Asian Economic and Financial Review
ISSN(e): 2222-6737
ISSN(p): 2305-2147
DOI: 10.18488/journal.aefr.2019.93.389.401
Vol. 9, No. 3, 389-401

URL: www.aessweb.com

THE EFFECTS OF RISKS ON THE STABILITY OF TUNISIAN CONVENTIONAL BANKS

Khemais Zaghdoudi[1]

[1]*Associate Professor in Economics, University of Jendouba, Tunisia; Faculty of Law, Economics and Management; Laboratory of Natural and Cultural Patrimony Valorization, Tunisia*
Email: k.zaghdoudi@yahoo.fr Tel: + 216 98553863

(+ Corresponding author)

Article History
Received: 17 December 2018
Revised: 23 January 2019
Accepted: 28 February 2019
Published: 2 April 2019

Keywords
Credit risk
Liquidity risk
Operational risk
Bank stability
Tunisian conventional banks
Panel data analysis.

JEL Classification:
G21; G28; D25.

ABSTRACT

This paper examines the impact of credit risk, liquidity risk, and operational risk on Tunisian bank stability. These major risks continue to threaten Tunisian banks which are still developing traditional activities, despite the exhaustion of the main factors that have long sustained banking intermediation. To do this, we used data from all conventional banks operational during the period 2005-2015 and we used panel data analysis. Empirical results show that the stability of banks is closely linked to factors specific to them. It depends positively and significantly on their profitability and their liquidity risk, and negatively and significantly on their size and the interaction of both credit and liquidity risks. As for the credit risk, it has no significant impact on the stability of banks when the latter is proxied by Z-score (ROE), but it becomes detrimental in the case of Z-score (ROE). These results could be of great importance for bank managers to draw appropriate strategies in order to manage various risks facing their banks, to know how to enhance their profitability, to make adequate restructurings to enlarge their size and to rely on highly qualified managers and staff who know how to coordinate various actions and manage large institutions.

Contribution/ Originality: This study is one of very few which have investigated the impact of three types of risks, incorporated in the same econometric model, on all conventional Tunisian banks using a recent database.

1. INTRODUCTION

In developed countries, the bank plays a dual role. It is both a financial intermediary and a service provider. By using its balance sheet, the bank provides loans to deficit agents and collects resources, mainly in the form of deposits, from surplus agents. These operations constitute the core of balance sheet intermediation. Similarly, banks intervene in various capital markets to balance their cash, limit their risks, manage portfolios of financial securities, and so on. These activities, not exclusive of others, constitute market intermediation. As a service provider, the bank provides to its customers different means of payments and takes care of their management, gives both exchange and securities services, provides advice on asset management and private banking, and offers financial engineering services, etc.

However, in developing countries, the two functions are unevenly developed. The intermediation function outweighs the service delivery function. More importantly, banks continue to play a leading role in financing those

countries' economies. They transform short-term resources into medium and long-term activities. This transformation exposes them to different types of risks, mainly credit risk, liquidity risk and operational risk.

These major risks have been the subject of several studies that dealt with their impact on, among other things, the stability of banks. The results of these works were not unanimous, as some authors found a negative effect (Imbierowicz and Rauch, 2014; Mensi and Labidi, 2015; Hakimi *et al*., 2017) while others achieved a positive effect (Ghenimi *et al*., 2017; Shoaib *et al*., 2018). A third category of works found a non-significant effect of risks on the stability of banks (Adusei, 2015; Tan, 2016).

These different results motivated us to examine the effects of risks on the stability of Tunisian banks, which continue to rely heavily on traditional activities, essentially the granting of credits, the collection of deposits and the provision of means of payments and their management, despite the exhaustion of the main factors that have long sustained banking intermediation. For this reason, we will focus in this study on three risks: credit risk, liquidity risk and operational risk, which are considered major risks. The majority of empirical works have emphasized credit and liquidity risks without giving attention to operational risk.

