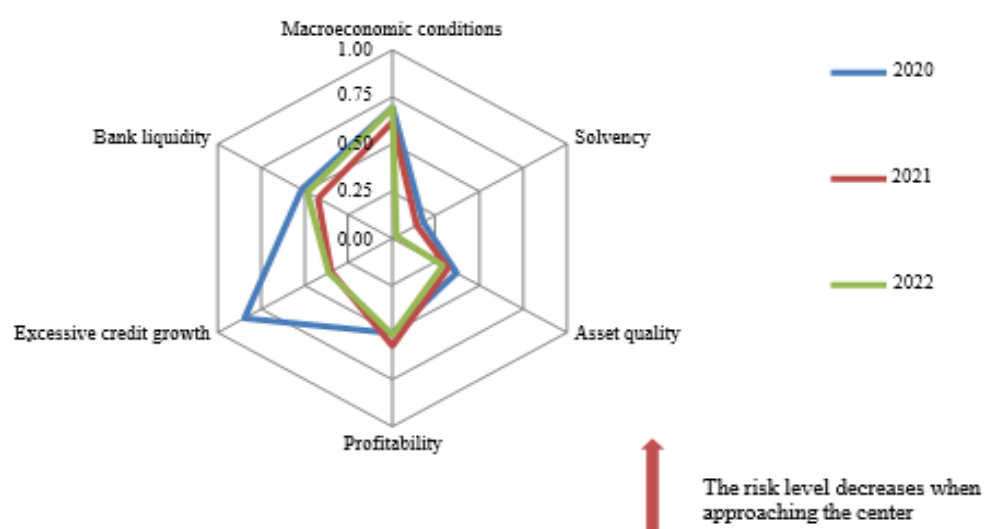
Source: CBT annual report 2022

1.1.1 Macroeconomics conditions

In Tunisia, economic growth slowed, going from 4.3% in 2021 to 2.4% in 2022. This deceleration results from a particularly unfavourable international situation, combined with structural problems within the Tunisian economy. Additionally, the growth rate in 2021 was influenced by the post-Covid-19 mechanical rebound effect. During the year 2022, average inflation stood at 8.3% compared to 5.7% earlier. Concerning the job market, the unemployment rate took a relative downtrend passing from 16.2% in Q4 2021 to 15.2% in Q4 2022. In 2022, the external sector experienced significant changes due to a difficult international situation, marked by the persistence of the effects of the COVID-19 health crisis and the conflict between Russia and Ukraine, which began in early of year. In this context, the current balance recorded an increasing net deficit in 2022, reaching -12.4 billion dinars, equivalent to 8.5% of GDP, compared to a deficit of -7.8 billion dinars, or 6 % of GDP the previous year. Concerning public finances, the budget deficit stood at 10,978 million dinars, an increase of 9.9% compared to that recorded in 2021.

1.1.2 Asset quality

One of the banking challenges facing the Tunisian sector lies in the poor quality of its assets. However, in 2021 the share of non-performing loans compared to all commitments stood at 12.6% at the end of 2022, down from 13. 1% at the end of 2021 and 13.6% at the end of the 2020. This positive change can be attributed to the write-off of claims amounting to 1.3 billion dinars as reported by the Information Unit of the CBT. There is a preponderance of class 4 since they represent 88% of all NPLs in 2021. The figure below shows the trend of non-performing loans.

Figure 3 : Trend in nonperforming loans ratio
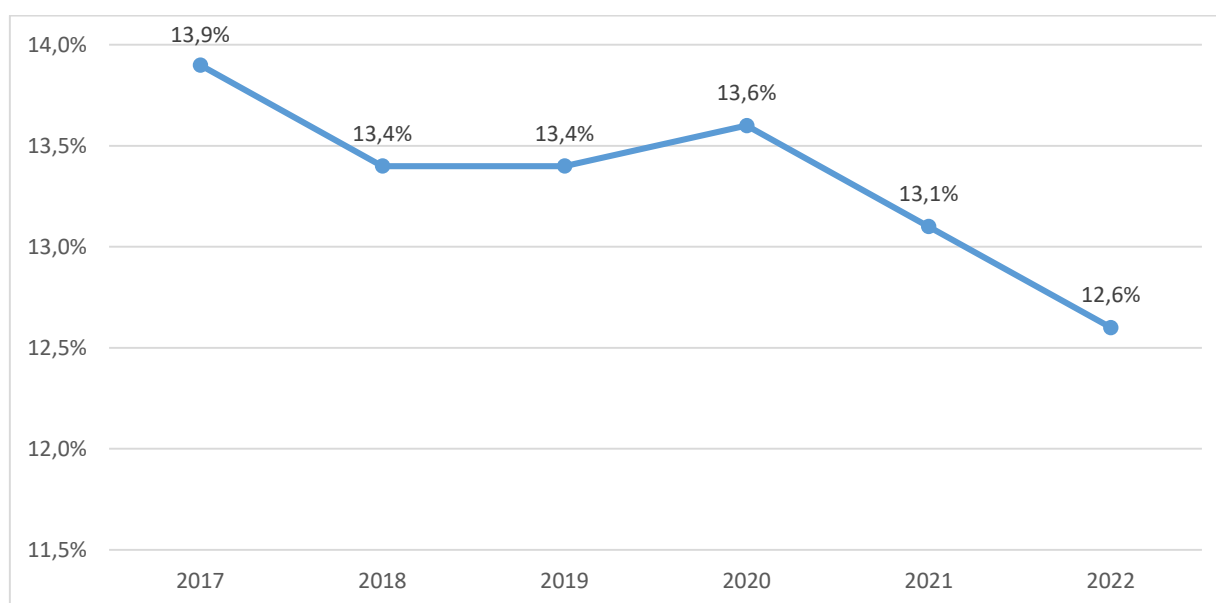
The coverage rate of receivables classified by provisions increased by 2.1 percentage points to reach 55.9% at the end of the year 2022 compared to 57.2% at the end of 2021.

1.1.3   Excessive growth of loans

The increase in loans to the economy was marked by a fast acceleration in 2022 compared to the previous year, showing growth of 8% compared to 6.1% in 2021. This deceleration affected both loans intended for businesses and those granted to individuals.

Loans extended to the public sector (administration and public enterprises) in 2022 rose by 9.2%, aligning notably with the 28.8% surge in commitments from public enterprises. Loans directed towards the private sector also increased by 7.8%, and their contribution to the overall growth of professional loans expanded in 2022, reaching 80.4%, compared to 62.6% in 2021 and 29.5% in 2020.

Figure 5 : Structure of the outstanding balance of the public sector's bank financing
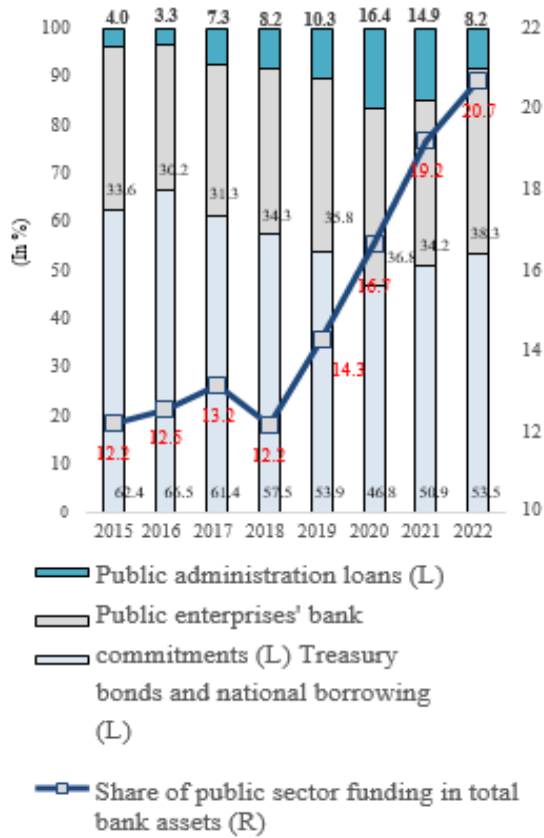
Figure 4 : Trends in public enterprises' commitments
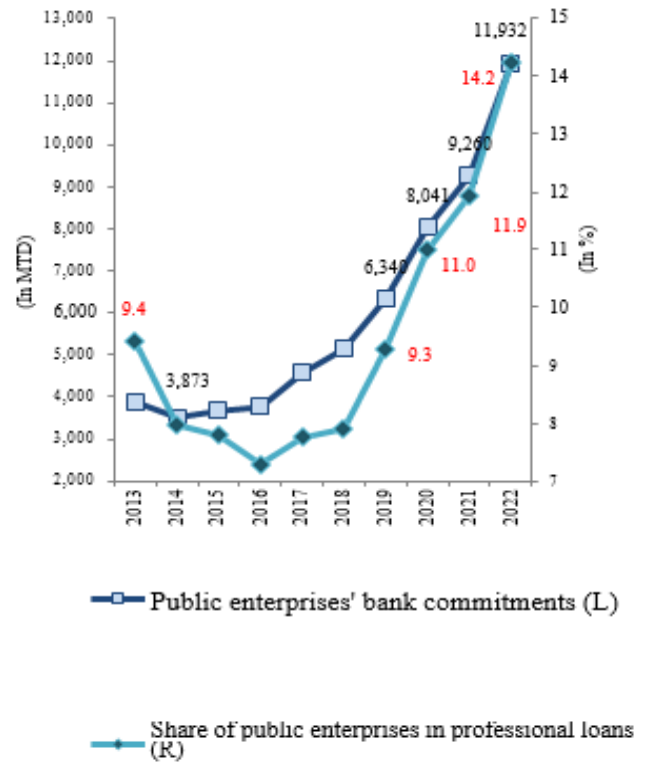
Source: CBT annual report 2022

1.1.4   Liquidity

The strain on bank liquidity resurfaced in 2022. This is evident in the heightened proportion of the overall volume of refinancing (excluding Treasury bond outright purchases) in the total liabilities of banks. It increased from 5.6% at the close of 2021 to 6.8% by the end of 2022, in tandem with a rise in the financing requirements of the State and public enterprises, which accounted for 20.7% of the banking sector's total assets.

Figure 6 : Trend in banks' need for liquidity (daily averages in MTD)
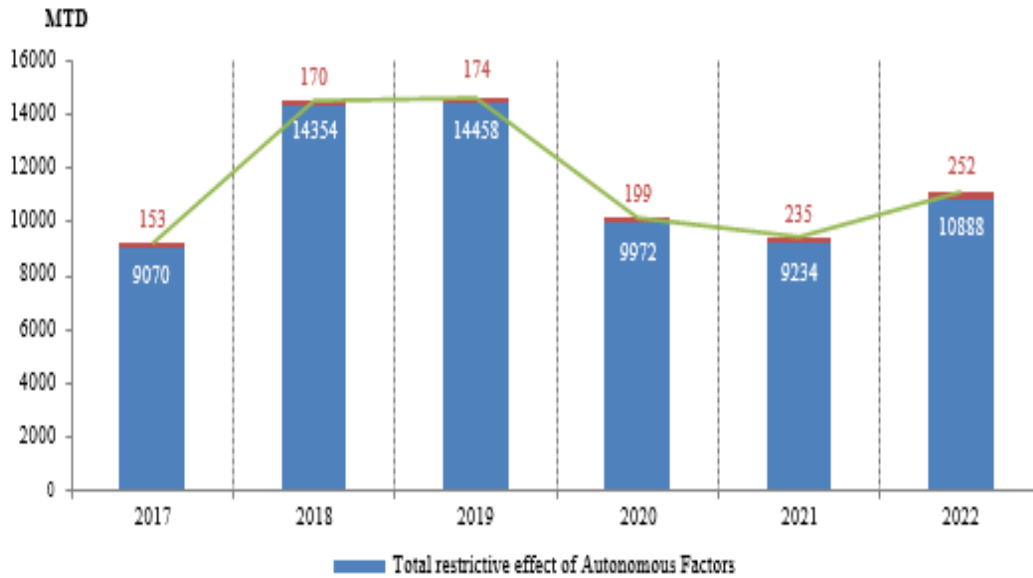
Consequently, the LTD ratio experienced a slight increase from 113.6% in 2021 to 113.8% in 2022. Simultaneously, the liquidity coverage ratio (LCR) declined from 180.3% to 171.7% during the same period.

Figure 7 : Trend in the Loan/Deposit ratio
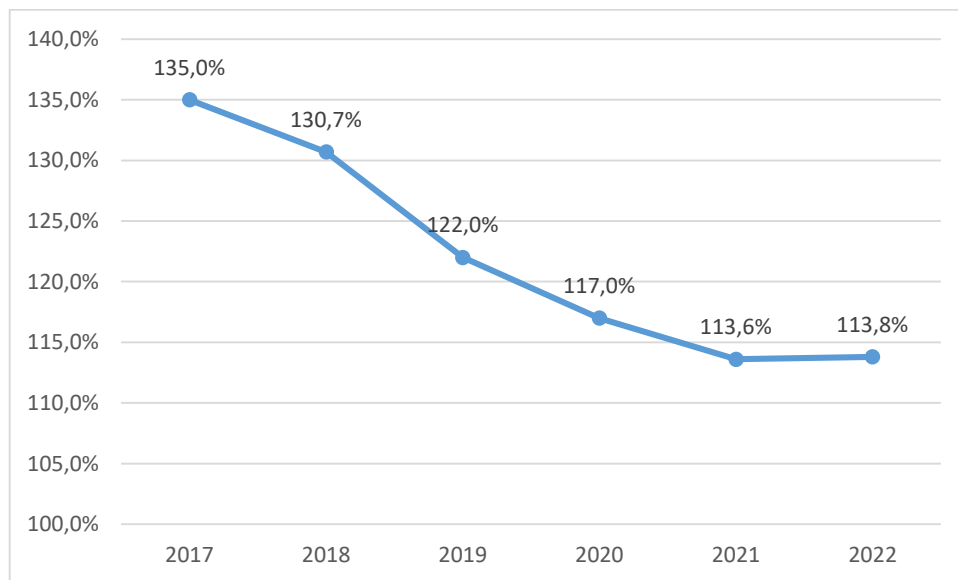
1.1.5 Solvency

At the end of 2022, the financial strength of the banking sector strengthened compared to the end of 2021, with a notable increase in solvency ratio and Tier1 rates, reaching 14.5% and 11.3% respectively. , compared to levels of 13.2% and 10.3% at the end of 2021. This outcome can be attributed, firstly, to the measures implemented by the CBT concerning dividend distribution and risk coverage, and secondly, to the injection of an additional capital of 240 million.

