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The Short-run and Long-run Relationships between Credit risk, Financial stability, and Macroeconomy: Evidence from Tunisia with an emphasis on the Banking Sector

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Abstract: The banks are at the core of the functioning of economies and the dynamic of the growth of the country. They ensure the activity of financial intermediation between those who have surpluses and those who have the needs of funding. For this, they are in front of several risks including the risk of credit. They are always seeking to ensure their financial stability.
The objective of this paper is to study the impact of credit risk on financial stability. The econometric procedure is based on a hypothesis within a model with panel co-integrated for a sample composed of 21 Tunisian banks for an annual frequency going from 2005 to 2019.
The results revealed that the relationship between credit risk and the performance of assets is unidirectional. In other words, within the meaning of Granger, the increase in credit risk causes an increase in the production of assets and not the reverse. Moreover, credit risk and the gross domestic product have a bidirectional relationship. These results have led to the conclusion that credit risk is positively linked to the financial stability of the Tunisian banks. To sum up, our findings support the result that there is a two-way relationship between the stability of banks and the total productive assets to the threshold of 1% in short and in the long term. These results confirm the high performance of Tunisian banks and especially the first three banks named in Tunisia, namely the International Bank Arabic of Tunisia (BIAT), the National Agricultural Bank (BNA) and the Attijari Bank (AB).

Keywords: Financial stability, financial intermediation, risk of credit, non-performing loans, funding,annual frequency,total productive assets, return on assets,hypothesis, gross domestic product,model of panel co-integrated, 21 Tunisian banks, productive assets, high performance, BIAT, BNA, AB.

1. INTRODUCTION

A financial system is generally under the form of three essential concepts: the financial markets, financial intermediaries and financial infrastructures. Its primary function is to ensure the effective transfer of resources of lenders towards borrowers. In particular, it allows you to finance the production of the company and the consumption of households. It, therefore, ensures the activity of intermediation, in fairly assessing the financial risks to absorb the financial and real shocks.

Mostly, the financial system performs its functions effectively. In some cases, the financial instability of businesses can be a significant magnitude such that the dysfunctions which are transmitted to the economy. Nevertheless, regardless of the reality and the monetary and financial conditions stable are necessary to limit the negative impacts of financial

crises. The costs of the recent financial crises have led to additional efforts of the authorities to identify the required instruments for the prevention of the occurrence of these events.

The interests of researchers and economists have focused on the identification of adequate instruments to detect and prevent financial crises. Several approaches were adopted in the past, but remain outdated due to the evolution of the economic model and systems of production. Currently, financial stability and financial risks have become a source of significant concern to the Global Plan. The main reason for this concern is the multiplication of the financial crises that weigh heavily on the financial system and in particular on the banks. These last are in the exposure to a variety of risks classified into four categories: financial risks, operational risks, risks of exploitation and accidental risks (Greuning and Bratanovic, 2004). The credit risk, as part of the financial risks, is considered as the main risk to which a bank is facing (Caprio et al. 1998; Campbell, 2007). Several researchers have concluded that the credit risk involves the banking failure, by the accumulation of credits not powerful (Thomson, 1991; Whalen, 1991; Cole and Gunther, 1995; Barnhill et al. 2002; Vazquez et al. 2012).

In the face of the importance of credit risk and the sustainability of the financial stability of banks in Tunisia, this paper aims to study the impact of credit risk on the financial stability of banks. To do this purpose, it was adopted in the recent developments of the econometrics of time series by following three steps: unit root test, a test of co-integration of Johansen and Granger causality test in the framework of a vector model to the correction of error.

2. LITERATURE REVIEW AND THEORETICAL ASSUMPTIONS

Credit risk is the fundamental risk incurred by a bank. Virtually, all banks in the world are confronted with problems of irrevocable debts (loans in progress). They must therefore continually improve their models and practices in the field of the management of credit risk, and find ways to prevent it. To cover the banks against these failures, several empirical studies have been implemented to study and measure the stability of banks, using different techniques, for example, the z-score, the NPL (non-performing loans).

Čihák and Hesse (2010) have studied the stability of Islamic banks and conventional 20 countries during the period 1994 and 2004, based on the technique z-score. Later, Beck et al. (2013) have used the same technique by comparing the commercial orientation; the efficiency and stability of banks, to show that the Islamic banks of small size have a credit risk lower than those with a considerable size. Subsequently, Beck et al. (2013) have used the NPL as an indicator of the quality of the assets. They have revealed that the doubtful debts of Islamic banks are lower than those of conventional banks because of their low credit risk.