This paper tries to fill this gap and contribute to the existing literature on three levels. First, our study enriches the literature that deals with the effects of risks on bank stability which has no consensus on the results. This justifies the need to deepen research on the risks that destabilize the banking sector in developing countries which continue to rely on this sector in financing their economies.

The second contribution lies in the use of three types of risks (credit, liquidity and operational risks) in the same econometric model. As far as we know, there are no published empirical studies that take into consideration these major risks together mainly for the Tunisian case. The last contribution of this paper is the use of all the Tunisian conventional banks and a recent database. In Tunisia, our principal sources of data concerning the banking sector are the Online Annual Reports of Tunisia's Professional Association of Banks and Financial Institutions. The latest available online report is that of from 2016. But this report does not contain data relating to the Franco-Tunisian Bank[1].

The aim of this paper is to study the impact of risks on bank stability focusing on credit risk, liquidity risk, interaction of both credit and liquidity risks, and operational risk. These risks are considered as major risks namely for Tunisian banks which remained specialist. To achieve this aim, we used all Tunisian conventional banks operational during the period 2005-2015 and we used panel data analysis based on the random effect which seems to be the most appropriate method given the characteristics of our data which are doubly indexed taking into account both temporal (eleven years) and individual (twenty homogeneous banks) dimensions.

The remainder of this paper is organized as follows. Literature review is given in section 2. Section 3 is devoted to methodology. Results and discussions are presented in section 4. Section 5 concludes and proposes some relevant policy implications.

2. LITERATURE REVIEW

The debate on the impact of risks on bank stability is inconclusive. The academic literature is plentiful and the empirical evidence provides different results. Findings on this subject matter can be divided into three groups. The first group of works supports the negative effect of risks on bank stability. The second group defends the positive impact. Compared to other financial institutions, banks have expertise in risk management. The bank exists because it provides liquidity and reduces transaction costs, information asymmetries and risks. Along this line of thinking, the third group of works focuses on the non-significant impact of risks on bank survival.

[1]For more details, please visit the following site: www.apbt.org.tn

The negative impact of risks on bank stability has been analyzed in several studies. To investigate the main determinants of Tunisian bank stability, Hakimi *et al.* (2017) used a dataset of ten Tunisian banks during the period 1990-2015 and employed two different approaches (Bayesian Model Average and panel data analysis). Results converge and show that the liquidity risk and the interaction between credit risk and liquidity risk exert a negative and significant effect on bank stability. Ghenimi *et al.* (2017) studied the effects of liquidity risk and credit risk on bank stability using 49 banks belonging to eight countries of the MENA region (Bahrain, Jordan, Qatar, Saudi Arabia, Turkey, UAE, Kuwait, and Yemen) over the period 2006-2013. They found that credit risk and interaction between both risks contribute to bank instability.

Adusei (2015) searched the impact of bank size and funding risk on bank stability by using 112 rural banks operating in Ghana over the period from Q1 of 2009 to Q4 of 2013. To do this, the author used three measures of bank stability: Z-score, risk-adjusted return on assets (RAROA) and risk-adjusted equity on assets ratio (RAEA). Empirical findings showed that credit risk has a negative and significant impact on bank stability when the latter is measured by RAEA. Mensi and Labidi (2015) tested the interaction between market power, diversification and financial instability of 157 commercial banks belonging to eighteen countries in the MENA region over the period 2000-2013. They confirmed that banks are poorly stable and exposed to different risks such as the liquidity risk which exerts a negative and significant impact on bank stability.

Imbierowicz and Rauch (2014) analyzed the relationship between liquidity risk and credit risk and their joint effect on banks' probabilities of default by using a sample of virtually all US commercial banks observed during the period 1998–2010. Their findings showed that when liquidity risk and credit risk increased separately, a bank's probabilities of default also increased for all specifications. For the interaction between these two risks, empirical results revealed its negative and significant impact on bank stability at the 1% level of significance across all specifications.