Figure 8 : Trends in solvency ratio and Tier 1
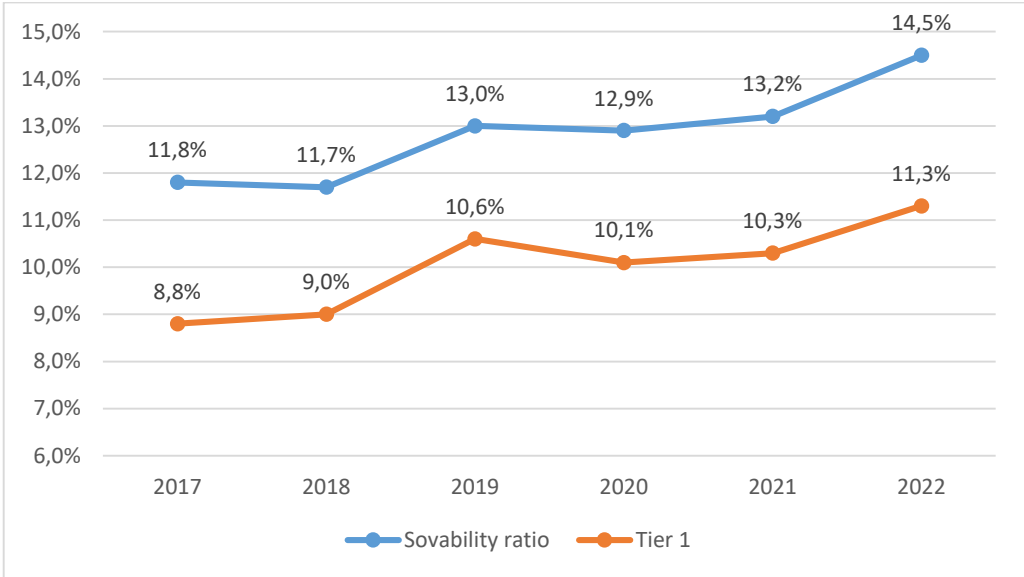
18 banks accounting for 96.1% of the sector's total assets displayed a ratio at the end of 2021 solvency greater than 11%. 16 banks holding 88.9% of the sector's total assets display, at the end of 2021, a ratio Tier 1 greater than 8% while 5 banks with a market share in terms of assets of 3.9% are, in 2021, in a situation of non-compliance with the minimum Tier 1 ratio of 7%.

1.1.6 Profitability

Regarding the profitability of banks, there was an improvement compared to 2021. The net profit and net banking income both experienced growth of 20.7% and 12.4%, influencing a positive impact on return on assets (ROA) and return on equity (ROE), which were registered at 1% and 11.5%, respectively, in 2022, as opposed to 0.8% and 9.1% in 2021. It is noteworthy that the sector's profitability was primarily propelled by increased income from the investment portfolio and a rise in the interest margin.

Figure 9 : Trends in ROA and ROE ratio
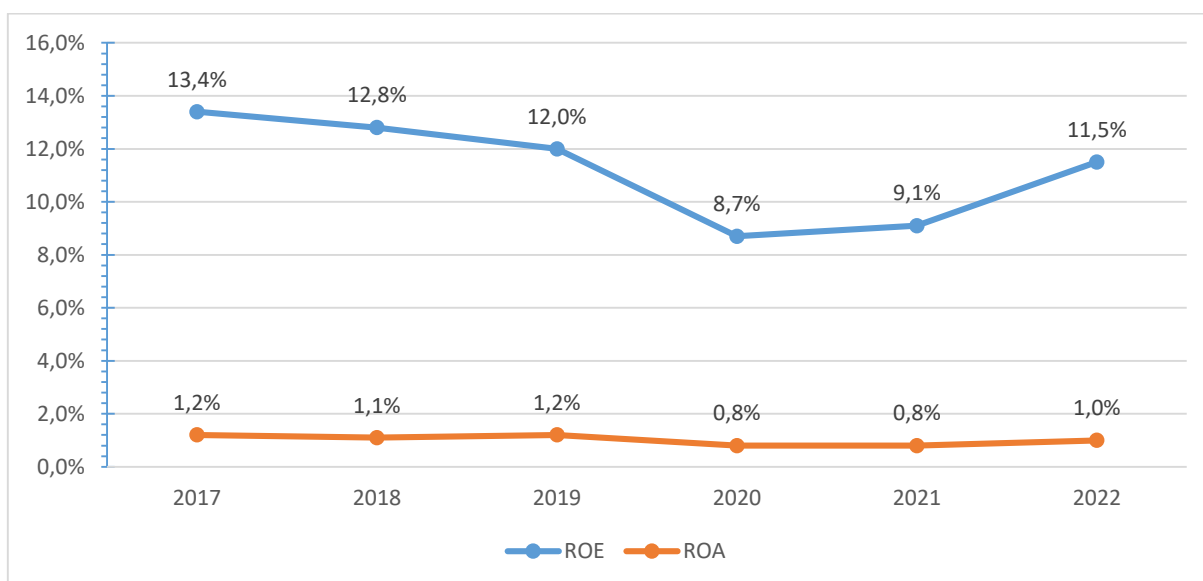
1.2 Zscore

The assessment of the Z-Score reveals a certain volatility particularly from 2006 to 2012 where it dropped from 30.46 to 27.04. This downfall was heightened from 2010 to 2012 which can be explained by the revolution that took place in Tunisia. From 2012 the trend was an upward one reaching 38.68 in 2021.

Figure 10 : Trend of Z score banks in Tunisia
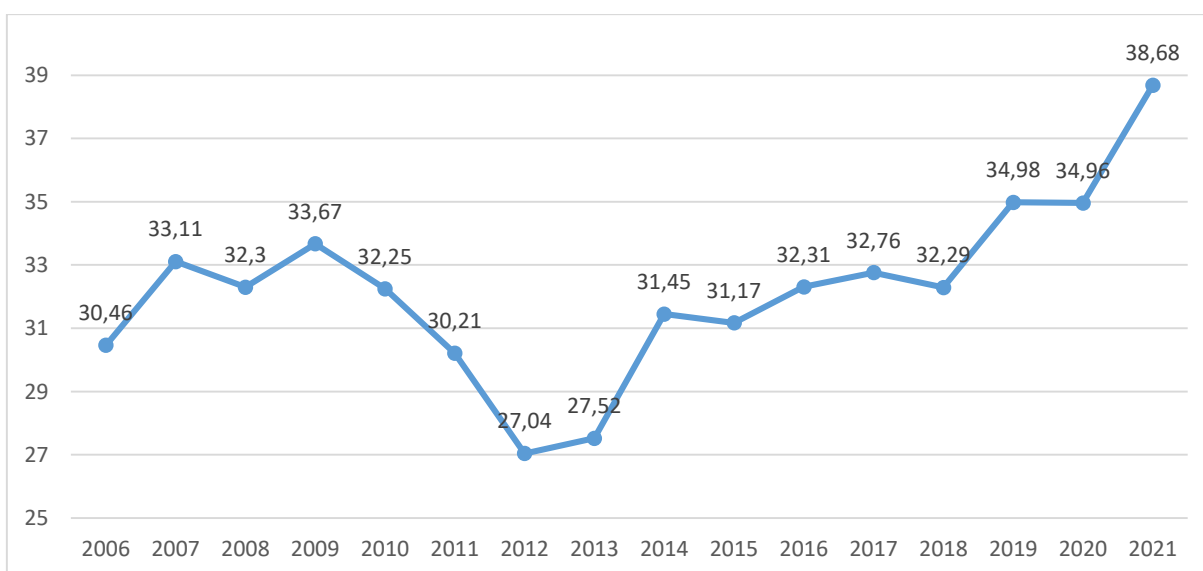
In order to gain a more comprehensive understanding of whether Tunisia possesses a favourable Z-score in comparison to the global standard we compared the Tunisian banking system Z-score of 2021 to the rest of the world and to certain countries that have similar economies.

The average value for the year 2021 across 136 countries stood at 17.25 index points. Luxembourg recorded the highest value at 51.67 index points, while Iceland reported the lowest at 1.28 index point. The average for the surveyed countries was 25.17 index points, with Jordan registering the highest value at 50.11 index points. Tunisia is ranked 7 in the world indicating a strong level of financial stability.

Figure 11 : Banking system Z score, 2021
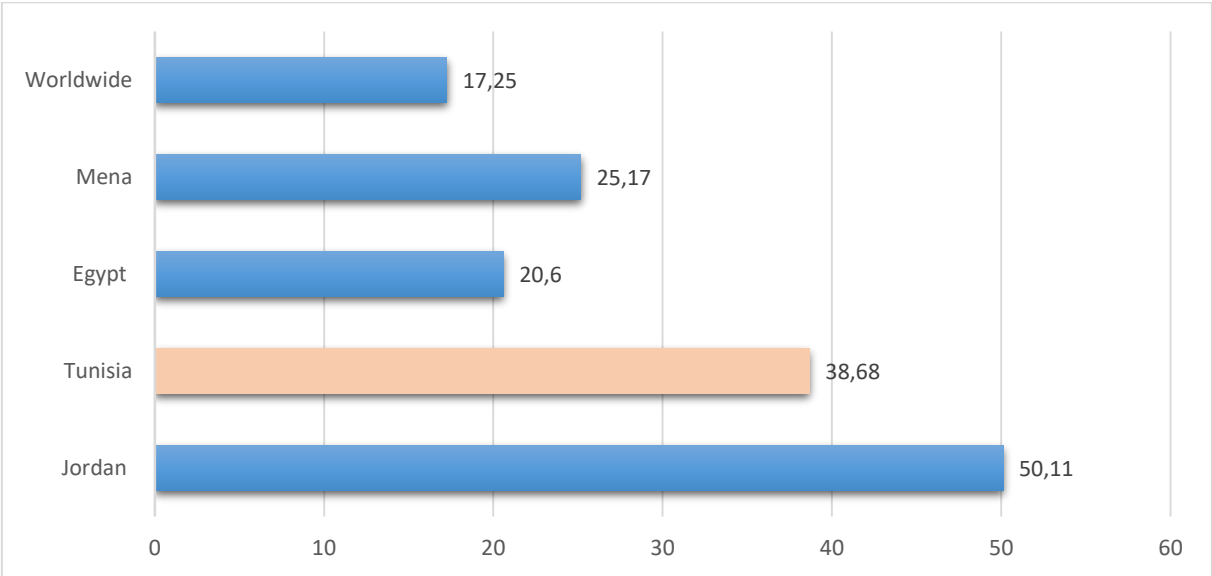
1.3 Constructing a composite index

In order to better asses Tunisia financial stability, we opted for the construction of a stability index. Constructing a composite index involves compiling a set of individual indicators to form a single index. The purpose of a composite index is to measure multidimensional phenomena and concepts that cannot be fully captured or understood using a single indicator. The use of indices as measuring tools is not limited to financial stability. The creation of a stability index is justified by the fact that synthetic indices make it possible to simplify and analyse complex or multidimensional problems, in order to help decision-makers and make the information accessible to the general public.

Composite indices offer a global vision of the phenomenon studied, which greatly facilitates its interpretation compared to the analysis of numerous distinct indicators to identify trends

concerning a multidimensional concept. Additionally, composite indices can attract public attention by providing clear and comparable measures of performance across countries and their progress over time. Additionally, aggregate indices can help reduce the list of indicators or include more information while respecting predefined size limits. However, it is important to note that despite their advantages, composite indices can also have disadvantages.

We will replicate the composite index used by the AMF since it is specifically designed to reflect the financial and economic performance of Arab countries including Tunisia and takes into account the challenges and particularities of the region. Using a regional index can make the stability index more relevant. It can serve as a reference or point of comparison. By including this index in our construction, we assess the stability of Tunisia compared to other Arab countries. To build this index we will use accessible historical data between the period of 2017 and 2021 allowing us to better understand trends and developments. We will present in the table below the indicators which are grouped in the sub-indexes representative of the financial stability situation. The breakdown of our aggregate financial stability index is as follows:

Table 15 : Weight of the financial aggregates

Category	Indicator	Sub indicator	Weight
Banking sector index	**Solvency**	solvency ratio	%13
	Asset quality	*NPL ratio [15]	%5
		*NPLS net of provisons To tier 1 capital	%5
		Coverage ratio	%5
	Liquidity	LCR	%6
		*Loan to deposit ratio	%6
	Profitability	ROA	%3
		ROE	%3
		*Operating expenses to net banking product	%4
		Net interest margin to net banking product	%3
Macro-economic conditions index		Real GDP growth rate	%4
		*Current account deficit to GDP	%4
		*Public debt to GDP	%4
		*Growth rate of state's revenue	%4
		*Inflation rate	%4
		Foreign exchange reserve to GDP	%4
Financial Market Index		AMF financial market index	7,5
		Market capitalization	%7,5
Financial cycle index		*Credit-to-GDP gap	%8
Composite financial stability index			100%

It is important to note that harmonization is necessary before applying this method, as recommended by Popovska (2014). This harmonization involves multiplying by (-1) the sub-indicator which do not follow the same trend as the index in question.

