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Topic

Non-Interest Income Activities, Bank Performance and Risk During Crises: Evidence from Tunisian Banks

Presented and defended by:

Rana Zoghlami

Supervised by:

Mrs. GANA Marjene

Student belonging to:

STB BANK

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Abstract

Using a sample of 10 Tunisian listed banks from a period going from 2005 to 2020, we investigate the effect of diversification into non-interest income-generating activities on both bank performance and risk during (i.e., financial and sovereign debt crisis, political crisis, and health crisis) compared to non-crisis period. Three main results emerge. First, bank risk (performance) significantly decreases (increases) if banks increase their share of non-interest income and this relationship is strengthened during the crisis period. Second, further analyses show that short-term trading income has a positive effect on bank performance and a negative one on its risk whereas long-term trading increases significantly non-performing loans. Hence, it's better for banks to diversify into profitable non-interest income sources to enhance their performance and their financial stability mainly when crises occur.

Keywords: Non-interest income; Bank Performance; Bank Risk; Financial and Debt Crisis (FDC); Political Crisis (PC); Health Crisis (COVID-19 pandemic; HC).

Résumé

A l'aide d'un échantillon de 10 banques tunisiennes cotées en bourse sur une période allant de 2005 à 2020, nous étudions l'effet de la diversification dans des activités générant des revenus autres que des intérêts, sur la performance et le risque des banques pendant (i.e. la crise financière et de la dette souveraine, le crise politique et la crise sanitaire) par rapport aux périodes de non-crise. Trois résultats principaux émergent. Premièrement, le risque (la performance) des banques diminue (augmente) de manière significative si les banques augmentent leur part de revenus hors intérêts et cette relation se renforce pendant la période de crise. Deuxièmement, des analyses plus poussées montrent que les revenus de trading à court terme ont un effet positif sur la performance des banques et un effet négatif sur leur risque, tandis que le trading à long terme augmente les prêts non performants. Par conséquent, il est préférable pour les banques de se diversifier dans des sources de revenus hors intérêts rentables afin d'améliorer leurs performances et leur stabilité financière, principalement en période de crise.

Les Mots Clés : Revenu hors intérêts ; Performance bancaire ; Risque bancaire ; Crise financière et de la dette (FDC) ; Crise politique (PC) ; Crise sanitaire (pandémie de COVID-19 ; HC)

Abbreviations

ATM: Automated Teller Machine

CAR: Capital Adequacy Ratio

CBA: Canadian Bankers Association

CBT: Central Bank of Tunisia

EDBT: The Economic Development Bank of Tunisia

EU: European Union

GCC: Gulf Cooperation Council

GDP: Gross Domestic Product

GFC: The Global Financial Crisis

HII: Herfindahl-Hirschman Index

IFRS: International Financial Reporting Standards

IMF: International Monetary Fund

IPO: Initial Public Offering

LCR: Liquidity Coverage Ratio

LTD: Loans to Deposit

M&A: Mergers and Acquisitions

MENA: Moyen-Orient et de l'Afrique du Nord

MMR: Money Market Rate

NDBT: The National Development Bank of Tunisia

NIM: Net Interest Margin

NOI: Net Operating Income

NPL: Non-Performing Loan

OBS: Off-Balance Sheet Activities

ROA: Return on Assets

ROE: Return on Equity

SHNII: The Share of Non-Interest Income

US: United States

VIF: Variance Inflation Factor

WHO: The World Health Organization

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GENERAL INTRODUCTION

The banking sector is one of the most fundamental financial sectors within an economy, playing a key role in supporting and driving its growth. This sector has experienced, over the world, tremendous diversification levels spurred by interest rate liberalization, financial disintermediation, market innovation, increasing competition, and technological progress over the last two decades. Indeed, policymakers and bank supervisors, on a multi-country level, have deregulated the scope of bank income diversification, lowered barriers among credit institutions to increase competitiveness, and made repeated recommendations to banks to diversify their activities (Guindos, 2020). This change has propelled the banking business towards a greater level.

The new banking environment change has dramatically altered Tunisian commercial banks. Over the years, traditional interest income has been the major source of revenue for the Tunisian banking sector. However, in response to the environmental change, these financial intermediaries have been steadily shifting away from the core-banking sources of income as loan-making and toward the multiple-revenue structure of both net interest income and non-interest income. According to the central bank of Tunisia's supervision report, in 2020 approximately 45% of Tunisian banks' net operating revenue came from a variety of non-interest sources, namely, X forex operations, insurance, service charges, short-term trading revenue, investment activities, as well as bank fees and commissions, were particularly important in driving industry revenue growth.

The literature on bank functional diversification has analysed the benefits and costs associated with this business strategy developed. From a theoretical standpoint, Markowitz's portfolio theory (1952) shows that investors should diversify since diversification maximizes investors' expected return for a given level of risk. Related to empirical studies, a large stand of research supports the idea that income diversification can create economies of scale by sharing activities (Barney, 1991); reduce a bank's monitoring cost and agency problem (i.e, Diamond, 1984; Chiorazzo et al. 2008), tends to enhance competitive advantage (i.e, Meslier et al. 2014 and Trivedi, 2015) and thus, boost the bank' market power using profits from one market to support predatory pricing in another market (i.e, Barney, 1991; Montgomery, 1994). Furthermore, related to the managerial efficiency theory, income diversification might reinforce the intermediation role of banks and motivate managerial efficiency. Thus, the

decision to diversify activities is desirable for both bank performance and risk management. Indeed, income where reductions in costs (especially fixed cost), the cross-selling of various products alongside other based services (Herring and Santomero, 1990) and efficiencies established by banks will increase profitability (i.e, Drucker and Puri 2009; Hamdi et al. 2017).

On the other hand, related to the traditional cost theory, when the costs exceed diversification benefits, this leads to a diversification discount instead of a diversification premium which hurts performance and increases bank risk (Lepetit et al., 2008; Laeven and Levine, 2007). In the light of agency theory, Pozsar et al. (2010) report that higher levels of income diversifications make the bank system too complex and, thus, substantial agency problems may arise. This statement is supported also by Laeven and Levine (2007). Some authors like Calmès and Liu (2009) and Wolfe et al (2007) provide empirical evidence that an increase in non-interest income share contributes to increased bank risk without increased profit. According to Stiroh (2004), non-interest income growth is much more volatile than interest income growth.

In the case of Tunisian banks, non-interest income activities are generally not very risky compared to developed countries, given that Tunisian bank managers generally are risk-averse and controlled by the central bank to not over-expand into industries with higher competition and higher risk (Abdelmoula, 2015). Moreover, banks' trading activities are based on less risky securities and mainly treasury bonds of the government. Furthermore, the results found for emerging and MENA banks provided evidence that revenue diversification into interest and non-interest income enhances bank performance and reduces risk (Sanya and Wolfe, 2011; Lin et al., 2012; Lee et al., 2014). More specifically in the Tunisian context, Hamdi et al. (2017) find that non-interest income is significantly associated with a higher level of profitability and lower risk. In contrast, using data from 19 commercial Tunisian banks, Ayadi and Ellouze, (2015) point out that non-interest income activities do not affect bank performance.

In this study, we seek to resolve the conflicts in the literature by examining the impact of non-interest income activities on Tunisian banks' risk and performance. A question that sparks the bankers and regulators' attention is:

Does shifting toward non-interest income activities is beneficial for Tunisian banks?

Furthermore, only a handful of existing studies rigorously consider the effect of the crises on the relationship between bank income diversification and bank risk and performance (i.e, Elsas et al., 2010; Cheng et al., 2019; Kim et al., 2020). Not only do these previous studies have inconclusive findings, but the empirical evidence and findings in the bank functional diversification literature are primarily based on the U.S banking industry, with much less focus on the emerging markets. Moreover, Tunisia has experienced successive crises of several types, both national, i.e the political crisis (2011 revolution), and international, such as the subprime crisis, the European debt crisis and the present health crisis. There is an ongoing debate on whether banks suffer or benefit from their income diversification strategy in an unstable context (crisis time) compared to a stable one.

A variety of studies reveal positive effects of non-interest income on bank performance and financial stability during the crises. They argued their finding by the fact that, banks turn to non-core business activities, which is an attempt to preserve revenue, when interest rates are low and during crises where there is an aggravation of default and liquidity risks (Curry et al. 2008; Ahmad et al. 2008), that non-interest income activities looks like as a shock absorber which can consolidate banks' revenues in times of crisis (Kamani, 2018; Simoens and Vennet, 2020) which can consolidate banks' revenues in times of crisis. In contrast, recent academic research shows opposite results. The disadvantages of non-traditional banking activities may outweigh the advantages in the crisis period. DeYoung and Torna (2013) concluded that non-interest income activities could reduce stability during a crisis period. Accordingly, DeJonghe (2010) displayed that banking institutions that are heavily involved in non-traditional activities are characterized by higher risks, which makes them more vulnerable to several market and macroeconomic shocks. Crises may badly weaken the financial health of the banking industry as documented by Williams (2016), however, the joint interaction between crises and non-interest income activities may lead to appreciation in that case.

For that reason, we wonder whether non-core-banking business activities differently impact bank performance and risk during the crisis period from how it does during the non-crisis period. In other words, the relationship between the share of non-interest income and bank risk and performance can have a temporal dimension (Kim et al. 2020). More specifically, we attempt to provide answers to the second following central question:

It is better for banks to increase the share of non-interest income activities during the crisis period, than concentrate on the core banking activity?

More importantly, we assume that crises do have not the same source or type (financial, economic, health, etc). Therefore, they don't also have the same consequences and impacts. That is to say the impact crisis period on the relationship between the non-interest income activities and bank risk/ performance differ depending on the type of crisis and its specificities. Thus, we try to answer the following question:

Does the crisis type matter on the non-interest income and bank risk/performance nexus?

In our empirical analysis, we used data from 10 listed Tunisian banks between 2005 and 2020, to first examine the effects of non-interest income-generating activities on bank risk and performance. Then, following previous studies (Cheng et al., 2019 and Park et al., 2020), we partition the entire sample period into two sub-periods (based on micro and macroeconomic analysis): "tranquil" period (2005-2008 and 2014-2019) and crisis period (2009-2013 and the fiscal year 2020) we investigate whether this relationship differs during the crisis and non-crisis periods. After that, in order to analyse the effect of each crisis separately, we have use dummy variables for each crisis (financial and debt crises (2009-2010), political crisis (2011 to 2013) and health crisis related to the COVID-19 pandemic), and adopt a methodology similar to Kim et al. (2020) and Onali and Mascia (2020). In this thesis, non-interest income is measured by the share of non-interest income in total operating income, following the research by Stiroh & Rumble (2006). Bank performance is measured by the (ROA) ratio and risk by Zscore ratio. Then, to test the robustness of our results, we perform additional tests; alternative measures of our dependent variables (ROE) and (NPL) for bank performance and risk, respectively and the Chow test of stability, following Cheng et al. (2019).

There are several motivations for our study. First, as Tunisian banks have developed, competitive pressure has pushed commercial banks to gradually reduce their dependence on traditional banking activities and modify their business model. This background motivates us to explore banks' business models. Second, not only do the previous studies have inconclusive findings, the empirical evidence and findings as well. These limitations motivate us to conduct a descriptive and empirical analysis of the different effects of non-interest income on banks' risk and performance during each crisis compared to the "normal" period. Then, in light of the different crises, regulators and banks need to understand if the diversification into non-traditional activities is beneficial to bank profits and stability especially during the economic downturn. Lastly, policy considerations motivate our research. As highlighted by Calomiris and Mason (2003), bank risk affects financial and economic fragility. The changing the business models may affect Tunisian banking sector risk

specifically during crises, it is an issue of concern for government supervisors. Finally, the existing studies further support the value of this research. Tunisia is an interesting setting for our research as so little is known about its banks' business models. We do know that the Tunisian banking sector has withstood the previous crises of recent years, which indicates that Tunisian banks have certain unique characteristics that set them apart from banks in other countries. These factors make our research important. Therefore, this study seeks to investigate the non-interest income-generation activities and their effects on Tunisian bank risk and performance during crises versus the "tranquil period".

This study makes four main contributions regards the existing literature. First, our work fills a gap in the literature on the implications of non-interest income-generating activities on the bank risk and performance in the Tunisian banking sector. The related literature mostly focuses on the implications of non-interest income bank risk and/or performance using US or European data (i.e, Kohler 2015; De Young and Torna 2013). Second, to the best of our knowledge, it's the first study that investigates this issue by considering crises impact, specifically, by introducing various type of crises and comparing the questioned relationship during the crisis period to the on-crisis period. Third, for the robustness of our results, we used various tests to non-interest income on bank risk and profitability in Tunisia. Furthermore, no empirical studies have considered the effect of the COVID-19 pandemic on the relationship between non-interest income activities and bank risk and performance except for China context.

The remainder of this study proceeds as follows: a literature review and empirical evidence are reported in the first chapter related to non-interest income effect on Tunisian banks' performance and risk during the crisis and non-crisis periods. At the end of the first chapter, we present an overview of the Tunisian banking sector. Then, the second chapter describes data and variables understudy. It also presents the methodology and reports empirical results as well as a battery of robustness checks. The conclusion is presented in the last part.

CHAPTER 1:

NON INTEREST ACTIVITIES, BANK PERFORMANCE AND RISK:

LITERATURE REVIEW

Introduction

As financial intermediaries, banks are the most important channel of money circulation between households, firms, and financial markets. The expansion of all intern areas and wireless technologies, as well as the removal of barriers to investment and international finance, are radically changing the structure and nature of financial services and rendering them more accessible. Hence, banks are considered as the backbone of economic development. However, in recent years, it there been a deterioration in interest margins of the international banking system. Consequently, banks resorted to non-interest resources. Unconventional activities such as investment banking, stock trading and brokerages have rapidly expanded, increasing non-interest income for banks. Nonetheless, there is no consensus in previous studies on the effects of non-interest income on bank performance and risk (DeYoung and Roland, 2001; Acharya et al., 2002; Stiroh, 2004b; Stiroh and Rumble, 2006; Meslier et al., 2014 Nguyen et al., 2015; Williams, 2016; Hamdi et al., 2017; Brahmana et al., 2018). This has led to a wide range of research on the potential relevance of adopting the new business model by financial institutions. In this regard, other researchers (i.e, Park et al., 2019; Flori et al. 2019; Cheng et al. 2019; Kim et al., 2020) have studied the effect of revenue diversification on banks' risk and return while taking into account the temporal specificity (normal period and crisis period). The findings of Kim et al. (2020) suggest that, although regulators incentivize diversification to limit bank risk, revenue diversification may exacerbate financial instability or even increase the risk of financial market crashes in the case of a financial crisis. This implies that the effects of diversifying income are contingent on the country's environment and regulations.

This chapter will provide a more in-depth understanding of how non-interest income activities impact bank performance and risk during the crisis and the non-crisis periods. First, there is an overview of the income diversification strategy related to changes in global finance, the relevant theories, the " merits" and "shortcomings" of such a strategy and an explanation of the banking risk and performance concepts. The subsequent section exposes the theoretical explanations behind non-interest income, bank risk and performance link, and highlights how crises influence the effect of non-interest income on bank risk and performance. Flowingly, we review the appropriate empirical research. And finally, in light of what emerges from the theoretical framework and the empirical results, we formulate our testable hypotheses.

I. Non-interest income and bank diversification

By financing economic activities and key market segments, banks are the heart of all economies. Indeed, profitable banks contribute to the stability and prosperity of the financial sector. In this section, we will focus on the diversification of the banking sector's revenues, discuss the bank's commercial strategy in general and then specifically address its earnings strategy and its non-interest income sources, to finally treat performance and risk for such institutions.

I.1. The transformation of the financial system and its impact on banks' business model

The banking industry has an important position in the financial system. In fact, it helps ease payments, the monetary decision process, and the establishment of a stable financial system. Banks serve as collectors of public funds and distribute them to debtors in the form of credits. *"A healthy bank performs its function well, thus, it will gain the trust of the community" (Susilo, 2000).*

An important change in the world's financial system, particularly in the banking system, was the introduction in the late 1980s of new prudential regulation standards outlined in the Basel Agreement. Over the years, traditional interest income[1] has been the main source of revenue for the banking system. However, due to increased competition in the financial sector and technology improvements, banking activities and products are changing rapidly. In fact, these factors are interrelated and affect banks simultaneously (Tome et al., 2012), as technology improvements influence the banking products and distribution channels, hence, impacting the bank's business model. The most noticeable improvements are in payment methods, more precisely, the increase in the use of credit cards and online payments. As a matter of fact, traditional paper-based transactions were surrogated by electronic network transactions which include the primarily internet-based electronic stock exchange, e-cash services, electronic banking, and smart cards (Herbst, 2001, p. 207-208). Basing on a sample of Spanish banks, Hernando and Nieto (2007) provided evidence that, over time, online banking was associated with lower costs and higher profitability. In a related study, De Young et al. (2007) reported that internet adoption improved U.S. bank profitability, mainly through deposits fees. Both

[1] We mean net interest income, which is defined as total interest income less total interest expense.

papers concluded that the internet channel is a complement to, rather than a substitute for, physical bank branches.

Moreover, the rise of Fintech[2] has accelerated the adoption of digital banking by drastically cutting fees and encroaching on big bank income and profits.

Technology improvements and database building had a great influence on the credit assessment process. In fact, retail loan applications are now routinely evaluated using credit scoring tools rather than a subjectively with the intervention of human judgment. Such an objective approach makes underwriting much more transparent to stakeholders and facilitates secondary markets for credits. In this spirit, technology can be thought of as a package of decisions taken out of the hands of the customer. Nowadays, to get optimal results, banks are obliged to follow the technological advancements and adjust their business strategies.

More specifically, several empirical studies (Chiorazzoet al., 2008; Curry et al., 2008; Ahmad et al., 2008; Does et al., 2013; among others) found that, following the global financial crisis, banks activities and business models have undergone large transformations. In fact, profound changes in cross-border banking activity, money and securitization markets, technological innovation, and the post-crisis regulatory response have affected how banks finance themselves, grant credits and maximize their profitability[3]. Nichkasova and Shmarlouskayae (2020) note that the potential strategic approach for the development of banks is both evolutionary and revolutionary, involving the transformation of their classical business model into a technology company. Therefore, organizations need to reconsider their productivity and survival tactics (business strategies) given that they are functioning in environments characterized by incessant competition, operational complexities as well as erratic fluctuations (By et al., 2009).

I.2. Bank diversification strategies

Over the last few decades, financial institutions have embarked upon drastic change on a global scale. Specifically, banks have adopted a diversification approach to move away from a traditional deposit-taking and lending model toward a more developed business model. Moreover, they have experienced many significant reforms over the years, featured by the shifts from specialized to diversified business models.

[2] Financial technology (Fintech) is used to describe new tech that seeks to improve and automate the delivery and use of financial services. For more detail see: https://www.investopedia.com/terms/f/fintech.asp
[3] https://www.bis.org/am_office/wgfinstab/cbbm.htm

I.2.1. Concept definition

The concept of diversification has been embraced by organizations to create value. It is defined as a risk management strategy that mixes a wide array of investments within a portfolio. In the contemporary competitive and evolving business environment, one of the key areas that have emerged is diversification as a strategy adopted by organizations to improve their performance (Benartzi and Thaler, 2001). It's considered as one of the important subjects of the finance literature and one such strategy for exploiting existing bank-specific resources (Ray et al., 2004). The diversification strategy is crucial for a bank that represents the strategic reaction to the bank disintermediation.

I.2.2. Related Theories on bank diversification

According to Karani et al. (2018) diversification strategy is related to:

- Market Power[4]Theory: Attainment of individual power by a firm in the market is a prerequisite towards the attainment of conglomerate status (Gribbin, 1976). The proponent of the market power theory was Porter (1980) and the argument has been presented regarding a firm's position relative to competitors based on a set of strategies. The market power theory related to the business model suggests the adoption of diversification to enhance competitive advantage and bank profitability by using profits from one market to support predatory pricing in another (Montgomery, 1994; Barney, 1991).
- Traditional Portfolio Theory: was developed by Harry Markowitz (1952), this theory deems that for the same expected return, a diversified portfolio is less risky than undiversified ones because diversification strategy eliminates the firm-specific risk. Maximizing profitability requires careful risk management, which is based on diversification. This last is the mixing of a portfolio of assets between risky ones or combining them with risk-free ones. The related E-V rule implies the superiority of diversification, except for some particular cases where an undiversified portfolio can present the optimal choice. Markowitz theory, therefore, provides a means of assessing the profit and risk that could accrue to a firm facing investment decisions (Cochrane, 2013). Banks, therefore, have to make a decision on how to invest to make optimum

[4] The market power is the ability of a bank to practice opportunistic prices by profitably raising the market price of financing service over marginal cost (Zouaoui and Zoghlami, 2020).

returns. Portfolio diversification is a way of managing a given portfolio by diminishing the instability and risk of a given set of unlike investments, assets, or products (Mutega, 2015).

- Diffusion of Innovation Theory: It was developed and popularized by Rogers (1962). In line with this theory, firms are considered to engage in a 'vicious circle' (Chandler, 1977, 1990); specializing first to build a resource pool and thus an innovative position and then diversifying to exploit economies of scope of this pool (Silverman, 1999; Miller, 2004 Rodriguez-Duarte et al., 2007). Accordingly, MA Hitt (1994) suggests that geographical diversification is positively related to both innovation and firm performance.
- Agency theory: The information asymmetry aspect of agency theory constitutes a relevant risk and hinders principal-agent relationships. The theory assumes that managers can widen the range of activities to extract private benefits (Jensen and Meckling, 1976). Agency costs weaken the profitability of diversified banks or financial conglomerates. When banks diversify their activities their organizational structure becomes more complex, thus, substantial agency problems may arise. This leads to asymmetric information between managers and shareholders which generates more costs and reduces profitability (Harris et al., 1982; DeYoung and Roland, 2001; Elyasiani and Wang, 2012). In light of the income diversification strategy, Pozsar et al., 2010 state that shifting toward non-traditional activities increases management costs.
- Traditional cost theory: this theory is based on a short-run as well as a long-run basis. When the costs associated with diversification exceed its benefits, diversification hurts performance (Lepetit et al., 2008). Excessive costs might arise from inefficient investment decisions over internal capital markets and from increased business complexity and bureaucracy. Supporting this idea, DeYoung and Roland, (2001) highlight that diversification through non-traditional business areas raises fixed costs due to new inputs' costs in technology and human resources. However, Barney (1991) argues that diversification based on resource capabilities can create economies of scale by sharing activities and core competencies transfer as a source of sustainable competitive advantage. In addition, Diamond (1984) finds that diversification reduces a bank's monitoring costs. Neverthless, Laeven and Levine, (2007) report that engaging in multiple activities destroys financial conglomerates' value due to increased costs and that economies of scope are not sufficient to compensate this loss which leads to a diversification discount instead of a diversification premium.

I.2.3. Why do banks opt for a diversification strategy

With the aim answering the question “why banks diversify?”, there has been a growing literature has taken up this task. A large stand of research provides empirical evidence that diversification is beneficial for a bank ((Montgomery, 1994; Yuliani et al., 2013; Mulwa et al. 2015). For example, Boyd and Prescott (1986) argue that a bank needs to be diversified as much as possible to optimize its value and reduce its costs. Thus, the motives behind diversification decisions are numerous and include; the synergistic motive, the financial motive as advanced in portfolio theory of Markowitz, the search for market power (related to market power theory), the application of resource bundles to attain competitive advantage (according to the innovation theory), the solution to agency problems (according to agency theory (Stulz, 1990; Stein, 2002)), the cost efficiency motive through economies of scale (based on traditional agency theory) and the cross-selling of various financial products alongside other based services (Herring and Santomero, 1990).

The ultimate goal of any bank is to grow its wealth. In other words, the benefits arising from positive spillovers to other industries are another reason why firms opt for diversification decisions. At the time of globalization and open borders, this goal is often hampered by the lack of capital necessary for the implementation of development strategies of banks. Firms diversify in response to environmental changes; search on this topic, consider diversification as an avenue to extend the boundaries of a firm as a result of problems that arise from internal coordination processes (Grossmann, 2007). Furthermore, imperfections in the financial markets force managers to diversify their activities and allocate funds more efficiently (Klein & Lien, 2009). Accordingly, the new reforms allow banks to diversify their products into new areas of business, offshoots of existing businesses, to satisfy a varied clientele by offering a wider range of products, and at the same time, banks became wider spreading their operations across many geographical markets to compete more effectively and to increase their potential revenues. When firms engage in diversification strategy, they stand a chance of reaping from economies of scale (due to the joint production of a wide range of financial services (Teece, 1982) by getting involved in the distribution of resources and capacities. Furthermore, firms could achieve allocation efficiency through the internal capital markets available in financial

conglomerates[5] (Stein, 1997; Tabash, 2019; Binh and Nguyen, 2020). As a consequence, an improvement in performance and/or reduction of idiosyncratic risk (Vander Vennet (2002).

I.2.4. Diversification typology

According to Kahl et al. (2015), Mercieca et al. (2007), and Paola et Valeria (2015), diversification can be understood as, on the one hand, penetration into new markets and investing in new products, and, on the other hand, enhancing the high level of relatedness of products. In the banking sector, the key and common approaches through which banks pursue diversification are income diversification, assets diversification, credit diversification, geographical diversification, and international diversification (Mulwa et al., 2015). For example, it can be done functionally by combining into a conglomerate such activities as commercial banking, trading, insurance, and other financial services (Baele et al., 2006) or forming a conglomerate of many banks (M&A activities) through a holding or banking groups (Kahloul and Hallara, 2010).

Following Olokoyo et al. (2020) bank diversification strategy can take specific forms as it is shown in the hereafter table (Tab. I.1).

Table I.1. Bank Diversification Strategy

Internal-Growth-oriented Diversification	**Product diversification**	**Marketing diversification**	**Service diversification**
-Financial Innovations -Customer satisfaction -Retained earnings -Efficient Staff -Compensatory scheme	-Mobile and internet banking -Agency banking -Money transfer services -Asset financing -Bank-assurance -Cash token	-Target Deposit Mobilization -Customer acquisition -Pricing -Advertising -Branding -Social Media Strategy	-Individual Banking services -Merchant services -Treasury services -Digital Banking services

Source: Researcher's Schematic Model (2020)

[5] Any group of companies under common control whose exclusive or predominant activities consist of providing significant services in at least two different financial sectors (banking, securities, insurance).

However, the most business diversification mentioned in the literature related to the banking sector is:

- Geographic diversification: is when banks expand their market locations and is considered as a way of reducing portfolio risk by avoiding excessive concentration in any one market (see Mercieca et al., 2007; Brighi and Venturellis, 2016).
- Income diversification: it is called also functional or activities diversifications in the banking literature. This kind of diversification is considered when banks operate in several businesses related to their function and increase the non-interest sources of revenue besides the core income intermediations activities. Ebrahim and Hasan (2008) define this type of diversification as the expansion into new income-earning financial services from distinct income-generating activities (Baele et al., 2006; Kiweu, 2012; Gambarcorta et al., 2014) other than the traditional intermediation services. The outcome of this kind of diversification is a reduction in risk level as well as higher risk-adjusted-performance. In light of the cross-subsidization theory, given the fact that there is a correlation between the non-interest activities and net interest income when a firm diversifies its sources of revenue, net operating income[6] is stabilized "the cross"[7]. According to this idea, income diversification is explained through the need for higher switching costs of the loan-based operations relative to fee-based activities and lower operating leverage of lending activities relative to fee-based activities. This variable is supported by the Portfolio theory which argues that a business needs to diversify its portfolio as a way of diversifying risk. It is argued that when the risk is diversified, commercial banks don't suffer from income volatility because it can be compensated with another venture (Milani et al., 2008). Generally speaking, diversification of a bank's income source reduces its dependence on the interest income from loan repayments, hence, the reduction in the bank credit risk.

Besides, diversification can be used for both sides of the balance sheet; that is, liability side and the asset side:

- Liability (funding) diversification: The diversification of funding is proxied as the non-deposit funding, that is as a share of total liabilities that reflects the reliance of

[6] Net operating Income is equal to the income from banking operations minus the expenses from banking operations.
[7] Refer to the stock market exchange.

banks on wholesale funding sources, such as interbank borrowing, repo agreements, certificates of deposit, commercial papers, and other debt securities.

- Asset diversification: Asset diversification is a group strategy joining together more than one asset to lower the whole investment portfolio risk (Mochabo et al. 2017). It is the practice of dividing a portfolio into a key asset class of equities, cash equivalents, fixed income, and alternatives (Derek, 2015). Asset diversification is the share of a portfolio spread through various classes of assets, regions, and markets. It involves the distribution of banks earning assets across lending assets and non-lending assets (Goetz et al., 2013).

As a gauge of banks' diversification strategy on both the assets and liability side, Demirgüç-Kunt and Huizinga (2010) note that, although the degree of diversification has declined relatively in some countries in the aftermath of the global financial crisis (Martel et al., 2012; Roengpitya et al., 2014), non-interest income and the liabilities from non-deposit sources are still widely regarded as the main determinants of bank' performance (Mergaerts and Vander Vennet, 2016). In our search study, we will concentrate on revenue diversification, mainly, on the bank non-interest component of income.

I.3. Bank income diversification strategy

In response to increased competition, and to maintain their market position, many conventional banks opted for diversifying their activities (Meslier et al., 2014). Hence, in this part, we will focus on the income diversification strategy and present the banks' sources of revenue and their effect on bank risk and performance.

I.3.1. Diversification of banking activities and the adoption of a new business model

In response to the changing financial systems, the increased competition from non-bank financial institutions, and the resulting pressure on net interest margins, banks adopted the new business model when they were first reflected in their non-core banking activities to increase market power, maintain their degree of competitiveness and increase their profitability. The development of these new sources of banking income, such as commissions and fees, is the other noticeable change in bank accounts.

Banks are involved in many business lines, such as personal and commercial banking, capital markets, wealth management, and insurance, generating revenue from a variety of businesses.

They categorize their revenue into two broad areas, based on how it is generated, which are net interest income and non-interest income. Nevertheless, interest received on various loans and advances to industries, corporates and individuals remain as a bank's main source of income.

Relatively, the level of income generated by banking activity is measured by net banking income, which is the difference between banking income and expenses from banking operations.

To clarify, let's consider bank revenue sources one by one:

- Interest on loans: Banks provide various loans and advances to industries, corporates, and individuals. The interest received on these loans is their main source of income.
- Interest on investments: Banks invest in various government and rated securities, and earn interest and dividends from these investments

The difference between interest on loans and interest on investments generates the net interest margin.

As for the non-interest-bearing activities, they can be regrouped as follows:

- Fees income: banks charge fees for performing services for their customers like syndication of loans, providing safety vaults, OBS activities[8], accepting bills of exchange, etc.
- Forex operations: banks also deal in foreign exchange and act as brokers
- Commission on third-party products: banks earn commission income by distributing insurance and mutual fund product.

I.3.2. Net interest sources of revenue: definition and determinants

Net interest income is generated from what is known as the 'spread'. The spread is simply the difference between the interest a bank earns on loans extended to customers and the interest paid to depositors and other creditors for the use of their money. In other words, it can be also defined as the difference between income and costs; that is, the difference between an asset's profitability (the credit lines and loans that the institution has on its balance sheet) and the

[8] Hassen et al. (1993) defined off-balance sheet activities as practices and products of banks that are not reflected in the on-balance sheet portfolio. This line of activities earns fee income that is not recorded in the bank's balance sheet.

interest that the bank pays for the resources it needs to finance that asset (such as wholesale[9] financing and customer deposits). If the bank interest income is greater than its interest cost, then bank profitability will logically increase. As it is stated in the theory of managerial efficiency earnings (Azam and Siddiqui, 2012).

Several studies investigated the determinants of net interest margin. Ho and Sanders (1981) proposed four factors for microeconomic analysis of a bank's interest margin: the average size of bank transactions, the degree of risk aversion, the market structure, and the variances of interest rates on loans and deposits. Similarly, by analysing 18 banks in Tunisia, for a period that spans from 2000 to 2013, Ben Moussa and Majouj (2016) provide evidence that internal factors such as risk, size, deposits and operating costs impact significantly the net interest margin, whereas macroeconomic factors, such as inflation, has a negative significant impact on NIM.

I.3.3. The non-interest income component of revenue

I.3.3.1. Definition

Non-interest income is defined as income generated by banks from sources unrelated to the collection of interest payments. This banks' income component is earned by providing a variety of value-added services, including trading of securities, arranging M&A for firms, brokerage commissions, investment banking, and advisory fees assisting companies to issue new equity financing, commissions on securities, and wealth management. Banks have more freedom to offer non-traditional products today than they had a decade ago, as a result of the relaxation of regulatory constraints. There are at least two reasons for the recent trends in non-interest income. First, it is explained by the technological and regulatory changes that opened up new sources of noninterest income. Second, non-interest income was believed to provide favourable attributes to a bank's revenue stream. Moreover, government deregulation has opened up the banking industry to previously unfelt market forces. As a result, banks face fierce competition and, with increased pressure, they have a greater incentive to exploit new sources of revenue[10].

I.3.3.2. Non-interest income' components

[9] Wholesale banking refers to banking services that are offered just to other institutional customers, huge companies with strong balance sheets, government agencies, local governments, and pension funds. It contrasts with retail banking, also called consumer banking, which is the provision of banking services to individual people.
[10] for more details see "Record bank profitability: How, who and what does it mean?" in the April 1998 *fedgazette.*

Feldman and Schmidt (1999) found that the rapid growth in non-interest income shows no signs of slowing. In this sense, they point out that the composition of non-interest income has also changed markedly during the last years. As a matter of fact, fee income has become the dominant source of non-interest income received by banks, replacing the traditional mainstays of service charges and income from trust activities.

Non-interest income is a mixture of heterogeneous components that differ in terms of their relative importance. It is derived primarily from fees relative to traditional banking activity including deposit and transaction fees, annual fees, monthly account service charges, inactivity fees, guarantee fees, check and deposit slip fees, and charges for a safety deposit box. Other forms of banks' non-interest income come from non-traditional activities, such as e-banking, ATM fees, brokering securities, portfolio management fees, corporate advisory fees, arranging M&A for firms, trading stocks and bonds, and forex income. Banks also earn noninterest income from real estate and from selling insurance. The following table (Tab. I.2) presents a recap of the non-interest income' sources states some examples.

Table I.2: Sources of non-interest income

Source of Non-interest Income	Examples
Income from Fiduciary Activities	Income from trust department transactions and services
Trading Revenue	Income from exposure to financial instruments relating to commodities, interest rates, foreign exchange, and equity securities and indices
Service Charges on Deposit Accounts	Charges for account maintenance, failure to maintain minimum balances, and processing of "insufficient funds" checks
Fee Income	Fees from credit cards, securitizing loans, mortgage refinancing and servicing, sales of mutual funds and annuities, and ATM surcharges
Other non-fee income	Income received from data processing services, sales of miscellaneous assets, and other income.

Source: Federal reserve bank of Minneapolis

I.3.3.3. Non-interest income determinants

Functional diversification is an endogenous decision that reflects a change in the managerial focus (Stiroh and Rumble, 2006 and Baele et al., 2007). The mixed results provided by earlier studies on the non-interest income determinants can be explained by the presence of several factors which can vary from one country to another as well as between banks (Lee et al., 2014; Nguyen and Pham, 2020). In fact, several bank characteristics such as bank-specific

factors (Mercieca et al., 2007; Chiorazzo et al., 2008; Doumpos et al., 2016; Hamdi et al., 2017) and the state of the macroeconomic, institutional, business cycle measured by the gross domestic product (GDP) growth (Nguyen et al., 2012) and the inflation rate (Athanasoglu et al., 2008; Meng et al., 2017) drive the development of non-core banking activities decision. However, other studies on this topic found that there are also other determinants of non-interest income.

Hakimi et al. (2012) reached results indicating that only bank size, information technology, and the banking strategy strongly affect the non-interest income. Conversely, the impact of macroeconomic factors appears to be insignificant. However, DeYoung and Rice (2004) studied US commercial banks over the period spanning from 1989 to 2001 and analysed the management quality impact on non-interest income. They empirically indicated that well-managed banks are less dependent on non-interest income, while banks with good service quality and customer relationships can produce more non-interest income.