On the other hand, other authors support the opposite result: that bank risks improve the performance of banks and ensure their stability. Shoaib *et al.* (2018) investigated the impact of revenue diversification on bank profitability and stability using a panel dataset of 200 commercial banks from all South Asian countries. They found that liquidity risk has a positive and significant relationship with risk-adjusted profits in all three GMM models. This means that adequate liquidity levels ensure higher risk-adjusted profitability (or stability) by guarding against the insolvency risk. Contrary to credit risk, (Ghenimi *et al.*, 2017) confirmed that liquidity risk contributes to bank stability for the eight MENA chosen countries.

As for the third group of works, Hakimi *et al.* (2017) confirmed that the credit risk has no importance for the stability of Tunisian banks. Tan (2016) studied the impacts of risks and competition on bank profitability in the Chinese banking industry over the period 2003-2011 under a one-step Generalized Method of Moments (GMM) system estimator. Results proved that risks haven't got any effects on bank profitability. Since profitability and stability are interdependent, bank stability is hence not sensitive to risks. Empirical results of Adusei (2015) also showed that liquidity risk is statistically insignificant for the three selected measures of bank stability. This suggests that in Ghana liquidity risk is not a significant predictor of rural bank stability.

3. METHODOLOGY

In this section, we present the data first and model specification and variable definitions second.

3.1. Data

To examine the effects of risks on bank stability, we used all the Tunisian conventional banks operational to be operational during the period 2005-2015 due to the limitations of the availability of recent data. The evolution of the number of Tunisian banks is presented in the Table 1.

Table-1. Number of Tunisian banks.

Years	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number	20	20	20	20	20	21	21	21	21	22	23

Source: Online Annual reports of Tunisia's Professional Association of Banks and Financial Institutions (www.apbt.org.tn).

In 2015, we had three Islamic banks in Tunisia (see Appendix, Table 2b). In this paper, we excluded them due to their specificities and we retained all twenty non-Islamic conventional banks (see Appendix, Table 1a). Data was collected from three sources: the online annual reports of Tunisia's Professional Association of Banks and Financial Institutions, the World Bank Development Indicators (WDI) online database and the Worldwide Governance Indicators (WGI) (Kaufmann *et al.*, 2010) produced by Daniel Kaufmann (Natural Resource Governance Institute and Brookings Institution) and Aart Kraay (World Bank Development Research Group).

For the empirical approach, we performed a panel data analysis based on random effects. Based on the individual and temporal characteristics of our data, the panel data method seemed to be the most appropriate.

3.2. Model and Variable Definitions

In this paper, we used an unbalanced annual data of 215 observations for twenty Tunisian Conventional banks observed during the period 2005 – 2015 to investigate the effects of credit, liquidity and operational risks on bank stability by using the econometric model written as follows:

$$BSTAB_{it} = \beta_0 + \beta_1 CR_{it} + \beta_2 LR_{it} + \beta_3 CR_{it} * LR_{it} + \beta_4 OR_{it} + \beta_5 PROF_{it} + \beta_6 SIZE_{it} + \beta_7 DIVERS_{it} + \beta_8 SBM_{it} + \beta_9 GROWTH_{it} + \beta_{10} INF_{it} + \beta_{11} POLIS_{it} + \varepsilon_{it}$$

In this model, bank stability depended on variables which reflected banks' specificities (CR, LR, OR, PROF, SIZE and DIVERS), the structure of their market (SBM), variables related to both macroeconomic (GROWTH and INF) and institutional (POLIS) environments in which banks operate.

