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End of Studies Project

Topic

Assessment of the credit channel in Tunisia and its effectiveness in transmitting monetary policy changes during the subprime crisis

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ABSTRACT

In this study, we examine the bank lending channel in Tunisia and the influence that the subprime crisis could have had on the transmission of monetary policy changes in order to examine the viability of the credit channel in Tunisia. The monetary policy instrument we used was the Tunisian monetary market rate (MMR), and for the subprime crisis we used a dummy variable that is equal to 1 in the period of the subprime crisis and 0 if not. We also consider the extent to which banks' specific characteristics, that showcase their financial strength (size, capital strength and liquidity) affect their response to monetary policy changes. To do so, we gathered our data from 15 conventional Tunisian banks (Public, Private and Mixed) operational during the period 2005-2019 which led us to the use of panel data analysis. The results showed that the monetary market rate has an important, negative, and significant impact on loans' growth of Tunisian banks. Furthermore, other factors did not mitigate the effect of monetary policy changes which means that the bank-lending channel operated effectively in response to changes in central banks' rates. The results also showed that the subprime crisis had a positive and significant, but moderate effect on Tunisian Banks' loans' growth which led us to the conclusion that the credit channel in Tunisia is viable even in periods of financial crises. As for the banks' specific characteristics, our findings were coherent with numerous previous studies, at the exception of banks' liquidity that had an insignificant impact while size and capital strength had a significant impact on loans' growth.

Keywords: *Monetary policy, Transmission channels of monetary policy, financial crises, Tunisian banks, Panel data analysis.*

Résumé

Dans cette étude, nous examinons le canal du crédit bancaire en Tunisie et l'influence qu'aurait pu avoir la crise des subprimes sur la transmission des changements de politique monétaire afin d'examiner la pertinence du canal du crédit en Tunisie. L'instrument de politique monétaire que nous avons utilisé était le taux du marché monétaire tunisien (TMM) et pour la crise des subprimes nous avons fait recours à une variable muette égale à 1 si nous sommes en période de crise des subprimes et 0 sinon. Nous examinons également dans quelle mesure les caractéristiques spécifiques des banques, qui mettent en évidence leur solidité financière (taille, solidité du capital et liquidité) affectent la réponse des banques aux changements de politique monétaire. Pour ce faire, nous avons collecté nos données auprès de 15 banques tunisiennes conventionnelles (Publiques, Privées et Mixtes) opérationnelles au cours de la période 2005-2019 ce qui nous a conduit à utiliser l'analyse de données de panel. Les résultats ont montré que le taux du marché monétaire a un impact important, négatif et significatif sur la croissance des prêts des banques tunisiennes et que d'autres facteurs n'ont pas atténué l'effet des changements de politique monétaire, ce qui signifie que le canal du crédit bancaire a fonctionné efficacement en réponse aux variations des taux de la Banque Centrale. Les résultats ont également montré que la crise des subprimes a eu un effet positif et significatif, mais modéré, sur la croissance des prêts des banques tunisiennes, ce qui nous a conduit à conclure que le canal du crédit en Tunisie est pertinent même en période de crise financière. Quant aux caractéristiques spécifiques des banques, nos résultats sont cohérents avec de nombreuses études antérieures, à l'exception de la liquidité des banques qui a un impact non significatif, la taille et la solidité du capital ont un impact significatif sur la croissance des crédits.

Mots clés : *Politique monétaire, Canaux de transmission de la politique monétaire, crises financières, Banques tunisiennes, Analyse de données de panel.*

SUMMARY

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LIST OF ABBREVIATIONS

ABBREVIATION	ORIGIN
CBT	Central Bank of Tunisia
ECB	European Central Bank
TSE	Tunis Stock Exchange
FMC	Financial Market Council
GMM	Generalized Method of Moments
LTD	Loan to Deposit
GDP	Gross Domestic Product
MMR	Monetary Market Rate
NPL	Non-Performant Loans
GLS	Generalized Least Squares

GENERAL INTRODUCTION

GENERAL INTRODUCTION

Monetary policy is described as the centerpiece of economic policy. The reasoning behind this is the fact that monetary policy is based on regulating the money supply of the country, which is entrusted to the central bank. The main objective behind this is to help the country reach its ultimate objectives which form what is known as the "magic square" (growth, full employment, price stability and external balance). To do so, the monetary authorities must pass their decisions through different channels that form a link between the monetary sphere and the real sphere (the real economy). These channels have been the subject of numerous studies over the decades, and we can distinguish three main channels namely: Interest rate channel, credit channel and other asset prices channel (Mishkin 1996). Moreover, the effect of these channels can range from key rates to aggregate demand.

Dealing with transmission channels implies considering the consequences that monetary policy changes can have on the real economy of the country. This statement supports the classics, who believed in the existence of the dichotomy between the real and monetary sphere, and automatically reject the quantitative theory that is solely based on the neutrality of the currency in affecting the real economy. Therefore, it is an important instrument in regulating the economy.

After the 1929 crisis, a new ideology emerged in the form of the Keynesian theory which opposed the classical theory by arguing that currency was more than just an instrument. In fact, Keynes asserted that currency could have its own demand thus making it active in and of itself. This theory was further cemented after World War II by assigning the extra role of fiscal policy to monetary policy.

However, roughly 40 years later after the establishment of the inflationary drift in the 1970s, economists started doubting the Keynesian theory as well as the Phillips curve. It was none other than the founder of the monetarist school, Milton Friedman, who helped revive these theories by showing that the Phillips curve was only valid in the short term. His reasoning led to the conclusion that inflation is purely monetary caused.

Soon after, the neo-Keynesian school of thought re-established the non-neutrality of currency using the principle of nominal rigidity and information asymmetry. This meant that money has real effects in the presence of rational expectations.

Therefore, the two conclusions of the history of economic thought are that the correlation between the monetary and the real spheres exists, and that inflation is highly impacted by monetary decisions.

The general conclusions of economic thoughts laid the foundation of what we know today as monetary policy. They helped the central banks better understand the possible impact of their decisions on the real economy and ensure that the transmission channels function correctly in order to achieve a stable environment for economic growth and price stability. The sensitivity of the role played by the central banks explains their independence from political power which allows them to maintain and reach their objectives without any interference. As a matter of fact, the economic literature has identified transmission channels, of which we can cite two main traditional channels. The interest rate channel, which conveys changes from monetary policy to investment and consumption, and the exchange rate channel that gives an international dimension to monetary transmission.

The transmission channels of monetary policy have changed over the years. They were always known as three, with the interest rate channel being the privileged one. As time went by and financial evolution began to expand, more channels emerged. The interest rate channel was always the preferred channel for monetary authorities because it seemed to affect the real economy more directly. However, this has long changed due to the financial evolution that the world has known and the subprime crisis that stuck the United Stated of America with a huge recession. During this crisis, monetary authorities resorted to the interest rate channel by lowering their key interest rates to the point where they came very close to the zero bound. These measures weren't as efficient as they used to be in past recessions as they did not help in reviving the economy. The ineffectiveness of the interest rate in a period of financial distress pushed authors to dig deeper and analyze the role of the banking sector in this chain of transmission by integrating the bank credit variable in their analysis. The results showed that the reason behind the failure of the interest rate channel is that the distribution of credits was very weak in the US economy. This has cast some doubts on the effectiveness of monetary policy transmissions through interest rates.

Theories related to transmission channels where contradictory as every author defended his beliefs and the transmission channel that he considers to be the most effective. For example, on one hand, Keynes was always in favor of the interest rate channel in effectively transmitting the monetary policy changes. On the other hand, the monetarists believed that other assets price channel is the go-to channel. Furthermore, considering the asymmetry of information, other

authors were in favor of the bank lending channel. Bernanke and Blind conducted two studies to empirically verify their CC/LM model based on US data. The first study involved a test of macroeconomic data, which explained the connection between financial, monetary, and real variables. The second study was based on more detailed data by analyzing the incomplete substitution between securities and loans. All research results strongly supported the existence and effectiveness of credit channels in currency transmission.

Choosing on which monetary transmission channel to focus depends on the country's level of development since the choice of channel results from the type and nature of the economy in which monetary policy operates. For example, credit channel is the most suitable one in an economy characterized by a strong involvement of banks in financing.

In developing countries, the banking sector plays the leading role in the financing and development of the economy, since a very large volume of transactions in the real economy is carried out through this system. For example, in the Tunisian economy, the banking sector has been called upon in numerous occasions to play a leading role in the financing of investment projects and business operations. This economic situation is due to the narrow stock market. In addition, the non-convertibility of the Tunisian dinar, combined with the specificities of the Tunisian foreign exchange market, has limited foreign funding. Therefore, the Tunisian banking sector is required to become the main promoter of corporate and even household financing.

For years, the Central Bank of Tunisia (CBT) has adopted a discretionary monetary policy with the objective of accomplishing its main mission of preserving price stability. To do so, the CBT conducts its monetary policy by acting on its main instrument. The transmission of the interventions of the CBT takes time to directly target the designed objective; Therefore, the optimal conduct of monetary policy requires a good evaluation in terms of the degree and time of reaction of each of the channels to the usual monetary policy transmission. This is especially important if the economy faces some unwanted challenges. For example, the subprime crisis did not greatly affect the Tunisian economy, nevertheless, Tunisia faced many problems, that were amplified after the 2011 revolution that led to huge unfortunate impacts on its economy especially on the GDP, inflation and Tunisian banks' liquidity. This caused the monetary authority (CBT) to intervene many times to revive the economy through different transmission channels using its monetary policy instruments, manipulating the key rate and adjusting the minimum reserves required. As stated earlier, the Tunisian economy is strongly dependent on the Tunisian banking sector. This explains why, considering the high pressure exerted on Tunisian

banks after 2011, the monetary authorities set financial stability as one of the main objectives of the Central Bank.

Consequently, it seems relevant for us to try to answer the following question:

How effective is the credit channel in Tunisia in transmitting monetary policy and how did it perform in the period of the subprime crisis?

Our research further strengthens the available empirical literature. In fact, there are multiple studies that deal with the choice between the different transmission channels, as well as the extent of the effect of a change in monetary policy on bank lending activity; the results of these studies are not subject to consensus. This justifies the need for more research on the behavior of the credit channel in developing countries that depend heavily on their banking sector for the financing of their economies. This will be achieved by constructing our model using a sample of 15 Tunisian banks. Our second contribution lies in the study of the effect that the international financial crisis that started in 2007 (subprime crisis) may have had on the behavior of the credit channel in Tunisia.

In the first chapter, we will present the theoretical framework, the different theoretical approaches to monetary policy over the decades and the definitions of our key concepts (monetary policy, transmission channels and financial crises). We will finish the chapter with the review of the corresponding literature to draw our conclusions about the possible relationships between the different key concepts.

The second chapter, dealing with the empirical study of the Tunisian case, will be divided into four sections. The first section will be dedicated to the presentation of the Tunisian economy, its characteristics, and the role that the central bank plays in regulating the Tunisian economy. The second section will include the details of the sample selection, the datasets used in the survey as well as the description and measurements of the variables and the different hypotheses of our research. In the third section, we will present the univariate analysis. Finally, in the fourth section, we will present the econometric analysis of the relationships and hypotheses tested, including the methodology adopted. It summarizes and discusses the empirical results and finally checks the validity of these results using robustness tests.

CHAPTER 1: REVIEW OF HISTORICAL LITERATURE AND THEORETICAL FRAMEWORK

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The purpose of this chapter is to summarize the state of knowledge in the literature concerning the concepts studied in this thesis.

This chapter will therefore be subdivided into four sections. In the first one, we will define the monetary policy and try to summarize the important theories related to the concept at hand. In the second section, we will present some of the important definitions regarding the transmission channels. This is to emphasize the role these channels play in assuring the good conduct of the monetary policy. We will also highlight the difference between conventional and non-conventional monetary policies. Third, we will define the concept of financial crises and present their different types. Finally, we will analyze previous studies linking our key concepts.

SECTION 1: MONETARY POLICY

Monetary policy is one of the economic policy instruments alongside fiscal policy and exchange rate policy. Its implementation is entrusted to the central bank of each country, which is responsible for helping achieve the "magic square": growth, full employment, price stability and external balance.

In this section, we will present some of the main definitions of monetary policy and we will establish its theoretical background.

1. Main Definitions

When it comes to monetary policy, even though there is an important amount of literature, we noticed that economists still face the challenge of giving an appropriate definition to the term. That is why monetary policy has several definitions which are not exclusive, but complementary.

R. Barre (1970), stated that monetary policy is "*an effective tool for balanced growth of overall economic policy, which is closely related to fiscal policy, price policy, and foreign trade policy.*". Whereas F.Jaffré (1996), defined monetary policy as " *an important component of general economic policy, because it ensures strong, sustainable growth and good social cohesion* " .

For J-L Bailly, monetary policy is "*the set of actions developed by a central bank and / or a government to influence the level of economic activity and maintain price stability by regulating the quantity and cost of money*".

These economists focused on the important role that the monetary policy plays in regulating the economy through its impact on economic activity.

On the other hand, there were researchers who took another approach to defining the monetary policy by focusing, not only on the role it plays in the economy, but also on its components.M. Burda and C. Wyploz (2006), defined the monetary policy as " *a series of measures taken by the central bank to affect the monetary and financial conditions of an economy*". This point of view was supported by V Lelievre and al. (2006), who stated that monetary policy is "*a series of actions formulated by the central bank and the government to influence the level of economic activity and maintain price stability by adjusting the quantity and cost of money*".

From the previous definitions, we can draw a general definition of monetary policy, one of the important elements of economic policy. The monetary policy is based on the principle of control of the money supply by the central bank, i.e., adjusting the quantity of money in circulation, taking into consideration the needs of the economic activity. Therefore, it can be argued that monetary policy aims to stabilize the currency by regulating the money supply. In addition, monetary policy uses specific instruments to achieve price stability through the interplay of interest rates and various tools, such as the open market, reserve requirement, and credit management. In this context, monetary policy is the main tool for achieving economic stability.

Most of the monetary policy's objectives are contradictory, making it nigh impossible to achieve them simultaneously. Therefore, the Central bank aims to achieve the objectives that he considers a prioritized subset of economic policy goals. The prioritized objectives are price stability economic growth, full employment, and external balance.

2. Fundamental theories of the monetary policy

The theories of monetary policy are numerous and cover different interpretations, and have evolved overtime. We will discuss the different theories and how they sat the foundation for nowadays economic policies.

1. Classical school

According to D. Ricardo in his book entitled "Political Economics and Taxation Principles, 1817", the economy can be divided into two spheres, namely the real sphere and the monetary sphere. It considers currency to be neutral with no impact on the real economy. In the real world, the law is that "supply creates its own demand". This law argues that the exchange of products with other products is still valid in a currency economy because, sooner or later, the money obtained from one single product sales will be used to buy a different one.

On the other hand, in the monetary sphere, quantitative theory states that money has a unique role that is determining the general level of prices: $MV = P*T^2$. The aim of this theory it to analyze the relationship between money supply and price. It is based on a causal relationship between changes in the money supply and changes in the general price level. O. Pfersmann (1998) stated that "*all classical and neoclassical schools have proved that money plays a very important role in price, and that their analysis is integrated in the quantitative theory of money*".

In conclusion, the underlying idea behind the quantitative theory is that money only influences the general price level but doesn't exert any influence whatsoever on the real economy. This is because real economic indicators (such as growth, unemployment rate, etc.), are perfectly separate and independent of monetary indicators (such as changes in the money supply).

2. The Keynesian theory of money

First, Keynes (1936) argued that money plays a determining role in the overall analysis of the economy, thus challenging the classical analysis. For Keynes (1936), " *money is active, it is not neutral, because it can be desired for itself* ". Thus, money plays a very important role in the economy, and it makes it possible to link the real sphere to the monetary sphere. In this context, Keynes, states that "*the essential importance of money stems essentially from the fact that it constitutes a link between the present and the future*".

To this end, money plays an active role in the economy and can influence production and employment.

Secondly, Keynes (1936) considers money to be a form of wealth, it is integrated via interest rates and viewed as a store of value. Thus, according to F. Comber and T. Tacheix (2001), money can be desired for itself and constitutes an element of the heritage of economic agents. According to Keynes, the interest rate is also considered as a monetary variable that allows us to leave traces on the real variables of the economy. This is why A. Heertje (1998)

mentions that " *the great novelty of Keynes is to have shown that money is not neutral, and is capable of inducing real effects through the intermediary of the interest rate* ".

Thirdly, Keynes believes that economic agents can choose between money and a money substitute. As a result, agents' preference for liquidity results from three reasons: precaution, transaction and speculation. M.Vaté defines the transaction motive as "*the need for currency for the current realization of personal and professional exchanges*". When it comes to the precautionary motive, it is considered as a way to provide security for the economic agents because it is used to face unforeseen expenses.