As for a different country sample, Ammar and Boughrara (2019) with the aim of answering the question "What drives the banks' functional diversification decision?", used a database of 365 banks set in selected Middle East and North Africa (MENA) countries over 1988–2015 and implemented a dynamic nonlinear panel data model. Their findings reveal that both market share and financial intermediation stratify the diversification decision for the whole MENA sample. By Splitting the sample, they established that the risk-adjusted profitability and the loan loss provision ratio exert a major influence over the diversification indicator for GCC[11] banks, whereas the net interest margin ratio, financial intermediation, and the bank market share are the major drivers of the income diversification strategic decision for the remaining non-GCC banks. In a related study, using a broad sample of commercial banks from 17 MENA countries over the period 1993–2014, Zouaouia and Zoghlami (2020) point out that, theoretically, banks with a higher level of market power get more involved in non-traditional activities. This positive relationship is explained by the fact that market power reinforces the banks' capacity to identify non-traditional activities' opportunities, leading to higher noninterest income share, which in turn may ensure better performance and more stability of the banking industry. Their finding is supported by Nguyen et al (2012), who documented that banking firms with a low degree of market power that sought new growth opportunities are more likely to shift towards non-bank product lines which boost bank performance. Accordingly, Doumpos et al. (2016) analyse a group of Indian banks and

[11] Gulf Cooperation Council

demonstrate that noninterest income is significantly influenced by bank size, ownership type, and managerial ability. More recently, Dong et al (2019) conclude that banks earn higher non-interest income when the aggregate value of IPO/M&A plus trading volume is higher. More specifically, with a focus on the Tunisian context, Hamdi et al. (2017) indicate that the main determinants of non-interest income are: bank size, relative performance, loan specialization, new payments channels, automatic teller machine (ATM), and credit cards.

I.4. Bank performance

Economic literature pays a great deal of attention to the performance of banks, expressed in terms of profitability, productivity, competition, concentration, and efficiency. This part provides a conceptual definition of this area, its determinants, and its principal measures used in the empirical literature.

I.4.1. Concept definition

"When banks are profitable, they are stable. When banks succeed, the economy and communities prosper", CBA[12].

Performance is a great achievement in any area of activity. The term "performance" is used in different areas; there is talk of economic, financial, technical, sporting, as well as social performance. In a bank, it is all that helps improve the torque value for money. Thus, it is defined as the ability to achieve the objectives while minimizing costs; it comes down to a couple of concepts, namely, efficiency and effectiveness, which cover two good instincts and complementary aspects of performance. The first relates to the means used and to the results obtained. As to the second, it relates to the objectives and results. According to Mouzas (2006), efficiency and effectiveness are key terms in the evaluation and measurement of business performance, but the challenge is to balance this past efficiency with effectiveness. Athanasoglou et al. (2008) conclude that the relationship between performance and efficiency is positive and explained that a more effective bank is more capable of the best use of its resources and reducing its costs, thus, generating a better profit.

Referring to the business activity, the performance is defined by Niculescu and Lavalette (1999) as "a state of competitiveness of the economic entity, reached by a level of efficiency and productivity that assures a sustainable presence on the market". Similarly, Verboncu and

[12] Refer to the Canadian Bankers association. See: https://cba.ca/

Zalman (2005) appreciate that "performance is a particular result in the management, economics, marketing domain, etc. which gives characteristics of competitiveness, efficiency, and effectiveness to the organization and the structural and procedural components".

I.4.2. Bank performance measures and determinants

Bank performance is generally measured by return on assets (ROA), return on equity (ROE), or net interest margin (NIM) and is a function of internal and external determinants. The determinants of bank performance have been studied since the seventies, following the seminal works by Short (1979) and Bourke (1989). Since then, a huge number of studies have been carried out on this issue (García-Herrero et al., 2009, Berger and Bouwman, 2013, Marozva, 2015). In fact, various internal and external factors can determine the financial performance of a bank. As shown in Staikouras and wood (2004), internal factors are related to the bank's management decisions and objectives, and external factors are related to macroeconomic variables which are beyond the control of the bank.

- **Internal Determinants**

Internal factors are the microeconomic determinants specific to each bank. They reflect its global situation and financial health. According to Garoui et al (2013), internal factors include, mainly, size, capitalization, liquidity, credit quality, efficiency, and degree of diversification. The main factors commonly fended in the finance literature research are:

- **Size**: Different researchers outlined different views about the effect of bank size on financial performance. The introduction of size is often justified on the issue of the existence or non-existence of scale economies. The first strand of works confirms a positive relationship between the two variables. With attention, Goddard et al (2004) find that large banks are more performing than small banks. The second strand of works shows that large banks performance is negatively impacted by their size. In this regard, the researchers based their point of view on the lack of manageability, where Stiroh and Rumble (2006) concluded that large banks have a problem conducting their affairs efficiently. In the same vein, Hamdi et al. (2017) analysed the Tunisian banking sector and suggested that large banks should focus on their traditional business lines because they have higher information asymmetry and agency costs.
- **Liquidity:** Liquidity is the main pillar on which a bank's financial intermediation activity is based. After analysing the relation between the liquidity ratio and the bank's

performance, Molyneux and Thornton (1992) reported a finding of a negative and statistically significant relationship between the two variables. In contrast, Bourke, (1989) provides evidence that the two variables are positively correlated.

- **Bank capitalization:** Capital is one of the internal determinants of performance of credit institutions which was the subject of several empirical studies. For instance, the link between bank performance and the capitalization ratio was established by Ben Naceur and Goaid (2001). They argue that the most performant banks are those that have fought to improve the productivity of labour and capital, and were able to strengthen their capital. Similarly, Abreu and Mendes (2002) agree on the fact that highly capitalized banks don't need external financing, bank failures are less pronounced and costs financing are lower, so, they performed better. Nevertheless, as for the Tunisian context, Ayadi and Ellouze (2014) analysed the determinants of the Tunisian banking sector's performance for the period 2003–2012. Their findings revealed that the increase of the capitalization's level of Tunisian banks resulted in superior performance, better quotation in stock exchange, and that size positively affects the performance of the studied banks.
- **Ownership structure:** researches on this topic found strong empirical evidence that ownership has an impact on performance. Few studies on the benefits of state ownership support performance arguments for state ownership (i,e, Hart et al., 1997). In contrast, most studies have found that state-owned firms are typically extremely inefficient, especially in emerging countries (i,e., Grossman and Krueger, 1993; Dewenter and Malatesta, 2001). According to Lannotta et al. (2007), public-owned banks exhibit lower profitability than privately owned banks because they finance projects with a higher level of risk. Hamdi et al (2017) deem that high solvability through a higher capital ratio might lead Tunisian banks to enter new businesses and allow them to perform in terms of competitiveness. In addition, in the same context, Ayadi and Ellouze (2014) conclude that private banks outperform their public counterparts. Similarly, Ghazouani and Moussa (2013) demonstrate that privately owned banks seem to be more profitable than state-owned ones. Hence, they recommend privatizing state-owned Tunisian banks in order to improve their performance. In contrast, Dietrich and Wanzenried (2011) examine the Swiss bank sector and find that public-owned banks are more profitable than private ones during the financial crisis. In this time of turmoil, public banks were considered as safer and better banks in comparison to privately owned institutions.

- **Non-Performing Loan (NPL):** Banks derive most of their income from loans. Because of the form of loans, banks are vulnerable in default or NPLs which indicates the ratio of bad debts to total credits. The issue of bad loans can hamper bank growth. According to the risk theory, high NPLs indicate low credit quality, so banks have to bear losses in operating activities. Kasmir (2004) concluded that eventually, loans will reduce a bank's profitability. The statement is supported by the results of research conducted by Socol (2013), Dumicic and Rizdak, (2013), Albulescu (2015).
- **Degree of diversification:** Barros et al. (2007) specified that a diversified bank is more likely to generate a poor result, hence, a poor performance. However, in their extensive survey article, Dietrich and Wanzenried (2011) showed that the degree of diversification has a positive effect on performance. While many other studies oppose the latter, more recently, Simoensa and Vander Venneta (2021) discussed whether more diversified banks would be better protected from incurring substantial valuation losses when a shock hits the economy. They conclude that more income diversified banks are more -able to absorb shocks and avoid distress.

❖ **External factors**

In addition to the bank-specific variables described above, the determinants of bank profitability include some macroeconomic characteristics that have an impact on bank performance. The most macroeconomic determinants used in the empirical literature are GDP growth and inflation. (Kosmidou et al., 2005; Pasiouras and Kosmidou, 2007; Athanasoglu et al., 2008; and Davydenko, 2010)

- **GDP growth:** The majority of researchers show a positive relationship between the development of economic activity and bank performance (i.e, Demirgüç-Kunt and Huizinga, 1999; Goddard et al., 2004; Bikker and Hu, 2002 and Dietrich and Wanzenried, 2011). This is explained by the strong growth related to the development of economic activity, leading to an increase in investment and consumption, from where a rise in credits and, consequently, an increase in bank performance and overall bank income. Besides, Murcia and Contreras (2018) provided evidence that, in normal times, credit growth tends to be more important for bank profitability than GDP growth. Thus, the financial cycle appears to predict bank performance better than the business cycle.
- **Inflation:** Another strand of studies found a positive significant relationship between inflation and bank performance (i,e., Bourke, 1989; Abreu and Mendes, 2002;

Athanasoglou et al., 2006, 2008; and Pasiouoras Kosmidou, 2007; Nguyen, 2014). These researches demonstrated that an increase in the inflation rate has a positive effect on bank performance. This is explained by the fact that even though inflation causes an increase in bank charges, the costs are mainly passed on to customers by the resulting increase in interest rates on loans, which, in turn, increases the interest margin and improves the bank's performance. Meanwhile, other studies provide opposed results (Ben Naceur and Kandil (2009).

- **Interest rate:** Murcia and Contreras (2018) studied the determinants of bank profitability in emerging markets. They highlighted that higher long-term interest rates tend to boost profitability, while higher short-term rates reduce profits by raising funding costs. They also pointed out that increases in sovereign risk premium reduce bank profits in a significant way, underscoring the role of credible fiscal frameworks in supporting the overall financial stability.

I.5. Bank risk

Banks use their business model to manage their risk. Through this part, we will define bank risk and present the main types and measures used in the financial literature.

I.5.1. Definition and forms of risk

Risk is usually defined as the uncertainty of future outcomes or the probability of an adverse outcome. It is usually measured as the volatility or standard deviation of returns around the mean return. Bank risk is usually referred to as the potential loss due to the occurrence of particular events. Nevertheless, banks are known to be better than other institutions at evaluating and managing risks.

The banking environment has become very unstable and very vulnerable to various fluctuations of the monetary sphere. Faced with these disturbances, banks are increasingly threatened by a variety of risks that are detrimental to their activity and their position in the financial market. Generally, key risks in banking include credit risk, interest rate risk, market risk, liquidity risk, operational risk, and solvency risk, which directly impact the financial stability of banks.

- **Credit risk**: is the risk that a counterparty to a financial transaction (‘the borrower’) will fail to comply with its obligations to service debt, or that the counterparty will

deteriorate in its credit standing. As a result, bankers must exercise discretion in maintaining a sensible distribution of liquidity in assets, and also conduct a proper evaluation of the default risks associated with borrowers. Previous literature (i,e, Zhang et al., 2016; Zhu and Yang 2016; Geng et al., 2019) used non-performing loans (NPL) as a proxy of credit risk as it can impact a bank's financial stability and performance.

In general, protection against credit risk involves maintaining high credit standards, appropriate diversification, good knowledge of the borrower's affairs, and accurate monitoring and collection procedures. In this respect, credit risk management for loans involves three main principles: selection, limitation, and diversification (Roncalli, 2001).

- **Liquidity risk:** covers all risks that are associated with a bank finding itself unable to meet its commitments on time, or only being able to do so by recourse to emergency borrowing. Liquidity risk relates to the eventuality that banks cannot fulfill one or more of these needs. Banks must ensure that they have a satisfactory mix of various assets or liabilities to reach their liquidity needs. Since a bank typically collects deposits that are short-term in nature and lends for long-term, the gap between maturities leads to liquidity risk and a subsequent cost of liquidity. As indicated by Waemustafa and Sukri (2016), risk management remains in the middle function of the bank and the early flag of banking crisis can be seen from the eccentrics of liquidity risk. The statement is supported by Berger and Bouwman (2017), who provided evidence that off-balance-sheet liquidity creation helps predict financial crises. Liquidity risk is inherent in banking since there is usually a maturity mismatch related to the bank's transformation of short-term liabilities into longer-term assets. Banks require liquidity for four major reasons: as a cushion to replace net outflows of funds, to compensate for the non-receipt of expected inflows of funds, as a source of funds when contingent liabilities fall due, and also as a source of funds to undertake new transactions when desirable.
- **Interest rate risk:** relates to the risk of loss incurred due to changes in market rates, for example, through reduced interest margins on outstanding loans or reduction in the capital values of marketable assets. In fact, interest rate risk affects:

  - the interest margin: this is a short-term impact. If the bank is a net borrower when rates are falling, it would experience a benefit in its interest margin; the adverse situation would produce if rates start to rise, without the bank reversing its position.

- the economic value: this is an impact of the long term. Variations in rates generate modifications on the discounted value of future flows and the discounted value of the balance sheet position ((WARGA et al., 1986).

- **Market risk:** relates to the risk of loss associated with adverse deviations in the value of the trading portfolio. Bessis (2002) defines market risk more narrowly as the risk of loss during the time required to impact a transaction (liquidation period). This risk has two components, which relate to volatility and liquidity. First, even though the liquidation period is relatively short, deviations can be large in a volatile market. Secondly, for instruments traded in markets with a low volume of transactions, it may be difficult to sell without suffering large discounts. According to Onali and Mascia (2021), international diversification decreases the negative price reaction to stock market crashes following the Covid-19 shock.
- **Operational risk:** is the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Operational risk can arise from any banking products, activities, processes, and systems. In this sense, Jobst (2007) argues that, for modern banks, since the business is more complicated and the scale is getting larger, the negative impact of operational risk on bank performance and financial stability is more serious than that of other types of risk.
- **Solvency risk:** This relates to the risk of having insufficient capital to cover losses generated by all types of risks, and is thus the bank's risk of default. From a regulatory viewpoint, the issue of adequate capital is critically important for the stability of the banking system. To address solvency risk, it is necessary to define the level of capital that is appropriate for given levels of overall risk. The key principles involved can be summarised as: risks generate potential losses, the ultimate protection for such losses is capital, capital should be adjusted to the level required to ensure capability to absorb the potential losses generated by all risks. The insolvency of a bank generally starts with a liquidity crisis. The insolvency risk can cause financial instability in distress periods (i,e, Mnasri and Abaoub, 2010; Cheng et al., 2019). The successive crises experienced by the international financial system have led the different supervising authorities involved (governments, central banks, etc.) to take several measures to further secure the functioning of the international banking system such as the Basel accords.

I.5.2. Bank performance and risk relationship

As financial markets became global and more integrated, the types of risks changed to include non-traditional risks such as off-balance sheet risk. Banks have had to adapt to these changes.

Three theories related to the banking process have emerged over time: credit creation theory[13], fractional reserve theory[14], and financial intermediation theory (Jayasekara et al., 2020). Nowadays, the financial intermediation theory is dominant in the banking process. The connection between risk and banking performance is explained by the nature of the intermediation business, which involves multiple risk factors. The financial intermediation theory builds on the notion that intermediaries serve to reduce transaction costs and informational asymmetries to enhance performance. Under this theory, Jayasekara et al. (2020) note that the efficiency of banks reflects the risk transformation process and increases performance.

More interestingly, as we have shown above, Markowitz (1952) emphasized the idea that risk cannot be divorced from return: the risk of an asset has no meaning except concerning the portfolio in which the asset is held. Not surprisingly, prior literature implies that the relationship between bank risk and performance is an important approach to judge banks. Thus, bank risk-taking is dependent on its performance. Financial intermediaries endeavour to maximize profits and shareholder value, and managing risk is a central issue. Therefore, they attempt to maximize return for a given level of risk or minimize risk for a given level of return. This leads to asking whether there is a way to reduce risk without compromising return? The answer is embodied in the portfolio theory principle: diversification and correlation. The very essence of the H. Markowitz (1952) thesis in respect of portfolio management is that risk is reduced by diversification. We also have to mention that diversification cannot eliminate the totality of a risk. For each security, there are two kinds of risk: systemic risk (related to market evolution) and specific risk (linked to specific factors). The diversification strategy can only decrease the specific risk. In that context, Yang et al. (2019) demonstrated that size and diversification play complementary roles to increase systemic risk, hence, total risk.

13 Credit creation theory of banking proposes that individual banks can create money, banks will not just lend out deposits that have been provided to banks. Instead, banks create bank deposits as a result of bank loans (Maurice, 2018).

14 Fractional reserve banking is a system in which only a small portion of bank deposits is backed by actual cash on hand and can be used for withdrawal. This is done to theoretically expand the economy by releasing capital for borrowing (Kagan, 2021).

Needless to say, increased competition in the market might force some banks to assume more risk in order to obtain a higher volume of profits, that which is taken away by the competition. Banks managers who usually have better information on the quality of the portfolio might aspire to follow an expansionary strategy, which could be excessively risky later (Altunbas et al., 2007).

Most previous papers on bank performance considered accounting ratios as a measure of the banks performance i.e., among other measures, return on assets (ROA), return on equity (ROE), and net interest margin (NIM). At the same time, the Z-score has also been considered as a measure of performance. Jayasekara et al., 2020 argue that these accounting ratios measure the short-term financial performance of banks, and Z-score measures the long-term performance of banks. This statement is supported by Rashid & Jabeen, (2016), performing banks are generally considered more stable and vice versa. On the other hand, risk-adjusted return on assets and Z-Score have been frequently used to measure bank financial stability. Both indicators depend on bank profitability and the volatility of profits (measured with the standard deviation of profits).

Ongore and Kusa (2013) demonstrated that assets quality, capital adequacy and management effectiveness impact the performance of commercial banks. They observe a strong positive connection between bank performance with capital adequacy, management effectiveness, and asset quality. These results show that high non-performing loans (NPL) (poor asset quality) are related to poor bank performance (supported by Dumicic and Rizdak, 2013). Dealing effectively with this issue, Zheng (2018) concluded that, to perform well and obtain more profits, many bankers pay more attention to the liquidity risk management of the banking sector. In this respect, Marozva (2015) found that there is a negative significant deterministic relationship between net interest margin (a bank performance measure) and funding liquidity risk. Similarly, Demirguc-Kunt et al., (2020) provided evidence that banks with higher liquidity coverage ratios (LCR) experienced higher stock market returns and higher profitability.

Many studies have investigated the impact of revenue diversification on both bank performance and risk. A brief review of these studies will be presented in the next section.

II. Results of some empirical studies and hypotheses development

Nowadays, the banking sector is at a much more complex level of activity than its traditional core business. The universal model offers better income diversification opportunities that facilitate resilience (Dietrich and Vollmer, 2012). The advances in information technology and regulatory changes allow banks to offer a wider range of products to a more diverse customer base.

The non-interest income component of bank revenue is well studied in the financial literature. A room body of literature has emerged on the relationship between non-interest income and bank performance and risk. One category of these studies implies that non-interest income is desirable, as it may improve bank return and reduce total risk (i.e, Demirgüç-Kunt and Huizinga 2010; Elsas et al., 2010; Rahman et al., 2015, among others). Nevertheless, other studies have identified a negative impact of bank diversification activities (i.e, Pozsar et al., 2010; Mazur and Zhang, 2015; Stiroh, 2004a,2004b). The third strand of income diversification literature leads rather to the insignificance of the effect non-interest income on bank risk and return has (i.e, Engle et al., 2014, Weiss et al., 2014, and Saunders et al., 2018). In addition, academic research of the impact of the economic and financial situation on the mentioned relationship is also inconclusive and still undeveloped. The conflicting results are more pronounced between developed and emerging nations due to the difference in internal and external factors (i.e., Bank size, governance, environment, and regulations). Undoubtedly, the impact of adopting the new business model varies from one country to another as well as between banks. In this part we refer to a literature review on this topic, we will present studies in the international context. Then we move on to the Tunisian context and develop our main hypotheses. In this section, we will provide a survey of the literature on the effect of the non-core business activities on bank performance and risk as to the first part. Then, we will review the literature and regroup studies that take crises into account and as we go along, we will build our hypotheses.

II.1. Non-interest income strategy, bank performance and risk nexus literature

For banking institutions, non-interest income is an important source of diversification (Huang and Chen, 2006). As developed in the previous section, the new business model based on the income diversification strategy uses both traditional and non-traditional banking activities. Diversification is dedicated to exploring the potential non-interest income benefits for banks engaging in a broader scope of activities. Based on prior literature addressing the effects of

non-interest income-generating activities on performance and risk is still inconclusive. Chiefly, we present in this part distinct empirical results in different contexts to finally develop our research hypotheses related to the Tunisian context.

II.1.1. The effect of non-interest income on bank performance and risk

Presenting non-interest income strategy in a positive light, related to Markowitz's portfolio theory (1952), investors should seek to diversify their portfolios with assets that are not highly correlated with one another. Based on this theories, we can expect that non-interest income besides interest income, can enhance banks' performance. Most important, income diversification might reinforce the intermediation role of banks and motivate managerial efficiency (i.e, Drucker and Puri 2009; Hamdi et al. 2017). Further, banks hope to attract as many customers as possible, thus improving their market share and increasing their profit. From a theoretical standpoint, the decision to diversify activities is desirable for both bank performance and risk management. Consistent with the managerial efficiency theory, income where reductions in costs and efficiencies established by banks will increase profitability. From this side, Vander Vennet (2002) reports a finding that financial conglomerates in Europe are more cost-efficient than specialized banks. Furthermore, greater diversification across new types of products and services might affect value creation in banking and reduce idiosyncratic risk, by expanding the investment opportunity. Klein and Saidenberg (1997) support this idea and argue that providing a wide range of financial services should increase a bank's efficiency and decrease total risk thanks to economies of scope.

Through an international sample of 1334 banks in 101 countries, Demirgüç-Kunt and Huizinga (2010) found that fee-based activities that produce non-interest income can improve bank performance and help diffuse risk. Similarly, using a panel data from 9 countries, Elsas et al. (2010) demonstrated that bank diversification improves a bank's market valuation and therefore boosts its profitability. They report in a more recent article in 2006, that diversified banks benefit from economies of scope which are stronger in banking than in many other industries.

The most representative studies that focused on developed countries focused on either European countries or the US. For example, using a sample of U.S banks, Saunders et al. (2014) showed that a high level of non-traditional activities is associated with higher bank profit. focusing on the risk issue, De Jonghe et al. (2015) document that non-interest income decreases the systemic risk of large banks in the U.S market. They added that the benefits of

lower systemic risk for large banks disappear in countries with more corruption, concentrated banking markets, and asymmetric information.

The European banks were studied by Kohler (2015), who foregrounds the impact of business models on bank stability in the European financial system over the period between 2002 and 2011. The author found that banks would be significantly more stable and profitable if they increase their share of non-interest income. He also argued that fee-earning-based activities reduce international review stability and improves the stability and profitability of banks. Through the European database, Baele et al. (2007) reported that bank diversification reduces operating costs (especially fixed costs) and improves loan origination and credit risk management owing to information and economies of scope.

In parallel, by analysing Italian banks, Chiorazzo et al. (2008) identified a positive association between non-interest revenue, bank diversification, and bank profitability by improving risk-adjusted returns trade-off. Similarly, Brighi and Venturelli (2016) found a positive link between geographic/income diversification and banks performance in 491 Italian banks. For income diversification, an increase in commissions and fee income enhances risk-adjusted profitability and reduces risk. Their result is supported by that of Milani et al. (2008). Additionally, Mergaerts and Vander Vennet (2016) used factor analysis to identify business models and samples of 505 banks from 30 European countries over a time span of 15 years. They highlighted that banks characterized by a high degree of income diversification perform better in the long run, they enjoy higher returns without being more susceptible to distress.

As for emerging markets, Lozano-Vivas and Pasiouras (2008) conducted a study on a sample of 87 countries in transition and demonstrated a statistically significant and positive impact of non-traditional banking activities on banks performance measured by their efficiency cost. Furthermore, there is a growing body of literature investigating the relationship between non-interest-bearing activities and bank stability in emerging economies. Pennathur et al. (2012) found that default risk is also reduced for Indian banks and that fee-based income significantly reduces risk. From a regulatory perspective, income diversification specifically benefits India's public sector banks. More recently, Doumpos et al. (2016) examined 95 Indian banks and provided evidence that the amount of non-interest income significantly impacts bank profitability, and they provided evidence that functional diversification improves banks' financial strength, especially in less developed countries as in the Indian case. Furthermore, using data for 20 Asian-Pacific countries, Lee et al. (2014) found that commissions and other non-interest income components would lead to increased stability and

profitability and less risk for bank-based groups. More interestingly, Ahamed (2017) and Tarazi et al. (2014) pointed out that the weak correlation between interest and non-interest income activities and the higher share of these fee activities increases profits and risk-adjusted profitability, especially when trading is involved. Similarly, Dawood et al. (2016) analysed empirical evidence from the GCC region and showed that banks engaged in substantial fee-based activities are more financially stable compared with those that predominantly generate their income from traditional activities. Additionally, Zheng et al. (2018) posit that diversification depends on the riskiness of the related activities. They found that diversification in the banking sectors of Thailand, Vietnam, the Philippines, and Malaysia improves the risk-return trade-off. Their finding is supported by Brahmana et al.'s (2018) study using the Malaysian banking system database and Nguyen's (2017) results of the Vietnamese banks.

Taken together, from these studies, there is evidence that shifting toward and within non-interest income is beneficial for the banking sector.

Moreover, as research on non-interest income has progressed, the above opinion of the beneficial effect of non-interest income has been increasingly questioned (Mazur and Zhang, 2015). Besides, the second strand of empirical studies has stressed the dark side of non-traditional bank activities and has suggested a distinct conclusion. Many arguments have been given in this sense such as the fact that non-interest income is more likely to fluctuate compared with interest income because banks face relatively highly competitive rivalry and relatively low switching and information costs (i,e., Demsetz and Strahan, 1997; Stiroh, 2004). In addition, the growth of non-interest income could fail in leading to higher profits if a relatively large part of the 'additional' non-interest income is absorbed by increased costs which can be associated with higher income volatility, thus, implying higher risk (i,e., Stiroh, 2004; Wolfe et al, 2007; Chiorazzo et al., 2008; Calmès and Liu, 2009). Besides, diversified income may lead to systemic or other channels of risk like credit risk, market risk, liquidity risk, or operational risk. In this sense, Hou et al. (2017) concluded that an increase in the degree of bank income diversification between traditional bank activities and non-traditional bank activities reduces bank liquidity creation. If we consider findings about developed countries, banks in the US and EU encounter greater levels of risk with the development of non-interest activities, depending mainly on the type of non-interest income components used (i.e, Shaffer, 1985; Stiroh and Rumble 2006; Laeven and Levine, 2007; Lepetit et al. 2008; Slijkerman et al., 2013; and Yang et al. 2020). Stiroh (2004a,2004b) and Mercieca et al.

(2007) have also showed that banks with higher non-interest income have higher risk and lower performance. In this regard, focusing on European banks, Lepetit et al. (2008) and Slijkerman et al. (2013) supported this statement and concluded that the cost of diversification outweighs its benefits and they argued that, in the case of banks that have over-expanded into industries with higher competition or lack of expertise, non-core banking activities may worsen risk-adjusted return. This was found to be mainly true for small banks (Goddard, 2008). In fact, researchers have demonstrated that higher insolvency risk is attributed to firms switching to non-interest-bearing activities such as items associated with securitization, investment banking, advisory fees, venture capital, and non-hedging derivatives. From another context, DeYoung and Roland (2001) tested whether and how shifts in new products affect earnings volatility for 472 U.S. commercial banks. They provided evidence of the negative effect of the non-traditional banking activities on bank risk and suggested three explanations. First, the high competition on non-interest-bearing activities. Second, the fixed costs associated with fee-based activities, and lastly, the lack of regulation on innovative non-interest income-earning activities. Notably, Nicholas Apergis (2014) tested the long-term role of non-traditional banking in profitability and risk. The results of the panel tests showed that non-traditional banking increases a bank's risk profile, particularly considering that such a bank is also likely to assume leverage and reallocate capital from long-term, goal-oriented activities to engage in non-core initiatives.

In the light of the agency theory, Pozsar et al. (2010) reported that higher levels of income diversifications can make the bank system too complex and, thus, substantial agency problems may arise. This is supported by Laeven and Levine (2007) who highlighted that the diversification of activities does not bring the expected benefits (i.e., added value, higher profits, efficient resources allocation, and economies of scope that boost valuations), but it intensifies agency problems across certain groups of those institutions' stakeholders with further negative implications on both profitability and value of the bank. Therefore, engaging in different activities may exacerbate conflicts of interest (John et al., 1994; Saunders, 1994) and moral hazard problems (Boyd et al. 1998). In another similar stand, Stiroh and Rumble (2006) pointed that the idea of ''cross-selling'' as a key strategy to diversify revenue, that means to lower costs and increase income, is not true. They argue their point of view by the fact that U.S financial holding companies try to diversify revenue by selling many products to the same customers, which may simply expose multiple businesses to the same shocks, increasing the correlation across interest and non-interest income, and as a consequence,

reducing potential diversification revenue. Moreover, these financial companies are shifting into non-traditional activities that are most volatile, which would surely offset any diversification benefits. In the same vein, Delpachitra and Lester (2013) supported the negative effect of noninterest income source of Australian banks revenue by proving that over-diversification undermines the gains of this functional diversification.

In a wider context, by using a sample of commercial banks based in 34 OECD member countries over the time period spanning from 2002 to 2012, a recent study by Hakkon et al. (2020) showed that excessive income diversification increases bank risk, whereas moderate diversification increases its stability. Their valuable findings indicate that financial stability increases with the new business model until diversification reaches its optimal level, after which it starts to decrease. In this line, regulators and market practitioners claim that excessive bank diversification into non-interest income accelerates the propagation of financial risk, leading to financial crises, and they suggest that policies and laws are needed to regulate excessive bank diversification (i.e, Acharya et al., 2006; DeYoung and Roland, 2001; Demircqus-Kunt and Huizinga, 2011). For example, the Korean government imposed sanctions on banks to limit their diversification strategies.

Finally, another line of findings shows an insignificant relationship between non-traditional banking activities and bank performance and risk. Acharya et al. (2006) and Hayden et al. (2007) found that income diversification neither increases the return nor reduces the banks' risk. For instance, Engle et al. (2014), Weiss et al. (2014), and Saunders et al. (2018) detected an insignificant relationship between non-interest income and bank risk. Similarly, Park et al. (2019) found that the non-interest incomes related to non-traditional activities have an insignificant impact on bank risk and returns. Their study suggests that non-interest income is not the source of bank instability. Whereas, other specific studies, using a dataset of Islamic and conventional banks in selected OIC (Organisation of Islamic Cooperation) countries during the period 2007–2016, reached that income diversification shows a not significant effect on risk-adjusted return for Islamic banks and financial stability for both conventional and Islamic banks (Andrea Paltrinieri, et al., 2020).

II.1.2. Hypotheses development

As mentioned before, the association between non-interest income and bank performance and/or bank risk has been the object of several theoretical and empirical studies. However, there are no consensus results. Besides, such studies that explore the Tunisian context are

scarce. Tunisia is an interesting case study since it has witnessed extensive financial reforms at the beginning of the 1990s such as the implementation of the structural adjustment programs, trade liberalization, and the ratification of many accords and trade agreements (Hamdi, 2013). For instance, through a study of 20 Tunisian banks data during the period 2005-2012 and by using a dynamic panel data, Hamdi et al. (2017) found that non-interest income is significantly associated with a higher level of performance measured by both ROA and ROE and a lower level of risk-taking. As for the Tunisian context, focusing on stock prices data after liberalization period (between 1997 and 2006), Mnasri and Abaoub (2010) reached findings that are not aligned with traditional intermediation theory which highlights the benefits of diversification for banks performance. They revealed a negative link between non-interest income and bank performance and showed that functional diversification also results in relatively higher levels of systemic risk. Meanwhile, by focusing on the determinants of 19 Tunisian banks from 2003-2012, Ayedi and Ellouze, (2015) pointed out that non-interest income activities do not affect bank performance.

Taking together, the results related to the Tunisian banking sector are also inconclusive. From here on out, based on both traditional portfolio theory (include the cross-subsidization theory) and financial intermediation theory, we would assume that this business strategy affects positively Tunisian banks performance and their risk negatively for three reasons. First of all, the trend of Tunisian banks to diversify into non-core banking activities is reinforced by the law n ° 2001–65 of 10 July 2001 on the application of the principle of universal banking and the act n° 2016-487 on diversifications of financial activities. Second, the beneficial effect of non-interest income activities is improved by the majority of empirical investigations in emerging markets (Lin et al., 2012; Nguyen et al., 2012; Lee et al., 2014; Mostak, 2017; among others). Third, according to Abedifar et al. (2018), small banks can benefit from diversification activity to improve their performance (supported by Lepetit et al., 2008) and reduce their risk exposure. Whereas, Tunisian banks are considered as small and medium banks, even compared to banks in African countries.

Based on the traditional diversification theory and the results of several studies, we expect that, for Tunisian banks, diversifying their activities beyond the traditional activity is the way to improve banks' performance and reduce their risk exposure.

Hence, our first hypothesis is formulated as follows:

H1: Non-interest income activities improve Tunisian bank's performance and reduce their risk exposure.

More specifically, based on findings from developed countries, banks in the U.S and EU encounter greater levels of risk, with the development of non-interest activities, depending mainly on the type of non-interest income components used (i.e, Shaffer, 1985; Stiroh and Rumble 2006; Laeven and Levine, 2007; Lepetit et al. 200; and Yang et al. 2020). Williams (2016) analysed a data from an Australian bank. He highlights that non-interest income increases bank risk, although some types of non-interest income reduce risk when bank specialization is included. Besides, using a data from U.S. commercial banks, DeYoung and Roland (2001) studied the impact of shocks to fee-based activities on bank earnings volatility and show that these revenue sources (which constitute an increasing share of banking activity) increase bank earnings volatility. In a companion similar study, Brighi and Venturelli, (2016) found that an increase in commissions and fees income reduce banks' profitability. However, Stiroh (2004) reported that the high volatility of trading revenue makes the negative effects of diversification persistent. Contrary to all above-mentioned, through a unique dataset of the Philippines' banks, Meslier et al. (2014) concluded that moving towards non-interest activities increases bank risk-adjusted profits particularly when banks are more involved in dealing with government securities (other non-interest income). Based on these latter observations, we can expect similar results for the Tunisian banking sector, given that the financial market is poorly developed and that banks' portfolios are mainly composed of government securities. Thus, we will go further and analyse the relationship between the components of non-interest income and the risk and performance of banks by isolating fee income from other non-interest income (trading income). Having this in mind, to examine the impact of the different types of non-interest activities on the performance/risk of Tunisian commercial banks, we will bet on the following hypothesis:

H2a: Diversification into fee-based activities negatively (positively) affects the performance (risk) of commercial banks in Tunisia.

H2b: Diversification into trading income positively (negatively) affects the performance (risk) of commercial banks in Tunisia.

II.2. Non-interest income, crises and bank performance and risk nexus literature

Before the global financial crisis, banks increasingly earned a higher proportion of their revenue from non-interest income activities specifically from non-lending activities, such as engaging in venture capital funding, trading, investment banking, and advising. Then, the subprime crisis resulted in reshaping the banks income structure[15]. It has pushed banks, through regulatory changes, to reinforce their capital ratios to maintain their position as financial intermediaries. Crises differ (financial, economic, health…), and they do not have the same source. Therefore, they don't have the same consequences and effects. Banks can face an unprecedented combination of pressures in terms of balance sheets, liquidity, and funding during these hard times. Thus, crisis may impact the business model and specifically, impact the relationship between non-interest income-generating activities and bank performance and risk.

A new business model appeared through the combination of traditional and non-traditional activities to assure the stability of the banking system (Chiorazzo et al., 2008). Empirical results found in the literature show that moving to non-traditional banking activities offers opportunities and threats. There is continuously increasing number of findings motivates researchers to take into account the temporal dimension (i.e, Derbali, 2011; Park et al., 2019; Flori et al. 2019; Cheng et al. 2019; Kim et al., 2020; Paltrinieri et al., 2020). Therefore, we chose to focus on various types of crises. In another word, we would try to theoretically evaluate the effect of the macroeconomic environment (crisis) on the association between non-interest income and bank performance and risk. The viewpoint that non-interest income can stabilize bank profits and manage the risks associated, has come into question. Until recently, the literature has suggested a mixed picture of such impacts.

II.2.1. Empirical results related to the crisis versus the "normal" periods

During the crisis period, funding sources become difficult to find and new regulatory pressures pushed banks to focus on capital and liquidity requirements which could contribute to a change of the bank strategy and weakness in the adopted business model (Acharya et al.,

[15] CGFS Papers No 60 "Structural changes in banking after the crisis". Report prepared by a Working Group established by the Committee on the Global Financial System.

2002). For that reason, functional diversification could be the perfect solution to reduce cost and enhance bank profitability.