The last two decades have witnessed the development of a range of techniques for the measurement of credit risk, grouped in two categories (Altman and Saunders, 1998; Colquitt, 2007; Allen et al. Powell, 2011). The first category based on accounting includes, but is not limited to Z-score of Altman, the credit risk z-score and the analysis NPL. The second consists of the external ratings; Standard & Poor's, Moody's... Recently, the risk is measured by indicators based on the market as the probability of default of Merton, Risk (VaR) and Credit Metrics. Altman and Saunders (1998)and CrouhyGalai, and Mark (2006)provide extensive investigations on the current models of credit risk.

In this study, we use NPL to measure the level of credit risk in the banks (Louzis et al. 2012). One of the advantages of this measure (NPL) is that it is a direct measure of the solvency which is challenging to manage and difficult to manipulate, more of its simplicity (Berger and DeYoung, 1997, Ahmad and Ariff, 2007; Jiménez et al., 2006; Fiordelisi and Mare, 2013). This measure indicates the increased likelihood of bank insolvency.

The non-performing loans are generally referring to loans, which, during a relatively long period, do not generate revenues (principal and/or interest). In addition, these loans shall designate the non-performing loans or even the overdue receivables. However, the primary criterion for the identification of non-performing loans which is the period of non-repayment varies from a financial system to another (Fofack, 2005; Nkusu, 2011). The non-performing loans have been widely used as a measure of the quality of the assets by the credit institutions, and have often been associated with the

presence of a risk of bankruptcy and financial crises. They are considered as a leading indicator statistically significant of the insolvency (Lanine&Vennet, 2006). Several banking institutions often have a substantial level of doubtful debts before the period of distress. The non-performing loans are among the main causes of the problems of economic stagnation (Nkusu, 2011). The presence of these loans in the financial sector has increased the possibility of having a company in difficulty and not cost-effective.

Over the past few years, the literature, which examines the non-performing loans (NPL) has attracted the attention of several researchers to understand the factors responsible for financial vulnerability. This vulnerability can be attributed to the role played by the Impaired Assets as evidenced by the strong association between the NPL and the financial crises. In effect, Sorge (2004)advocates the use of such variables (the non-performing loans and provisions for losses on loans), in the framework of stress tests to assess the vulnerability and the fragility of the financial system.

Nkusu (2011) class work in three components. The first component of the literature has emphasized the explanation of the NPL in financial institutions, highlighting the role of macroeconomic performance, the quality of management and the political choices (Dash &Kabra, 2010; Espinoza& Prasad, 2010; Louzis, Vouldis, & Metaxas, 2010). The second component of the literature analyzes the link between the NPL and the conditions macro-financial, highlighting the positive impact of the NPL on the probability of crisis (Caprio&Klingebiel, 1996; Kaminsky& Reinhart, 1999). The third branch of the literature focuses on the explanation of the NPL at the macro-economic level. These aggregates may relate either to the total outstanding loans in an economy, either to certain types of loans (Pesola, 2007; Jappelli, Pagano, & Marco, 2008; Nkusu, 2011).

Several empirical studies have analyzed the causes of bank bankruptcy in the concern to the study of various determinants of NPL. The work of Sinkey and Greenawalt (1991), Kwan and Eisenbeis (1997), as well as Salas and Saurina (2002) take into account the macroeconomic factors as well as to financial conditions, at the level of the American banks and Spanish. Similarly, Espinoza and Prasad (2010), Kabra (2010), Louzis et al. (2012) have shown that the NPL depend on the macro-economic factors as well as to the factors specific to the banks. In the same current of this literature, Messai A.S, and Jouini. A (2013) have studied a sample consisting of 85 banks of three countries for a period ranging from 2004 to 2008 and have found that the NPL depend on macroeconomic factors and factors specific to the banks. Similarly, Abid et al (2015) have made their studies on Tunisian banks and have shown the same results.

The academic literature provides evidence to suggest a strong association between the NPL and several macroeconomic factors (Fernandez of DSL and al 2000, Salas&Saurina, 2002, Caprio and Kingebiel (1996, 2003), Chase et al. 2005, Jimenez et Sauurina 2006, Festic&Beko, 2008; Khemraj& Pasha, 2009). These factors, which the literature provides as important determinants are: the annual growth in the GDP, the growth of credit, the real interest rate, the annual rate of inflation, the real exchange rate, the annual unemployment rate, the monetary mass and the GDP per capita, etc. Festic&Beko (2008), have examined the importance of macroeconomic variables on the non-performing loans in Hungary and Poland, using the method of vector autoregressive (VAR).

By analyzing the relationship between the solvency ratio and the NPL, Berger and DeYoung (1997), Bikker (2002), Chase et al (2005), Quagliariello (2007), Khemraj and Pasha (2009),Greenidge and Grosvenor (2010), Misraetand Dhal (2010), Louzis, Vouldis and Metaxas (2010) and Louzis et al (2012) agree that in addition to macroeconomic variables, the factors specific to the bank (such as the size of the institution, the profit margins, the efficiency, effectiveness, credit conditions, the risk profile, and the market power) are important determinants of the NPL. Salas and Saurina (2002), Barth et al (2002), Hu et al (2004), Miccoet al (2004)and Boubakri et al (2005)have studied the impact of the property of the Bank; private, public, or foreign, on the volume of bad debts by comparing between them.