(BSTAB) is bank stability which represented the dependent variable. It was proxied in this study by both Z-score (ROA) and Z-score (ROE) leading to two econometric models. The Z-score (ROA) is equal to the mean of return on assets plus the capital adequacy ratio[2] divided by the standard deviation of return on assets. The Z-score (ROE) is equal to the mean of return on equities plus the capital adequacy ratio divided by the standard deviation of return on equities. Z-score reflected the efforts made by the bank to reduce risks and absorb losses. When the Z-score's value was high, the bank was stable and vice-versa. Several authors used Z-score in their works to capture bank stability (Chien-Chiang *et al.*, 2014; Imbierowicz and Rauch, 2014; Adusei, 2015; Köhler, 2015; Mensi and Labidi, 2015; Ozsuca and Akbostanci, 2016; Tan, 2016; Ghenimi *et al.*, 2017; Hakimi *et al.*, 2017; Eichler *et al.*, 2018; Shoaib *et al.*, 2018).

(CR) is the credit risk measured by total loans to total assets (Adusei, 2015; Djebali and Zaghdoudi, 2017; Hamdi *et al.*, 2017). (LR) is the liquidity risk measured by total loans to total deposits (Ogilo and Mugenyah, 2015; Zaghdoudi and Hakimi, 2017; Ogilo *et al.*, 2018). (CR*LR) is the interaction of both credit and liquidity risks which can affect bank stability (Imbierowicz and Rauch, 2014; Ghenimi *et al.*, 2017; Hakimi *et al.*, 2017).

(OR) is the operational risk which is a non-financial organizational risk related to the internal operation of the bank and its management process, which can cause significant direct or indirect losses and a lack of trust in the bank. These losses result from failing business processes and inadequate internal procedures, staffing deficiencies, internal system failures including computer system malfunction, and adverse external events. Unlike credit and liquidity risks, operational risk has a measurement problem.

Some authors tried to measure this risk such as Elbadry (2018) and Diallo *et al.* (2015) who proxied it respectively by net income to total assets, and operational expense to operational revenue. In this paper, we used

[2] The capital adequacy ratio is measured by capital equities as a share of total assets.

the Basic Indicator Approach (BIA) adopted by the Basel Committee to measure operational risk. This approach is considered the most adapted to the reality of Tunisian banks which are mostly of small and medium size. It consists of calculating the required economic capital (K_{BIA}) that can be hedged against potential failures and losses. This capital requirement is approximated by the Average Net Banking Income (ANBI) for the previous three years multiplied by a flat-rate coefficient (δ). Thus, the economic capital required $K_{BIA} = \delta * ANBI$. According to the Basel Committee, the coefficient δ is equal to 15%.

(PROF) is the profitability of bank measured by the net interest margin as a share of total assets (Zaghdoudi *et al*., 2016; Hakimi *et al*., 2017; Pierluigi, 2018). (SIZE) is bank size measured by natural logarithm of total bank Assets (Alzoubi, 2017; Djebali and Zaghdoudi, 2017; Ghenimi *et al*., 2017; Tan and Anchor, 2017; Abedifar *et al*., 2018; Hryckiewicz and Kozlowski, 2018; Ogilo *et al*., 2018; Pierluigi, 2018; Shoaib *et al*., 2018). (DIVERS) is the revenue diversification of bank measured by total non-interest incomes as a share of total assets. This variable includes revenues from commissions and other net non-interest incomes (Nguyen *et al*., 2012; DeYoung and Torna, 2013; Hamdi *et al*., 2017; Shoaib *et al*., 2018).

(SBM) is the structure of banking market measured by Herfindahl-Hirshman Index (HHI) which is equal to the sum of squared market share of each bank in terms of total assets of all banks (Albertazzi and Gambacorta, 2009; Hakimi *et al*., 2017; Hamdi *et al*., 2017; Pierluigi, 2018). (GROWTH) is the economic growth measured by annual growth rate of Gross Domestic Product (Tan *et al*., 2017; Hryckiewicz and Kozlowski, 2018; Kim, 2018; Pierluigi, 2018). (INF) is the inflation rate measured by the customer price index (Altaee *et al*., 2013; Amidu and Wolfe, 2013; Adusei, 2015; Köhler, 2015; Louati *et al*., 2015; Mensi and Labidi, 2015; Mndeme, 2015; Tan, 2016; Djebali and Zaghdoudi, 2017; Ghenimi *et al*., 2017; Tan *et al*., 2017; Eichler *et al*., 2018; Pierluigi, 2018; Shoaib *et al*., 2018).