A variety of studies reveal positive effects of non-interest income on bank performance and financial stability during the crises. Hence, banks turn to non-core business activities, which is an attempt to preserve revenue, when interest rates are low and during crises where there is an aggravation of default and liquidity risks (Curry et al. 2008; Ahmad et al. 2008). "Diversification should work when it matters most" and functional diversification should act as a shock absorber when banks are hit by an unexpected shock (Simoens and Vennet, 2021). With deeper analyses by using European banks' data, Kamani (2018) find that incomes from commissions and fees are less financial market-sensitive, which can consolidate banks' revenues in times of crisis.

In contrast, recent academic research shows opposite results. The disadvantages of non-traditional banking activities may outweigh the advantages in the crisis period. In this regard, few empirical studies endorse income diversification as a method of hedging risk because concentrating on traditional functions (i.e., deposits and loans) can be more effective for banks during a crisis. Accordingly, DeJonghe (2010) displayed that banking institutions that are heavily involved in non-traditional activities are characterized by higher risks, which makes them more vulnerable to several market and macroeconomic shocks. For the author, the non-core intermediation activities represent a new source of systematic risk exacerbating not only overall financial instability but also high fluctuations in the real economy. This argument is supported by several empirical studies (e.g; Acharya et al., 2002; Song and Thakor, 2007; Baele et al., 2007; Hayden et al., 2007; Hayden et al., 2007; De Jonghe, 2010; Li and Zhang, 2013; Moore and Zhou, 2014; and Bostandzic and Weiss, 2018). Using a database of 151 commercial banks from four countries; India, Pakistan, Sri Lanka, and Bangladesh spanning the period 1999-2008, Nguyen (2012) found that banks with a higher share of non-interest income is characterized by increased volatility of bank profits and increases the likelihood of failure for financially distressed banks. Further, income diversification, in turn, increases the likelihood of illiquidity and can cause systemic risk and crises (Wagner, 2008-2010; Brunnermeier et al., 2012). DeYoung and Torna (2013) argued that during the crisis period, the asset-based diversification of U.S banks aggravated their probability of failure. Bank diversification also involves allocations of limited resources, limiting the ability of more diversified banks to focus their resources on specific businesses

during a crisis. As a result, they conclude that non-interest income activities could reduce stability during a crisis period.

More recently and related to Tunisian banking system, financial experts consider that since the revolution and then the Covid-19 pandemic, Tunisian banks have been operating in an unstable and competitive environment that requires innovation, digitalization, and the adoption of new sources of revenue besides the revenue from the main activity of banking intermediation to maintain their return and reduce their risk. Furthermore, as presented in Hamdi et al. (2017)' paper, GDP and inflation are shown to be positively associated with bank performance, it is obvious that when the economy is thriving, banks are more efficient and have better results. Thus, we predict that the during the crisis period, it's better for Tunisian banks to concentrate on their core-business generating activities in order to preserve their financial stability during economic recession or financial shock.

H3: Crises weakens the effect of bank diversification into non-interest income activities on bank performance and risk compared to non-crisis period.

More interestingly, we assume that crises do have not the same source or type (financial, economic, health, etc). Therefore, they don't also have the same consequences and impacts. For that reasons, we investigate the major crises of the last two decades.

II.2.1.1. Empirical results related to the global financial crisis and the sovereign debt crisis

Related to the global financial crisis, In the same vein, Park et al. (2019) investigated how the non-interest income influences bank risk/return of U.S. bank holding companies during the financial crisis of 2007–2009. They documented that the non-interest incomes have a positive impact on bank risk and return during the crisis and that non-core business activities are not the source of bank instability and low returns during the financial crisis. For instance, studying a sample of commercial banks based in 34 OECD member countries over the period from 2002 to 2012, Kim et al. (2020) noted that a moderate degree of bank diversification increases bank stability, but excessive one has an adverse effect. Furthermore, they demonstrated that this relationship has a temporal dimension. Hence, banks should concentrate on traditional intermediation functions rather than diversifying their activities and investments during crises. This statement is supported by Loutskina and Strahan (2011), Vallascas et al. (2012) and Tsai et al. (2015). Nguyen et al. (2020), through a group of commercial banks in 28 countries for a period covering before and after the financial crisis,

tried to verify if off-balance sheet (OBS)[16] activities lead to higher risk-adjusted profits. They discovered that the positive effect of the non-traditional activities on bank profits is verified just in the pre-crisis period. Nevertheless, there is a significant negative relationship between the two variables in the post-financial crisis, implying that functional diversification benefits are low especially in the periods following economic downturns. Based on the sources of banks revenues, to measure diversification and through data of U.S. commercial banks from 2000 to 2013, Feng et al (2013) found that diversification is significantly associated with an increase in systemic risk during the 2007–2009 credit crunch and 2010–2013 European Debt crisis. On the same note, in his extensive survey article, Maudos (2017) emphasized the importance to review the bank business model since income structure review had become crucial during the crisis period and he found that diversified banks are riskier and less profitable during the crisis. He supported the idea that only banks that are specialized in traditional activities were able to maintain their solvency level and avoid the negative impact of the crisis on their performance. More recently, Haubrich and Young (2019) took a closer look at the non-interest income, documenting how it and its components have changed over time, particularly in response to the financial crisis shock. Through a multi-period logit model, they indicated that the probability of distressed bank failure declined with pure fee-based non-traditional activities such as securities brokerage and insurance sales, but increased with asset-based non-traditional activities such as venture capital, investment banking, and asset securitization. Added to that, they stated that non-traditional banking activities contributed to the failures of hundreds of U.S. commercial banks during the financial crisis. The statement is supported by Stiroh (2006), Nguyen (2012), Drakos and Kouretas (2015), and Williams (2016). In line with the results of Stiroh (2004) and Mercieca et al. (2007), Brighi and Venturelli (2015) investigated the Italian market using bank-level data on 491 banks over the period 2006-2012 to test the impact of functional diversification on bank performance during the global financial crisis and 2010's sovereign debt crisis[17]. First, they indicated that both scenarios negatively affect bank profitability while opposite results emerge in the case of the Z-Score analysis. Second, as the interest margins become largely nil with drastically reduced volumes in the post-crisis period, bank performance was strictly related to the noninterest income. In the post-crisis period, smaller banks appear to be riskier, being more exposed to local environmental shocks and strictly linked to traditional interest-bearing

16 Off-balance sheet activities defined as the banking products and practices that are not reflected in the on-balance sheet portfolio. These activities earn fee income that is not recorded in the bank's balance sheet (Hassan et al., 1993).

17 "Since the sovereign debt crisis erupted in the autumn of 2009 when the true scale of the Greek fiscal deficit was revealed, the EU, and especially the euro area, has staggered from crisis to crisis" (Iain Begg (2012))

activities. Analysing revenue diversification, their evidence suggests that greater diversification among different fees and commissions components decreases bank risk and, in line with Stiroh and Rumble (2006), increases risk-adjusted profitability particularly in the post-crisis period. Cheng et al. (2019) evaluated the influence of business models on bank risk before, during, and after the financial crisis using Chinese data from 2004 to 2016. They provided empirical evidence that increasing banks' non-interest income share increases insolvency risk and ROA volatility, and this relationship is most visible during and after the financial crisis. Additional analysis revealed that the effects of non-interest income on bank risk are primarily due to asset-based non-interest income. Supporting this idea, Tsai et al. (2015) pointed out that functional diversification of Taiwanese banks increases systematic risk during the economic recession and that this increase far exceeds the benefit of lowering idiosyncratic risk.

Moving to our national context, in a strongly connected and integrated world, Tunisia was not saved. Hamdi et al. (2017) concluded that the international crisis has increased the risk of Tunisian banks. In addition, they found that non-interest-bearing activities are important since they increase banks revenues and also lower the probability of occurrence of distress such as a bank crisis. On the contrary, Houssem Rachdi (2013) provided evidence that the Tunisian banking sector was slightly exposed to the effects of the financial crisis because of its low integration in international financial markets and the strict control by the CBT. His results contend that the financial crisis has increased the risk for the Tunisian banks by the increase of the economic and financial returns (bank's activity mix strategy increases the bank income). We expect that financial and debt crisis reduce the effect of diversification into non-interest income activities on performance and risk during the financial and debt crisis from how it does during the non-financial/debt crisis period.

Thus, our Third hypothesis will be introduced as follows:

H3a: Financial and debt crises weaken the relationship between non-interest income activities and bank performance and risk.

II.2.3. Empirical results related to the political crisis

By analysing MENA countries, Ghosh (2016) concluded that the Arab Spring has lowered profitability and raised the risk of MENA countries' banks. Amidst this context, the banking sector suffers from several shortcomings, notably, a strong need for liquidity and a high level

of non-performing loans which put more pressure on credit viability. Tunisian banks have been particularly affected by the revolution's disturbance, at the liquidity mismatch and the level of risk-taking (Ben Salem, 2019). Since the Arab Spring, Tunisian banks are facing more stringent regulation, a deterioration of their liquidity position, and a worsening of the quality of their assets. Using a sample of 18 Tunisian commercial banks over the period spanning from 2007 to 2017, Ihaddaden (2020) indicated that the Tunisian revolution has had a lasting negative impact on bank profitability. He observed that political transition did not succeed in achieving recovery for productivity. However, Tunisian banks have experienced a strong improvement in technical efficiency. We expect that this improvement is related to the new services and products, thus, improvement of the non-interest income sources of revenues. In a related study, Ayadi and Ellouze (2014) found that the performance of Tunisian banks was negatively affected by the revolution of 14 January 2011, and since 2011, macroeconomic vulnerabilities are still persistent in the Tunisian context, hampering the stability of the financial system. However, banks continued to fulfill their funding mission.

Thus, we assume that net interest marge is still stable and important, that is, the negative (positive) effect of the crisis on bank performance (risk), can present a linear (direct) or non-linear (indirect) effect by reducing the diversification premium. Hence, we will bet on the following hypothesis:

H3b: Political crisis weakens the relationship between non-interest income activities and bank performance and risk.

II.2.3. Empirical results related to the health crisis (COVID-19 pandemic)

The World Health Organization (WHO) characterized the spread of the coronavirus Covid-19 as a global pandemic[18]. The spread of this pandemic caused enormous impacts on economies and financial markets around the world and it represents an unprecedented global shock that exerts tremendous pressure on corporate liquidity and solvency. In fact, the higher disease incidences and disease severity led to a spike in risk aversion and uncertainty globally (Xu et

[18] World Health Organization: WHO Director-General's opening remarks at the media briefing on COVID-19 – 11 March 2020. For more detail see: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020 .

al., 2021)[19]. In the immediate aftermath, the financial sector, particularly banks, played an important role in absorbing the shock by supplying vital credit to households and the corporate sector. The economic effect of the pandemic resulted in tightened credit standards and reduced demand for many types of loans (Li et al., 2021). Demirguc-Kunt et al. (2020) reached results suggesting that the Covid-19 crisis and the countercyclical lending role have put banking systems around the world under stress, having a differential impact depending on their characteristics and pre-crisis vulnerabilities. Li and Zhang (2013) studied the Chinese banking industry and noted that:" When the benchmark interest spread changes little, traditional interest activities can ensure steady growth, even during a recession. In contrast, noninterest income exhibits cyclicality, being affected by some market factors. For instance, during economic depressions, the scarcity of funds and investment channels will result in a decrease in noninterest income, while the availability of sufficient funds and investment channels during economic booms will lead to an increase in noninterest income. They highlighted that unreasonably higher shares of noninterest income may increase risks rather than bring profits. Given this situation, a relevant question to investigate is whether banks with diversified revenues in both interest and non-interest income activities during the pandemic have better performance and lower risk than banks based on the traditional core intermediation business or not. To analyse banks business models, Simoensa and Vander Venneta (2021) discussed whether diversified banks were able to better withstand the shock and whether they are protected from incurring substantial valuation losses when a pandemic hits the economy. Using a sample of 56 European banks, they found that functional diversification (reliance on non-interest income) acts as an economically important shock absorber: banks with high-income diversification exhibit a stock market return of 8.9 to 10.2 percentage points higher than specialized banks during the first months of the pandemic. Furthermore, Çolak and Öztekin (2020) evaluated the influences of the ongoing pandemic on global bank lending patterns from around the world. The results of these studies showed that, during the Covid-19 crisis, traditional activity of banks declined, especially in countries more affected by the crisis. Consequently, central banks are strongly encouraging banks to focus on their business model to find new sources of revenue and to meet the new needs of their customers to maintain their financial stability. Unfortunately, until now there are no empirical studies that treat this subject except for Li et al. (2021). To investigate the effect of the COVID-19 pandemic on the relation between the use of noninterest income and bank profit

[19]The authors show that high frequency risk aversion and uncertainty measures both reacted significantly to information regarding the volume of new cases of infection.

and risk, they provided evidence that banks with non-interest sources of revenue are positively related to performance but inversely related to risk. This result is consistent with a beneficial diversification effect during the pandemic from banks expanding beyond traditional lending sources of revenue.

In 2020 and due to total and partial containment in most countries of the world, 90% of users made payments with their smartphones; it's expected that mobile transactions will account for 88% of all banking transactions in 2022 (Blaney, 2020). Hence, we have expected before that it's better for Tunisian commercial banks to concentrate on their traditional activities during political and financial/debt crises. In other words, predict that these letter crises weaken the effect of income diversification on bank performance and return. However, given the fact that a pandemic is a very specific and unpredictable phenomenon, and based on the recent study of Li et al. (2021), we expect for non-interest income to positively impact bank risk and performance during the COVID-19 pandemic as in normal economic conjuncture. To assess these relations, we will test the following hypothesis:

H3c: Health crisis reinforces the relationship between non-interest income activities and bank performance and risk.

III. Overview of the Tunisian banking sector

In this section, we will present the history and the structure of the Tunisian banking system as well as the trends of some indicators that seem to be related to our study. Then, we will analyse the current activity of Tunisian banks by shedding light on net operating income and its components.

III.1. Historical development

In the context of globalization, the liberalization of financial services in Tunisia has proven to be a strategic choice for the whole economy, in particular, monetary authorities with so automotive investment and diversifying the economy. The Tunisian banking system, which has supported the economic development of the country, has had considerable progress during the last two decades as a result of a broad modernization program of financial institutions initiated by the central bank of Tunisia.

During the 90s, the Tunisian banking system has been subject to the introduction of the new banking law n°94-25 of 27-02-1994 aiming at reinforcing the regulatory powers and

supervision conferred by the CBT. Hence, the 2000s have been a critical period for the evolution of the Tunisian banking industry. This was due to the reforms undertaken in 2001[20] that aimed at the consecration of the "universal bank" as well as the protection of depositors. An M&A operation was marked between the deposit and development banks as is the case between the STB bank and two development banks, which are NDBT[21] and EDBT[22].

The amendment of May 2nd, 2006 came later with the objectives of strengthening rules of good governance and control, setting the list of basic banking services, and ensuring their quality. Then, in January 2008, and within the framework of the restructuring program, there was the privatization of Tunisian-Koweitien Bank by the transfer of 60% of its equity to the profit of the financial company "OCEOR"[23]. Despite these efforts, the monetary authority continues to suffer from deep-rooted structural problems. Nevertheless, in 2010, the Tunisian banking landscape has been strengthened by the new Islamic institution Zitouna Bank.

The Tunisian economy relies heavily on its financial system to stimulate economic development. Nevertheless, the 2011 Jasmine Revolution had significantly affected the Tunisian economy, social and political stability, and the financial industry and so have changed the country's prospects[24]. The deep impact of the political crisis on the Tunisian banking system in terms of liquidity and stability has prompted the CBT to implement new reforms to adjust their monetary policy. Thanks to this, banks have had access to the necessary liquidity for funding the country's economic activity[25]. Thus, the crisis has had a limited effect on Tunisian businesses by lightening their financial obligations and, the banking system was able to maintain its reliability, specifically when turned to its normal level of profitability (compared to the pre-revolution period) from the year 2014 (see Figure 1.2 in the next part). Weak institutional governance existed well before Tunisia's 2011 political uprising, and earlier attempts to restructure the banking sector have pushed Tunisia to sign a four-year agreement with the International Monetary Fund (IMF) in May 2016 that included many important commitments, namely, the restructuring of the public banks and the improvement of banking resolutions and supervision frameworks. In fact, the three Tunisian public banks are structurally illiquid due to low deposit growth, which increased their recourse to CBT refinancing. To comply with these recommendations, the Parliament adopted

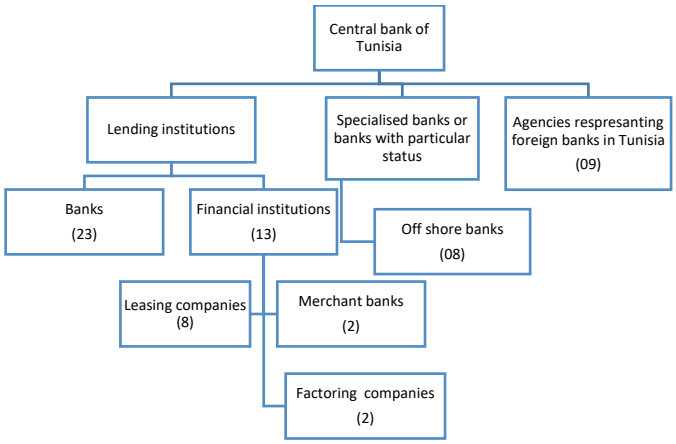
[20] Law n°2001-65 of July 10, 2001, relating to the credit institutions[21] The National Development Bank of Tunisia
[21] The National Development Bank of Tunisia
[22] The Economic Development Bank of Tunisia
[23] See Hakimi et al (2010)
[24] See: "Center for Affordable Housing Finance in Africa". Retrieved 2012-03-03.
[25] Annual report of central bank of Tunisia (2011)

a new Central Bank Statute in May 2016, as well as laws regarding the recapitalization of both BH bank and STB bank. Other recent reforms included mandates for financial stability, consumer protection, and emergency liquidity assistance to insolvent banks, as well as a macro-prudential oversight committee to ensure the banking system's overall stability. The activities that were permitted for banks with the act n° 2016-487 were deposit collection, lending, leasing, factoring, payment tools management, trading, currencies exchange, financial engineering, and Islamic transactions. The law also included the liberalization of some activities that were previously allowed to be practiced only by banks such as the management of payment tools and currency exchange.

These aforementioned reforms led us to conclude that the CBT has opened doors for banks to diversify their assets and shift toward non-traditional activities in order to reinforce market competition and maintain financial stability. Furthermore, all Tunisian banks are now forced to improve their performance and balance sheets. Recent bank actions include continued reductions in NPL ratios, implementation of tighter credit risk controls, enhanced recovery procedures, and upgrades of under-developed IT applications.

III.2 Tunisian banking system structure

From 2017 until the end of 2020, the physiognomy of the Tunisian banking sector, as well as the credit institutions' number remained unchanged despite the operations of absorption of "Tunisie Factoring" by "Tunisie Leasing" or the transfer of the State's share in the ZITOUNA BANK, that is to say, 42 establishments distributed as shown hereafter.



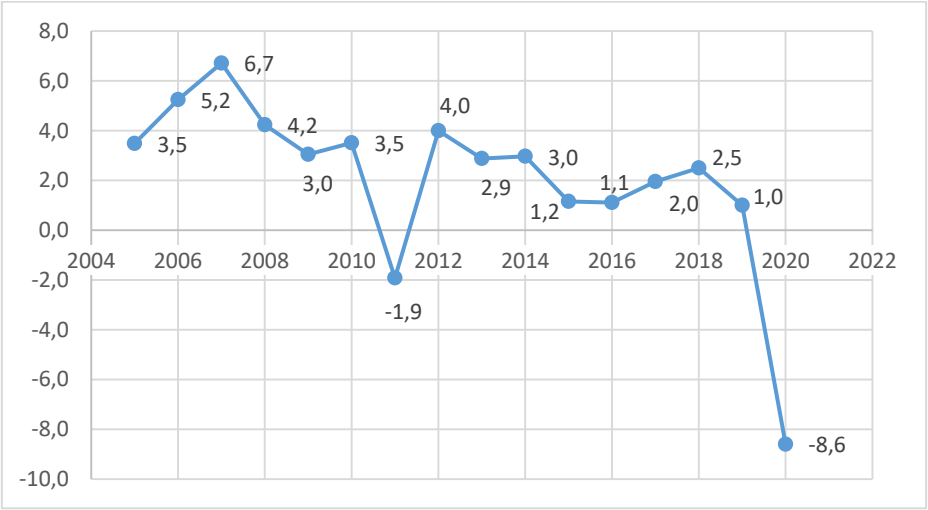
Source: Central Bank of Tunisia

Figure I.1: The organization of the Tunisian banking system

The Tunisian banking system is currently made up of 23 resident banks with only 12 banks listed on the stock market, 7 non-resident (offshore) banks, 8 leasing companies, 2 factoring companies and 2 investment banks. The largest banks are the state-owned STB bank, National Agriculture Bank, and BH bank, which collectively represent 40% of banking assets and 34% of banking sector deposits. As for the regulatory authority, it is the Central Bank of Tunisia (CBT).

III.3. Analysis of the current Tunisian bank activity

Tunisian banks represent the main source of funds for the corporate sector. According to the World Bank[26], by the end of 2016, the ratio of loan by deposit money banks to GDP for Tunisia reached 73.45%, significantly higher than the values observed regionally (63.17%, 22.06%, and 28.10% respectively in Morocco, Algeria, and Egypt). The Tunisian economy faced after the revolution unprecedented difficulties arising from political instability that persists to this day. As shown in the following figure (Fig. I.2), we can note that the real GDP growth reached 1% in 2019 against -6,7% in 2007, which remains very low for the economy's target and for reducing the unemployment rate.



Data source: Annual reports of Central Bank of Tunisia

Figure I.2: Trends of the GDP over the period between 2005-2020

In fact, despite all the reforms that the central banking of Tunisia (CBT) has implemented, the Tunisian banking system remains vulnerable.[27] Amidst this context, the banking sector suffers from several shortcomings, notably, a strong liquidity needs and NPLs is alarming as it is

[26] Data.worldbank.org 2019

[27] For more detail visit: https://www.export.gov/apex/article2?id=Tunisia-Banking-Systems

more than three times the international standard (13.9% against 4%). The stock of NPLs is highly vulnerable to both the industrial and tourism sectors, the sectors most affected by the current crisis. In addition, support measures such as payment moratoria can delay the emergence of NPLs. Taking this into account, stress testing of the financial system and close monitoring loans payments past their dates are critical to assessing the build-up of vulnerability.

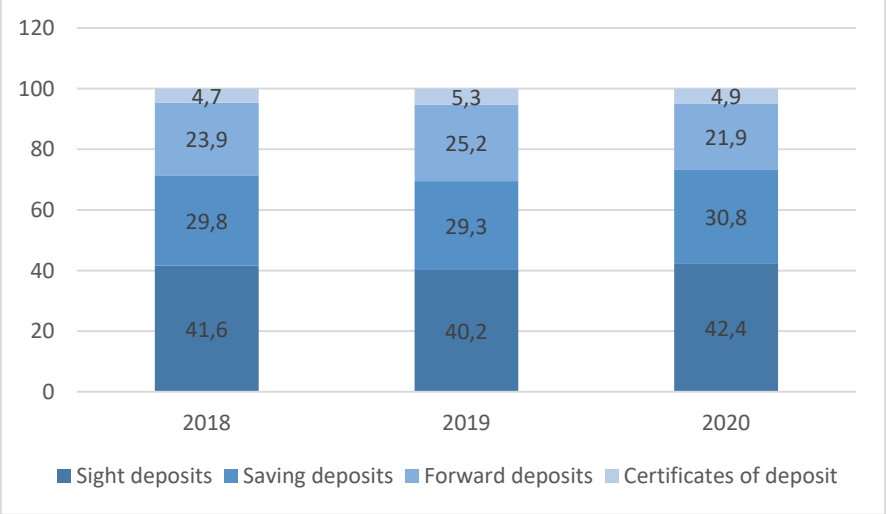
According to the supervision report of the central banking of Tunisia (CBT), just 7 banks, which hold 25.8% of the sector's assets in 2018, have an LCR ratio above 100% compared to 11 banks in 2017 and 13 banks in 2016. However, at the beginning of March 2018, CBT refinancing of commercial banks reached a record of 13 billion Dinars, having more than doubled in 2017. This was partly owed to net foreign asset outflows of about 3 billion dinars from the financial system in 2017, thus, draining bank liquidity. In response to these preoccupying trends, the CBT raised its interest rate from 50 basis points (bps) to 200 bps in December 2017, then raised the policy interest rate by 75 bps to 5.75 percent in March 2018[28].

Consequently, due to the persistence of the political, economic crisis and the delay in engaging profound reforms, Tunisia was poorly prepared to face a consistent shock as the one provoked by the Covid-19 pandemic. It experienced a sharper decline in economic growth than most of its regional peers, having entered this crisis with slow growth and rising debt levels. The pandemic caused an unprecedented paralysis of the economy, affecting both supply and demand, in particular from the Euro Zone (Tunisia's main trading partner). The GDP growth contracted by 8.6% in 2020 (see Fig. I.2). Moreover, unemployment increased from 15% prior to the pandemic to 17.8% by the end of the first quarter of 2021. Similarly, the current account deficit, at 6.8% of GDP in 2020, remained high. Nonetheless, it has improved as it was 8.5% in 2019 as imports declined at a faster pace than exports[29]. In contrast, the fiscal deficit has reached 10% of GDP, aggravated by a decline in revenues due to the reduction in economic activity and tax deferral measures, along with the costs of the COVID-19 response program. The health crisis had worsening debt vulnerabilities. Public debt rose from 72% of GDP in 2019 to 87% of GDP in 2020. According to the World Bank's report, low penetration of digital financial services is slowing Tunisia's deployment of rapid and agile measures, which are needed in an economic lockdown and social distancing context.

[28] The central banking report (2018)
[29] Supervision report (CBT 2020)

- **Trend in resources**

Banking resources had an evolution comparable to the one recorded a year before, that is 7,602 MTD (9.2%), where 93% came from the higher level of deposits. Deposits' evolution is relevant to deposits in dinars (12.4% vs. 11.7%) against an ongoing regression of deposits in foreign currency (0.5% in 2020 against 0.7% in 2019). In 2020, deposit mobilization focused mainly on demand deposits (15.5% vs. 6% in 2019) and savings deposits (14.8% vs. 7.9% in 2019). Forward deposits and certificates of deposits fell by 3.9%. This testifies to migration of a part of forward deposits towards sight deposits and savings deposits. These trends affected deposits structure with a firmed-up share of sight deposits (+2.2 percentage points) and savings deposits (+1.5 pp) against a lower share of forwarding deposits (-3.3 pp) and certificates of deposits (-0,4 pp) (+1.5 pp) against a lower share of forward deposits (-3.3 pp) and certificates of deposits (-0,4 pp).



Source: Supervision report (CBT 2020)

Figure I.3: Trends of the structure of deposits in %

- **Trend in uses**

Tunisian resident banks' uses grew at a speeded-up pace as it almost doubled, up from 3.9% in 2019 to 6.9% in 2020. This acceleration was related to customer loans (+6.4% in 2020 against +3.8% in 2019), as well as the securities portfolio (9.6% in 2020 against +4% in 2019). Loans' acceleration is due to postponement of professional and non-professional loans' maturities, Covid-19 related exceptional loans and better mobilization of deposits in dinars. The increase in the outstanding balance of securities portfolio concerned shareholding

securities (369 MTD or 18.6% against 58 MTD or 3% in 2019), in line with the important volume of profits reinvested as SICAR- managed funds, following suspension of dividend distribution decided by the BCT in 2020. The significant increase in the outstanding balance of Treasury Bond and other State securities is attributable to banks' important subscriptions to Treasury issues in 2020. Banks posted, at the end of 2020, an average LTD ratio of 117% against 120% in 2019 and 130.7% in 2018.

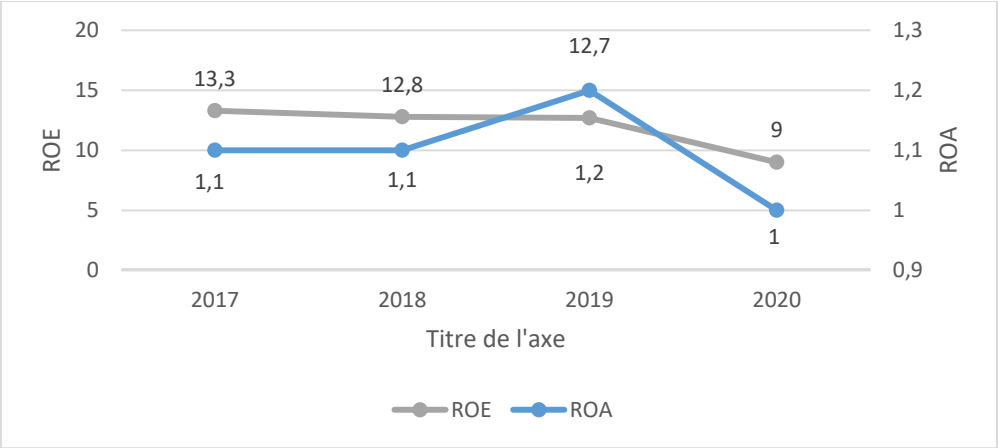
Table I.3: Evolution in Tunisian banks' uses

	2018	2019	2020	Variations	
				2019/2018	2020/2019
Loans to Customers	82,615	85,777	91,269	3,8%	6,4%
Securities portfolio:	14,518	15,096	16,549	4%	9,6%
Shareholding and similar securities	1,925	1,983	2,352	3%	18,6%
Trade and placements securities	1,877	2,20	1,903	12,9%	-10,2%
Bonds	433	327	250	-24,5%	-23,5%
Treasury bonds and national borrowings	9,436	9,545	10,235	1,2%	7,2%
Total uses	97,133	100,873	107,818	3,9%	6,9%

Source: Supervision report (CBT 2020)

- **Bank profitability**

For 2019, 16 banks posted had a cumulative profit of 1,478 MTD (against 18 banks with a cumulative profit of 1,227 MTD in 2018) and 7 banks posted a deficit result amounting to 165 MTD (against 70 MTD loss posted by 5 banks in 2018). The accumulated profit of 2019 has been fully allocated in reserves following the decision of the CBT to invite banks and financial institutions to suspend any measure of dividend distribution for the year 2019 and to refrain from carrying out any operation of repurchase of their own shares, in order to reinforce their capital to face the potential risks related to the impact of the COVID-19 pandemic on economic sectors (CBT, Annual report 2019).

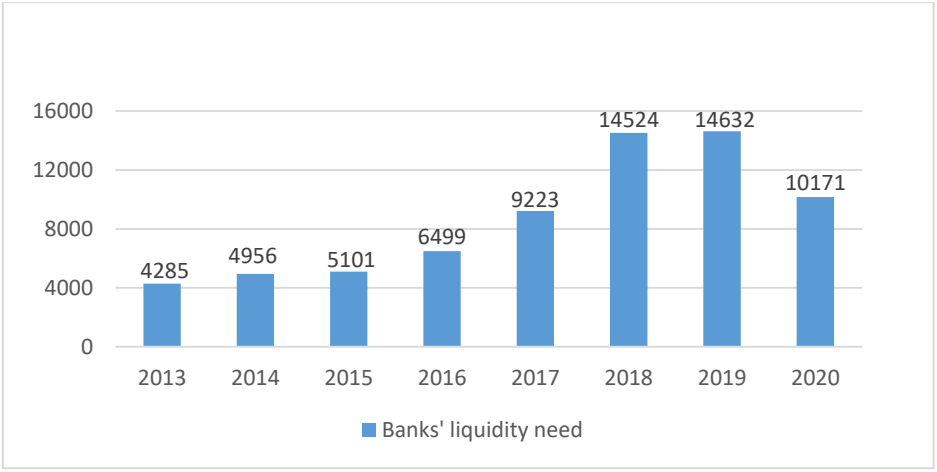


Source: CBT, annual reports (2017 to 2020)

Figure I.4: Trends of the ROA and ROE over 2017-2020

Because of the economic recession caused by the pandemic, the Tunisian banking sector faced difficulties, particularly in terms of profitability deterioration. Figure (Fig. I.4) shows that bank profitability measured by the ROA was relatively stable between 2017 and 2018 then rose to 1,2% in 2019 and recently in 2020, mainly due to the health crisis. However, the ROA declined to reach just 1%. More surprisingly the ROE measure of profitability has declined respectively from 13,3% in 2017 to 12,8% and then 12,7% in 2019 to decrease sharply in 2020 and reach 9%.

- **Bank liquidity**



Source: CBT, Annual report (2015-2017) and Supervision report (2020)

Figure I.5: Evolution of the Tunisian bank's liquidity demand (MDT) from 2013 to 2020

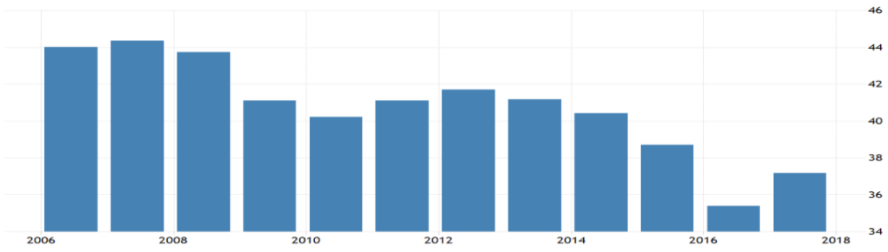
Based on figure (Fig. I.5), banks liquidity demand had a continuous increase reaching 14500 MTD in 2018 and 2019. More recently, liquidity has been strongly affected by the impact of the health crisis throughout 2020, and even in early 2021, recording a clear drop in banks'

liquidity needs of about 30% in 2020, going back from 14.632 MDT, in 2019, to 10,171 MTD in 2020.

In this context of strong uncertainties, and in spite of limited monetary and budgetary room for manoeuvre, the Central Bank of Tunisia decided to act proactively by implementing a series of exceptional measures to support the Government's action in order to limit the pandemic's repercussions on economic activity and support businesses, as well as the most affected social categories. These measures, combined with the explosion of sanitary expenditure weigh down heavily on global balances and result in an important increase in financing needs and a worsening of indebtedness and the budgetary deficit. According to the World Bank's report, close supervisory scrutiny, adherence to robust classification standards and effective financial safety nets are particularly important to increase transparency and maintain confidence in the system.

- **Bank concentration ratio**

As presented in figure (Fig. I.6), according to the World Bank, the bank concentration ratio[30] was reported at 37.18 % in 2018. This can be explained by the fact that Tunisian banks are changing their business model and opting for diversification strategies, especially since the global financial crisis.



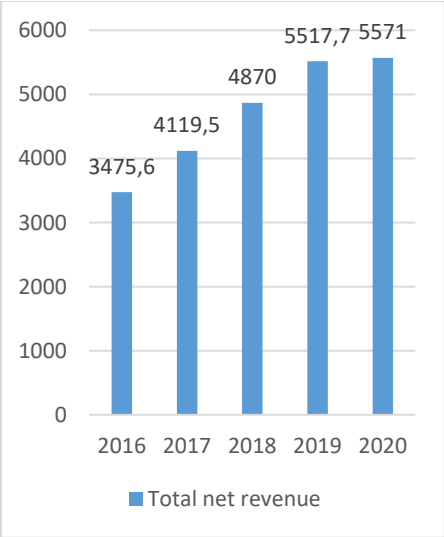
Source: world bank (Bankscope)

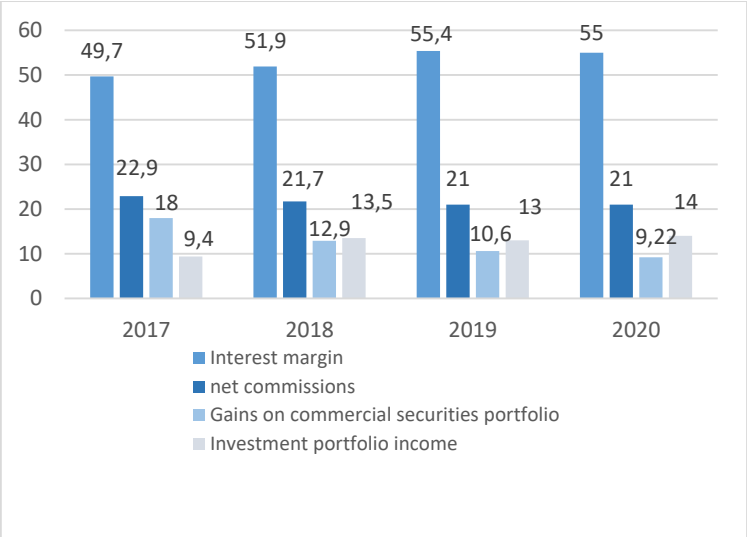
Figure I.6: Trends of Bank concentration ratio

- **Operating activity**

According to the Professional Association of Tunisian Bank's statistics, the total net operating income of universal banks has increased on average by 60% % during the period 2016-2020 (Fig. I.7). It is also clear that during this timeframe, bank revenue is attributable to both interest and non-interest income.

