The impact of interest rates rising on Bank performance

MAHJOUB Amine
Encadré par : Dorra Hmaied

Introduction

Banks are the most financial institutions involved in financing the economy, especially in developing countries. Therefore, the existence of a banking system is a crucial pillar for the economic development.

Hence, the traditional activity of a bank is the intermediation between the various economic agents, which consists in mobilizing the funds collected in the form of deposits and reinvesting them to grant loans that help stimulate economic growth in the country. However, the intermediation activity introduces the risk concept in which the interest rate risk is very significant. The latter, is defined as the current or prospective risk to a bank's capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book.

Interest rates in the recent years have become a very sensitive factor in the operation of commercial banks. The central bank of Tunisia has used it as a tool to control the inflation levels and also to manage the foreign exchange rates to acquire stability in the economy. With these happenings the commercial banks have had to contend with periods of high interest rates which have affected the banks differently as different banks react differently to the impact of interest rate changes.

In this vein, the bank must be sufficiently solid and stable. To ensure its stability, the bank must be profitable and able to generate profits and develop further in order to face unexpected financial crises and avoid bankruptcy. The importance of these two key concepts, namely profitability and interest rate risk, has been studied in the literature with the aim of determining of the relationship between the interest rate risk and the stability of the bank and the whole banking sector.

Moreover, the main encouragement in interest rate risk study resides in the severity and magnitude of the latter which could cause harmful effect on banks as well as the speed of its spread that have just highlighted many questions and concerns about the relation between the interest rate changes and bank profitability that is why governments and Monetary authorities have to take into consideration this relation and understand its mechanisms in order to take decisions that could reduce the damages. In addition to that, the adoption of the IFRS standards will have a harmful effect on the income statement volatility in which the IFRS 9 raises the risk that more assets will have to be measured at fair value with changes in fair value recognized in profit and loss as they arise.

Hence, Bank profitability is the bank's ability to generate sufficient profits to be able to continue and develop its activities. It reflects the bank's financial health. Improving profitability remains the primary concern of the bank's shareholders and managers and too achieve this, it is essential to take into account the internal and external factors that can influence it. In this context, the interest rate risk management can be an important determinant of bank profitability.

The literature based on the relationship between liquidity and bank performance is quite ambiguous. Some studies have shown that liquidity has a positive impact on banking performance, while others have argued the opposite. In addition, some researchers argue that the nature of the relationship between liquidity and bank profitability varies depending on the banking sector studied, the economic situation in the country, the size of the banks studied, the degree of risk exposure, the profitability and liquidity measures used.

Then, the number of works concerning the contagion phenomenon give a description of the importance of the latter and the effects which can emerged and affected the whole economy. The economists and researchers did not agree on one result. The first group outlines that there is a negative effect of the interest rate on the performance such as **Flannery and James (1984)**, which were the pioneers and they addressed how the performance of commercial banks is affected by the varying of market interest rates in a negative way. The second group shows a

positive relation between the interest rate and bank profitability such as **Pérez Montes and Ferrer Pérez (2018)** which they found a non-linear relation between interest rates and net interest income: positive relationship at low levels of interest rates. The final group presents a non-significant relation as indicated by **Aloui and Jarboui (2019)** in their article in which the interest rate does not present a significant impact on the bank return.

The research field concerning the market risk is still of increasing interest mainly due to the fact that there is always modification in the interest rate by the central banks in order to reach their objective and to stabilize the economy. In this context, our thesis opts to test and empirically verify the impact of the interest rate fluctuations on bank performance and to reach this objective we tend to use a panel estimation to test the significance of the interest rate risk on banks through a different variables and also testing the change of interest rate and its impact on the net interest income of the BH Bank through the adoption of the ARDL Model (

Hence, our thesis is therefore articulated around the following question:

What is the impact of interest rate fluctuations on bank performance?

The ultimate objective of our work is to study the impact of interest rate level on bank profitability. To do this, and after defining the two key concepts, namely profitability and interest rate risk, we present an empirical review on this subject and conclude with an empirical validation of this relationship by referring to the Tunisian context.

The structure of this thesis is as follows; **Chapter 1**: Theoretical Framework which contains 3 sections. **Section 1**: a brief presentation of interest rate risk in which we show its sources and its effects. **Section 2**: presents a literature review concerning the different theory of interest. **Section 3**: is dedicated to present the literature review concerning the relationship between interest rate risk and bank performance. Then, the **Chapter 2**: Empirical Framework which contains 4 sections. **Section 1** is dedicated for the empirical methodology; **Section 2** presents a brief description of the evolution of interest rate in Tunisia. **Section 3** in which we outline the main findings concerning the impact of interest rate level on bank performance with an econometric study on panel data and finally **Section 4** which present the impact of interest rate level on BH bank performance through an ARDL Cointegration Method.

Chapter I: Theoretical Framework

Introduction

The banking sector in Tunisia plays an important role in the financial sector especially in the term of savings mobilization and providing credits facilities to many sectors of the economy. Hence, the interest rate is one of the key determinants of banks 'profitability in many economies and according to many authors, banks are exposed to adverse movements in interest rates because on average, rates on their long, fixed-term assets are locked in for longer than rates on their liabilities. When the general level of interest rates rises, banks typically experience a loss in economic value because the value of assets decreases more than the value of liabilities.

This first chapter present a brief discussion concerning the theoretical literature in which the first section outlines a short presentation about the interest rate risk concept, the second section explains the different theories of interest rate presented in the literature and finally, the third section in which we present an overview about the relationship between the interest rate risk and bank performance.

Section1: The presentation of interest rate risk

Banking activity is a risky business, given the functions that the bank provides such as granting credits, raises funds, financial engineering, etc. these activities present a range of risks which affect the financial performance and the stability of the bank.

In this section we will focus on the interest rate risk by presenting the definition of IRR, the different sources, the effect of interest rate risk and finally the link between the IRR and other risks.

I. The Concept of Interest Rate Risk (IRR)

1. The difference between Banking book and trading book

First of all, to understand the risks generated by movements in interest rates for a banking book and the regulators' motivation to introduce an appropriate capital charge, we should have an idea about the difference between a banking book and trading book of a bank.

In fact, the bank positions that are held for trading purposes are presented in the trading book, contrarily to the positions that are held to maturity belong in the banking book. In addition to that, the Basel Committee on Banking Supervision (BCBS, 2013b) presented in his paper the different risk measures for the two books in which the capital charge required for an asset in one book could be different compared to the same asset in the other book.

The interest rate risk in the trading book carries a capital charge because it's a subject of PillarI, contrary to the interest rate risk in the banking book which does not carry a regulatory charge (subject to Pillar II).

More precisely, the Basel Committee on Banking Supervision (BCBS) [1] tends first with the interest rate risk of the banking book to cope with the potential loss of economic value due to a change in the interest rates and credit spread risk in the banking book[2], so it's important to align capital charges for market risks to the different books especially with the new requirements for the capital treatments for trading book positions, such as the BCBS's Fundamental Review of the Trading Book (FRTB) (BCBS, 2016)[3], and the circular N° 2018-06 for Tunisian banks.

---

[1] Basel Committee on Banking Supervision, 2016. Standards: Interest rate risk in the banking book. Retrieved from http://www.bis.org/bcbs/publ/d368.htm

[2] European Banking Federation "Interest Rate Risk in the Banking Book (IRRBB) – Industry perspective".2014

[3] BCBS (2016). Minimum capital requirements for market risk.

2. Definition of the Interest Rate Risk

Banks play a role as intermediaries between lenders and borrowers and for pure competitive reasons they are obliged to accept funds of clients with different maturities that could have an impact on the balance sheet's structure due to an interest rate sensitive position.

In fact, the interest rate risk is considered as one of the most significant risks of a bank and they fail in employing short-term deposit to invest long-term fixed rate asset, or even short-term asset. Hence, the interest rate risk should be defined clearly.

In fact, there is several ways to define the IRR, that's why during this section we will present the main definitions which were mentioned in the literature.

According to Hellwig (1994)[4], Interest rate risk encompasses all risks that are directly or indirectly induced by uncertainty about future interest rates.

Francis and Wolf (1994)[5], focused on three definitions that are discussed frequently in the literature:

- First, the interest rate risk is defined as the percentage change in forecasted future earnings (or net interest income) with a 1% change in interest rates. This type of risk emerged from the mismatching in the maturity of assets and liabilities.
- The second definition used in the literature, consider the interest rate risk as the change in present value of net assets (or market value of portfolio equity) associated with a change in interest rates. This definition is essentially similar to the notion of "duration" of a bond.
- Finally, a third definition discussed in the literature consider the interest rate risk as the percentage change in market value of equity associated with a 1% change in interest rates.

Another definition, presented by Koch and MacDonald (2014)[6], give more precisions in which the interest rate risk is considered as the loss from unfavorable changes in interest rates on a bank's profitability and equity's market value.

[4] Hellwig, M. (1994). "Liquidity provision, banking, and the allocation of interest rate risk". In: European Economic Review 38.7, pp. 1363–1389.
[5] Francis, J. C., & Wolf, A. S. (Eds.). (1994). The handbook of interest rate risk management. Irwin.
[6] Koch and MacDonald (2014). Bank management. Nelson Education.

In this thesis we use the definition of interest rate risk in the banking book provided by the BCBS (2016). This definition resembles the previous definition, but stresses the direct effect of adverse fluctuations in the yield curve on earnings and capital. Interest rate risk in the banking book refers to the current or prospective risk to a bank's capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book.

II. Sources of interest rate risk

The literature that interest rate risk has an impact on the bank's income and economic value directly and indirectly in short-term and long-term periods. The IRR can be seen in multiple ways, such as, the mismatching between assets and liabilities maturity of a bank in which the risk emerged when the earned interests are lower than the interests.

Banks encounter interest rate risks as different forms that the Basel Committee on Banking Supervision (2004, 5-6) [7]are divided into four main types (see Figure1)

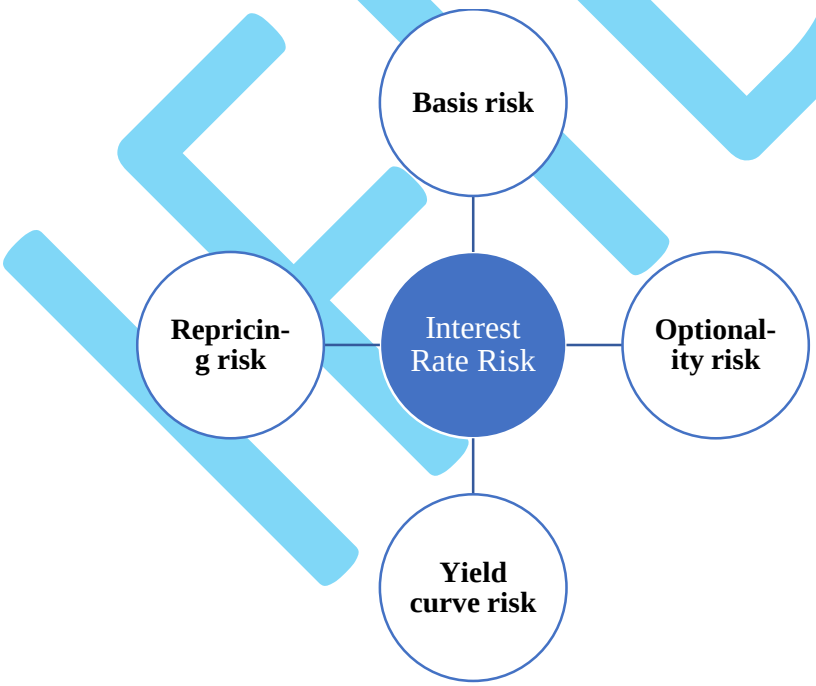

Figure 1: The forms of Interest Rate Risk (Basel Committee on Banking Supervision 2004)

1. Repricing Risk

[7] Basel Committee on Banking Supervision. 2004. Consultative Document: Principles for Management and Supervision of Interest Rate Risk. Bank for International Settlements.

According to the Basel Committee on banking Supervision[8], the Re-pricing risk presents a possibility of mismatching of assets and liabilities at different times (maturity) and rates (floating rate).

In fact, this risk can be seen in two different situations as we can see in the figure below:

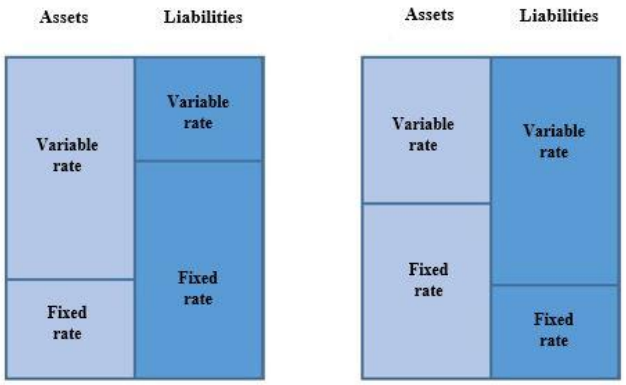

Figure 2: Structure of a Balance-sheet Source: « ALM Course » Bouguerra Ramzi 2019

The first situation is a discordance between assets and liabilities' volume indexed at variable rate. On one hand, if assets' volume indexed at variable rate is superior to liabilities' volume, the difference will be financed by resources at fixed rate and then, an interest rate decrease will affect the interest margin and so the bank result. On the other hand, in the inverse case in which assets' volume indexed at variable rate is inferior to liabilities' volume, an interest rate risen will minimize the interest margin of the bank and so will affect the bank performance.

The second situation, presents the possibility of a difference of maturities between assets and liabilities indexed at fixed rate. For example, a bank who finances a fixed-rate asset with a maturity of 2 years by a resource with a maturity of 1 year, hence an increase in interest rate will affect negatively the interest margin of the bank.

2. Yield curve risk

According to Basel Committee on Banking Supervision (2004, 5), the Yield Curve Risk is a result of changes in the slope and the shape of yield curve, which refers to the relationship between short-term and long-term interest rates gained by bank.