Several empirical studies carried out by Salas and Saurina (2002), Rajan and dhal (2003)have demonstrated that the banks of significant size have a higher capacity for reduction of credit risk, while Hu et al. (2004), Kemraj and Pasha (2009) have shown that more than the size of the Bank is large, more than it will be exposed to risks.

To analyze the relationship between bank profitability and the NPL, Fofack (2005), Iskandar (2005), Seuraj and

Watson (2007), Louzis, Vouldis and Metaxas (2012), were used as a measure of this last the ROE (Return on equity) and ROA (Return on Assets), which are also used in the literature as a proxy for the quality of the management of the banks. These researchers have stated that the increase in profitability resulted in a decrease of NPL and vice versa.

The ROA (Return on Assets) is a variable that represents the profitability of capital invested and expresses the ability of this capital to create a certain level of operational benefits. This measure was used by a number of significant authors such as Adams et al. (2005) to measure the performance, profitability and between other the financial stability of banks. Following this literature, stem the assumptions of this research:

H1- the credit risk positively affects the financial stability of banks.

H2- the credit risk and the total productive assets (TEA) are in a relationship of long-term equilibrium.

H3- the credit risk causes the ATE.

H4- the ATE causes credit risk.

H5- the credit risk and the performance of assets (ROA) are in a relationship of long-term equilibrium.

H6- the credit risk causes the ROA.

H7- the ROA causes credit risk.

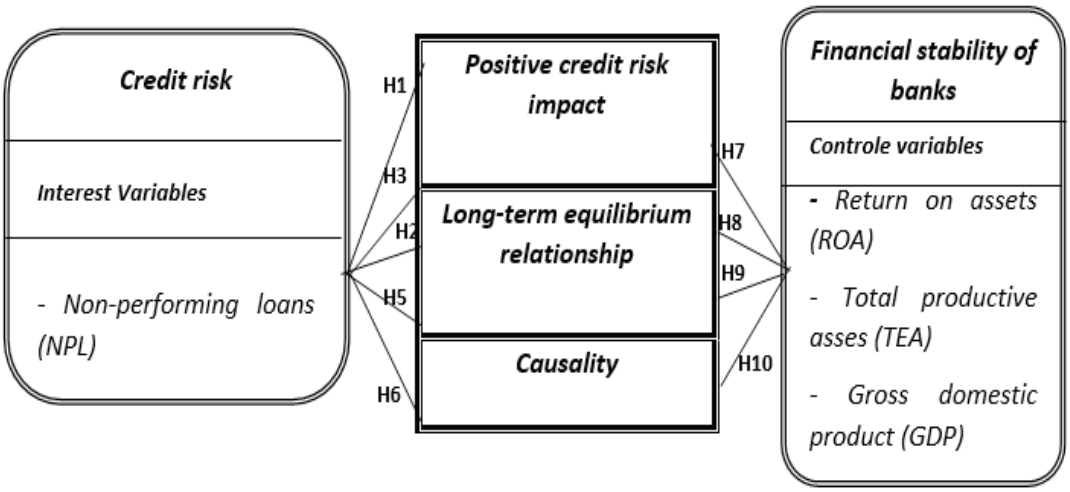
H8- the credit risk and the gross domestic product (GDP) are in a relationship of long-term equilibrium.

H9- the credit risk causes the GDP.

H10- the GDP causes the credit risk.

These assumptions lead to the release of this model of research:

Figure 1



Source: Authors conception using hypothesis; The impact of credit risk on financial stability

3. RESEARCH METHOD

This study is essentially based on the approach of Pedroni (1999,2004) of unit root test and co-integration. These tests are used to verify the existence of a relationship between the variables in the research, as well as infer the direction of causality between them. Nevertheless, their properties are reduced due to the data period of the time series, which is considered to be rather long.

This approach follows three steps. It begins by an audit of stationarity of the variables, using the unit root test to avoid any correlation. Then, we are trying to test the existence of relations of co-integration between the variables, using the test of co- heterogeneous integration in panel developed by Pedroni (1999). The test of co-integration examines whether a relationship of long-term equilibrium exists between the variables when individual variables are non-stationary. Because of heterogeneity between variables, once the relationship of co-integration has been established, after Apergis and Payne (2009), we apply the model of the vector tothe correction of error (VECM) in the panel to review the direction of the causal relationship between the variables.

4. VARIABLES AND DATA SOURCES

The sample of our study consists of 21 Tunisian banks observed during the period from 2005 to 2019, therefore a panel of 315 observations.