[30] The bank concentration ratio is measured as the share of assets held by the largest banks (typically three or five) in a given economy, or the Herfindahl-Hirschman index (HHI), the sum of the squared market shares of each bank in the sector.





Data Source: Tunisian professional association of banks and financial institutions

Figure I.7: Trends of Net operating revenue (in MTD)

Figure I.8:Trends in net operating revenue structure (In %)

Furthermore, the structure of net operating income reported in figure (Fig. I.8), shows that Tunisian banks revenues are approximately evenly split between interest and non-interest revenues where the weight of the interest margin represented 55,4% of net banking income in 2019 and 55% in 2020 even crisis and containment impact compared to the non-interest income which represent approximately 44 % composed by the net commissions and gains on commercial and investment portfolio.

Table I.3: Operating results of Tunisian resident banks over 2018-2020 (in MDT)

	2018	2019	2020	Variations	
				2019/2018	2020/2019
Interest margin	2,299	3,022	3,068	31,4%	1,5%
Net commission	956	1,169	1,207	22,3%	3;3%
Gains on commercial securities-portfolios	553	585	514	5,8%	-12,1%
Income from investment securities portfolio	580	713	782	22,9%	9,7%
Net operating income	4,388	5,489	5,571	25,1%	1,5%

Source: CBT, Banking supervision report (2020)

As shown in Table (Tab. I.3), the analysis of the financial year 2020's Statements result compared with that of 2019 shows:

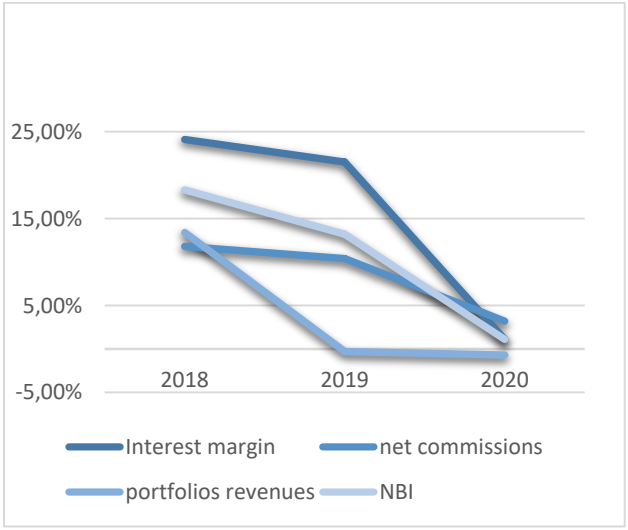
-A lower pace of the interest margin (1.5% against 31.4%) which is due, on the one hand, to the drop in interests paid with respect to postponement of credit maturities and, on the other hand, to the decrease in the money market rate (MMR).

-A very accentuated decline of net commissions' evolution pace, down from 22.3% in 2019 to 3.3% in 2020 in line with economy- support measures related to monetary operations (ATM, Card, Electronic payment terminals…) and the unprecedented showdown of economic activity.

-A 12.1% regression in foreign exchange gains.

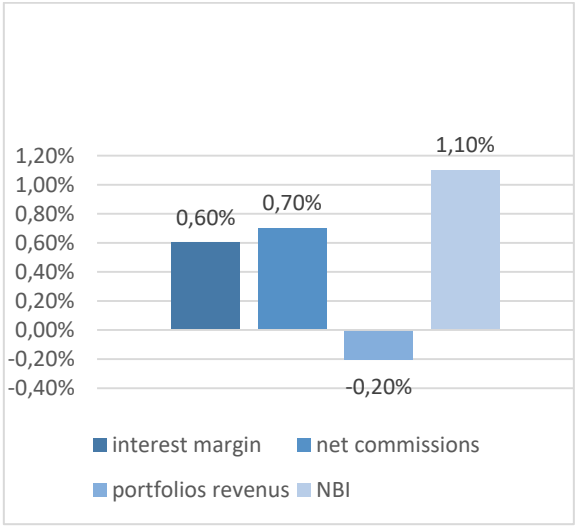
-A 69 MTD or (9,7%) progress in income from investment securities portfolios in 2020 against 133 MTD or (22.9%) in 2019. As a consequence, the net operating income growth of resident banks decelerated significantly, evolving by 1.5% in 2020 against 25,1% in 2019.

Despite the Covid-19 crisis and the decisions of the CBT to postpone the maturity of loans made to professionals and businesses (06-2020 and 21-2020 circular), listed banks have shown remarkable resilience. The examination of figures 13 and 14 below reveals that the contribution of interest income is higher than that of non-interest income (NII). By the end of the year 2020, the NOI of listed banks increased by 1.1% (+54.5 MTD) (Fig. I.9). As illustrated in figure 14, the 12 listed banks show that the income growth by 1.1% in 2020 is coming from +0.7% of net commissions, +0.6% of interest margins and -0.2% of portfolios revenues



Source : ilboursa.com

Figure I.9: Growth rates of the NOI components of listed banks

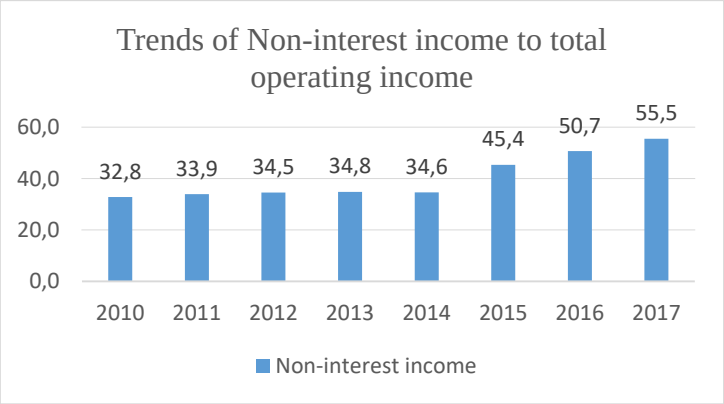


Source : Tira finance

Figure I.10: Contribution in NOI growth (2020)

- **Banks' non-interest income activities**

Bank non-interest income to total income (%) in Tunisia was reported at 55.5 % in 2017, according to the World Bank, compared to 32,8 % in 2010 (Fig. I.11).



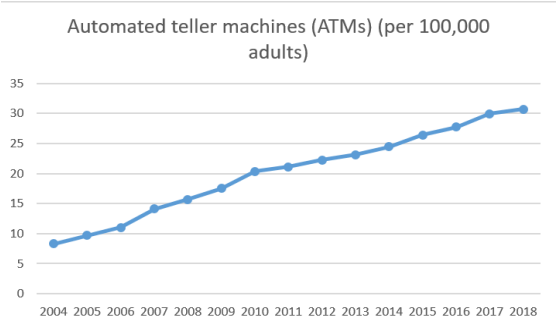
Source: world bank (Bankscope)

Figure I.11: Bank non-interest income to total operating income, in percent over years

- **The use of electronic means of payments**

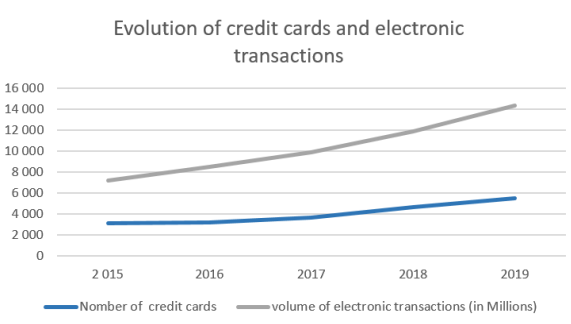
Until recently, Tunisian law had mandated that only certified financial institutions with banking licenses are allowed to manage financial transactions. Consequently, electronic payment platforms required participation from at least one Tunisian bank, with payments only between existing Tunisian bank accounts. The Central Bank circular 2018-16, issued on December 31, 2018, allowed new e-payment providers to enter the market.

In May 2019, the Ministry of Finance introduced a set of new digital services to facilitate the payment of bills, taxes, and other charges by citizens and businesses. Undoubtedly, the Covid-19 pandemic and related social-distancing measures created a surge in demand for online shopping businesses. We quote, for example the evolution of the number of ATMs (per 100,000 adults) from 4,31 in 2005 to 30,72 in 2018 (Fig. I.12)



Source: world bank

Figure I.12: Automated teller machines (ATMs)



Source: CBT: annual report 2019

Figure I.13: Electronic payments used to make payments (%)

In addition, the number of electronic payments and credit cards such as presented in figure (Fig. I.13), show the increase in the use of credit cards over time. The number of credit cards issued at the end of 2019 amounted to 5.5 million cards, representing an average annual growth of 15.7% over the 2015-2019 period. At the same time, the number of ATMs increased by an average of 6.1% annually to reach 2,854 units at the end of 2019.

In fact, there were about 15,650 point-of-sale terminals (i.e., credit cards) in Tunisia by the end of 2017, and it is expected that there are many more now in 2021 mainly due to the COVID-19 pandemic and CBT measurements. Furthermore, according to recent statistics, the credit card penetration rate in Tunisia was at 7.1 percent[31] at the end of 2020.

Overall, the most remarkable conclusion to be drawn is that the level of the non-interest income is becoming considerably higher from one year to another which can be explained by the orientation of Tunisian banks to the use of new technologies of information and communication. Similarly, it results from an increase in the use of electronic means of payment such as e-banking, ATMs and credit cards.

Currently, cash use is decreasing, and this is accelerated by the COVID-19 pandemic. Besides, the reduction in the net interest margin can be compensated by the non-interest income source. Interestingly, Tunisian banks continue to maintain long-term relationships with their customers, who remain loyal to their banks despite the emergence of new banking service providers. Customer deposits did not fall even during hard times (the popular revolution of January 2011 and the current health crisis). The financing of the economy by the banking sector reached 8.554 MDT in 2020 against 6.130 MDT in 2016. However, the adoption of IFRS 9 which started at the end of fiscal year 2021 could have a significant impact on the reported asset quality indicators, requiring additional provisions (Fitch Ratings 2021). In the same vein, Moody's downgraded long-term deposits note for four Tunisian banks and maintains a negative outlook (i.e., Amen Bank, ATB, BT and BIAT with confirmation of STB's downgrade to Caa1). Furthermore, Moody’s states that the main reason for these rating is the increasingly difficult operating environment for the banking sector in Tunisia with the decline in the country's macro profile score from very low to very low + and also the weakening of the credit profile of the Tunisian government, as the decision to lower the sovereign rating from B3 to Caa1.

[31] https://www.statista.com/statistics/1233933/credit-card-ownership-in-tunisia-by-gender/

Conclusion

As a result of the deregulation in the late 1990s, the banking landscape changed significantly, especially in terms of business models. The practice of income diversification has created conflicting arguments about its impact on banks risk and performance. On the one hand, a non-interest income is motivated by certain advantages that concentrated banks cannot have such as gaining from exploiting managerial skills and abilities across products (Iskandar et al., 2007), taking advantage of economies of scale by sharing costs across various markets and products (Drucker and Puri, 2009), and offering a wide range of banking services to clients who require various products. On the other hand, the other ones that prefer the concentration strategy claim that income diversified banks can reduce their comparative management advantage when investing in many areas they are not experts in (Klein and Saidenberg, 1998). In addition, shifting toward non-interest business increases competition (Winton, 1999) and creates higher agency costs resulting from diminishing value activities when managers want to reduce their risk (Laeven and Levine, 2007). Nevertheless, only a handful of existing studies rigorously consider the effect of the crises on the effect of income diversification strategy on bank performance and risk (Nguyen et al. 2021). Not only do previous studies have inconclusive findings, but the empirical evidence and findings in the bank diversification literature are primarily based on the US banking industry, with more or less focus on diversification effect on banks performance and risk during crises periods.

From the Overview of the Tunisian banking sector section, we note that the banking sector is the main promoter of funds for the economy in Tunisia, it plays a crucial role in the economic development of the country. During the last years, the banking activity has evolved. Tunisian banks remain profitable and stable, recording an operating income growth rate of 26,1% between 2018 and 2020. Nevertheless, nowadays, this sector is facing a multiple of economic aggregates that can affect its activity, strength and even its financial stability. Tunisian banks have to be very vigilant, and the CBT must be efficient in both supervision and support.

Through this theoretical chapter, we have explained the main variables related to our research question. Then, we have explained bank business strategy as a whole to arrive at the non-interest income activities of the income diversification strategy of banks. Then we have presented a review of the literature that has been conducted on the relationship between non-interest sources of revenue and performance and/or risk of banks. As we have shown, there is an ongoing debate on whether banks suffer or benefit from their income diversification

strategy in a stable and unstable context. After setting up our hypotheses and presenting an overview of the Tunisian banking sector and analysing the current financial situation of residents banks, the next chapter will provide empirical evidence to catch how non-interest income can affect the Tunisian banking system in terms of performance and risk in stable versus crisis period.

CHAPTER 2

METHODOLOGY AND EMPIRICAL RESULTS

Introduction

The impact of non-interest income on the financial performance and risk of banks has been the subject of several empirical studies (e.g., Craigwell and Maxwell, 2006; Elsas et al., 2010; Lee et al., 2014; Hamdi et al., 2017). However, the genuine benefits of the non-interest activities are still under scrutiny. While recent literature, such as Chiorazzo et al. (2008), Meslier et al. (2014); Trivedi (2015); and Hamdi et al. (2017), supports the positive effects of non-interest income on banks performance and risk. Some researchers question whether the new sources of income may be more volatile and entail a higher level of risk and bank fragility (DeYoung and Roland, 2001; Stiroh, 2004; Stiroh and Rumble, 2006, Williams and Prather, 2010). So, the continuously increasing number of findings motivate researchers to consider the temporal dimension. More specifically, another set of empirical studies (Derbali, 2011; Park et al., 2019; Flori et al. 2019; Cheng et al. 2019; Kim et al., 2020; Paltrinieri et al., 2020) show that the inconclusive results on the efficiency of the new business model are mostly related to the economic context and financial situation (tranquil or crisis period). Kim et al. (2020) results suggest that although most regulators worldwide encourage diversification to reduce bank risk, bank diversification may exacerbate bank financial instability or increase the risk of financial market collapse when financial crises occur. The crises may badly weaken the financial health alone of the banking industry as evidenced by Williams (2016) related to the GFC, but the joint interaction between financial crises and bank diversification may lead to appreciation in that case. Under this caption, we extend our study from Williams (2016), DeYoung and Torna (2013), Cheng et al. (2019), Kim et al. (2020), Li et al. (2021), and Onali & Mascia (2021), given new heights of attention on the crisis effect on the relation between the non-interest income and bank performance and risk in emerging economies rather than developed countries. The core focus is to analyse the effect of functional diversification across non-interest income, and their effect in terms of risk and performance, verifying also if the results have been affected by crises.

Taken together, the absence of prior literature on the joint effect of the new business model and crises on bank performance and, risk in the Tunisian context, led us to choose this subject. What can be considered more interesting is taking into account several types of crises (global financial crisis and the European debt crisis, the political crisis (Tunisian revolution), and the economic crisis brought on by the COVID-19 pandemic) in order to shed the light on their effects on the relationship between banks business models and their performance/risk.

This chapter is structured as follows. In the first section, we describe the data sources, variables definitions, and present the main methodological issues. We will analyse in the second section the descriptive statistics and provide the specification tests. Lastly, in the light of what was tested through empirical regressions, the third section presents and discusses the empirical results, while the final section provides concluding comments and policy implications.

I. Data, variables definition and methodology

We aim to investigate whether the diversification into non-interest income activities is beneficial or not for Tunisian banks and if this diversification strategy has the same effect on bank profitability and risk during crises. In this section, we present our data and describe banks' specific and macroeconomic variables that will be used later in empirical estimation.

I.1. Sample selection and data sources

Our data includes 10 conventional banks. We chose to study listed banks only because of information accessibility. Three of banks included in our study are public (i.e., STB Bank, BH Bank and BNA Bank, where the government owns more than 36% of their equity). Furthermore, understudied banks represent 90.58% of the total banking sector balance sheet in Tunisia. Besides, we aim to assess the impact of non-interest income on Tunisian banks from 2005to 2020. Our sample therefore covers a 16-year time span that includes the tranquil period before the global financial crisis and sovereign debt crisis, the political crisis as well as the health crisis of 2020. This would allow us to compare the effects of diversification on the banks' financial stability and performance during normal and crises periods. Financial data are collected from the professional association of banks website and from the banks' annual reports. As for the macroeconomic indicators, they are collected from the CBT and from the World Development Indicators database which is an open data source of the World Bank. Hereafter, listed banks with their outstanding deposits and total assets are presented in table (Tab. II.1).

Table II.1: Denomination, total assets, and total loans, of listed banks

Date: 12/31/2020			
	Denomination	**Total Assets**	**Total Loans**
STB	Société Tunisienne de Banque	12 249 436	9 080 399
BH	BH Bank	12 243 399	9831523
BNA	Banque Nationale Agricole	14 422 115	11 924 837
BT	Banque de Tunisie	6 286 476	4 827 549
ATB	Arab Tunisian Bank	7 399 214	5 121 128
UIB	Union internationale des Banques	6 459 243	5 832 983
BIAT	Banque Internationale Arabe de Tunisie	17 874 418	11 340 970
AMEN BANK	Amen Bank	9 177 571	6 003 059
ATTIJARI BANK	Attijari Bank	9 684 942	5 979 454
UBCI	Union Bancaire pour le Commerce et l'Industrie	3 470 722	2 498 880

Note: This table presents the value of total loans and total assets for 2020 expressed in millions of dinars.

Source: author's construction (Data from Financial statements of listed banks)

I.2. Variables' definitions and measures

According to Garoui et al (2013), internal factors related to bank risk and performance include, mainly, size, capitalization, liquidity, credit quality, efficiency and degree of diversification. Moreover, the macroeconomic determinants that are mostly used in empirical literature (Kosmidou et al., 2005; Davydenko, 2010) are GDP and inflation. Following Lütkepohl and Xu (2010), in order to reduce the skewness and enhance variance stability, most of the variables in the final sample are kept in the fraction form, except for total assets, which is converted to log form. Detailed formula and description for each variable are presented in Table (Tab. II.2) presented hereafter.

I.2.1. Dependent Variables

The dependent variables are:

- **Bank Performance Measure**

ROA: The Return on assets ratio shows the profit per dollar dinar of assets. It reflects the ability of the banks to use the financial data and real estate resources to generate profits (Naceur; 2003, Karawesh; 2011, Ongore and Kusa; 2013). If ROA increases, therefore, the bank is more effective (Wen, 2010). The ratio is calculated as follows:

$$\text{ROA} = \frac{\text{Net income}}{\text{Total assets}}$$

- **Bank Risk Measure**

Z-score: In our study, we chose the Z-score measure because it represents an important indicator of risk and bank stability. It can be used as a proxy of banks global risk (Zhou et al., 2014; Cheng et al., 2016; Geng et al., 2019). It is calculated through dividing the sum of the return on assets and the capital ratio by the standard deviation of ROA. It used by the World Bank and by several authors (e.g., Boyd and Runkle, 1993; Demirgüç-Kunt et al., 2008; Demirguc-Kunt and Huizinga, 2010) and it indicates the probability of failure of a given bank. Furthermore, it is the inverse of the probability that the bank's losses surmount its capital[32] and it measures the distance to default (Laeven and Levine, 2009; Dong et al., 2014). Higher values of Z-score indicate higher resilience, thus, more stability and lower risk. It has an advantage over other accounting-based measures of risk, such as non-performing loans, as it includes the return on both intermediation and fee-based activities of the bank (Kohler, 2015). For a sample of panel data, Z-score is measured as follow:

$$\text{Zscore} = \frac{\text{ROA} + (\frac{\text{Equity}}{\text{Total assets}})}{\sigma\text{ROA}}$$

Where ROA is the return to assets ratio as measured above and σ ROA is the standard deviation of the ROA.

I.2.3. Independent Variables

The independent variables are:

SHNII: Our choice of explanatory variables has been significantly influenced by theoretical and empirical contributions from a broad range of literature on income diversification strategy bank performance and risk. Stiroh & Rumble (2006) demonstrated that SHNII (the share of non-interest income)33 captures the direct effect of non-interest income compared to other measures of bank diversification and bank business model (such as Herfindahl-Hirschman Index (HHI34)). Baele et al. (2007) measure bank diversification using the ratio of non-interest income to operating income and argue that this ratio is an effective proxy for diversification. The ratio is measured as follows:

[32] That is the probability (–ROA < E/A), where E/A is the capital to assets ratio (equity/assets).

[33] DeYoung and Rice (2004) use the ratio of non-interest income to assets to proxy for bank diversification, whereas Stiroh (2006), Lin et al. (2012) and Williams (2016) use the ratio of non-interest income to total operating income (or total revenue or total income). However, to look directly for the non-interest income impact on bank performance and risk, Cheng et al. (2019) use the share of the non-interest income to total operating income.

[34] Herfindahl-Hirschman Index is used widely by empirical studies (Elyasiani and Wang, 2012; Nguyen et al. 2015; Williams, 2016; Nguyen et al. 2020; Nepali, 2018)

$$\text{SHNII} = \frac{\text{Non-interest income}}{\text{Net operating income}}$$

where Net operating income is the summation of net interest income and non-interest income (Majumder and Uddin, 2017) and Non-interest income is the composition of revenues from commissions, trades and other non-interest incomes. The higher the ratio of SHNII, the more a bank focuses on non-traditional bank activities. As reported by Maudos and Guevara, (2004) and Demirguc-Kunt and Huizinga, (1999), a higher value of net-interest income ratio implies that the bank can diversify and make its intermediation activity beneficial. Thus, this measure reflects banks' reliance on non-interest generating activities. As the core activity of Tunisian banks is the deposit-lending business, we expect this ratio to contribute to banks' performance before crises more than during and/or after crises because the effect of distresses takes time to manifest and the non-traditional activities are riskier and more volatile, as proven in previous literature. Additionally, previous studies proved that crises impact emerging countries with a time lag. Nguyen et al. (2020) found a significant positive effect of non-interest income (NII) on bank profits in pre-crises period. However, there is a significant negative effect of NII share on risk-adjusted profits in the post-financial crisis (following economic downturns). In the same vein, using Chinese data from 2004 to 2016, Cheng et al. (2019) provided evidence that if banks increase their share of NII, insolvency risk and ROA volatility increases significantly, this relationship appears during and after financial crises. More specifically, they demonstrated that this effect is mainly from assets-based non-interest income.

COM: The first and main component of non-interest income is the fees and commissions.

The ratio is calculated as follows:

$$\text{COM} = \frac{\text{Fees and commissions}}{\text{Net operating income}}$$

Edirisuriya et al. (2015) and Nisar et al. (2018) demonstrated that fees and commissions affect negatively bank profitability and stability. Most commissions and fee incomes come from traditional activities such as lending, payment, and deposit account services. DeYoung and Rice (2004) revealed that fees and commissions stemming from traditional banking activities, like lending, are highly and positively correlated to the intermediation activity. However, Meslier et al. (2014) showed that this source of revenue increases income volatility. This is supported by Stiroh (2006), studying the U.S banking sector, he explained the correlation of

the fees and commissions income with the net-interest income by the cross-selling marketing. Other researchers, such as Meslier et al. (2014), have reached opposing results. In fact, Meslier et al. (2014) found that fees and commissions incomes are positively associated with bank profitability.

SHORT: This ratio represents short-term trading to total assets ratio for income stemming from the commercial portfolio profit. It is used to account for the short-term trading source of revenue. Following Nisar et al. (2018), this ratio is measured as follows:

$$\text{SHORT} = \frac{\text{Commercial potfolio}' \text{ profit}}{\text{Net operating income}}$$

LONG: This ratio represents long-term trading profits from investment portfolio. Following Nisar et al. (2018), it is measured as follows:

$$\text{LONG} = \frac{\text{Investment potfolio}' \text{ profit}}{\text{Net operating income}}$$

Previous studies such as DeYoung and Rice (2004), Lepetit et al. (2008), Meslier et al. (2014), and Mostak (2017) found that trading activities positively affect bank performance. Hence its growth is weakly or negatively correlated with intermediation-activity. Furthermore, related to risk and return, Lepetit et al. (2008) found that trading-income decreases risk and enhances profitability of small European banks. Stiroh (2004) reported that relying on trading income activities increases bank risk. Taken together, previous researches in different contexts found that the trading income impacts banks' performance and stability in a way or another.

I.2.4. Control variables

In our empirical analyses, several control variables are employed to account for the potential effects of the banks' specific features on the level of systemic risk. Previous studies postulate that the riskiness of financial institutions is linked to variables such as size, profitability capital ratio, and income structure (Pathan, 2009; Iqbal et al., 2015; Iqbal et al., 2019). Hereafter, we will be presenting each measure and its effect.

- **Bank specific factors**

Banks' risk and return are affected by several factors, some of which are bank-specific, while others are macroeconomic. Bank-specific factors are directly linked to each financial

institution's business strategy, whereas macroeconomic factors affect the economy as a whole, thereby affecting banks' performance. Based on the existing research about the Tunisian banking sector, bank-specific and macroeconomic control variables selected are the Net Interest Income (NIM), Size, Assets Growth (AG), Capital Adequacy Ratio (CAR) and Expenses (EXP).

NIM: is the net interest income to total assets ratio. It is computed as the difference between interest revenue and interest expense divided by total assets. This ratio investigates the influence of net interest margin (Cheng et al., 2016; Geng et al., 2019; Cheng et al., 2019). We introduce this ratio to account for intermediation activity which is the bank's core activity and to control for the share of the non-interest income ratio to better understand the bank income diversification strategy and to show its impact on bank risk and return. In fact, NIM indicates the efficiency of financial intermediation (Hamadi and Awdeh, 2012). In our case, it will not be used as a performance measure since it is only helpful to track the profitability of traditional interest business lines. It is measured as follows:

$$\text{NIM} = \frac{\text{Net interest income}}{\text{Total assets}}$$

Where the net interest income is interest receivables minus interest incurred. According to Maudos and Guevara (2004) and Ayadi and Ellouze (2015), higher levels of this ratio indicate that banks are focusing on the lending-deposit activity.

SIZE: bank size is introduced in order to test for the validity of the small financial system view in order to test whether large banks benefit more from scale economies (Beck and Hesse, 2009). It is measured by the natural logarithm of bank total assets as follows:

$$\text{SIZE} = \text{Ln}(\text{Total assets})$$

It is one of the most used control variables in the literature. Its importance is based on the expectation that banks of different sizes will present different results. As argued by Boyd and Runkhle (1993), large banks benefit from economies of scale which reduce the production cost and information gathering. According to Sanya and Wolfe (2011), when entering a new market, larger banks tend to have greater diversification opportunities and less income volatility than small ones. Taken together, we expect that larger banks will have higher profitability and lower risk. The idiosyncratic risk could be lower (e.g., when the bank is considered to be too big to fail et al. (2004)).

AG: Assets growth is used to control for the bank's operations expansion strategies and to examine the effects of growth opportunities (Li and Zhang 2013). It can also be considered as a measure for growth through acquisition (Stiroh & Rumble, 2006; Mercieca et al., 2007; Chiorazzo et al., 2008; Sanya and Wolfe, 2011; Calmès and Liu, 2009). The ratio is measured by the growth rate of a bank's assets as follows:

$$\mathrm{AG} = \frac{\mathrm{TAt} - \mathrm{TA(t-1)}}{\mathrm{TA(t-1)}}$$

CAR: The capital adequacy ratio is the equity to total assets ratio. A bank that has a good CAR ratio has enough capital to absorb potential losses. Previous literature proved the crucial role of bank capitalization in both performance and stability. The ratio is calculated as follows:

$$\mathrm{CAR} = \frac{\text{Equity}}{\text{Total assets}}$$

The capital ratio is used to control for the degree of risk preferences of a given financial institution i.e., risk-taking banks may hold less equity (Stiroh, 2006; Mercieca et al., 2007; Chiorazzo et al., 2008; Sanya and Wolfe, 2011). Furthermore, the equity to total assets ratio shows the strength of bank capital against the vagaries of the economic and financial environment (Ben Moussa; 2014). As documented by Gull (2011), the capital is positively associated with the performance and financial stability of banks. Dhouibi, (2015) shows that for Tunisian banks, the capital structure has a positive relationship with bank performance measured by the ROA ratio.

EXP: Expenses is a measure of operating costs. Following Elsas et al. (2010), it could be also a measure of bank efficiency. Athanasoglou et al. (2008) found a positive relationship when studying Greek banks and explained that more efficient banks are more-able to use their resources in the best way and reduce their costs, thus, generating a better performance. This reasoning is used by Liu et al (2010) in their analysis of Japanese banks from 2000 to 2007.They indicated that the cost-to-income ratio has a negative impact on performance. The expenses ratio is calculated as follows:

$$\mathrm{EXP} = \frac{\text{Total operating costs}}{\text{Total assets}}$$

Nguyen et al. (2015) showed that operating in new business lines increases banks costs such as wages and marketing costs, which could influence bank risk. As for performance, Karakaya and Er, (2013) opine that banks must manage operating costs to be more efficient and to have better profits.

I.2.4. Macroeconomic factors

The macroeconomic view for non-interest income source adjustment and bank performance of Tunisian banks are examined through the introduction of two pertinent macroeconomic variables, namely economic growth (GDP growth rate) and the inflation rate (annual change of Price consumer index).

GDP: This control variable is measured by the Gross Domestic Product (GDP) growth rate. Since business conditions in the economy affect firms' appetite for credit, as well as their ability to repay, this variable has an impact on banks' performance (Sanya and Wolfe, 2011; Stiroh, 2004 and Nguyen et al., 2018).

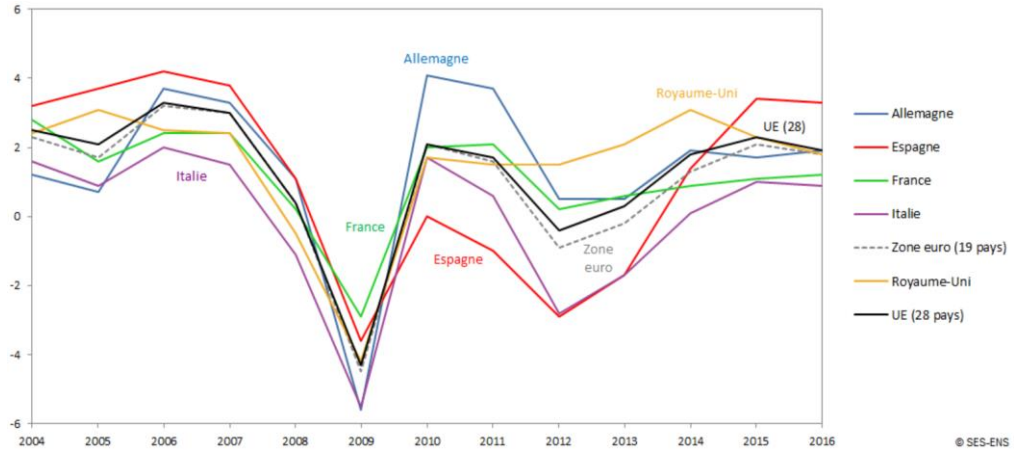
INF: Inflation rate represents a proxy of macroeconomic conditions. It is more likely to decrease banks' profitability and stability (Dhouibi, 2015; Nisar et al., 2018). Tan and Floros (2012) investigated whether inflation impact performance of Chinese banks. They revealed that there is a negative relationship between the two variables. In contrast, Alexiou

and Sofoklis (2009) provided empirical evidence of positive relationship between inflation and bank profitability. This can be explained by the fact that higher inflation rates increase uncertainty and reduce credit demand (Ben Naceur and Kandil, 2009). Thus, banks attempt to counter this environment by reducing the cost of intermediation.

In our study we use three dummy variables to indicate the crises that occurred during our study period (2005-2020) as follows:

FDC: Previous studies (Lins et al., 2013, Wang, 2014; Drakos and Kouretas, 2015; Dungey and Gajurel, 2015; Curi et al. 2015; Kuppuswamy and Villalonga 2015; Adrian et al. 2017; Adelopo et al., 2018; Cheng et al., 2019) agree that the financial crisis occurred mainly between 2007 and 2009. That is, in developed nations, it started in 2007 and ended in 2009. However, Martin Khor, the new Director of the South Centre in Geneva said :"Developing

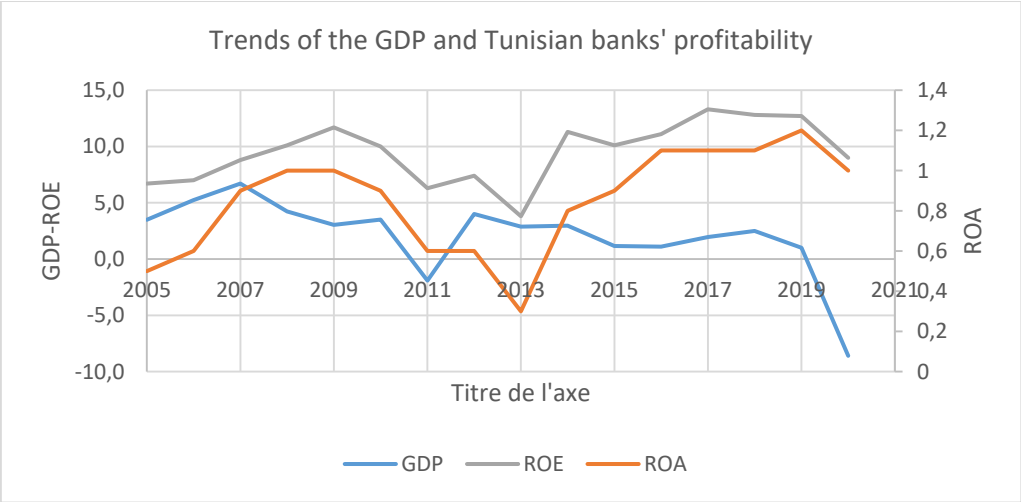
countries are not responsible for it, but they are now seriously affected"[35]. We support the idea that the impact on developing and transition countries was gradually apparent. It was only when the crisis turned into a global economic recession that developing and emerging market economies were affected, mainly through financial and trading channels (Gurtner, 2010). The sovereign crisis is introduced because the financial crisis did not end in 2009[36] in Europe, as it did in American countries. Tunisia's main partners (i.e, France, Italy and Germany) have experienced the second wave of the financial crisis in 2010 (Annual report of the CBT, 2010). Figure (Fig. II.1) shows how much this crisis impacted the GDP growth of these countries in 2009, which in turn influenced national economy until 2011 (see Fig. II.2.). It's clear that the GDP decline from that date was followed by a decrease of bank profitability (ROA and ROE) in 2010 and 2011(According to IMF and the annual report of CBT). More interestingly, the sharp fall of these indicators in 2011 is related mainly to the direct effect of the revolution which worsened the Tunisian national economic and financial situation.



Source : Eurostat, *Comptes nationaux annuels (série tec00115, dernière mise à jour 11/12/2017)*

Figure II.1: Real GDP growth rates from 2004 to 2016 in the EU, the Eurozone and selected EU countries (%)

[35] This South Centre's "South Bulletin" shows in detail how the developing countries were impacted by the crisis. South Centre. *South Bulletin*, Issue 34, 16 March 2009.
http://www.southcentre.org/index.php?option=com_content&task=view&id=978&Itemid=1.
[36] See Allegret et al. (2017)



Data source: The annual report of Professional Association of Tunisian Banks ***(2005-2020)***

Figure II.2: Trends of GDP, ROA and ROE over the period of 2005-2020

FDC is used in our study as a dummy variable that takes the value 1 for the years 2009 and 2010, and 0 otherwise. Some studies on the impact of the GFC on Tunisian banks used a dummy variable that takes one for the time period 2007-2010. Rachdi (2013) found that the Tunisian banking sector was not impacted by the international financial crisis because of its low integration in international financial markets and the strict control by specific and rigorous rules by the central banking of Tunisia (CBT).

PC= is a dummy variable that takes 1 for the years 2011 to 2013 and zero otherwise. It is used to identify the effect of the political crisis on the effect of the income diversification strategy on bank risk and return. The choice of three years instead of just the year of the shock of revolution in 2011 as documented in many studies in the Tunisian context (Ayadi and Ellouze, 2014; Saadaoui, 2018; Ben Salem, 2019), is explained by the fact that the crisis's influence on bank profitability and risk appears with a time lag. As shown by Figure (Fig. II.2), despite the recovery in economic growth, performance indicators continue to decline sharply in 2013. Thus, the year 2013 is the most difficult for the banking sector. It was marked by the establishment of the circular n° 2013-15 concerning the internal control rules for the management of risks related to money laundering and terrorist financing (consequence of the political crisis and instability), which reveals the willingness of the CBT to adopt best practices and gain efficiency by implementing risk-based supervision to maintain the integrity of the banking sector[37].