[8] Basel Committee on Banking Supervision 2004, 5.

In order to understand this concept, we take an example of a retail bank in which the demand deposits are placed at short-term rate $i_{C(ST)}$ and credits (granted at long -term rate $i_{D(MLT)}$) are financed by medium-term resources at the rate $i_{C(MLT)}$. So, we can express the bank's interest margin as follows:

Interest Margin = $i_{D(MLT)}$ + $i_{C(ST)}$-$i_{C(MLT)}$

Interest Margin = $i_{D(MLT)}$ -rate's spread (MLT&ST)

With:

$i_{D(MLT)}$: long-term lending rate

$i_{C(ST)}$: short-term credit rate

$i_{C(MLT)}$: long-term credit rate

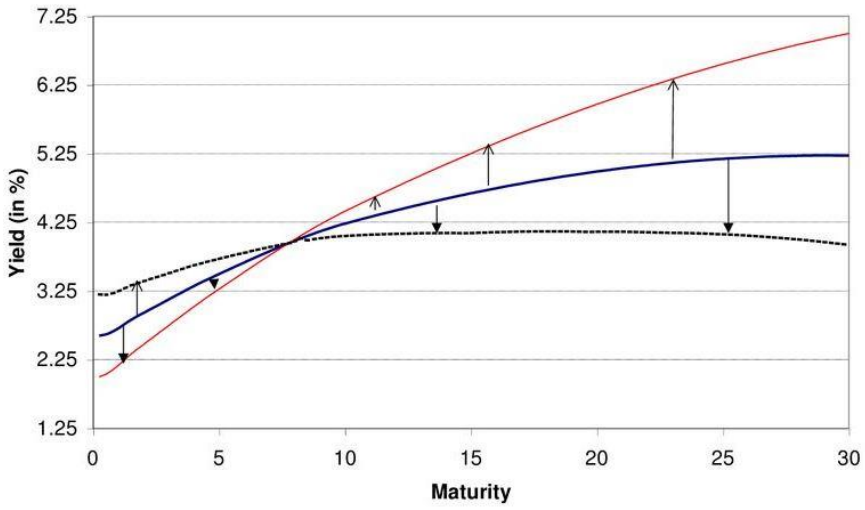

Figure 3 : The yield curve deformation

In fact, when the increase of the long-term rates is more important than the short-term rates (steepening of the yield curve), the rate's spread will increase and it will affect the bank result negatively by minimizing the interest margin.

3. Basis Risk

This source of interest rate risk emerged from an imperfect correlation in the adjustment of the rates earned and paid on different instruments with otherwise similar repricing characteristics.

When interest rates change, these differences can create the uncertainty about the interest margin of the bank.

Assets (Variable rate)	Liabilities (Variable rate)
Libor (6 Months)	Libor (3 Months)

To summarize, the basis risk is born when assets and liabilities maturities are equal but they are dependent on different basis, or also when they are indexed at the same variable rate but with different maturities.

In this case, in each rate's revision the bank will suffer from unexpected changes in revenues and expenses. More precisely, an unfavorable change in rates' level will affect negatively the interest margin and so the bank profitability.

Assets (Variable rate)	Liabilities (Variable rate)
Libor (6 Months)	Euribor (6 Months)

4. The Optionality Risk

The Optionality Risk, as its name, is the risk caused by options that are embedded in bank's assets and liabilities. Unless adequately managed implications, the products with optionality features can be a source for signification risk for the banks offering them. (Basel Committee on Banking Supervision 2004, 6.).

III. Effects of interest rate risk

The study of the different sources implied that the effect of IRR, as normal understanding, gives the impact earnings of commercial banks due to their nature of business based on investing, lending, and borrowing financial assets.

However, IRR also causes adverse effects to banks' economic value. As claimed by Basel Committee on Banking Supervision (2004), IRR not only impacts on banks' earnings, but also affects its economic value.

1. Effect on Interest Margin

Retail Banks search always to increase their earnings which are one of the main objectives of any institution and especially commercial bank. Also, we may say that earnings affect directly the Bank's financial stability and performance and an unpredictable interest rate fluctuation can threaten the capital adequacy and market confidence.

Normally, bank's earnings are regarded as the net interest income which is which is the difference between total interest income and total interest expense.

In fact, according to the Basel Committee on Banking Supervision (2004,6.), the net interest income shows the relationship with the interest rate as well as, impacts from the interest rate.

2. Effect on Bank's economic value

The bank's economic value is the worth of the bank as determined by the market. It is evaluated via the present value of current and future net cash flow which a bank actually has money in hand so that it can be invested and obtain its interest in return.

Thus, cash flow is sensitive to the fluctuation of market interest rate and this will affect the worth of bank.

In addition to that, the report of Basel Committee on Banking Supervision (2004, 6) mentioned that interest rate's changes and the present value of net cash flow have a long-term relationship of which the worth of bank is affected by interest rate in long-term period in comparison with the earning perspective where bank's earnings is in short-term impact.

IV. Interest rate risk and others risks

It is obvious that Interest rate risk characteristics and its management are linked to a number of other risks.

Interest rate risk may be presented as a contributory risk to other risks, and the effective management of interest rate risk can either aid or deter from the effective management of other financial risks.

1. Interest rate risk and credit risk

Banks may shift an important portion of their interest rate risk exposure to borrowers (i.e. hedge) by making a larger portion of their lending activities at a variable rate of interest.

If this method is presented, it is imperative that the selection of borrowers is conducted with the correct amount of due diligence, as the potential for borrowers to rescind or fail in terms of the agreed contract is increased.

In this scenario the bank has not reduced its interest rate exposure at, but has rather increased its exposure to credit risk.

2. Interest rate risk and liquidity Risk

There is a special affinity between the liquidity risk and the interest rate risk, or the liquidity risk is related to cash flow's due dates of the assets and liabilities, while the interest rate risk depends on their repricing period.

According to (Resti and Sironi 2007)[9], the link between these two risks in one of the principal functions of credit institutions which is the maturity transformation.

Generally, Banks opted to finance their investments by transmitting liabilities with a shorter maturity than that of their investments, so, we might say that this difference between assets and liabilities' terms means that they are under an interest risk and a liquidity risk.

Section 2: Interest rate: Theoretical framework

The literature has come up with many theories aimed at explaining the effect of interest rate variations on the financial performance of Commercial Banks. In this section, we will present some of these theories.

I. The Classical Theory of Interest

The explanation of interest rate by the classical theory began in 1776 and ended around 1870, which contrary to the neoclassical theory, believes saving and investments are equal.

According to this theory, the fundamental idea is that the economy is self-regulating and interest rate is the main factor that affects the amount of investments and the willingness for investors to save as well as ensuring that an equilibrium is maintained between the two.

[9] Resti, A, Sironi, S (2007), Risk Management and Shareholders' Value in Banking. From Risk Measurement Models to Capital Allocation Policies. Wiley, Oxford.

Moreover, in order to understand the theory, we might say that according to several classical economists, investment is seen as the demand while savings as the supply and so interest rate as the 'price' of the investible resources. When the resource's demand is equal to the supply, the price will be fixed. A situation whereby the investment and savings are equal at a certain rate is known as an equilibrium point (Milgate, 1977)[10]

To summarize, the importance of this theory in relation to our study lay in the role of interest rate fluctuation in which it can affect the equilibrium between investments and savings.

II. Loanable Funds Theory

This neo-classical theory of interest was presented by Robertson & Ohlin in the 1930s [11]in which the demand and supply of loanable funds are the main things what determines interest rates.

More precisely, according to Kohn (1981) [12]the demand for loanable funds is affected by three factors; investment, hoarding and dissaving.

In fact, the major portion of demand for loanable funds comes from the business firms to meet their investment expenditure. The business firms need funds to purchase raw materials, capital equipment or to build up inventories etc. so, investment demand for loanable funds depend on the level of interest rate; it increases with a decrease of interest rate and decreases with a rise in the rate of interest.

Moreover, Loanable funds are also demanded for hoarding purposes. Hoarding means keeping money in idle cash balances. People have a tendency to hold cash balances to satisfy their desire for liquidity. A higher rate of interest discourages people to hoard and a low rate of interest induces people to hoard.

Finally, another source of demand for loanable funds comes from dissaving, in other words, consuming more than the current income. People tend to borrow funds when they want to spend more than their current incomes. So, dissaving decreases when the level of interest rate is high and vice versa. (Conard (1959)).[13]

---

[10] Milgate, M. (1977). Keynes on the'classical'theory of interest. Cambridge Journal of Economics, 1(3), 307-315.
[11] Meade, J. E. (2013). A Neo-Classical Theory of Economic Growth (Routledge Revivals). Routledge.
[12] Kohn, M. (1981). A loanable funds theory of unemployment and monetary disequilibrium. The American Economic Review, 71(5), 859-879.
[13] Conard, J. W. (1959). An introduction to the theory of interest. Univ of California Press.

III. Keynes Liquidity Preference Theory

This theory is created by Keynes (1936)[14], who defined rate of interest as the 'price' for money. According to him, the demand for resources and the supply of money determines the level of interest rates.

Also, Keynes describes the liquidity preference theory in terms of three motives that determine the demand for liquidity.

First, the transactions motive mentions that people have a preference for liquidity in order to have sufficient cash on hand for basic needs. have a preference for liquidity in order to guarantee having sufficient cash on hand for basic day-to-day needs.

Second, the precautionary motive relates to an individual's preference for additional liquidity in the event that an unexpected problem or cost arises that requires a substantial outlay of cash.

Third, stakeholders may also have a speculative motive that refers to the desire to hold one's assets in liquid form in order to take advantages of market movements due to the future changes in interest rate.

Section 3: The relationship between interest rate risk and bank performance: literature review

The literature has confirmed, through the works of many authors, the effect of the interest rate on banks' performance. in this section, we will show this relationship by presenting first of all the determinants of profitability in the banking sector, then the factors that determine the level of interest rate and finally the different effects of interest rate risk on bank performance.

I. Determinants of Profitability in the Banking Sector

various internal and external factors can determine the financial performance of a bank. Internal factors are related to the bank's management decisions and objectives (Staikouras and wood, 2004)[15], and external factors are related to macroeconomic variables which are beyond the control of the bank.

1. Internal Determinants

[14] Keynes, J. M. (1936). The general theory of employment, interest and money (1936). Kessinger Publishing.
[15] Staikouras, C. K. & Wood, G. E. (2004). Determinants of European bank Profitability. International Business and Economic Research Journal, 3(6), 57 – 68.

According to Garoui et. al. (2013)[16], internal factors include, mainly, size, capitalization, liquidity, credit quality, efficiency and degree of diversification.

1.1 Size

Different researchers outlined different views about the size of a bank and its relation with the financial performance, or we can divide them into three classes.

In fact, there is firstly those who admit that size has a positive effect on the financial performance, secondly those who think that the effect is negative and finally, other researchers who believed that the size factor has no definitive impact on a bank's financial performance (Nassreddine, Sessi & Anis, 2013).[17]

More precisely, the first group suggest that a large bank has the ability to lower their cost due to economies of scale and also as Bikker & Hu (2002) stated that a large bank can increase capital at lower cost.

The second group, based their point of view on the lack of manageability in which a large bank has a problem to conduct its affair efficiently (Stiroh & Rumble, 2006)[18].

Finally, according to Panizza & Yanez (2007)[19] which represents the third view, there is no statistical impact of bank's size on profitability.

1.2 Capitalization

Capitalization is generally measured by the CAR ratio (capital to asset ratio). In fact, a high ratio indicates a lower risk, and then this led us to infer a lower profitability.

According to many authors who have treated the issue (Bourke (1989), Berger (1995)); the rise of this ratio may indicate that the share of the debt decreases and then lower earnings which will affect the bank's performance.

1.3 Liquidity

[16] Nassreddine, G., Fatma, S., & Anis, J. (2013). Determinants of banks performance: Viewing Test by Cognitive Mapping Technique: A case of biat. International review of management and business research, 2(1), 20.
[17] Nassreddine, G., & Sessi, F. (2013). Determinants of Banks Performance. Tunisia: Gabes University
[18] Stiroh, K. J., & Rumble, A. (2006). The dark side of diversification: The case of US financial holding companies. Journal of banking & finance, 30(8), 2131-2161.
[19] Micco, A., Panizza, U., & Yanez, M. (2007). Bank ownership and performance. Does politics matter? Journal of Banking & Finance, 31(1), 219-241.

Generally, the liquidity is measured by the ratio of loans to assets. Thus, the high level of the ratio conducts to a problem of liquidity in the bank.

In fact, Authors like Miller (1997), or Naceur et al (2011), mentioned that the ratio of loans to assets is a measure of credit risk, so a higher ratio will increase the risk of default. To remedy to this problem banks, opt for increasing their margins on interest on loans which will affect positively the net income margin and so the performance.

1.4 Credit quality

Credit quality, is usually measured by two ratios: the ratio of provisions for credit losses to total loans and the ratio of provisions for doubtful debts on total loans. (To be completely accurate, note that these ratios actually measure the quality of non-credit). Miller (1997), Athanasoglou et al. (2008) and Liu H. et al. (2010) mentioned that a negative result or performance is related to a deterioration of the credit quality. Hence, the impact on the NIM will be positive because banks will increase their margins in order to compensate the risk of default and also any other costs necessary to manage these credits.

1.5 Efficiency

The efficiency is one of performance's determinants and it measured by the ratio of costs or result by the ratio of overheads to total assets.

Athanasoglou et al. (2008) arrived to a conclusion in which 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 reduce its costs, which generates a better performance.

This result was confirmed by Liu et al. (2010), in their study on Japanese banks, in which they find that, no matter the variable used to measure the performance (return on assets (ROA),return on equity (ROE) or net interest margin (NIM)), the cost efficiency impact positively the result of a bank.

1.6 Degree of diversification

The degree of diversification is generally measured by the ratio of non-interest income related to loans on operating income. In fact, the relationship between the performance and the degree of diversification was a controversial issue in which it exists, on one hand, those who believes that there is a positive effect and on the other hand those who find that the effect is negative.