To study the impact of credit risk on the financial stability of these banks, it has used three variables; namely the credit risk, total productive assets "total earning assets" (TEA), return on assets (ROA) and the gross domestic product (GDP). The model of our study is the model of panel co-integrated. The software Eviews8 will carry out the unit root test, the test of co-integration and the Granger causality.

The variable to explain is a credit risk. As a measure of risk, it retains the non-performing loans NPL. Although this measure of NPL can get affected by economic variables and by factors specific to the banks. It remains the most straightforward measure and used as a proxy of the probability of default or default rates of appropriations of the banks. Concerning our control variables, it highlights the effect of the profitability of the assets (ROA), the total of the productive assets (TEA) and the gross domestic product (GDP) on the financial stability of banks.

As was already been mentioned that the primary role of a bank is the granting of credit and it is the same that it is from these loans that these companies make profits. Therefore, it is crucial for banks to measure the impact of the credit function on stability. The performance of the assets (ROA) is the expression of the profitability of the assets of the Bank. He reported the net result to the total balance sheet. This ratio is used to measure the ability of the Bank to pay its funds. It allows us to assess the operational efficiency of the Bank. ROA is the quotient of the net result and the totals of the assets. Its major drawback is, on the one hand, it places the totality of the assets on the same plan, whereas the corresponding risks are different. On the other hand, it neglects the off-balance sheet activities that take on more of the magnitude in recent years.

An asset represents a stock of resources. The financial resources concerned appropriations, capital, and pensions. The ability that possesses the different assets to generate the flow, revenues and stocks allow you to qualify as 'productive' (Barrett and Reardon, 2000). The economic analysis is interested generally in those productive assets in relation to economic growth and well-being. In effect, the productive assets have an impact on the well- be c is to say have an effect on the income (Abdelhak et al. 2012), on the growth of income and the poverty of the long-term (Siegel P. B. 2005) and consumption (Katz, Chamoro J. 2003). In addition, productive assets include all assets that generate revenue without the need for additional work or investment on the part of the owner. This includes items such as interest-bearing accounts, securities such as stocks and bonds, and everything that pays dividends. Once the initial expense is complete, the assets will begin to return the funds, providing a stable source of income and security.

The last variable is the gross domestic product (GDP). The GDP is an indicator of the assessment of the production of goods and services. It measures the economic activity of a country. This indicator is considered as a determinant important macroeconomic of a bank. Two methods estimate it either by the income, either by the expenditures. A growing economy is reflected by the steady growth of GDP. The growth of GDP is related to a high income and a low unemployment rate, which improves the capacity of borrowers to reimburse the loan.

In 2015, ESA Jokivuolle, JarmoPesola and MattiViren examined the losses on loans from banks in nine European countries during the period 1982 up to 2012 using a non-linear model to three factors. They have measured the credit risk

of the Bank by the losses on loans made in the banking sector and have the modeled with three macroeconomic variables: production, the real interest rate and the ratio of credit to the private sector in GDP relative to its trend. These authors show that a decrease in the production leads to an increase in losses on bank loans of the Indebtedness Before the private sector at high speed. If the rate of indebtedness is low, the losses on bank loans may remain moderate same after a very sharp decline in production, as has been the case for example in Finland in 2009. The work of these authors has completed the point of view of the work of Drehmann et al. (2011),and Drehmann and Juselius (2014). The two studies have examined the ability of GDP credit as well as other indicators to anticipate the episodes of crisis. Repullo and Saurina (2011)present a critical view of the use of the ratio of credit / GDP relative to its tendency to create depreciation counter-cyclical of capital. The article of Lousis et al (2012)is linked to the literature on the banks of the stress with macroeconomic variables; see for example Borioet al (2014), Castrén et al. (2010).

Empirically, the relationship between NPL and GDP was the subject of debate for several jobs. Some work to validate the negative correlation between these following variables (Salas and Suarina, 2002; Rajan& dhal, 2003; Fofack, 2005), while others deny this relationship and affirm the existence of a positive effect between GDP and NPL (Louzis 2012). Following this literature, it has inspired the idea of integrating the gross domestic product in our research to study the effect of credit risk on the financial stability of a share and the gross domestic product of another part.

The table below summarizes the descriptive statistics associated with the 4 variables; loans not insured(NPL), the total of the productive assets "total earning assets" (TEA), the performance of the assets (ROA) and the gross domestic products (GDP) which are downloaded from the Bankscope (World Region/Country: TUNISIA).

The empirical study is based on annual observations. It is clear from the table1 that the standard deviation (SD) of ROA is the higher and that of GDP is the lowest. The review of the asymmetry of distribution (skewness) allows concluding that the distribution of the variables NPL, ROA and TEA is stretched toward the right as all their values are positive with several observations on the left, while the distribution of GDP is away from the normal distribution to the left. The statistics on the Jarque-Bera allows you to evaluate the hypothesis of normality.