[37] See annual report of CBT, 2013

HC: Is another dummy variable that takes one for the year 2020 and zero otherwise. This variable is used to capture the effect of the health crisis (i.e., the COVID-19 pandemic) on the association between non-interest income sources and bank performance and risk. In fact, the only study on this subject so far is that of Demirguc-Kunt et al. (2020). Their results suggest that the adverse impact of the pandemic shock on banks was much more pronounced and long-lasting than other non-bank financial institutions. By studying the market response to policy initiatives, their findings show that, there are noticeable differences between the COVID-19 shock versus previous events of financial and economic stress.

Taken together, in this work we consider the influence of the different recent crises on the association between income banking strategy and bank performance and risk which previous studies have overlooked (Rachdi, 2013; Fahlenbrach et al.,2020; Cheng et al., 2020; Chen and Yeh, 2021; Çolak and Öztekin; 2021). Kim et al. (2020) highlighted that the relationship between bank diversification and financial stability has a temporal dimension (opposite results prior and during the financial crisis). A similar study provided by Cheng et al. (2020) revealed that during and after a financial crisis, increasing banks' non-interest income share increases insolvency risk and ROA volatility compared to the pre-crisis period. However, Zheng et al. (2020) provide evidence that during crises, emerging economies can use portfolio diversification as a mechanism for controlling risk and improving bank performance.

The next table (Tab. II.2) presents a synthesis of the above described variables.

Table II.2: Variables' description

1	Variable	Measure	References	Perfor - mance	Risk
Dependent variables	Performanc e	-**ROA**: Return on assets measured as net income to total assets.	Hannan, 1991; Chiorazzo et al., 2008; Ongore and Kusa, 2013; Nisar et al., 2018	NA	NA
	Risk	-- **Z-score**[38]: is calculated as the sum of the ROA and the equity-to-asset ratio, divided by the standard deviation of the ROA.	Molyneux and Thornton (1992) ; Barth et al., 2004 ; Cheng et al., 2016 ; Hung et al., 2017 ; Talavera et al., 2018; Geng et al., 2019 ; Li et al., 2021.	NA	NA
Independent variables	SHNII (income diversificati on strategy)	- the share of non-interest income is used as a proxy of bank income diversification strategy and bank business	Stiroh & Rumble, 2006 ; Baele et al., 2007 ; Brunnermeier et al., 2012 ; Nisar et al. (2018);	+	+

[38] The Z-score (or Z) is the number of standard deviations below the mean by which profits must fall to bankrupt the firm (cited from Lown et al. 2000)

		model. It is measured as the ratio of non-interest income to total income (net operating revenue) with SHNII = COM + TRD and the NII =NOI[39] - NIM			
	COM	is net fees and commission revenue measured as the ratio of net commission to total income.	DeYoung and Rice, 2004; Brunnermeier et al., 2012; Nisar et al., 2018.	+	+
	SHORT	is short-term trading income, measured as the ratio of commercial portfolio' profits to total income (net operating income). Investment portfolio' profits to total income.	Brunnermeier et al., 2012; Nisar et al., 2018.	+	+
	LONG	is long-term trading income measured as the ratio of investment portfolio' profits to total income.	Brunnermeier et al., 2012; Nisar et al., 2018.	+	+
Control variables	NIM	Net interest margin is measured as the net interest revenues to total earning assets.	Flori et al., 2019 ; Cheng et al.,2019.	+	+
	SIZE	the natural logarithm of total assets	Zhang et al, 2014.	+	+
	AG	Assets growth is proxied as the growth in total assets ratio	Li and Zhang, 2013.	+	+
	CAR	is measured by the equity to total assets ratio	Berger, 1995; Naceur and Goaid, 2001; Stiroh, 2006; Mercieca et al., 2007; Chiorazzo et al., 2008; Sanya et Wolfe, 2011.	+	+
	EXP	Expenses are a measure of operating costs or bank efficiency. It is calculated as operating costs to total assets.	Karakaya and Er, (2013).	-	-
Macro-economic variables	FDC	is equal to one for the years 2009 to 2011 and equal to zero otherwise.	Rachdi, 2011, Iain Begg, 2012; Brighi and Venturelli, 2014.	-	-
	PC	is equal to one for the years 2011 to 2013 and equal to zero otherwise.	Saadaoui, 2018; Hamid et al., 2017	-	-
	HC	is equal to one for the year 2020 and equal to zero otherwise.	Chen and Yeh, 2021; Fahlenbrach et al., 2020; Demirguc-Kunt et al., 2020;	-	-
	GDP	Gross Domestic Product growth rate measure of economic growth	Meslier et al., 2014 ; Belghuith and Bellouma, 2017 ; Nguyen et al., 2018;	+	+
	INF	inflation rate	Dhouibi, 2015; Nisar et al., 2018	-	-

Source: Authors' synthesis

[39] The net operating income is the sum of the net interest margin and the non-interest income

I.3. Methodology

In this sub-section, we tend to highlight our models' specifications, including detailed econometric models with the aim of answering our hypotheses. To this end, we embark on a discussion of the methodology used to measure the impact of income diversification on Tunisian banks during crises and non-crises periods and we consider the econometric method used to estimate this impact on bank risk/performance.

I.3.1. Model specifications

First, we will test whether shifting toward and within non-interest income business activities is beneficial or not for Tunisian banks. That is, testing the effect of income diversification on bank performance and risk over the period 2005-2020. Second, we will test the effect of each component of non-interest income on both bank risk and performance in order to test our second hypothesis. After that, following Cheng et al. (2019), we partition the entire sample period into two sub-periods, tranquil, non-crisis period and crisis period which includes the years of the different crises mentioned before. This method is used in order to demonstrate the difference in coefficient and significance of our explanatory variables between the two sub-samples with an aim of comparing the impact of non-interest income on bank performance and risk in crisis and non-crisis periods. Since our sample is limited in time, we would not be able to divide the period into several sub-periods in order to study the effect of each crisis independently. For that reason, following Onali and Mascia (2021), and Nguyen et al. (2021) we chose to use dummy variables. Finally, we attempt additional tests and variables' measures to examine the robustness of our main results.

Step1: Non-interest income, bank performance, and risk

As a first step, we examine whether non-interest income and the new business model as a whole is beneficial for Tunisian banks. To capture the effect of the non-interest income source on bank performance and risk, and to test our two first hypotheses, we follow the method of Stiroh and Rumble (2006), Calmès and Liu (2009), Nguyen (2012) and Rachdi (2013) by using the following estimation:

$$Y_{i,t} = \alpha 1 + \beta 1\ SHNII_{i,t} + \Sigma\ \delta k\ Controls_{\ k,i,t} + \varepsilon_{i,t} \quad (A)$$

The dependent variable $Y_{i,t}$ is the ROA when we measure bank performance and NPL when we measure its risk. i,t denotes, respectively, bank and year. $\beta$and δ are estimated parameters.

The variable SHNII is constructed as a ratio of non-interest income to net operating income. Net operating income is composed of net interest income and non-interest income. Non-interest income covers fees and commissions, trading revenue and other sources of non-interest income. Controls K_{it} is a matrix of additional bank controls including NIM, CAR, SIZE, AG, EXP, INF, GDP as presented before. ε refers to the disturbance term (stands for the regression residual).

Step 2: The non-interest income components, bank performance and risk

According to previous researches, non-interest income is a mixture of heterogeneous components that differ in terms of their relative importance. According to Brighi and Venturelli (2016), an increase in commissions and fees income enhances risk-adjusted profitability and reduces risk. In the same vein, DeYoung and Torna (2013) concluded that the probability of failure is positively associated to asset-based non-traditional activities (e.g., securitizations or venture capital), while decreases are associated with pure fee-based operations such as securities brokerage and insurance distribution. However, Edirisuriya et al. (2015) provided empirical evidence that securities trading and insurance are beneficial, while fees and commissions are not. We follow Brunnermeier et al. (2012) and decompose non-interest income into three different sub-groups: short-term trading income (SHORT), long-term trading income (LONG) and, fees and commissions income (COM). As presented in equation (B), using this splitting into more detailed categories, we will be able to gain knowledge regarding the impact of non-interest income components on bank performance and/or risk.

$$Y_{i,t} = \alpha 1 + \beta 1\ COM_{i,t} + \beta 2\ SHORT_{i,t} + \beta 3\ LONG_{i,t} + \Sigma\ \delta k\ Controls_{k,i,t} + \varepsilon_{i,t} \quad (B)$$

Where COM, SHORT and LONG are non-interest income' components as defined in the following table.

Step3: Non interest income, bank performance and risk during crises and non-crises periods

As a last step, we consider the time dimension of the relation between non-interest business and bank performance and risk. A considerable body of literature (Stiroh and Rumble, 2006; Jiang, Yao, and Feng, 2013; Tsai et al., 2015; Maudos, 2017; Yang et al., 2019) report that bank diversification into non-traditional activities affects bank performance and financial stability during the financial crisis differently from how it does during non-financial crisis periods. Crises may badly weaken the financial health of the banking industry as evidenced by

Williams (2016) in relation with the global financial crisis (GFC), where the joint interaction between crises and non-interest income activities may lead to appreciation in that case. Following previous studies (Cheng et al., 2019; Park et al., 2020), we partition the entire sample period into two subperiods, tranquil and crisis periods. This method is used in order to demonstrate the difference in the regression including even the control variables with the aim to compare the impact of non-interest income on bank performance and risk in crises and non-crises periods. Since our sample is limited, it is not possible to divide the period into several sub-periods to see the effect of each crisis separately. For that reason, following Onali and Mascia (2021) and Nguyen et al. (2021), we will use dummy variables presented previously, and adopt a methodology similar to Kim et al. (2020) and Cheng et al. (2019), investigating the double effect of the financial and debt crisis (2009-2010), the Tunisian political crisis (2011-2013) and the COVID-19 pandemic (2020) on the relationship between the banks diversification strategy into non-interest income activities and their performance and risk. In other words, we try to test if these crises amplify or weaken the relationship between non-interest income and bank risk and performance compared to non-crises periods using our basic model (A). Thus, following Stiroh and Rumble (2006) and Kim et al. (2020), we will estimate the following equations:

$$Y_{i,t} = \alpha 1 + \beta 1\ SHNII_{i,t} + \beta 2\ SHNIIFDC_{i,t}\ (SHNIIPC_{i,t}\ or SHNIIHC_{i,t}) + \beta 3\ FDC\ (PC\ or\ HC)$$

$$+ \Sigma\ \delta_k\ Controls_{k,i,t} + \varepsilon_{i,t} \quad (C)$$

Where FDC, PC and HC are dummy variables (see Tab. II.2) used to assess the macroeconomic influence of these various types of crises on bank performance. Following Kim et al. (2020), we include interaction terms (i.e, SHNIIFDC, SHNIIPC and SHNIIHC) between the crises dummy variables and the income diversification measure used in our analysis (SHNII). Otherwise, the variable where a dummy variable is multiplied by SHNII represents the quadratic effect of crises and the use of non-interest income activities on bank activity. Using these interaction terms, we examine the different relationships between bank income diversification into non-interest activities and bank risk and performance during each crisis compared to non-crisis period.

I.3.2. Econometric estimation

First, we will specify the estimation type, which is a regression on panel data. Our choice is justified by the presence of a double dimension at the level of our data; the first one is

temporal (a period of 16 years from 2005 to 2020) and the second is individual (10 listed banks). The panel data analysis method provides the advantage of solving the 'omitted variables problem' (Wooldridge, 2002). Numerous scholars, such as Pathan (2009) and Bellot et al. (2017), have used panel data analysis to conduct their research. We focus on the modelling of individual effects for panel data by determining the appropriate model for our estimates, whether it is a fixed effect or a random effect, and this by referring to the Hausman specification test. Regarding the error terms, and in order to test the stability of the variance, it is necessary to study the heteroscedasticity through the BreuschPagan test. Then, to study the auto-correlations between these error terms we proceed to the Wooldrige test. The importance of these two tests lies in the specification of the estimation method. In fact, if these two tests indicate that there is a problem of heteroscedasticity or auto-correlation of the errors, it is no longer appropriate to use the Ordinary Least Squares (OLS) method, thus, justifying the use of the Generalized Least Squares (GLS) method.

I.3.3. Robustness check

To examine the robustness of our results, we attempt to conduct additional analyses by using two alternative measures that is ROE instead of ROA and NPL instead of Z-score.

ROE: following previous literature (Klein and Saidenberg, 1997; Pham et al., 2020; Jayasekara et al., 2020), we use return on equity, calculated as net income to total equity, as an alternative measure of bank performance.

NPL: similarly, to several previous researches (Acharya et al., 2001; Lin and Zhang, 2009; Tabari et al., 2013; Liang et al., 2013; Chaibi and Ftiti, 2015; Zhang et al., 2016; Zhu and Yang 2016; Talavera et al., 2018; Geng et al., 2019), we use non-performing loans (NPL) as a proxy of bank' credit risk as it can provide an overview of the banks financial situation (Lanine & Vennet, 2006). We believe that the credit risk (NPL) is most related to the bank's core business and represents the main risk that banks should take into account (the reasons for success or failure are attributed to changes in the quality of the loan portfolio). One of the few observable signals about loan quality is the amount of NPL. The ratio is measured as follows:

$$\text{NPL} = \frac{\text{Non} - \text{performance loans}}{\text{Total loans}}$$

Chow test: we check if the main results related to income diversification during various crises hold when using a Chow test for structural break to examine the stability of the main relationship. A regression using interaction variables can impact the significance of the

explanatory variables and the significance of the change in magnitude between different periods. Using this test, we can confirm the change in the slop between the non-interest income and our dependents variables during the crisis period compared to the non-crisis period.

Many banks that operate in Tunisia have changed their ownership form, which brings into focus an attempt to explore the importance of ownership structure on the effect of income diversification and on bank performance and risk. With regard to the banking sector, most researches show that public banks are less efficient than private banks (Ghazouani and Moussa, 2013; Ayadi and Ellouze, 2014; Hamdi et al., 2017) and that state ownership is positively correlated with risk-taking.

II. Empirical results

In this section, we will discuss the empirical findings of our regression analysis. First, preliminary tests will be conducted to assess the validity of the regression estimator. Then we will highlight the descriptive statistics followed by a graphical analysis and the correlation of our selected variables. Finally, we will present and discuss our results.

II.1. Univariate analysis and preliminary tests

We will first provide a descriptive analysis of our variables supported by a graphic analysis to explain the trends of used variable over the period (2005-2020). After which, we will present the correlation matrix between the variables and a VIF test to verify the presence of a multi-collinearity problem that could affect our results.

II.1.1. Descriptive statistics

II.1.1.1. Graphical Analysis

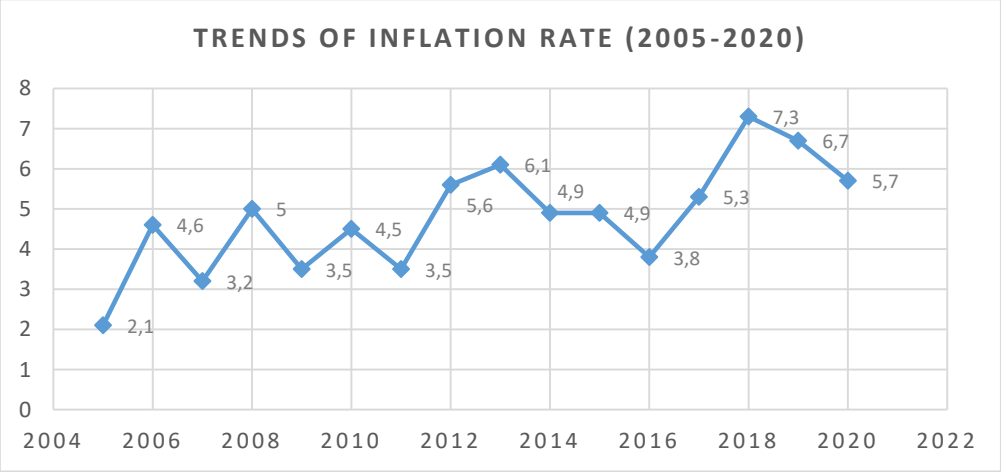
We seek to provide graphical analyses on the trends of our dependent, independent and macroeconomic variables in order to visually verify and understand the relationship between them during the study period and to identify any underlying explanations. The ROA, ROE, Zscore, SHNII, INF, GDP and the critical context as presented earlier, are used to give us a synthetic view of the operational policy of Tunisian banks during our study period.

- *Economic growth rate (GDP)*

Figures I.2 and II.4 show that, during the period that spans from 2008 to 2012, the GDP declined from 6.7% in 2007 (the highest level of growth during the entire period) to reach -1.9% in 2011. Then, it stabilized at a steady rate between 1% and 3% before dropping as a result of the unprecedented economic recession related to the fallout of the COVID-19 pandemic.

- *Inflation Rate*

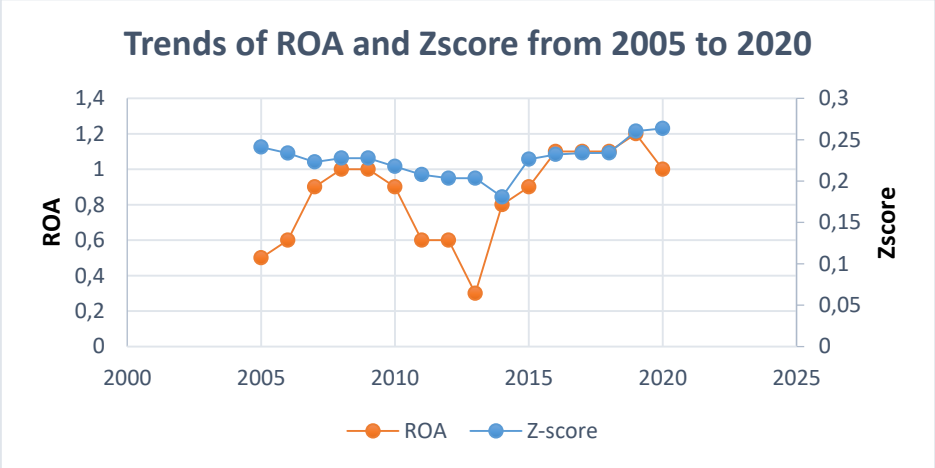
Figure III.1 shows a significant change in the inflation rate, from 2.1% to 5%, between 2005 and 2008. Flowingly, it rose from 3.5% to 6.1% during 2011-2013 despite the decline in GDP and investment during the same period. Finally, the inflation rate peaked from around 3.8% in 2016 to 7.3% in 2018 which was supported by positive growth (see Figure II.3). This represents a risk indicator. The high rate of inflation (approximately 6.1%) affects both salaries and other operating costs of Tunisian banks (Annual report of CBT, 2018).



Data Source: World Development Indicators world bank

Figure II.3: Trends of inflation rate in Tunisia from 2005 to 2020

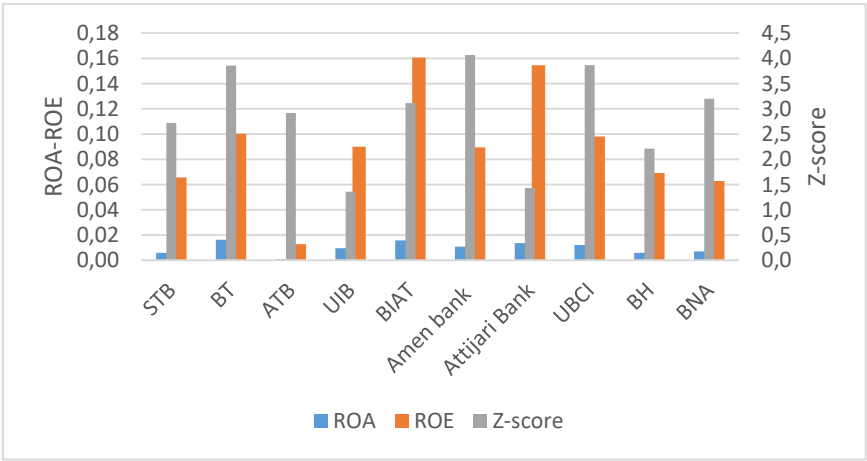
- *Bank performance and risk*



Source: Own construction

Figure II.4: Trends of the average Z-score and average ROA of Tunisian listed banks over 2005-2020

Figure II.4 shows that the Z-score of Tunisian banks is between 22% and 25% during the studied period with a sharp decline in 2014. Ben Salem (2018) documents that, after the 2011 revolution, the sector was characterized by the accumulation of a large stock of non-performing loans. In fact, concerned with their profitability, banks increased their interest margins, leading to a greater likelihood of counterparty default. Bank profitability, as measured by both ROA and ROE, deteriorated during the period covering 2009-2013. Trujillo-Ponce (2013) argues that poor economic conditions can worsen the quality of the loan portfolio and increase the provisions that banks need to hold, thereby reducing bank performance and increase bank credit risk.



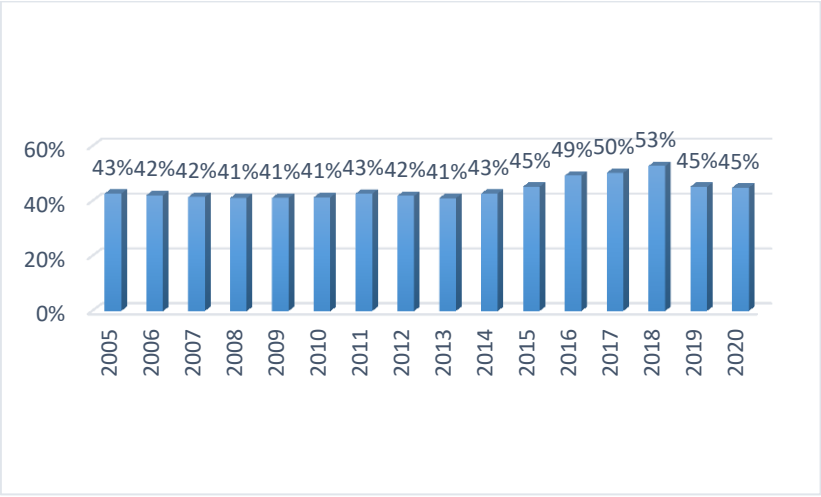
Source: Own construction

Figure II.5: Listed Tunisian banks' performance and risk during the COVID-19 pandemic (2020)

According to Boussaada (2016), institutional and structural changes in the Tunisian banking sector have significantly affected the level of banking performance. The Tunisian economy experienced, in 2020, its strongest recession since the sixties with an annual GDP of -8.8% against +0.9% a year earlier[40] (see Fig. II.5). According to the Figure III.3, the risk and performance of Tunisian banks show great heterogeneity. We realize that UIB and Attijari bank are particularly vulnerable to the insolvency risk. BT and BIAT have the highest ROA while, using ROE as a performance measure, BIAT and BNA Bank are the highest performers. As for the impact of the COVID-19 Tunisian banks, its real effect is not yet observed in the banking sector. Fitch rating notes that "*The central bank measures will allow banks to defer the classification of loans as impaired and hold off on making loan impairment charges in the near term, providing an artificial boost to profitability and capital as the banks will report artificially high net income. We view this as credit-negative as it clouds the transparency of financial reporting".*

- *Interest versus noninterest income*

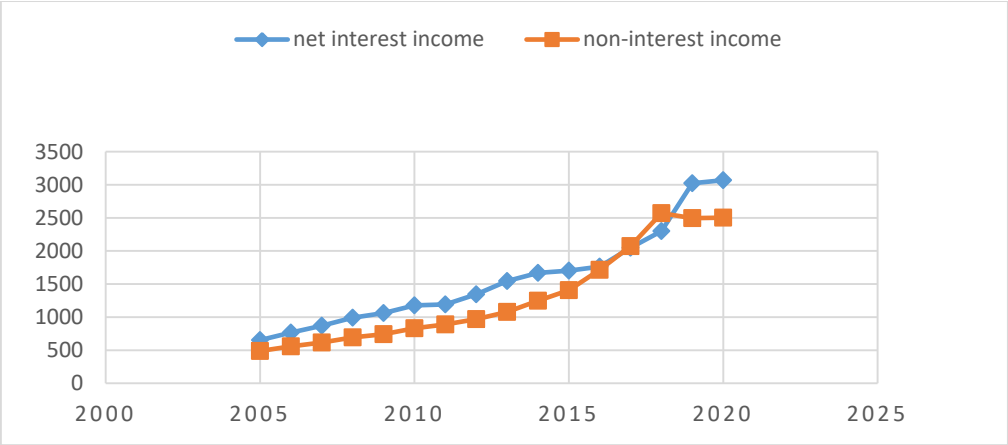
From figure (Fig. II.6), the non-interest income has been stable, at around 40%, since 2005 with a considerable increase between the years 2015 and 2018, reaching 45,35%, 50,68% and 55,48% in 2015, 2016 and 2017 respectively. Then, it declined and fell to 45% of the total interest and non-interest income in 2019 and 2020.



Source: The authors from annual reports from the CBT and PATB from 2005 to 2020

Figure II.6: Trends on the share of non-interest income over years (2005-2020)

[40] See CBT supervision report 2020



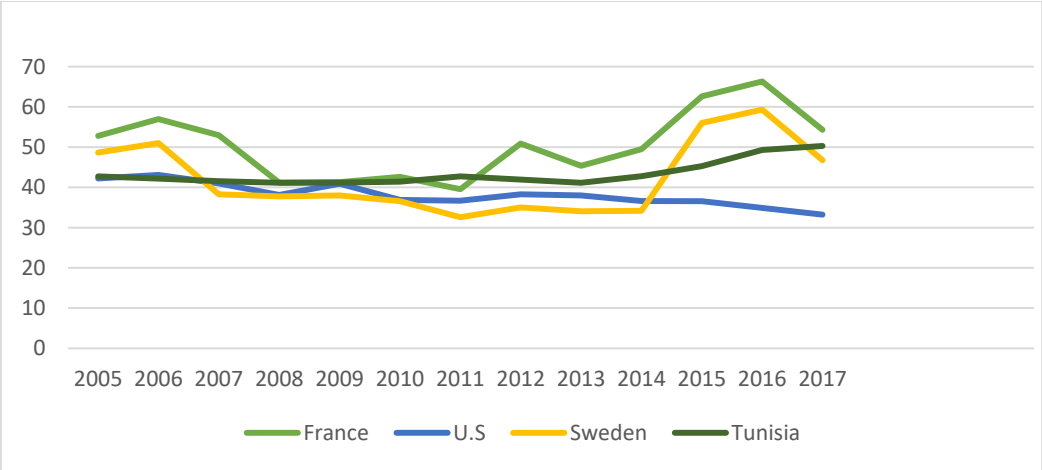
Data source: The authors from annual reports from the CBT and TPAB[41] from 2005 to 2020

Figure II.7: Trends of net operating income components from 2005 to 2020

To better understand this important source of bank revenue, we shall examine Figures II.6 and II.7 which document how the level of the net operating income' sources of Tunisian banks have changed over time. Figure II.7 summarizes the evolution of both income components before and after the global financial crisis. We note that Tunisian banking revenues did not stop growing during the whole analyses period despite the global financial crisis and the harmful effects of the revolution on the Tunisian economy. From 2005 to 2016, Tunisian banking income was based on traditional banking activities. However, between 2017 and 2018, non-interest income seems to have increased at the expense of net interest margin, thus, non-interest income bearing activities exceeded interest income activities, however, as from 2018 they declined to reach 45% of total operating income (Fig. II.7).

To compare the business models of Tunisian banks to other banks in developed countries such as France, U.S and Sweden, we chose to compare banks non-interest income to total income, as shown in Figure II.8.

[41] The Professional Association of Tunisian Banks and Financial Institutions : https://www.apbt.org.tn/



Source: Own construction from Word Bank

Figure II.8: Bank's non-interest income to total income for France, U.S and Sweden (2005 -2017)

Accordingly, we remark a high volatility of this revenue during the analyses period. This can be explained by an adjustment of banks business models related to both national and international economic and financial conditions (e.g., inflation, economic recession, unemployment rates)[42]. In fact, the share of non-interest income accounts for 34.9% of operating income in 2016 among all the US banks. In France, the non-interest income accounts for 41,19% in 2008 and 66,3% in 2016. However, the share of non-interest income in Sweden presents 48,6% in 2005, 32,6 % in 2011 and 59,3% in 2016 which confirms our remarks. Furthermore, for the Asian region, non-interest income contributes more than 30% to the total income of the banking industry in Singapore and Thailand as of 2014 (The Global Economy). In Tunisia, the trends of the non-interest income of Tunisian banks, from 2005 to 2009, seem to be similar to that of the U.S banks (Stable around 40% to total income). Then NII evolved positively for the Tunisian banking sector and negatively for U.S banks. The comparison of the trends of this NII source of revenue with the trends of the same variable in France and Sweden, shows that Tunisian banks do not effectively modify their diversification strategies with accordance to the changing environment. Nevertheless, we must not omit that the interest rate, compared to that of developed countries, remains high even during a recession. In fact, the money market rate averages 4.8% in 2010 and 6.12% in the end of the year 2020. Furthermore, the Tunisian financial market is still under developed and banks cannot raise their profit from trading. However, it is not appropriate to judge the income diversification strategy of Tunisian banks using this graph as non-interest income, specifically

[42] See annual reports of France, Euro zone and U.S

net commissions, is based on the traditional activity and linked to the volume of credit. Moreover, the Tunisian financial market is underdeveloped and Tunisian banks are risk-averse. Rachdi et al. (2013) argue that bank risk-taking is associated with bank size where Tunisian banks are considered small and unable of assuming high investment risks. In fact, their investment' portfolio is mainly constituted of State treasury bonds. Besides, diversification strategy in developed countries is based on non-traditional bank activities, such as items associated with securitization, investment banking, advisory fees, venture capital, and non-hedging derivatives which are absent or very limited in Tunisian banking sector (Hamdi et al., 2017).

II.1.1.2. Summary statistics

Table II.3 reports the descriptive statistics for the variables used in the regression analyses, where panel A presents the descriptive statistics of bank performance and risk measures, ROA and Z-score[43]. ROA records a minimum of -0,081 and a maximum of 0.029, which gives an overall idea about banks effectiveness in converting its assets into net income (i.e., the higher the ROA, the better the bank manages its assets). This measure indicates the disparities between the Tunisian banks included in our study. Listed banks show relatively low performance with performance averaging1%. Nevertheless, it is similar to U.S financial institutions, as reported by Iqbal et al. (2019), which average an ROA of 0.119. The Z-score varies from (-0.052) to 0.584 with a mean of 0.226. Hence, the Tunisian banking market contains banks with high level of instability risk, mainly public banks such as STB Bank and BH Bank, versus stable banks such as BT and Amen bank with Z-scores of 0.58 in 2020 (Despite the negative effect of the Covid-19 pandemic). Panel B presents the descriptive statistics of the independent variables. The sample is heterogeneous and contains banks that show different levels of share of non-interest income. Noticeably, there is a large spread for the income diversification strategy between banks as well as across years. The minimum value of the share of non-interest income (SHNII) in the Tunisian banking sector is 22,1%, which belongs to the BH bank in 2008. Still, its maximum reaches 76,6% (an excess of the non-interest income compared to the basic intermediation activity of the bank refered to ATB bank). Furthermore, a mean value of 45.6% shows that non-interest income it is significantly high and close to the 50% which indicates an even split between net interest income and non-interest income and shows a complete diversification Stiroh (2004). Similarly, the mean of

[43] As z-score is highly skewed, following Laeven and Levine (2009), we use to a skilling by divided the z-score by 100, which is normally distributed.

COM is 24% for commercial banks, which is closer to the mean of trading income (i.e.,21,6% SHORT+LONG), but with large spread between the min and the max for these components of non-interest income.

Let's consider the BH Bank which has zero long term trading from 2005 to 2008. This could be explained by the development of Tunisian financial market after the global financial crisis (GFC) which led banks to trade more and shift toward non-traditional activities. According to several empirical studies (i.e., Curry et al., 2008; Ahmad et al., 2008; Deos et al., 2013), after the 2008 financial crisis, banks' activities have undergone large transformations (money and securitisation markets, technological innovation, Fintech development).

Table II.3.: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Dependent variables					
ROA	160	.01	.01	-.081	.029
Zscore	160	.226	.157	-.052	.584
Panel B: Independent variables					
SHNII	160	.456	.116	.221	.766
COM	160	.24	.047	.155	.365
SHORT	160	.144	.101	.001	.516
LONG	160	.072	.062	0	.32
Panel C: Control variables					
NIM	160	.024	.007	.008	.041
SIZE	160	6.697	.246	6.084	7.252
AG	150	.084	.068	-.084	.245
CAR	160	.088	.032	-.016	.175
EXP	160	.022	.006	.011	.042
Panel D: Macroeconomic variables					
INF	160	.048	.013	.021	.073
GDP	160	.021	.034	-.086	.067
FDC	160	.125	.332	0	1
PC	160	.188	.392	0	1
HC	160	.063	.243	0	1

Note: This table (Tab. II.3) provides summary statistics of all variables used in model specifications. Panel A presents descriptive statistics of our key variables bank performance and risk measures. Panel B contains descriptive statistics of independent variables used as bank income diversification strategy' measures. Panel C presents summary statistics of our control variables. Further, panel D summarize our macroeconomic variables.

Overall, , we conclude that the income structure of Tunisian banks is indeed changing after the global financial crisis and is heterogeneous between banks[44]. These statistics provide evidence that Tunisian banks diversify their income and adopt a new business model.

[44] To see chart in appendix 1

Additionally, Panel C presents empirical results statistics of the control variables. The variable SIZE, measured by the natural logarithm of total assets, demonstrates that our sample is divergent, containing different bank sizes. The amount of total assets ranges from 1 212 154 MTD (UBCI in 2005) to 17 874 418 MTD (BIAT in 2020). Over the years, it is recorded that the largest Tunisian bank, with reference to total assets, is BIAT and the smallest is UBCI. Besides, on average, the CAR of Tunisian banks represents 8,8%. According to the Tunisian banking circular of 2018 and under the Basel accord, Tunisian banks have to hold a minimum capital ratio of 10%. This ratio has a minimum of -0.6 and a maximum of 0,17 with a standard deviation of 0.32, the negative value is due to the negative amount of net income for some banks such as UIB in 2007 and STB in 2013-2014. As for the banks' expenses, the mean of operating costs ratio is 2.2%, with a low standard deviation of 0.006 and a range min-max 1.1%-4.2%. The trends of GDP and INF variables are related to the Tunisian economic context which has been in deterioration since the revolution of 2011.

Overall, the descriptive statistics presented above suggest that our sample is sufficiently composed of a mixture of heterogeneous banks. Thus, we probably will use a random effect model later to control for this difference. We can decide using an Hausman test later.

II.1.1. Correlation analysis

Table II.2 shows correlation coefficients for all variables included in our study. We document that ROA and Z-score are positively correlated to each other, at 0.413, suggesting that more performing banks are less risky and more financially stable. Furthermore, there is a positive correlation between bank performance (ROA), AG, NIM and CAR, suggesting that banks with greater assets growth, higher net margin and important capital ratio generate more return and have a lower insolvency risk. More interestingly, it can be seen that non-interest income and net interest margin are strongly and negatively correlated. Therefore, according to the financial intermediation theory, income diversification is beneficial. Furthermore, SHNII is strongly and positively correlated with the financial stability of banks which mean that income diversification using non-interest income activities reduces insolvency risk. However, this relationship between trading and risk is inconsistent with the results of Brunnermeier et al. (2012). This can be explained by the fact that most Tunisian banks' trading is based on governmental Treasury bills. As for the COM variable, it is negatively correlated with bank performance and bank stability. Consistantly with Edirisuriya et al. (2015), an increase in commissions and fees income reduces banks' profitability.

Furthermore, it is worth noting that the dummy variable FDC is negatively correlated to bank size, long term trading and net interest margin. However, the PC is negatively correlated with bank capitalization, bank profitability and the long-term trading. Lastly, the health crisis is positively correlated to bank capitalization and long-term trading but it negatively impacts the economic growth rate and the other non-interest income (commissions and short-term trading). These relationships differ between crises and confirm that they have various impacts. In fact, following the global financial crisis, Tunisian banks became more vigilant and applied Basel statements. Thus, they developed their business model and reinforced their capital. In crises periods, Tunisian banks diversify their activity to reduce risk and enhance their profitability.

The business cycle, measured by the growth of the gross domestic product is favourable to the improvement of the performance and the reduction of credit bank risk. The correlation between GDP with both ROA and Zscore confirm our expectation.

Table II.4. Matrix of correlations

This table reports correlation coefficients for our variables. The correlation matrix provides the Pearson correlation coefficients. The details of variables' description as well as their measures are reported in Table II.2..