According to Dietrich and Wanzenried (2011), the degree of diversification has a positive effect on performance, but many other studies find the opposite result and point out that this movement towards non-interest results did not improve the risk-return torque.

Thus, Demirgüç-Kunt and Huizinga (1999) concluded that the existence of a large part of assets which do not earn interest in a bank affect negatively the performance. They argued this finding with the positive impact between loans and asset performance.

Also, Barros et al. (2007) specified that a diversified bank is more likely to generate a poor result and so a poor performance.

2. External Determinants

External determinants of banks, such as the business cycle, inflation, or interest rates also affect performance. In other words, External determinants have been treated in the literature in which they have a real impact on the determinants of bank performance.

2.1 Inflation

The work presented by Revel (1979) in which he tested the effect of inflation on bank performance, was the first paper who deal with this issue.

In fact, he mentioned that the impact on performance is dependent on the rate of growth in operating expenses: a negative effect on performance is shown when these expenses increased faster than inflation and vice versa if the growth rate is lower.

Many other researchers as Bourke (1989), Demirgüç-Kunt and Huizinga (1999), Athanasoglou et al. (2006, 2008), and Pasiouoras Kosmidou (2007) have found a positive significant of inflation.

However, Ben Naceur and Kandil (2009) have found an opposed result concerning the inflation and its relation with bank performance. In fact, they arrived to a conclusion in which the inflation will play a harmful role on performance especially the interest margins and they offer this explanation: the main role of a bank is the granting of credit and so the market is based on a supply of credit (Offred by banks) and the request (by individuals and firms). The fact that there is inflation, it leads to a reduction of credit demand, because it rises uncertainty about the future. However, individuals and companies are generally very sensible to the uncertainty and the aversion about the risk is high, that's why this will lead to a fall of the demand of credits and thereby a lower financial result which will affect negatively the bank performance.

2.2 Business cycle

We believe that the role of bank in the economy was very important during last decades and so, the development of economic activity which is normally measured by the growth of gross domestic product (GDP), is a sign of banks' performance, i.e. a period which is marked by a strong growth leads to an increase in investment and consumption, from where a rise in credits and then an increase of bank performance. This conclusion was the result of the majority of researchers who have studied the relationship between the development of economic activity and the bank performance, namely Goddard et al. (2004), Demirgüç-Kunt and Huizinga (1999), Bikker and Hu (2002) and Dietrich and Wanzenried (2011).

In addition, Bernake and Gertler (1989) and Demirgüç-Kunt et al. (2004) have found a different result in which the relationship between GDP growth and banks' performance is inversed. They give one explanation of this result: in a period of recession, the risk of default of the borrower will be high and banks will raise interest rates on loans, which leads to an improvement of banks' result and so, the bank performance.

II. Factors that determine the level of interest rate

Multiple factors determine the changes in interest rate, including credit supply and demand, competition in the loanable market, as well as other economic factors such as inflation rate, expectation of investors, monetary policy of the government etc.

1. Demand and Supply of Loanable Funds

In a free-market, interest rate is determined in the market place by the interaction of borrowers and lenders (supply and demand of funds) (Shetty et al, 1995). When the preferences of borrowers and lenders are successfully matched, the resulting interest rate is considered an equilibrium interest rate. The latter is accepted by both parties as the rate at which the transaction is completed (Rose et al 1995).

The supply of funds depends on the preference of society for current against future consumption, the lower the preference for current consumption, the stronger the incentive to accumulate funds. Whereas the demand for funds depends on the available opportunities for using funds efficiently and profitably, the more profitable the usage is, the greater the demand.

If demand for funds increases, or the supply declines, the price of funds (interest rate) will rise and vice versa.

2. Inflation

Inflation affects the interest rate by affecting the value of money promised in the future (Kohn, 2004). The interest rate quoted in the financial market is sometimes compared with the real rate, which is the observed market rate corrected for price changes (inflation) (Goedhuys, 1982). More precisely, real interest rate is measured as the difference between the nominal interest rate and the expected inflation rate, because an expectation about future inflations definitely affects market interest rate (Kaufman, 1986). Furthermore, according to the Fisher effect, expectations of high inflation lead savers to require higher nominal (market) interest rate, which is the only way to maintain the existing real rate of interest. In fact, many studies have provided research on the relationship between expected inflation and interest rate; Booth and Ciner (2001), and Laatsch and Klein (2003) stipulated that there is one-for-one relationship between expected inflation and nominal interest rate in the long run. Laatsch and Klein (2003) went further to clarify that nominal interest rate adjust one-for-one with any change in expected inflation, thus supporting Fisher's hypothesis. Whereas changes in nominal interest rate does not lead or lag changes in expected inflation.

Just as borrowers may, lenders would also anticipate inflation, therefore expectations of inflation should tend to drive up interest rate as:

a. Borrowers seek to obtain funds to purchase goods before their prices rise.

b. Lenders seek to protect the purchasing power of their funds.

c. Federal Reserve tightens credit in an effort to retard inflationary pressure.

If banks were able to fully anticipate inflation rate, they can properly adjust interest rates in order to increase their revenues faster than their costs, hence acquiring higher profits. However, unanticipated inflation can lead to improper interest rate adjustments, and hence to a possible increase in costs faster than revenues. (Anthanasoghou et al, 2006).

3. Monetary Policy

One of the purposes of Central Banks is controlling both money supply and credits through monetary policies. The implication of a monetary policy is, when money supply is targeted, the resultant interest rate has to be accepted, or vice versa. An increase in money supply by the

Central Bank leads to a decrease in interest rate, resulting in an increase of the demand (Blanchard (2011)). On the other hand, if the monetary policy is used to fight inflation, the Central Bank sells securities (open market operations), raises banks reserve requirement, and raises the discount rate, hence reducing money supply, banks excess reserves, and increasing the cost of credits (interest rates) (Godspower-Akpomiemie (2012)). Also, if the Central Bank wants to restrict lending to the private sector because of one reason or another, it increases the bank rate [discount rate (what it charges to banks)], this induces an increase in the rate of interest charged on bank loans.

4. Investors' Expectation

The expectation theory argues that interest rates are functions of investors' expectations (Rose et al, 1995). If the investors expect, over the next period, an increase in the money supply by the Central Bank, the level of interest rate will increase. Even though the policy aiming to increase the money supply has not actually been implemented, investors already reacted towards it, resulting in an increase in the interest rate.

5. Competition

Obviously, competition in the loanable market also affects the interest rate. If commercial banks lower the deposit cost and raise the interest on loans, they will realize more profit. But the ability to do so depends on how much competition exists in the industry. Even if there are few commercial banks to compete with, the non-bank substitute may be a problem, leading to disintermediation. (Rose et al, 1995)

6. Uncertainty

Uncertainty about the future also plays a predominant part in the process of interest rate determination. Among more predominant types of uncertainties, there is:

a. The term period over which funds are made available. The longer the term of the loan, the greater the uncertainty that circumstances may change and the higher the compensation demanded by the lenders. Hence, the longer the term of the loan, the higher the interest rate charged.

b. Another major concern is the ability of the borrower to repay the loan. The higher the risk of default by the user (or the lower his/her credit rating), the higher the interest rate charged by the supplier.

c. During the period of low economic growth (measured by the GDP), banks narrow the spread between the deposit rate and repo rate, probably an attempt to attract deposits.

III. The different effects of interest rate risk on bank performance

Movement of interest rate affects decision making, performance and growth of any particular financial institution (Madura, 1989). Therefore, it is a major concern to all markets and financial institutions. In fact, changes in interest rate as well as interest rates expectations affect the income and expenditure of financial institutions. Moreover, as it was presented by Flannery M.J (1983) the interest rate variations can cause many problems for a bank and affect its net worth, assets and liabilities. Hence, its net interest margin.

1. The effect of interest rate risk on banks' net worth

Commercial banks face, in addition to market value risk, refinancing and reinvestment risks which occur when interest rates change. Whereby the market value of a bank's assets declines due to rising interest rates, the interest rate shock that results in losses in the market value of assets directly affects the net worth (owners' equity) because debt holders are senior claimants on a firm's assets, whereas equity holders are junior claimants (Saunders and Cornett, 2003). Moreover, Molyneux and Thorton (1992) examined the determinants of banks profitability in several countries, they found an active association between return on equity and the level of interest rates.

Furthermore, if the assets' maturity is longer than that of the liabilities, any given change in interest rate results in a fall more sever for the market value of assets (A) than of the market value of liabilities (L). As the balance sheet identity is E = A – L, this definitely affects the net worth [equity (E)] (Saunders and Cornett, 2003). Saha et al. (2009) confirmed this, they stated that danger lurks in the banking books because interest rate hike reduces the present value of assets much more than that of liabilities, thereby depleting a bank's net worth.

This takes us to Pillar 2 of Basel II, which states that interest rate risk in the banking book should also attract capital charges, if losses in the Economic Value of Equity (EVE) is severe enough, where EVE equals present value of assets minus present value of liabilities.

2. The effect of interest rate risk on assets

Interest rate fluctuations affect a bank's revenues in two forms. First, an increase in the interest rate will conduct to an increase of its income. For each bank, the speed at which interest income

adapts to new market conditions depends on the time required for the average rate of return on assets to be adjusted to the current market rate.

In addition to that, the adjustment may happen when the assets arrive at maturity (i.e. an old loan repaid or a new one with current conditions of the market), or when the assets are indexed at a variable rate.

Second, the interest rate variability affects a bank's interest income as a result of the bank decisions on loan levels, on securities to be acquired and on the level of cash that it must hold.

In fact, when the interest rate of credits rises more than the interest rate of treasury bills, banks will grant more loans instead of acquiring investment securities. Moreover, as long as the income from bank assets fluctuates according to the balance-sheet's composition, building up cash reserves and unproductive assets should be minimized in order to increase the performance of productive assets. Therefore, in general, the time required to adjust the portfolio of assets depends on its structure and the reaction of loans following a rise in interest rate.

3. The effect of interest rate risk on liabilities

The impact of variations of interest rate on a bank's costs depends on the average maturity of its liabilities portfolio. Many types of resources, such as deposit certificates, fixed-term deposits and debenture loans, generate interest costs and have well-defined terms. But, the overnight deposits which have an important proportion in a bank's portfolio constitute an issue because their maturities are quite volatile and unpredictable.

Furthermore, another complication affecting the liabilities emerged, it is that the real cost of certain deposits exceeds the normal rates required by the regulation. In fact, if an interest rate decreases below their competitive level during a certain period, it will create more competition between banks by offering more interest.

Moreover, it should be noted that the reaction of bank liabilities following an interest rate fluctuation is similar to the reaction of its assets. Therefore, bank's costs follow the interest rate changes, where the adjustment speed depends on the liabilities' composition.

4. Effect of interest rate risk on interest margin

The bank net interest margin is "*typically used for a bank or investment firm that invests depositors' money, allowing for an interest margin between what is paid to the bank's client and what is made from the borrower of the funds*[20]*"*.

Generally, the interest margin is a part of the income which we should take into consideration because it is highly sensitive to interest rate fluctuations.

In addition to that, we might say that a perfect situation of the balance sheet allows bank profits to be immune, which is only possible if each asset is financed with a resource of the same duration. Therefore, we could be looking at three situations depending on the concordance between assets and liabilities' durations:

- First, the net interest margin is unchanged as long as the duration of assets is equal to that of liabilities.
- Second, the negative effect on NIM when there is discordance of durations (Liabilities' duration < assets' duration)
- Finally, a positive effect on NIM as long as the liabilities' duration is superior to that of assets.

In other words, the interest rate variations affect the revenues and costs with the same magnitude, but the speed of adjustment differs according to the length of durations.

IV. Empirical Literature

During the last years, the interest rate risk and its determinants were an important subject, they were studied by many researchers who aimed to detect its effects on banks' performance.

In fact, a vast analytical and empirical literature has been devoted to study this phenomenon. Its objective is not only to examine the effect but also to seek a measure of interest rate risk and to analyze its evolution over time.

Hence, most empirical studies aim to investigate two main questions, i.e. the degree of sensitivity of bank stocks' returns to interest rate fluctuations and whether the interest rate sensitivity of bank stocks is related to bank characteristics.

In order to give an answer to these questions, the capital market approach which is based on the two factors regression model presented by Stone (1974), has been used to detect the sensitivity of bank stocks' returns to interest rates changes. According to Ballester et al. (2009), the idea

[20] https://www.investopedia.com/terms/n/netinterestmargin.asp

behind this model is to incorporate the interest rate fluctuations as an explanatory variable to the model estimation in order to explain the changes and the variability of bank stock returns.

However, according to Fraser et al. (2002), there is unequal interest towards the two questions where most studies focus on answering the first one regarding the relationship between the variation in interest rates, whereas there is less attention given to identify the explanatory factors of banks' interest rate exposure.

Regardless of the market and time span, most empirical studies found that changes in interest rates are negatively related to bank stock returns. In particular, many researchers investigated U.S. banks in different time periods, they all reached the same conclusion, finding a negative correlation between interest rate fluctuations and banks' stock returns (Lynge & Zumwalt (1980), Flannery & James (1984), Booth et al. (1985), Bae (1990), Kwan (1991), Elyasiani & Mansur (1998) and Fraser et al. (2002)). Likewise, other studies (e.g. Oertmann et al. (2000) who were interested by European financial corporations, Ballester et al. (2009) who studied 23 Spanish banks) also document a significantly negative impact of interest rate fluctuations on bank stocks return. Primarily, this was explained by the duration gap, it was said that banks have been generally exposed to a positive duration gap where the average duration of banks' liabilities is less than the average duration of banks' assets (Ballester et al., 2009). However, empirical studies also document the declining sensitivity to interest rate across banks in the early 90's as attributed to the increasing use of interest rate derivatives for hedging purposes (Allen & Jagtiani, 1997; Benink & Wolff, 2000; Choi & Elyasiani, 1997).