Approximate the distribution. This hypothesis is confirmed in our study; that is to say that the variables of study have a normal distribution.

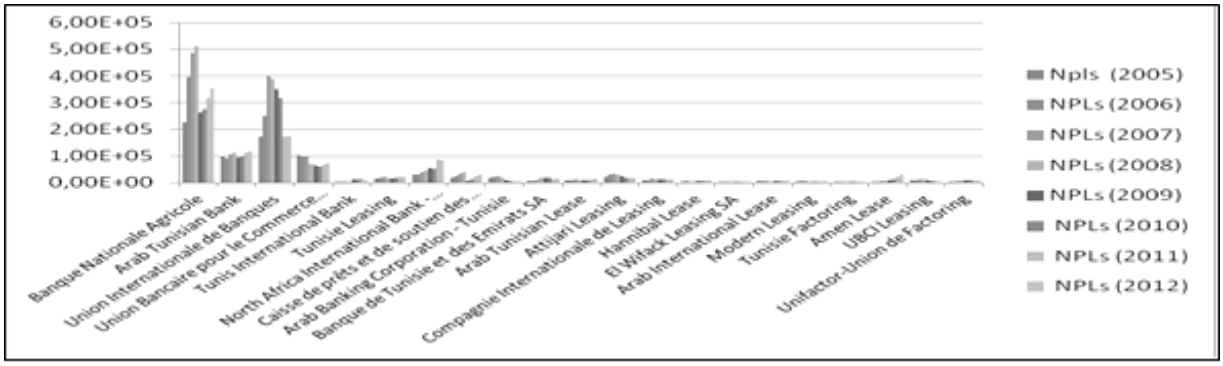
Table 1

	NPL	TEA	ROA	GDP
Mean	50789.57	695848.5	894827.4	5771.816
Median	1512041 00.00	251876.6	278861.5	1959.789
Maximum	521900.0	5819189.	7218615.	49014.21
Minimum	-6880.000	9636.882	12046.10	-146391.4
Std. Dev.	94540.45	1104801.	1372122.	17209.35
Skewness	2.901210	2.716231	2.702317	-4.523219
Kurtosis	11.10254	9.985316	9.765312	50.04317
Jarque-Bera	910.4216	677.6789	676.1632	16245.98
Probability	0.000000	0.000000	0.000000	0.000000
Sum	11958498	2.52E+08	2.30E+08	946984.7
Sum Sq. Dev.	2.37E+12	2.81E+14	5.04E+14	4.90E+10
Comments	315	315	315	315

Source: Authors calculations using Descriptive Statistics of the variables used, i.e., credit risk measured by the loans not insured (NPL), total productive assets "total earning assets" (TEA), return on assets (ROA) and gross domestic product (GDP).

Figure 2 shows the distribution of credit risk for the 21 banks during the period 2005- 2019. According to this figure, the National Bank of agricultural has a higher value compared to other banks.

Figure 2



Source:Authors conception showing the Representative diagram of classification of the banks according to the credit risk (NPL).

5. RESULTS AND DISCUSSION

5.1 Correlation test

The correlation quantifies the extent to which two quantitative variables X and Y vary together. This table provides the results on the degree of relationship between the variables used in this study. The degree of correlation between NPL on the one hand and ROA, TEA and GDP of another part is moderate, but there is an extreme value between ROA, TEA, and GDP. These variables appear to be strongly positively correlated (0.9715203et 0.913152).

In conclusion, the correlation test confirms a positive relationship between credit risk and the stability of banks in Tunisia (0.544338), as it shows a positive relationship between NPL and the GDP. By following the hypothesis, H1 is confirmed.

Table 2

	NPL	ROA	TEA	Gdp
NPL	1.000000	0.544338	0.519719	0.505668
ROA	0.544338	1.000000	0.9715203	0.913152
TEA	0.519719	0.9715203	1.000000	0.930602
Gdp	0.505668	0.913152	0.930602	1.000000

Source: authors' calculation based on the correlation test

5.2 Unit root test

The unit root tests are used to identify the presence of the unit root in a series. A chronological series is stationary if it contains neither a trend or seasonality. Several unit root tests in the panel have been proposed in the literature, including Maddala and Wu (1999), Breitung (2000). Recently, Hlouskova and Wagner (2006), by a large scale of Monte Carlo simulation, have found that the unit root test in panel Breitung (2000)is used for a large or small size distortions among the other tests.