(POLIS) is the governance variable which "measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5"[3]. This variable is one of the six[4] governance measures compiled by Kaufmann *et al*. (2010) to detect institutional development of countries, which has an effect on banks' financial stability (Altaee *et al*., 2013). The value of -2.5 implies weak political stability while the value of 2.5 indicates strong political stability and institutional development.

The index i refers to banks (i = 1,...., 20), t represents time period in years (t = 2005,...., 2015). β_0 is the constant and ε_{it} is the error term. All variables of the econometric model were collected from the online annual reports of the Tunisia's Professional Association of Banks and Financial Institutions except for macroeconomic (GROWTH and INF) and institutional (POLIS) variables which meet international definitions and are taken from the World Bank Development Indicators (WDI) and the Worldwide Governance Indicators (WGI) (Kaufmann *et al*., 2010) databases respectively.

4. RESULTS AND DISCUSSIONS

We presented variable descriptive statistics of the model and their correlation matrix. In this section, we discuss the model estimation results and their interpretation.

4.1. Descriptive Statistics

Descriptive statistics are used to reveal the main characteristics of data used in this study. For each variable, we derived mean, standard deviation, minimum and maximum values. Table 2 below summarizes the variable descriptive statistics of the model.

[3] Definition is taken from WGI database.

[4] The six governance measures are (1) voice and accountability, (2) political stability, (3) government effectiveness, (4) regulatory quality, (5) rules of law, and (6) control of corruption.

Table-2. Variable Descriptive Statistics.

Variables	Obs.	Mean	Std. Dev.	Min	Max
Z-score (ROA)	220	20.87	18.089	-22.109	80.622
Z-score (ROE)	220	4.58	4.862	-13.486	18.590
Cr	220	0.84	0.104	0.177	0.988
Lr	220	1.76	4.107	0.136	47.348
cr*lr	220	1.55	3.973	0.094	46.138
Or	215	8.84	1.490	3.616	11.288
Prof	220	0.02	0.019	-0.173	0.055
Size	220	14.00	1.388	9.699	16.169
Divers	220	0.01	0.008	-0.004	0.035
Sbm	220	0.09	0.004	0.090	0.101
Growth	220	0.03	0.021	-0.019	0.067
Inf	220	0.04	0.010	0.020	0.058
Polis	220	-0.29	0.453	-0.931	0.238

The average value of Z-score (ROA) is equal to 20.87 with a maximum value of 80.622 and a minimum value of -22.109. The zscoreroe has an average value equal to 4.58 with minimum and maximum values of -13.486 and 18.59 respectively. The average of credit risk (cr) of Tunisian conventional banks is 0.84 with a maximum value of 0.988 and a minimum value of 0.177. The average value of liquidity risk (lr) is 1.76 with minimum and maximum values of 0.136 and 47.348 respectively. The interaction between credit risk and liquidity risk (cr*lr) has an average value of 1.55 with a maximum value of 46.138 and a minimum value of 0.094. The average of operational risk (or) is 8.84 with minimum and maximum values of 3.616 and 11.288 respectively.

Tunisian conventional banks have an average profitability of 2% with a minimum value of -17.3% and a maximum value of 5.5%. Their average size is 14 with minimum and maximum values of 9.699 and 16.169 respectively. The average income from the diversification of banks' activities was very low and equal to 1% with minimum and maximum values of -0.4% and 3.5% respectively. The average Herfindahl-Hirschman Index (HHI) is equal to 9%, meaning that the Tunisian banking market tends towards being a competitive structure.

Over the sample period 2005-2015, the average economic growth rate was 3% with minimum and maximum values of -1.9% and 6.7% respectively. As for the inflation rate, it was equal on average to 4% with a minimum value of 2% and a maximum value of 5.8%. The average value of political stability (Polis) was -0.29 which was is negative showing the deterioration of institutional quality which can destabilize financial and banking sectors.