The second question, concerning the explanatory factors that affect the interest rate sensitivity of bank stocks, has received less attention (Fraser et al., 2002). However, it is clear that the empirical research addressing this can be divided into two fundamental groups. The first approach focused on determining the relation between the interest rate sensitivity of bank stocks' returns and the banks' maturity composition of their assets and liabilities. Whereas the second approach centralizes on a set of bank specific characteristics regarding on- and off-balance sheet activities as explanatory factors (Ballester et al., 2009).

Flannery and James (1984) were the pioneers in these studies, the addressed how the performance of commercial banks is affected by the varying of market interest rates. They used a data of 70 US commercial banks and compared the assets owned by banks to the interest rates offered by the market. After using a pooling regression and statistical tests, it was found that the profitability of the studied banks is adapted to the level of interest rates, which implies that a change in the market rates was accompanied with a response by the bank revenues and costs,

which always cancelled one another. Despite that some recent researchers have criticized these findings based on the age of the research, this study could give a relation between interest rates' fluctuations and bank performance, which is a negative relation: "*large banks have effectively hedged themselves against market rate risk by assembling asset and liability portfolios with similar average maturities.*"[21]

However, the maturity gap analysis of banks' assets and liabilities is considered as a static measure of interest rate sensitivity and hence the results could be an inadequate indicator of the bank's situation and its interest rate exposure in the future.

Hence, the alternative solution which was presented by many authors is based on the role of bank-specific characteristic sets, including both on- and off-balance sheet activities. More specifically, many researchers like Drakos (2001), Fraser et al. (2002), Saporoschenko (2002), Ghazanfari et al. (2007), Au Yong et al. (2009) and Ballester et al. (2009) have tried to identify the principle determinants of the interest rate exposure by running multi-regression models of many different sets of bank ratios against the banks' interest rate sensitivity. They used this methodology in order to remedy to the limitations that are often met by the static measure, i.e. the duration gap analysis.

Drakos (2001) mentioned in his study that there is a significant sensitivity of banks' stock returns to interest rate fluctuations. He examined the interest rate sensitivity of ten main Greek banks listed on the Athens Stock Exchange to the changes in Greek long-term interest rates by using a pooling regression. While testing five financial variables, including total debt, market-to-book value, equity, working capital and leverage, the working capital variable has exhibited the most significant correlation with interest rate sensitivity. He found that the greater the working capital, the higher a bank's interest rate exposure, which results in a greater potential loss derived from wealth redistribution due to unexpected increases in inflation. Furthermore, equity capital and total debt ratios are also suitable explanatory factors of the variation of banks' interest rate sensitivity, whereas the remaining two ratios do not play a significant role.

Fraser et al. (2002) investigate the determinants of banks characteristics to interest rate sensitivity in a study of 116 American banks, ranging from the large money center banks to small banks, during the period of 1991-1996. They found that a bank's size doesn't have any significant correlation with its interest rate sensitivity and, among other variables used, the

[21] Flannery, M. J. (1981). Market interest rates and commercial bank profitability: An empirical investigation. The Journal of Finance, 36(5), 1085-1101.

interest rate exposure presents a negative correlation with some of them, which are: the equity capital ratio, the proportion of demand deposits over total deposits and the proportion of loans to banks total assets. Also, banks that generate most of their revenues by non-interest income experience greater interest rate sensitivity, possibly because a substantial part of their non-interest income is derived from activities related to securities.

In contrast, Saporoschenko (2002), [22] while studying the sensitivity of interest rate with a sample of 47 Japanese banks during the period from 1986 to 1992, he stated that bank size has a significant and positive effect on its interest rate sensitivity. Moreover, banks' deposit proportion also plays an important role in justifying Japanese banks interest rate sensitivity. So, the greater the volume of deposits (thus a larger deposits-to-total asset ratio) the greater the extent to which the banks are exposed to interest rate risks. Meanwhile, the maturity gap does not have a significant impact on banks' interest rate sensitivity.

Ghazanfari et al. (2007), using a sample of 272 American commercial banks, investigated the effect of an announcement by the Federal Reserve considering a change in the interest rate on the banks' stocks, testing for abnormal returns five days prior to the announcement as well as five days after it. During the studied period, two distinct events occurred, a raise of the interest rate as well as a drop. Abnormal returns were explained by a multiple regression model using a set of financial proxies. Out of the four ratios used as proxies, only two were found to be significant. It was found that portfolio securities-to-total assets is significantly related to average abnormal returns during a rate hike, whereas equity-to-total assets is significantly related to cumulative abnormal returns when the rate is cut. The researchers imply that, by using management techniques, bank managers can structure the bank's assets and liabilities as a way of hedging against interest rate shocks.

In addition to that, many other authors aimed to identify the relationship between bank performance and interest rate fluctuations, among the said authors Nduati (2013) studied the interest rate spread which was a major highlight to this research. He defined the spread as the variance between the customers' deposit rate and the borrowers lending rate. In his extensive results he discovered that the spread was determined by individual institutions. Besides, when it comes to financial institutions seeking a competitive edge, low spreads were perceived to provide a stiff foundation. These findings were drawn using data collected from the central bank of Kenya (CBK) offices and analyzing the spread of different banks, which was helpful

[22] Saporoschenko, A. (2002). The Sensitivity of Japanese bank Stock Return to Economics Factors an Examination of Asset/Liability Differences and Main bank status. Global Finance Journal, 13(2), 253–270.

in relating the material collected from international scholars as it gave a local view on the findings of the spread. This research states that the interest rate spread is the single most important determinant of banks financial performance in Kenya, hence explaining why the interest rates in Kenya are so high.

Adjei-Frimpong, Gan and Hu (2014) [23]analyzed the efficiency of the banking industry in Ghana over the period of 2001-2010 using the data envelopment analysis. The study investigated the impact of size, capitalization, interest rate, inflation rate and GDP growth rate on Ghana's bank efficiency using both static and dynamic panel data models. The static model was estimated by the fixed effects estimator whereas the dynamic model was estimated by the two-step system GMM estimator. The results suggested that Ghana banks are inefficient and revealed that the well-capitalized banks are less cost efficient. In addition, bank size has no influence on bank cost efficiency suggesting that larger banks in Ghana have no cost advantages over their smaller counterparts. The findings also exhibited that interest rate has no effect on bank efficiency in Ghana. Furthermore, this study found GDP growth rate negatively influences bank cost efficiency and that lagged cost efficiency tends to persist from year to year.

Moreover, Khan and Sattar (2014), using data from four of the major commercial banks in Pakistan between 2008 and 2012, examined the effect of interest rate variations on their profit. They based their study on Pearson correlation technique, where they related the interest rates provided by each individual bank with the profits experienced at the end of a financial year. They concluded that a bank's profitability depends on its monetary tools, and in this case the monetary tool was interest rate. This research is closely related to the Kenyan financial market especially when it came to the overcharged interest rates. In fact, in all the studied banks, borrowers were given higher interest rates than that of depositors.

A similar study was done by Olamide et al. (2015), he highlighted just how interest rate risk affects the performance of Nigerian Banks. To identify the causality line between the interest rate and banking, Apir analyzed data from some Nigerian banks using the granger causality. He found that the volatility of interest rates affects the overall financial performance of banks. However, it also depends on the administration offered by governments in relation to the interest rates they offer. This study also revealed the existence of a level of uniformity of interest rates which results in greater competition among commercial banks. Therefore, in Nigeria, the

[23] Adjei-Frimpong, K., Gan, C., & Hu, B. (2014). Cost efficiency of Ghana's banking industry: A panel data analysis.

Central bank should enforce radical policies which seek protecting entrepreneurs from harsh interest rates changes thus, increasing the lending rate and also improving investment.

Owusu-Antwi et al. (2017) restudied commercial banks in Ghana and investigated their interest rates spread as well as their profitability. Using a sample of 28 banks and employing ordinary least square regression, their results show that bank spread affects profitability of commercial banks in Ghana positively, yet the relationship was statistically insignificant. The outcome shows that there is a relationship between interest margin and banks profitability, though when it doesn't respect the positive existing relation, it turns out to be insignificant. This implies that in order to improve profitability, the bank will seek increasing its net interest margin by effectively and efficiently increasing interest income and decreasing interest expense. It will also raise interest margin to cover increases in operating costs, consequently the increase in ROA will encourage banks to raise interest margin.

More recently, Pérez Montes and Ferrer Pérez (2018) study the sensitivity of bank profits and balance sheet structure to fluctuations in the level of interest rate in Spain between 2000 and 2016 using an autoregressive distributed lag (ARDL) models and they found a non-linear relation between interest rates and net interest income which is positive at low levels of interest rates. This relation is associated with the effect of interest rates on asset and liability returns which have an effect on the profitabity of the bank.

Aloui and Jarboui (2019) present in their article the effect of the market index, interest rate and foreign exchange rate risk on Tunisian banks stock returns using OLS and GARCH estimation models. They reach a conclusion in which the exchange rate and market index have an impact and an important role in determining the dynamics on the conditional bank stock return, but the interest rate does not present a significant impact on the Tunisian bank return.

Conclusion

To recapitulate, we present the interest rate risk in the banking book which refers to the current or prospective risk to a bank's capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book and the difference between the banking book and trading which have been discussed in the literature.

Moreover, we studied the different theories of the interest rate in which how the customer demands and the banks' supply loanable funds determines the interest rates in the Loanable fund theory, in contrast to the classical theory (opposite of the loanable theory) where saving

and investment determine interest rates and also can be equal at times. Also, Keynes theory somehow provides a compromise between the two. In this theory, the demand and supply of resources or money is the determinant of interest rate variation. Finally, we have found that the principal effect of interest rate on bank performance is seen especially through the assets, liabilities and the interest margin.

CHAPTER II: Empirical Framework

Introduction

In this chapter, we will do an empirical work concerning our topic mentioned above in which we will test the impact of the interest rate on bank profitability.

On one hand, we will use a panel estimation of 10 quoted banks in Tunisia in order to detect the effect of the interest rate volatility on the whole banking sector and to choose the appropriate variable which have the real effect on the bank profitability measured by the return on asset.

On the other hand, we will conduct an empirical study of the different components of the net interest income of the BH Bank and explain the different relation between the MMR

This chapter is organized as follows: The first section presents the empirical methodology that we will use in order to reach our objectives and we answered ours problematic. The second section describes the evolution of the interest rate during the period of our study, then the third section reports the main results of the panel estimation to assess the impact on the bank sector profitability. Finally, the last section gives the main findings from the analysis of the BH Bank net interest income through the ARDL model and impulse response function.

Section1: The empirical methodology

Our work aims to empirically test the impact of interest rate changes on bank profitability. We are going to start by presenting the evolution of the MMR in Tunisia, then we will apply a panel regression with a set of variables chosen according to previous studies, especially those that focused on emergent countries due to their similarity to the Tunisian context. Furthermore, for more precision, we choose to take more interest in the banking book items because they are more significant and more vulnerable to the interest rate risk than those of the trading book. Therefore, we adopted the definition of BCBS (2016) "Interest rate risk in the banking book refers to the current or prospective risk to a bank's capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book.".

Afterwards, by applying the ARDL model, we will present the impact of the interest rate level on the main interest sources of BH bank balance-sheet. Hence, determining whether there is a long run relation between the growth of assets and liabilities with changes in interest rate levels as well as each one's speed of adjustment to its long-term value.

Finally, we will use the impulse response functions in order to assess the impact of a shock on the MMR on both credits and deposits.

Section 2: Interest rate evolution in Tunisia (2005-2019)

According to the Tunisian Central Bank, the interest rate experienced several variations between 2005 and 2019.

During the year 2006, the interest rate has gone through three distinct phases. In the first semester, the monthly average money market rate (MMR) was at 5%. During the period of July-September, it experienced a slight increase and it was between 5% and 5.04%. During the last quarter, and following the rise in the central bank's interest rate, the MMR went from 5.22% in October to 5.33% in December.

For 2007, the interest rate fluctuated between 5.10% and 5.42%, as a result the average money market rates for October, November and December were 5.25%, 5.20% and 5.26% respectively.

Considering the year 2008, the average money market rate which stood at 5.22% in April and May decreased to 5.19% in June, reflecting, for example, the market's liquidity situation. The MMR was at 5.27%, 5.17% and 5.19% during the months of October, November and December respectively.

Figure 4: The evolution of the money market rate during the period 2005-2019

As for the year 2009, the average monthly MMR gradually declined from 4.70% in January to 4.47% and, 2.6% in February and March respectively. In order to reduce the pressure on market rates, the Central Bank decided, early in September of the same year, to further reduce its key interest rate by 50 basis points, hence it became 3.5%. In line with this decline, the interest rates for savings (TRE) has decreased to reach 2%.

For the year 2010, the interest rate fluctuated between 4.05% and 4.80%. Therefore, average MMR stood at 4.52%, 4.61% and 4.52%, respectively, during the months of July, August and September. Hence, reflecting the contraction in banks liquidity compared to the previous quarter.

The contraction in bank liquidity was felt at the level of interest rates. In the first half of 2011, most of the requesting banks resorted to interbank transactions at rates higher than those charged by the Central Bank. As a result, the average monthly MMR was above the central bank's policy rate (with an exception for April), reflecting the banks' cash position and their liquidity position. The transmission of changes in MMR to bank lending rates remained

significant, reflecting the continued indexing behavior of bank rates. As a result, the decline by 107 basis points in the MMR during the second half of 2011 resulted in a decrease in the average effective rate for all credit categories by 58 basis points in the same six-month period and by 38 basis points during the following six-month period.

Regarding the conduct of the monetary policy, and in the light of the evolution of both national and international situations, the Board of Directors of the Tunisian Central Bank decided during its meeting of August 29th 2012 to increase the interest rate of 25 basis points, raising it from 3.50% to 3.75%, in order to counter the amplification of inflationary pressures. As a result, the monthly average MMR was 3.85%, 3.88% and 3.90%, respectively during the months of July, August and September 2012. Hence, a quarterly average of 3.88%, compared to 3.67% in the second quarter.