The pioneering work of Levine-Lin-Chu and Im -Pesaran-Shin has allowed appearing the test LLC and the IPS test. These tests will enable you to check the order of integration of the variables and to indicate the position of stationarity of

the variables in the time series. They are based on the principle of the test classic increased Dickey-Fuller (ADF). They explore the heterogeneity of the interceptions differently. The test LLC The explores through the members of the group, while the IPS test the explores in the slope coefficient.

The unit root test Dickey-Fuller increased is estimated as follows:

$$\Delta X_t = \mu_i + \gamma_i X_{it-1} + \sum_{j=1}^{pi} \beta_{ij} \Delta X_{it-j} + \delta_i t + \varepsilon_{it} \quad (1)$$

p_i With; $i = 1,2 \ldots N$;$t = 1,2 \ldots T$;X_{it} is the panel series on the period;t is the number of delays selected for the ADF regression; Δ is the first difference$(1 - L)$; And ε_{it} is an error white noise.

Table 3

The variables	NPL	ROA	TEA	Gdp
At the level				
Methods				
Levin, Lin & Chu t*	-2.32671 ***(0.0102)***	-1.24120 ***(0.1412)***	-1.25485 ***(0.1278)***	-31.2421 (0.2689)
Im, Pesaran And Shin W-stat	0.49684 ***(0.6888)***	3.12413 ***(0.9998)***	3.12516 ***(0.9998)***	-4.312587 (0.4957)
ADF - Fisher Chi-square	43.6123 ***(0.4096)***	19.6584 ***(0.9987)***	19.7863 (0.9987)	120.012 (0.5265)
PP - Fisher Chi-square	29.5420 ***(0.9262)***	21.5348 ***(0.9978)***	21.3658 ***(0.9978)***	504.365 (0.0147)
1St Difference				
Levin, Lin & Chu t*	-21.1029* (0.0000)	-21.3255* (0.0000)	-21.3252* (0.0000)	-21.9857* ***(0.0000)***
Im, Pesaran And Shin W-stat	-9.24541* (0.0000)	-12.4763* (0.0000)	-12.4587* (0.0000)	-3.98547* ***(0.0000)***
ADF - Fisher Chi-square	144.425* (0.0000)	198.689* (0.0000)	198.648* (0.0000)	*117.215** ***(0.0000)***
PP - Fisher Chi-square	173.163* ***(0.0000)***	233.789* ***(0.0000)***	233.125* ***(0.0000)***	146.658* ***(0.0000)***

Source: Estimation results for the Unit Root Tests

Note:*, ** Represents a meaning to levels of 1% and 5%, respectively, of importance (entries in bold). The null hypothesis is that the variable follows a process unit root.

Table 3 indicates the possibility of the presence of a relationship of long-term equilibrium between NPL, tea, ROA and GDP. Since all the variables are stationary at the first level, it commented on the existence of long-term relationships.

5.3 Analysis of co-integration

The study of the co-integration allows you to test the existence of a stable long-term relationship between two non-stationary variables, by including variables delays and exogenous variables. For the detection of the possible involvement of co-integration between the variables in our panel, it uses the test of co-integration introduced by Pedroni (1999), which is effective for the resolution of problems encountered. The principle of this test is simple; two-time series is called co-integrated if the difference between the two series non-stationary itself is in the same order, which means the possibility of the existence of a relationship of long-term equilibrium between the variables used (Pedroni (2004)). This leads to inferring that the absence of along-term relationship is interpreted by a lack of co-integration, which translates into an arbitrary displacement of variables; some are placed away from the other.

The test of co-integration of Pedroni (2004)follows the following equation:

$$LROA_{it} = \Phi_{it} + \Upsilon^{t} + \phi_{1t} NPL_{it} + \phi_{2t} tea_{it} + \phi_{3t} GDP_{it} + \mu_{it} \quad (2)$$

With i = 1.2, ..., n indicates each bank in panel, t = 1.2, , n means the period of the time can be used in the panel.

The results of the tests for co-integration of Pedroni are detailed in the Table 4:

Table 4 An alternative hypothesis: Common AR coefs. (Within-dimension) Pedroni

	Weighted			
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-2.624213	0.0768	0.772014	1.0000
Panel RHO-Statistic	3.023549	0.8912	1.315105	0.9987
Panel PP-Statistic	1.217565*	0.0000	1.41215*	0.0000
Panel ADF-Statistic	-1.524356*	0.0000	3.785651*	0.0000

An alternative hypothesis: individual AR coefs. (Between-dimension) **Pedroni**

	Statistic	Prob.
Group RHO-Statistic	1.726812	0.9598
Group PP-Statistic	-1.42178	0.0000
Group ADF-Statistic	-5.32567*	0.0069

Kao Residual cointegration test

	T-Statistic	Prob.
ADF	-1.12573*	0.0000

Source: Authors' calculation using the Analysis of co-integration of Pedroni and Kao
Notes:*, ** Indicate the rejection of the null hypothesis at 1%, 5%, where the null hypothesis is that the variables are not cointegrated.