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) ROA	1.000															
(2) Zscore	0.413	1.000														
(3) SHNII	0.038	0.141	1.000													
(4) COM	-0.204	-0.223	0.251	1.000												
(5) SHORT	0.037	0.011	0.673	-0.066	1.000											
(6) LONG	0.161	0.406	0.396	-0.168	-0.093	1.000										
(7) NIM	0.232	0.083	-0.673	-0.164	-0.687	-0.242	1.000									
(8) SIZE	0.083	-0.224	0.115	-0.340	0.025	0.422	-0.167	1.000								
(9) AG	0.311	-0.018	-0.250	0.058	-0.227	-0.140	0.161	-0.007	1.000							
(10) CAR	0.509	0.767	-0.012	-0.376	-0.025	0.293	0.275	-0.101	0.001	1.000						
(11) EXP	-0.184	-0.238	-0.226	0.224	-0.249	-0.183	0.411	-0.249	-0.130	-0.248	1.000					
(12) INF	0.078	0.025	0.121	-0.103	-0.083	0.430	0.087	0.444	-0.167	0.056	0.034	1.000				
(13) GDP	-0.081	-0.058	-0.131	0.098	0.085	-0.449	-0.032	-0.446	0.189	-0.156	-0.003	-0.185	1.000			
(14) FDC	-0.012	-0.024	-0.047	0.040	0.044	-0.185	-0.102	-0.192	0.159	-0.023	-0.074	-0.495	-0.064	1.000		
(15) PC	-0.145	-0.089	-0.005	0.110	0.075	-0.210	-0.131	-0.040	-0.130	-0.145	-0.034	0.040	-0.049	0.167	-0.145	
(16) HC	0.000	0.066	-0.010	-0.148	-0.161	0.348	0.148	0.270	-0.175	0.157	0.039	0.168	-0.823	-0.105	-0.134	1.000

Source; own construction

It is worth saying that the correlation matrix reports low values of correlations between variables. This gives insight into the presence of a non-linear link which will be tested in the next section. Overall, no high correlation coefficients (>0.8, Hair et al. (2001)) are found between independent variables making them eligible to be included in our regression models since they reject the potential problem of multi-collinearity (except for HC and GDP which is expected, we will have eliminated GDP in the model when control for HC). The absence of multi-collinearity between principal variables is also confirmed by the Variance Inflation Factor (VIF)[45] as presented in the next part.

II.1.3. Econometric tests

- **Testing for multicolinearity**

Multi-collinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly linearly related. Strong multi-collinearity is problematic because it can increase the variance of the regression coefficients and make them unstable and difficult to interpret. Variance inflation factor (VIF) quantifies how much the variance is inflated. If it is higher than 10, the variation will appear larger and the factor will appear more influential than it is. Results in Appendix X show that VIF for each variable is inferior to 10 and that its mean is less than 5. Hence, there is no problem of multi-collinearity (James et al., 2013). In the case of using crises and their interactions with SHNII, a multi-collinearity problem arises. Centering[46] the variables is a simple way to reduce structural multi-collinearity (Jim Frost, 2020)[47]. Furthermore, we will eliminate GDP when we test for HC effect to avoid a multi-collinearity issue (See appendix 3).

- **Testing normality**

To assess the normality of variables' distribution, we run Skewness/Kurtosis tests for normality. A normal distribution has a skewness of 0 and a kurtosis of 3 and Prob>chi2 lower than 5%. Results of the test presented in Appendix 4 show that all variables are symmetric except for NIM, SIZE, AG and INF. Nevertheless, according to the law of large numbers, this will not cause a problem.

[45] See Appendix 3.
[46] Centring is therefore an important step when testing interaction effects in multiple regression to obtain a meaningful interpretation of results.
[47] https://statisticsbyjim.com/regression/multicollinearity-in-regression-analysis/

- **Testing stationarity**

Given the importance of stationarity of a data set and its influence on the behaviour of the said data set as well as on its properties, we chose to check the stationarity of our data by using a unit root test. Following Chen et al. (2019), we test our continuous variables using the unbalanced panel-data unit-root test developed by Maddala and Wu (1999). Levin-Lin-Chu unit-root, in which the first hypothesis suggests the presence of unit roots (i.e., variables are stationary). The results of the test with trend are reported in the following Table (Tab. II.5). The results indicate that tested variables do not contain a unit root except for GDP. Hence, we used the first difference as well as the natural logarithm of GDP and retested it for stationarity. The results show the presence of unit root (P=0.000) for just the natural logarithm of GDP. In fact, following Kim el al. (2020), we will use LGDP instead of GDP for more efficient results.

Table II.5: Unit root test

Variable	Chi(2)-statistic value	P-value
ROA	-18.2600***	0.0000
Zscore	-6.7374 ***	0.0000
SHNII	-8.1344***	0.0329
COM	-1.8759***	0.0303
SHORT	-2.203***	0.0138
LONG	-2.4136***	0.0076
NIM	-3.4510***	0.0003
SIZE	-3.7875***	0.0001
AF	-4.2251***	0.0000
CAR	-2.2796***	0.0113
EXP	-4.0524***	0.0000
INF	-2.7853***	0.0027
GDP	5.6271	1.0000
CP	-2.6159***	0.0044
FDC	-7.0346***	0.0000
PC	-3.5732***	0.0002
HC	-	-
LGDP	-10.4515***	0,0000

Note: The null hypothesis of the unit-root test is that all the panels contain a unit root. And indicate significance at the 1%, 5% and 10% levels, respectively. See (Tab. II2) for variables measurements.

Source: Author's own analysis

II.2. Multi-variate analysis

Beside the tests for multi-collinearity, normality and stationarity, we also tested our variables for both auto-correlation or heteroscedasticity, which could affect our analysis' results. Kim et al. (2020) showed a significant non-linear relationship between bank diversification and financial stability.

- **Testing autocorrelation**

To test the assumption of no autocorrelation, we will use the Wooldridge test. When serial correlation is not detected and solved it would produce inefficient estimates. The null hypothesis for the test is that there is no first order autocorrelation.

Table II.6: Wooldridge test' results

Model	Wooldridge test	P-value
1	3.87	0.0233
2	3.87	0.0234
3	3.85	0.0237
4	3.98	0.0210
5	4.23	0.0159
6	488.14	0.0000
7	280.01	0.0000
8	480.46	0.0000
9	471.41	0.0000
10	409.35	0.0000

Source: Author's own analysis

Results reported in Table II.6[48] show that the probability for autocorrelation for all models related to ROA measure doesn't exceed 5%. In other words, we reject the null hypothesis and confirm that our models suffer from an autocorrelation problem. The pooled OLS cannot be used in our case.

- **Detecting heteroscedasticity (Breusch-Pagan test)**

Several tests exist to detect heteroscedasticity. The most commonly used is the Breusch-Pagen test. It represents a Chi2 test for linear regressions. In fact, a principal assumption of the ordinary least squares regression is that homoscedasticity should be verified. In other words, the variance of the error term has to be constant. If not, the OLS estimation is going to be

[48] See appendix 4 for more detail

biased and cannot provide reliable predictions. To test the homoscedasticity of our variables, we applied the Breusch-Pagan test, where the null hypothesis is that the variance of the Error term is constant (homoscedasticity). This hypothesis is rejected if the P-value of the test is less than an appropriate threshold (Generally P<0.05). In that case heteroscedasticity is assumed and the variance of the error term is a linear function of the independent variables. Results are reported in Table (Tab. II.7).

Table II.7: Breush-Pagan test' results

Model	Breush-Pagan chi2-Value	P-value
1	274.88	0.0000
2	291.71	0.0000
3	277.07	0.0000
4	297.75	0.0000
5	293.76	0.0000
6	0.05	0.8196
7	1.35	0.2452
8	0.06	0.8088
9	0.04	0.8455
10	0.00	0.9571

Source: Author's own analysis

Results of the heteroscedasticity Breusch-Pagan test show a P-value equal to 0.0000[49] for the ROA regression models, therefore we reject the null hypothesis and confirm that there is a problem of heteroscedasticity. Thus, the GLS is the appropriate estimation to resolve the said problem.

- **<u>Testing for heterogeneity</u>**

Testing the individual and temporal effects should be out of the question in panel data. The F-test verifies the existence of fixed effects under the assumption of the independently identically distributed errors. In other words, there is no unobserved heterogeneity.

[49] See appendix 5 for more detail

Table II.8: F-test' results

Model	F-test value	P-value
1	16.62	0.0000
2	13.47	0.0000
3	13.47	0.0000
4	13.14	0.0000
5	15.31	0.0000
6	32.18	0.0000
7	34.78	0.0000
8	25.50	0.0000
9	25.62	0.0000
10	26.45	0.0000

Source: Author's own analysis

Through the Fisher specification test results, as presented in Table (Tab. II.8), our regressions reported a P-value of strictly less than 5%, which confirms the heterogeneity of our data. We can assume that the error term includes individual or temporal effects and that the GLS is the appropriate regression model to deal with the heterogeneity issue.

- **Hausman test**

revious tests revealed the existence of individual effects. However, we have to specify whether these individual effects are fixed or random. Therefore, a test for the model specification is required. We run a Hausman test (Hausman; 1978) where the null hypothesis is that the preferred model is random effects vs. the alternative which is the fixed effects (Green, 2008). More specifically, this test basically tests whether the unique errors (ui) are correlated with explanatory variables. The null hypothesis is the non-correlation between the said unique errors and the explanatory variables. The fixed effect model assumes that the influence of explanatory variables on the dependent variable is the same for all individuals (banks in our case), whatever the year (Sevestre, 2001). Thus, if the Hausman test has a P-value greater than 5%, our null hypothesis is accepted. Thus, the random effect is more appropriate than the fixed effect estimation and vice-versa. Table II.9 presents the results of the Hausman test for our models.

Table II.9: Hausman test' results

Regressions	Chi-square test	P-value	Appropriate model
1	11.38	0.1013	Random effects
2	9.46	0.4887	Random effects
3	13.76	0.1842	Random effects
4	11.04	0.1371	Random effects
5	8.95	0.4418	Random effects
6	3.57	0.7348	Random effects
7	62.98	0.0000	Fixed effects
8	3.73	0.8108	Random effects
9	2.71	0.9104	Random effects
10	10.44	0.1649	Random effects

Source: Author's own analysis

All models, except for model 7, report a p-value higher than 5%. Hence, fixed effects model will be more appropriate for models 7 and random for others.

Taking into account all our findings for understanding the variables and models, and in order to reach our purposes, the Generalized Least Squares (GLS) seems to be the best estimation.

III. Findings and discussions

In this study, we examine, on the one hand, whether diversified banks are more profitable and financially stable than non-diversified banks, and on the other hand, which non-interest component has more influence on performance and risk. Since previous empirical studies present inconclusive results, we analyse the effect the share of non-interest income has on bank performance and stability during both tranquil and crises periods. In fact, we distinct various types of crises, namely, the financial and debt crisis (FDC), political crisis (PC) and health crisis (HC) where we examine the interaction of each crisis with the share of non-interest income to better understand each's impact on the association between non-interest income and bank performance and risk. Besides, we conducted robustness tests to confirm our results

III.1. Non-interest income, bank performance and risk

In order to answer our main hypotheses regarding the impact of non-interest income activities and their components on Tunisian banks' performance and risk, we expose our empirical results in the following Table. (Tab. II.10).

Table II.10: Regression results related to the effect of the SHNII on ROA/Zscore

	ROA		Zscore	
	(1)	(2)	(6)	(7)
SHNII	0.066***	-	0.254***	
	(0.124)		(0.040)	
COM	-	0.0352		0.306***
		(0.0224)		(0.075)
SHORT	-	0.070***		0.259***
		(0.0176)		(0.434)
LONG	-	0.063***		0.315***
		(0.024)		(0.055)
NIM	1.1.14***	1.179***	3.977***	4.490***
	(0.228)	(0.302)	(0.642)	(0.708)
SIZE	0.118***	0.014***	-0.039***	-0.047***
	(0.005)	(0.005)	(0.016)	(0.024)
AG	0.046***	0.049***	0.007	0.001
	(0.101)	(0.011)	(0.023)	(0.024)
CAR	0.098***	0.081***	1.753***	1.73***
	(0.028)	(0.010)	(0.087)	(0.086)
EXP	-0.284*	-0.245	-0.196	-0.162
	(0.172)	(0.220)	(0.568)	(0.593)
INF	-0.122*	-0.148**	-0.097	-0.133
	(0.067)	(0.074)	(0.175)	(0.180)
LGDP	0.036	0.042**	-0.000	-0.008
	(0.022)	(0.024)	(0.055)	(0.056)
Constant term	-1.126***	-0.141***	0.120	0.147
	(0.035)	(0.035)	(0.113)	(0.178)
Observations	130	130	130	130
Adj R-squared	0.484	0.471	0.863	0.869

Table (Tab.II.10) provides regressions' results using the random/fixed effects estimator. Note that, ROA is used to measure performance and Zscore is a measure of bank risk (instability). All accounting variables are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2.

Table (Tab. II.10) reports the regression estimates of Models (A) and (B)[50] with the ROA and Z-Score as the dependent variables respectively. We started by computing the baseline regression (Equation (1) for ROA and equation (6) for Zscore) related to our first model, which tests the effect of non-interest areas on bank performance and risk. Results for both specifications show that non-interest income has a positive and significant impact (at the 1% level) on bank performance and stability. In fact, if banks increase their non-interest-generating-business lines, their performance will go up by 6.6% and their stability (global

[50] See the previous methodology part

risk) will rise (decrease) by 25.4%. These results are in line with our first hypothesis and are consistent with previous results (e.g., Nisar et al., 2018; Lin et al., 2012; Nguyen et al., 2012; Lee et al., 2014; Mostak, 2017; and Hamdi et al., 2017) by indicating that the importance of income diversification in promoting banking profitability and stability. More particularly, to answer our H2a and H2b, from the Column 2 and 4, we note that all non-interest sources of revenue are positively associated to both bank performance and stability (which is in turn inconsistent with Stiroh, 2004 and Williams, 2016). Fees and commissions as sources of income significantly reduce Tunisian banks' risk of failure. However, it doesn't produce high return as it has insignificant coefficient in the ROA equation, which does not support our hypothesis (H2a) that predicts that income diversification into fee-based activities negatively affects Tunisian banks performance and stability. This can be due to the fact that these fees and commissions are highly correlated with the traditional intermediation activity of Tunisian banks. As for the trading income, it is found to be positively and significantly associated with both ROA and Z-score, which is in line with hypothesis (H2b). This result is discussed in Meslier et al. (2014), who noted that moving towards non-interest activities increases banks risk-adjusted profits particularly when they are more involved in dealing government securities (which is the case of Tunisian banks). In the same line, Kohler (2018) suggests that bank insolvency risk is negatively correlated with the share of income of securities, possibly because it offers the largest diversification potential related to environmental changes. Taken together, our results support previous research concerning the beneficial effects of shifting towards non-interest income generating activities for both performance and stability(e.g., Lin et al., 2012; Nguyen et al., 2012; Lee et al., 2014; Mostak, 2017; Abedifar et al., 2018). This can be related to the fact that non-interest income in the Tunisian banking sector is more or less related to traditional banking activities, such as service fees, whereas in developed countries the non-interest income is based on non-traditional activities such as brokerage of securities, arranging M&A for firms, and trading stocks, which can be considered as risky activities. Even by investing in trading activities, Tunisian banks' managers are not risk-taking and prefer safe securities such us governmental treasury bills. This supports the opinion that a lack in the experience and knowledge to engage in non-traditional activities might increase banks risk (Kohler, 2015).

Moving to the control variables. The results for net interest income (NIM) show high positive coefficients with high significance levels at 1% for both ROA and Z-score. To put it clearly, since interest rates remain high even during a recession as the CBT adopts a monetary policy

with the aim of controlling the high inflation rates, Tunisian banks still rely heavily on intermediation activity. In light of our findings, we can assume that a higher net-interest income also contributes in enhancing Tunisian banks' performance and reducing the probability of their failure (Demirgüç-Kunt et al., 2008). Mnasri and Abaoub (2010) pointed out that banks that have diversified across both interest and non-interest income generating activities have higher levels of profitability and lower insolvency risk than banks with concentrated portfolios.

Findings highlighted in Table II.10 are consistent with those of Ayadi and Ellouze (2014) who also studied the banking sector in the Tunisian context. We found that there is a positive and significant link between banks performance and size (SIZE), assets growth (AG), capitalization (CAR) and the economic growth (LGDP). In other words, large banks with high capitalization and high levels of growth, experiences an increase in their profitability in times of economic prosperity. This is consistent with our prediction, which postulates a positive link between the latter control variables and the bank performance. In this regard, Sanya and Wolfe (2011) argued that, when entering a new market, larger banks tend to have greater income diversification opportunities and less income volatility than smaller banks. This finding is supported by De Haan & Poghosyan (2012), who reported that large banks are more stable and effective, hence, contributing more to the financial system stabilization. Furthermore, the CAR's significant impact is explained by the fact that the most performant banks are those who were able to strengthen their capital (Naceur and Goaid, 2001). With regard to operating costs and inflation, as expected, and however insignificant, they show a negative impact on banks' performance and stability. This supports the findings of Naceur and Kandil (2009) and Nisar et al. (2018) who argue that a high level of inflation rate caused high expenses, thus, increasing banks risk and consequently affecting performance and stability.

When considering bank resilience, our results show that high capital enhances bank stability, in fact, there is a significant and negative relationship between bank size and risk (there is a positive and significant coefficient at the 1% level), in contrast with our expectations. This was argued by Hamdi et al. (2017) who suggested that large Tunisian banks should focus on traditional business lines because they have higher information asymmetry and agency costs.

- **Robustness test**

To ensure the robustness of our results, we ran our model using ROE instead of ROA as a measure of bank performance, and we introduced NPL as an alternative measure of risk. In fact, NPL represent the main risk related to banks intermediation activity, which banks should manage to preserve their stability (Lee et al., 2014). After testing individual and multivariate analyses, results of the regression model are presented in Table (Tab. II.11).

Table II.11 Regression results related to the effect of SHNII on ROE/NPL: Robustness check

Table II.11 provides the regressions' results using the random/fixed effects estimator. Note that, ROE is used to measure performance and NPL is a measure of bank credit risk. All accounting variables are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2.

	ROE		NPL	
	(1)	**(2)**	**(6)**	**(7)**
SHNII	0.910***	-	-0.289**	-
	(0.278)		(0.154)	
COM	-	0.243	-	0.082
		(0.442)		(0.278)
SHORT	-	1.104***	-	-0.022
		(0.295)		(0.161)
LONG	-	1.138**	-	0.482***
		(0.538)		(0.219)
NIM	17.67***	19.509***	-7.83***	-4.989**
	(5.221)	(6.435)	(2.57)	(2.700)
SIZE	0.123	0.037	-0.121**	-0.313***
	(0.092)	(0.134)	(0.063)	(0.079)
AG	0.640***	0.744***	-0.134	-0.147
	(0.249)	(0.254)	(0.104)	(0.108)
CAR	-1.021	-1.719**	-0.515	-0.517
	(0.732)	(0.779)	(0.367)	(0.372)
EXP	-6.958**	-7.076**	5.632***	4.794**
	(3.340)	(3.330)	(2.119)	(2.185)
INF	-0.568	-0.429	0.680	0.784
	(1.691)	(1.78)	(0.687)	(0.760)
LGDP	0.138	-0.016	-0.047	-0.086
	(0.685)	(0.046)	(0.224)	(0.018)
Constant term	-1.358*	-0.656	1.201***	2.252***
	(0.685)	(0.774)	(0.385)	(0.445)
Observations	130	130	130	130
Adj R-squared	0.166	0.199	0.317	0.398

Table II.11 provides the regressions' results using the random/fixed effects estimator. Note that, ROE is used to measure performance and NPL is a measure of bank credit risk. All accounting variables are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2.

Overall, the output of both regressions show similar results except for the variables COM and LONG. In brief, the most important finding is that if trading rises by 1%, the ROE increases by 110%. Nevertheless, the effect of commissions is not significant neither on ROE nor on NP, which supports the main results found in the above Table (Tab. II.11) which in turn led to the rejection of hypothesis (H2a) predicting that fee based activities negatively impact bank

performance and bank stability. As for the risk measures (NPL), the difference is that for the long term trading increases bank credit risk by deterring assets quality (There is a positive and significant relationship between the variables LONG and NPL which reaches 48% at a 1% level). This result is similar to that of Nicholas Apergis (2014) who shows that long-term capital investment increases the bank's risk profile, particularly considering that such a bank is likely to assume leverage to engage in non-core initiatives. It's clear that long term investment decreases the bank assets quality and, consequently, the bank's credit risk.

All other variables have the same effect, except for bank capitalization which is negatively and significantly linked to ROE.

Moussu and Petit-Romec (2017) show that while ROE is used to measure banks' performance, it is in fact an excellent risk indicator. Banks are by definition not transparent, and their actual level of risk materialises and is observable during the crisis period. According to Stiroh (2006) and Chiorazzo et al. (2008), risk taking banks may hold less equity.

Therefore, in order to survive in a competitive environment, Tunisian bankers are invited to consider the importance of investing in different channels other than traditional business lines that became obsolete. Doumpos et al. (2016) point out that income diversification is more fruitful for emerging countries than developed nations.

III.2. Non-interest income share, bank performance, and risk during the crisis period (time new roman)

III.2.1. Effect of the share of non-interest income on bank performance during the crisis versus the non-crisis periods analysis

As shown in Table II.12, for all models, the estimation coefficient of the SHNII is significant (at the 1% level) in both crises and non-crises periods. Meanwhile, the ratio of non-interest income of total net operating income participates by 6.4% in banks performance during 'normal' time but it falls to 4.88% during crises. This can be due to higher costs of investments and diversification products during crises (the negative effect of EXP on bank performance and risk was made worse and became significant during the crisis) . Supporting the traditional cost theory, Kim et al. (2020) provided evidence that concentrating on traditional functions (i.e., deposits and loans) can be more effective for banks during hard markets. However, for the Tunisian context, our results show that the NIM has dramatically

decreased from 125% to 93%. Furthermore, when considering the Z-score, the effect of SHNII on bank stability is only 20% in tranquil periods but reaches 24% during crises. This finding is inconsistent with those reported by Stiroh and Rumble (2006). In sum, a 2% decrease in bank profit compared to a 4% increase in bank stability during crises leads to the conclusion that engaging in non-interest income activities is beneficial for Tunisian banks over time regardless of the economic conjecture, that is, there is no negative effect neither on ROA nor on Z-score, which is inconsistent with Hayden et al. (2007); De Jonghe (2010); Li and Zhang (2013); Moore and Zhou (2014) and Williams (2016) who found it better for banks to concentrate on their basic traditional activities and that non-interest income activities provide higher risk, especially during crises.

Table II.12: Regression results related to crisis and non-crisis periods' effect on the relationship between SHNII and ROA/Zscore

	ROA		**Zscore**	
	(1)	**(2)**	(6)	(7)
	Non-crisis Period	**Crisis Period**	**Non-crisis Period**	**Crisis period**
SHNII	0.064***	0.0488***	0.200***	0.244***
	(0.020)	(0.013)	(0.057)	(0.083)
NIM	1.25***	0.930***	3.442***	2.905**
	(0.362)	(0.244)	(0.956)	(1.235)
SIZE	0.010	0.003	-0.034**	-0.039
	(0.006)	(0.005)	(0.017)	(0.028)
AG	0.016***	0.032***	0.000	-0.012
	(0.016)	(0.010)	(0.034)	(0.049)
CAR	0.086*	0.104***	1.662***	1.74***
	(0.049)	(0.026)	(0.120)	(0.219)
EXP	-0.268	-0.390***	-0.000	-1.753*
	(0.243)	(0.152)	(1.316)	(1.316)
INF	-0.141	-0.108	-0.027	-0.060
	(0.102)	(0.074)	(0.205)	(0.301)
LGDP	0.032	0.035*	0.235	1.133*
	(0.084)	(0.024)	(0.210)	(0.640)
Constant term	-0.122**	-0.060	0.138	0.108
	(0.053)	(0.041)	(0.113)	(0.186)
Observations	90	60	90	60
Adj R-squared	0.431	0.703	0.854	0.891

Table II.12 the regressions' results using the random/fixed effects estimator. Note that, ROA is used to measure bank performance and Zscore is a measure of bank insolvency risk (financial stability). All accounting variables are measured at the end of the prior year. The crisis period is a dummy variable that takes one for the years 2009, 2010, 2011, 2012, 2013 and 2020 and zero otherwise (see regression results in the appendix). The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2.

For bank-specific characteristics, as for the capital ratio (CAR), there is a positive significant impact, as predicted, in both crisis and non-crisis periods. In fact, the ratio is higher during crises. By analysing the Tunisian banking sector, Abreu and Mendes (2002) showed that capital enhances bank profitability and has a stabilizing effect on bank revenues during the crisis period. Thus, Tunisian banks use capital as a cushion against potential risks. In another

way, by lowering the bankruptcy costs, increased capital fuels the managers' incentives to engage in non-traditional activities, making banks more profitable. As for the diversification strategy, the net interest margin revenue (NIM) has declined during crises. This contraction of the core business revenue pressures bankers to develop their income diversification strategy and engage in new services and products. In fact, the results shown in Table (Tab. II.12) cannot totally confirm the expectations that crises weakness the effects of SHNII on bank performance and risk. Therefore, we analyse the model's robustness which is shown in next Table (Tab. II.13).

- **Robustness check**

Using alternative measures of performance and risk that were employed in previous studies and as reported in the hereafter table (Tab II. 14), the main results mostly remain unchanged.

Table II.13: Regression results related to Crisis and non-crisis effect on the relationship between SHNII and ROE/NPL: Robustness check

	ROE		NPL	
	(1) Non-crisis Period	(2) Crisis Period	(6) Non-crisis Period	(7) Crisis period
SHNII	1.002**	1.019***	-0.266**	-0.362***
	(0.449)	(.387)	(0.112)	(0.166)
NIM	15.908**	25.652***	-2.41	-4.188***
	(7.77)	(7.358)	(1.838)	(1.588)
SIZE	0.294*	-0.092	0.133**	0.28
	(.152)	(.151)	(.043)	(0.088)
AG	1.222***	-.143	-0.020	-0.072
	(.333)	(.327)	(0.06)	(0.054)
CAR	1.267	-3.548***	0.774	0.782***
	(1.062)	(.778)	(0.232)	(0.221)
EXP	1.464	-18.101***	4.526	2.69
	(5.345)	(4.334)	(5.18)	(3.69)
INF	-2.729	-0.699	0.040	2.674*
	(2.101)	(2.424)	(0.422)	(0.714)
LGDP	0.2	0.276	1.403**	0.767
	(1.76)	(0.67)	(0.36)	(0.207)
Constant term	-2.849**	0.403	-0.882***	-1.672***
	(1.149)	(1.16)	(0.272)	(0.58)
Observations	90	60	90	60
Adj R-squared	0.431	0.403	0.373	0.6730

Table II.13 provides the regressions' results using the random/fixed effects estimator. Note that, ROE is used to measure bank performance and NPL is a measure of bank credit risk. All accounting variables are measured at the end of the prior year. Crisis period is a dummy variable that takes one for the years 2009, 2010, 2011, 2012, 2013 and 2020 and zero otherwise (see regression results in the appendix). The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2.

As expected, during the crisis period the effect of the share of non-interest income on both banks' performance measured by the ROE and on banks' risk measured by NPL has increased by1% and 10% respectively. In contrast with Yang et al. (2019), who report that bank diversification into non-traditional activities differently affects bank performance and financial stability during the GFC crisis from how it does during the non-financial crisis period.

Our results are in contrast with our expectations because the positive effect of non-interest income activities on bank performance and stability is reinforced during the crisis period compared to the normal period.

III.2.2. Effect of the SHNII on bank performance and risk during financial and debt crises (FDC), political crisis (PC) and health crisis (HC)

Table II.14 reports three models of each dependent variable related to equation (C), as presented before in our methodology. That is, models (3), (4) and (5) are estimated to test the link between non-interest bearing activities and bank performance (ROA) during crises and models (8), (9) and (10) are also used to explain the effect of income diversification on bank stability (Z-score) during each crisis.

First, the coefficients indicate that shifting within non-interest sources of income has a positive effect on both bank performance and stability. Such findings are consistent with those of Meslier (2014), an emerging-country-based study, which confirms the presence of income diversification benefits for bank performance and risk.

Furthermore, we found that there is no significant direct effect of the crises included in our study on bank performance. This contradicts with the results of Ihaddaden (2020). In fact, the positive effect of non-interest income on bank performance seems to be unaffected by the various crises.

Meanwhile, risk increased during the political and the current health crisis (negative significant direct effect at 1% level). However, the positive effect of the SHNII on bank stability increased (SHNIIPC+SHNII=0.253+ 0.253 =0,477; SHNIIHC+SHNII=0.280 + 0.277 = 0.557 respectively). In other words, during the political crisis as well as the COVID-19 pandemic, Tunisian banks reinforced their investments in non-interest generating activities to maintain their stability. Hence, non-interest-bearing activities are important to lower the probability of distress during political crises. Furthermore, inconsistent with our H3b

hypothesis, the political crisis reinforces the positive effect of non-interest generating-activities on bank but it has no significant effect on the SHNII, ROA association. As reported before by Rachdi (2013) and Froot and Stein (1998), income diversification is considered as a hedge against risk-adjusted return as it reduces the probability of distress.

As for the current crisis, Table II.14 indicates that the health crisis (HC) intensifies the effect of non-traditional income activities on bank risk, as expected. During the COVID-19 pandemic, the share of non-interest income reduced bank global risk by 55,7%. That is, the coefficients increased during the pandemic. This can be explained by Çolak and Öztekin's (2020) findings; they stated that the COVID-19 crisis decreased the traditional activity of banks especially in countries more affected by this health crisis. It's also important to note that the health crisis pushed banks to look for new sources of income in order to maintain their stability and reduce their global risk. However, in contrast to our expectation, the crisis did not impact the effect non-interest income has on bank performance. This can be interpreted by compensation between a positive and a negative effect in the given year. In fact, there were worries about the negative effect of the COVID-19 crisis on bank revenue, specifically during containment, when cash withdrawals at ATMs became free, as well as the issuance of debit and credit cards, and all charges made for electronic payments on small amounts suspended. This had a negative effect on banks' profitability in the short term. However, on the other side, the number of credit cards as well as e-banking transactions increased. Followingly, at the third quarter of the year and with the decontamination, the number of transactions sharply increased with the cancellation of free services.

Table II.14: Regression results related to FDC, PC, and HC crises' effect on the relationship between SHNII and ROA/Zscore

	ROA			**Zscore**		
	(3)	**(4)**	**(5)**	**(8)**	**(9)**	**(10)**
SHNII	0.064***	0.062***	0.063***	0.245***	0.224***	0.280***
	(0.012)	(0.011)	(5.02)	(0.041)	(0.041)	(0.041)
SHNIIFDC	0.010	-	-	0.094	-	-
	(0.035)			(0.085)		
SHNIIPC	-	0.012	-	-	0.253***	-
		(0.005)			(0.253)	
SHNIIHC	-	-	-0.219	-	-	0.277***
			(0.24)			(0.070)
NIM	1.162***	1.11***	1.189***	3.822***	3.454***	4.494***
	(0.229)	(5.15)	(0.23)		(0.658)	(0.669)
SIZE	0.011***	0.010***	0.011***	-	-0.041***	-0.045***
	(0.003)	(0.003)	(0.003)	0.040***	(0.016)	(0.014)
				(0.017)		

AG	0.046***	0.047***	0.046***	0.011	-0.002	0.003
	(0.010)	(0.010)	(0.010)	(0.024)	(0.024)	(0.024)
CAR	0.097***	0.102***	0.097***	1.752***	1.731***	1.748***
	(0.029)	(0.026)	(0.029)	(0.087)	(0.085)	(0.088)
EXP	-0.278**	-0.265**	-0.298**	0.237	0.116	-0.300
	(0.153)	(0.134)	(0.153)	(0.574)	(0.556)	(0.580)
INF	-0.097	-0.109	-0.119*	-0.106	-0.018	-0.102
	(0.069)	(0.068)	(0.068)	(0.175)	(0.169)	(0.160)
LGDP	0.040*	0.033	-	-0.014	-0.025	-
	(0.023)	(0.024)		(0.057)	(0.054)	
FDC	-0.004	-	-	-0.052	-	-
	(0.002)			(0.045)		
PC	-	-0.004	-	-	-0.141***	-
					(0.057)	
HC	-	-	0.107	-	-	-0.125***
			(0.123)			(0.278)
Constant term	-0.130***	-0.117***	-	0.134	0.165	0.146
	(0.031)	(0.024)	0.125***	(0.116)	(0.116)	(0.090)
			(0.026)			
Observation	150	150	150	150	150	150
Adj R-squared	0.486	0.488	0.492	0.578	0.580	0.597

Table II. 14 provides the regressions' results using the random/fixed effects estimator. Note that, ROA is used to measure bank performance and Zscore is a measure of bank insolvency risk (financial stability). All accounting variables are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2..

Taken together, crises do not significantly and negatively impact the beneficial effects of income diversification on ROA. However, both political and health crises reinforced the negative effect of the SHNII on bank risk. Thus, during crises, non-interest income business lines continue to significantly and positively (negatively), impact bank profitability (risk). This is consistent with the findings of Kamani (2018), Simoens and Vander Vennet, 2021 but fails to join those of DeJonghe (2010).

The question that arises is: how can crises significantly impact banks stability without influencing their performance. Jayasekara et al., 2020 argued that ROA is an accounting ratio that measures the short-term financial performance of banks whereas the Z-score measures the long-term performance of banks. In fact, some authors used Z-score as an additional bank performance measure. Another explanation for these results is that the CBT continued to set up strict regulatory capital adequacy standards like the introduction of capital requirements to cover credit, liquidity, operational risk (2016) and market risk (2018).

- **Robustness check**

To determine whether our core evidence is robust, we computed our model with ROE instead of ROA and replaced the insolvency risk by the credit risk. As shown in Table II.15, the results didn't change noticeably.

The results in column (3), (4) and (5), where the ROE is the dependent variable measuring bank performance, confirm the insignificant effect of studied crises on both performance and the effect of non-interest income generating activities on bank performance. The positive and significant effect of the SHNII on ROE is persistent during crises as well as during non-crisis periods.

Furthermore, our estimations for NPL regressions confirm our previous results using the Z-score measure. Once again, the positive effect of non-traditional activities on bank risk (NPL) is confirmed because the coefficient of SHNIIPC is negative and statistically significant. SHNII × PC is negative and significant, and the sum of its coefficient with that on SHNII (-0.348+ (-0.094) = 0.442) is larger than that on non-political (-0.348). This suggests that the increase in NPL by the business income diversification has been reinforced during the acute phase of the political crisis (2011-2013). This confirms our results and reinforces the findings of many previous studies, that shifting towards non-interest revenue-generating activities entails a diversification premium. Hence, it's profitable for banks to focus on diversification during political crises to reduce their credit and insolvency risks. Meanwhile, we found that the health crisis has no significant direct and indirect effect on bank credit risk, which is inconsistent with the findings of Li et al. (2021). This can be related to the fact that non-performing loans exist after a time gap of the country' economic recession and that in the Li et al. (2021) study, risk is measured by the standard deviation of ROA.

Table II.15: Regression results related to FDC, PC, and HC' effect on the relationship between SHNII and ROE/Zscore

	ROE				NPL	
	(3)	**(4)**	**(5)**	**(8)**	**(9)**	**(10)**
SHNII	1.020***	1.139***	0.925***	-0.346**	-0.348**	-0.220
	(0.307)	(0.309)	(0.272)	(0.157)	(0.154)	(0.156)
SHNIIFDC	0.212	-	-	0.103	-	-
	(0.950)			(0.110)		
SHNIIPC	-	0.365	-	-	-0.094***	-
		(1.235)			(0.029)	
SHNIIHC	-	-	-0.453	-	-	0.031
			(5.990)			(0.285)
NIM	20.209***	22.277***	18.275***	9.786***	-10.477***	-7.91***
	(5.671)	(5.71)	(0.137)	(2.498)	(2.55)	(2.617)
SIZE	0.158	0.191**	0.1377*	-0.176***	-0.137**	-0.168***
	(0.104)	(0.103)	(0.03)	(2.498)	(0.050)	(0.051)
AG	0.647***	0.730***	0.602***	-0.077	-0.172*	-0.103
	(0.251)	(0.250)	(0.249)	(0.916)	(0.089)	(0.284)
CAR	-1.229*	-1.113	-0.978	-0.398	-0.529*	-0.557*
	(0.722)	(0.715)	(0.651)	(0.329)	(0.331)	(0.346)
EXP	-7.860**	-7.695**	-6.920**	5.795***	5.246***	5.824***
	(3.327)	(3.737)	(3.32)	(2.096)	(2.03)	(2.410)
INF	-0.284	-1.567	-0.616	0.0274	1.004	0.908
	(1.828)	(1.737)	(1.662)	(0.660)	(0.621)	(0.622)
LGDP	0.320	0.414	-	-0.347	-0.296	-
	(0.512)	(0568)		(0.109)	(0.394)	
FDC	-0.071	-	-	-0.116**	-	-
	(0.512)			(0.051)		
PC	-	-0.110	-	-	0.071	-
		(0.653)			(0.043)	
HC	-	-	0.164	-	-	0.034
			(3.089)			(1.158)
Constant term	-1.69***	-1.988***	-1.466***	1.676***	1.395***	1.468***
	(0.764)	(0.765)	(0.602)	(0.383)	(0.422)	(0.280)
Observation	150	150	150	150	150	150
Adj R-squared	0.198	0.226	0.198	0.424	0.467	0.348

Table II.15 regressions' results using the random/fixed effects estimator. Note that, ROE is used to measure performance and NPL is a measure of bank risk. All accounting variables are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in table II.2.