In 2013, the Central Bank's monetary policy was interpreted as a desire to keep the MMR close to the ceiling rate in order to center inflationary pressures. The MMR's variation was significant as it increased by 73 basis points compared to 2012, which risked attracting the bad borrowers, hence resulting in a deterioration of the quality of the banks portfolios.

Furthermore, the MMR eased slightly from 4.98% to 4.88% in July 2014. The monthly average money market rates were 4.93% in October and November 2014 and 4.88% in December, for a quarterly average of 4.91%. %. Compared to 4.95% in the previous quarter, it reflects the easing of banks needs from one quarter to the next.

For the year 2015, the downward adjustment of the policy rate resulted in a significant drop in the overnight weighted interest rate on the interbank market. Also, the MMR decreased from 4.75% to 4.30% then to 4.28% respectively in October, November and December 2015. Thus, a quarterly average of 4.44% against 4.77% in the third quarter. Overall, the MMR has evolved throughout the year 2015, being close to the key rate.

For the year 2017, during the second quarter, the interest rate increased and reached 4.94%, hence confirming the severe economic situation. Therefore, in order to counteract inflationary pressures, the Tunisian Central Bank has taken corrective action and increased the interest rate to 5.23% at the end of the year.

Last but not least, concerning the year 2018, the Tunisian Central Bank decided to increase the key interest rate by 75 and 100 basis points in March and June respectively. This had an impact on the savings rate which increased by 100 basis points to reach 5%, thus helping mobilize

long-term resources and encouraging savings. Furthermore, it also impacted the MMR which increased to 6.04% and 6.72% in March and June respectively.

Finally, at the end of February 2019, and following the decision of the Central Bank to raise its key rate by 100 basis points to set it at 7.75%, the MMR for the months of April, May and June adjusted, so that the market rate is 7.84% in the second quarter compared to 7.47% in the first quarter.

Section 3: Impact of interest rate level on bank performance: an econometric study on panel data

Our objective in this section is to study the relation between the level of interest rate and the bank performance for the Tunisian banking sector. Therefore, we will start by presenting the data and the preliminary tests. Afterwards, we will introduce the used model and we will finish by stating the different results as well as the discussions.

I. Data description and Preliminary Tests

1. Data Description

Our study aims to detect the relation between the interest rate level and bank performance in the Tunisian context. Thus, we are going to use a dependent variable, a set of independent variables and others for control.

To examine whether the profitability of Tunisian commercial banks was affected by interest risk, we have composed a sample of 10 commercial banks, with biannual data gathered from financial statements of each bank in the studied sample, during the period (2005-2019). Thus, yielding a total of (290) observations.

Table 1:List of banks

Bank	Acronym
Amen Bank	***AB***
Arab Tunisian Bank	***ATB***
Attijari Bank	***ATTIJARI***
BH Bank	***BH***
Arab International Bank of Tunisia	***BIAT***
National Agricultural Bank	***BNA***
Bank of Tunisia	***BT***
Tunisian Society of Banks	***STB***

Bank of Tunisia and Emirates	***BTE***
International Union of Banks	***UIB***

a. Variables Description

By referring to the empirical literature, we have selected each of the following variables to include in our study:

- Dependent variable

We are going to use Return on Assets (ROA) to represent bank profitability. It is the most used variable in previous studies as a measure of bank profitability (Musah (2017); Raharjo et al. (2014); Owusu-Antwi et al. (2017)).

- Independent variables

The key independent variable in our study is interest spread. Bank interest rate spread is the difference between a bank's lending rate and its deposit rate. However, as for the lending and deposit rates on individual banks level, there is no available data except for the summary presented by the central bank in their periodic policy report. Therefore, there exists different measures for this variable. Among the existing measures, we have chosen three to incorporate in our study. Firstly, it is measured as the ratio of net interest income, as it was measured by Owusu-Antwi et al. (2017), which reflects the bank's interest profitability involving the cost of financial intermediation. Secondly, we are going to use the net interest margin which is presented as the best measure of interest rate risk by Amidu and Wolfe (2013). The third measure, which is the volatility of the money market rate (Vtmm), we chose because most of Tunisian bank assets and liabilities are very sensitive to changes of the interest rate.

- Control variables

As for the control variables, bank size (SIZE), capital adequacy ratio (CAP), credit risk (CREDIT), Customer deposit growth (GROWTH), Growth of gross domestic product (GDP) and inflation rate (INF) are presented in the literature as key determinants of bank profitability.

Table 2 : Variable definition and measurement

Variable	Definition	Measurement
ROA	Return on Assets	Net income before tax divided by Total Assets

IntSp	Interest spread	interest received/all interest-bearing assets)- (paid/ interest earning liabilities
NIM	Net interest Margin	banks' interest income – banks interest expenses) divided by total assets
SIZE	Bank size	Natural logarithm of Total Assets
CAP	Capital adequacy ratio	Equity divided by total assets
GROWTH	Customer deposit growth	(Deposit at year 1 – previous year)/ previous year deposit
Credit	Credit Risk	Loan loss provision divided by Total Assets
VTMM	Volatility of interest rate	standard deviation of the money market rate
GDP	Growth of gross domestic product	(GDP at year 1 – previous year)/ previous year GDP
INF	Inflation rate	Represents the rate of inflation

b. Descriptive statistics

Starting with the dependent variable, we have already stated that we are using the ROA as a measure of each bank's profitability. According to Table (3), this variable average is 0.53% with a standard deviation of 0.92%, which indicates that the profitability of Tunisian commercial banks is low with high variation.

Table 3: Descriptive statistics of the different variables

	Mean	Standard deviation	Maximum	Minimum	Kurtosis	Skewness
Int Sp	0.014891	0.013252	0.042331	-0.107969	58.96784	-6.859223
NIM	0.012242	0.004077	0.038156	0.002766	8.263313	0.841104
CAP	0.099730	0.069678	0.489282	-0.016222	16.11804	3.162338
SIZE	8.299562	0.805356	9.682909	5.575570	4.687704	-1.309593
Growth	0.061301	0.097749	0.956522	-0.146225	48.05065	5.369466
Credit	0.005405	0.007191	0.081610	-0.001434	84.73866	8.313035
GDP	0.028338	0.019284	0.066000	-0.014000	2.525140	-0.043963
INF	0.048860	0.032716	0.205897	0.018546	18.52427	3.793356
Vtmm	0.001252	0.001299	0.004881	0.000000	3.701483	1.243823
ROA	0.005393	0.009268	0.037623	-0.081248	53.32112	-5.603787

The average performance of commercial banks in our study are similar to those of Naceur (2003) [24]where the mean return on assets for Tunisian banks was 0.6%.

Regarding the independent variables, the interest spread had a mean of 1.48% and ranges from 0.10 to 0.042. As for Net Interest Margin (NIM), which is the main independent variable in our study, it has a mean of 1.22%, a minimum of 0.27% and a maximum of 3.8%. This variable simply measures the cost of financial intermediation in Tunisia. The results are different to those of Naceur (2003) where it was found that the mean of NIM was 3% with a maximum of 4%. Concerning the volatility of the money market rate (Vtmm), it averaged 0.12% with a standard deviation of 0.129%, this indicates that the volatility might be considered low for the Tunisian context.

Other than the mean and the standard deviation, other measures are used to assess the different variables in question. Starting with the Skewness, which measures the asymmetry of the distribution, it is the averaged cubed deviation from the mean divided by the cubed standard deviation. The results show that ROA, IntSp, Size and GDP exhibit negative skewness,

[24] Naceur, S. B. (2003). The determinants of the Tunisian banking industry profitability: Panel evidence. University Libre de Tunis working papers.

implying that these variables have the tendency to take negative values with greater probability than that suggested by a normal distribution, whilst the remaining variable are positively skewed.

Concerning the kurtosis coefficient, which represents the fourth-order central moment of a random variable and allows to measure the "peakedness" of the distribution, all the variables included in this study exhibit a higher coefficient than that of a normally distributed variable, which is equal to 3. This suggests that the distribution of the series is leptokurtic and that the tails of each distribution are thicker than those of a normal one except for GDP.

2. Diagnostics tests

Before estimating the regression model, it is crucial to perform some pre estimation tests in order to overcome any problem that could have negative impact on our results, namely, Panel unit root tests, a normality test and a couple of multicollinearity tests.

2.1 Panel Unit Root Tests

This thesis employs multiple panel unit root tests that can be arranged in groups by cross section dependence or independence, homogenous or heterogeneous unit roots, which are defined by each of Levin Lin & Chu (2002), Im, Pesaran& Shin (2003) and Phillips-Perron (2000). Individual unit root has limited powers, hence there is a possibility of rejecting the null hypothesis.

2.1.1 Levin Lin & Chu (2002)

Levin, Lin and Chu assume that the model below produces the stochastic term y_{it} :

$$y_{it} = \rho_{it}\ y_{i,t-1} + \varepsilon_{i,t}$$

The null hypothesis supposes that the panel data contains a unit root, while the alternate one suggests that the panel is stationary.

Table 4: Stationarity test of Levin Lin & Chu (2002)

	ROA	Int Sp	NIM	Size	CAP	Growth	Vtmm	GDP	INF	Credit
H	1	1	1	0	1	1	1	1	1	1
Test statistic	-3.88	-5.95	-3.52	-1.016	-3.385	-4.802	-3.213	-4.13	-4.4	-4.61
P-value	0.0001	0.00	0.00	0.154	0.0004	0.00	0.0007	0.00	0.00	0.00

Table (4) reports the results of the Levin Lin & Chu (2002) test. We find that all the P-values corresponding to the variables included in our study are lower than 0.05, except for that of the variable Size. Hence, the variables are stationary and have no unit root except for the variable Size.

2.1.2 The Im Pesaran and Shin IPS (2003)

This tests for the presence of unit roots in panels and it combines information from both the time series and the cross-section dimensions, thus fewer time observations are required to make this test. IPS specifies ADF regression for a cross-section with individual effects and no time trend as in:

$$\Delta y_{it} = \alpha_i + \rho_i \; y_{i,t-1} + \sum_{j=1}^{P_i} \beta_{ij} \; \Delta y_{i,t-j} + \; \varepsilon_{i,t}$$

Where:

i = 1, . . ., N and t = 1, . . ., T

It also uses separate unit root tests for the N cross-section units. Their test is based on the Augmented Dickey-fuller (ADF) statistics averaged across groups.

Table 5: Stationarity test of Im Pesaran and Shin IPS (2003)

	ROA	Int Sp	NIM	Size	CAP	Growth	Vtmm	GDP	INF	Credit
H	1	1	1	1	1	1	1	1	1	1
Test statistic	-4.86	-6.92	-3.92	-2.02	-4.57	-6.38	-7.17	-4.65	-5.1	-5.748
P-value	0.000	0.00	0.00	0.021	0.00	0.00	0.00	0.00	0.00	0.00

Table (5) reports the results of the Im, Pesaran& Shin (2003) test. We find that the P-values corresponding to all the variables included in our study are lower than 0.05.

2.1.3 Phillips-Perron (2000)

This test proposes non-parametric transformation of t- statistics from the original Dickey Fuller regressions. Thus, under the null hypothesis which supposes the existence of a unit root, the transformed statistics have DF distribution. The test regression for the PP test is:

$$y_{it} = \alpha_i + \rho_{it}\ y_{i,t-1} + \varepsilon_{i,t}$$

Where:

t = 1, 2…… T

$\varepsilon_{i,t}$ = 1 or 0 may be heteroscedastic.

Table 6: Stationarity test of Phillips-Perron (2000)

	ROA	Int Sp	NIM	Size	CAP	Growth	Vtmm	GDP	INF	Credit
H	1	1	1	1	1	1	1	1	1	1
Test statistic	103.22	105.5	71.01	39.23	42.53	126.76	147.78	85.71	136.40	122.75
P-value	0.0001	0.00	0.00	0.034	0.0004	0.00	0.0007	0.00	0.00	0.00

The results presented in table (6) lead us to accept the alternative hypothesis of the PP test, since all P-values are inferior to 0.05. Hence, all the variables we're using are stationary.

Consequently, we move forward to the normality test in order to verify the distribution of each series included in our sample. Hence, testing whether the different series are normally distributed or not in order to take this into account when it comes to interpreting our results.

2.2 Normality testing

Table 7: Jarque-Bera (JB) test

	ROA	Int Sp	NIM	Size	CAP	Growth	Vtmm	GDP	INF	Credit
H	1	1	1	1	1	1	1	0	1	1
Test statistic	32115.3	4805.1	368.93	117.31	2562.6	25917.3	1041.32	2.818110	3607.6	84071.43
P-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2346	0.00	0.00

As we have already stated, and even though it is rare to find financial time series that are normally distributed, we are going to test the normality of the different time series included in our study. Therefore, we are going to use the Jarque-Bera test.

Apart from the variable GDP, the Jarque–Bera test indicates that all variables are non-normally distributed, this can be seen by examining the P-Values of each variable (P-value <0.05).

2.3 Test for Multicollinearity

According to William et al. (2013)[25], multicollinearity occurs when there are correlations among the variables. In order to make sure that there is absence of multicollinearity in panel data, we will use firstly the unconditional correlation among the different variables, and secondly, we will compute the VIF test.

2.3.1. Unconditional Correlation

Table 8 : Correlation matrix between variables

Correlation	CAP	CREDIT	GDP	Growth	INF	Int Sp	NIM	ROA	Vtmm	Size
CAP	**1.000000**									
CREDIT	-0.165524	**1.000000**								
GDP	0.110659	0.179066	**1.000000**							
Growth	0.343045	-0.044071	0.144549	**1.000000**						
INF	0.037104	-0.035191	0.048950	-0.048615	**1.000000**					
Int Sp	0.044992	-0.042047	-0.066373	0.010114	0.022497	**1.000000**				
NIM	0.201122	0.036627	0.161122	0.142738	0.012887	0.017807	**1.000000**			
ROA	0.262454	-0.696906	-0.127459	0.065791	0.014035	0.026929	0.283816	**1.000000**		
Vtmm	-0.036994	0.079514	0.238253	-0.08697	0.131737	0.048196	-0.06167	0.065167	**1.00000**	
Size	-0.68775	-0.05286	-0.312218	-0.30899	0.008562	0.062776	-0.17366	0.064415	0.234181	**1.00000**

Our methodology and the idea behind our study is searching to detect the impact of interest rate fluctuations on banks performance. But, before presenting the principal results of our model estimation, it is necessary to examine the dependence between the different variables in our sample.