In the light of the results of the tests of Pedroni recorded in table 4, the null hypothesis of the absence of a relationship of co-integration for our Panel is rejected in the majority of tests. In effect, the likelihood of having long-term relationships between the credit risks measured by the loans not insured (NPL), the total of the productive assets "total earning assets" (TEA), the performance of the assets (ROA) and the gross domestic product (GDP) is justified. In conclusion, H2, H5 and H8 are confirmed.

Therefore, it uses the Granger causality test to detect the dynamic linkages between the different variables used.

In this study, all of the variables are integrated of order 1, or I (1). To overcome this problem, there specifies a model with a dynamic representation of error correction, to estimate a vector model to the correction of error (VEC) by increasing the regression of model vector autoregressive (VAR) with a period in term of correction of a mistake.

The dynamic model to the correction of an error is based on the following regressions, to detect the causal links in a given to panel (Apergis and Payne, (2009)).

$$\Delta ROA_{it} = \alpha_{i1} + \Sigma^{k}_{p-1} \mu_{1ip} \Delta NPL_{it-p} + \Sigma^{k}_{p-1} \beta_{1ip} \Delta TEA_{it-p+} + \Sigma^{k}_{p-1} \Upsilon_{1ip} \Delta PIB_{it-p+} \phi_{1i} ECT_{it-1+} \varepsilon_{1i} \quad (3)$$

$$\Delta NPL_{it} = \alpha_{i2} + \Sigma^{k}_{p-1} \mu_{2ip} \Delta NPL_{it-p} + \Sigma^{k}_{p-1} \beta_{2ip} \Delta TEA_{it-p} + \Sigma^{k}_{p-1} \Upsilon_{2ip} \Delta PIB_{it-p+} \phi_{2i} ECT_{it-1+} \varepsilon_{2it} \quad (4)$$

$$\Delta TEA_{it} = \alpha_{i3} + \Sigma^{k}_{p-1} \mu_{3ip} \Delta NPL_{it-p} + \Sigma^{k}_{p-1} \beta_{3ip} \Delta TEA_{it-p+} + \Sigma^{k}_{p-1} \Upsilon_{3ip} \Delta PIB_{it-p} + \phi_{3i} ECT_{it-1} + \varepsilon_{3it} \quad (5)$$

$$\Delta PIB_{it} = \alpha_{i3} + \Sigma^{k}_{p-1} \mu_{4ip} \Delta NPL_{it-p} + \Sigma^{k}_{p-1} \beta_{4ip} \Delta TEA_{it-p+} + \Sigma^{k}_{p-1} \Upsilon_{4ip} \Delta PIB_{it-p} + \phi_{4i} ECT_{it-1} + \varepsilon_{4it} \quad (6)$$

Or Δ is the operator of difference; ECT is the correction term of the error from the relationship of co-integration in the long term; $\alpha, \mu, \beta, \gamma, \delta, \theta, \vartheta, \rho, \sigma, \varphi$ a et ω are parameters of estimates; k is the lag order determined by the Schwarz information criterion (SIC).

Table 5

Null Hypothesis:	Obs	F-statistic	Prob.
ROA does not Granger Cause NPL	315	***5.31235***	0.0443*
NPL does not Granger Cause ROA		1.125865	0.7235
TEA does not Granger Cause NPL	315	***5.25142***	0.0321*
NPL does not Granger Cause TEA		0.12142	0.7802
Gdp does not Granger Cause NPL	315	***0.64441***	0.0421*
NPL does not Granger Cause GDP		0.42345	0.0223*
TEA does not Granger Cause ROA	315	4.79210	0.7001
ROA does not Granger Cause TEA		12.9872	0.7875
Gdp does not Granger Cause ROA	315	0.0125	0.9897
ROA does not Granger Cause GDP		28.5489	0.7011
Gdp does not Granger Cause TEA	315	0.04789	0.8897
TEA does not Granger Cause GDP		30.7895	0.7775

Source: The estimation results for non-Causality Granger test (pairwise)
Notes: *, ** And *** indicate that the estimates of the parameters are significant to the level of 1%, 5% and 10% respectively.

According to table5, there is not a strong causal between the credit risk and the stability of the bank in Tunisia measured by ROA. In effect, there is only a unidirectional relationship ranging from NPL toward ROA at the threshold of 5%. Similarly, this table shows that an increase in GDP growth leads to an increase in the volume of doubtful loans and vice versa since our results are significant at the 5% threshold. In summarizing, the relationship between GDP and NPL is bidirectional.

Although in the economic literature and financial, the credit risk negatively affects the stability of the Bank. In this study, it shows the reverse; c-to-of the credit risk for the Tunisian banks has no significant adverse effect on the sustainability of the financial stability of banks.