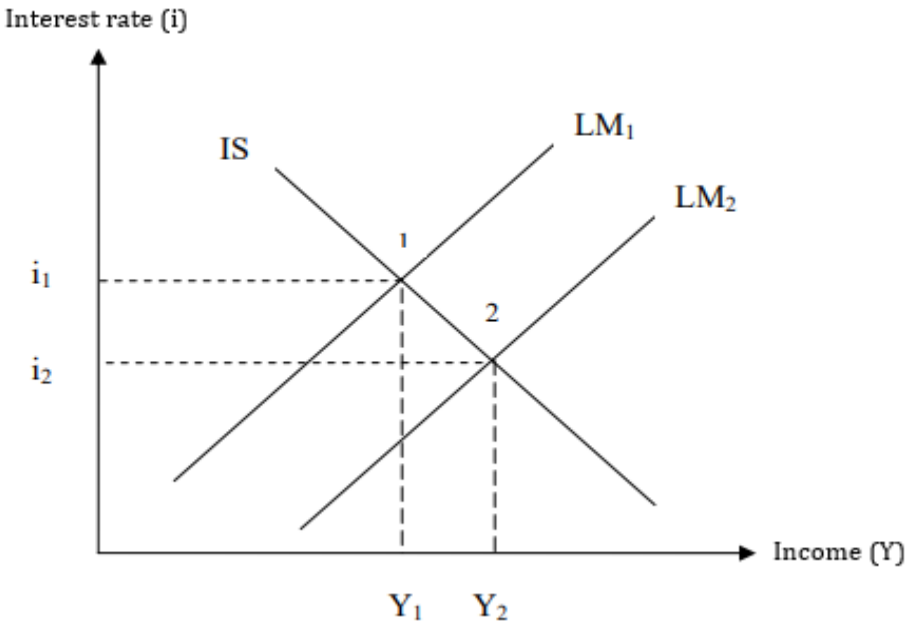
On the other hand, Keynes considers that "*the motive for speculation is the desire to benefit from better-than-market knowledge of what the future holds*".

2.1 Keynes and the IS-LM model

The IS / LM model is an economic model proposed by John Hicks in 1937.This model is an intersection between two curves, on the one hand the IS curve which represents the equilibrium on the market of goods and services. And, on the other hand the LM curve which represents the equilibrium on the money market. The intersection between the IS and LM curves makes it possible to obtain both equilibrium on the money market and on that of goods and services. This balance corresponds to the full employment balance.

B. Bernier and Y Simon, when it comes to the Keynesian monetary policy in the IS-LM model, stated that, when the interest rate falls, companies invest more because the return on investment is greater than the cost of borrowing. Therefore, the investment expenditure increases, and the equilibrium income rises. Thus, implying that the increase in income is explained by the interest rate’s influence on the investment expenditure.

Figure 1: Keynesian monetary policy in the IS-LM model



Source : B.Berrnier and Y.Siomon « Initiation à la macroéconomie », Ed Dunod, 8em Ed, Paris, P428.

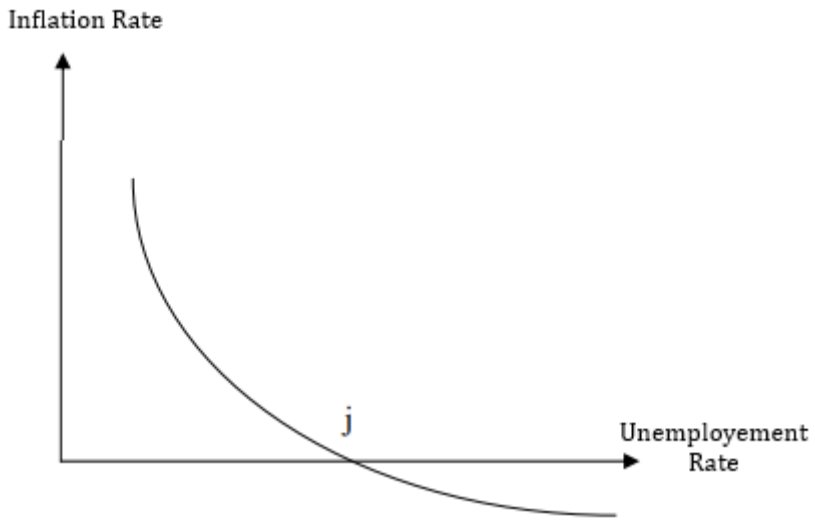
According to this model, any increase in the money supply translates into a fall in the interest rate. Graphically (figure n°1), this situation results in a shift of the LM1 curve to the right in LM2 and a displacement of the point of simultaneous equilibrium of the market for goods and services and money towards point 2.

2.2 Keynes and the Phillips curve

Originally, the Phillips curve is a relationship noted by its author A.W. Phillips, who analyzed unemployment data for the United Kingdom between 1861 and 1957 by comparing them to the rates of change in nominal wages. His study emphasized the existence of an inverse relationship between the rate of change in nominal wages and the unemployment rate. The explanation behind this statement is that, when the unemployment rate is low, companies have more difficulty recruiting employees thus forcing them to increase wages to attract new employees. On the other hand, when the unemployment rate is high, companies have no difficulty in recruiting employees. Therefore, they will not be obliged to increase the wages and they can even decrease them for some employees.

Keynes, reacting with this curve, argued that a trade-off is possible between the unemployment rate and the inflation rate. Thus, placing a new Point "j" on the phillips curve,as we can see in figure n°2, that corresponds to price stability, while full employment is not achieved.

Figure 2: Keynes and the Phillips curve



Source : G.Jacoud, « L'Europe monétaire », Ed Armand Colin, Paris, 2006, P143

This interpretation of Phillips curve by Keynes indicates that monetary authorities can lower the unemployment rate at the cost of rising inflation. Conversely, accept more unemployment to overcome inflation. Therefore, the choice of economic policy by governments is made according to the economic conditions of the country. Depending on the state of economic indicators, they decide between inflation and unemployment.

To sum up, John Maynard Keynes proposed a radically different approach, that of a production cash economy, breaking the previous dichotomy. His approach gave a new perspective to the money, more specifically, he rejected the idea that money is neutral and considered interest rates as money variables that affect the real economy.

The Keynesian monetary policy was first questioned by monetarists who consider it effective in the short term but not in the long term. Subsequently, the new classicals stated that Keynesian monetary policy is neither effective in the short nor in the long term.

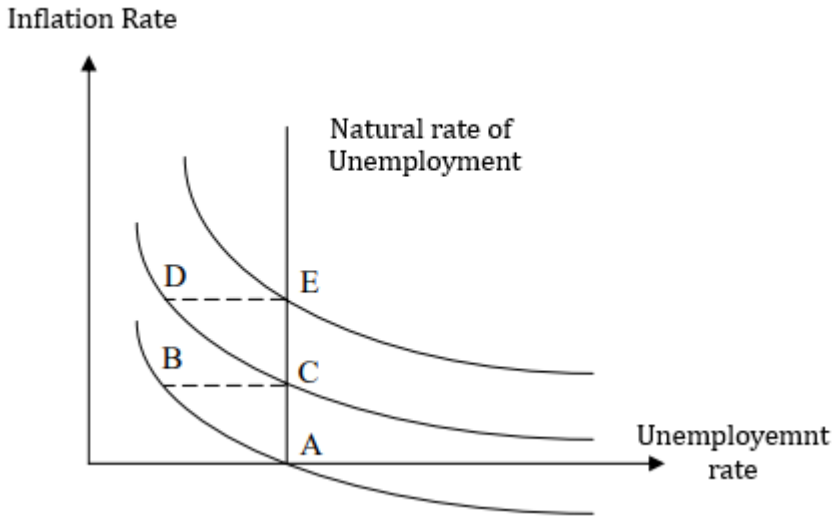
3. Monetarists

3.1 The critiques to the Phillips curve

The terms "monetary illusion" and " false expectations" characterized Friedman's critiques of the Phillips curve. This is because Friedman considers that Keynesian stimulus monetary policy may stimulate job creation in the short term, due to the two terms that we stated earlier, but in the

long run it will be ineffective in restoring full employment. In fact, M. Friedman (1956) states that, an increase in the money supply tends to lower the interest rate and thus stimulate demand for consumer and investment goods. This will force employers to increase employment and up their nominal wages to attract a new workforce. In the short term, this policy will lead to an increase in prices.

Figure 3: Interpretation of the Phillips curve by monetarists



Source: G .Jacoud, op.Cit, P144.

Over the long term, economic agents realize that their salaries are increasing less quickly than prices and that their purchasing power has diminished causing them to demand wage increases. The cost of labor then begins to increase and causes companies to reduce employment forcing unemployment to return to its initial level (situation C). Any further effort to reduce unemployment will only lead to a temporary improvement (situation D) and unemployment will return to its previous level (situation E).

3.2 The new quantitative theory of money

According to the new quantitative theory of money, money has an impact on the general level of prices. This is consistent with the quantitative theory of money according to which it is neutral in the long run and does not influence the general price level. Friedman showed that inflation always comes from the excessive issuance of money, that is, the increase in the quantity of money is the main determinant of the inflation rate. E. Kesler and O. Sichel (2000) support this view and point out that there is a connection between the growth of the quantity of money and inflation, that is, there is a

direct connection between the quantity of money and the price. grade. Therefore, it is confirmed that inflation is mainly caused by the increase in the money supply. On the other hand, in terms of short-term effects, the evolution of the amount of money will indeed affect the real economy, and currency shocks will have an impact on production. This is why Friedman believes that it is necessary to strictly control the money supply circulating in the economy to avoid inflation. To this end, L. Simon and D. Bellemare stated that "*central banks should increase the money supply according to strict rules*".

Friedman rejected Keynes's idea of the demand for money by agents, which is tied to the interest rate and depends on their current income and instead introduced the concept of permanent income, which is opposed to the idea of current income (short-term income). Friedman argues that the behavior of agents vis-à-vis the currency is linked to their permanent income. In this sense, according to Friedman (1989), "*the behavior of agents vis-à-vis money is not linked to the interest rate and does not depend on their current income, but on their permanent income. For this, he considers that the demand for money depends on the notion of permanent income which explains the demand for money"*. This means that the economic agent adjusts his cash balances not to his current income, but to his long-term income, which he (Friedman) calls permanent income.

According to Friedman's analysis, money is only one form of holding the wealth of any economic agent and that there are other forms like in stocks, bonds, and real assets. The economic agent seeks to determine the optimal composition of his wealth by considering its overall size, the relative prices and returns of the various assets as well as the preferences of the agents given by the utility function.

In summary, Friedman (1989) proposed a new theory of money demand, which is a new expression of the quantitative theory of money. His theory depends on the wealth of individuals and the expected returns of other assets compared to that of money. Ultimately, we can say that in Friedman's monetary analysis, money is active in the short term, while in the long term, it is neutral because it has no influence on the real economy.

SECTION 2: TRANSMISSION CHANNELS AND THE CONDUCT OF MONETARY POLICY

In this section, we aim to give a clear definition of the different transmission channels and highlight the main difference between conventional and non-conventional monetary policies.

I.Transmission channels

The actions of the central bank in monetary policy are transmitted to the real economy through several channels. These allow monetary authorities to accurately assess the pace and impact of their actions on the economy.

According to Frederic Mishkin, the monetary transmission channels have three main categories:

- The interest rate channel
- The credit channel
- The channel of the prices of other assets

1. Interest rate channel

The traditional interest rate channel can be traced back to the early work of Keynes (1936) and neoclassical synthesis. Main transmission mechanism of monetary policy in Keynesian theory, the interest rate channel concerns all the means by which the variation in key rates is likely to affect the real sphere, through investment decisions and consumption by businesses and households. According to the New Keynesian theory represented by the IS-LM model, monetary shocks are transmitted to the real sphere through the interest rate which is the privileged channel. (Hicks 1937). The IS curve makes it possible to visualize the equilibrium situations on the goods and services market as it corresponds to the (production and interest rate) pairs. On the other hand, the LM curve corresponds to the equilibrium on the money market, it gives us all the combinations (income, interest rate) corresponding to a situation of equilibrium between money supply and demand. In this model, the money supply is exogenous while the demand for money varies positively with income (transaction and precautionary motive) and negatively with the interest rate (speculation motive).

Mishkin (1996), states that the transmission mechanism through this channel can be indicated as follows:

"*Expansionary monetary policy* $\boldsymbol{M \Rightarrow i_r \downarrow \Rightarrow I \uparrow \Rightarrow Y \uparrow}$

Where M indicates the conduct of an expansionary monetary policy, which results in a fall in real interest rates (i_r); this lowers the cost of capital, which leads to an increase in investment expenditure (I) and hence to an increase in aggregate demand and output (Y)."

The statement presented above by Mishkin means that, in the presence of short-term rigid prices, expansionary monetary policy will cause the real interest rate i_r to fall. Which will reduce the cost of capital and stimulate investment spending denoted I. The increase in total demand therefore leads to an increase in the production denoted Y.

However, starting from the theory of expectations of the term structure of interest rates (Fisher, 1933), monetary policy measures affecting the interest rate to short term, also impact medium- and long-term interest rates.

According to Robinson (1965), a low interest rate policy promotes investment and economic growth. Reinforcing this point of view, Chandavarkar (1971) assures that fixing interest rates at appropriate levels allows to ensure the desired investment in volume and composition. Therefore, according to him, the interest rate must be kept low to stimulate investment.

Mc Kinnon and Shawn (1973), took the opposite view of this reasoning, and showed that low interest rate levels do not promote capital accumulation and economic growth. Indeed, low interest rates can stimulate investment demand. However, due to their relatively low level, they cannot generate the savings necessary to meet this new demand created. The result, therefore, is a decrease in investment. For these reasons, these authors advocate financial liberalization. Consequently, developing the theory of financial repression, they succeed in showing that interest rates kept at low levels could have harmful effects on savings.

This channel acts through these three effects: a substitution effect, a wealth effect, and an income effect.

a. Substitution effect

The interest rate channel can be analyzed through the substitution effect. In fact, a fall in the interest rate simultaneously reduces the cost of credit and the remuneration of savings. This favors the emergence of a substitution effect that stimulates immediate consumption at the expense of savings:

$\mathbf{i \downarrow \Rightarrow C \uparrow \Rightarrow Y \uparrow}$

b. Income effect

The interest rate can also be analyzed through its income effect (Modigliani, 1971) which impacts both the consumption and savings decisions of consumers. Changes in market interest rates have a broadly neutral effect on national income. However, due to the different consumption intentions of different types of economic agents, changes in interest rates will lead to income shifts. Therefore, the decrease of interest rate i increases the present value of financial assets, leading to the appreciation of household P's wealth. The result is that the household's permanent income Yp increases, so they are:

$$\mathbf{i \downarrow \Rightarrow P \uparrow \Rightarrow Y_p \uparrow \Rightarrow C \uparrow \Rightarrow Y \uparrow}$$

Being the rent of money, it can be analyzed both as the rate of return on a composite asset (financial security or physical capital) but also as a relative price or a financial burden. When considered as a relative price, it influences the composition of the portfolios of economic agents, the liquidity of the economy or the balance of current payments. Analyzed as a financial burden, it affects the production cost of companies and remains decisive in the choice between the different modes of production that are intensive in capital or in labor.

c. Wealth effect

It operates through fluctuations in the prices of financial assets. In fact, lower rates tend to increase household income which covers both future income from their human capital, physical capital, and financial capital.

To sum up, we are going to refer to Taylor (1995), who argued that the consumer spending and investment are significantly impacted by the levels of interest making this channel a powerful mechanism of transmission. On the other hand, Bernanke and Gertler (1995), argue that empirical studies have had great difficulty in detecting a significant impact of interest rates through the cost of capital. These experts believe that the failure of the interest rate as a transmission mechanism for monetary policy has encouraged the search for other mechanisms, including the credit channel.

2. Credit channel

The credit channel has been the subject of numerous studies in recent years. These studies observe the weakness of the traditional relations of the monetary channel and attempt to show the specific role of credits in the transmission of the impulses of monetary policy to the real economy. Some authors such as Tobin and Brainard or Modigliani, in the sixties, had underlined

the importance of the distortions between the costs of the different sources of finance and had shown how credit rationing could operate. Since the sixties, the advances of economic theory in incomplete information, as well as the weakening of the traditional relations of the monetary channel have made it possible to renew the approach to bank credit, which has prompted the authors to attempt to demonstrate its importance in the transmission of monetary policy.

In this research study, we are going to divide this channel into two channels (Bank lending channel and balance sheet channel) considered as two basic channels for the transmission of monetary policy (Mishkin 1996).

2.1 Bank lending channel

This channel is based on the idea that banks are well placed to resolve information asymmetries in the credit market. These financial imperfections intervene in the relations between banks and borrowers as well as between monetary authorities and banks (Kashyap and Stein (1995)) and argue that banks are confronted, like other agents, with problems of information asymmetry.

The theoretical foundations of the bank lending channel are highlighted by Bernanke and Blinder in 1988. These two authors presented a neo-Keynesian-inspired macroeconomic model, very often used in most studies related to the credit channel.

The model shows an economic system where banks are hypersensitive to monetary policy decisions. This high sensitivity is due to the banks' dependence on central bank liquidity. The latter has a monopoly on all bank-refinancing operations. In other words, banks are unable to issue debt securities or to solicit the financial market to escape the constraint of refinancing with the central bank. Alongside this reliance, there is a second dependency which is linked to bank financing. Borrowers do not have access to the financial market, they can only get financing from banks. With this double dependence, we thus have a highly hierarchical economy. This is likely to facilitate the progress of monetary policy decisions from the financial sphere, represented by the banks to the real sphere.

To track the transmission of monetary policy decisions, Bernanke and Blind used the analytical framework of the standard IS/LM model to make some important changes. Especially because of the information friction between the capital and credit markets. With the presence of informational asymmetries, we are falling into a universe where the market is now considered imperfect. This was not the case with the IS / LM model which describes a transmission channel where information is considered perfectly symmetrical. This gives market operators more leeway

in the event of an interest rate shock because they can easily substitute the various assets that make up their portfolio. On the other hand, banks have the possibility of arbitrage between deposits and securities. In addition, it is all adjustments made within the agent's portfolio that will result in a modification of the interest rate curve. These adjustments will modify the money situation, thereby changing the demand for currency. Moreover, the degree of transmission of monetary policy decisions largely depends on the degree of substitutability between different assets. The stronger the substitutability between assets, the larger the impact of monetary decisions on the real sphere. However, the degree of substitutability between assets is related to the information asymmetry between different participants in the capital market, and it turns out to be completely symmetrical.