[25] Williams, M. N., Grajales, C. A. G., &Kurkiewicz, D. (2013). Assumptions of multiple regression: correcting two misconceptions. Practical Assessment, Research & Evaluation, 18(11), 2.

The result shows a significant and positive association between the ROA and each of the capital adequacy ratio (CAP) and Net interest margin (NIM) (r=0.2624, r=0.283816). This implies that CAP and NIM move in the same direction as the financial performance of commercial banks which is measured in terms of ROA.

Furthermore, there is a negative and significant association between credit risk and ROA (r=-0.696906), implying that credit risk moves in oppositely to the ROA, in other words, to the financial performance of commercial banks.

In addition to that, we find that the volatility of the MMR and the bank size have a negative and non-significant relation with bank profitability, contrary to the GDP in which the relation is positive and low (r=-0.127459).

According to Kennedy (2008)[26], the problem of multi-collinearity arises when the correlation is greater than 0.8. Yet, it can be seen from table () that the highest correlation, which is between the efficiency ratio and the income ratio is 69.69%, still lower than 80%. Hence, we can say that there is no multicollinearity problem in the linear model, and to further confirm this, we opt for the variance inflation factor test.

2.3.2 VIF test

To test the presence of strong relations amongst the independent variables, we used Variance Inflation Factor. Its main rule is, if it has a value greater than 10, there exists a problem of multicollinearity and it requires further investigations.

Table 9: Test for Multicollinearity (VIF Test)

Variable	VIF
SIZE	2.003655
CAP	1.514031
GROWTH	1.099092
NIM	1.214196
VTMM	1.234408
INT_SPREAD	1.022247
GDP	1.441257
CREDIT	1.110911
INF	1.033610

[26] Kennedy, P. (2008), « A guide to Econometrics", 6th edition, MIT Press

As it can be seen in Table (9), each one of the variables included in our study has a VIF inferior to 10. Thus, confirming our findings of the inexistence of multicollinearity problems.

II. Presentation of the model and Empirical findings

1. Empirical Model

In order to detect the interest rate level's impact on bank profitability, and by referring to the study of Musah et al. (2018)[27], we have developed the following panel Model:

$$ROA_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 INF_{it} + \beta_3 Size_{it} + \beta_4 Intspread_{it} + \beta_5 NIM_{it} + \beta_6 Vtmm_{it} + \beta_7 CAP_{it} + \beta_8 Credit_{it} + \beta_9 Growth_{it} + \varepsilon_{it}$$

Where:

i=1,2……10 refers to banks composing our sample

t=1,2……29 refers to the number of semesters of our study period

Before estimating our model, we will present, in a concise way, the panel data technique as well as the different types of panel models.

2. Panel estimation technique

Panel models combine two dimensions at once: the cross section of our sample, as well as the time series of each variable. This constitutes a major advantage, seeing that it increases the number of observations. In addition, the panel models allow us to study the evolution of relations over time while controlling the heterogeneity between the banks included in our study.

In fact, there are two types of panel models: fixed effect models and random effects models. Hereafter, we are going to present these models, as well as conduct some tests to choose the more adequate one.

- **Fixed effect model:**

The fixed effect model assumes that the relation between the dependent variable and each of the explanatory variables is identical for all the banks. This model is presented as follows:

$$\mathbf{ROA_{it}} = \alpha_i + \sum_{k=1}^{K} \beta_k X_{it} + \varepsilon_{it} \quad (i=1, 2\ldots, n;\ t=1, 2\ldots, T)$$

Where:

[27] Musah, A., Anokye, F. K., & Gakpetor, E. D. (2018). The Impact of Interest Rate Spread on Bank Profitability in Ghana. European Journal of Business, Economics and Accountancy.

α_i : represents each bank's specificity

ROA_{it} : Return on assets ratio for each bank

X_{it}: the different independent variables

ε_{it} : Idiosyncratic error term.

- **Random effect model**

The random effect model assumes that the individual specificities are actually random. The constant term breaks down into a fixed term and a random term which is specific to each individual, this actually helps controlling individual heterogeneity.

The random effect model is as follows:

$$\mathbf{ROA_{it}} = \alpha_i + \sum_{k=1}^{K} \beta_k X_{kit} + \sum_p \lambda_i Z_{pi} + \varepsilon_{it} \quad (i=1, 2\ldots, n\ ;\ t=1, 2\ldots, T)$$

Where:

α_i: individual random terms / $\alpha_i = \alpha + U_i$

X_{kit} : the different independent variables over time

Z_{pi} : the invariant factors over time

3. Detecting the effect of interest rate risk on bank performance

Before implementing the regression, we will perform a couple of statistical tests in order to appreciate the appropriate empirical estimation of our model.

3.1 Testing for individual effects

This test consists in verifying the existence of individual effects and to determine if the theoretical model is identical for all banks or if there are specificities to each bank.

Table 10: Results of the individual effect test

F-statistic	**15.277052**
Prob (F-statistic)	**0.0000**

Seeing that the P-value is < 5%, we accept the hypothesis which suggests the presence of individual effects. However, this effect can be either fixed or random. Therefore, we have to perform another specification test, namely the Hausman test.

3.2 Test Hausman

The Hausman test statistic is a transformation of the difference between the parameter estimates from each of the fixed effects and random effects. That becomes asymptotically χ2chi- square distributed under the null hypothesis.

H_0: Random effect Model

H_1 : Fixed effect Model

Table 11: The Results of the Hausman test

Test summary	Chi-sq. statistic	Chi-sq. d.f	Prob
Cross-section random	5.24	9	0.8125

Hausman test reported a chi-square of 5.24 with a P-value of 0.8125. This implies that, for return on assets, the random effect model is preferred to that of the fixed effect.

3.3 Regression analysis

The empirical results of the estimation, which are grouped in the table below, are obtained from Stata Software after several tests in order to avoid a biased regression and to get better results.

3.3.1 Heteroscedasticity test

To test for heteroscedasticity, we used Modified Wald test. The null hypothesis in this test is that error terms have a constant variance.

The result shows a probability lower than 5%. Hence, we accept the hypothesis that suggests the heteroscedasticity of the residues.

Table 12: Heteroscedasticity Test

Modified Wald test
H_0: sigma(i)^2 = sigma^2 for all i
Prob> chi2 = 0.0000

3.3.2 Test for autocorrelation

To establish whether or not the residuals are serially correlated over time, we conducted Wooldridge test for autocorrelation. The null hypothesis supposes the inexistence of first order serial, that is, auto correlation exists. The results, which are presented in Table (13), lead to the acceptance of the null hypothesis. Thus, we confirm that the residuals are not autocorrelated (P-value=0.0707 > 0.05).

Table 13: Wooldridge test for autocorrelation in panel data

Wooldridge test for autocorrelation in panel data
H_0: no first-Order autocorrelation
F (1, 9) = 4.199
Prob > F = 0.0707

According to these tests, the errors are heteroscedastic, therefore we cannot apply the within estimator (OLS). Yet, the GLS estimator is suitable and can overcome such problems. It is the most appropriate estimator, hence, in the next section, we will present the results of the GLS estimation.

3.3.3 Model Output

Table 14: Panel estimation Results

Variables	Coefficient	**Prob**
Constant	-0.0242599	0.0000*
SIZE	0.0028068	0.0000*
CAP	0.0405781	0.0000*
GROWTH	-0.0034794	0.072**
NIM	0.5853044	0.0000*
VTMM	-0.1412571	0.268
INT_SPREAD	0.0877035	0.0000*
GDP	0.0108243	0.242
CREDIT	-1.084628	0.0000*
INF	-0.0052206	0.269
Prob	0.0000	
R-squared	0.902660	

(*): Significant at the 1% Level (prob <= 0.01)

(**): Significant at the 10 % Level (prob <= 0.1)

First of all, we can state that, at a 5% confidence level, the model is significant. In addition, the value of the R-squared, which is around 0.9, suggests that the independent variables can explain up to 90% of the variations in the dependent variable (Return on Assets).

The results from Table 14 show that both interest rate measures (INT_SPREAD and NIM) are positively and significantly related to bank profitability (ROA). As for the control variables, more precisely bank size (SIZE) and capital adequacy (CAP), we found that both are also positively associated with banks profitability. Moreover, banks profitability is negatively related to the credit risk, this is shown by significant and negative coefficient of the variable (CREDIT) at a confidence level of 1%.

Our findings are consistent with those of Raharjo et al. (2014). They found a strong positive association between net interest margin and the profitability of Indonesian banks. Furthermore, the results also confirm the findings of Malik et al. (2014)[28] who conducted their study on Pakistan banks.

The obtained results could also be interpreted by referring to the loanable funds theory. It says that the interest rate spread will be high if the demand for loanable funds exceed the supply. This means that the demand for loans in the Tunisian banking sector exceeds the supply, which is making banks keep the lending interest rate at a high level. Our findings suggest that, in order to improve banks profitability, they have to increase their net interest margin by increasing the interest income. They will also raise the interest margin in order to cover increases in their operating costs, which will result in an increase of the ROA. Yet, it is indispensable to consider the excessive rate which can constitute a barrier and prevent banks from adjusting their interest rate of lending appropriately.

Proceeding to the control variables, our findings are in line with the literature, as we've established that larger banks are more profitable than small ones (Musah, 2017). This implies that bank size induces economies of scale, hence, making larger banks more profitable. Economies of scale reduce the costs of gathering and processing information. They could also mean that the bank's size is associated with diversification, thus, impacting favorably on both risk and on performance.

[28] Malik, M. F., Khan, S., Khan, M. I., & Khan, F. (2014). Interest rate and its effect on Bank's profitability. *J. Appl. Environ. Biol. Sci*, *4*(8S), 225-229.

As for the capital adequacy ratio, which had a significant relation with profitability, our result is consistent with the findings of Barnor and Odonkor (2013) as well as the findings of Naceur (2003) and Pasiouras and Kosmidou (2007). There exists a significant relation between CAP and banks profitability. Theoretically, this is interpreted by the existence of an optimal capitalization ratio for each bank, which needs to be respected, hence, banks need to remain well-capitalized. Moreover, a commercial bank with high enough capital can take higher risks. Thus, having higher income and absorbing shocks emanating from liquidity and credits risks, hence having higher profitability.

In addition, concerning the inflation and the growth of the GDP, we might say that there is some ambiguity. We found that the two measures have different impacts on the banks' performance. More precisely, inflation has a negative, but not statistically significant impact, which can only lead us to conclude that the profitability of Tunisian banks has no direct relation with inflation. Furthermore, theoretically, the inflation is an un-impiously evil phenomenon, but it has not been obviously proved by economists that it is totally a bad thing to economies. We can conclude that the inflation's effect is not direct, hence, the estimated coefficient is not statistically significant.

Concerning the volatility of the MMR (VTMM), we found a nonlinear relation between the latter and the bank performance. This can be interpreted as a non-direct relation between the two variables; thus, we can conclude that the volatility of the MMR doesn't directly impact the banks' profitability.

Seeing that, according to the literature, the MMR affects mostly the NIM, which in its turn affects the most banks profitability, we will take the main components of the NIM and test whether they are affected by the MMR.

Section 4: Impact of interest rate level on BH bank performance: an ARDL Cointegration Method

During this section we will focus on the BH Bank by modeling the principle components of the net interest income to see if they are sensitive to the change of the interest rate and also the speed of adjustment to their long-term value.

In order to achieve this objective, we will present the data used during this study and preliminary tests. Then, we will present our model and the results and discussions.

I. Data and methodology

Our methodology is based on the study of Pérez Montes and Ferrer (2018) which consists on taking into consideration the principal components of balance-sheet which have an impact on the net interest Income of BH Bank: Net loans and Deposits.

For the components of NII, two volume series are obtained from balance sheet reports and two average interest rates series are constructed from the ratio of P&L income or expense items and balance sheet stocks for the corresponding net loans and Deposits. For example, the series of average interest rate on net loans is obtained by dividing the series of interest income from credit exposures by the volume of interest producing credit. So, thee variable NII can be expressed by the formula:

$$\mathbf{NII} = \mathbf{Vol_c} * \mathbf{Rate_c} - \mathbf{Vol_d} * \mathbf{Rate_d}$$

where Vol denotes balance sheet stock, Rate denotes average interest rate, c indexes the net loans and d indexes the Deposits of the bank.

For the interest rate proxies, we use the money market rate (MMR), obtained from the Statistical Bulletin of central bank and the growth of the MMR (GMMR) from one period to another.

As controls for the state of the business cycle, we consider inflation, and real GDP growth data obtained from the Tunisian Ministry of Finance and the National Statistical Institute. All variables are measured bi-annually from 2005 to 2019 which allow us to study a full economic cycle including both expansive and recessive years.

1. Data Description

the Table (15) presents the main descriptive statistics of the interest rate and macro variables and the components of NII.This table shows the wide range of values of the macro variables over the sample period (e. g., inter-annual real GDP growth varies from –1.4% in 2011s2 to 6.6% in 2007s1). For the interest rate, it varies from 3.49% in 2011 s2 to 7.56% in 2019s2 which confirm that the monetary policy changed by the central bank which could constitute a risk on the bank performance.