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[15]The sub indicators marked with * were multiplied by (-1)

Next, the sub-indicators underwent normalization to standardize their variances. In the existing literature, two primary approaches of normalization are commonly found: statistical normalization and empirical normalization. The AMF uses the latter.

Secondly, All indicators are standardized on a common scale within the range of zero to one [0;1]. The corresponding formula for this approach is presented as follows, as outlined by Petrovska and Mihajlovska (2013):

$$I_{it}^n = \frac{I_{it} - Min\ (I_i)}{Max\ (I_i) - Min\ (I_i)} \qquad (12)$$

Where:

I_{it}^n : Normalized value of indicator i in period t

I_{it} : Value of indicator i in period t;

$Min(I_i)$ and $Max(I_i)$: The minimum and maximum of the indicator i in the analyzed period.

Then we will weigh the sub indicators as follow:

$$d_i = \sum_{i=1}^n I_{it}^n * w_i \qquad (13)$$

Where:

d_i : The sub indicator value

N : Number of observations

w_i : Weight of the sub indicator

Finally we will determine our composite financial stability index by summing all the sub indicators.

In adherence to the specified procedures, the resultant graphical representation is as follows:

Figure 12 : Financial stability index in Arab countries and Tunisia

	2017	2018	2019	2020	2021
Tunisia	0,330	0,305	0,598	0,470	0,639
AMF	0,527	0,547	0,564	0,487	0,526
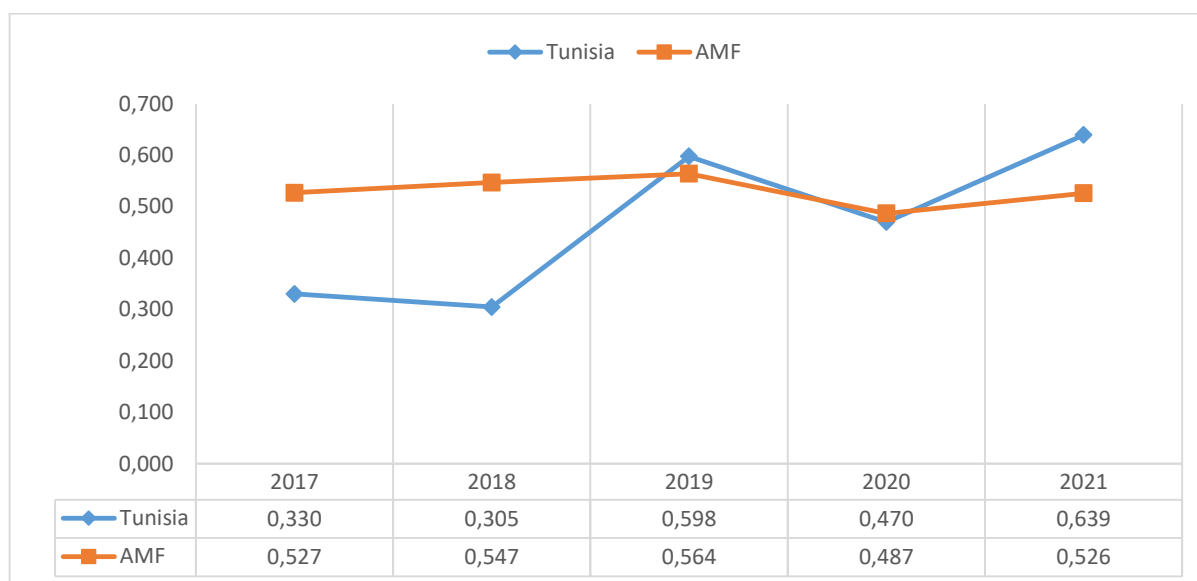
Source: Author

The stability index in the Arab region was steady during the period between 2017 and 2021 for the exception of 2020 where there was a decrease in the financial stability index which was associated with Covid-19 health crisis varying from 0.564 to 0.487. The index regained its usual values in 2021 reaching 0.526.

The stability index in Tunisia recorded a marked improvement, increasing from 0.33 to 0.639 between 2017 and 2021. In 2021, Tunisia's financial stability index increased due to the reduction in pressures on the liquidity and the strengthening of its resilience. This was made possible following the tightening of provisioning rules, while calling on banks to pursue a prudent dividend distribution policy and thus to cope with the persistent consequences of the health crisis linked to Covid-19, the weak economic growth and the successive downward revisions of the sovereign rating.

2 Banking competition in Tunisia

The activity of the Tunisian banking system remains centred on resident banks, which hold 93% of total assets, 97% of deposits and 95% of loans in 2021. However, the analysis of banking concentration is not as straightforward given that banks operate in various segments. This is why we will carry out the analysis of banking concentration using the appropriate indicators, namely the HHI and the CR4 for loans, deposits and assets.

The figure below illustrates the evolution of the HHI index of deposits, loans and assets over the period from 2009 to 2021, based on all resident banks. It is calculated by adding the squares of the market shares of all establishments. Its relevance is increased when the market examined is small. In terms of interpretation, a value below 0.1 indicates a lightly concentrated market, between 0.1 and 0.18 indicates a moderately concentrated market, while a value above 0.18 indicates a highly concentrated market.

Figure 13 : HHI trend
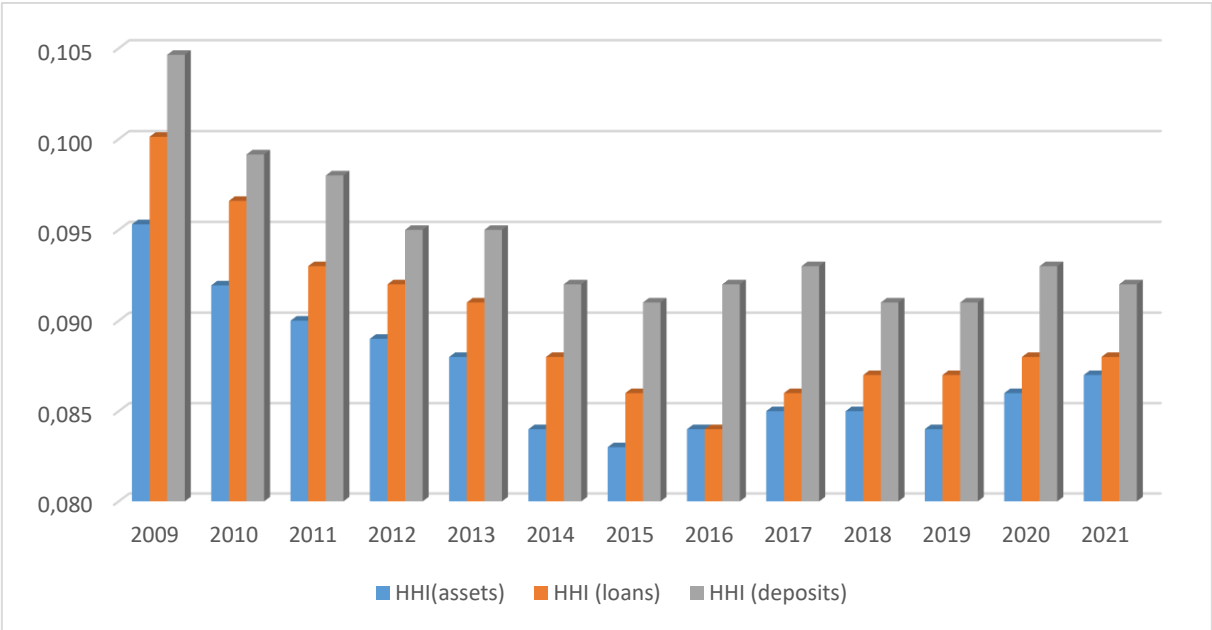
We start with the analysis of the HHI deposit index. The graph shows a decrease in concentration, going from 0.105 in 2009 to 0.092 in 2021. This change suggests that the Tunisian banking sector was moderately concentrated in terms of deposits thus reflecting moderate competition. But from 2010 until 2021 it became a lightly concentrated market. According to the work of Mason (1939) and Bain (1951), an inverse relationship between concentration and competition in a market is observed. Therefore, it becomes possible to interpret the level of competition is high in Tunisia.

As for the HHI loan index, the graph shows a drop from 0.1 in 2009 to 0.084 in 2016. There was a slight increase in 2017 with the value of 0.087 and it remained steady throught the rest of the years. This is manifested by a moderate concentration in 2009 and a slightly low

concentration for the rest of the years which reflects the existence of a competitive credit market.

Concerning the HHI assets, it has known a decrease in its value from 0.095 in 2009 to 0.083 in 2015. It has slightly increased from 2015 to 2021 to finally reach 0.087. This shows that Tunisian banking system has a lightly concentrated market in terms of assets from 2009 until 2021.

We will precede to analyse the CR4 concentration rate of the first fours banks in terms of deposits credits and assets as illustrated in the figure. It should be noted that a CR index below 40% indicates a poorly concentrated market. A value between 40% and 60% indicates moderate concentration, while a value above 60% suggests high market concentration.

Figure 14 : CR4 Trend
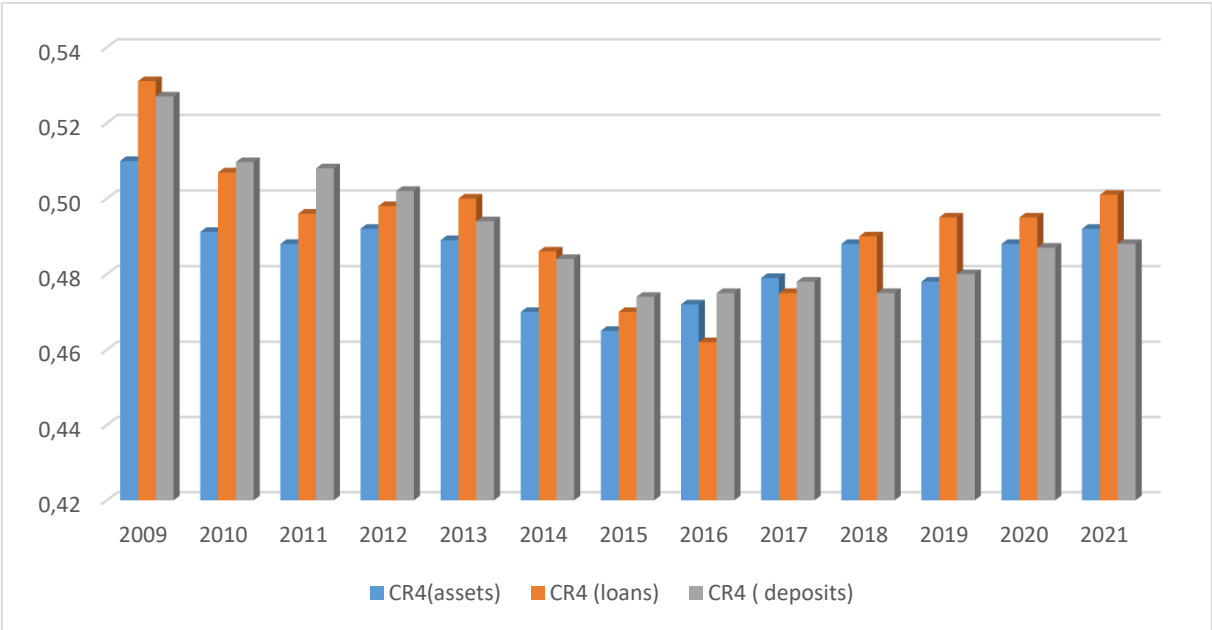
The CR4 of deposits varies between 0.53 and 0.49, indicating a moderate concentration throughout the period which is slightly different from what we have found for the HHI deposits.

The CR4 of loans and assets show a result consistent with the CR4 deposits where the concentration is moderate which suggests that there is a moderate mild competition.

Tunisian public banks have a significant role in the country's financial and economic system. Their importance can be highlighted through several aspects. As public institutions, these banks

can play a role in maintaining the financial stability of the country. Their financial solidity is often seen as an element of confidence for depositors and investors. Thus we opted to study their contribution in terms loans, deposits, and asset.