On the other hand, in an imperfect market where it is impossible, according to Bernanke and Blinder (1988), to substitute bank loans and securities both on the liability side of the borrowers' balance sheet and on the asset side of lenders, bank credit becomes a powerful vector for transmitting monetary impulses.

This channel can be accompanied by rationing of credit. Rationing corresponds to a situation where the demand for credit exceeds the supply at the interest rate offered by the banks. Even though borrowers are prepared to take on debt at higher interest rates, banks refuse to grant them the requested loans. This situation is explained by the problems of adverse selection and moral hazard problems. A rise in interest rates from banks to balance supply and demand will lead to lower gross profits by attracting the riskiest borrowers and discouraging the least risky projects (Stiglitz and Weiss (1981)). Credit rationing will mainly affect small borrowers such as households and small and medium enterprises that have no other sources of finance, thus reducing their consumption and investment spending.

2.2 Balance sheet channel

The balance sheet mechanism looks at the effect of monetary policy fluctuations on the balance sheets of borrowers, primarily households and businesses. By affecting the external finance premium of borrowers in credit markets, monetary policy can affect the balance sheets of borrowing agents.

According to Mishkin (1996), this channel affects firms’ and households’ decision making when it comes to their investment.

a. Effect on firms

Monetary policy may affect corporate balance sheets. In fact, the weaker the company, the more serious the problems of adverse selection and moral hazard, leading to reduced loans and consequently reduced investment expenditures.

The deterioration of the company's net position depends on its external financing premium. For example, rising interest rates have a negative impact on the financial situation because it increases the financial costs and the cost of repaying debts. This leads to an increase in the risk premium for granting loans to the company.

As Mishkin stated in 1996, interest rates, stock prices, and general price levels are the three ways in which the monetary policy affects corporate balance sheets.

b. Effect on households

The analysis of the impact of monetary policy on household balance sheets runs through the impact of such policies on household wealth and consumer spending, especially durable goods and housing. Therefore, the impact of monetary policy on household balance sheets requires analysis of the impact of reduced bank loans and the impact of stock price fluctuations. In this case, the impact of monetary policy on household wealth works through the household's propensity to consume rather than the propensity to rely on bank loans.

3. Other asset price channel

Money impulses are not only transmitted through the interest rate and credits but also through the relative prices of other assets. These relate to currencies and stocks through the exchange rate channel and that of stock prices.

3.1 Exchange rate channel

If we take the case of open economies, the exchange rate channel acts as the main tool in the integration between the real and monetary spheres. According to Mundell (1962), in a flexible exchange rate regime, capital mobility implies a simple relationship between the interest rate and the exchange rate: the anticipated change in the exchange rate is equal to the differential between the interest rates of two countries. Thus, an expansionary monetary policy leads to a fall in interest rates which stimulates production through two effects:

- The increase in investment and capital outflows leading to a depreciation of the exchange rate;
- On the other hand, a boost to the production by increasing exports and reducing imports.

According to Dornbusch (1976), the liquidity effect induced by the initial monetary impulse stimulating domestic demand is also accompanied by an increase in foreign demand following a depreciation of the short-term exchange rate greater than the long-term depreciation. This point of view is refuted by real-cycle school theorists who believe that economic fluctuations are due to technological innovations and the better qualification of workers. From this point of view, monetary policy has only nominal effects and not real effects.

3.2 Equity price channel

Since the 1980s, the rise of direct finance and the transmission of financial assets in the economy have highlighted the importance of financial market channels as a new mechanism for transmitting monetary policy impulses.

Several authors have studied the financial market channel. Chami and Casino (1999), for example, state that "*The role of the stock market in transmitting monetary policy impulses is established through the imposition of key conditions in a general equilibrium with money model*".

There are two important channels involving stock prices for the transmission mechanism of monetary policy. This is the theory of the Tobin coefficient and the effect of wealth on consumption.

a. Tobin Q ratio

This theory establishes a mechanism by which monetary policy affects the economy through its effects on the valuation of stocks. A rise in stock prices increases the profitability of investments measured by the “Tobin Q ratio ", which is favorable to investment. If Q increases, the stock market value of companies will increase relative to the cost of renewing capital and new investments. Products are inexpensive relative to the stock market value of companies, which encourages investment. When Q is low, companies do not seek to acquire new equipment because their market value is low relative to the cost of capital.

The existence of a relationship between Tobin's coefficient (Q) and investment spending allows us to understand how monetary policy affects stock prices,

in a Keynesian and monetarist conception.

In fact, according to monetarists, when the money supply increases, agents feel that their liquidity is too high compared to what they expected, thus pushing them to try to reduce cash by increasing spending. For this reason, the financial market provides them with the

opportunity to consume this surplus, thereby increasing the demand for stocks leading to increased prices.

Meanwhile, for Keynesians, the fall in interest rates following an expansionary monetary policy makes investments in bonds less attractive than in equities, which causes an increase in their prices.

Mishkin (1996), summarized all the above in the following, simplified, mechanism of transmission of the monetary policy:

$$"M \uparrow ==> P_e \uparrow \Longrightarrow q \uparrow \Longrightarrow I \uparrow \Longrightarrow Y \uparrow"$$

-M: Money supply

-P_e: Stock prices

-q: Tobin Q ratio

-I: Investment

-Y: Production

b. Wealth effects

The transmission channel through stock prices acts through the effects of wealth on consumption. This channel was highlighted by Franco Modigliani. According to him, consumer spending is determined by the resources of consumers which are made up of human capital, material capital and financial wealth. As the price of stocks rises, the value of this financial wealth increases, and the resources of consumers will increase along with consumption.

II. The conduct of monetary policy

1. Conventional monetary policy

Monetary policy is the method used by the monetary authority to control, or at least to attempt to control the money supply. This is done by targeting interest rates to promote economic growth and macroeconomic stability. However, since central banks cannot act directly on the general level of prices or on real GDP, they must then choose policy instruments, which they directly control, to act on aggregate demand, according to the needs of the situation. In the implementation of any type of monetary policy, the essential method then consists in modifying the amount of the money supply of the economy. This is achieved by the use of various

traditional instruments which are the transmission channels that we mentioned in the previous subsection as well as other instruments.

1.1 Market intervention

Central banks can change the reserve volume of the entire banking system, either directly, through open market operations, or indirectly through the manipulation of policy rates and reserve requirement rates.

1.2 The off-market instruments

Apart from these three universally adopted market intervention instruments, there are other instruments available to central banks which were used at one time or another by some countries. Some of these instruments are credit supervision, selective credit controls, and foreign exchange controls to name a few. These instruments were in vogue especially before the 1980s, i.e., the return of market fundamentalism, during the period of Reaganism and Thatcherism. The objective pursued was to try to control the money supply directly and at the same time to channel credits to the economy, bypassing market mechanisms.

In some situations, the usual channels of monetary policy can become ineffective, leaving central banks with no choice but to move towards so-called unconventional measures.

2. Unconventional monetary policy

The transmission channels of monetary policy most often differ from one economic space to another depending on the size of the banking sector, the depth of the financial sector and the reforms implemented by the states. The interest rate channel, which is the main transmission mechanism of monetary policy in Keynesian theory, concerns all the means by which the change in the key rate is likely to affect the real sphere, through investment decisions and consumption by businesses and households. According to the neo-Keynesian theory represented by the IS-LM model, monetary shocks are transmitted to the real sphere through the interest rate which is the privileged channel (Dramani L., Diack B. and al., 2007, p. 11).

The rapid deterioration in the economic situation, a corollary to the 2008 crisis, required key rates to be cut down drastically such that, in many countries, the central bank's key rate reached or came close to 0% (Zero bound). In this context, the interest rate channel is quite inoperative.

The interest rate channel wasn't the only one to suffer during the crises, as a matter of fact, during the subprime crisis, banks recorded losses that reduced their capital base and their

ability to lend. Thus, with the deterioration of economic conditions and the increase in uncertainty, loans have become riskier and lenders more reluctant. This increased risk premiums, the cost of bank resources and discouraged borrowers from seeking financing elsewhere. The interbank market, the main source of refinancing for banks, was blocked due to a mutual loss of trust between stakeholders.

As traditional transmission channels, interest rate and credit channels, became powerless to guide the behavior of economic agents, some central banks have resorted to unconventional monetary policy measures.

Unconventional measures are temporary monetary policy measures whose objective is the re-establishment of the transmission channels of monetary policy and ultimately support for bank credit and liquidity on the money market. When traditional monetary policy transmission fail, unconventional monetary policies can be adopted to reach the wanted objectives (Drumetz and Pfister (2010). This could happen due to poor functioning of financial markets and / or when the conduct of an expansionary monetary policy becomes unable to stimulate activity because of the very low level of the nominal interest rate.

Unconventional monetary policies have some known advantages such as:

- Facilitating finding a transmission channel for monetary policy when the traditional channel no longer works.

- Allowing the control of the use of liquidity instead of injecting it at random, thus reducing the risk of subsequent bubbles.

Many authors emphasized on the fact that, in spite of the advantages which are recognized to them, they can have some disadvantages. The drawbacks are first of all microeconomic, linked to the fact that central banks are not normally commercial banks: how do they choose the beneficiaries of financing? How do they set the risk premiums? There is also the recurring question of the risk that there is to introduce in the balance sheets of central banks of assets presenting risks of default. In addition, an important point, if the decline in distributed credit comes from the demand for credit and not from the supply of credit, unconventional policies are also ineffective (Artus P., 2009).

SECTION 3: FINANCIAL CRISES

In this section, we will present the main definitions and different types of financial crises. Then, we will go through some of the recent financial crises that marked financial history in order to better understand what happened and how the central banks reacted to the crisis at the time.

I.Main Definitions

Since the 19th century, with the beginnings of the industrial revolution and the rise of capitalism, the notion of crisis has been one of the most widely used in economics. As Pierre Drouin wrote in 1983, "*if we entrusted the computer with the task of spotting the use of the word 'crisis' in French books, magazines and newspapers for ten years, we would be shocked by the result*".

According to Arvai and Vincze (2000), "*the financial crisis is a crisis that takes place in a financial market. We can distinguish four types of financial crises: currency crisis, debt crisis, capital crisis and crisis of the banking system. Each of these seizures can occur on its own or in combination with the others*".

It can also be defined as a significant variation affecting totally or partially the financial variables of an economy, which are the volume and price of securities, the outstanding loans and bank deposits and the value. currency. Usually, in times of crisis, financial markets collapse, securities decline, and bankruptcies multiply. Note that the magnitude of these effects depends on the type of market, the period and the country concerned (Bordo and al., 2001).

Mishkin (1996), defined the financial crises as follows " *The financial crisis is defined as a disturbance that affects financial markets. It significantly exacerbates every type of information asymmetry problem, making these markets no longer able to effectively direct funds to the most profitable agents for investment projects. The result is a sharp contraction in economic activity*".

The term financial crisis is applied to a wide variety of situations in which certain financial institutions or property suddenly lose a large part of their value.

1. Different types of financial crises

Four types of financial crises can be defined, namely: banking crises, currency crises, sovereign debt crises and stock market crises (Boyer and al. (2004) and Reinhart & Rogoff (2009)).

1.1 Banking crisis

In the case of banking crisis, Laeven and Valencia, 2010, observed obvious signs of weakness in the banking system, which can be explained by the sharp deterioration in the value of assets held by banks and/or large withdrawals of deposits, which may lead to bankruptcy The number of institutions has increased significantly and the supply of credit has shrunk sharply (Allen and al., 2009; Goldstein, 2013). In order to avoid the collapse of the banking system which would risk causing a paralysis of the economic system, banking crises are generally associated with a massive intervention by the public authorities aimed at managing the illiquid assets of banks and maintaining their access to liquidity (Laeven & Valencia, 2008).

1.2 Currency crises

According to Cartapanis (2004), a currency crisis can be defined as a situation in which "*a speculative attack causes a devaluation, at fixed exchange rates, or a sharp depreciation of the exchange rate, at flexible exchange rates, despite massive interventions by the banks. central*". Boyer and al. (2004) show that there are two methods for dating the onset of a currency crisis. The first considers that an exchange rate crisis occurs when the value of a currency, expressed in a reference currency, undergoes over a given period (usually a year) a loss in value above a certain level, generally set between 15 and 30% (Reinhart & Rogoff, 2011; Laeven & Valencia, 2012). The second method, for its part, calculates an indicator called "speculative pressure" which combines variations in the exchange rate, foreign exchange reserves, as well as the interest rate and considers that a currency crisis occurs when the variations of this indicator, compared to its average value, exceed a certain threshold, fixed in general at 1.5 times the standard deviation (Kaminsky, 2006).

1.3 Sovereign debt crises

A sovereign debt crisis corresponds to a situation in which a state is unable to repay its debt due, for example, to a rise in interest rates or an unfavorable economic situation. This situation results in either a default or the implementation of a debt restructuring plan which may take the form of " an extension of the repayment period, a reduction in the capital to be repaid or a reduction in interest rates (Reinhart & Rogoff (2009, 2011), Levy-Yeyati & Panizza (2011)).

1.3 Stock market crises (Krach)

As Mishkin & White (2002) and Boucher (2004) indicate, stock market crises are generally linked to the bursting of a speculative bubble and result in a significant drop in stock prices over a very short period. Traditionally, two measures, very similar to those used in the currency crisis literature, are commonly adopted to date a stock market crisis. The first considers that a stock market is in crisis if, during a given period, its price variations exceed a certain threshold, the value of which is generally set at 20%, with reference to the crashes of 1929 and 1987 (Mishkin and al. White, 2002; Boyer and al., 2004). The second method evaluates the differences between the extreme levels of an index over a given period (Boucher, 2004). The idea is to calculate a "tension" index which corresponds to the ratio of prices at period t to the maximum of the price during a reference period. A standard deviation of this index greater than a threshold fixed at 1.5 or 2 signals the onset of a stock market crisis (Boyer and al., 2004).

II.Crises that marked financial history

Economic history has been marked by many periods of financial crises. Many of these were associated with bank runs and other situations, which are often referred to as financial crises, are stock market crashes.

The history of economic facts has recorded at least 38 financial crises from the year 1637 to date. These are the most significant crises in history, which have been thoroughly analyzed by economists.

1.1 The Asian financial crisis in 1997

The Asian crisis was a structural crisis that was aggravated by the applied economic policies inspired by the Bretton Woods institutions. It affected the countries of Southeast Asia from July 1997 then spread, to a lesser extent, to other emerging countries such as Russia, Argentina, and Brazil.

Overinvestment and very high external debt levels are the underlying causes of this crisis, which started as a monetary crisis (important depreciation of Asian currencies). These countries affected by the crisis had enjoyed remarkable economic performance for more than two decades. They generally had balanced budgets, moderate interest rates and enviable macroeconomic positions. However, microeconomic imbalances had accumulated in the portfolios of bank creditors, management of exchange rate risk, price-term debt and the behavior of investors.

The arrival of waves of private capital in a liberalized financed environment had resulted in stock market and real estate bubbles, especially in Thailand. This change took place in mid-1997 and triggered a process of loss of investor confidence, capital outflows, monetary depreciation, business and debt difficulties and generalization of the financial crisis.

Monetary policy has been a key component of reform programs as the Asian financial crisis first manifested itself in the collapse. Oddly enough, the programs received critical criticism: some argued that countries should have raised their interest rates even further, while others believed that rising interest rates were only going to make the problem even bigger.

Several theorists have argued that in times of recession, the classic approach would be to lower interest rates and allow the currency to depreciate to revive economic activity. But the depreciation of currencies during the Asian financial crisis was meteoric as the Korean currency fell sharply in just one month. In such an extreme situation, the priority must be to stabilize the exchange rate before an inflationary spiral begins. The moment domestic prices are allowed to drastically increase, it becomes very costly to carry out the monetary tightening required to restore price stability.

The strategy followed by Asian countries was to raise short-term interest rates to slow down the exchange rate slippage, and then gradually lower interest rates as the currency stabilized.

1.2 Subprime crisis 2008

The 2008 crisis is more complex than the Asian one since a whole society had participated directly and indirectly thereby affecting the whole world. The subprime crisis is explained by the conjunction of three phenomena: macroeconomic imbalances, microeconomic dysfunctions, themselves coupled with high-risk financial practices.

Concerning the macroeconomic imbalances, Claudio Borio (2013) describes the situation best when he states: "*The credibility of the commitment of central banks to fight inflation can to be a double-edged sword. On the one hand, credibility reinforces other structural factors that may contain inflationary pressures. On the other hand, while long-term inflation expectations are better anchored around the central bank's target, unsustainable expansion phases may only be reflected with a delay in accelerating inflation... This paradox of credibility means that the central bank can be the victim of its own success. Bringing inflation under control can contribute to changes in the dynamics of the system that may obscure the risks to which the economy is exposed.* "

At the microeconomic level, all the ingredients of the crisis were there. We have many loans given to increasingly fragile populations coupled with the increasingly complex structure of said loans. This made it possible to finance the progression of collateral, thus, creating a bubble on assets and hiding the risks and their distribution.

Unlike its counterparts, the FED has a complex system and a specific structure which enables it to carry out the task of price stability. Nevertheless, its policy in the 2000s contributed to the expansion of a systemic crisis through the establishment of variable rate loans, known as subprime for non-creditworthy households.

In the case of the subprime crisis, the potential culprits of it are the American banks. They damaged systems economic; financial and real estate in several states in an attempt to get rich.

Banks were not the only culprits, of course. The nonchalance that was present at the level of the authorities responsible for regulation and control, as well as dangerous policies like that of the FED in the 2000s are to be called into question. This crisis weakened the economic system states but especially the banks, which had to rebuild themselves in the aftermath of this crisis.