In effect, the Wald test based on Granger causality, presented in the table6, shows similar results than that of Table 5. According to this table, there is a two-way relationship between the stability of banks and the total productive assets to the threshold of 1% in short and in the long term. These results confirm the high performance of Tunisian banks and especially the first three banks named in Tunisia, namely the International Bank Arabic of Tunisia (BIAT), the National Agricultural Bank (BNA) andthe Attijari Bank (AB).

For the first three banks, which are very appointed in Tunisia, head of the classification, the International Bank Arabic of Tunisia (BIAT) has seen its net banking income evolve in 8,06% compared to 2014. The structure of the GNP of the BIAT is composed of a margin of intermediation to figure 53.02% with a margin of the commission of 24.63% and with a net income of a portfolio of 24,16%.

The National Agricultural Bank (BNA), which is ranked second, saw its GNP decline of 0.36% compared to 2014. Its GNP has reached the end of 2015 347,5 million dinars. The share of the GNP of the BNA was carried out by its margin of intermediation that has achieved 67,34%.

In addition, the third bank, which is Attijari Bank (AB) with a GNP of a value of 274.9 million dinars, performs an evolution of 4.64% compared to 2014. In effect, the margin of intermediation has reached 48.08% of the product net banking income of Attijari Bank.

The Arab Tunisian Bank (ATB) has carried out the highest increase inthe net banking income. Between 2014 and 2015, the GNP of the ATB has evolved from 17.14% to achieve a value of 203.4 million dinars. The net income of the portfolio of the ATB has contributed to a height of 42,29%it's GNP.

Table 6

The short- term					The long-term
Excluded variables: block homogeneity					
	NPL	ROA	TEA	GPD	ECMT-1
NPL	-	2.9897 (0.1604)	2.83012 (0.1978)	8.88745 (0.0059)	-0.0278** [-4.3845]
ROA	0.89784 (0.3365)	-	7.01089 (0.0325)	12.42351 (0.0352)	***-0.13201**** ***[-1.7847***]
TEA	3.26879 (0.43587)	8.69872 0.0084	-	15.58791 (0.0056)	**-0.0354**** **[-1.8754]**
GDP	10.35489 (0.3674)	11.31458 (0.01457)	12.63147 (0.0163)	-	**-0.0343***** **[-2.2154]**

Source: Estimation results for non-Causality Granger test (Wald)

Notes: ECT is the coefficient of the term of correction of an error. *, ** And *** indicate that the estimates of the parameters are significant to the levels of 1%, 5% and 10% respectively.

6. CONCLUSION

This research is given in ambition to study the impact of credit risk on the financial stability of banks for the case of the Tunisian economy. The originality of this work lies in the empirical validation that was made with the theoretical literature of credit risk as well as financial stability. Our study has helped to identify the relationships between the four selected variables (the NPL, the ROA, the AME, and the GDP). They are stationary in the first difference. They are co-integrated. They evolved together and displayed, therefore, a relationship of long-term equilibrium in at least one direction. The relationship between credit risk and the performance of assets is unidirectional. In other words, within the meaning of Granger, the increase in credit risk causes an increase in the production of assets and not the reverse. While the credit risks and the total of the productive assets are in the two-way relationship. In other words, the credit risk because of the productive assets and vice versa.

Similarly, the credit risk and the gross domestic product have a bidirectional relationship; this means that the credit risk causes the gross domestic product and vice versa. These results have led to the conclusion that the credit risk is positively linked to financial stability; it is to say that an increase in the level of credit risk makes the banking system more immune and more stable. The maintenance of this financial stability of Tunisian banks despite the rise in the credit risk is mainly due to the device to the guarantee of deposits, sharing of risk and derivatives of risk. This range of the technique of cover against the risk of credit allows the banks to obtain the payment of their claims in the event of failure.

The literature relating to the field of banking has highlighted the role played by credit risk in banking failure. At the end of this literature, we have noticed that the researchers are moving to study the banking system for developed countries, while few of the studies are interested in developing countries. Besides, abundant literature has several families of indicators of financial stability to trigger at the right time the implementation of a policy of stabilization of the financial system of banking. Therefore, the construction of a comprehensive indicator of the latter proves to be difficult to achieve. Several studies that are carried out on different periods, in different countries, at levels of financial stabilities different, but none of these studies has given a useful result on a specific state.

In this article, we have studied the impact of credit risk on the financial stability of banks, taking the case of a developing country and taking as an indicator of stability performance of the assets, the total productive assets and the gross domestic product which are in direct relationship with the financial stability of banks.

Our study suggests several future tracks of research. One of these tracks is to choose other variables to measure credit risk and financial stability. In addition, we can study this theme based on methods and techniques for the assessment of Credit Risk the most advanced including the neural networks of neurons.

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