Figure 15 : Contribution of public banks to loans, deposits, and assets
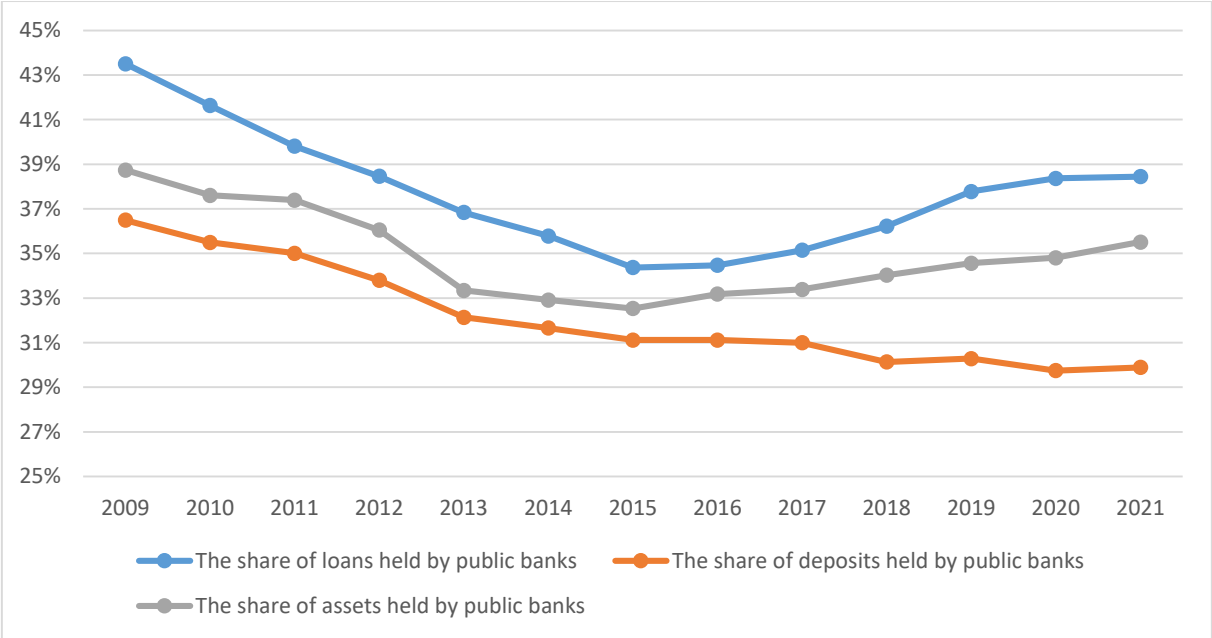
The share of loans, assets and deposits held by public banks have known a decline from 2009 until 2015 dropping respectively from 44% to 34%, 36% to 31% and from 39% to 33%. This downward trend is explained by the entry of new participants, with private banks asserting themselves.

Since 2015, the contribution of public banks has expanded with a market share in terms of assets of 36.6% and 40.3% in terms of loans in 2021 driven, essentially, by the intensification of the loans granted to state and public enterprises mainly with public banks. Thus the share of public enterprises in terms of loans accredited to businesses and professionals were at 11.9% in 2021 compared to 7.9% in 2018. It should be noted that the indicators of positioning, profitability, portfolio quality and financial solidity of the three banks have significantly improved during their restructuring programs which started in 2016 with the strengthening of the financial solidity of STB and BH. On the other hand, the share of public banks in deposits kept on dropping during the same period to stand at 29.8% in 2021.This change can be explained by the entry into activity of new entrants such as Islamic banks.

SECTION III: RESAERCH METHOLOGY

This section is dedicated to presenting our hypotheses as well the sample, elucidating the data source, and outlining the selected variables.

1. Sample

To explore the impact of competition on financial stability, we utilized a sample of 17 Tunisian conventional banks. Due to data availability constraints, our analysis focused on Tunisian conventional banks from 2009 to 2022.

The sample consists of 3 public banks, 3 mixed banks, and 11 private banks. The data collected is annual, resulting in a total of 238 observations.

We specifically excluded Islamic banks for two main reasons. The first one is that Islamic banks didn't emerge in Tunisia until 2010[16], while our study focused on the period starting in 2009.Therefore, relevant data for Islamic banks was not available for the time interval that we examined, and the second one is due to their distinct characteristics.

We also omitted the inclusion of BTS and BFPME, given the distinct nature of their business models in contrast to conventional banking institutions.

Our data was drawn from five different sources, including the annual reports of Tunisia's Professional Association of Banks and Financial Institutions, data from the World Bank Development Indicators (WDI), Central Bank of Tunisia (CBT), Ministry of finance, data from the website of Tunis stock exchange

To conduct our empirical analysis, we employed a panel data approach. The panel data methodology emerged as the most suitable choice for our research.

2. Variable definition

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[16] The Tunisian banking system has been enriched since March 2010 by the entry into activity of a new bank specializing in Islamic finance called Banque Zitouna.

Since January 2014, the off-shore bank "Al Baraka Bank Tunisia (al baraka)" has been transformed in universal banking from December 2013.

Since November 2015, the financial institution "EL Wifack leasing" has transformed into a bank specialized in Islamic banking operations called "Wifak Bank" (WIFAK BANK)

After outlining our sample, the next part will introduce the independent and dependent variables to be used in our empirical analysis.

The research examines how banking competition influences financial stability in Tunisia. This investigation uses panel data spanning of 13 years and applies a linear econometrics model. Four sets of independent variables are utilized which are the following: banking competition, bank-specific factors, macroeconomic and dummy variables.

$$Stability_{it}$$
$$= (Competition_{it}, Bank\ specific\ variables_{it}, Macroeconomic\ variables_{it}, Dummy\ variables_{it},)$$

After having defined the composition of our sample, we will present the variables that we will use in our empirical analysis.

Dependent variables

➢ **Z score**

The Bank Z-score is a commonly employed in academic research to assess financial stability. An elevated Z-score suggests a reduced likelihood of insolvency and a greater degree of financial stability. This particular gauge of financial stability draws inspiration from the research conducted by (2014), Boyd and De Nicolo (2005) and Jiménez et al. (2013).

➢ **NPL**

The non-performing loans ratio is calculated by dividing the amount of loans that are either experiencing late payments or are at risk of non-repayment, whether partially or entirely, by the total gross loans. Non-performing loans are commonly used in academic studies as an indirect measurement of financial stability and as a direct indicator of risk-taking behavior. The decision to employ the non-performing loans ratio as a measure of financial stability draws its inspiration from the research conducted by Schaeck and Cihák (2014) as well as Kasman and Kasman (2015).

The independent variables: Represent different variables that are likely to influence the financial stability and will be categorized in terms of banking

competition, variables specific to each bank, macroeconomic variables and two dummy variables.

➢ **Banking competition**

The primary independent variable under study is the banking competition, which is the focal point for assessing its impact on financial stability. The study incorporates a measure of competition in the loan market, by using the Hirschman-Herfindahl index . This index serves as a direct measure of market concentration and an inverse measure of banking competition.

➢ **Bank specific variables**

They refer to control factors within individual banks that could potentially impact financial stability. These variables are included because a bank's business model that can have implications for the overall stability of the banking sector. In our analysis, we incorporate several commonly employed bank-level variables that have been extensively discussed in the existing literature.

✓ **Size :** To assess the impact of a bank's size on its stability, we will use the measure of total assets. This variable has been examined by the majority of studies, but the difference lies in how it is measured across studies. Fu et al. (2014) and Al-Nasser (2017) opted for the logarithm of total assets. Most studies have shown that the larger a bank is, the more it is able to withstand shocks and financial problems, which makes it more stable, following the principle of "too big to fail". In a study aimed at determining the impact of competition on stability in a direct manner, Kouki and Al-Nasser (2017) confirmed that bank size is a key factor in improving its stability. Another study focusing on risk analysis to assess the level of banking stability, conducted by S. Kasman and A. Kasman (2015), argued that large banks result in a less credit risk, thereby enhancing their stability. Similarly, Leroy and Lucotte (2017) found that size reduces risk taking, measured by distance to default, which helps improve stability.

- ✓ **Capitalization:** We will examine the impact of capitalization through the equity ratio which is a percentage of each bank's total assets. The literature presents various effects of capital on the risk-return profile of banks. For instance, some theories claim that capital increases can jeopardize bank performance and reduce credit. However, according to some studies, well-capitalized banks have a higher return on assets. According to some studies, well-capitalized banks have achieved higher profitability ratios during the financial crisis (Demirguc-Kunt et al., 2010). From this perspective, some argue that banks' higher capitalization increases their capacity to absorb losses and to better face risks (Coval & Thakor, 2005)

- ✓ **Liquidity:** We employ the ratio of total loans to total deposits as an indicator of liquidity, with a higher ratio signifying a reduced level of liquidity. This finding is consistent with the research done by Hakimi and Zaghdoudi (2017) which suggests that banks with a greater proportion of loans (in relation to their total deposits) exhibit increased fragility, implying lower stability.

  - ✓ **Net interest income:** It is calculated as interest income minus interest expense, divided by interest-earning assets and it represents a measure of the profitability of the banking sector. It as a factor influencing the overall stability of the banking sector. In this analysis, when considering the NIM, researchers such as Ali (2015) and Borio (2003) observed that bank profitability indicators are closely related to the stability of the banking sector.

  - ✓ **Non-interest income:** This variable, measured by the ratio of non-interest income to total assets, is also included as an independent variable to account for the impact of bank income diversification. The studies by Altunbas and al and Demirgüç-Kunt and Huizinga suggest that higher non-interest income enhances bank stability, especially for smaller banks

- ➤ **Macroeconomic variables**: In order to account for economic indicators that may impact financial stability, we incorporate two variables: gross domestic growth and inflation.

- ✓ **GDP growth:** Since the demand for loans and repayment capability are influenced by economic conditions, GDP can have an impact on the stability of banks. This variable also affects the performance of banks (Nguyen et al., 2021). Intuitively, banking stability is likely to be impacted positively by GDP growth. However, in times of economic expansion, there are indications suggesting that loan errors are more likely to occur compared to times of recession, as pointed out by Jimenez and Saurina in 2006. There are two potential reasons for this phenomenon. First, when an economy is growing at a fast rate, banks tend to become overly optimistic about their borrowers' ability to repay. This pushes them to adopt more lax credit policies with less stringent lending standards, which often ends up leading to a higher number of risky loans and defaults. Second, in good times, increased competition can reduce the profit margins of financial institutions, incentivizing managers to seek higher-return, but also riskier, activities.

- ✓ **Inflation:** As shown by Demirgüç-Kunt and Huizinga (2010), it is a factor that, on one hand, allows banks to achieve high returns on their assets, but on the other hand, generates a high level of risk. In fact, borrowers' ability to repay their debts is called into question, increasing the likelihood of default as noted by Woodford (2012)

- ➢ **Dummy variables**
- ✓ **Deposit insurance:** Deposit insurance is represented using a dummy variable, taking the value 1 when Tunisia disposed of a deposit insurance system, and 0 otherwise. In principle, deposit insurance is designed to strengthen the stability of the financial system however it may increases moral hazard and make financial systems more vulnerable to crises in good times, it can also build confidence among depositors and reduce the likelihood of contagious banking crises during turbulent times. The net effect of deposit insurance on bank risk and stability depends on whether its advantages can outweigh its disadvantages.

- ✓ **Crisis:** We examine the impact of crisis on banking stability respectively set at 1 for the years 2020-2021 when Covid hit the country, otherwise it will take the value of 0,. In accordance with the study by Soedarmono et al, it is shown that the behaviour of banks can vary between periods considered normal and those identified as periods of crisis.

The subsequent table provides measures utilized for the various variables**.**

Table 16 : Variables' summary

Variables	Definitions	Measures
Z- score	The standard scorE	$\dfrac{ROA+CAP}{\sigma\ ROA}$
NPL	Non-performing loans	Non-performing loans/ total loans
Size	The size of the bank	The natural logarithm of total assets
HHI	Herfindahl-Hirschman Index	$\displaystyle\sum_{i=1}^{n} S_i^2$
CAP	Equity ratio	Equity/ Total assets
LTD	Loan to deposit ratio	Total loans/ Total deposits
NIM	Net interest margin	Net interest income / Total assets
NII	Non-interest income	Non-interest income / Total assets
GDP	The Gross Domestic Product	The growth rate of an economy
Inflation	Inflation	The rate of change of consumer price index
Crisis	Crisis	Dummy variable
DI	Deposit insurance	Dummy variable

Source: Author

3. Model definition

Drawing from the comprehensive theoretical and empirical literature discussed earlier, our study aims to examine three hypotheses in which will present their models:

H1: The relationship between banking competition and financial stability is linear

The relationship between financial stability and competition in the banking sector can be characterized as linear. This assertion suggests that there is a direct and predictable relationship between the degree of competition within the banking sector and the level of financial stability observed. In other words, as competition increases or decreases, financial stability changes proportionally.

Hypothesis H1 is subdivided into two sub-hypotheses, namely H1A and H1B, which respectively embody the two theoretical perspectives of competition-stability and competition fragility.

H1A: Competition has a negative effect on financial stability

Intense competition within the banking sector has the potential to increase the vulnerability of banks. In a highly competitive banking environment, larger banks may be capable of offering lower interest rates and accessing more favourable conditions in international markets

H1B: Competition has a positive effect on financial stability

The reduction of competitiveness is associated with an escalation in financial instability and it has a stabilizing effect, because in its existence, interest rates decrease, which leads to a reduction in the risk of default of borrowers.