SECTION 4: STYLIZED FACTS

A lot of empirical work has been carried out to establish the link between financial crises and monetary policies. In this section, we will critically analyze previous studies linking our key concepts, namely, the monetary policy, credit channel and financial crises. The goal is to determine the expected relationship between financial crises and monetary policies to establish a link between these concepts.

I.The nature of the link between financial crises and the credit channel

Many authors studied the relationship between financial crises and the classic credit channel to analyze the relevance of the latter in difficult times so that the monetary policy can adjust its future interventions accordingly.

The article "**Global financial crisis and its effects on the bank lending channel in the Colombian economy**" by David Rodríguez-González and Inés María Ulloa-Villegas (2020) studied the effect of the financial crisis that occurred in 2008 on the bank landing channel in the Colombian economy which is why we are going to review this article in depth.

1. Objectives

This article studied the effects that the subprime crisis had on the Colombian economy by examining the credit channel in a period of 20 years (1995-2015).

To simplify the mathematical aspect of the research, the authors supposed numerous hypotheses, namely,

- The bank has no excess reserves. It is understood that the demand deposits variable has an inverse relationship with the interest rate.
- The average market rates for term deposits and loans are directly linked to the benchmark rate with a constant spread
- Banks will always try to maximize their profits.

2. Models and results

2.1 Models

Taking into consideration the hypotheses listed above, they used two panel data models to analyze the credit channel. The first model analyzes how the behavior of the bank credit supply evolves in the face of changes in the benchmark interest rate considering the heterogeneity between commercial banks. The second studies the behavior of bank debt by companies, including heterogeneous aspects between them.

a. Model used for banks

$$Y_{it} = \alpha + \sum_{j=1}^{2} \beta_j X_{t-j} + \sum_{j=1}^{2} \gamma_j i_{t-j} + \sum_{j=1}^{2} \delta_j Z_{it-j} + \sum_{j=1}^{3} \theta_j i_{t-1-j} Z_{it-1} + \sum_{j=1}^{3} d_{ij} \emptyset_j + \partial Crisis + e_{it},$$

- α, β, γ, δ, θ, $\emptyset$ and ∂: The parameters to be estimated.

- Y_{it}: The logarithm of the supply of credit for bank i in a period t.

- X_t: Matrix that is composed of the real exchange rate and the real production index of the Colombian manufacturing industry.

- Z_{it}: Matrix that comprises the set of variables that capture the banking characteristics.

- Crisis and d_{ij}: dichotomous variables

-e_{it}: Error term

b. Model used for firms

$$RDB_{it} = \alpha + \beta RDB_{it-1} + \sum_{j=1}^{2} \gamma_j i_{t-j} + \sum_{j=1}^{2} \omega_j Z_{it-j} + \sum_{j=1}^{2} \theta_j Z_{it-1} i_{t-1-j} + \partial Crisis + e_{it},$$

- α, β, γ, δ, θ, ∅ and ∂: The coefficients to be estimated.

-RDB_{it}: The ratio of bank debt to total debt of company i at time t.

-i_t: Actual reference rate.

-Z_{it}: Matrix that contains the set of variables that capture the financial characteristics of the firms.

-Crisis: variable included in the model to capture the financial crisis experienced in the 1998-2000 period.

-e_{it}: The error term

2.2 Results

a. Bank results

The results that they found show that monetary policy has an impact on bank credit supply and corporate debt structure. For banks' estimates, there is evidence that in the pre-crisis period, financial characteristics such as the level of capitalization can produce heterogeneous effects of monetary policy transmission through credit channels. However, in the post-crisis period, monetary policy seems to have been distorted because the benchmark interest rate was no longer important.

b. Firm results

When it comes to firms, the results, in a dynamic panel, do not provide any evidence on the existence of the bank credit channel and on its possible distortion. However, when the authors used a random-effects model and took the period 1995-2015, they found that the global financial crisis influenced the structure of corporate debt. Before this crisis, there was a bank credit channel that impacted businesses in a heterogeneous way.

II. The nature of the link between financial crises and monetary policy

The global financial crisis had a significant impact, especially when it came to the different economies of the world. That is why every central bank was obliged to take drastic monetary measures to save the economy. These measures had an impact on important financial components such as stock prices and house prices which is why the work of Christophe Blot, Paul Hubert and Fabien Labondance (2012) in the article **"Monetary policy and asset prices in the euro area since the global financial crisis"** tried to assess the indirect impact of monetary policy on asset prices and the real estate markets since the global financial crisis.

1. Objectives

The main objective of this article was to analyze the effectiveness of monetary policy in guiding interest rates in the euro area since the crisis. To do so, the authors studied two important factors:

- The predictability of money market interest rates based on monetary policy expectations.

- The impact of unconventional central bank measures on money market interest rates.

This study also focused on the impact of those measures implemented by the ECB on stock and house prices during the period in question.

2. Models and results

2.1 Models

The following model is the main one that they used to capture the effect of monetary policy decisions on asset prices.

$$y_{t+h} = \alpha_h + \beta_h \epsilon_t . D_t + \beta_h \epsilon_t . (1 - D_t) + \sum_{i=1}^{K} \phi_{h,i} \cdot y_{t-i} + \eta_{t+h}$$

- y_{t+h}: Asset prices at the horizon h

- y_{t-i}: the lag of asset prices and the indicator of asset price imbalances

-D_t: Dummy variable for when there are restrictive monetary policy shocks

- α, β: the coefficients to be estimated

To measure stock prices, the authors resorted to two approaches.

a. Structural approach

The first approach is the structural approach using the Discounted Cashflow method as it is presented in the following model:

$$P_t = \alpha_0 + \alpha_1 .D_t + \alpha_2 . \rho_t + \alpha_3 \phi_t + \epsilon_t$$

- P_t: The log of a stock's real price at a given time
- D_t: Dividend associated to the stock
- ρ_t: long-term sovereign interest rates
- ϕ_t: Approximation of the risk premium
- α_0, α_1, α_2, α_3 : Coefficients
- ε_t: Error term

b. Data-driven approach

In this approach, a wide variety of macroeconomic and financial factors present stock prices which led to an OLS estimate of a specific stock price conditional to the given information.

$$P_t = \beta_0 + \beta(L) . P_t + \beta_1 .M_t + \beta_2 . F_t + v_t$$

- P_t: Stock price
- M_t and F_t: Vectors of macroeconomic and financial variables
- v_t: Error term

2.2 Results

The authors found that, since 2008, the policies of ECB (restrictive and expansionary monetary policies) impacted only stock price imbalances in Europe. Conversely, the house price imbalances weren't affected by either of them.

The impact of the ECB policies on stock price imbalances is due to the information shock and not to the policies themselves which suggests that investors, when processing the monetary policy decision, react to the information transfers.

III. The effects of the 2007 crisis on the credit channel and monetary policy

After the subprime crisis, to soften the impact of the crisis and restore the economy, many central banks used conventional measures whilst others opted for non-conventional ones. This divergence in choice spiked the interest of researchers to dig deeper and analyze whether the unconventional measures were more efficient than the classic ones in reviving the economy post-crisis.

The article " **The bank-lending channel and monetary policy during pre- and post-2007 crisis** " by Evangelos N. Salachas, Nikiforos T. Laopodis and Georgios P. Kouretas (2017) studied the influence of the monetary policy on the credit channel before and after the subprime crisis to try to settle this debate.

1. Objectives

In this article, the authors assessed the impact of monetary policy on bank credit channels before and after the financial crisis using conventional and unconventional measures.

To test these measures, the authors used the following specific variables:

- The asset purchases ratio in the central banks' balance sheets is used to quantify unconventional measures.

- The (real) short-term central bank rates are the main conventional monetary policy instruments.

2. Model and results

2.1 Models

The study was conducted using yearly macroeconomic and financial variables for 480 commercial banks on a period of 13 years (2001-2013). The banks selected were the top eighty commercial bank in every country present in the study (US, UK, Japan, Germany, Italy and France).

The study was divided into 2 steps and each step used a different model. The first step was to run separate cross-sectional regressions for each year of observations using the following model:

$$\Delta \log(Y_{i,t}) = a + \Delta \log(Y_{i,t-j}) + \beta_t X_{i,t-j} + Controls + \varepsilon_{i,t}$$

- $Y_{i,t}$: The loans growth of each commercial bank i in a period of time t

- $X_{i,t-1}$: The bank liquidity measure

- Controls: control variables (Bank size, capitalization and efficiency)

- $\varepsilon_{i,t}$: Error term

To detect the extent to which bank lending behavior varies with monetary policy shifts and to estimate the coefficients β_{it}, the authors proceeded to the next step in which they used β_{it} as a dependent variable in the following model:

$$\beta_t = \delta + k_j MP_t + zGDPgr + Controls + \upsilon_t$$

- MP_t: Indicator of monetary policy

- GDPgr: GDP growth

-Controls: Control variables

-v_t: Error term

In the second approach, they tried to directly capture the impact of both conventional and unconventional monetary policies on credit expansion. This was done whilst focusing on the interpretation of interactive items using the following one-step model:

$$\Delta \log(Y_{i,t}) = \beta_0 + \beta_1 MP_{i,t-1} + \beta_2 liquidity_{i,t-1} + \beta_3 MP_{i,t} \times liquidity_{i,t} + \varepsilon_{i,t}$$

- $Y_{i,t}$: The loans growth of each commercial bank i in a period of time t

- $MP_{i,t}$: The two instruments of monetary policy discussed in the previous two models

- liquidity: bank liquidity

- β_0, β_1, β_2, β_3 : Coefficients

- $\varepsilon_{i,t}$: Error term

The authors then proceeded to conduct a robustness and viability check with different tests. The robustness tests confirmed the viability of the results found.

2.2 Results

The authors found that in the pre-crisis period, credit channels, when central bank interest rates change, operated effectively. An increase in the bank's balance sheet dependance was noticed when a tighter monetary policy with high short-term interest rates was adopted. In addition, the impact of short-term interest rates on bank-level loan interest rates is positive and significant.

However, in the post-crisis period, due to the inconsistency between the behavior of commercial banks and changes in short-term interest rates, the implementation of monetary policy within the credit channel was distorted. More specifically, the impact of short-term interest rates on control

variables such as bank's capitalization and size are statistically insignificant. On the other hand, the impact of unconventional measures on bank behavior is statistically significant.

IV.Other empirical studies

The below table summarizes other studies that weren't mentioned above. These were omitted because they either did not use the same methodology as ours or focused on topics that were not directly relevant to ours.

Table 1: Previous studies

Study	Sample	Methodology	Main results
Bernanke and Bliner (1992)	US	VAR (1959-1989)	Bank deposits are highly affected by federal rates changes as they drop instantly if the rates go up whilst loans drop after a period of time.
Sims (1992)	US, Japan, Germany, France and UK	VAR	Effectiveness of the interest rate channel on economic activity. Unexpected increase in money supply has a positive effect on prices in five countries.
Balke and Emery (1994)	United-States	VAR	A positive shock on the interest rate causes a drop in unemployment.
Kashyap and Stein (1995)	US	Time series	The response of the small sized banks is more sensitive to monetary contractions than the one of bigger sized banks.
Barran, Coudert and Mojon (1995)	US, Japan and Germany	VAR	Even with a fall in the money supply, credit does not react: the behavior of economic agents does not depend on the economic situation.
Kashyap and Stein (2000)	US commercial banks	Panel 1976-1993	The monetary policy changes highly affect banks with small sizes and don't have a very liquid balance sheet. The results support the presence of a bank lending channel

Stock and Watson (2001)	7 OECD countries	Time series	Asset prices have predictive content for the output growth of a few countries during certain periods. Obtaining Economic Information Improves Forecast Accuracy.
Marco Arena, Carmen Reinhart, and Francisco Vázquez (2007)	20 emerging countries (1981-2001)	Panel	During financial distress, the lending and deposit rates of foreign banks tend to be smoother. Foreign banks act almost the same to monetary policy changes as the domestic ones when it comes to loanable funds.
Matousek and Sarantis (2009)	8 CEE countries	Panel (1994-2003)	Even though results show that bank lending channels exist in these countries, the size and liquidity of the bank plays the biggest role in determining the reaction of the bank to monetary policy changes.
Montes (2013)	Brazil	VAR	Credibility in inflation-targeting positively affects the expectations of entrepreneurs.
Olmo, Sano-Navarro (2014)	Euro zone and US	VAR	In times of crisis, in a competitive context, interest rates and the level of loans do not greatly influence real activity.
Jeon and Wu (2014)	Asian countries	Panel	Foreign banks do not behave distinctly from national banks when it comes to adjusting loans and interest rates in a calm period.
Spulbar and al.(2014)	Romania	BVAR	The interest rate channel is the most effective.
Khan, Rubi and Chan (2016)	Asean countries	Panel	The response of banks to monetary policy shocks varies with the size of the bank (scale, liquidity, and capitalization). Banking industry concentration affects the efficiency of policy transmission.

Source: Established by the author

CONCLUSION

The objective of this chapter was to review the main definitions of the key concepts of our research namely, financial crises, monetary policy and transmission channels as well as present the different theories related to these concepts.

Although in the first three sections we have attempted to review the main definitions and theories relating to the crises-monetary policy relationship, the study of previous theoretical work remains insufficient to conduct a relevant and solid research study. This is why a study of the various empirical works concerning the relation between the financial crises and monetary policy through the credit channel was needed in the fourth section.

The theoretical study of the key concepts has helped us understand the interactions between them. The second chapter, which is intended to be empirical, will be devoted to the test of the causal model and to the comparison of the results that we will acquire against those obtained theoretically.

CHAPTER 2 : METHODOLOGY AND EMPIRICAL RESULTS

CHAPTER 2: METHODOLOGY AND EMPIRICAL RESULTS

In this chapter, we will start by studying in depth the Tunisian economic landscape which will help us in our second section analyze the relevance of the credit channel in Tunisia by studying the relationship between the variables that reflect the country's monetary policy decisions and the annual variation in loans granted by Tunisian banks. It is necessary to analyze the relation between the variables that represent the financial characteristics of each bank (size, liquidity and capital strength) and the loans' growth in Tunisian banks. The financial crisis will be presented in our model as a dummy that is equal to 1 if we are in the period when financial crisis emerged (2007,2008 and 2009) and 0 if not. This will help us capture the effect that the subprime crisis could have had on the Tunisian economy and whether or not the credit channel can thrive in the case of a crisis or not.

The sample is 15 Tunisian private, state and mixed banks over 15 years (from 2005 to 2019). Empirical investigations are needed to provide the best answers for this study. We will therefore try to empirically test the following hypotheses, that we developed basing on previous studies that tackled the same problematic:

H1: The MMR has a negative impact on loans' growth.

H2: Deposits have a positive impact on loans' growth.

H3: The strength of the bank's capital has a positive impact on loans' growth.

H4: The size of the bank has a negative impact on loans' growth.

H5: Liquid assets have a positive impact on loans' growth.

H6: The financial crisis has a significant positive / negative impact on loans' growth.

SECTION 1: MONETARY POLICY AND THE BANKING SYSTEM IN TUNISIA

The CBT (Central bank of Tunisia) does not depend on a long-term strategy but rather on an active policy aimed at achieving a balance according to its circumstances. This "strategy" started in the 90's when the CBT first adopted the discretionary monetary policy.

The first and most important objective of the central bank is to maintain price stability, but to do so, the central bank must go through intermediate objectives (economic growth, full employment, and external balance) and these objectives can be contradictory. Therefore, the monetary policy adopted by the Central Bank of Tunisia is efficient since it negates the conflicts between the aforementioned objectives.

The CBT acts on the main instrument of the conduct of monetary policy, which is the interest rate, to influence real production and the general level of prices. The indexation of bank rates on the MMR (Market Monetary Rate) induces an automatic transmission of monetary policy. This direct effect allows the central bank to act on disposable income after deduction of the interests of economic agents.

I. Characteristics of the Tunisian economy

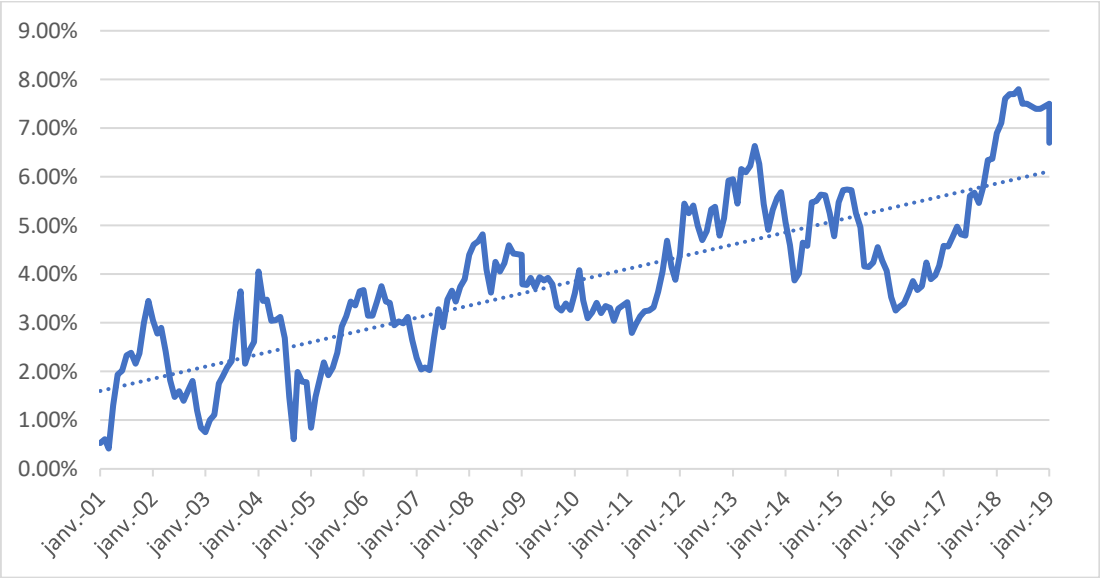
Before proceeding to the analysis of the evolution of monetary policy instruments used by the central bank to deal with the different situations that faced the country, a description of the Tunisian economic landscape would be appropriate. The main actors that shape the Tunisian economy are:

1. Inflation

The mission of preserving price stability, ensured from the 2000s by the CBT, includes a price administration strategy, which has succeeded in blocking the transmission of price shocks and in maintaining the purchase power and consumption despite the various unfavorable situations.