From our estimations results for NPL regressions (Tab. II.15), it appears that that the global financial crisis compounded by the Sovereign crisis (FDC) is negatively and significantly associated with NPL, inconsistent with Rachdi (2013)' results, which highlight that the Tunisian banking sector was slightly exposed to the effects of the financial crisis because of its low integration in international financial markets.

Besides, estimation results of model (9) from the table (Tab. II.15) confirm our previous results using the Zscore measure for risk. Even if the PC does not show a significant linear impact on NPL but the crisis strengthens the negative effect of the SHNII on bank risk. This is granted that the coefficient of SHNIIPC is also negative and statistically significant, in the event that the sum of its coefficient with that on SHNII (-0.348+ (-0.094) = 0.442) is larger than that on non-political (-0.348).

During the acute phase of the political crisis (2011-2013), shifting within non-interest revenue-generating activities entails a diversification premium. Such conclusion corroborates. It's better for bank to diversify more during political crisis to reduce their credit and insolvency risk.

Overall, our results related to bank performance are in contradiction with Ihaddaden (2020)' findings, who indicate that Tunisian revolution has a lasting negative impact Tunisian banking sector. For that reason and as w additional test, we will perform a Chow robustness test[51] to check if the relationship we're testing is stable over the entire period or there is a change in the magnitude on the slope of the SHNII with both Performance and risk. In other words, testing the structural breaks of the non-interest income and our dependent variables association during the political crisis as well as the FDC because introducing interaction term in the same equation with the both variables constituted can weakens the significance of the coefficients in some cases, more precisely if the sample is small (Note: the test cannot be applied for the HC due to the lack of observation after the crisis).

Table II.16: Chow test' results

	ROA	**Zscore**
FDC	0.12	0.13
	(0.8888)	(0.8802)
PC	0.18	0.65
	(0.8341)	(0.5235)

Note: In the context of the Chow test, the null hypothesis is that there is no structural change, i.e. the coefficients are equal for both subsamples. Therefore, if we reject the null hypothesis ("p-value" < alpha), there is a structural change in the magnitude of the tested relationship. The P-value of the test is presented in parentheses. For more detail see appendix 10.

The Chow tests' results as reported in the above table (Tab. II. 16), show that the coefficients of SHNII significantly differ for the ROA model between the PC period and non-PC period (F = 1.931, p = 0.072) and also there is instability of the impact of SHNII on ROA during the FDC as expected and in consist with previous studies on the Tunisian context. From the both dependents variables, the FDC has no direct effect on Tunisian banks performance (see Tab IIV.5) but it has reinforced the effect of income diversification on ROA (F = 0.12, p = 0.8888) and on Zscore (F=0.13, p=0.8802) from the chow test, indicating a structural break starting from the crisis shock (the first year of the crisis period in our case). In other words, the effects of non-interest income on bank performance and solvability (Zscore) become stronger

[51] Chow test is a statistical and econometric test to determine if the coefficients of two linear series are equal. The coefficients are established by linear regression.

(positive coefficient from previous tables) during the FDC and PC. This conclusion is explained by the fact that Tunisian banks' non-interest income components are less risky (except for long-term trading which has a negative significant impact on NPL as we have shown from the first analysis part (Tab. II.11)) than other non-interest income' sources used by banks in developed countries. This view is supported by De Young and Torna (2013) and Cheng et al. (2019), who find that the probability of bank failure during the crisis declines with fee-based non-traditional activities such as securities brokerage and insurance sales. This finding is inconsistent with those reported by Stiroh and Rumble (2006).

In sum, inconsistent with DeYoung et al. (2001), Stiroh (2006), Nguyen (2012), DeYoung and Torna (2013), and Williams (2016), from our results, it is assumed that the greater the bank diversify their activities, the high is the bank performance and the lower is the global risk even during the crisis period. More interestingly, the studied crises reinforced the beneficial effect of the share of non-interest income activities on Tunisian banks' performance and risk.

Conclusion

World-wide financial sectors, as well as economies as a whole, are driven by the banking sectors. In fact, banking sectors lead economies to the creation of wealth, mainly by providing funds for investments. It is said that a well-organized banking system provides liquidity and mobility to the financial resources available in the economy. However, banks, like any other organisation, are susceptible to economic crises and shocks. Thus, there is a need for protection strategies, like hedging and portfolio diversification, in order to face the said shocks and crises and reduce their impact on banking entities, and hence, on the economy.

As documented in the "Shadow Banking" literature, our results support the argument put forth in earlier literature that diversification into non-interest banking activities enhances bank profitability due to economies of scope/scale, and reduces global risk. It is interesting to note, however, that our results are at odds with those by Stiroh (2004) and Wolfe et al (2007) but are in line with those of Kohler (2015) and Sanya and Wolfe (2011) who show that diversification across non-traditional income activities reduce insolvency risk and enhance profitability. More interestingly, since non-interest incomes are generated by different activities, we find also that all non-interest income components positively impact ROA and Zscore, except for long-term trading which seems to increased bank credit risk measured by NPL (consist with Park et al. (2019)' results). For that reason, Tunisian banks should be more

cautious about investing in long-term trading that shows an adverse consequence on credit risk by raising the non-performing loans that as a consequence, will decrease bank potential profit. However, they may highly invest in short-term trading (commercial investments) that show a high significant effect on both performance and stability. Then, by dividing our sample into crisis and non-crisis periods, we provide evidence that the positive effect of non-interest income activities on bank performance and stability is reinforced during the crisis period compared to the tranquil period. It should be noted that, inconsistent with Demirguc-Kunt et al. (2020)' findings, who proved that there are differences between the health crisis due to the pandemic versus previous events of financial and economic stress, we find that there is no difference between financial, political or health crisis in terms of their impact on the effect of income diversification strategy on Tunisian bank's risk and performance. More clearly, diversifying into non-interest income activities is beneficial for both performance and risk during (financial, political, or health) crises as well as during the "Tranquil/normal period". Income diversification not only increases performance and stability in spite of the economic and financial situation, the positive effect persists even during the various type of crisis. This can be justified by the fact that: competition in the banking system leads to a decline in interest revenue, which ultimately forces bank to look for additional non-traditional income sources. In general, after the global financial crisis, Tunisian banks have seen a strong improvement in technical efficiency and digitalization that drive banks to diversify their activities and their products (Ayadi and Ellouze, 2014). All things considered and based on our empirical results, Tunisian banks are invited to diversify their activity during the economic growth period and specifically during the economic downturns to reduce their risk exposure and to enhance their performance.

GENERAL CONCLUSION

Policymakers and bank supervisors in many countries have deregulated the scope of bank diversification, lowered barriers among commercial and investment banks and security and insurance companies to increase competitiveness in the banking industry, and have made repeated recommendations to banks to diversify their activities both functionally and geographically (Clark and Siems, 2002).

This new banking environment, characterized by a combination of regulatory reform, product market innovation, increased competition, and technological change, has dramatically altered Tunisian commercial banks. In fact, these latter have continued to broaden their potential sources of income growth and to improve their capital and liquidity ratios, especially in light of declining margins on traditional retail lending. One possible effect of these attempts to diversify income sources might be an increase in the share of non-interest income, such as investment banking, securities brokerage, ATM fees and wealth management. In other words, the transition from traditional to modern banking with the implementation of the so-called "universal banking model"[52] allowed banks to expand, over the past two decades, their traditional and specialized business strategies to a wider range of products and services.

In the same vein, Ayadi et Ellouz (2015) argue that the trend of Tunisian banks to diversify into non-core banking activities or markets is reinforced by the law n ° 2001–65 of July 10, 2001 on the application of the principle of universal banking, which allows credit institutions to perform all banking activities. As a result, increasing non-interest income has become especially important and urgent for banks (Li and Zhang 2013), and non-traditional banking activities have evolved from a supporting role to a major contributor of bank revenue sources.

In addition, the growth of these non-interest business areas has been accompanied by a significant change in their components. In the Tunisian banking sector, the composition of non-interest income has also changed markedly during the last ten years. Trading (commercial and investment portfolio) income has become the dominant source of non-interest income received by Tunisian banks, reaching 53% of total non-interest income as documented in the

[52] This model was formally introduced in the EU by the Second Banking Directive in 1992, in the US via the Gramm-Leach-Bliley Act in 1999 and in Japan by the "Japanese Big Bang" financial reforms in the 1990s (Casu et al. 2015; Hoshi and Kashyap 1999). Banks operating in emerging markets have also been subject to widespread financial deregulation and innovation that have impacted their business strategies as shown e.g. in Hawkins and Mihaljek (2001).

annual supervision report of the central banking of Tunisian (2020), replacing the traditional mainstays of service charges and income from lending activity.

As reported in the theoretical background, previous literature on this topic is divided between stipulations that it is necessary for banks to diversify into non-traditional banking activities to increase profits, allocate capital efficiently, exploiting managerial skills, and enjoy scale economies as well as cross-selling opportunities (Diamond, 1984; Herring and Santomero, 1990; Hahm, 2008; Drucker and Puri, 2009; Mostk, 2017), supporting the traditional portfolio theory.

From another conjecture, there are some stipulations that such functional diversification increases asymmetry of information, agency-related problems, growing organizational complexity, and the loss of focus and bank idiosyncratic and/or systemic risks (DeYoung and Roland, 2001; Stiroh and Rumble, 2006; Abedifar et al., 2018) could offset income diversification benefits. These inconclusive results raise the question of the effect of non-interest income activities on Tunisian banking sector performance and risk.

More interestingly, the recent global financial crisis and the economic crisis related to the COVID-19 pandemic, as well as the revolution in many Arabic countries, raise questions about the benefits of such functional diversification specifically in stressed times. A set of empirical studies (Derbali, 2011; Park et al., 2019; Flori et al. 2019; Cheng et al. 2019; Kim et al., 2020; Paltrinieri et al., 2020) show that the inconclusive results on the efficiency of the new business model are mostly related to the economic context and market financial situation (tranquil or crisis period). Kim et al. (2020)' results suggest that although most regulators worldwide encourage income diversification into non-core banking activities to reduce bank risk, bank diversification may exacerbate bank financial instability or increase the risk of financial market collapse when crises occur. As the crisis may badly weaken the financial health of the banking industry alone, as evidenced by Williams (2016) related to the global financial crisis (GFC), the joint interaction between the financial crisis and bank diversification may lead to appreciation in that case. In the same vein, Onali & Mascia (2021) give new heights of attention to the COVID-19 crisis' effect on the relationship between non-interest income-generating activities and bank performance and risk in emerging economies rather than developed countries. The core focus of their analysis is to investigate the effects of functional diversification, across non-interest income, on bank risk and performance, verifying also if the results have been affected by crises. Thus, they provide evidence that diversification dampens the negative impact of COVID-19 on idiosyncratic and total stock

volatility during the acute phase of the outbreak, while business diversification works in the opposite direction, amplifying the impact of the pandemic on idiosyncratic and total volatility

The absence of prior literature on the joint effect of the new business model and crises on bank performance and risk in the Tunisian context motivates us to run this study. More interestingly, to take into account several types of crises (global financial crisis and the European debt crisis, the political crisis (Tunisian revolution), and the economic crisis brought on by the COVID-19 pandemic) to shed the light on their effects on the relation between bank business model and bank performance/risk. Thus, we hypothesize that the association between bank diversification and financial stability differs across the non-crisis and crisis periods. That is, crisis reduces the effect of non-interest income of bank performance and risk.

We consider the periods from 2005 to 2008 and from 2014 to 2019 as 'the crisis' period, and the periods from 2009 to 2013 and the fiscal year 2020 as "the normal" or "tranquil" period. Then, we identified the period between 2009-2010 as the financial and debt crisis (FDC), we relate the period between 2011 to 2013 to the political crisis (PC) and finally the health crisis of COVID-19 pandemic in 2020. We opt for a data sample of 10 listed Tunisian banks over the period 2005–2020 and a random/effects model. Then, for robustness check, we used alternative measures for our dependent variables measured by ROE and NPL instead of ROA and Zscore for bank performance and bank risk, respectively. Therefore, a Chow test is employed to test the stability of the relationship between non-interest income and bank performance and/or risk.

In line with those of Kohler (2015) and Sanya and Wolfe (2011), our first main result reveals that bank performance and bank financial stability will be increased if Tunisian banks increase their non-interest income share, suggesting that developing non-interest activities has positive effects on Tunisian' financial environment, as predicted. This is in contradiction with Cheng et al. (2019)'s results in the Chinese context. The difference can be argued by the fact that Tunisian banks' non-interest income components differ from those in other developed or even emerging countries. Moreover, the second main result suggests that all non-interest income components (fees and commissions, short-term and long-term trading) are positively and significantly associated with both bank performance' measures (ROA and ROE) and also with bank stability measured by Zscore ratio. However, it seems that long-term trading income have significantly positive impact on non-performant loans, in contrast to our

predictions. As a consequence, lower assets quality will reduce bank performance (Zhang et al., 2016; Zhu and Yang, 2016).

Then, our results from the second analysis part postulate that increasing the share of non-interest income-generating activities always leads to increased profitability and resilience and a reduction in bank risk during a crisis period with a higher intensity than during a non-crisis period, indicating that during an economic or financial downturn, Tunisian banks should increase their non-interest income activities to preserve their stability and performance.

Finally, inconsistent with Demirguc-Kunt et al. (2020)' findings, who proved that there are differences between the health crisis due to the pandemic and previous events of financial and economic stress, we find that there is no difference between the financial, political, or health crisis in terms of their impact on the effect of non-interest income activities on the Tunisian bank's risk and performance. Simoensa and Vander Venneta (2021) argue that income-diversified banks are better able to absorb shock and distress. More clearly, diversifying into non-interest income activities is beneficial in terms of performance and risk during (financial, political, or health) crises as well as during the "tranquil" period.

In other words, contrary to the findings of Kim et al. (2020), which suggest that diversification has a negative impact on stability during a crisis period, our findings from the regressions, more importantly, the structural break test of Chow suggests that all types of crises reinforce (exacerbate) the positive (negative) effect of non-interest income-generating activities on bank performance (risk).

In sum, after the global financial crisis, Tunisian banks have seen a strong improvement in technical efficiency and digitalization that has driven banks to provide a wide range of financial services (Ayadi and Ellouze, 2014). This led to a continuous improvement in the non-interest income of resident banks from 472 MDT in 2005 to 2.503 MDT, as presented in CTB' annual reports.

The purpose of this study is to shed more light and to give more results on the best income structure for the Tunisian banking system. This question is even more interesting since the Tunisian government is launching a major plan to restructure and reform the banking system. Moreover, new central bank and banking laws have been voted in 2016, providing more importance to the enforcement of good governance principles and to the enhancement of the banking system's robustness and efficiency.

Our results have implications for both policymakers and practitioners. First, our results could be important to regulators as they could serve as an advance warning signal that sends them a clear message about the importance of diversifying into non-traditional activities by changing their business models to adapt to Tunisia's financial environment and they should start seeking adequate staff in terms of skills.

The most importantly, during a crisis period (any crisis type), it is beneficial to more diversify into non-interest income activities, given that these letter have a greater significant positive (negative) effect on bank performance (risk). Furthermore, because different types of non-interest income have different impacts on bank risk in Tunisia in terms of coefficient and significance, banks should formulate different development strategies based on their characteristics. It should be noted that Tunisian banks should be cautious about long-term investments that may increase non-performant loans, thus lowering asset quality. Finally, policymakers should also create different regulatory policies for different types of non-interest activities.

Based on the existing research methods and results, this study contributes to the literature on income diversification in several ways: First, most empirical research in the literature uses U.S. and EU bank data, and this is one of the first studies dedicated to the issue of diversification that examines the case of an emerging banking industry that experienced tremendous changes over the last decade. Indeed, Tunisia is an appropriate place to investigate this issue because deregulation has provided ample scope for functional diversification in banking since at least 1994 onwards. Furthermore, banks are preparing for the transition to Basel III by 2021, and several measures aimed at energising the banking sector have recently been adopted or will be adopted shortly. Second, while the banking industry's highly regulated nature protects banks, it also exposes them to new vulnerabilities as they diversify, such as high competitiveness. Third, to the best of our knowledge, no study has examined the impact of non-interest income generating activities on bank performance and risk while accounting for the effects of crises, particularly different and successive crises at the same time. Moreover, the choice of the period of the crisis was well analysed based on very relative indicators and a well-structured micro and macroeconomic analysis.

Finally, by analysing the new business model during the pandemic, we added a new line of search to the nascent literature on the effects of the COVID-19 shock on the banking sector. And finally, our study is important not only as a theoretical synthesis but also, and especially,

at the empirical level, where we have run various robustness tests, such as the structural break test of Chow, to check our mainly results and to assure the effectiveness of our interpretations.

It is worth mentioning that our study contains some limitations that can be addressed in future research. We note first that the sample size is small; it is possible that the results are not highly accurate, specifically with interaction terms; second, the breakdown of non-interest income must be more detailed if the data base is available to get more accurate results.

Several research perspectives can be suggested. For instance, the special features of the banking industry provide strong motivation for studying the relationship between non-interest income and bank risk and performance during different crises using more sophisticated models (i.e., dynamic GMM, SVAR, instrumental models, etc.). Moreover, the effect of the COVID-19 pandemic on the performance and risk of Tunisian banks is not yet clear; either so future research can take more observations for analysis in order to obtain relevant results. Finally, it would be very interesting to break down the non-interest income sources of revenue in more detail and to perform the analysis for periods of crisis to properly identify the components generating revenue in such hard times.

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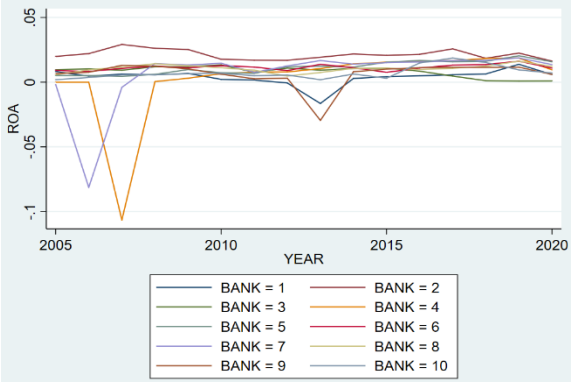
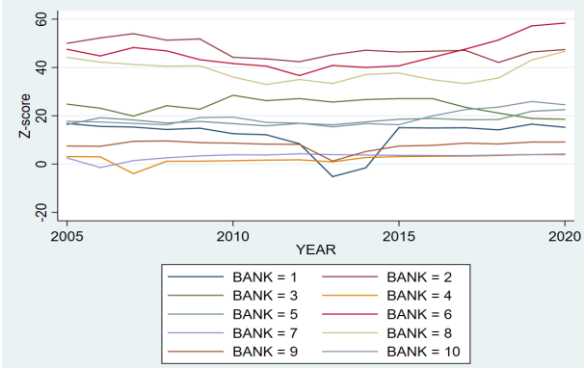
Appendixes

Appendix 1:

Bank profitability and risk measures for listed banks between 2005-2020





Note: numbers are related to listed banks as follow: Bank1 refer to the STB bank; Bank2 refer to BT; Bank3 is ATB; Bank4 is UIB; Bank5 represent BIAT; Bank6 refer to Amen bank; Bank7 refer to Attijari bank; Bank8 is UBCI; Bank9 is BH bank and finally Bank10 is the BNA.

Data Source: Own construction from listed banks annual reports

Appendix 2: Normality test

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
ROA	160	0.0000	0.0000	.	0.0000
Zscore	160	0.0123	0.0000	19.41	0.0001
SHNII	160	0.0003	0.6231	11.34	0.0034
COM	160	0.0125	0.1208	7.90	0.0193
SHORT	160	0.0000	0.0002	42.00	0.0000
LONG	160	0.0000	0.0005	35.98	0.0000
NIM	160	0.3779	0.4520	1.36	0.5061
SIZE	160	0.2972	0.1505	3.20	0.2018
AG	150	0.8914	0.2684	1.26	0.5321
CAR	160	0.2667	0.0005	11.56	0.0031
EXP	160	0.0302	0.8735	4.79	0.0911
INF	160	0.6973	0.2150	1.71	0.4247
GDP	160	0.0000	0.0000	52.29	0.0000
FDC	160	0.0000	0.0000	58.19	0.0000
PC	160	0.0000	0.1325	33.08	0.0000
HC	160	0.0000	0.0000	.	0.0000

Appendix 3: VIF test

. vif

Variable	VIF	1/VIF
NIM	5.96	0.167828
SHNII	4.35	0.229807
SIZE	2.00	0.499410
EXP	1.92	0.521296
CAR	1.79	0.557764
INF	1.60	0.623938
GDP	1.54	0.651253
AG	1.20	0.835696
Mean VIF	2.54	

. vif

Variable	VIF	1/VIF
HC	37.62	0.026581
SHNIIHC	36.75	0.027209
SHNIIPC	19.30	0.051819
PC	19.20	0.052082
SHNIIFDC	14.99	0.066727
FDC	14.81	0.067522
NIM	6.37	0.157088
SHNII	5.18	0.193117
EXP	1.94	0.515059
CAR	1.82	0.548563
SIZE	1.69	0.591184
INF	1.64	0.609956
AG	1.23	0.810975
Mean VIF	12.50	

. vif

Variable	VIF	1/VIF
NIM	6.36	0.157236
SHNII	5.30	0.188585
SIZE	2.42	0.412738
LGDP	2.07	0.483404
EXP	1.85	0.540441
CAR	1.77	0.564216
INF	1.56	0.642899
AG	1.17	0.853295
Mean VIF	2.81	

```
. reg ROA SHNII NIM SIZE AG CAR EXP INF LGDP FDC PC HC
note: HC omitted because of collinearity
```

Source	SS	df	MS		
Model	.007684119	10	.000768412	Number of obs	= 130
Residual	.007757673	119	.000065191	F(10, 119)	= 11.79
				Prob > F	= 0.0000
				R-squared	= 0.4976
				Adj R-squared	= 0.4554
Total	.015441792	129	.000119704	Root MSE	= .00807

ROA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.0609781	.0138966	4.39	0.000	.0334615	.0884946
NIM	1.123496	.2522964	4.45	0.000	.6239234	1.623068
SIZE	.0090152	.0047519	1.90	0.060	-.000394	.0184243
AG	.0462799	.0112126	4.13	0.000	.0240777	.068482
CAR	.1046458	.0294708	3.55	0.001	.0462907	.1630009
EXP	-.2779205	.1519345	-1.83	0.070	-.5787661	.022925
INF	-.1049667	.0846929	-1.24	0.218	-.2726671	.0627337
LGDP	-.0007424	.0017884	-0.42	0.679	-.0042837	.0027989
FDC	.0008227	.0021577	0.38	0.704	-.0034498	.0050952
PC	.0011184	.0022044	0.51	0.613	-.0032465	.0054833
HC	0	(omitted)				
_cons	-.110567	.0325251	-3.40	0.001	-.17497	-.046164

Appendix 4: Unit root test

Levin-Lin-Chu unit-root test for **ROA**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-22.0202	
Adjusted t*	-18.2600	0.0000

Levin-Lin-Chu unit-root test for **Zscore**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-10.2875	
Adjusted t*	-6.7374	0.0000

Levin-Lin-Chu unit-root test for **SHNII**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

> ———

	Statistic	p-value
Unadjusted t	-8.1344	
Adjusted t*	-1.8398	0.0329

Levin-Lin-Chu unit-root test for **COM**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

> ———

	Statistic	p-value
Unadjusted t	-4.8317	
Adjusted t*	-1.8759	0.0303

Levin-Lin-Chu unit-root test for **SHORT**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-8.2552	
Adjusted t*	-2.2032	0.0138

Levin-Lin-Chu unit-root test for **LONG**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-7.0705	
Adjusted t*	-2.4136	0.0079

Levin-Lin-Chu unit-root test for **NIM**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

> ———

	Statistic	p-value
Unadjusted t	-8.5644	
Adjusted t*	-3.4510	0.0003

Levin-Lin-Chu unit-root test for **SIZE**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

> ———

	Statistic	p-value
Unadjusted t	-7.3019	
Adjusted t*	-3.7875	0.0001

Levin-Lin-Chu unit-root test for **AG**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 15

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-9.8486	
Adjusted t*	-4.2251	0.0000

Levin-Lin-Chu unit-root test for **EXP**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-8.2084	
Adjusted t*	-4.0524	0.0000

Levin-Lin-Chu unit-root test for **CAR**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-6.0774	
Adjusted t*	-2.2796	0.0113

Levin-Lin-Chu unit-root test for **GDP**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-8.0221	
Adjusted t*	5.6271	1.0000

Levin-Lin-Chu unit-root test for **INF**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 16

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-10.2329	
Adjusted t*	-2.7853	0.0027

Levin-Lin-Chu unit-root test for **LGDP**

Ho: Panels contain unit roots — Number of panels = 10
Ha: Panels are stationary — Number of periods = 14

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **8.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-16.2583	
Adjusted t*	-10.4515	0.0000

Appendix 5: Auto-correlation error test

Model1

```
. reg U1 L.U1 L2.U1
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	3.87
Model	.000125623	2	.000062811	Prob > F	=	0.0234
Residual	.002061345	127	.000016231	R-squared	=	0.0574
				Adj R-squared	=	0.0426
Total	.002186967	129	.000016953	Root MSE	=	.00403

U1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U1						
L1.	.2336155	.0840427	2.78	0.006	.06731	.3999209
L2.	-.033386	.0477041	-0.70	0.485	-.1277838	.0610118
_cons	.0004106	.0003587	1.14	0.254	-.0002991	.0011203

Model2

```
. predict U2,r
(10 missing values generated)

. reg U2 L.U2 L2.U2
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	3.87
Model	.000129963	2	.000064981	Prob > F	=	0.0233
Residual	.002130022	127	.000016772	R-squared	=	0.0575
				Adj R-squared	=	0.0427
Total	.002259985	129	.000017519	Root MSE	=	.0041

U2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U2						
L1.	.2322577	.0837361	2.77	0.006	.066559	.3979564
L2.	-.026567	.0486946	-0.55	0.586	-.1229248	.0697907
_cons	.0004313	.000365	1.18	0.239	-.0002909	.0011536

Model3

```
. predict U3,r
(10 missing values generated)

. reg U3 L.U3 L2.U3
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	3.85
Model	.000125647	2	.000062824	Prob > F	=	0.0237
Residual	.002069969	127	.000016299	R-squared	=	0.0572
				Adj R-squared	=	0.0424
Total	.002195616	129	.00001702	Root MSE	=	.00404

U3	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U3						
L1.	.2332503	.0840384	2.78	0.006	.0669535	.3995471
L2.	-.0343945	.0477481	-0.72	0.473	-.1288793	.0600904
_cons	.0003885	.0003593	1.08	0.282	-.0003225	.0010995

Model 4

```
. predict U4,r
(10 missing values generated)

. reg U4 L.U4 L2.U4
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	3.98
Model	.000131392	2	.000065696	Prob > F	=	0.0210
Residual	.002094969	127	.000016496	R-squared	=	0.0590
				Adj R-squared	=	0.0442
Total	.002226361	129	.000017259	Root MSE	=	.00406

U4	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U4						
L1.	.2347222	.0832099	2.82	0.006	.0700649	.3993796
L2.	-.0431271	.0481987	-0.89	0.373	-.1385036	.0522493
_cons	.0003765	.0003605	1.04	0.298	-.0003368	.0010899

Model5 :

```
. predict U5,r
(10 missing values generated)

. reg U5 L.U5 L2.U5
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	4.23
Model	.000129613	2	.000064807	Prob > F	=	0.0166
Residual	.001945332	127	.000015318	R-squared	=	0.0625
				Adj R-squared	=	0.0477
Total	.002074945	129	.000016085	Root MSE	=	.00391

U5	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U5						
L1.	.2373448	.0815925	2.91	0.004	.0758879	.3988017
L2.	-.0365696	.0463475	-0.79	0.432	-.128283	.0551437
_cons	.0003484	.0003463	1.01	0.316	-.0003368	.0010337

Model6 :

```
. predict U6,r
(10 missing values generated)

. reg U6 L.U6 L2.U6
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	488.14
Model	1.00098944	2	.500494718	Prob > F	=	0.0000
Residual	.130213245	127	.001025301	R-squared	=	0.8849
				Adj R-squared	=	0.8831
Total	1.13120268	129	.008769013	Root MSE	=	.03202

U6	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U6						
L1.	.7587668	.0717309	10.58	0.000	.6168243	.9007094
L2.	.2135301	.0723638	2.95	0.004	.0703352	.356725
_cons	-.0010146	.0028188	-0.36	0.719	-.0065926	.0045633

Model7:

```
. predict U7,r
(10 missing values generated)

. reg U7 L.U7 L2.U7
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	280.01
Model	.752292407	2	.376146204	Prob > F	=	0.0000
Residual	.170604146	127	.00134334	R-squared	=	0.8151
				Adj R-squared	=	0.8122
Total	.922896554	129	.007154237	Root MSE	=	.03665

U7	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U7						
L1.	.8308243	.0851871	9.75	0.000	.6622544	.9993942
L2.	.1112647	.0875974	1.27	0.206	-.0620748	.2846042
_cons	.0005112	.0032183	0.16	0.874	-.0058572	.0068796

Model8:

```
. predict U8,r
(10 missing values generated)

. reg U8 L.U8 L2.U8
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	480.46
Model	.995414554	2	.497707277	Prob > F	=	0.0000
Residual	.131560065	127	.001035906	R-squared	=	0.8833
				Adj R-squared	=	0.8814
Total	1.12697462	129	.008736237	Root MSE	=	.03219

U8	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U8						
L1.	.7680253	.0724384	10.60	0.000	.6246828	.9113678
L2.	.2024623	.0730346	2.77	0.006	.0579401	.3469846
_cons	-.0007062	.0028345	-0.25	0.804	-.0063152	.0049029

Model 9

```
. predict U9,r
(10 missing values generated)

. reg U9 L.U9 L2.U9
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	471.41
Model	.988959905	2	.494479953	Prob > F	=	0.0000
Residual	.133215036	127	.001048937	R-squared	=	0.8813
				Adj R-squared	=	0.8794
Total	1.12217494	129	.008699031	Root MSE	=	.03239

U9	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U9						
L1.	.7603749	.0718956	10.58	0.000	.6181065	.9026432
L2.	.2076332	.0724585	2.87	0.005	.0642509	.3510156
_cons	-.0009832	.0028505	-0.34	0.731	-.0066238	.0046574

Model 10:

```
. predict U10,r
(10 missing values generated)

. reg U10 L.U10 L2.U10
```

Source	SS	df	MS	Number of obs	=	130
				F(2, 127)	=	409.35
Model	.951763936	2	.475881968	Prob > F	=	0.0000
Residual	.147640665	127	.001162525	R-squared	=	0.8657
				Adj R-squared	=	0.8636
Total	1.0994046	129	.008522516	Root MSE	=	.0341

U10	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
U10						
L1.	.7441926	.0786958	9.46	0.000	.5884678	.8999173
L2.	.2018879	.0794806	2.54	0.012	.0446101	.3591657
_cons	-.0008987	.0029996	-0.30	0.765	-.0068344	.0050371

Appendix 6: F-test and Breusch-Pagan test

```
. hettest

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

         chi2(1)      =   274.88
         Prob > chi2  =   0.0000
```

```
. hettest

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

         chi2(1)      =   291.71
         Prob > chi2  =   0.0000
```

```
. hettest

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

         chi2(1)      =   277.07
         Prob > chi2  =   0.0000
```

```
. hettest

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

         chi2(1)      =   297.75
         Prob > chi2  =   0.0000
```

```
. hettest

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

         chi2(1)      =   293.76
         Prob > chi2  =   0.0000
```

```
. hettest

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

         chi2(1)      =     0.05
         Prob > chi2  =   0.8196
```

```
. hettest

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

         chi2(1)      =     1.35
         Prob > chi2  =   0.2452
```

```
. hettest

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

         chi2(1)      =     0.06
         Prob > chi2  =   0.8088
```

```
. hettest

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

         chi2(1)      =     0.04
         Prob > chi2  =   0.8455
```

```
. hettest

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

         chi2(1)      =     0.00
         Prob > chi2  =   0.9571
```

Appendix 7: Hausman test and appropriate Random/Fixed effect regressions

Model 1

Random-effects GLS regression — Number of obs = 150; Number of groups = 10
Group variable: BANK

R-sq: within = 0.4167; between = 0.7922; overall = 0.4836
Obs per group: min = 15; avg = 15.0; max = 15

Wald chi2(8) = 119.73; Prob > chi2 = 0.0000
corr(u_i, X) = 0 (assumed)

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.0638882	.0124314	5.14	0.000	.0395232	.0882532
NIM	1.144645	.2285818	5.01	0.000	.6966328	1.592657
SIZE	.0118327	.0042308	2.80	0.005	.0035405	.020125
AG	.0466418	.0101811	4.58	0.000	.0266872	.0665963
CAR	.0975717	.0295603	3.30	0.001	.0396346	.1555088
EXP	-.2843262	.1547328	-1.84	0.066	-.587597	.0189446
INF	-.12198	.0692639	-1.76	0.078	-.2577348	.0137748
LGDP	.0368822	.022707	1.62	0.104	-.0076228	.0813871
_cons	-.1279105	.0303339	-4.22	0.000	-.187364	-.0684571
sigma_u	.00155573					
sigma_e	.00734755					
rho	.04290768	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 11.38
Prob>chi2 = 0.1813
(V_b-V_B is not positive definite)

Model 2

Random-effects GLS regression — Number of obs = 150; Number of groups = 10
Group variable: BANK

R-sq: within = 0.4430; between = 0.6435; overall = 0.4715
Obs per group: min = 15; avg = 15.0; max = 15

Wald chi2(10) = 113.71; Prob > chi2 = 0.0000
corr(u_i, X) = 0 (assumed)

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
COM	.0352934	.0232956	1.52	0.130	-.0103652	.0809519
SHORT	.0700062	.0145671	4.81	0.000	.0414552	.0985572
LONG	.063026	.0204114	3.09	0.002	.0230204	.1030316
NIM	1.179287	.2565348	4.60	0.000	.6764886	1.682086
SIZE	.0149249	.0053712	2.78	0.005	.0043975	.0254522
AG	.0499707	.0104698	4.77	0.000	.0294503	.070491
CAR	.0813366	.035265	2.31	0.021	.0122185	.1504547
EXP	-.2450961	.1916678	-1.28	0.201	-.6207581	.1305658
INF	-.148943	.0741621	-2.01	0.045	-.294298	-.003588
LGDP	.0428883	.0242526	1.77	0.077	-.0046458	.0904225
_cons	-.1419652	.0375916	-3.78	0.000	-.2156434	-.068287
sigma_u	.00324728					
sigma_e	.00722665					
rho	.16799318	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 9.46
Prob>chi2 = 0.4887
(V_b-V_B is not positive definite)

Model 3

Random-effects GLS regression — Number of obs = 150; Number of groups = 10
Group variable: BANK

R-sq: within = 0.4190; between = 0.7975; overall = 0.4867
Obs per group: min = 15; avg = 15.0; max = 15

Wald chi2(10) = 120.85; Prob > chi2 = 0.0000
corr(u_i, X) = 0 (assumed)

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.064594	.0124784	5.18	0.000	.0401368	.0890512
SHNIIFDC	.0103685	.0382978	0.27	0.787	-.0646938	.0854308
NIM	1.162593	.2299002	5.06	0.000	.7119966	1.613189
SIZE	.0118567	.0042271	2.80	0.005	.0035718	.0201416
AG	.0459256	.0105367	4.36	0.000	.025274	.0665772
CAR	.0971762	.0293121	3.32	0.001	.0397255	.1546269
EXP	-.2785582	.1526705	-1.82	0.068	-.5777868	.0206704
INF	-.0974047	.0737217	-1.32	0.186	-.2418966	.0470873
LGDP	.0400167	.0237924	1.68	0.093	-.0066156	.086649
FDC	-.0040382	.0206457	-0.20	0.845	-.044503	.0364266
_cons	-.13045	.031004	-4.21	0.000	-.1912168	-.0696832
sigma_u	.00141464					
sigma_e	.00736539					
rho	.03557695	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 13.76
Prob>chi2 = 0.1842
(V_b-V_B is not positive definite)

Model 4

Random-effects GLS regression — Number of obs = 150; Number of groups = 10
Group variable: BANK

R-sq: within = 0.4172; between = 0.8281; overall = 0.4887
Obs per group: min = 15; avg = 15.0; max = 15

Wald chi2(10) = 132.88; Prob > chi2 = 0.0000
corr(u_i, X) = 0 (assumed)

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.0629417	.0116162	5.42	0.000	.0401743	.085709
SHNIIPC	.0123755	.0500146	0.25	0.805	-.0856514	.1104024
NIM	1.113827	.2162259	5.15	0.000	.6900325	1.537622
SIZE	.0101858	.0038402	2.65	0.008	.0026591	.0177124
AG	.0473128	.0102852	4.60	0.000	.0271541	.0674715
CAR	.102912	.0266173	3.87	0.000	.0507432	.1550809
EXP	-.2653702	.1353658	-1.96	0.050	-.5306823	-.0000581
INF	-.1090194	.0697562	-1.56	0.118	-.245739	.0277002
LGDP	.0333962	.0228726	1.46	0.144	-.0114333	.0782257
PC	-.0049659	.0264163	-0.19	0.851	-.056741	.0468091
_cons	-.1174878	.0288927	-4.07	0.000	-.1741165	-.0608591
sigma_u	0					
sigma_e	.00731427					
rho	0	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 11.04
Prob>chi2 = 0.1371

Model 5