To test this hypotheses we will test two models

$$\text{Z-SCORE}_{it} = \alpha + \beta_1 \text{HHI}_{it} + \beta_2 \text{Size}_{it} + \beta_3 \text{CAP}_{it} + \beta_4 \text{NIMP}_{it} + \beta_5 \text{NIID}_{it} + \beta_6 \text{LTD}_{it} +$$
$$\beta_7 \text{GDPgrowth}_{it} + \beta_8 \text{INFLATION}_{it} + \beta_9 \text{Crisis}_{it} + \beta_{10}\text{DI}_{it} + \textbf{\textit{u}}_{it} \text{ (I.1)}$$

$$\text{NPL}_{it} = \alpha + \alpha + \beta_1 \text{HHI}_{it} + \beta_2 \text{Size}_{it} + \beta_3 \text{CAP}_{it} + \beta_4 \text{NIMP}_{it} + \beta_5 \text{NIID}_{it} + \beta_6 \text{LTD}_{it} +$$
$$\beta_7 \text{GDPgrowth}_{it} + \beta_8 \text{INFLATION}_{it} + \beta_9 \text{Crisis}_{it} + \beta_{10}\text{DI}_{it} + \textbf{\textit{u}}_{it} \text{ (I.2)}$$

with:

i : bank i = [1…17] ;

t : year t = [2009…2022]

$\boldsymbol{\beta}$: Coefficient for the control variables

$\boldsymbol{u}$ it : error term

H2: There is a non-linear relationship between financial stability and competition

There is an optimal degree of competition which may suggest that both the competition-fragility and the competition-stability paradigms are relevant

In order to assess this hypothesis, we incorporate a quadratic term related to competition, following the methodology proposed by Martinez-Miera and Repullo (2010). The models that represents the non-linearity hypothesis are outlined as follows

$$\text{Z-SCORE}_{it} = \alpha + \beta_1 \text{HHI}_{it} + \beta_2 \text{HHIsquare}_{it} + \beta_3 \text{Size}_{it} + \beta_4 \text{CAP}_{it} + \beta_5 \text{NIM}_{it} + \beta_6 \text{NII}_{it} + \beta_7 \text{LTD}_{it}$$
$$+\beta_8 \text{GDPgrowth}_{it} + \beta_9 \text{INFLATION}_{it} + \beta_{10} \text{Crisis}_{it} + \beta_{11}\text{DI}_{it} + \textbf{\textit{u}}_{it} \text{ (II.1)}$$

$$\text{NPL}_{it} = = \alpha + \beta_1 \text{HHI}_{it} + \beta_2 \text{HHIsquare}_{it} + \beta_3 \text{Size}_{it} + \beta_4 \text{CAP}_{it} + \beta_5 \text{NIM}_{it} + \beta_6 \text{NII}_{it} + \beta_7 \text{LTD}_{it} + \beta_8$$
$$\text{GDPgrowth}_{it} + \beta_9 \text{INFLATION}_{it} + \beta_{10} \text{Crisis}_{it} + \beta_{11}\text{DI}_{it} + \textbf{\textit{u}}_{it} \text{ (II.2)}$$

Finally, we will test the third hypotheses

H3: The effect of competition and bank size is non-linear to financial instability

The size of a bank can influence its stability, with larger banks potentially having a different impact on stability compared to their smaller counterparts. The underlying idea is that larger banks can benefit from economies of scale, but at the same time their size can lead to greater systemic risks in the event of financial distress. Thus, understanding how banking stability relates to the size of financial institutions is essential to assess. For this hypothesis we're going to use a fifth model. We're going to use the model (I.1) and add two variables which are HHI*size and HHIsqaure*size The model is as follow.

$$\text{Z-SCORE}_{it} = \alpha + \beta_1 \text{HHI}_{it} ++ \beta_2\text{Size}_{it} + \beta_3\text{Size}_{it} *\text{HH}_{it} + \beta_4\text{Size}_{it} *\text{HHIsquare}_{it} + \beta_5 \text{CAP}_{it} + \beta_6 \text{NIM}_{it} + \beta_7 \text{NII}_{it} + \beta_8 \text{LTD}_{it} + \beta_9 \text{GDPgrowth}_{it} + \beta_{10} \text{INFLATION}_{it} + \beta_{11} \text{Crisis}_{it} + \beta_{12}\text{DI}_{it} + u_{it} \ (III)$$

SECTION IV: DESCRIPTIVE STATICSTICS AND PREMILINARY TESTS

This section begins by a descriptive analysis of the variables retained as well as a set of preliminary tests allowing the choice of the appropriate estimation method. We also present our selected models.

1. Descriptive Statistics

We employ descriptive statistics to highlight the main characteristics of the data used in this paper. For each variable, we present its mean, standard deviation, as well as the minimum and maximum values. The following table summarizes the descriptive statistics.

Table 17 : Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Zscore	238	20.445	15.975	-5.54	60.966
NPL	238	13.926	9.401		
HHI	238	8.709	0.326	8.3	9.531
LTD	238	122.273	39.529	8.957	266.068
Size	238	14.804	1.172	11.856	16.865
CAP	238	10.502	5.734	-5.822	46.606
NIM	238	2.183	0.839	-0.576	4.212
NII	238	2.177	0.766	0.683	7.873
Inflation	238	5.197	1.558	3.24	8.31
GDPgrowth	238	1.445	3.234	-8.818	4.405

Source: Author – Results obtained using STATA 15

The bank Z-score, which assesses financial stability, ranges from -5.54 to 60.966. In this sample, certain banks have a low Z score meaning that they're less stable. The highest Z-score values are observed in private banks thus being more competitive. The mean of the NPL ratio is 13.926%.

As for the banking competition ratio, low values of the Herfindahl index indicate high levels of competition, while higher values indicate lower levels of competition. The average change in the Herfindahl index is 8.709 indicating that the Tunisian banking market tends to have a moderate or low concentration..

As for bank liquidity represented by the LTD ratio, it is on average 122% and the majority of banks in our sample have complied with the regulatory requirement since its introduction in 2018. Some of the banks in our sample dispose of high liquidity.

In our sample, most banks have a capital adequacy ratio (CAP) of 10%, while a few private banks stand out for having a notably high CAP. This highlights a significant disparity among Tunisian banks in terms of their capital adequacy. This discrepancy can be attributed to the fact that certain large private banks maintain a substantial capital ratio, while other banks struggle with low, and in some cases, negative capital.

The average size is 14,808 with minimum and maximum values of 11.85 and 16.865, respectively. Public bank institutions have larger sizes than the vast majority of private banks. Tunisian conventional banks exhibit an average profitability of 2.183%, ranging from a

minimum of -0.576% to a maximum of 4.212%. The average income generated from diversification of banks' activities is, standing at 2.177%, and it varies from a minimum of 0.766% to a maximum of 7.873%.

Economic growth rate stood was 1.445% with maximum and minimum values of 4.405% and -8.8%. This negative value was recorded in 2020 and it reflects the recession due to the covid-19 crisis. As for the inflation rate, its mean is 5.197% which is considered to be a high percentage since the ideal percentage should be at 2%. 2022 had the highest inflation rate with 8.31%, which was triggered by the global inflation triggered by the Russian-Ukrainian war.

2. Matrix of correlations

The correlation matrix provides information about the strength and nature of relationships between variables by calculating the coefficients of their linear correlations. The Table below displays the correlation matrix of all variables used in this study.

Table 18 : Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Zscore	1.000											
(2) NPL	-0.435	1.000										
(3) HHI	0.015	-0.029	1.000									
(4) LTD	-0.030	0.293	-0.180	1.000								
(5) Size	0.349	-0.121	-0.172	-0.068	1.000							
(6) CAP	0.229	-0.088	0.191	0.397	-0.385	1.000						
(7) NIM	0.383	-0.422	-0.013	-0.042	0.337	0.167	1.000					
(8) NII	0.107	-0.068	-0.217	-0.158	0.093	-0.038	0.051	1.000				
(9) Crisis	0.009	0.072	-0.093	-0.024	0.082	-0.064	-0.021	0.085	1.000			
(10) DI	0.019	0.102	-0.205	-0.009	0.230	-0.169	0.027	0.465	0.372	1.000		
(11) Inflation	-0.001	0.079	-0.308	0.038	0.229	-0.204	0.040	0.487	0.077	0.424	1.000	
(12) GDPgrowth	-0.010	-0.043	0.134	-0.022	-0.051	0.036	0.017	-0.050	-0.088	-0.232	0.042	1.000

Source: Author – Results obtained using STATA 15

We observe that Z score has a positive correlation with size, capitalization, noninterest income, net interest margin. On the other hand, the LTD ratio has a negative correlation with financial stability, amounting to -0.147. Regarding macroeconomic variables, inflation is negatively correlated with financial stability.As for the NPL, it has positive relationship with LTD, crisis and inflation and a negative relationship with HHI, size, noninterest income and net interest income.   It is worth noting that the negative correlation between the capitalization ratio and the LTD is of the order of 0.397 .This can be interpreted as meaning that banks with higher levels of equity are exposed to lower liquidity risk.

To conclude, the analysis of the correlations between the different explanatory variables highlights the absence of multicollinearity problems, because the degrees of correlation are all less than 0.7

To ascertain the absence of multicollinearity among the variables, we will employ the Variance Inflation Factor (VIF) test. In the event that the test reveals an average VIF exceeding 6 and an individual VIF surpassing 10, this indicates the presence of a multicollinearity issue.

The following table shows the variance inflation factor when we Zscore is the dependent variable.

Table 19 : Variance inflation factor

	VIF	1/VIF
Crisis	5.422	0.184
GDPgrowth	5.017	0.199
DI	4.664	0.214
Inflation	4.519	0.221
CAP	1.842	0.543
Size	1.545	0.647
LTD	1.492	0.67
NII	1.489	0.671
NIM	1.332	0.751
HHI	1.316	0.76
Mean VIF	2.864	.

Source: Author – Results obtained using STATA 15

This result implies that all variables can be introduced simultaneously into our model. Similar results were found using NPL as the dependent variable as shown in the appendix 3

3. Preliminary tests

A priori, we choose to employ a dynamic panel model due to its ability to capture the evolving nature of financial stability and address the potential endogeneity issue between financial stability and bank competition. Additionally, it yields superior results in comparison to a static model utilizing random effect and/or fixed effect models. The use of random and/or fixed effect models is prone to serious econometric bias and produces inconsistent results owing to the presence of correlation between the error term and lagged dependent variables.

To test our theory, the dataset is subjected to testing for robustness heteroscedasticity, autocorrelation and endogeneity using the, Fisher's individual effect test, Breusch-Pagan/Cook-Weisberg test, Wooldridge test and the Wu-Hausman test, respectively.

3.1 Test for the presence of individual effects

To test the robustness of this regression, we will test Fisher's individual effects test, which consists of verifying the existence of effects specific to banks. This test is based on the following Hypotheses:

$H0$	Absence of individual effects
$H1$	Presence of individual effects

Decision rule:

$P\ (value) > 5\%$	we accept $H0$
$P\ (value) \leq 5\%$	we accept $H1$

According to appendix 4 , the value of P is less than 5%, which confirms the presence

individual effects as it is shown in the appendix

3.2 Hausman test

Upon detecting the presence of individual effects, the next step is to estimate fixed effects and random effects models. To make a choice between these two models, we need to conduct the Hausman specification test (1978), which is employed to address the issue of endogeneity. This test is based on the following hypotheses and decision rule:

Hypotheses:

$H0$	Random effects model
$H1$	Fixed effects model

Decision rule:

$P\ (value) > 5\%$	we accept $H0$
$P\ (value) \leq 5\%$	we accept $H1$

According to the table in the appendix 5, the P-value is greate than 5%, signifying that we accept the null hypothesis H0. Consequently, we opt for the random effects model.

Following the Hausman test, we must then assess the presence of heteroscedasticity and autocorrelation, using the following two tests, as detailed below.

3.3 Heteroscedasticity test

To check the presence of heteroskedasticity, we will perform a Breusch-Pagan test. Indeed, one of the conditions for estimation by the ordinary least squares (OLS) method is homoscedasticity, which means that the variance of the error component must remain constant.

Therefore, this test will be used to assess this condition

Hypotheses:

H0	$\sigma u^2 = 0$: the residuals are homoscedastic
H1	$\sigma u^2 \neq 0$: the residuals are heteroskedastic

• Decision rule:

P (value) > 5%	we accept $H0$
P (value) ≤ 5%	we accept $H1$

The Breusch-Pagan test indicates a P-value $< 5\%$, as shown is appendix 6, which confirms the presence of heteroscedasticity. In other words, it appears that the variance of the error component is linearly related to the independent variables. In such a situation, estimation by ordinary least squares (OLS) will lead to biased estimates.

3.4 Autocorrelation test

For an Ordinary Least Squares (OLS) estimator to be unbiased, it is necessary for autocorrelation to be absent. This requirement implies that the error terms of distinct observations should not exhibit correlation with each other. To verify the fulfillment of this condition, we conduct the Wooldridge test.

Hypotheses:

H0	Absence of autocorrelation
H1	Existence of autocorrelation

Decision rules:

P (value) > 5%	we accept $H0$
P (value) ≤ 5%	we accept $H1$

The Wooldridge autocorrelation test reveals that errors exhibit correlation as shown in appendix 7. The rejection of the null hypothesis indicates the presence of autocorrelation in the errors.

We conducted the same tests using the NPL as dependent variable. We had similar results as shown in appendices (8, 9, 10, and 11).

4. Model choice

We choose to employ the two-step Generalized Method of Moments (GMM) as introduced by Blundell and Bond is based on:

- Its robustness as a regression estimator, which aims to achieve highly reliable estimations.

- The two-step GMM is particularly well-suited for scenarios characterized by a limited number of time periods (T) and a large number of cross-sections (N), where the dependent variable exhibits persistence (dynamics)

- The explanatory variables are not exogenous (potentially correlated with the error term), The use of GMM estimation allows us to address endogeneity problems

  As noted by various authors (e.g., Noman, Gee and Isa, 2018). GMM effectively mitigates concerns related to reverse causality, which could occur when stability, competition, and other independent variables influence each other.