This rate is calculated based on a basket of consumer goods, mainly made up of subsidized products and services.

Figure 4: The evolution of inflation



Source: Established by the author

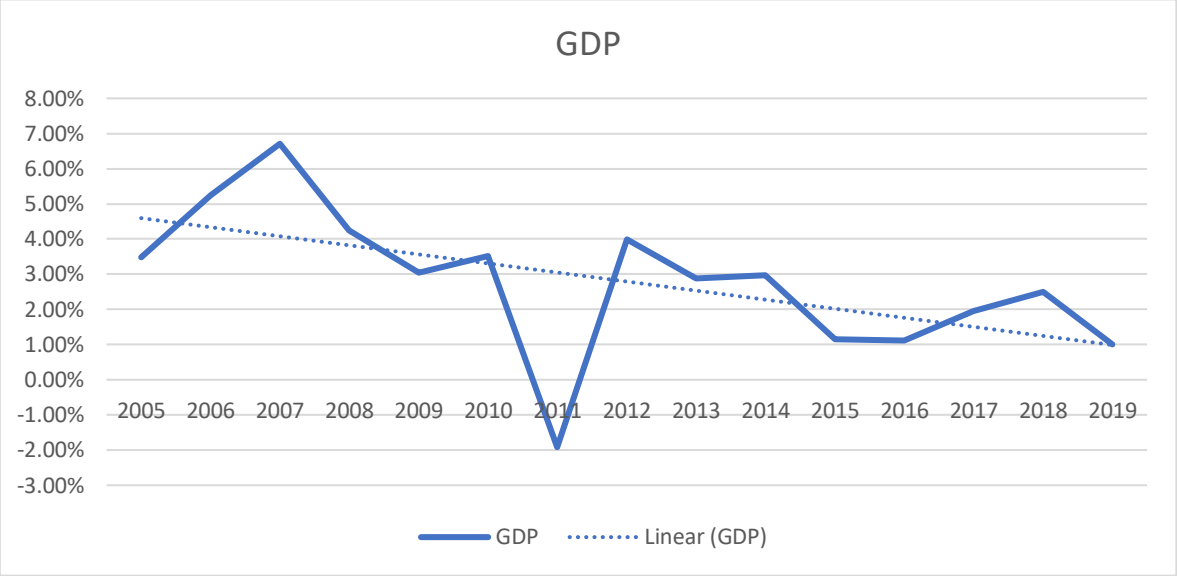
By analyzing the curve above, we can notice that, although the inflation rate rose, the financial crisis that hit the world in 2007 did not highly affect the inflation in Tunisia and that the level was maintained under control from 2007 until 2012. Starting from the year 2012, we can clearly see that there is an upward trend that was engraved between 2012 and 2015.This upward trend can be explained by the imported inflation amplified by the depreciation of the Tunisian Dinar against the main currencies in particular the Euro and the US Dollar. During this period, the central bank devoted all its efforts to achieving its main objective, which is price stability, by maintaining inflation at an appropriate level. This strategy was fruitful since the CBT succeeded in maintaining the inflation level under control from 2015 to 2017.

Starting from the year 2017, the inflation rate has seen a sharp increase that can be explained by the socio-political problems that faced the country, The high cost of production (due in particular to rising wages), which has led to the increase in the prices of many products and also by the continued depreciation of the TND against the main currencies.

2. Gross Domestic Product

Economic growth refers to a continuous increase in the quantity and quality of goods and services produced each year in a country or geographic area, linked to the increase in the productivity of labor and capital. The most widely used indicator to measure the growth rate is the sum of added values or GDP (Gross Domestic Product).

Figure 5: Gross Domestic Product trend



Source: Established by the author

Before the 2007 financial crisis, the GDP growth rate was around 5% per annum, a rate that did not create enough jobs or include all regions in the development process. After 2007, despite other economic indicators such us inflation remaining intact, the GDP experienced a downturn. This change was the result of the subprime crisis that resulted in a huge recession in Europe and the reduction in foreign demand, particularly that of Europe, which has led to the fall in exports and to the widening of the trade deficit.

After all this, the regional imbalance and the unemployment of graduates largely contributed to the demands of the 2011 revolution. A revolution that was beneficial when it came to human rights (freedom of speech, freedom of the press etc..) but had its downsides in terms of economic growth. Its effects can clearly be seen through the fact that the GDP has known its biggest crash as it went from over 3% in 2010 to -1.9% in 2011.Tunisia soon recovered from this crash by managing to raise the GDP up to 4%, which was higher than its pre-crash value.

This didn't last long as the repercussions of the revolution began to unfold, sending the country's GDP into disarray as it rose and fell repeatedly. The slowness of the democratic transition in addition to the political tensions and especially the political assassinations and the terrorist misdemeanor plagued the national economy. For the most part, non-economic variables have contributed to the fall in foreign investment, the bankruptcy of many industrial companies, and the deterioration of the business climate. Hence the lack of visibility and confidence in the national economy.

3. The Banking system

The Tunisian banking system includes the central bank of Tunisia, 23 banks, 2 investment banks, 7 offshore banks, 6 representative offices of foreign banks, 3 factoring companies and 8 leasing organizations.

The banking sector has been called upon to be the main promoter of funds for businesses and even for households in Tunisia. Given its important role, it is considered a key player in our economy. Financial services used to contribute around 3% to the GDP and the wage bill distributed in the sector amounts to more than 400 million Tunisian Dinars, or 3.6% of the total wage bill.

The sector's activity experienced a sharp slowdown in 2019 recorded in 2018, caused by restrictive monetary policy measures taken by the CBT and the introduction of the Loans/Deposits ratio from the end of 2018. Consequently, the share of assets of banks and financial institutions in the GDP fell more than 300 basis points.

3.1 Resources

Bank resources grew by 9.5% in 2019, almost at the same rate as in 2018. This trend was the result of the acceleration of the outstanding deposits (9.4% in 2019 against 9% in 2018) which concerned deposits in dinars (11.7% against 6.2% in 2018) against a decline in deposits in foreign currency (0.7% against 21.2% in 2018).

Table 2: Tunisian banks resources

				VARIATIONS			
	2017	**2018**	**2019**	**2018/2017**		**2019/2018**	
		MDT		MDT	%	MDT	%
Deposit	62 740	68 375	74 805	5 635	9	6 430	9,4
Dinars	50 942	54 081	60 414	3 139	6,2	6 333	11,7
Foreign Currency	11 798	14 294	14 391	2 496	21,2	97	0,7
Loans on Monnetay market	8 484	11 846	8 995	3 362	39,6	-2 851	-24,1

Source: Annual report 2019 CBT

The increase in deposits in 2019 was observed at the level of term deposits and certificates of deposits against a slowdown in sight deposits and savings deposits. This reflects a migration of

part of sight deposits from institutions and companies and savings invested in the stock market to the term compartment under the pressure of the up-bid movement practiced by the banks. Deposits grew at a sustained pace in 2019, i.e. 9.4%. Consequently, and given the slowdown in loans, the banks' recourse to money market resources has clearly diminished, as evidenced by the drop in outstanding loans on the money market of 24.1% compared to 2018 (it went up by 39,6%) before going down to 9 billion dinars at the end of 2019.

3.2 Expenditure of resources

Table 3: Expenditure of resources of Tunisian banks

-	2017	2018	2019	Variations 2018/2017		Variations 2019/2018	
Tunisian Banks		MDT		MDT	%	MDT	%
Loans	81 707	88 987	92 176	7 280	8,9	3 189	3,6
Loans granted to professionals	58 994	65 027	68 123	6 033	10,2	3 096	4,8
Loans granted to individuals	22 713	23 960	24 053	1 247	5,5	93	0,4

Source: Annual report 2019 CBT

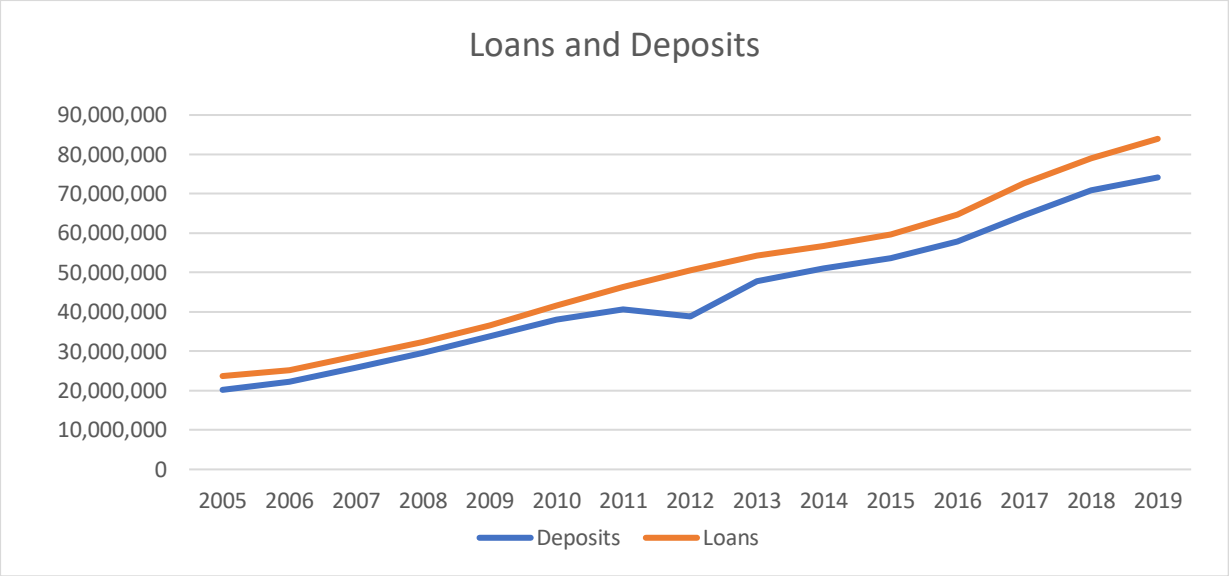
The year 2019 was marked by the continued deceleration of banking activity. Bank operating jobs such as lending activities grew at a slower pace than the previous year, i.e. 3.6% against 8.9% in 2018, reaching 92.176 billion dinars.

The expenditures of banks recorded a deceleration (3 189 MTD against 7 280 MTD in 2018). This change particularly concerned loans to individuals (93 MTD against 1 247 MTD in 2018) as well as the deceleration of loans to professionals which fell from 10.2% between 2017-2018 to only 4.8% growth in 2018-20190.These changes were mostly caused by:

- The increase in the Money Market Rate.
- The introduction of the Loans / Deposits ratio which stood at an average level of 120% at the end of 2019 compared to 130.7% at the end of 2018.

After the capping of LTD ratio have been introduced, banks have been paying more attention to their deposits to issue more loans which is why an analysis of the Loans/Deposits evolution over the course of the years is necessary.

Figure 6: Loans and deposits of Tunisian banks



Source: Established by the author

The graph above shows that the gap between loans and deposits was at the same level starting from 2005 but grew in 2011 due to the revolution that caused instability in the country. Investors were forced to pull away from their planned investments and avoid depositing money in banks due to the inability to conduct proper forecasting, which is a very important factor in the investment world. On the other hand, demand started to rise, and consumers were asking for more loans to meet their daily needs. All these factors combined contributed to growing the gap between loans and deposits.

After 2011, with CBT's intervention, investors regained confidence and the gap shrank but remained at a higher level than during the period of 2005-2010. The gap between loans and deposits remained at the same level from 2013 until 2018 when the gap began to shrink again. 2018 was the year when the CBT introduced the LTD ratio and capped it at 120%, thus forcing banks to pay more attention to their loanable and deposited funds. This measure was taken to avoid any liquidity problems that may occur, especially with the difficult economic situation of Tunisia.

4. The foreign exchange markets

The Tunisian foreign exchange market is characterized by a floating exchange rate administered with the objective of maintaining the competitiveness of the Tunisian dinar. This regime results in the adjustment of the effective exchange rate.

Since 1997, authorized banks have been authorized to enter forward exchange contracts and to sell foreign exchange options to importing and exporting companies and to non-resident agents. However, the maturities of these operations are limited to 12 months for currency purchases and

9 months for sales. It should be noted that the basket of foreign currencies is dominated mainly by the euro. The Central Bank of Tunisia has placed restrictions on the capital account to be able to manage the value of the national currency.

II. Monetary authorities' interventions

Since 2018, the central bank of tunisia has implemented a set of measures (increase in the key rate, macro-prudential measures, etc.) to deal with inflation and the deterioration of macroeconomic balances, to stabilize them in 2019 and prepare for a healthy economic recovery in 2020.

These measures prevented the inflation rate from sliding to unavoidable levels, reduced the overall volume of refinancing and helped improve external balances.

1. Liquidity injection and punction

The main task of monetary policy is to preserve price stability. Indeed, policymakers firmly believe that a good control of inflation, as reflected by the evolution of the consumer price index (CPI), makes it possible to ensure healthy growth contributing to the creation of employment and the improvement of social well-being through the preservation of purchasing power. However, this belief has been called into question after the financial crisis of 2007, and especially after the revolution.

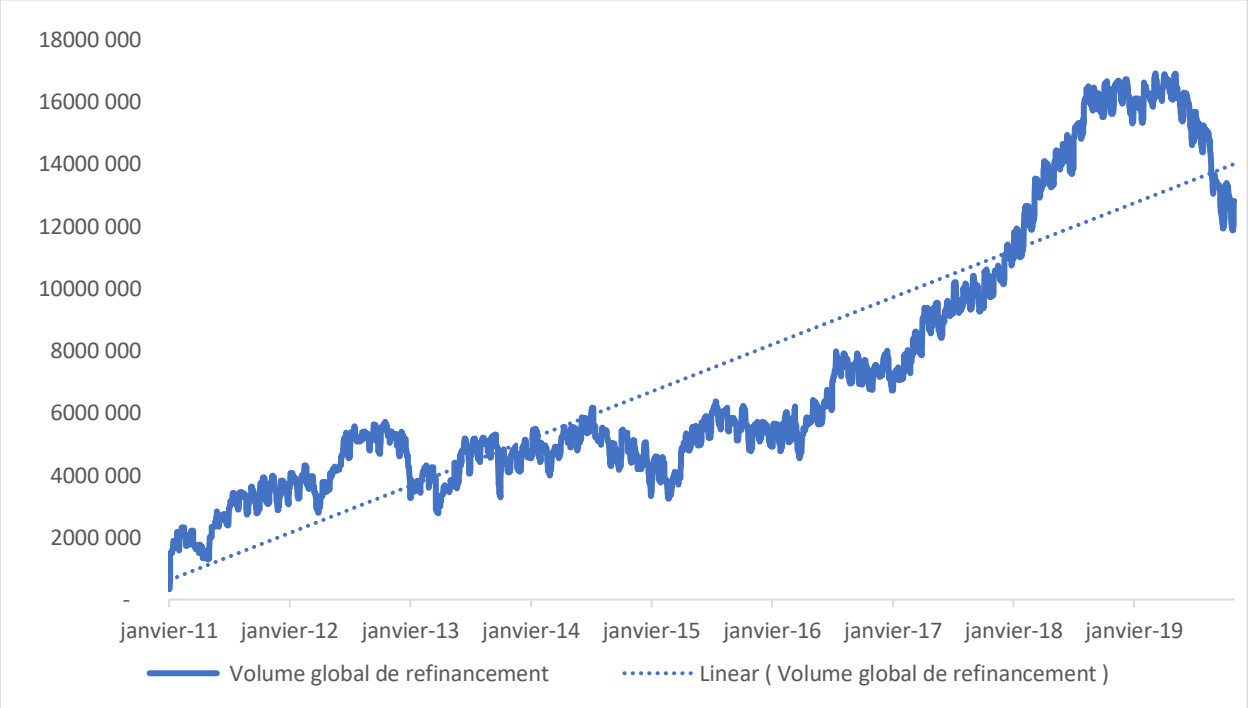
Throughout this subsection, we will first present the evolution of monetary policy instruments in Tunisia, then I will describe the context in which the monetary authorities operate.

Since the 1990s, the Central Bank of Tunisia has used a multitude of instruments. The 2006 law, set "price stability" as the general mission of the CBT which clarified the operational framework for the conduct of monetary policy, and it is as follows:

- The management of interbank rates through intervention operations on the money market to mop up or provide liquidity.
    - Call for tenders: Based on the liquidity needs forecast for the following week, the Central Bank had set the amount to be injected into the market which was at the time capped at 7,000 MTD per week for all banks but now isn't. If the quantity of money to be injected is less than the quantity requested, the CBT grants a percentage of the requests expressed by the banks via the single rate method. If the market is liquid: All banks are served.

- Currency swap: It is an instrument for adjusting market liquidity. It also represents a structural operation of injection or liquidity drain. The minimum amount must be a multiple of one million dinars. The currencies primarily affected by the FX swap are the USD and the Euro.
- The 1-day loan facility: In the event of insufficient liquidity following the call for tenders, the CBT intervenes as a last resort to meet this liquidity requirement for 24 hours only via the loan facility.
- The 1-day deposit facility: in the event of excess market liquidity, the CBT intervenes to absorb this excess via the deposit facility.
- Long-term refinancing operation (6 months): The 6-month refinancing operations aim to orient bank loans towards the financing of investment in the real sector. This refinancing operation is characterized by the participation of Islamic banks because the latter do not participate in the OPR (Main Refinancing Operation)

Figure 7: Overall refinancing volume



Source: Established by the Author

The period between 2000 and 2006 was characterized by a tightening of bank liquidity, which led the CBT to increase its support to banks, mainly through calls for tenders at 7 days.