Table 15 : Descriptive statistics of the data

	Mean	Standard deviation	Max	Min
Macro Variables				
GDP (%)	2.833	1.95	6.6	-1.4
INF (%)	4.886	3.32	20.58	1.85
MMR (%)	4.884	0.908	7.56	3.49
GMMR (%)	0.018	0.090	0.183	-0.233
Growth (%)				
Net Loans	4.97	3.53	11.93	-2.69
Deposits	5.98	4.39	12.76	-4.09
Interest rate (%)				
Net Loans	3.48	0.417	4.62	2.83
Deposits	2.09	0.414	3.42	1.47

The standard deviations are very small which means that all series are around the mean in which the growth of deposits has the highest stander deviation (4.39%) comparing with the growth of net loans which implies that deposits are more volatile. Concerning the average interest rate, we can conclude that both of the variables are not volatile.

Figure (5) presents graphically the evolution of the main components of NII in the period 2005-2019. Interest on loans and Interest on deposits follow a mostly positive growth trend with a peak in the second semester of 2019 and we see clearly that the two variables peak in the second semester of 2019, which is a year of maximum interest rates in which the effects of recession had not still materialized fully in the bank balance sheets.

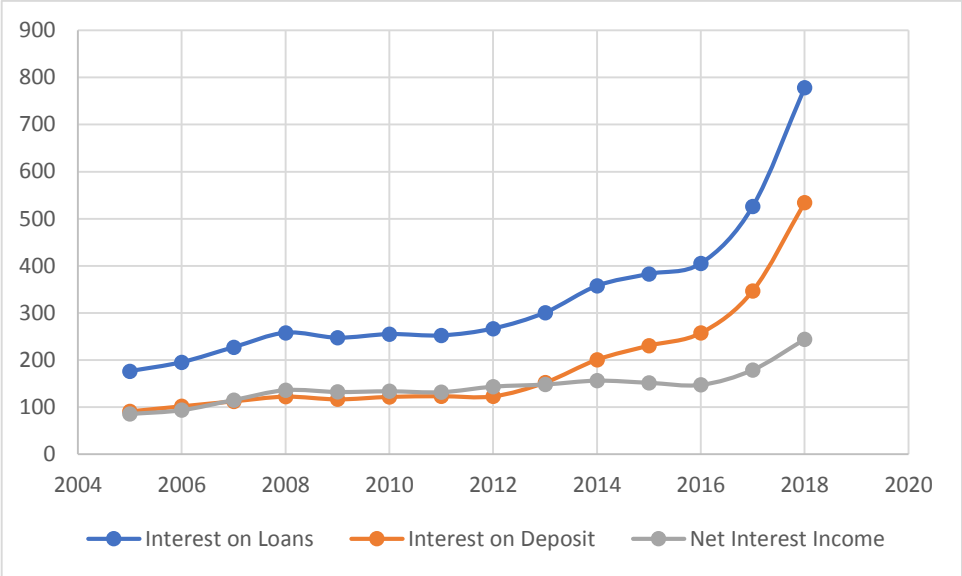

Figure 5: The evolution of net Interest Income and its components For BH Bank

2. Unit root tests

Before estimating our model, it is crucial to test the stationarity, normality and the unconditional correlation of the variables in our study, in order to determine if there are any problems.

a. Stationarity test

In order to test the stationarity of our data we will apply the ADF test, and to further verify its results, we will further test it by applying the PP test.

Table 16 : Stationarity tests For Credits and Deposits

Variables	ADF Test				PP Test				Integration
	Level		First diff		Level		First diff		
	T_stat	Prob	T_stat	Prob	T_stat	Prob	T_stat	Prob	
MMR	-1.432	0.5515	-2.851	0.0645**	0.7089	0.9902	-2.9369	0.0542**	I (1)
GMMR	-3.108	0.0380*	-5.441	0.000*	-5.6808	0.0001*	-16.484	0.0001*	I (0)
Av Rate Loans	-1.362	0.5846	-1.848	0.0624**	-0.7702	0.8121	-6.2249	0.0000*	I (1)
Av Rate Deposits	1.23	0.9976	-3.010	0.0466*	0.5492	0.9854	-3.0104	0.0466*	I (1)
Growth Net Loans	-2.92	0.0551**	-6.780	0.0000*	-2.9702	0.0502**	-7.6730	0.0000*	I (0)

Growth Deposits	-5.32	0.0002*	-6.594	0.0000*	-5.3231	0.0002*	-23.5173	0.0001*	**I (0)**
GDP	-1.923	0.3169	-5.270	0.0002*	-1.3320	0.6003	-3.5849	0.0131*	**I (1)**
INF	-7.656	0.0000*	-10.31	0.0000*	-5.5791	0.0001*	-12.068	0.0000*	**I (0)**

Notes: (*) Significance at 5%

(**) Significance at 10%

The results in table (16) show that five variables are stationary at level and the rest are stationary in order 1. It is therefore useful to note that all the variables used are stationary at level or order 1, a primordial condition for a good estimation of the ARDL model.

b. Normality test

In order to test the normality, we will verify the results by the Jarque-Bera test in which the null hypothesis suggests that the used data are normal.

As it shown in table (17), the GDP growth, growth of loans and growth of deposits are normal and the rest of the variables are non-normal.

Table 17: Normality test

	GDP	**INF**	**MMR**	**GMMR**	**G_Loans**	**G_Deposits**	**Av_Loans**	**Av_Deposits**
H	0	1	1	1	0	0	1	1
Test-stat	0.28	36.7	19.15	8.0722	0.08	1.65	5.82	16.894
P-value	0.86	0.00	0.00	0.017	0.96	0.43	0.054	0.0004

c. Unconditional correlation

Before proceeding with estimating the model, we will begin by analyzing the correlation matrix that lets us to know the sign (positive or negative) and the correlation force between the variables. This step is essential, according to many researchers because a very important correlation can lead to a problem in the estimation of the coefficients (multicollinearity problem).

This table in the appendix (2) shows that there is a very strong positive correlation between MMR and the average interest rate of loans (0.91) and the variable average interest rate of

deposits (0.96). These strong correlations were expected given the relationship between the variables that have the same trend. Since all the variables are integrated of order 1 and to eliminate the trend effect, we opted for the first difference correlation matrix which shows no strong correlation.

II. ARDL Model Result: BH Bank

1. Presentation of the ARDL Model

In order to estimate the impact of the interest rate on the different components of the net interest Income of the BH Bank that is why we opt for the ARDL Model.

This "Auto Regressive Distributed Lag" Model belongs to the family of dynamic models, it allows to estimate the short-term dynamics and the long-term effects for series cointegrated or integrated at different orders by the use of the Bonds-test from Pesaran et al. (1996), Pesaran and Shin (1995), and Pesaran et al. (2000). It combines the criteria of the AR models "autoregressive model" and models DL "model with staggered delays". In a dynamic model the dependent variable "y_t" can be explained by:

- His own values shifted in time(lags). This is called an autoregressive model "AR" which is expressed as follows:

$Y_t = a_0 + a_1 Y_{t-1} + \cdots + a_p Y_{t-p} + \varepsilon_t$ Or

$$Y_t = a_0 + \sum_{i=1}^{p} a_i Y_{t-i} + \varepsilon_t (\mathbf{1})$$

- Present values of the independent variables "X_t" and even their lagged values "X_{t-1}". This is referred to as the staggered delay distribution model (DL), which is written as follow:

$Y_t = \beta + b_0 X_t + \cdots + b_q X_{t-q} + z_t$ Or

$$Y_t = \beta + \sum_{j=0}^{q} b_j X_{t-j} + z_t (\mathbf{2})$$

We estimate through OLS the following ARDL equation for the variable of interest

$Y_t = \varphi + a_1 Y_{t-1} + \cdots + a_p Y_{t-p} + b_0 X_t + \cdots + b_q X_{t-q} + e_t$ Où

$$Y_t = \varphi + \sum_{i=1}^{p} a_i Y_{t-i} + \sum_{j=0}^{q} b_j X_{t-j} + e_t (\mathbf{3})$$

Where: « $\boldsymbol{e_t}$ » Error term; «$\boldsymbol{b_0}$ » represents the Short run effect of X_t on Y_t.

So, to have the long run relationship « $\boldsymbol{\lambda}$ » of X_t on Y_t , we have this long run relation: $Y_t = k + \lambda X_t + \mu$, which donates:

$$\lambda = \sum b_j \Big/ (1 - \sum a_i)$$

In this study, we search to evaluate the impact of the interest rate on the different components of the net interest income, that is why we will compute four models in which we will change in every time the dependent variable:

Y = f (**MMR, VKR, GDP, INF**) **(4)**

Where Y is going to take the growth of the different components of the balance sheet and the average interest rate.

- **Model 1:** Growth of loans
- **Model 2:** Growth of deposits
- **Model 3:** Average interest rate of loans
- **Model 4:** Average interest rate of Deposits

The presentation of the short-run effect and long-run effect of the ARDL Model will be:

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} a_{1i} \Delta Y_{t-i} + \sum_{i=1}^{q} a_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{q} a_{3i} \Delta INF_{t-i} + \sum_{i=1}^{q} a_{4i} \Delta MMR_{t-i} + \sum_{i=1}^{q} a_{5i} \Delta VMMR_{t-i} + b_1 Y_{t-1} + b_2 GDP_{t-1} + b_3 INF_{t-1} + b_4 MMR_{t-1} + b_5 VMMR_{t-1} + e_t \quad (\mathbf{5})$$

Following the procedure of Pesaran et al. (2001), we can confirm the existence or absence of cointegration between variables by the "ECM" error-correction model presented as follows:

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} a_{1i} \Delta Y_{t-i} + \sum_{i=1}^{q} a_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{q} a_{3i} \Delta INF_{t-i} + \sum_{i=1}^{q} a_{4i} \Delta MMR_{t-i} + \sum_{i=1}^{q} a_{5i} \Delta GMMR_{t-i} + e_t \quad (\mathbf{6})$$

2. Bound Test: Existence of Long-term cointegration relationship

In our study, the test we will use is Pesaran et al. (2001) which applies even in the presence of different sets of integration orders. this test is calculated according to the Fisher statistic and it is as follows:

- If calculated Fisher statistic > upper bound: Existence of a LT cointegrating relationship
- If Fisher statistic < upper bound: No existence of a LT cointegrating relationship
- If lower bound < Fisher statistic <upper bound: No conclusion

In fact, the result of the "Bound test" shows that the Fisher statistic is higher than the upper bound for the different levels of significance. We therefore reject the null hypothesis and admit that there is a long-term cointegration relationship between the variables for all the models. (see appendix (3)).

3. Estimation Results

As we have mentioned above, we will present during this sub-section the results of the ARDL model in which we will detailed the long run relationship and the short run relation in order to specify the impact of the money market rate fluctuation on the net interest income of the BH Bank and so on the bank performance.

3.1 Short-term Dynamism

The short-term relation is a good tool to detect the effect of the interest rate changes on the different components of the net interest income because it presents the lagged effect of the variable on the dependent variable and thus, permits to know if there is a linear or non-linear relationship between the different variables in our study.

3.1.1 ECM Relation

The reparameterization of the ARDL models in error correction form offers a consistent information in which the error correction term a_0 measures the speed of adjustment of the dependent variable to their long-term value.

Table 18: Speed of adjustment of the different components of BH Bank NII

ECM coefficient	Model 1	Model2	Model 3	Model 4
a_0	-2.923 (0.0104*)	-2.923 (0.0006*)	-0.675 (0.0007*)	-1.04 (0.0447*)

(*) significatively at 5% level

In fact, the results presented outline that the error correction model (ECM) is very significant, with the expected negative sign of the error correction term for all models. First, this result confirms the existence of a correction mechanism and also involves a high rate of adjustment to equilibrium after a relatively rapid shock for the growth of net loans and also for the deposits.

With an important absolute value of this coefficient indicating a greater adjustment given a deviation from this long-term value and also it confirms the result of the bound test which present the existence of a long-term cointegrating relationship.

3.1.2 Short term models for balance sheet growth

We display the estimated ARDL models for the growth of the main balance sheet elements of the BH Bank in the Appendix (4). We observe that GDP growth is the most common control for the state of the business cycle, being present only in the model of the loans' growth. On the other hand, the inflation is present in the two models and there is a linear relation with the dependent variable. First order autoregressive dynamics are found sufficient to fit the data in Loans and Deposits with a significant coefficient which is a necessary condition for the significance of the model.

Focusing on the controls for the levels of market interest rates, the MMR enters through both linear and non-linear effects in the model for growth of loans, and in the model for growth of deposits.

The net effect of the money market on credit could be seen as a mixed effect: the linear coefficient is positive but the second and third non-linear coefficients are negative, which means a positive relation with the interbank rate at higher levels. At lower levels, the linear and non-linear effects cancel each other and the effect is expected to be non-significant.

On the same, the growth of the MMR receives a positive and linear coefficient in the model for loans' growth which confirm that the short run effect is non-significant on the bank's loans which lead us to conclude that the MMR have not a significant effect on the loans' growth in the long term.

Hence, this result means that banks tend to invest more in credit products when the level of interest rates is higher, altering the product mix of their assets and it reveals also that the MMR has a positive short run impact on the credit and it seems that BH bank choose to not transmit instantly the increase of MMR, to the cost of credits especially on the consumer loans since it is characterized by a lower risk and a relative comfortable margin with the aim to preserve their competitiveness.

Also, since the volume of the equipment acquisition, extension credit for firms and housing credits for households are more or less rigid to a change in the MMR compared to other credit categories could explain the growth of the loans' volume.

In the liability side, we observe that deposits present a negative linear and nonlinear short-term relation with the interbank rate. Thus, given these estimates, we might say that the bank will suffer from a decrease of the total deposits which can be interpreted as the increase in the MMR revealed a shortage of the liquidity in the banking sector and so, the bank need to be more competitive in collecting funds and this will have a negative effect in the short term.

But, in order to support the increase of credits' demand the BH bank has recourse to the term deposits which constitutes a refuge for the liquidity problem and also for the sight deposits which can also be remunerated at a maximum of 2% and so, agents with financing capacity are able to deposit more in the long term in order to take profit from this rise.

3.1.3 Short term model for Average Interest rate

The estimation results for the ARDL models of average bank interest rates are presented in the appendix (5).