- There are indications of heteroscedasticity, time-invariant individual fixed effects, and autocorrelation within individuals.

These conditions are commonly encountered in bank-level data analysis.

Following the implementation of the two-step system GMM, several post-diagnostic tests are conducted, including AR(1) and AR(2) tests to assess the presence of autocorrelation at the first and second differences, as well as Hanen's J-test to examine the validity of instruments for endogenous variables. Additionally, a Wald test is employed to ensure the goodness of fit for all our regression models.

SECTION V: INTERPRETATION OF THE RESULTS

In this final section, we will present the obtained results and their interpretations. Initially, we will test the hypothesis of linearity and the moderating effect. Subsequently, we will examine the non-linear relationship between banking competition and financial stability. Finally, we will examine the non-linear effect that size has on financial stability.

1. Linear relationship

For the regression analysis of our models investigating the linear relationship between banking competition and financial stability, we used the Zscore and the NPL ratio. To assess the level of banking competition we used the HHI. Regarding banking-specific variables, we included bank size, banking performance, diversification, capitalization, as well as liquidity risks. The macroeconomic variables encompassed the GDP growth rate, inflation. We also included two binary variables indicating crises and deposit insurance. The results of our regression model

obtained by using STATA 15 software, are summarized in the following table:

Table 20 : Results obtained of the linear relationship

VARIABLES	Zscore (I.1)	NPL (I.2)
L.Zscore	0.678***	
	(0.148)	
L.NPL		0.955***
		(0.036)
HHI	-2.891***	-0.998*
	(0.999)	(1.971)
LTD	-0.035***	0.022***
	(0.010)	(0.006)
Size	2.919***	0.410*
	(0.726)	(0.212)
CAP	0.626**	-0.148***
	(0.270)	(0.056)
NIM	0.863	-0.510***
	(1.119)	(0.187)
NII	0.957**	-0.137
	(0.483)	(0.132)
Inflation	0.066	0.106
	(0.151)	(0.124)
GDPgrowth	0.017	-0.043
	(0.085)	(0.061)
Crisis	-0.139	0.798
	(1.274)	(0.786)
DI	-0.804**	0.378
	(0.340)	(0.230)
Constant	-18.189	15.060
	(13.926)	(19.006)
Observations	221	221
	17	17
AR (2)	0.189	0.280
Hansen	0.686	0.125
Sargen	0.186	0.103
Standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$		

Model (I.1): In accordance with the results we have obtained the variables GDPgrowth, inflation crisis and NIM do not show any significance, unlike the other variables. Our initial finding is that bank stability is more affected by bank industry specifics rather than macroeconomic factors.

We will endeavor to analyze the determinants of financial stability and their influence on the dependent variable, taking into account the unique characteristics of the Tunisian context. The variables CAP, Size and NII are positively correlated with the dependent variable Z-Score, contrary to the variables LTD, HHI and DI.

The Herfindahl index (HHI) is utilized as a reverse indicator of banking competition. The inverse correlation observed indicates that during the study period, banks tend to exhibit greater financial stability when the banking sector is less consolidated. This suggests that financial stability is positively associated with higher levels of banking competition and inversely linked to increased market concentration. This result is theoretically consistent with the competition-stability hypothesis. This view is mainly based on the works of Boyd and De Nicoló (2005). According to this perspective, an increase in concentration or a decrease in bank competition in the lending market results in higher interest rates for borrowers. High interest rates make it more difficult to repay loans and encourage borrowers to take on riskier projects to offset these high borrowing costs. This practice increases the risk of default and leads to an increase in non-performing loans, which increases the risk of bank failure and creates greater banking instability due to the problem of adverse selection on the part of borrowers. As a result, banking systems characterized by greater competitiveness are considered more stable. Furthermore, the presence of large banks is seen as a potential threat to the safety and soundness of the financial system. Fears of contagion and financial crisis resulting from the failure of large banks are prompting regulators to avoid letting them fail in the event of solvency problems. Therefore, governments will guarantee the survival of these banks to avoid a nationwide crisis

The capitalization is positively correlated to Zscore. This anticipated outcome aligns with the expectation that well-capitalized banks have the capacity to prudently manage their risks and proactively mitigate the likelihood of future financial crises. In fact, several studies have indicated that banks with better capitalization are more profitable and more stable. (Thakor, 2014). Moreover, better capitalized banks are more capable to accelerate economic recovery after a crisis as shown by Coval and Thakor (2005) .By maintaining high capital ratios, banks tend to benefit from lower financing costs and are able to cope with unexpected losses. Additionally, banks with adequate capital are better prepared to avoid potential shocks that

could trigger crises. These findings are in line with the directives provided by the Central Bank of Tunisia, as outlined in Circular No. 2016-03 and Circular No. 2018-06. These directives emphasize the imperative for financial institutions to bolster their capital reserves by the end of 2018 and would explain the recapitalization of public banks in 2020 as a part of a restructuring process. This is because a higher capital adequacy level serves as a capital buffer, rendering banks less vulnerable to insolvency when confronted with crises.

The results reveal a significant negative correlation between bank stability and liquidity risk. Banking operations heavily rely on liquidity, therefore, banks with ample liquidity are less susceptible to crises, which can result in significant economic losses. The recent financial crisis underscored the vital role of liquidity. Banks with sufficient liquidity, especially when combined with substantial equity, exhibited greater stability during periods of crisis. In cases of unexpected financial shocks or massive deposit withdrawals, banks with higher liquidity levels demonstrated increased efficiency and stability. However, banks with elevated liquidity risk are more vulnerable to banking fragility and potential failures (,hakimi et al.2017). It should be noted that on the prudential level, the CBT introduced in November 2018 a new LTD ratio at the level of 120% which contributed to reducing the liquidity needs of banks.

As for bank size, it is positively correlated to Zscore. This calls into question the "Too Big To Fail" theory put forward by Mishkin (1999) that suggests that larger banks are riskier. In this research, bank size has many advantages one of which is that these large banks have high profits and are less exposed to liquidity risks or macroeconomic shocks. Additionally, they benefit from economies of scale and a broader range of services, which allows them to further diversify the risks associated with their loan portfolio (Mirzaei, Moore, and Liu, 2013). Another advantage, is that these banks have is that "too big to fail", which is an important guarantee from the point of view of state authorities. Uhde and Heimeshoff (2009) view that large banks are less prone to financial fragility. Instead, their size favors better diversification, which lessen the risks and allows them to be present in different market segments, which brings us to our next variable which is NII that present diversification. Demirgüç-Kunt et al. (2010) concluded that diversification provide some security to financial institutions, while providing the opportunity to improve their profitability ratios. In fact, by diversifying their activities, banks can increase their sources of income. Furthermore, diversification helps reduce dependence on economic cycles. For instance, if a bank relies heavily on real estate loans and the real estate market slows, it can offset its losses by generating revenue from other activities, such as or trading operations.

As for the dummy variable, deposit insurance is negatively correlated to Zscore which can be explained by the fact that deposit insurance result in more moral hazard and excessive risk-taking by banks (Demirguc-Kunt and Kane, 2002)

Jensen et al. (1976) highlighted an agency issue wherein, if the risk taken proves to be successful, the bank would enjoy the benefits, but if it results in losses, the expenses would ultimately be borne by the deposit insurance fund.

To assess the robustness of our findings, we will repeat our regression analysis by substituting the Z-score measure of stability with the non-performing loan ratio, an alternative commonly used in the literature to assess financial instability.

Model (I.2): Concerning macroeconomic variables, they do not affect banking stability as it was shown in the model (I.1). As for the remaining variables, these results show a negative correlation between capitalization and the NPL and a positive relationship between liquidity risk and the NPL. This confirms our results found previously, since the NPL and the Z-score are opposite measures.

The productivity variable became significant and is negatively correlated to the NPL. These results go in line that profitable banks have lower NPL as it was found by Suruya Bahadur (2016). This indicates that banks that manage to maintain high levels of productivity are more likely to manage their loan portfolio effectively and maintain a low NPL. These results thus underline the importance of solid financial management to maintain the financial health of banks. Financial institutions possessing extensive liability portfolios and inefficient risk management practices may experience elevated levels of NPLs which will diminish the profitability.

As for the variable size, we have found contradicting results than those have previously found in the first model since in model I.2 size and NPL are positively correlated. In fact, large banks may be tempted to adopt higher risk policies when they believe that governments are willing to come to the aid of banks in difficulty, as was highlighted by Demirgüç-Kunt et al. (2013). This Temptation arises from the perception that, in the event of a major problem, governments will intervene to save these large financial institutions. Smaller banks are often more cautious about granting risky credit, primarily due to concerns about financial stability. Unlike larger financial institutions, smaller banks generally have more limited resources to absorb large losses from risky loans. As a result, smaller banks tend to take a more conservative approach to lending, prioritizing the safety and quality of borrowers to minimize default risks and preserve their

financial stability.

The result of this stress test highlights a negative and significant correlation between HHI and the rate of non-performing loans (NPLs) in the banking sector. This means that when concentration within the banking sector increases, there is generally a decrease in non-performing loans. Conversely, an increase in competition results in an increase in NPLs, which contributes to greater stability. These findings support the theory of competition fragility., According to this perspective, competition erodes banks' profit margins, leading to a decrease in their franchise value, and thus lessening their incentives to behave prudently. This can lead to more aggressive risk-taking strategy in an effort to achieve higher profits which will ultimately cause an increase the NPL ratio. This would result in financial instability, making less concentrated banking systems more susceptible to crises (Berger, Klapper). Moreover, in a heightened competitive setting, banks generate reduced informational income from their borrower relationships, diminishing their motivation to conduct thorough borrower monitoring. This, in turn, escalates the risk of fragility.

The results drawn from the empirical study on the relationship between competition and stability in the Tunisian banking system shows a contradiction between the results of the two measures of banking stability. When the Z index is used as an indicator of the stability, the results support the competition stability hypothesis. However, when the NPL was used as proxy for stability, the results support the idea of competitive fragility. These findings prompt us to consider the presence of a nonlinear association between banking competition and stability, in line with the hypothesis proposed by Martinez-Miera and Repullo (2010). The forthcoming section of our study will focus on assessing this hypothesis of the non-linear relationship.

2. Non-linear relationship

We seek to evaluate the hypothesis of the non-linear relationship between competition and stability by introducing the quadratic term of concentration, as suggested by Berger et Al. (2009), Tabak et Al. (2012), Kasman and Kasman (2015). To verify the robustness of our results, we repeat the regression by replacing the stability measure (Z-score) with the non-performing loan (NPL) ratio. The results of our estimation are presented in the following table:

Table 21 : Results obtained of the non-linear relationship

VARIABLES	Zscore(II.1)	NPL(II.2)
L.Zscore	0.564***	
	(0.000)	
L.NPL		0.926***
		(0.000)
HHI	-220.762*	-786.120**
	(0.056)	(0.046)
HHI_sq	12.611*	45.398**
	(0.060)	(0.046)
LTD	-0.0244***	0.0328***
	(0.002)	(0.000)
Size	2.586***	0.034
	(0.000)	(0.874)
CAP	0.595***	-0.157***
	(0.000)	(0.009)
NIM	1.322	-0.847**
	(0.254)	(0.017)
NII	1.178*	0.0973
	(0.063)	(0.771)
GDPgrowth	0.190*	0.596**
	(0.063)	(0.044)
Inflation	0.026	0.560*
	(0.857)	(0.074)
DI	-0.889**	-0.257
	(0.023)	(0.771)
Crisis	2.915	11.159**
	(0.111)	(0.013)
Constant	925.75*	3,395.7**
	(0.060)	(0.046)
Observations	221	221
Number of id	17	17
ar2p	0.230	0.188
Hansenp	0.936	.
Sarganp	0.740	0.0557
Standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$		

Model (II.1): Upon introducing a quadratic term into the model (I.1), the linear term shows a negative and statistically significant effect, whereas the quadratic term exhibits positive and statistically significant impact. This suggests a U-shaped functional relationship.

As a result, an increase in the degree of competition increases banking stability in accordance with the competition-stability hypothesis but only up to a certain threshold. Beyond this point, an increase in competition leads to a decrease in banking stability, in line with the concentration-stability hypothesis, in other words the competition-fragility relationship.

Tabak (2012) provides empirical evidence supporting the U-shaped relationship between bank stability and competition in Latin America. This finding contradicts the conclusions of Liu et al. (2013) and who found evidence for an inverse U-shaped association between competition and bank stability in Europe.

The U-shape pattern is explained by the fact that in a banking market with higher concentration, banks might have the potential to achieve increased profits, as they would be in a position to impose higher interest rates on borrowers but at certain point an increase of competition will lead banks tend to reduce their lending rates, which reduces their income. This can influence the stability of banks.

Model (II.2): we found that macroeconomics variables including GDPgrowth, inflation and crisis are all significant and have a positive relationship with NPL.

For the control variable crises, banking instability tends to increase in time of crisis, manifested by a significant increase in the non-performing loan (NPL) ratio. This dynamic can be attributed to several interrelated factors. First, deteriorating economic conditions during a crisis can cause financial hardship for many borrowers, making it more difficult to repay their loans. This financial distress of borrowers often results in an increase in payment defaults, thus contributing to the increase in NPLs. Furthermore, confidence in the financial system can be undermined during periods of crisis, leading to mass withdrawals of deposits and panic. This flight of funds can worsen the financial situation of banks, creating a vicious circle of instability. This result is supported by the findings of Kasman and Kasman (2015).