From 2007 until June 2010, the CBT had to deal with a situation of excess liquidity and had to intervene to mop up the excess liquidity, either through negative calls for tenders or through firm sales of Treasury bills as part of the open-market, or through reverse repo transactions.

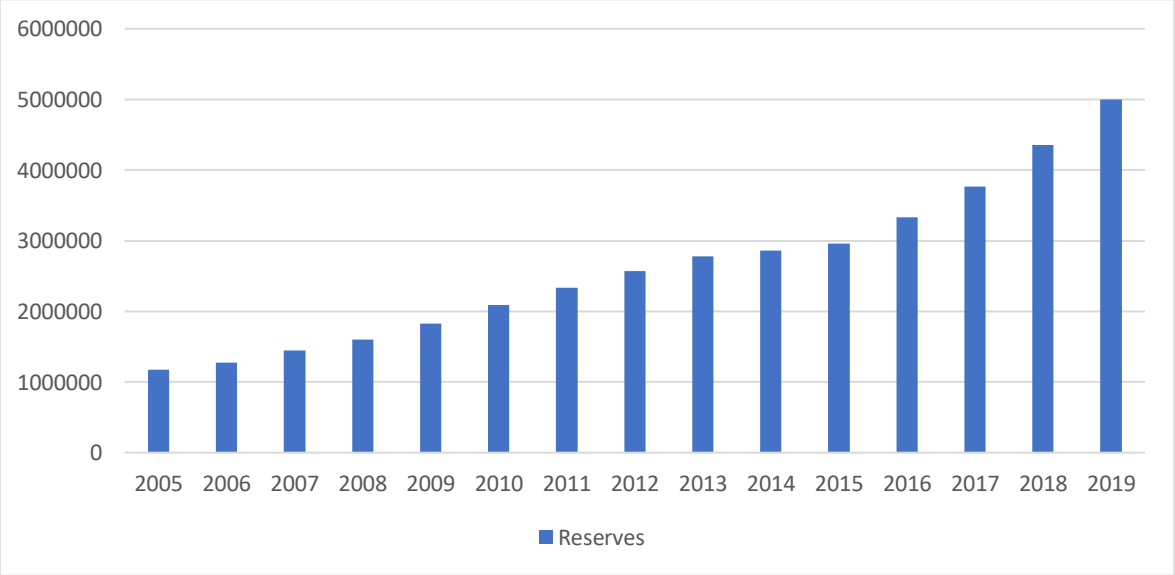
The year 2011 was characterized by the unprecedented increase in banks' liquidity needs due to massive withdrawals by depositors during the week preceding the revolution and the weeks following it, reflecting a change in preference for holding liquid assets. In this context, the CBT had to intervene many times to strengthen the banks which were facing a tense economic context, at national and international level.

The graph above shows that the level of overall refinancing grew rapidly especially from the years 2015 where it has known its biggest spike going from 4000 MDT in January 2015 to over 16000 MDT in January 2018.After that, and with the different interventions made by the CBT that we stated earlier, the banking sector managed to overcome the liquidity drain that was a concern for over 3 years to the Central Bank of Tunisia and Tunisian banks.

2. Minimum reserve requirements

Tunisian banks are obliged to hold a minimum amount of money in their CBT account as reserves. This instrument is a privileged one because of its immediate impact on the liquidity and monetary creation of banks via the credit channel.

Figure 8: Evolution of the reserves



Source: Established by the author

The excess of liquidity on the money market that Tunisia experienced between mid-2007 and mid-2010, forced the CBT to choose to pursue a restrictive monetary policy. As a result, several rates have been revised upwards: A first decision was to increase the rate on short-term deposits from 2% to 3.5% in November 2006. Subsequently, there was a increase in November 2007 to 5% of the rate on deposits with less than 3 months then successively to 7.5% and 10% in April and September 2008.

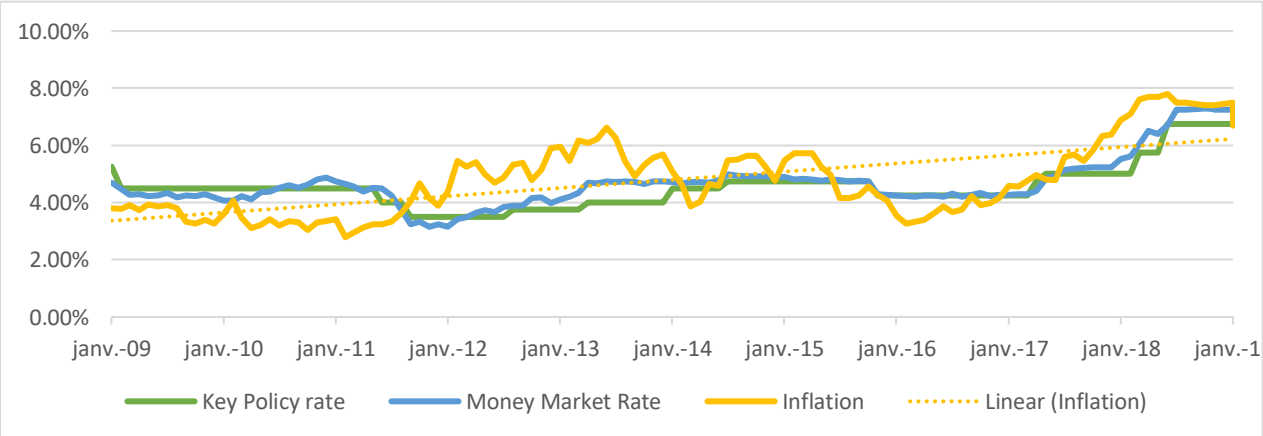
In view of the persistence of this excess liquidity situation and the desire to reduce inflationary pressures, the reserve requirement rate was raised, as of May 1, 2010, to 12.5% for demand deposits. and 1.5% (against 1% previously) for deposits in term accounts and other special savings accounts with a maturity of between 3 and 24 months.

These measures were accompanied by the introduction of remuneration for additional deposits made by banks with the CBT. As shown by the graph above, the reserves held by the CBT follows an upward trend reaching 5000000 MDT in 2019 after just being at 1000000MDT in 2010.These interventions on the minimum reserve rate led to the increase in the level of reserves as shown by the graph above which in turn, in addition to other circumstances that we briefly mentioned earlier, created a liquidity shortage which is why the CBT had to intervene using other instruments to regulate the monetary market.

3. Manipulating the key rate

The key rate manipulation was always the go to strategy that the central banks used to tackle any unwanted inflation rising.

Figure 9: Targeting inflation with the key rate adjustments



Source: Established by the author

From January 2011 until December 2011, the CBT had to avoid a "credit crunch", and at the same time, support economic activity. In fact, at the start of 2011, Tunisia went through a period of great uncertainty. This led economic agents to withdraw their assets on a massive scale, as they preferred to hold them in liquid form, which consequently increased the banks' liquidity needs. Thus, in 2011, the CBT twice reduced its key rate by 50 basis points to bring it down to 4.5% and then to 3.5%.

From January 2012 to July 2012: the CBT pursued a neutral monetary policy, insofar as it had to provide the necessary liquidity to the banking sector while ensuring price stability. From August 2012 until September 2014, the monetary authority favored a gradual tightening of monetary policy. As a result, interbank rates have tightened, going above the key rate. In fact, the CBT increased its key rate four times, from 3.5% to 4.75% on (June 25, 2014), thus trying to send a strong signal to economic operators to stem inflationary pressures by orienting falling inflationary expectations of economic agents. In addition, the Central Bank of Tunisia, decided, in 28th October 2015, to lower the key rate by 50 basis points, bringing it down to 4.75%, in effect since June 2014, at 4.25%. After that, in November 2015, the CBT lowered furthermore the key rate by 50 points since inflation was successfully maintained at an appropriate level. Other measures have been taken to deal with the problem of draining liquidity in the banking system of reducing reserve requirement rates, which has made it possible to better rationalize the intervention of the CBT in the money market.

After 2016, with the socio-political problems that faced the country, inflation rose again after being under control for 3 years (2014,2015 and 2016) which forced the central bank to up the key rate by 50 points in mars 2017 and 25 other points after just one month and then again after another month to reach 5% in May2017. The key rate was maintained at 5% starting from May 2017 until Mars 2018 where the CBT decided to up it by 75 points and another 100 points after 3 months. These drastic measures were necessary as inflation rose again and started to follow an accelerated upward trend (figure 9). These measures prevented the inflation rate from sliding to unavoidable levels and prepared for a healthy economic recovery in 2020.

SECTION 2: SAMPLE, DATA AND MEASUREMENT OF VARIABLES

In this section, we will first show the process we have chosen for the selection of our sample and the time period that we will be studying. Next, we will provide a brief definition and explanation of the method used to measure the dependent variable: "loan growth" as well as the different independent variables present in our model.

I.Sample and data

The sample contains 15 Tunisian banks (8 private, 3 public and 4 mixed) over a period of 15 years (2005 to 2019). The choice of the sample was not only for the availability and reliability of the data, but also for its representativeness since it includes a large number of banks operating in Tunisia.

Data was collected mainly from the financial statements of the various banks, the Tunisian Stock Exchange (TSE) and the Financial Market Council (FMC).

Another (econometrics) question that may arise is whether it is feasible to use annual data to analyze monetary policy and bank lending channels. Empirical research shows that annual data is sufficient to explain the impact of monetary policy actions on bank loans. Ashcraft (2006) and Gambacorta (2005) compared the results of annual data collection with the results of quarterly data collection of similar samples and found that the information provided by the annual data is the same as the quarterly data.

To weaken the effect of extreme outliers at the 5th and 95th percentile, we used the “winsor” method by applying it to all variables with outliers. The reason we went through this step is that, outliers can increase the variance of a variable and therefore affect the level of significance. After this step, we ended up with a sample of 255 observations.

II. Variables' definitions and measures

1. Loan growth

To have an idea about the functioning of the bank lending channel in Tunisia, we needed to study the credit supply provided by banks. To do so, we used, as our main variable, the same variable used by many authors (Kashyap and Stein, 2000; Ashcraft, 2006; Marco Arena, Carmen Reinhart, and Francisco Vázquez,2007 and Petya Koeva Brooks,2020) which is the loan growth.

The loan growth in this study was measured as follows:

$$Loan\ growth = \frac{Total\ loans(t) - Total\ loans(t-1)}{Total\ loans(t-1)}$$

2. Monetary policy

Many authors used monetary market rate (MMR) to capture the effect of the changing monetary policies over the years on the loans growth (Gunji & al., 2009; Olivero & al., 2011a, 2011b; Amidu & Wolfe, 2013), we will use the same approach in this study. Bernanke and Blinder [1992] found that that a positive shock (increase) in the federal funds rate is followed by a contraction in bank deposits and securities and that loans have fallen as much as deposits. This allows us to make the following assumption:

H1: The MMR has a negative impact on loans' growth.

3. Deposit growth

Deposits play an important role in affecting the supply of loans that banks offer, which is why we can't construct our model without this variable as it may create non robust and irrelevant results so we will follow the steps of other authors who found a positive relationship between deposits and loans' growth (Gunji & al., 2009; Olivero & al., 2011a, 2011b; Amidu & Wolfe, 2013; Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Gee,2016). This allows us to make the following assumption

H2: Deposits' growth has a positive impact on loans' growth

The deposit growth will be measured as follows:

$$Deposit\ growth = \frac{Total\ deposit(t) - Total\ deposit(t-1)}{Total\ deposit(t-1)}$$

4. Capital strength

Many authors used capital strength as variable that explains the behavior of the loans' growth in banks (Kishan and Opiela, 2000; Petya Koeva Brooks,2007and Roman Matousek, Nicholas Sarantis,2009). These authors found that the lending activity of the bank and its reaction to

monetary changes is affected by the banks' characteristics and their financial strength. These findings allowed us to make the following assumption:

H4: The strength of the bank's capital has a positive impact on loans' growth.

The strength of the bank's capital is measured as follows:

$$Cap = \frac{Equity}{Total\ assets}$$

5. Size

Amidu & Wolfe, 2013; Gunji & al., 2009; Olivero and al., 2011a, 2011b argued that larger banks are almost immune to monetary policy shocks as they can easily isolate loanable funds from them by switching to alternative funding sources. Therefore, we made the following assumption:

H4: The size of the bank has a negative impact on loans' growth.

The bank's size was measured as the natural log of the bank's total assets

$$SIZE = \log(Total\ Assets)$$

6. Liquidity

The liquidity of a bank allows the latter to mitigate the effect monetary policy shocks as they can easily guard their loanable funds (Gunji and al., 2009; Olivero and al., 2011a, 2011b; Amidu & Wolfe, 2013; and Habib Hussain Khan Rubi Binti Ahmad, Chan Sok Gee,2016). This allowed us to make the following assumption:

H5: Liquid assets have a positive impact on loans' growth.

Liquidity was measured as the ratio of high-quality liquid assets to total assets

$$Liquidity = \frac{High\ quality\ liquid\ assets}{Total\ assets}$$

7. Non-performant loans ratio

Many previous research found that non-performant loans impact the loanable funds that banks allocate since banks which have high NPL ratio put a strain on loanable funds unlike banks which have a low NPL ratio.

Non-performant loans were measured as follows:

$$NPL = \frac{Non\ performant\ loans}{Total\ loans}$$

8. Macroeconomic variables

The macroeconomic variables that we used in our model are the annual growth rate of GDP (Gunji and al., 2009; Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Geeand, 2016) and Inflation (INF) (Marco Arena, Carmen Reinhart, and Francisco Vázquez,2007; Roman Matousek, Nicholas Sarantis,2009; Gunji and al., 2009; Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Geeand, 2016).

9. Financial crisis

Since Tunisia was not really affected by the international crisis that occurred in 2007 (subprime crisis) any indicator of the financial crisis that we include in our model will generate false results. The financial crisis will be present in our model as a dummy variable that is equal to 1 if we are in the years where the subprime crisis occurred (2007,2008 and 2009) and equal to 0 if not.

Marco Arena, Carmen Reinhart, and Francisco Vázquez (2007) found that the lending rates of the banks tend to be smoother in a period of distress. Salachas, Laopodis and Kouretas (2016) study found that the credit channel was effective in transmitting monetary policy changes in the period of crisis. These previous findings helped us make the following assumption:

H6: The financial crisis has a significant positive / negative impact on loans' growth.

The table below summarizes the different variables present in this research study with the formulas used to calculate them. We also included the expected sign of the relationship of each

variable of interest or control with our dependent variable according to our assumptions that we stated in the previous chapter.

Table 4: Measures of variables and expected signs

DEPENDENT VARIABLE	**ABBREVIATION**	**MEASURE**	**SIGN**
Loan growth	*Loan growth*	Annual percentage change in banks' loans	
EXONGEANOUS VARIABLES	**ABBREVIATION**	**MEASURE**	**SIGN**
Deposit growth	*Deposit growth*	Annual percentage change in banks' growth	**(+)**
Capital strength	*Cap*	Equity on total assets	**(+)**
Liquidity	*Liquidity*	Ratio of high-quality liquid assets to total assets	**(+)**
Bank's size	*SIZE*	Log (Total assets)	**(+)**
Non-performant loans	*NPL*	Non-performant loans to total loans	**(-)**
Monetary market rate	*MMR*	/	**(-)**
Gross Domestic Product	*GDP*	Annual percentage change in real GDP	**(-)**
Inflation	*INF*	/	**(-)**
Crisis	*Crisis*	Dummy variable Equal to 1 if the year is 2007,2008 or 2009 and equal to 0 if not	**(-)/(+)**

Source: Established by the author

SECTION 3: UNIVARIATE ANALYSIS

In this section, we will first conduct a descriptive analysis of all the variables present in our study, in which we will examine their stationarity by applying the unit root test. Following that, we will move on to descriptive statistical analysis of the sample.

This section will end with the presentation of the correlation matrix to determine the correlation coefficients between the different variables. This helps us detect the existence of any problem of correlation between our independent variables.

I. Descriptive analysis

1. Stationarity tests

We start by checking the stationarity of our variables. This is important because it can influence the behavior of said variables and their properties. For this, we use the Unit Root Test which considers as a null hypothesis H0 that the variable contains a unit root (i.e., the variable is nonstationary).

Table 5: Stationarity tests

Variable	Without lag nor trend	With trend	With lag	With lag and trend	Status
Loan growth	0.0000	0.0000	0.0000	0.0000	Stationary
Deposit growth	0.0000	0.0000	0.0760	0.8481	Stationary
Capital strength	0.0012	0.9999	0.0000	0.0044	Stationary
Size	0.0002	0.9560	0.0000	0.0021	Stationary
Liquidity	0.0121	0.0050	0.7535	0.9665	Stationary
NPL	0.0001	0.9817	0.2892	0.8007	Stationary
MMR	0.0000	0.0001	0.0000	0.0008	Stationary
Inflation	0.0000	0.0000	1.0000	0.9637	Stationary
GDP	0.0000	0.0000	0.6191	0.4042	Stationary

Source: Established by the author

To understand the above table, we will briefly explain the decision rule for the Augmented Dickey-Fuller test:

-If the "p-value" is less than 5%, the hypothesis H0 is rejected; the variable is stationary.

-If the "p-value" is greater than 5%, the hypothesis H0 is accepted, and the variable is not stationary.