4.2. Correlation Matrix

The correlation matrix gives information on the level and the nature of linkages between variables by determining the coefficients of their linear correlations. Table 3 below presents the correlation matrix of all variables used in this study.

The liquidity risk, the interaction between credit risk and liquidity risk (cr*lr) and the inflation rate were negatively correlated with both Z-score (ROA) and Z-score (ROE). Credit risk is negatively and positively associated with Z-score (ROE) and Z-score (ROA) respectively. Operational risk, profitability, size, divers, sbm, growth and polis variables were positively correlated with both Z-score (ROA) and Z-score (ROE).

Table 3 reveals a high level of correlation between operational risk and size. The structure of the banking market (sbm) and (polis) variables were also highly associated. Except for these two cases, the remaining variables were weakly correlated rejecting the existence of multi-colinearity problem.

Table-3. Correlation Matrix.

Variables	Z-score (ROA)	Z-score (ROE)	cr	Lr	cr*lr	or	prof	size	divers	sbm	growth	inf	polis
Z-score (ROA)	1.00												
Z-score (ROE)	0.73	1.00											
cr	0.07	-0.08	1.00										
lr	-0.05	-0.06	0.17	1.00									
cr*lr	-0.06	-0.07	0.20	1.00	1.00								
or	0.07	0.04	-0.11	-0.19	-0.19	1.00							
prof	0.36	0.42	0.24	0.08	0.07	0.04	1.00						
size	0.06	0.03	-0.06	-0.15	-0.15	0.96	0.12	1.00					
divers	0.00	0.21	-0.47	-0.20	-0.21	0.20	-0.13	0.09	1.00				
sbm	0.23	0.19	-0.02	-0.11	-0.12	-0.24	0.23	-0.26	-0.11	1.00			
growth	0.11	0.10	0.01	-0.04	-0.04	-0.13	0.13	-0.13	-0.02	0.50	1.00		
inf	-0.17	-0.14	0.06	0.13	0.13	0.18	-0.18	0.18	0.17	-0.62	0.01	1.00	
polis	0.21	0.19	0.02	-0.17	-0.18	-0.24	0.26	-0.23	-0.24	0.89	0.47	-0.60	1.00

4.3. Estimation Results of Random effect Model

In our paper, we relied on the panel data approach, which has several advantages. It increases the number of observations and that of the freedom degree, reduces the problem of co-linearity between explanatory variables and improves the estimation results.

However, before using panel data, it was first necessary to check the homogeneous specification of the data generating process by using the specification test called also the Fisher homogeneity test. Let Y_{it} and X_{it} be two processes that are related by the following linear relationship:

$$Y_{it} = \alpha i_{+} \beta i\, X_{it} + \varepsilon it \qquad (1)$$

With i and t denoting individual and temporal dimensions respectively. α_i and β_i are parameters that do not vary with time but differ from one individual to another. ε_{it} is the error term supposed white noise. In model (1), four cases are possible:

- All the constants α_i are different ($\alpha_i \neq \alpha$) and all the parameters β_i are different according to the individuals ($\beta_i \neq \beta$). In this case, we have different models that reject the panel structure.
- All the constants α_i are identical ($\alpha_i = \alpha$) and all the parameters β_i are different according to the individuals ($\beta_i \neq \beta$). In this case, we also have different models that reject the panel structure.
- All the constants α_i are identical ($\alpha_i = \alpha$) and all the parameters β_i are identical ($\beta_i = \beta$). In this case, we have a perfectly homogeneous panel.
- All the constants α_i are different ($\alpha_i \neq \alpha$) and all the parameters β_i are identical ($\beta_i = \beta$). In this case, we have a panel with individual or specific effects.

The homogeneity test consists in retaining these two last cases and comparing the two following hypotheses: H_0: (($\alpha_i = \alpha$) and ($\beta_i = \beta$)) versus H_1: (($\alpha_i \neq \alpha$) and ($\beta_i = \beta$)).