The inflation also showed a positive and significant relationship with NPL. During times of inflation banks tend to raise their interest rates to maintain their real profit margin. This may make it more difficult for borrowers to repay their loans, which may contribute to an increase in NPLs.

As for the GDP that has positive relationship with NPLs, this finding was not anticipated in our research but it can be explained by the fact in times of economic growth, banks may be tempted to reduce financial restrictions in order to further stimulate economic activity and exploit lending opportunities generated by rising GDP. However, this approach can also increase the risks inherent in the financial system causing in increase in the NPL ratio as it was pointed out by Matsuyma 2017.

In Model I.1, the quadratic term is employed to examine the potential non-linear connection between HHI and NPL. The findings reveal that the linear term is negative and is statistical significant, whereas the quadratic term is positive and is similarly statistical significance. This suggests a U-shaped relationship which indicate that the increase in market power, resulting in a reduction in competition, reduces financial instability measured by the non-performing loan ratio, in accordance with the competition-fragility hypothesis, up to a certain threshold. Beyond this threshold, an intensification of market power leads to an increase in financial instability, thus corroborating the competition-stability hypothesis.

We do not interpret these findings as contradictory to the earlier one when the dependent variable is the Zscore. In fact increased market power (less competition) results in a riskier loan portfolio. Banks wielding higher market power also experience enhanced overall stability, indicating that they employ additional risk management methods to safeguard themselves.

3. The effect on size and competition on financial instability

We 're going to test the third hypothesis which is the non-linear effect of competition and bank size to financial instability since we found that the NPL and Z-score have contradicting results concerning size.

Table 22 : Results obtained of the effect of size on financial instability

VARIABLES	Zscore (III)
L.Zscore	0.882***
	(0.181)
HHI	15.246*
	(8.357)
LTD	-0.022***
	(0.006)
Size	92,015***
	(33.573)
Size.HHI2	1,063672
	(0.4374284)
Size.HHI	-19,69274
	(7.660179)
CAP	0.284
	(0.231)
NIM	0.299
	(0.076)
NII	0.705**
	(0.340)
GDPgrowth	0.216*
	(0.114)
Inflation	0.176
	(0.162)
Constant	(153.499)**
	(72.810)
Observations	221
Number of id	17
AR(2)	0.189
Hansen	0.686
Sargen	0.186
Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1	

The relationship between size and the HHI, as well as between SIZE and the squared term of the HHI, reveal a U-shaped relationship with the financial fragility of the system. This U-shaped

relationship would initially show a decrease in financial fragility as entity size increases, reaching a point where fragility is minimal. Then, beyond a certain size, financial fragility would start to increase again, thus forming the lower part of the U. The observation suggests that, initially, an increase in the size of a financial entity is associated with a reduction in financial fragility, but beyond a certain size, this advantage diminishes or even reverses, contributing to an increase in financial fragility.

CONCLUSION

The main objective of our study was to determine the nature of the existing relationship between banking competition and financial stability as well as to assess the impact of other indicators, notably the size of the bank on this relationship, through the panel data from 17 banks over the period 2009-2022. First, we presented an overview of banking competition and financial stability in Tunisia. Then, we carried out the regressions testing our hypotheses of linearity, the non-linearity and the impact of size on competition, by applying the GMM method. In order to obtain the results we used the Z-score and the NPL ratio as dependent variables.

We were apprehensive about employing the Non-Performing Loans as a dependent variable since the CBT published on March 1, 2022, a circular No. 2022-01 to banks and financial institutions, relating to the prevention and resolution of non-performing "NPL" debts. The said circular provides, in particular, for the obligation for banks and financial institutions to write off from their balance sheets, debts classified 4 for 5 years or more which meet the conditions for write-off set by the tax legislation in force. We proceeded to use the NPL with caution.

Our results for the first hypothesis were mixed. First, the study showed using the Z-score that less concentration leads to greater financial strength or stability. Then, the robustness test showed the opposite result, that competition in the banking sector leads to an increase in financial stability. These results, which support both the competition-fragility and competition-stability paradigms, led us to test the non-linearity hypothesis. To do this, we introduced a quadratic term. The results obtained show that the relationship between financial stability and banking competition is indeed non-linear in Tunisia in both models.

The effect of size on the relationship between banking competition and financial stability remained unclear as we obtained mixed results which led us to believe there is non-linear effect on the relationship between banking competition and financial stability which we tested in model (III). We found that small banks increase financial instability. If there would be mergers

between small banks this will enforce financial stability but beyond a certain point this may cause financial instability due the importance of mergers between small banks. It would need to maintain a delicate balance in the financial sector. Mergers can be strategic for several reasons. On one hand, the consolidation of small banks can help strengthen their resilience to economic shocks. Entities resulting from such mergers may benefit from greater risk diversification and an accumulated capacity to absorb economic disruptions, which, in turn, promotes the stability of the financial system. On the other hand, banking sector consolidation can reduce risks associated with large financial institutions by limiting the number of banks considered "too big to fail".

In most models we found that financial stability is predominantly influenced by bank-specific variables rather than macroeconomic factors. This implies that the specificities of individual banks play a more substantial role in shaping the overall financial stability landscape rather than economic conditions.

GENERAL CONCLUSION

The maintenance of financial stability is among the major concerns of regulatory authorities, tasked with implementing appropriate macro-prudential policies to prevent systemic risks. This importance manifests through two fundamental dimensions. On one hand, financial crises can generate considerable financial, social, and economic costs. On the other hand, financial stability is essential to ensure prosperity and economic growth. As such, it becomes crucial to be proactive in monitoring financial stability and potential risks in order to take the appropriate regulatory measures. The initial step involves defining and measuring financial stability to effectively guide subsequent prudential decision-making processes. Constructing a composite financial stability index stands out among the tools used by central banks worldwide to assess this complex and multidimensional phenomenon.

The proper functioning of the Tunisian banking system is regarded as a fundamental pillar supporting the overall economy and fostering financial stability. It holds considerable importance within the country's economy for various compelling reasons since it serves as the primary source of financing. Its contributions extend beyond the private sector, encompassing the government's financial needs through the acquisition of Treasury bills, thereby fostering stability in public finances.

Banking competition is one the factors that can influence financial stability, hence, the rise of the ongoing discussion on the connection between banking competition and the overall stability of the financial system in academic and policy circles. These studies have resulted in the emergence of two contrasting perspectives: the "competition-fragility" hypothesis, suggesting an adverse relationship between banking competition and financial stability, and the "competition-stability" hypothesis, affirming a positive relationship (Berger et al 2008). Recently, a more new theory emerged which taken into account both scenarios. (Martinez-Miera and Repullo, 2010). Numerous studies have scrutinized these relationships across different countries and regions, unveiling a variety of outcomes. In this paper, we empirically studied the relationship between financial stability and bank competition.

To elucidate the findings and contributions presented in this paper, the following steps were taken. First, we presented the theoretical framework in the first part through four distinct

sections: The first one defined financial stability, its measures. The second one presented the prudential and supervision framework of financial stability on both international and national level. The third one studied banking competition, its definition and its measures. Finally, the last section presented the different theories of the relationship between banking competition and financial stability as well as the results of some empirical studies. The second part of our paper focused on assessing the financial stability in Tunisia and on studying the nature of this relationship between financial stability and competition. In order to evaluate Tunisia's financial stability, we chose to construct a stability index and we found that the overall stability of Tunisia has been in constant improvement.

To determine the impact of competition on financial stability, we analysed a representative sample of Tunisian banks over the period 2009–2022.A proxy for bank competition, namely the HHI, along with two proxies for bank stability, the Z-score, and the NPL were used. We also used other control variables that were classified into three categories which are bank specific, macroeconomics variables and dummy variables.

In our paper, we exercised caution in incorporating Non-Performing Loans (NPLs) as a dependent variable due to recent developments. Specifically since the Central Bank of Tunisia issued Circular No. 2022-01 on March 1, 2022, addressing the prevention and resolution of non-performing debts (NPLs).

The findings indicated that when using the Z-score as a proxy, the results were aligned with the competition-stability paradigm but when we used the NPL as proxy, test revealed a contradictory outcome, suggesting the competition-fragility paradigm. These findings, aligning with both paradigms, prompted the exploration of the non-linearity hypothesis. To further analyse this, we introduced a quadratic term for the competition measurement indicator. The obtained results demonstrate that the connection between financial stability and banking competition is indeed non-linear in Tunisia across both models.

The impact of size on the relationship between banking competition and financial stability remained uncertain, as we obtained divergent outcomes. This led us to explore the possibility of a non-linear effect in the relationship between size and financial stability.

In order to enhance financial stability, small banks should opt for mergers up to a certain level for several strategic reasons. Their consolidation can strengthen their resilience to economic shocks and will allow them to benefit from improved risk diversification and an accumulated capacity to absorb economic disruptions, thereby promoting the stability of the financial system.

It will help reduce the risks associated with large financial institutions by limiting the number of banks considered "too big to fail."

With the aim of enhancing macroprudential policy, capital tools such as CCB and systemic ones mainly the D-SIB should be implanted. The latter tool will ensure the stability of systematically important banks especially that four major banks account for more than 45% of the banking sector as it was shown the CR4. Such tools will strengthen the financial resilience of banks, prevent solvency problems and stimulate financial prudence, thereby reducing the risk of bankruptcy in the event of an economic shock.

We believe our findings offer significant support for future research on the relationship between banking competition and financial stability in Tunisia. Nevertheless, we propose additional research directions to expand and deepen our analysis. Specifically, exploring the impact of competition on financial stability for both Islamic and conventional banks. Given the quadratic and U-shaped relationship between bank concentration and financial stability, it would be valuable to identify the inflection point at which concentration levels become detrimental to stability. This could be achieved through various methods.

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AMF- Financial stability report (2022)

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CBT - Circular No. 2022-01 to BEFs regarding the prevention and resolution of non-performing loans.

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https://www.cbt.gov.tn/

http://www.bvmt.com.tn/

https://www.cmf.tn/

APPENDICES

Appendix 1 : Correlation matrix

```
         |   Zscore     NPL      HHI      LTD     Size      CAP      NIM      NII   Crisis Guaran~e Inflat~n
---------+--------------------------------------------------------------------------------------------------
  Zscore |   1.0000
     NPL |  -0.4350   1.0000
     HHI |   0.0148  -0.0286   1.0000
     LTD |  -0.0303   0.2931  -0.1802   1.0000
    Size |   0.3489  -0.1205  -0.1724  -0.0676   1.0000
     CAP |   0.2288  -0.0879   0.1914   0.3970  -0.3849   1.0000
     NIM |   0.3830  -0.4215  -0.0131  -0.0423   0.3366   0.1665   1.0000
     NII |   0.1069  -0.0680  -0.2171  -0.1581   0.0934  -0.0376   0.0512   1.0000
  Crisis |   0.0092   0.0723  -0.0933  -0.0244   0.0820  -0.0640  -0.0212   0.0851   1.0000
      DI |   0.0190   0.1024  -0.2049  -0.0089   0.2295  -0.1695   0.0265   0.4651   0.3721   1.0000
Inflation|  -0.0010   0.0793  -0.3076   0.0385   0.2294  -0.2041   0.0399   0.4874   0.0772   0.4240   1.0000
GDPgrowth|  -0.0099  -0.0428   0.1339  -0.0222  -0.0513   0.0364   0.0174  -0.0500  -0.0820  -0.2321   0.0421

         | GDPgro~h
---------+---------
GDPgrowth|   1.0000
```

Appendix 2 : Variance inflation factor (Z-score)

```
estat vif

    Variable |       VIF      1/VIF
-------------+----------------------
      Crisis |      5.42    0.184430
   GDPgrowth |      5.02    0.199330
          DI |      4.66    0.214430
   Inflation |      4.52    0.221274
         CAP |      1.84    0.542949
        Size |      1.55    0.647158
         LTD |      1.49    0.670168
         NII |      1.49    0.671462
         NIM |      1.33    0.750763
         HHI |      1.32    0.759854
-------------+----------------------
    Mean VIF |      2.86
```

Appendix 3 : Variance inflation factor (NPL)

```
. estat vif
```

Variable	VIF	1/VIF
Crisis	5.42	0.184430
GDPgrowth	5.02	0.199330
DI	4.66	0.214430
Inflation	4.52	0.221274
CAP	1.84	0.542949
Size	1.55	0.647158
LTD	1.49	0.670168
NII	1.49	0.671462
NIM	1.33	0.750763
HHI	1.32	0.759854
Mean VIF	2.86	

Appendix 4 : Fisher test (Z-score)

```
. ovtest
```

```
Ramsey RESET test using powers of the fitted values of Zscore
      Ho:  model has no omitted variables
              F(3, 224) =     13.18
                Prob > F =      0.0000
```

Appendix 5 : Hausman test (Z-score)

```
                 ─── Coefficients ───
                 (b)          (B)            (b-B)        sqrt(diag(V_b-V_B))
                 fixed        random         Difference        S.E.

       HHI     -.3983326    -.3983326            0                0
       LTD      .0252662     .0252662            0                0
      Size     1.478302     1.478302             0                0
       CAP      .9642326     .9642326            0                0
       NII     1.273165     1.273165             0                0
    Crisis     1.0749       1.0749               0                0
        DI     1.396675     1.396675             0                0
 Inflation    -.2697496    -.2697496            0                0
 GDPgrowth     .0731034     .0731034            0                0
       NIM    -.0709505    -.0709505            0                0

                      b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

               chi2(0) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =         0.00
             Prob>chi2 =           .
             (V_b-V_B is not positive definite)
```