For the dependent variable, the table above indicates that, the loan growth is stationary without trend nor lag and in first difference and first difference with trend according to a p-value = 0.0000<5%. The loan growth variable represents the measure for the growth of loans granted in Tunisian banks from year to year starting from 2005,

The variables that are specific to each individual bank namely, deposit growth, capital strength, size, liquidity, and the non-performant loans, have a "p-value"<5% in the first level which is without trend nor lag which leads us to the conclusion that all these variables are stationary.

The MMR (Monetary market rate) which is the variable used to capture the effect of monetary policy changes on the loans granted by Tunisian banks, presented a "p-value"<0.005 at every level which means that the variable is stationary.

For the case of macroeconomic variables, Inflation and GDP, the results also show that they are stationary at both levels with and without trend.

To summarize, we can confirm the non-existence of the problem of non-stationarity because our variables are stationary in level.

2. Summary statistics

Table 6: Summary statistics

Variable	Obs	Mean	Standard Deviation	Min	Max
Loan growth	225	.1003348	.0790525	-.0234822	.3008357
Deposits growth	225	.0904441	.1488966	-.1332019	.4563544
CAP	225	.1382344	.1273073	.041288	.5536529
SIZE	225	6.3641	.5039361	5.3417	6.999618
LIQUIDITY	225	.0845867	.0649153	.0112323	.2447516
NPL	225	.1494114	.0962911	.0457529	.3808736
MMR	225	.0498087	.0099092	.0375181	.0773857
INF	225	.0473333	.0133948	.021	.073
GDP	225	.0279178	.0196563	-.0191718	.0670962
Crisis	225	.2666667	.4432026	0	1

Source: Established by the author

We will start the analysis with our dependent variable LOANGROWTH. Its average is equal to 0.1, with a maximum and minimum value of 0.3 and -0.023 respectively which gives us an idea

on the bank lending market in the Tunisian economy. The results show that some banks in one year granted 30% more loans than the previous year. But when it came to reducing their offers, banks only reduced their loans by 0.2% at best. This allows us to draw the conclusion that banks are willing to up their loans when the circumstances are in their favor but when the circumstances change, they become reluctant to reduce the granted loans.

Regarding the bank-specific characteristics, the banks that we included in our sample are characterized by an average size (SIZE) of 6.364 with a minimum size of 5.341 and maximum size of 6.999. The non-performant loans to total loans ratio has an average of 0.1494 with a maximum of 0.3808 and a minimum 0.0475. This means that 14.94% of the loans granted by the Tunisian banks present in the study are non-performant. The results also show the existence of banks in which 38.08% of the loans are non-performant. On the other end of the spectrum, we see that, in other banks, the non-performant loans are only 4% of the total loans. Banks' liquidity averaged at 0.084 with a maximum of 0.245 and a minimum of 0.01 which is a significant difference thus justifying explains the low mean value. These numbers allow us to conclude that many Tunisian banks don't have a high-quality liquid asset compared to their total assets whilst other banks invest in high quality liquid assets to ensure that they will always be prepared to better manage the liquidity risk.

The monetary market rate MMR wasn't very volatile over the years of the study which is explained mainly by the fact that we took annual data instead of monthly. The average of the MMR in the years of study is 0.05 with a maximum and minimum of 0.0774 and 0.0375 respectively.

For the macroeconomic variables, Over the period studied, the average rate of GDP growth was 0.0279 with a minimum rate equal to -0.019 and a maximum rate equal to 0.067.

For the inflation rate in this same period, it has an average equal to 0.047 and a minimum and maximum value equal to 0.027 and 0.073 respectively.

II. Multicollinearity

Whilst the analysis of panel data can limit the multi-collinearity problem according to Baltagi, Bratberg, & Holmas (2005), the verification of multi-collinearity remains an important diagnostic test to ensure that no independent variables in the model are strongly correlated, which can result in variance bias, thus making the estimates unreliable.

Multicollinearity is a situation in which any two or more variables are strongly correlated. This problem has been raised by several researchers such as Gloede, Hammer, Ommen, Ernstmann & Pfaff (2013), who assert that multi-collinearity refers to the degree to which a variable can be described by other variables present in the model. The problem with multi-collinearity is that it confuses the interpretation of the variety because it is more difficult to determine the impact of a single variable.

The tests that we will be using to check if there is a multi-collinearity problem in our data are the correlation matrix between the different variables and the VIF test.

1. Correlation matrix

Correlation analysis is important in describing the direction and strength of the linear relationship between model variables. Specifically, Pearson's correlation analysis to clarify and assess the strengths of the relationship between the variables present in our study.

Table 7: Correlation matrix

Variables	Loan growth	Deposit growth	Capital strength	Size	Liquidity	NPL	MMR	Inf	GDP
Loan growth	1.000								
Deposit growth	0.292***	1.000							
Cap	0.392***	0.405***	1.000						
Size	-0.290***	-0.321***	-0.611***	1.000					
Liquidity	-0.015	-0.008	-0.089	0.065	1.000				
NPL	-0.112*	0.110*	0.017	-0.402***	-0.075	1.000			
MMR	-0.144**	-0.029	-0.155**	0.153**	0.032	0.056	1.000		
Inflation	-0.159**	0.014	-0.214***	0.227***	0.073	0.044	.673***	1.000	
GDP	0.162**	-0.078	0.191***	-0.199***	0.002	-0.024	0.068	-.120*	1.000

**** p<0.01, ** p<0.05, * p<0.1*
Source: Output STATA

The correlation matrix tells us about the level and nature of the relationship between variables by determining their linear correlation coefficients. The table above shows the correlation matrix of all the variables used in this study. Most of the correlation coefficients between our variables do not exceed 0.7, which is, if it was the case, we speak of a multi-collinearity problem, except for the correlation between the Inflation and the monetary market rate (MMR) and between (SIZE) and (CAPITAL STRENGHT) which has a high level of correlation. The other variables are weakly or moderately correlated so there is no problem of multi-collinearity.

Deposit growth is positively correlated with Loan growth and the correlation between the two variables is significant at 1%. Capital strength is also positively correlated with loan growth but at a slightly higher level of 0. 392. Unlike the latter, almost all of the other control variables namely SIZE, LIQUIDITY and NPL present a negative and significant correlation with loan growth at different levels that don't exceed 0.2 which is considered a low correlation.

The monetary market rate (MMR) also is correlated negatively and significantly with loan growth at a low level of -0.144

The macroeconomic variables have opposite correlation with loan growth, inflation has a negative and significant correlation at a low level of -0.159 which may be due to the moderate correlation between inflation and MMR which has a negative correlation with loan growth. Especially considering that MMR is the rate that Tunisian banks use as an index to their granted loans. The GDP has a positive and significant correlation with loan growth at a low level of 0.162

After analyzing the correlation matrix of all the variables used in the model, we will use the variance inflation factor (VIF) to confirm that the multi-collinearity problem does not exist.

2. Variance inflation factor test

The Variance Inflation Factor (VIF) is an example of a common test to examine the multi-collinearity problem. It treats one (1) of the independent variables as dependent variables and the other independent variables as independent variables.

The general rule is that further study should be done for variables with a VIF value greater than 10. Therefore, the variance inflation factor of each variable should be less than the critical value, which is equal to 10. In addition, the tolerance defined as 1 / VIF is used by researchers to check the degree of collinearity. A tolerance value less than 0.1 or a VIF value greater than 10 means that the variable is treated as a linear combination of another independent variable.

The results that we got from the variance inflation factor test that we conducted on our model are presented in the following table.

Table 8: Variance inflation factor test

Variable	VIF	1/VIF
SIZE	4.26	0.234893
Cap	3.93	0.254208
NPL	1.93	0.518489
INF	1.89	0.528489
Deposit growth	1.64	0.610211
MMR	1.58	0.632899
Crisis	1.25	0.799871
Liquidity	1.15	0.866060
GDP	1.10	0.907840
Mean VIF	2.08	

Source: Established by the author

The table above shows that the average value of the VIF of our model (2.02) is less than 10; more precisely, the value of the VIF of all our variables is less than 10 which is the critical value. Therefore, we can conclude that there is no multi-collinearity problem.

SECTION 4: MULTIVARIATE ANALYSIS

After having carried out the verification of the stationarity of our variables and discussed the results of the univariate analyzes. In this section, we aim to present the methodology that we will adopt. The next step consists of conducting a multivariate analysis as follows. We will start by checking the validity and reliability of the model by the tests which would inform us about the problems of Autocorrelation and Heteroscedasticity if they exist, then we will test our three hypotheses. After that, we will present a detailed analysis and a full discussion of our main findings. Finally, we will perform robustness tests to ensure that our model is solid.

I. Model reliability and fiability

1. Empirical model

This study provides unique empirical evidence that assesses the discussed relationship. To test our hypotheses and perform our analysis, we use the following model:

$$\text{Loan growth}_{it} = \alpha_{it} + \beta_1 \times \text{Deposit growth}_{it} + \beta_2 \times \text{NPL}_{it} + \beta_3 \times \text{MMR}_{it} + \beta_4 \times \text{Cap}_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times \text{Liquidity}_{it} + \beta_7 \times GDP_{it} + \beta_8 \times INF_{it} + \beta_9 \times \text{Crisis} + \varepsilon_{it}$$

LOAN GROWTH = Annual percentage change in banks' loans.
DEPOSIT GROWTH = Annual percentage change in banks' deposits.
NPL = Non-performant loans ratio.
MMR = Monetary market rate.
Cap = Capital strength.
SIZE = Bank's size.
LIQUIDITY = Bank's liquidity.
GDP =Annual percentage change in real GDP**.**
INF =Inflation.

In this model, the loans' growth in Tunisian banks depends on several variables that reflect the specificities of banks and their financial strength (DEPOSITS, LIQUIDITY, NPL, SIZE and CAPITAL STRENGTH) to examine the presence of the distributional effects of monetary policy among banks and other variables that relate to the macroeconomic environments (INF and GDP).

We also included the MMR to analyze the effect of monetary policy and to see to what extent the monetary policy changes could affect loans growth in Tunisian banks. This could provide information concerning the bank lending channel behavior in Tunisia.

Crisis is a dummy variable that is equal to 1 if we are in a period of crisis (the subprime crisis in our case) and equal to 0 if we are not. This is to showcase the role that a financial crisis can play in weakening or strengthening bank lending.

2. Hausman test

To estimate the panel data, Baltagi and al (2005) proposed a fixed-effects model or a random-effects model. The fixed-effects model is a regression with a constant slope, however, the intersection varies with cross-sectional units, while the random-effects model will have a constant random term. The choice of fixed-effects or random-effects models can be tested using the normative Hausman test proposed by Hausman in 1978. The rule that applies in this test is that the fixed-effect model is preferable to the random-effect one if p-value <5% i.e., when the result of the Hausman test is significant in the model.

Table 9: Hausman test

	Fixed effects	Random effects	Difference	S.E
Deposit growth	.0640163	.0976962	-.03368	.0135261
Cap	.0716723	.1289437	-.0572714	.0558832
SIZE	.3609871	-.0876672	.4486543	.2962586
Liquidity	-.2000021	.0167159	-.216718	.0898142
NPL	-.2783299	-.1094322	-.1688977	.0712222
MMR	-1.15406	-1.143326	-.0107335	.
INF	.1381474	.6948482	-.5567008	.3048946
GDP	.8065376	.4462329	.3603046	.1841881
Crisis	.0494471	.0509777	-.0015306	.0021113

Source: Established by the author

STATA allowed us to perform the Hausman test to choose between a fixed-effects model or a random-effects model, and its null hypothesis assumes that there is no systematic difference in the coefficients. From the results obtained, we notice that the p-value is equal to 0.0311 which is much less than 5%. Therefore, we should use the fixed-effects model.

3. Autocorrelation test

The word autocorrelation can be used to know whether a random procedure was done to create the data sample or not. It is common that the residual terms of any two cases are not correlated but rather independent. It is believed that there is autocorrelation when the residual terms are not independent.

According to Carneiro (2006), in the analysis of panel data, the test for checking whether there is autocorrelation in the panel is based on the Wooldridge autocorrelation test. The test consists of checking the significance of the null hypothesis, that is, there is no specific error in the linear panel data model. We, therefore, need to check the autocorrelation in the model, because the

correlation between errors in panel data (especially linear data) can limit the effectiveness of the results obtained and bias the standard error. To see if the errors are related to each other, we use Wooldridge's "xtserial" test, where we assume that H0 confirms that there is no correlation and that the residuals are normal.

Table 10: Autocorrelation test

	***F* (1, 14)**	***p*-value**
Autocorrelation	4.499	0.0522
H0	Accepted	Accepted

Source: Established by the author

The results obtained show that the p-value of our model is equal to 0.0522 which is more than 5%. Consequently, we can accept the hypothesis H0 which confirms the presence of the problem of autocorrelation between the errors in our model.

4. Heteroscedasticity

Heteroscedasticity or what is commonly referred to as unequal variance is considered one of the common transgressions. It is known in multivariate analysis in which the residue in the regression measure is heteroscedasticity. Heteroscedasticity arises with any expansion or reduction in variance, leading to problems of statistical extrapolation in the regression model. Therefore, this test should be done before employing regression analysis on the results. Heteroscedasticity can be identified by doing tests with graphical results where the model residuals are plotted in contradiction with the expected value of the bank's performance and each descriptive variable to determine if the error terms of the model have consistent variances. The heteroscedasticity problem can also be detected using several tests, such as Park's test, White's general heteroscedasticity test, Glejser's test, Spearman's rank correlation test, the Goldfeld-Quandt test, and the Breusch-Pagan-Godfrey test.

In our study, we will use the Breusch-Pagan-Godfrey test to detect the existence of a heteroscedasticity problem.

Table 11: Heteroscedasticity test

	Chi2	***p*-value**
Breusch-Pagan	33.86	0.0000
H0	rejected	rejected

Source: Established by the author

The result of the Breusch-Pagan / Cook-Weisberg test is shown in the table above. Given the result, we can confirm the existence of a heteroscedasticity problem because the p-value is less than 0.05 which means that the H0 hypothesis is rejected.

5. Winsorizing

Statistics such as variance and mean are very sensitive to outliers; Winsor is a simple way to reduce the impact of outliers. Therefore, we process all variables at the 5th and 95th percentiles through the Winsor command. These variables are continuous variables to solve the problem of outliers and improve statistical efficiency.

This method converts the outliers in these percentiles so that they are equal to the values corresponding to those percentiles. We performed this procedure because the extreme outliers affect the significance level.

II. Main findings

1. Results

In this part, we will focus on the empirical results of our model over the period from 2005 to 2019.

First, we begin by presenting the results of the effect that monetary policy changes may have on loans growth of the banks in our sample taking into consideration the specific characteristics of each bank.

According to the tests that we carried out, we accepted the hypotheses of absence of correlation but rejected the one related to the absence of homoscedasticity, which obliges us to avoid the method of ordinary least squares, in order not to have biased results, and to use a regression method by generalized least squares (GLS).

Table 12: Empirical results

Loans growth	*Coefficient*
Deposits growth	.0676439**
Cap	.1449439**
SIZE	-.1322136*
NPL	-.1175463**
Liquidity	.0121261
MMR	-1.099248**
INF	.9488313**
GDP	.3276737
Crisis	.0554721***
_cons	.3281629**

**** p<0.01, ** p<0.05, * p<0.1*

Source: Established by the author

As shown by the table n° 12, monetary market rate has a negative and significant impact, at a 5% level on loans' growth. Thus, a restrictive monetary policy where the MMR could go down 100 points would decrease the Tunisian banks' lending activity by 1.09%. These results support the presence and the strength of the credit channel in the Tunisian economy.

Deposit growth that is added in order to represent the supply side of the bank lending channel, has a positive and significant relationship with loans' growth which is understandable especially after the capping of the Loans to Deposit ratio at 120%. This cap forced banks to link the loanable funds to their deposits in order to respect the ratio and avoid sanction. Besides, deposits provide a safety pad for the bank in question especially in the case of monetary tightening (restrictive monetary policy). This relationship is consistent with the one found by Gunji and al., (2009); Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Gee.

Banks' specific variables that showcase every bank's financial strength such as size, capital strength and liquidity have different relations with the loans' growth.

"SIZE" has a negative and significant impact on loans' growth which means that growth in the lending activity of banks with large size is low. Tunisian banks with large size usually have their own selected customers with whom they conduct the majority of their business transactions. This explains why these banks are selective in their loaning decisions and why they don't grant as

many loans as banks with smaller sizes. These results are consistent with the results found in earlier studies (Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Gee,2016).

Non-performant loans ratio has a negative and significant impact (at 5% level of confidence) on banks' loans' growth. This means that banks with higher "NPL" ratio tend to lower their loanable funds as they avoid increasing the level of non-performant loans which in turn can harm their financial statements.

The results show that capital Strength has a positive and significant (at 5% confidence level) impact on loans' growth which means that banks with stronger capital are more immune to monetary policy changes and tend to give more loans as compared to banks who have weak capitalizations.

Contrary to the other bank specific financial characteristics that presented different significant relations with loans' growth, "Liquidity" has an insignificant impact on the loans' growth of Tunisian Banks (p-value=0.876), This means that high-quality liquid assets don't affect the lending activity of the concerned bank. These findings are incoherent with the results of previous studies (Petya Koeva Brooks,2007; Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Gee,2016).

The macroeconomic variables included in our model to control the demand side effects are Inflation and GDP. Inflation has a positive and significant impact on banks' loans growth with a p-value=0.026. These results showcase the dynamic of business cycles in the Tunisian economy and they are in coherence with previous studies (Petya Koeva Brooks,2007; Habib Hussain Khan, Rubi Binti Ahmad, Chan Sok Gee,2016; Evangelos N. Salachas , Nikiforos T. Laopodis , Georgios P. Kouretas,2016).On the other hand, the results showed that GDP has an insignificant impact on bank loans' growth.