The interbank rate enters non linearly all the interest rate models, where it presents a non-linear lagged positive effect for the average interest rate of deposits. This result is expected as the impact of the interest rate cannot be detected in the short term and so there is not a significant effect of the increase of the interbank rate on the average interest rate of loans and deposits and this confirms the long run relationship in which the increase of the interest rate affect positively the average interest rate. This result can be interpreted as the bank will not immediately have an impact of the MMR's increase on its interest income and will not have an impact on the interest coming from previous credits and the same thing for the deposits that's why it's obvious that the short run relation is non-significant. But, the lagged effects of the deposits' rate variable are mixed: we must pass at least a year to hope to see the MMR stimulate deposits whose effects become significant after one semester and one year.

3.2 Long-term Dynamism

During this paragraph we will present the long-term relation between the different components of the NII and in order to have better results, we impose several simplifying assumptions to make the study process feasible. First, we limit the maximum lags of any explanatory variable to four and the same thing for the dependent variable in which the maximum lag is two, then, we choose the final specification to be implemented as that with the lowest value of the Schwarz Information criterion (SIC).

3.2.1 Estimated Models for Balance Sheet Growth

The result outlines that the GDP and the inflation rate are present in the deposits' growth and loans' growth models as a relevant macro control. (see appendix (6))

Focusing now on our variables of interest which is the money market rate and its growth, we find that the MMR has a positive effect on the net loans growth and also on the deposits' growth. In our case, a 1% increase in the MMR leads to an increase in the net loans' growth of 1.97% and an increase of 0.8% in the deposits' growth.

This result suggests that the increase of the MMR will cause in the long term a rise of credits and so, this will cause an increase in investment.

Therefore, increasing investment will also impact the demand for investment credit, and therefore elevate its volume. This should suggest that if a company needs funds, can still borrow from banking sector. This explanation is concurrent with the classical theory which confirm that interest rates are not determinants in the demand for money (Tang et al. (2015)).[29]

Concerning the deposits, the long-run effect of the rise in the MMR is positive also, which we can say that people tend to deposit more, when there is a high interest rate and in the Tunisian context in which there is a lack of liquidity banks are more competitive towards collecting funds and this result present that the BH bank has made a good effort in collecting deposits despite the increase of the rate but in the same time, it searches to satisfy the increase in credits' demand and so ensuring a stability in terms of liquidity and to take profit from the spread between the received and paid interests.

An advantage for the BH Bank, is that the positive effect on the loans is more important comparing to the deposits which confirm that at high level of interest rate, the structure of its balance sheet is favorable to the increase of the MMR but in the same time, at a low level the increase of the MMR will affect negatively the loans' growth.

As a conclusion from this results, we might say that the transmission channel of the monetary policy (key rate) become inefficient to achieve the objective of the central bank in which the latter increases the key rate in order to minimize the volume of credits especially the consumer credits, but the study of the long term relation between the loans' growth and the MMR of the

[29] Tang, M.M., Puah, C-H., & Liew, V. K. 2015. The interest rate pass-through in Malaysia: An analysis on asymmetric adjustment. International. Journal of Economics and Management 9(2) : 370-381.

BH Bank which is a prestigious bank in the sector show that the relation is positive and the bank generates more profits.

3.2.2 Estimated Models for Average Interest Rates

The estimation results for the ARDL models of average bank interest rates are presented in the Appendix (7). For this set of models, the long run coefficients on the MMR or GMMR in the model for interest rate on Loans are significant and point to the existence of a long-term relation between the interbank rate and the average interest rate in which an increase of 1% of the interbank rate will cause an increase of 1.93% in the average interest rate of loans. This result is expected as the credits are indexed on the MMR and so, the increase of loans' volume will lead to an increase in interest and the bank will receive more profits in the long term.

Concerning the average interest rate of deposits, we found that an increase of 1% of the MMR cause an increase of 0.51% in the average interest rate which is expected especially in the Tunisian context in which banks are searching to collect funds even with high rates in order to remedy to the problem of the liquidity shortage.

The results of the BH bank average interest rate exhibits an expected result as the rise of the loans and deposits will lead in the long term to an increase of interests and our model show that the increase of the MMR has a positive effect on the interest which seems expected as the bank will raise the cost of its credits in order to preserve its profit and also, in the same vein the latter will be obliged to pay more interest on deposits in order to maintain the liquidity level and to be more attractive especially for the term deposits.

3.3 validity tests

After interpreting the results of the different models, in this next step, we focus on checking the three main hypotheses, namely: the heteroskedasticity test, the error autocorrelation test and stability test of the coefficients of the Model, so that the model remains globally significant and not to fall into false regressions. According to the results, we therefore accept the null hypothesis of homoskedasticity (ARCH Test P(T-stat) > 0.05) for all models, and we find an absence of autocorrelation (Breusch-Godfrey P(T-stat) >0.05. concerning the Cusum test, the coefficients are stable over time, so we reject the hypothesis of structural change (see appendix (8)).

4. Bank Income responses and Interest Rate Shock

We perform in this subsection a sensitivity analysis of bank income components to market interest rate (MMR) by constructing the impulse response of the different components of the BH bank balance sheet. Impulse response function used to correlate the effect of shock among the set of variables in the dynamic system when pulse responded to the variables change, it also used to estimate a small number of parameters and without imposing any restriction in the economy. This study adopts unrestricted VAR analysis and the graphical representations of the impulse response functions of the MMR shock to the different variables are given in figure (6).

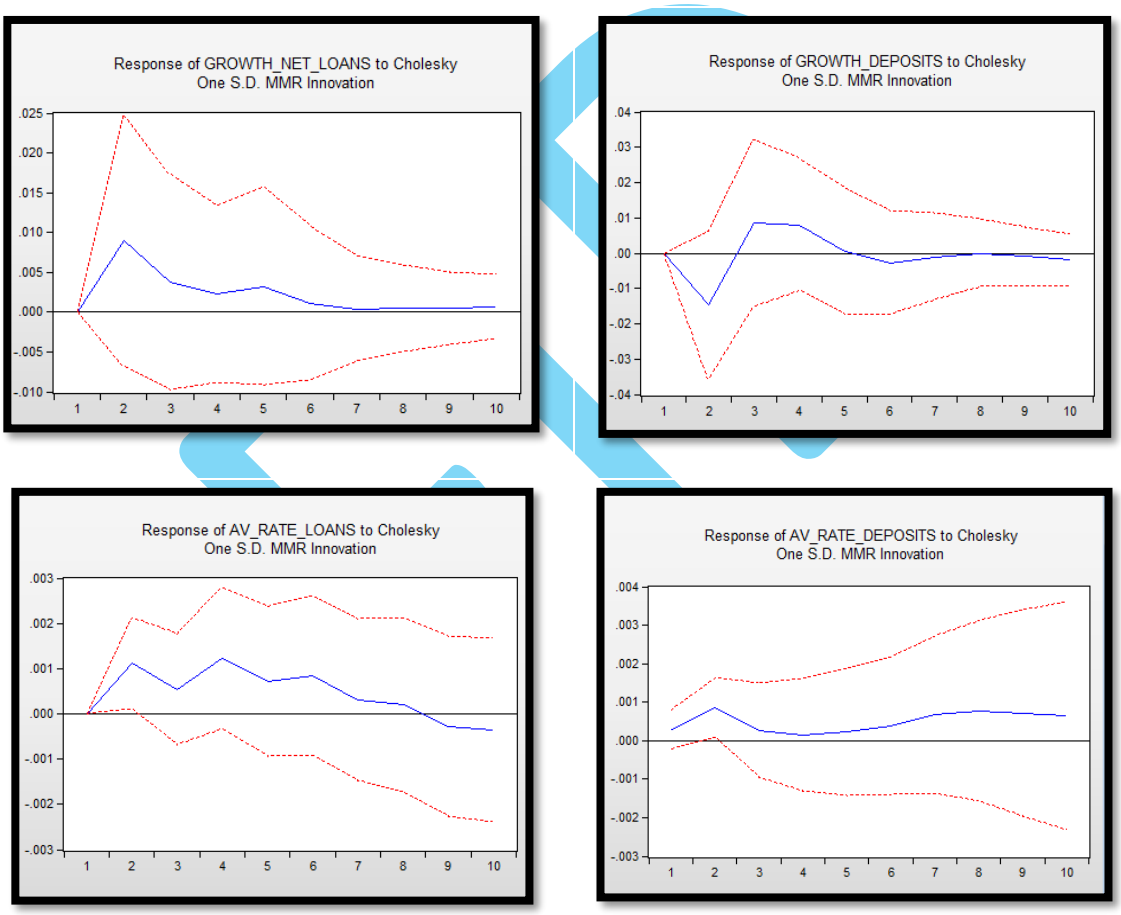

Figure 6: Impulse response of the different variables to MMR positive shock

A positive shock on MMR variables results in an immediate positive response of the loans growth that lasts two periods to reach its max after there is a gradual return to equilibrium that requires almost 4 periods. Concerning the deposits growth, we find that the latter has an immediate negative response that lasts 2 periods and then there is a slightly increase on the third period, and after that, there is a return to the equilibrium.

For the average interest rates, we found that the positive shock of the MMR has a positive effect on the average interest rate of loans in which we have a bullish trend that lasts 6 periods but there is not a return to the equilibrium which presume that the shock effect will be continued. The same thing for the average interest rate of deposits, we might say that there is a slightly increase on the first period and then return to the equilibrium.

Conclusion

In this chapter we opted for the use of different methods in order to examine the impact of the interest rate on the bank profitability. As a first step, we based our work on the panel model in which we regressed the ROA by a different explanatory variable that we give more interest to the interest spread, the net interest margin and the volatility of the MMR. The results confirm the significance of the interest spread and the net interest margin of a bank in explaining the level of profitability but, the volatility does not give a significant impact in which we have assume that there is a nonlinear relation between the MMR and the ROA ratio.

After this result, we have conducted another study in which we evaluate the interest rate impact on the different components of the net interest income of the BH Bank through the ARDL model.

We find that in the long term we have a positive impact of the MMR on the credits' growth and on the deposits' growth but the net effect is seen to be more important on credits which implies that BH bank will benefit from the increase of the money market rate due to essentially the structure of its balance sheet.

As for the impulse response function, we found that in the short term the impact of a positive shock on the MMR has a positive impact on credits which implies that the latter is not affected really by the change in the interest rate contrarily to deposits which will decrease in the first two periods due to the shock and then as a cumulative interpretation we may say that the increase of the MMR does not affect the net interest income of the BH Bank and it promotes the credits' volume then, more interest and at the end an increase in the net interest income.

Summary and Conclusions

During these recent decades, the international sphere experienced huge difficult financial and economic situations that had big costs and harmful effects on the whole economic well-being. These shocks highlighted the violent and systemic nature of the transmission of financial crises to the banking sector where the latter does not remain stable especially with the market risk in which the change in interest rate may cause distortions. These events reflected the fragile nature of the financial system, where much effort has gone into trying to prevent and limit the harmful effects of crises by setting entities of risk management.

Our problematic was to demonstrate the impact of the interest rate changes on the whole banking sector performance by empirically verifying the significance of a set of variables in which we choose three variables which are proxies of interest rate (IntSp, IM and VMMR).

On one hand, the panel estimation of 10 quoted Tunisian banks shows different results. the obtained results could also be interpreted by referring to the loanable funds theory. It says that the interest rate spread will be high if the demand for loanable funds exceed the supply. This means that the demand for loans in the Tunisian banking sector exceeds the supply, which is making banks keep the lending interest rate at a high level. Our findings suggest that, in order to improve banks profitability, they have to increase their net interest margin by increasing the interest income. They will also raise the interest margin in order to cover increases in their operating costs, which will result in an increase of the ROA.

In addition to that, the non-significance of the volatility of the money market rate on the banks' performance measured by the ROA ratio suggests that the relation is non linear and also, the transmission channel of the monetary policy which is the key rate has no effect on the bank performance as banks are managing the market risk in a way the changes in the MMR has not a significant effect on banks credits that is why we found a positive coefficient between the net interest margin and the ROA ratio.

On the other hand, referring to **Pérez Montes and Ferrer Pérez (2018)** study we performed an analysis study of the net interest income of the BH Bank in order to assess the different effect on credits and deposits which are the main components of the NII.

Breaking down the components of profit variation can be useful to evaluate the impact of these changes on different bank stakeholders. We find that higher interest rates lead to an increase in loans' growth in which we can say that banks in Tunisia continue to boost the traditional activity even if there is a high rate level. Even though higher rates can boost NII growth at high interest rate levels, they lead to higher provisioning charges, dragging net interest related profitability.

At high interest rate levels, further interest rate increases are found to deteriorate profitability both through credits and deposits. The relation between the interest rate level and bank profitability and balance sheet structure is therefore nonlinear, varying as a function of the level of interest rates and bank balance sheet composition.

In addition to that, the impulse response function was conducted in order to determine the behavior of each assets and liabilities' side to a positive shock of the money market rate. We found that the credits have a positive and immediate reaction contrary to the deposits which have a negative reaction and this led us to say that the increase of the MMR have no longer a significant effect on the net interest income and so on bank performance.

In fact, the results of our research have important implications in terms of economic policies in which the latter show a crucial interest in the decisions of the monetary authorities. They condition the definition of the measures to be put in place in order to reach the objective of reducing the credits' volume by increasing the interest rate but, this conventional method remain insufficient since we assess to the opposite effect in the Tunisian context and this increase has a harmful effect in which the increase of credits, especially consumer loans will lead to an increase in global consumption and so it affects positively the inflation which is the main objective of the Tunisian central bank. That is why, it is more interesting to adopt global strategies and unconventional methods with the aim to reinforce the economic well-being.

Finally, we might say that this work is not comprehensive and in this case, we propose improvements that may constitute an extension of this work or suggestion of future scientific research in which the principle axes are: the improvement of the data frequency and increasing the observations' number, also we opt for testing the significance of each channel of transmission in the balance sheet by building proxies in each side and assess the optimal methodology of a bank market risk management, at the end we may say we could opt for the GARCH models which have more interesting results especially concerning the volatility persistence.