```
R-sq:                                         Obs per group:
     within  = 0.4319                                 min =        15
     between = 0.7881                                 avg =      15.0
     overall = 0.4927                                 max =        15

                                              Wald chi2(9)      =    120.65
corr(u_i, X)   = 0 (assumed)                  Prob > chi2       =    0.0000
```

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.0637916	.0127034	5.02	0.000	.0388934	.0886898
SHNIIHC	-.2196982	.2402	-0.91	0.360	-.6904816	.2510852
NIM	1.189315	.2341845	5.08	0.000	.7303216	1.648308
SIZE	.0114979	.0039075	2.94	0.003	.0038392	.0191565
AG	.0461963	.0101282	4.56	0.000	.0263453	.0660473
CAR	.0972903	.0305931	3.18	0.001	.0373289	.1572517
EXP	-.2971588	.1621161	-1.83	0.067	-.6149005	.0205828
INF	-.1189508	.0673636	-1.77	0.077	-.250981	.0130795
HC	.1070354	.1238723	0.86	0.388	-.1357499	.3498207
_cons	-.1253633	.0269679	-4.65	0.000	-.1782195	-.0725072
sigma_u	.00198935					
sigma_e	.00736307					
rho	.06803066	(fraction of variance due to u_i)				

```
Test:  Ho:  difference in coefficients not systematic

             chi2(9)  =  (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =          8.95
           Prob>chi2  =        0.4418
           (V_b-V_B is not positive definite)
```

Model 6

```
Random-effects GLS regression                 Number of obs     =        150
Group variable: BANK                          Number of groups  =         10

R-sq:                                         Obs per group:
     within  = 0.8634                                 min =        15
     between = 0.6153                                 avg =      15.0
     overall = 0.5795                                 max =        15

                                              Wald chi2(8)      =    854.66
corr(u_i, X)   = 0 (assumed)                  Prob > chi2       =    0.0000
```

Zscore	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.2541956	.040888	6.22	0.000	.1740566	.3343347
NIM	3.97764	.6426761	6.19	0.000	2.718018	5.237262
SIZE	-.0392305	.0168918	-2.32	0.020	-.0723378	-.0061233
AG	.0074049	.0240558	0.31	0.758	-.0397436	.0545534
CAR	1.753105	.087768	19.97	0.000	1.581083	1.925127
EXP	.196214	.5687222	0.35	0.730	-.918461	1.310889
INF	-.0971728	.1697208	-0.57	0.567	-.4298194	.2354738
LGDP	-.0005869	.0554574	-0.01	0.992	-.1092814	.1081077
_cons	.1209024	.113018	1.07	0.285	-.1006089	.3424136
sigma_u	.13981462					
sigma_e	.01595468					
rho	.98714559	(fraction of variance due to u_i)				

```
             chi2(6)  =  (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =          3.57
           Prob>chi2  =        0.7348
           (V_b-V_B is not positive definite)
```

Model 7

```
R-sq:                                         Obs per group:
     within  = 0.8692                                 min =        15
     between = 0.6142                                 avg =      15.0
     overall = 0.5845                                 max =        15

                                              F(10,130)         =     86.39
corr(u_i, Xb)  = 0.4558                       Prob > F          =    0.0000
```

Zscore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
COM	.3605019	.0706405	5.10	0.000	.2207482	.5002557
SHORT	.2594791	.0408465	6.35	0.000	.1786691	.340289
LONG	.3150728	.055542	5.67	0.000	.2051895	.4249561
NIM	4.49074	.6839882	6.57	0.000	3.137551	5.843929
SIZE	-.0479207	.0179712	-2.67	0.009	-.0834745	-.0123669
AG	.0011126	.0242921	0.05	0.964	-.0469463	.0491715
CAR	1.739058	.0874687	19.88	0.000	1.566011	1.912104
EXP	-.1627427	.593833	-0.27	0.784	-1.33757	1.012085
INF	-.1336555	.1713591	-0.78	0.437	-.472669	.205358
LGDP	.0088217	.0565297	0.16	0.876	-.1030155	.1206588
_cons	.1471435	.1135728	1.30	0.197	-.0775467	.3718337
sigma_u	.11776807					
sigma_e	.01573304					
rho	.98246573	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(9, 130) = 453.04                     Prob > F = 0.0000

Test:  Ho:  difference in coefficients not systematic

             chi2(8)  =  (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =         62.98
           Prob>chi2  =        0.0000
           (V_b-V_B is not positive definite)
```

Model 8

```
Random-effects GLS regression                 Number of obs     =        150
Group variable: BANK                          Number of groups  =         10

R-sq:                                         Obs per group:
     within  = 0.8648                                 min =        15
     between = 0.6147                                 avg =      15.0
     overall = 0.5782                                 max =        15

                                              Wald chi2(10)     =    856.98
corr(u_i, X)   = 0 (assumed)                  Prob > chi2       =    0.0000
```

Zscore	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.2452192	.0416235	5.89	0.000	.1636386	.3267999
SHNIIFDC	.0944721	.0851744	1.11	0.267	-.0724666	.2614109
NIM	3.822675	.6601615	5.79	0.000	2.528782	5.116568
SIZE	-.0401085	.0170063	-2.36	0.018	-.0734402	-.0067769
AG	.0118301	.0243271	0.49	0.627	-.0358502	.0595105
CAR	1.752276	.0878765	19.94	0.000	1.580042	1.924511
EXP	.2376175	.5744699	0.41	0.679	-.8883228	1.363558
INF	-.1064898	.1750873	-0.61	0.543	-.4496546	.236675
LGDP	-.0140501	.0577825	-0.24	0.808	-.1273016	.0992015
FDC	-.0523323	.0459354	-1.14	0.255	-.142364	.0376994
_cons	.1346032	.1165958	1.15	0.248	-.0939203	.3631267
sigma_u	.1505012					
sigma_e	.01599269					
rho	.98883429	(fraction of variance due to u_i)				

```
Test:  Ho:  difference in coefficients not systematic

             chi2(7)  =  (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =          3.73
           Prob>chi2  =        0.8108
           (V_b-V_B is not positive definite)
```

```
Random-effects GLS regression                   Number of obs      =       150
Group variable: BANK                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.8725                                         min =        15
     between = 0.6206                                         avg =      15.0
     overall = 0.5801                                         max =        15

                                                Wald chi2(10)      =    922.63
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

Zscore	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.2247383	.0410236	5.48	0.000	.1443335	.305143
SHNIIPC	.2532919	.1076253	2.35	0.019	.0423501	.4642337
NIM	3.454536	.6586924	5.24	0.000	2.163523	4.745549
SIZE	-.041583	.0165417	-2.51	0.012	-.0740041	-.0091619
AG	.0025238	.0237753	0.11	0.915	-.0440749	.0491226
CAR	1.731899	.0850881	20.35	0.000	1.565129	1.898668
EXP	.1163659	.5567059	0.21	0.834	-.9747576	1.207489
INF	-.0184353	.1694753	-0.11	0.913	-.3506009	.3137302
LGDP	-.0258673	.0549003	-0.47	0.638	-.1334698	.0817353
PC	-.1411536	.0570207	-2.48	0.013	-.2529121	-.029395
_cons	.1650858	.1166624	1.42	0.157	-.0635683	.3937399
sigma_u	.16647139					
sigma_e	.01552998					
rho	.99137222	(fraction of variance due to u_i)				

```
Test:  Ho:  difference in coefficients not systematic

           chi2(7) =  (b-B)'[(V_b-V_B)^(-1)](b-B)
                   =          2.71
         Prob>chi2 =        0.9104
         (V_b-V_B is not positive definite)
```

```
Random-effects GLS regression                   Number of obs      =       150
Group variable: BANK                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.8790                                         min =        15
     between = 0.6322                                         avg =      15.0
     overall = 0.5977                                         max =        15

                                                Wald chi2(9)       =    858.60
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

Zscore	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.2804273	.041495	6.76	0.000	.1990986	.361756
SHNIIHC	.2777851	.0707463	3.93	0.000	.1391248	.4164453
NIM	4.494748	.6692556	6.72	0.000	3.183031	5.806465
SIZE	-.0450043	.0140337	-3.21	0.001	-.0725098	-.0174989
AG	.003203	.0242155	0.13	0.895	-.0442586	.0506646
CAR	1.748546	.0889496	19.66	0.000	1.574208	1.922884
EXP	-.3008592	.5802008	-0.52	0.604	-1.438032	.8363134
INF	-.1027447	.1603176	-0.64	0.522	-.4169614	.211472
HC	-.1256115	.0331072	-3.79	0.000	-.1905004	-.0607226
_cons	.1468248	.0878907	1.67	0.095	-.0254379	.3190874
sigma_u	.06618839					
sigma_e	.01506864					
rho	.95072362	(fraction of variance due to u_i)				

```
Test:  Ho:  difference in coefficients not systematic

           chi2(7) =  (b-B)'[(V_b-V_B)^(-1)](b-B)
                   =         10.44
         Prob>chi2 =        0.1649
         (V_b-V_B is not positive definite)
```

Appendix 8: regression related to crisis period versus non-crisis period

Crisis period

```
Random-effects GLS regression                   Number of obs      =        60
Group variable: BANK                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.5092                                         min =         6
     between = 0.8977                                         avg =       6.0
     overall = 0.7038                                         max =         6

                                                Wald chi2(8)       =     92.40
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.0488641	.0133489	3.66	0.000	.0227007	.0750274
NIM	.9306875	.2449999	3.80	0.000	.4504965	1.410878
SIZE	.0039451	.0055651	0.71	0.478	-.0069623	.0148524
AG	.0324915	.0101391	3.20	0.001	.0126193	.0523637
CAR	.1043228	.0268646	3.88	0.000	.0516692	.1569764
EXP	-.3900183	.1526989	-2.55	0.011	-.6893027	-.090734
INF	-.1085122	.0746665	-1.45	0.146	-.2548559	.0378315
LGDP	.0358512	.0213784	1.68	0.094	-.0060497	.0777522
_cons	-.0603893	.0418808	-1.44	0.149	-.1424741	.0216956
sigma_u	.0015021					
sigma_e	.0039206					
rho	.12800005	(fraction of variance due to u_i)				

```
Fixed-effects (within) regression               Number of obs      =        60
Group variable: BANK                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.8911                                         min =         6
     between = 0.5104                                         avg =       6.0
     overall = 0.5109                                         max =         6

                                                F(8,42)            =     42.97
corr(u_i, Xb)  = 0.3389                         Prob > F           =    0.0000
```

Zscore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.2441908	.0835538	2.92	0.006	.0755725	.4128091
NIM	2.905863	1.235815	2.35	0.023	.4118879	5.399837
SIZE	-.0394279	.0289186	-1.36	0.180	-.0977879	.0189322
AG	-.0128517	.0493023	-0.26	0.796	-.1123478	.0866444
CAR	1.744315	.2194817	7.95	0.000	1.301383	2.187247
EXP	1.753309	1.316525	1.33	0.190	-.9035451	4.410163
INF	-.0609793	.3015081	-0.20	0.841	-.6694472	.5474886
lGDP	1.133193	.6408881	1.77	0.084	-.1601714	2.426558
_cons	.1081507	.1866567	0.58	0.565	-.2685377	.4848391
sigma_u	.11979702					
sigma_e	.01675654					
rho	.98081059	(fraction of variance due to u_i)				

Non-crisis period

```
Random-effects GLS regression                   Number of obs      =        90
Group variable: BANK                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.3980                                         min =         9
     between = 0.6358                                         avg =       9.0
     overall = 0.4316                                         max =         9

                                                Wald chi2(8)       =     58.54
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.0648968	.0209474	3.10	0.002	.0238407	.105953
NIM	1.254498	.3628019	3.46	0.001	.5434189	1.965576
SIZE	.0109798	.0069944	1.57	0.116	-.0027289	.0246885
AG	.0502659	.0162114	3.10	0.002	.0184921	.0820396
CAR	.0862682	.0491445	1.76	0.079	-.0100533	.1825896
EXP	-.2685662	.2433843	-1.10	0.270	-.7455907	.2084583
INF	-.1410286	.1023415	-1.38	0.168	-.3416142	.059557
LGDP	-.0322865	.0845618	-0.38	0.703	-.1980246	.1334516
_cons	-.1223434	.0537314	-2.28	0.023	-.2276551	-.0170317
sigma_u	.00219896					
sigma_e	.00871556					
rho	.05984687	(fraction of variance due to u_i)				

```
Fixed-effects (within) regression               Number of obs      =        90
Group variable: BANK                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.8542                                         min =         9
     between = 0.6560                                         avg =       9.0
     overall = 0.6076                                         max =         9

                                                F(8,72)            =     52.71
corr(u_i, Xb)  = 0.5224                         Prob > F           =    0.0000
```

Zscore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.2003786	.0577543	3.47	0.001	.0852475	.3155096
NIM	3.442145	.9565645	3.60	0.001	1.535269	5.349022
SIZE	-.0349286	.0178707	-1.95	0.055	-.0705531	.000696
AG	.0002961	.0344339	0.01	0.993	-.0683466	.0689387
CAR	1.6626	.1209948	13.74	0.000	1.421402	1.903799
EXP	.0003505	.7682507	0.00	1.000	-1.531129	1.53183
INF	-.0274148	.2050313	-0.13	0.894	-.4361372	.3813077
lGDP	.2357133	.2107315	1.12	0.267	-.1843723	.6557989
_cons	.1382861	.1122058	1.23	0.222	-.085392	.3619642
sigma_u	.12021053					
sigma_e	.01561921					
rho	.98339793	(fraction of variance due to u_i)				

Appendix 9: Robustness test alternative measures for bank performance and risk

Crisis period

Random-effects GLS regression
Group variable: **BANK**

R-sq:
within = **0.3049**
between = **0.7519**
overall = **0.3580**

corr(u_i, X) = **0** (assumed)

Number of obs = **60**
Number of groups = **10**

Obs per group:
min = **6**
avg = **6.0**
max = **6**

Wald chi2(**8**) = **28.43**
Prob > chi2 = **0.0004**

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	1.018579	.3866269	2.63	0.008	.2608044	1.776354
NIM	25.65227	7.358348	3.49	0.000	11.23017	40.07437
SIZE	-.0924734	.1506978	-0.61	0.539	-.3878357	.2028889
AG	-.1427789	.3273435	-0.44	0.663	-.7843603	.4988025
CAR	-3.547723	.7778857	-4.56	0.000	-5.072351	-2.023095
EXP	-18.10084	4.333959	-4.18	0.000	-26.59525	-9.606439
INF	-.6988308	2.423636	-0.29	0.773	-5.44907	4.051409
LGDP	.2759655	.6702949	0.41	0.681	-1.037788	1.589719
_cons	.4026083	1.160498	0.35	0.729	-1.871926	2.677143

sigma_u	0	
sigma_e	.15462276	
rho	0	(fraction of variance due to u_i)

Random-effects GLS regression
Group variable: **BANK**

R-sq:
within = **0.3495**
between = **0.1544**
overall = **0.2804**

corr(u_i, X) = **0** (assumed)

Number of obs = **90**
Number of groups = **10**

Obs per group:
min = **9**
avg = **9.0**
max = **9**

Wald chi2(**8**) = **36.27**
Prob > chi2 = **0.0000**

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	1.001818	.4491994	2.23	0.026	.1214037	1.882233
NIM	15.90778	7.770221	2.05	0.041	.6784249	31.13713
SIZE	.293612	.1521429	1.93	0.054	-.0045826	.5918066
AG	1.222402	.3329797	3.67	0.000	.5697734	1.87503
CAR	1.266908	1.06152	1.19	0.233	-.813632	3.347449
EXP	1.463715	5.345475	0.27	0.784	-9.013224	11.94065
INF	-2.729151	2.1008	-1.30	0.194	-6.846643	1.388342
LGDP	.2000746	1.759775	0.11	0.909	-3.24902	3.64917
_cons	-2.849359	1.149087	-2.48	0.013	-5.101529	-.5971897

sigma_u	.06222187	
sigma_e	.18147034	
rho	.10519674	(fraction of variance due to u_i)

Non-crisis period

Fixed-effects (within) regression
Group variable: **BANK**

R-sq:
within = **0.3718**
between = **0.2321**
overall = **0.0055**

corr(u_i, Xb) = **-0.7756**

Number of obs = **90**
Number of groups = **10**

Obs per group:
min = **9**
avg = **9.0**
max = **9**

F(**8,72**) = **5.33**
Prob > F = **0.0000**

NPl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	-.2668718	.112299	-2.38	0.020	-.4907357	-.0430079
NIM	-2.416211	1.838835	-1.31	0.193	-6.081863	1.24944
SIZE	.1331963	.0431144	3.09	0.003	.0472494	.2191432
AG	-.0206226	.060242	-0.34	0.733	-.1407128	.0994675
CAR	.7746289	.2323362	3.33	0.001	.3114752	1.237783
EXP	4.526652	5.186669	0.87	0.386	-5.812785	14.86609
INF	.0408218	.4221015	0.10	0.923	-.8006222	.8822659
LGDP	1.403239	.3620186	3.88	0.000	.6815677	2.12491
_cons	-.8824574	.2721751	-3.24	0.002	-1.425028	-.3398863

sigma_u	.06433294	
sigma_e	.0306834	
rho	.81467827	(fraction of variance due to u_i)

F test that all u_i=0: F(**9, 72**) = **9.10** Prob > F = **0.0000**

Fixed-effects (within) regression
Group variable: **BANK**

R-sq:
within = **0.6730**
between = **0.3637**
overall = **0.0104**

corr(u_i, Xb) = **-0.8891**

Number of obs = **60**
Number of groups = **10**

Obs per group:
min = **6**
avg = **6.0**
max = **6**

F(**8,42**) = **10.80**
Prob > F = **0.0000**

NPl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	-.362828	.1011403	-3.59	0.001	-.5669373	-.1587187
NIM	-4.188934	1.588529	-2.64	0.012	-7.394716	-.9831519
SIZE	.285164	.0883019	3.23	0.002	.1069636	.4633645
AG	-.0723605	.0549475	-1.32	0.195	-.183249	.038528
CAR	.7824905	.2219298	3.53	0.001	.334618	1.230363
EXP	-2.690047	3.692514	-0.73	0.470	-10.14184	4.761747
INF	-2.674216	.7149035	-3.74	0.001	-4.11695	-1.231483
LGDP	.7670469	.2077636	3.69	0.001	.3477629	1.186331
_cons	-1.672224	.5829342	-2.87	0.006	-2.848633	-.4958152

sigma_u	.07490912	
sigma_e	.0193556	
rho	.93741427	(fraction of variance due to u_i)

F test that all u_i=0: F(**9, 42**) = **7.14** Prob > F = **0.0000**

Regressions related to ROE

Random-effects GLS regression
Group variable: **BANK**

R-sq:
within = **0.1904**
between = **0.2214**
overall = **0.1566**

corr(u_i, X) = **0** (assumed)

Number of obs = **150**
Number of groups = **10**

Obs per group:
min = **15**
avg = **15.0**
max = **15**

Wald chi2(**8**) = **26.22**
Prob > chi2 = **0.0010**

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.9102684	.2788073	3.26	0.001	.3638162	1.456721
NIM	17.6758	5.184686	3.41	0.001	7.514006	27.8376
SIZE	.1236235	.0927828	1.33	0.183	-.0582275	.3054744
AG	.6400892	.2495322	2.57	0.010	.1510151	1.129163
CAR	-1.02107	.6536759	-1.56	0.118	-2.302251	.2601108
EXP	-6.958254	3.340695	-2.08	0.037	-13.5059	-.4106118
INF	-.5684061	1.691097	-0.34	0.737	-3.882896	2.746083
LGDP	.1380507	.5550167	0.25	0.804	-.949762	1.225863
_cons	-1.35811	.6856779	-1.98	0.048	-2.702014	-.0142064

sigma_u	.0048647	
sigma_e	.18556994	
rho	.00068675	(fraction of variance due to u_i)

Random-effects GLS regression
Group variable: **BANK**

R-sq:
within = **0.1988**
between = **0.2126**
overall = **0.1615**

corr(u_i, X) = **0** (assumed)

Number of obs = **150**
Number of groups = **10**

Obs per group:
min = **15**
avg = **15.0**
max = **15**

Wald chi2(**10**) = **28.52**
Prob > chi2 = **0.0015**

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	1.020653	.3075457	3.32	0.001	.4178744	1.623431
SHNIIFDC	.2122178	.9500094	0.22	0.823	-1.649767	2.074202
NIM	20.20946	5.671868	3.56	0.000	9.092805	31.32612
SIZE	.1582001	.1040187	1.52	0.128	-.0456728	.3620729
AG	.6476225	.2614404	2.48	0.013	.1352086	1.160036
CAR	-1.229981	.7220777	-1.70	0.088	-2.645227	.1852654
EXP	-7.860415	3.753181	-2.09	0.036	-15.21652	-.5043145
INF	-.2845595	1.828742	-0.16	0.876	-3.868828	3.299709
LGDP	.3202944	.5898623	0.54	0.587	-.8358145	1.476403
FDC	-.0716684	.5121316	-0.14	0.889	-1.075428	.932091
_cons	-1.691611	.7646064	-2.21	0.027	-3.190212	-.1930105

sigma_u	.03392842	
sigma_e	.18616258	
rho	.03214782	(fraction of variance due to u_i)

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 10.10
Prob>chi2 = 0.1205
(V_b-V_B is not positive definite)

Test: Ho: difference in coefficients not systematic

chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 7.76
Prob>chi2 = 0.6522
(V_b-V_B is not positive definite)

Random-effects GLS regression
Group variable: BANK

R-sq:
within = 0.2262
between = 0.2250
overall = 0.1776

corr(u_i, X) = 0 (assumed)

Number of obs = 150
Number of groups = 10

Obs per group:
min = 15
avg = 15.0
max = 15

Wald chi2(10) = 32.30
Prob > chi2 = 0.0004

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	1.139607	.3095656	3.68	0.000	.5328694	1.746344
SHNIIPC	.3652453	1.235679	0.30	0.768	-2.056641	2.787132
NIM	22.27708	5.713667	3.90	0.000	11.0785	33.47567
SIZE	.1916801	.1038491	1.85	0.065	-.0118603	.3952205
AG	.7304254	.2540385	2.88	0.004	.232519	1.228332
CAR	-1.11361	.7154815	-1.56	0.120	-2.515928	.2887078
EXP	-7.695981	3.705105	-2.08	0.038	-14.95785	-.4341085
INF	-1.567758	1.737852	-0.90	0.367	-4.973887	1.83837
LGDP	.4140197	.568981	0.73	0.467	-.7011626	1.529202
PC	-.1108825	.6530391	-0.17	0.865	-1.390816	1.169051
_cons	-1.988485	.7652488	-2.60	0.009	-3.488345	-.4886245
sigma_u	.03300084					
sigma_e	.18305958					
rho	.03147571	(fraction of variance due to u_i)				

Random-effects GLS regression
Group variable: BANK

R-sq:
within = 0.1981
between = 0.2266
overall = 0.1623

corr(u_i, X) = 0 (assumed)

Number of obs = 150
Number of groups = 10

Obs per group:
min = 15
avg = 15.0
max = 15

Wald chi2(9) = 27.13
Prob > chi2 = 0.0013

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	.9259669	.2725848	3.40	0.001	.3917105	1.460223
SHNIIHC	-.4535431	5.990271	-0.08	0.940	-12.19426	11.28717
NIM	18.27554	5.144738	3.55	0.000	8.192038	28.35904
SIZE	.1377431	.083323	1.65	0.098	-.025567	.3010531
AG	.6028081	.249269	2.42	0.016	.1142499	1.091366
CAR	-.9782976	.6511474	-1.50	0.133	-2.254523	.2979278
EXP	-6.920321	3.32714	-2.08	0.038	-13.44139	-.3992471
INF	-.6164782	1.66271	-0.37	0.711	-3.875329	2.642373
HC	.1648296	3.089916	0.05	0.957	-5.891295	6.220954
_cons	-1.466524	.6029802	-2.43	0.015	-2.648343	-.2847042
sigma_u	0					
sigma_e	.18569093					
rho	0	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 10.47
Prob>chi2 = 0.4005
(V_b-V_B is not positive definite)

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 11.81
Prob>chi2 = 0.1070
(V_b-V_B is not positive definite)

Related to NPL

. **xtreg NPL SHNII NIM SIZE AG CAR EXP INF LGDP, re**

Random-effects GLS regression
Group variable: BANK

R-sq:
within = 0.3175
between = 0.0152
overall = 0.1164

corr(u_i, X) = 0 (assumed)

Number of obs = 150
Number of groups = 10

Obs per group:
min = 15
avg = 15.0
max = 15

Wald chi2(8) = 56.92
Prob > chi2 = 0.0000

NPL	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	-.2892648	.1544703	-1.87	0.061	-.5920209	.0134913
NIM	-7.839018	2.571021	-3.05	0.002	-12.87813	-2.799908
SIZE	-.1213801	.0603164	-2.01	0.044	-.2395981	-.0031622
AG	-.134689	.0985225	-1.37	0.172	-.3277895	.0584115
CAR	-.5150363	.3496571	-1.47	0.141	-1.200352	.1702791
EXP	5.632703	2.11967	2.66	0.008	1.478225	9.787181
INF	.6803121	.6850348	0.99	0.321	-.6623315	2.022956
LGDP	-.0471701	.2241167	-0.21	0.833	-.4864308	.3920906
_cons	1.201844	.3852164	3.12	0.002	.4468338	1.956854
sigma_u	.06359714					
sigma_e	.06466047					
rho	.49170999	(fraction of variance due to u_i)				

Fixed-effects (within) regression
Group variable: BANK

R-sq:
within = 0.3984
between = 0.1103
overall = 0.0050

corr(u_i, Xb) = -0.6573

Number of obs = 150
Number of groups = 10

Obs per group:
min = 15
avg = 15.0
max = 15

F(10,130) = 8.61
Prob > F = 0.0000

NPL	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
COM	.0821819	.2789378	0.29	0.769	-.4696632	.634027
SHORT	-.0221716	.1612906	-0.14	0.891	-.3412657	.2969225
LONG	.4827761	.2193187	2.20	0.029	.0488803	.916672
NIM	-4.989361	2.700862	-1.85	0.067	-10.33269	.3539724
SIZE	-.3134834	.0709627	-4.42	0.000	-.4538746	-.1730922
AG	-.1478656	.0959219	-1.54	0.126	-.3376357	.0419045
CAR	-.5177777	.3453874	-1.50	0.136	-1.201085	.1655299
EXP	4.799879	2.344867	2.05	0.043	.1608407	9.438917
INF	.7848237	.6766453	1.16	0.248	-.553838	2.123485
LGDP	-.0861451	.2232185	-0.39	0.700	-.5277561	.355466
_cons	2.252437	.4484646	5.02	0.000	1.365204	3.139671
sigma_u	.12002809					
sigma_e	.06212501					
rho	.78870785	(fraction of variance due to u_i)				

F test that all u_i=0: F(9, 130) = 12.19 Prob > F = 0.0000

Test: Ho: difference in coefficients not systematic

chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 10.47
Prob>chi2 = 0.4005
(V_b-V_B is not positive definite)

B = inconsistent under Ha, efficient under Ho; obtained

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 34.08
Prob>chi2 = 0.0000

Random-effects GLS regression — Number of obs = 150
Group variable: **BANK** — Number of groups = 10

R-sq: — Obs per group:
within = 0.4242 — min = 15
between = 0.0003 — avg = 15.0
overall = 0.1189 — max = 15

Wald chi2(10) = 91.41
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

NPL	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	-.3462118	.1571312	-2.20	0.028	-.6541833	-.0382403
SHNIIFDC	.1036509	.1107747	0.94	0.349	-.1134634	.3207653
NIM	-9.786765	2.498921	-3.92	0.000	-14.68456	-4.888971
SIZE	-.1760328	.0603699	-2.92	0.004	-.2943556	-.0577099
AG	-.0775912	.0916849	-0.85	0.397	-.2572903	.1021078
CAR	-.3988575	.329309	-1.21	0.226	-1.044291	.2465762
EXP	5.795808	2.096666	2.76	0.006	1.686417	9.905199
INF	.0274943	.6604138	0.04	0.967	-1.266893	1.321882
LGDP	-.3471956	.2163764	-1.60	0.109	-.7712856	.0768944
FDC	-.116296	.0519931	-2.24	0.025	-.2182005	-.0143914
_cons	1.676492	.3836978	4.37	0.000	.9244582	2.428526
sigma_u	.07898273					
sigma_e	.06031842					
rho	.63162245	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 11.44
Prob>chi2 = 0.1205
(V_b-V_B is not positive definite)

Random-effects GLS regression — Number of obs = 150
Group variable: **BANK** — Number of groups = 10

R-sq: — Obs per group:
within = 0.3962 — min = 15
between = 0.0298 — avg = 15.0
overall = 0.1646 — max = 15

Wald chi2(10) = 81.53
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

NPL	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	-.3487908	.1520339	-2.29	0.022	-.6467718	-.0508098
SHNIIPC	-.0942996	.0325212	-2.90	0.004	-.1580399	-.0305592
NIM	-10.47757	2.55885	-4.09	0.000	-15.49283	-5.462318
SIZE	-.1374656	.064153	-2.14	0.032	-.263203	-.0117281
AG	-.1721882	.0944264	-1.82	0.068	-.3572605	.0128841
CAR	-.5292393	.3330595	-1.59	0.112	-1.182024	.1235453
EXP	5.24695	2.066714	2.54	0.011	1.196266	9.297635
INF	1.004913	.70471	1.43	0.154	-.3762931	2.386119
LGDP	.2963299	.3948347	0.75	0.453	-.4775319	1.070192
PC	.071637	.0439747	1.63	0.103	-.0145518	.1578257
_cons	1.395319	.4229451	3.30	0.001	.5663617	2.224276
sigma_u	.06845793					
sigma_e	.06158034					
rho	.55274142	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 12.18
Prob>chi2 = 0.0949
(V_b-V_B is not positive definite)

Random-effects GLS regression — Number of obs = 150
Group variable: **BANK** — Number of groups = 10

R-sq: — Obs per group:
within = 0.3486 — min = 15
between = 0.0002 — avg = 15.0
overall = 0.0744 — max = 15

Wald chi2(9) = 64.63
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

NPL	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SHNII	-.2201233	.1565343	-1.41	0.160	-.5269249	.0866784
SHNIIHC	.0310719	.2856931	0.11	0.913	-.5288764	.5910201
NIM	-7.915941	2.617854	-3.02	0.002	-13.04684	-2.785041
SIZE	-.1682703	.0516507	-3.26	0.001	-.2695039	-.0670367
AG	-.1030742	.0961475	-1.07	0.284	-.2915199	.0853714
CAR	-.5574045	.3467223	-1.61	0.108	-1.236968	.1221587
EXP	5.824159	2.156147	2.70	0.007	1.598188	10.05013
INF	.908186	.6375816	1.42	0.154	-.341451	2.157823
HC	.0345644	.1338	0.26	0.796	-.2276788	.2968075
_cons	1.46827	.3203309	4.58	0.000	.8404334	2.096107
sigma_u	.07679932					
sigma_e	.06385825					
rho	.59123181	(fraction of variance due to u_i)				

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 2.88
Prob>chi2 = 0.9688
(V_b-V_B is not positive definite)

Appendix 10: Robustness check : Chow test

```
reg ROA SHNII SHNIIFDC FDC
```

Source	SS	df	MS	Number of obs	=	160
				F(3, 156)	=	0.20
Model	.00006142	3	.000020473	Prob > F	=	0.8986
Residual	.016245526	156	.000104138	R-squared	=	0.0038
				Adj R-squared	=	-0.0154
Total	.016306946	159	.000102559	Root MSE	=	.0102

ROA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.0041711	.0072718	0.57	0.567	-.0101927	.0185349
SHNIIFDC	.0006215	.0259485	0.02	0.981	-.0506343	.0518773
FDC	.0013385	.0120918	0.11	0.912	-.0225463	.0252234
_cons	.0075872	.0034243	2.22	0.028	.0008232	.0143511

```
test SHNIIFDC FDC

( 1)  SHNIIFDC = 0
( 2)  FDC = 0

       F(  2,    156) =    0.12
            Prob > F =    0.8888
```

```
. reg ROA SHNII SHNIIPC PC
```

Source	SS	df	MS	Number of obs	=	160
				F(3, 156)	=	0.24
Model	.000074665	3	.000024888	Prob > F	=	0.8689
Residual	.01623228	156	.000104053	R-squared	=	0.0046
				Adj R-squared	=	-0.0146
Total	.016306946	159	.000102559	Root MSE	=	.0102

ROA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.0041911	.0071723	0.58	0.560	-.0099763	.0183585
SHNIIPC	-.0006974	.030877	-0.02	0.982	-.0616884	.0602936
PC	-.0016885	.0144775	-0.12	0.907	-.0302857	.0269087
_cons	.0078045	.0033759	2.31	0.022	.001136	.0144729

```
. test SHNIIPC PC

 ( 1)  SHNIIPC = 0
 ( 2)  PC = 0

       F(  2,    156) =    0.18
            Prob > F =    0.8341
```

```
. reg Zscore SHNII SHNIIFDC FDC
```

Source	SS	df	MS	Number of obs	=	160
				F(3, 156)	=	0.82
Model	.06043542	3	.02014514	Prob > F	=	0.4869
Residual	3.85182649	156	.024691195	R-squared	=	0.0154
				Adj R-squared	=	-0.0035
Total	3.91226191	159	.024605421	Root MSE	=	.15713

Zscore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.1668578	.1094471	1.52	0.129	-.0493317	.3830474
SHNIIFDC	-.3153477	.752809	-0.42	0.676	-1.802362	1.171667
FDC	.1596197	.4038076	0.40	0.693	-.6380165	.9572558
_cons	.1516737	.0519554	2.92	0.004	.0490468	.2543007

```
. test SHNIIFDC FDC

 ( 1)  SHNIIFDC = 0
 ( 2)  FDC = 0

       F(  2,    156) =    0.13
            Prob > F =    0.8802
```

```
. reg Zscore SHNII SHNIIPC PC
```

Source	SS	df	MS	Number of obs	=	160
				F(3, 156)	=	1.17
Model	.086004463	3	.028668154	Prob > F	=	0.3235
Residual	3.82625745	156	.024527291	R-squared	=	0.0220
				Adj R-squared	=	0.0032
Total	3.91226191	159	.024605421	Root MSE	=	.15661

Zscore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SHNII	.162381	.1084187	1.50	0.136	-.051777	.3765391
SHNIIPC	-.1040635	1.000382	-0.10	0.917	-2.080105	1.871978
PC	.0189349	.5291991	0.04	0.972	-1.026385	1.064255
_cons	.1587945	.0512544	3.10	0.002	.0575523	.2600368

```
. test SHNIIPC PC

 ( 1)  SHNIIPC = 0
 ( 2)  PC = 0

       F(  2,    156) =    0.65
            Prob > F =    0.5235
```

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