The variable "Crisis" has a positive impact on the variation in loans granted by Tunisian banks, nevertheless, its effect is relatively moderate at around 0.05.Indeed, the Tunisian economy has proven its resilience in the face of the financial crisis, which comes down to the importance of the role played by Tunisian banks and by the Central Bank of Tunisia to further support economic agents, in particular, Tunisian companies which continued to operate in the usual way despite the spread of the financial crisis internationally. Even though the important impact that had the financial crisis on the financial sphere by affecting international banks, the effect was not so apparent since banks anticipated the slow, but inevitable, propagation of the crisis which made it possible to mitigate any effect the latter could have on the Tunisian economy. The strength of the Tunisian credit channel, even in a period of financial crisis, is due

to the fact that credits are fully indexed on the MMR and the strong dependance of the Tunisian banks on Central Bank of Tunisia.

All of our main variables have a significant relationship at a 5% confidence level with the loans' growth in Tunisian banks which is a good indicator of the viability of our collected data and our model. Nevertheless, a robustness check is a must in order to provide more evidence of the viability of the model and to ensure that it is not sensitive to any changes.

2. Robustness check

In this subsection, we will check the robustness of the main results by adding alternative substitutes and using another regression method. Therefore, we will re-examine the relationship between loans' growth and the different variables present in our model. This will allow us to either capture the demand for money or give an idea about the bank's financial strength.

To test the robustness of our model, we will try to estimate our model by applying the GMM method (General Method of Moments).

GMM estimates provide solutions to the problems of simultaneity gap, reverse causality, and missing variables. Specifically, it makes it possible to resolve the endogeneity of the variables, which will inevitably appear when we study the relationship between banking development and economic development.

The results of our tests will be presented in the table n° 13 below

Table 13: GMM regression results

Loans growth	*Coefficient*
Deposits growth	.1098643***
Cap	.1773228**
SIZE	-.0999766
Liquidity	.016805
NPL	-.1197891**
MMR	-1.236162**
INF	.7903814*
GDP	.4787831*
Crisis	.0587003***
Constant	.2696092

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

Source: Established by the author

As shown in Table 13 above, even if the regression method is modified, our results are consistent with the first estimate with the GLS method and all our variables remained significant with the same signs of their coefficients except for the variable SIZE that became insignificant.

Deposit growth has a positive and significant (at a 1% level of confidence) on the loans' growth.

Capital strength, with a p-value=0.015, has a positive and significant impact on loans' growth.

Both Size and liquidity have insignificant impact on loans' growth with p-value=0.253 and p-value=0.853 respectively.

MMR has a negative and significant impact (at 5% level of confidence) on Tunisian banks' loans' growth.

The macroeconomic variable inflation and GDP have a positive and significant impact (at a 10% confidence level) on the Tunisian banks' loans' growth.

To sum up, our results are robust even if we change the regression method.

CONCLUSION

This study aims to examine the behavior of the credit channel in times of financial crises. Our approach was to focus on the bank lending channel and this by examining the impact that a change in monetary policy can have on the growth of Tunisian banks' loans granted. In addition, we examined, on one hand, the relationship between the variables specific to each bank reflecting its financial strength (size, capital strength and liquidity) and the dependent variable which is loan growth and, on the other hand, The effect that variation in deposits may have on the dependent variable mentioned above.

According to the results of the panel data analysis, for our main variables, just like our control variables, they all have a significant relationship with credit growth except for bank liquidity which had an insignificant impact. We found that the subprime crisis had a significant but relatively moderate impact on Tunisian banks' loans' growth which is due to the different measures that the Central bank and Tunisian banks adopted in that period of time in anticipation to the propagation of the international financial crisis and, also, to the characteristics of the Tunisian economy.

To conclude, the results of the study obtained from the analyzes of panel data showed that four hypotheses were confirmed while two others were rejected.

GENERAL CONCLUSION

GENERAL CONCLUSION

After a review of the theoretical literature, we have asserted that the central bank in the conduct of its monetary policy, assesses monetary conditions and makes macroeconomic projections before making decisions that may affect the real economy. As a result, monetary policy is now at the heart of debates about measures that are likely to promote sustainable growth and price stability in an economy.

In this study, we have tried to answer an essential question; how effective is the transmission channels of monetary policy, the credit channel in particular? and does the banking system effectively transmit the effects of monetary policy to the real sphere or do they get mitigated thanks to the bank's financial strengths?

In the first chapter, we clarified through the review of the literature the different key concepts of our study and presented the different theories related to them that have emerged over the years. Therefore, the aim of the first chapter was to synthesize the theoretical work of the concepts studied.

In the second chapter, we began our empirical approach by making a diagnosis of the situation of the Tunisian economy in the first place and that of the Tunisian banking sector in the second place during the previous years. The goal was to determine the achievements and the major problems that faced the country. The descriptive analysis that we conducted subsequently helped us to interpret and validate the empirical results. Then, we collected and structured the data by extracting the necessary data of 15 conventional Tunisian banks (Private, Public and Mixed) during the period 2005-2019. Our main sources of data concerning the banking sector are the APTBEF online annual reports and CMF online reports.

After collecting the necessary data, we proceeded to perform the calculation of our variables present in the model followed by the analysis of panel data. Being our dependent variable, the annual growth of loans granted by Tunisian banks was present in our sample (loans' growth). We followed the same methodology and used the same variables used by other authors in earlier studies (Amidu & Wolfe, 2013; Gunji and al., 2009; Olivero and al., 2011a, 2011b) to evaluate the credit channel in Tunisia. But we resorted to a different method of estimation due to the presence of the heteroscedasticity problem in our model.

For The independent variables that we used in our model, we included the Tunisian monetary market rate (MMR) to help us capture the effect of monetary policy changes on banks'

loans growth because it contains all the information that concerns the monetary policy adopted by the Central Bank of Tunisia. We included variables that represent the financial strength and the different characteristics of each individual bank present in our model namely (size, capital strength and Liquidity) and we included the ratio of the non-performant loans that will act as a control variable in our model. We also included deposit growth and other macroeconomic variables like inflation and the annual growth of the gross domestic product.

Most of our results were coherent with the previous studies as they showed that the monetary market rate has a negative and significant impact on loans' growth of the Tunisian banks, thus, confirming our first research hypothesis (H1).

Deposits' growth has a positive and significant impact on the loans' growth which confirms our second research hypothesis (H2).

As for the banks' specific characteristics' size has a negative impact on loans' growth whilst the capital strength of the bank impacted positively and significantly the loans' growth. Thus, confirming our third research hypothesis (H3) but rejecting our fourth hypothesis (H4) On the other hand, liquidity has an insignificant impact on the lending activity of the Tunisian banks which means that our fifth hypothesis (H5) is invalid.

The results that showed that "Crisis" has a positive impact on the variation in loans granted by Tunisian banks, nevertheless, its effect is relatively moderate at around 0.05. Even though the important impact that had the financial crisis on the financial sphere by affecting international banks, the effect was not so apparent in Tunisia since banks anticipated the slow, but inevitable, propagation of the crisis which made it possible to mitigate any effect the latter could have on the Tunisian economy. The inclusion of the variable "Crisis" in our study was to examine the viability of the credit channel in Tunisia in the case of a financial crisis. Therefore, based on the previous stated results; we can confirm our sixth research hypothesis (H6).

The macroeconomic variables Inflation and GDP had contradictory effects on the loans' growth of Tunisian banks. Inflation has a positive and significant impact on banks' loans growth whereas the gross domestic product's growth has an insignificant impact of on our dependent variable.

We did additional tests to verify the robustness of our model, these tests consisted of using another regression method (GMM). Our results were consistent with our first results which is a good indicator of the robustness of our model

To sum up, the results has led us to confirm four research hypotheses and reject the other two.

It is important to note that our research has certain limitations. First, our sample was based on only 15 traditional banks, excluding Islamic banks and offshore banks operating in Tunisia. Secondly, it is impossible to study the impact of the "Covid-19" pandemic on the credit channel in Tunisia because the data necessary to conduct this study is unavailable at this time. Thirdly, our study only examines the bank-lending channel without the balance sheet channel which is mainly due to the insufficient data and the limited time to gather all the necessary information and data in order to conduct a viable study. Nevertheless, many authors based their studies on the behavior of the bank lending channel when they tried to examine the credit channel which is what our study's methodology and results are in coherence with.

Given the empirical results that we have obtained and the limitations presented, we can suggest future projects of research which seem, in our opinion, relevant to be explored. Future research should take into account new contexts, such as the "Covid-19" crisis which will increase the persistence of political problems and affect the macroeconomic variables such as the GDP. In addition, it will be interesting to study the balance sheet channel in Tunisia.

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APPENDICES

APPENDICES

- **Stationarity tests**
  - Loan growth

```
. xtfisher Loangrowth

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

          chi2(30)      =    99.3945
          Prob > chi2   =     0.0000


. xtfisher Loangrowth, trend

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

          chi2(30)      =    83.8176
          Prob > chi2   =     0.0000


. xtfisher Loangrowth, lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    81.2347
          Prob > chi2   =     0.0000
```

```
. xtfisher Loangrowth, lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    81.2347
          Prob > chi2   =     0.0000


. xtfisher Loangrowth, trend lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    81.0022
          Prob > chi2   =     0.0000
```

➢ Deposit growth

```
. xtfisher Deposigrowth

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

         chi2(30)     =  107.5498
         Prob > chi2  =    0.0000


. xtfisher Deposigrowth , trend

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

         chi2(30)     =   78.3281
         Prob > chi2  =    0.0000


. xtfisher Deposigrowth , lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

         chi2(30)     =   41.6929
         Prob > chi2  =    0.0760
```

```
. xtfisher Deposigrowth , trend lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

         chi2(30)     =   22.1617
         Prob > chi2  =    0.8481
```

- Capital strength

```
. xtfisher Cap

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

         chi2(30)      =   58.9511
         Prob > chi2   =    0.0012


. xtfisher Cap , trend

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

         chi2(30)      =    9.0472
         Prob > chi2   =    0.9999


. xtfisher Cap , lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

         chi2(30)      =   79.5612
         Prob > chi2   =    0.0000
```

```
. xtfisher Cap , trend lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

         chi2(30)      =   54.1413
         Prob > chi2   =    0.0044
```

- Non-performant loans

```
. xtfisher NPL

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

         chi2(30)     =   69.3100
         Prob > chi2  =    0.0001


. xtfisher NPL , trend

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

         chi2(30)     =   16.1206
         Prob > chi2  =    0.9817


. xtfisher NPL , lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

         chi2(30)     =   33.7935
         Prob > chi2  =    0.2892
```

```
. xtfisher NPL , trend lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

         chi2(30)     =   23.3484
         Prob > chi2  =    0.8007
```

- Liquidity

```
          chi2(30)      =    50.0939
          Prob > chi2   =     0.0121


. xtfisher  Liquidity , trend


Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

          chi2(30)      =    53.6364
          Prob > chi2   =     0.0050


. xtfisher  Liquidity , lag(1)


Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    24.4031
          Prob > chi2   =     0.7535


. xtfisher  Liquidity , trend lag(1)


Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    17.4727
          Prob > chi2   =     0.9665
```

- Size

```
          chi2(30)      =    65.0394
          Prob > chi2   =     0.0002


. xtfisher  SIZE , trend


Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

          chi2(30)      =    18.1514
          Prob > chi2   =     0.9560


. xtfisher  SIZE , lag(1)


Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    75.5660
          Prob > chi2   =     0.0000


. xtfisher  SIZE , trend lag(1)


Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    56.9346
          Prob > chi2   =     0.0021
```

- Monetary market rate (MMR)

```
          chi2(30)      =    72.1931
          Prob > chi2   =     0.0000


. xtfisher  MMR , trend

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

          chi2(30)      =    67.8765
          Prob > chi2   =     0.0001


. xtfisher  MMR , lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    60.6723
          Prob > chi2   =     0.0008


. xtfisher  MMR , trend lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    92.8487
          Prob > chi2   =     0.0000
```

- Inflation

```
          chi2(30)      =    81.8321
          Prob > chi2   =     0.0000


. xtfisher INF , trend

Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

          chi2(30)      =   142.1005
          Prob > chi2   =     0.0000


. xtfisher INF , lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =     5.6661
          Prob > chi2   =     1.0000


. xtfisher INF , trend lag(1)

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

          chi2(30)      =    17.6646
          Prob > chi2   =     0.9637
```

- Gross domestic product growth (GDP)

```
        chi2(30)      =   72.7996
        Prob > chi2   =    0.0000


. xtfisher GDP , trend


Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags)

Ho: unit root

        chi2(30)      =  118.4664
        Prob > chi2   =    0.0000


. xtfisher GDP , lag(1)


Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

        chi2(30)      =   27.0800
        Prob > chi2   =    0.6191


. xtfisher GDP , trend lag(1)


Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags)

Ho: unit root

        chi2(30)      =   31.2297
        Prob > chi2   =    0.4042
```

- **Variance inflation factor test**

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
        SIZE |      4.26    0.234893
         Cap |      3.93    0.254208
         NPL |      1.93    0.518489
         INF |      1.89    0.528489
Depositgro~h |      1.64    0.610211
         MMR |      1.58    0.632899
      Crisis |      1.25    0.799871
   Liquidity |      1.15    0.866060
         GDP |      1.10    0.907840
-------------+----------------------
    Mean VIF |      2.08
```

- **Hausman test**

```
. hausman fe re
```

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
DEPOSITSG~H	.0640163	.0976962	-.03368	.0135261
CAPITALST~H	.0716723	.1289437	-.0572714	.0558832
SIZE	.3609871	-.0876672	.4486543	.2962586
Liquidity	-.2000021	.0167159	-.216718	.0898142
NPL	-.2783299	-.1094322	-.1688977	.0712222
MMR	-1.15406	-1.143326	-.0107335	.
INF	.1381474	.6948482	-.5567008	.3048946
GDP	.8065376	.4462329	.3603046	.1841881
Crisis	.0494471	.0509777	-.0015306	.0021113

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

  Test:  Ho:  difference in coefficients not systematic

              chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =       18.37
            Prob>chi2 =      0.0311
            (V_b-V_B is not positive definite)
```

- **Autocorrelation test**

```
. xtserial  Loangrowth  Depositgrowth  Cap  SIZE  NPL  Liquidity MMR INF GDP Crisis

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      14) =      4.499
          Prob > F =      0.0522
```

- **Heteroscedasticity test**

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

         chi2(1)       =     33.86
         Prob > chi2   =    0.0000
```

- **Empirical results**

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =        15          Number of obs      =       225
Estimated autocorrelations =         0          Number of groups   =        15
Estimated coefficients     =        10          Time periods       =        15
                                                Wald chi2(9)       =     78.30
                                                Prob > chi2        =    0.0000
```

wLoangrowth	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wDepositgrowth	.0676439	.0307782	2.20	0.028	.0073197	.127968
wCap	.1449439	.0635336	2.28	0.023	.0204203	.2694675
wSIZE	-.1322136	.0801451	-1.65	0.099	-.2892951	.0248679
wNPL	-.1175463	.0545446	-2.16	0.031	-.2244517	-.0106408
wLiquidity	.0121261	.0779208	0.16	0.876	-.1405959	.1648481
MMR	-1.099248	.5277976	-2.08	0.037	-2.133713	-.064784
INF	.9488313	.4261667	2.23	0.026	.1135598	1.784103
GDP	.3276737	.223082	1.47	0.142	-.109559	.7649064
Crisis	.0554721	.0106351	5.22	0.000	.0346277	.0763164
_cons	.3281629	.1574328	2.08	0.037	.0196002	.6367255

- Robustness check (GMM regression)

```
. ivregress gmm wLoangrowth wDepositgrowth wCap wSIZE wNPL wLiquidity MMR INF GDP Crisis

Instrumental variables (GMM) regression              Number of obs =     225
                                                     Wald chi2(9)  =   66.10
                                                     Prob > chi2   =  0.0000
                                                     R-squared     =  0.3321
GMM weight matrix: Robust                            Root MSE      =  .07614
```

wLoangrowth	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
wDepositgrowth	.1098643	.0387808	2.83	0.005	.0338554	.1858732
wCap	.1773228	.0730387	2.43	0.015	.0341696	.320476
wSIZE	-.0999766	.0875162	-1.14	0.253	-.2715053	.071552
wNPL	-.1197891	.0576838	-2.08	0.038	-.2328473	-.0067309
wLiquidity	.016805	.0905349	0.19	0.853	-.1606403	.1942502
MMR	-1.236162	.567814	-2.18	0.029	-2.349057	-.1232675
INF	.7903814	.4413364	1.79	0.073	-.0746219	1.655385
GDP	.4787831	.2579262	1.86	0.063	-.0267431	.9843092
Crisis	.0587003	.0141875	4.14	0.000	.0308933	.0865074
_cons	.2696092	.1799961	1.50	0.134	-.0831766	.622395

```
(no endogenous regressors)
```

	Type of governance		
	Public	**Private**	**Mixed**
Banks	Société tunisienne de Banque (STB)	Arab Tunisian Bank (ATB)	Banque tuniso-koweïtienne (BTK)
	BNA BANK (BNA)	AMEN BANK	TSB BANK (TSB)
	BH BANK (BH)	Banque internationale arabe de Tunisie (BIAT)	BANQUE TUNISO-LIBYENNE (BTL)
		Union internationale de banques (UIB)	Banque de Tunisie et des Émirats (BTE)
		Union bancaire pour le commerce et l'industrie (UBCI)	
		Attijari Bank	
		Banque de Tunisie (BT)	
		Qatar National Bank (QNB)	

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