Appendix 6 : Breusch-Pagan test (Z-score)

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
       Ho: Constant variance
       Variables: fitted values of Zscore

       chi2(1)       =      6.88
       Prob > chi2   =    0.0087
```

Appendix 7: Wooldridge test (Z-score)

```
. xtserial  Zscore HHI LTD Size CAP NIM NII Crisis DI Inflation GDPgrowth

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F( 1,     16) =    81.954
          Prob > F =      0.0000
```

Appendix 8 : Fisher test (NPL)

```
. ovtest

Ramsey RESET test using powers of the fitted values of NPL
       Ho:  model has no omitted variables
             F(3, 224) =        0.64
             Prob > F =       0.0000
```

Appendix 9 : Hausman test (NPL)

```
hausman fixed random
```

| | ── Coefficients ── | | | |
| | (b) | (B) | (b-B) | sqrt(diag(V_b-V_B)) |
	fixed	random	Difference	S.E.
HHI	-3.620998	-.3983326	-3.222666	.7799452
LTD	-.0032112	.0252662	-.0284774	.0082819
Size	-10.46168	1.478302	-11.93998	.9383867
CAP	-.4911967	.9642326	-1.455429	.0554197
NII	.4606258	1.273165	-.8125393	.3617259
Crisis	3.590415	1.0749	2.515515	1.614168
DI	4.698123	1.396675	3.301448	.8524942
Inflation	.4527273	-.2697496	.7224769	.2540622
GDPgrowth	.1996481	.0731034	.1265447	.1236911
NIM	-6.234048	-.0709505	-6.163098	.4276411

```
                  b = consistent under Ho and Ha; obtained from xtreg
         B = inconsistent under Ha, efficient under Ho; obtained from xtreg

  Test:  Ho:  difference in coefficients not systematic

             chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =     2177.21
             Prob>chi2 =      0.0000
```

Appendix 10 : Breusch-Pagan test (NPL)

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of NPL

        chi2(1)      =     92.45
        Prob > chi2  =    0.0000
```

Appendix 11 : Wooldridge test (NPL)

```
. xtserial NPL HHI LTD Size CAP NIM NII Crisis DI Inflation GDPgrowth

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      16) =     83.636
           Prob > F =      0.0000
```

Appendix 12 : GMM Regression linear relationship (Z-score)

```
Dynamic panel-data estimation, two-step system GMM
─────────────────────────────────────────────────────────────────────────
Group variable: id                      Number of obs      =        221
Time variable : Year                    Number of groups   =         17
Number of instruments = 14              Obs per group: min =         13
Wald chi2(11) =    2580.12                             avg =      13.00
Prob > chi2   =      0.000                             max =         13
─────────────────────────────────────────────────────────────────────────
      Zscore │     Coef.   Std. Err.      z    P>|z|    [95% Conf. Interval]
─────────────┼───────────────────────────────────────────────────────────
      Zscore │
         L1. │   .6778439   .1480047     4.58   0.000    .3877599    .9679279
             │
         HHI │   -2.89052    .999014    -2.89   0.004   -4.848552   -.9324888
    GDPgrowth │   .0167972   .0846138     0.20   0.843   -.1490428    .1826372
    Inflation │   .0662647   .1509047     0.44   0.661   -.2295031    .3620325
         LTD │  -.0345912   .0099747    -3.47   0.001   -.0541412   -.0150412
        Size │   2.918795   .7255958     4.02   0.000    1.496653    4.340936
         CAP │   .6258598   .2701743     2.32   0.021    .0963278    1.155392
         NIM │    .863045   1.118908     0.77   0.441   -1.329975    3.056065
         NII │   .9570931   .4829489     1.98   0.048    .0105307    1.903656
          DI │  -.8041532   .3403701    -2.36   0.018   -1.471266   -.1370401
       Crisis │   .1392962   1.273645     0.11   0.913   -2.357001    2.635594
       _cons │  -18.18906    13.9264    -1.31   0.192    -45.4843    9.106187
─────────────────────────────────────────────────────────────────────────
Instruments for first differences equation
  Standard
    D.(HHI GDPgrowth Inflation LTD Size CAP NIM NII DI Crisis)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/3).L.Zscore collapsed
Instruments for levels equation
  Standard
    HHI GDPgrowth Inflation LTD Size CAP NIM NII DI Crisis
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.L.Zscore collapsed
─────────────────────────────────────────────────────────────────────────
Arellano-Bond test for AR(1) in first differences: z =  -2.13  Pr > z =  0.033
Arellano-Bond test for AR(2) in first differences: z =  -1.31  Pr > z =  0.189
─────────────────────────────────────────────────────────────────────────
Sargan test of overid. restrictions: chi2(2)    =    3.36  Prob > chi2 =  0.186
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(2)    =    0.75  Prob > chi2 =  0.686
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:      chi2(1)   =    0.29  Prob > chi2 =  0.592
    Difference (null H = exogenous): chi2(1)   =    0.47  Prob > chi2 =  0.495
```

Appendix 13: GMM Regression linear relationship (NPL)

```
Dynamic panel-data estimation, two-step system GMM

Group variable: id                        Number of obs      =        221
Time variable : Year                      Number of groups   =         17
Number of instruments = 18                Obs per group: min =         13
Wald chi2(11) =  1.72e+06                              avg =      13.00
Prob > chi2    =     0.000                             max =         13
```

NPL	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
NPL						
L1.	.95538	.0362426	26.36	0.000	.8843459	1.026414
HHI	-.9981649	1.971026	-0.51	0.008	-4.861306	2.864976
LTD	.0222647	.0058092	3.83	0.000	.0108788	.0336505
Size	.4102877	.2115601	-1.94	0.052	-.8249379	.0043626
CAP	-.1482565	.0555742	-2.67	0.008	-.2571799	-.0393331
NIM	-.5100968	.1870973	-2.73	0.006	-.8768008	-.1433928
NII	-.1365896	.1322526	-1.03	0.302	-.3957999	.1226207
Crisis	.7979269	.7861793	1.01	0.310	-.7429562	2.33881
DI	.3777303	.2301902	1.64	0.101	-.0734343	.8288949
Inflation	.1059667	.1243327	0.85	0.394	-.1377209	.3496544
GDPgrowth	-.0432119	.061469	-0.70	0.482	-.163689	.0772652
_cons	15.06022	19.00649	0.79	0.428	-22.19182	52.31225

```
Instruments for first differences equation
  Standard
    D.(HHI LTD Size CAP NIM NII Crisis DI Inflation GDPgrowth)
Instruments for levels equation
  Standard
    HHI LTD Size CAP NIM NII Crisis DI Inflation GDPgrowth
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL(2/8).L.NPL collapsed

Arellano-Bond test for AR(1) in first differences: z =  -3.16  Pr > z =  0.002
Arellano-Bond test for AR(2) in first differences: z =  -1.08  Pr > z =  0.280

Sargan test of overid. restrictions: chi2(6)    =  19.69  Prob > chi2 =  0.003
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(6)    =  10.00  Prob > chi2 =  0.125
  (Robust, but weakened by many instruments.)
```

Appendix 14 : GMM regression non-linear relationship (Z-score)

```
Dynamic panel-data estimation, two-step system GMM
```

Group variable: id			Number of obs	=		221
Time variable : Year			Number of groups	=		17
Number of instruments = 23			Obs per group: min =			13
Wald chi2(12) = 10947.68				avg =		13.00
Prob > chi2 = 0.000				max =		13

Zscore	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Zscore						
L1.	.5646774	.1007351	5.61	0.000	.3672403	.7621146
HHI	-222.0176	115.4882	-1.92	0.055	-448.3702	4.335047
HHI_sq	12.68433	6.689824	1.90	0.058	-.4274878	25.79614
GDPgrowth	.1911924	.1021868	1.87	0.061	-.0090901	.3914749
Inflation	.0272256	.1491559	0.18	0.855	-.2651146	.3195659
LTD	-.0244808	.0077967	-3.14	0.002	-.0397621	-.0091996
Size	2.585124	.5416302	4.77	0.000	1.523548	3.646699
CAP	.5955259	.1648862	3.61	0.000	.2723549	.9186968
NIM	1.322165	1.160087	1.14	0.254	-.9515641	3.595894
NII	1.178726	.633937	1.86	0.063	-.0637674	2.42122
DI	-.8888244	.3911074	-2.27	0.023	-1.655381	-.122268
Crisis	2.928458	1.829828	1.60	0.110	-.6579397	6.514856
_cons	931.1985	492.7729	1.89	0.059	-34.61869	1897.016

```
Warning: Uncorrected two-step standard errors are unreliable.
```

Appendix 15 : GMM regression non-linear relationship (NPL)

```
Group variable: id                          Number of obs      =         221
Time variable : Year                        Number of groups   =          17
Number of instruments = 19                  Obs per group: min =          13
Wald chi2(12)  =   5837.76                                 avg =       13.00
Prob > chi2    =     0.000                                 max =          13
```

NPL	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
NPL						
L1.	.9264931	.0469686	19.73	0.000	.8344363	1.01855
HHI	-786.1193	393.8244	-2.00	0.046	-1558.001	-14.2377
HHI_sq	45.3988	22.74067	2.00	0.046	.8279025	89.9697
GDPgrowth	.5969239	.296805	2.01	0.044	.0151967	1.178651
Inflation	.5600656	.313553	1.79	0.074	-.054487	1.174618
LTD	.0328904	.0074656	4.41	0.000	.018258	.0475228
Size	.0346645	.2192669	0.16	0.874	-.3950908	.4644198
CAP	-.1571982	.0601525	-2.61	0.009	-.2750949	-.0393015
NIM	-.8478414	.3554428	-2.39	0.017	-1.544496	-.1511863
NII	.0973843	.3339192	0.29	0.771	-.5570852	.7518539
DI	-.2579968	.8852683	-0.29	0.771	-1.993091	1.477097
Crisis	11.15957	4.487567	2.49	0.013	2.364097	19.95504
_cons	3395.784	1701.609	2.00	0.046	60.69101	6730.877

```
Instruments for orthogonal deviations equation
  Standard
```

```
Instruments for orthogonal deviations equation
  Standard
    FOD.(HHI GDPgrowth Inflation LTD Size CAP NIM NII DI Crisis)
Instruments for levels equation
  Standard
    HHI GDPgrowth Inflation LTD Size CAP NIM NII DI Crisis
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL(4/11).L.NPL collapsed
```

```
Arellano-Bond test for AR(1) in first differences: z =  -3.53  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -1.32  Pr > z =  0.188
```

```
Sargan test of overid. restrictions: chi2(6)    =  12.29  Prob > chi2 =  0.056
  (Not robust, but not weakened by many instruments.)
```

Appendix 16 : GMM regression Effect of size on financial instability

```
Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:      chi2(4)    =   1.29  Prob > chi2 =  0.863
    Difference (null H = exogenous): chi2(1)    =  -0.03  Prob > chi2 =  1.000
Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: id                          Number of obs      =        221
Time variable : Year                        Number of groups   =         17
Number of instruments = 17                  Obs per group: min =         13
Wald chi2(13) =   8430.85                                  avg =      13.00
Prob > chi2   =     0.000                                  max =         13
------------------------------------------------------------------------------
     Zscore |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
     Zscore |
        L1. |   .8822991    .181192     4.87   0.000     .5271694    1.237429
            |
        HHI |    15.2468   8.357446     1.82   0.068    -1.133489     31.6271
   GDPgrowth |   .2165202   .1140412     1.90   0.058    -.0069964    .4400368
   Inflation |   .1764285    .162393     1.09   0.277     -.141856    .4947129
        LTD | -.0221992   .0060224    -3.69   0.000    -.0340028   -.0103955
       Size |   92.01538   33.57362     2.74   0.006     26.21229    157.8185
        Cap |   .2845331   .2314303     1.23   0.219     -.169062    .7381281
        NIM |    .299629    .762657     0.39   0.694    -1.195151    1.794409
        NII |   .7056059   .3407119     2.07   0.038     .0378227    1.373389
         Di | -.4740894   .3270684    -1.45   0.147    -1.115132    .1669529
      Crisis |   2.842565   1.594525     1.78   0.075    -.2826455    5.967776
  Size.HHI2 |   1.063672   .4374284     2.43   0.015     .2063277    1.921016
   Size.HHI | -19.69274   7.660179    -2.57   0.010    -34.70641   -4.679063
       _cons | -153.4994   72.81058    -2.11   0.035    -296.2056   -10.79332
------------------------------------------------------------------------------
Warning: Uncorrected two-step standard errors are unreliable.
```

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```
Instruments for first differences equation
  Standard
    D.(HHIassets GDPgrowth Inflation LTD lnassets cap NIM NII Garantie crisis
    AH AH2)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(9/11).L.Zscore collapsed
Instruments for levels equation
  Standard
    HHIassets GDPgrowth Inflation LTD lnassets cap NIM NII Garantie crisis AH
    AH2
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL8.L.Zscore collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -2.49  Pr > z =  0.013
Arellano-Bond test for AR(2) in first differences: z =  -1.23  Pr > z =  0.218
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(3)    =    5.03  Prob > chi2 =  0.170
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(3)    =    2.63  Prob > chi2 =  0.452
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:    chi2(2)   =    2.48  Prob > chi2 =  0.289
    Difference (null H = exogenous): chi2(1)   =    0.15  Prob > chi2 =  0.700
```

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