Table-4. Fisher Homogeneity Test.

Test	Results and decision
Fisher statistic F	F (12, 202) = 21.26
p-value	Prob > F = 0.0000
Verified hypothesis	H_1
Type of panel	Panel with individual effects

To decide between these two hypotheses, we referred to Fisher statistic F. If this statistic admitted a p-value higher than 5%, H_0 was accepted, ie the panel was perfectly homogeneous. To estimate the coefficients, we applied

the Ordinary Least Squares (OLS) method. If, on the other hand, the Fisher statistic had a p-value lower than 5%, H_1 was accepted, and the panel therefore had individual effects. The results of Fisher homogeneity test are presented in Table 4.

The results displayed in Table 4 show that Fisher's statistic F was equal to 21.26 and admitted a p-value of 0.0000, which was lower than 5%. We therefore accepted hypothesis H_1, which insisted on the existence of a model with individual effects.

Here two cases can arise: the individual effects could be either represented by constants (in this case we would have a model with fixed effects) or could be random (we would then have a random effects model). To choose the most appropriate model, we used the well-known test of Hausman (1978) which tested the two hypotheses (H_0: E (α_i / X_i) = 0 versus H_1: E (α_i / X_i) ≠ 0)) concerning the correlation of individual effects (α_i) and explanatory variables X_i. If H_0 was verified, the random effects model was chosen and the Generalized Least Squares (GLS) estimator was retained. If H_1 was verified, the fixed effects model was specified and the within estimator was kept.

In doing so, we found that for Z-score (ROA), the Hausman test value was 4.87 with p-value of 93.71% which was greater than 5%. Hence the appropriate model was the random effects model. Similarly, for the variable Z-score (ROE), the Hausman test value was 9.96 with p-value of 53.36% which was greater than 5% favoring the same model. To estimate the coefficients, we applied the Generalized Least Squares (GLS) method described initially by Alexander Aikten in 1934. This method is used to estimate an unknown parameter in a linear regression model especially in the presence of correlation between the residuals since the use of the OLS method leads to biased coefficients. We applied the GLS method to correct the problem of autocorrelation between errors' terms and improve the estimation efficiency when the variance of a parameter was not scalar variance-covariance matrix.

The results of the random-effects GLS regression are reported in Table 5 below.

Table-5. Coefficients' Estimation of the Model.

Dependent variables	Z-score (ROA)			Z-score (ROE)		
Independent variables	**Coef.**	**Std. Err.**	**Z**	**Coef.**	**Std. Err.**	**Z**
Cr	-9.754	5.936	-1.640*	-1.036	1.535	-0.670
Lr	6.380	3.176	2.010**	4.461	0.822	5.430***
cr*lr	-6.679	3.299	-2.020**	-4.617	0.854	-5.410***
Or	0.219	1.249	0.180	0.340	0.323	1.050
Prof	242.506	50.321	4.820***	59.665	13.030	4.580***
Size	-7.201	1.531	-4.700***	-1.903	0.395	-4.820***
Divers	50.209	77.438	0.650	-0.322	20.036	-0.020
Sbm	82.128	210.496	0.390	-16.601	54.422	-0.310
Growth	-9.814	18.778	-0.520	-3.867	4.863	-0.800
inf	-5.551	44.752	-0.120	5.847	11.584	0.500
polis	0.365	1.800	0.200	0.160	0.466	0.340
_cons	114.564	33.368	3.430	28.790	8.568	3.360
Hausman test Chi2 (11)		4.87			9.96	
Prob > Chi 2		0.9371			0.5336	
Wald Chi 2 (11)		300.02			264.15	
Prob > Chi 2		0.000			0.000	
Nber of Obs		215			215	

Note: ***. ** and * indicate level of significance respectively at 1%. 5% and 10%.

Regardless of the measure of bank stability (Z-score (ROA) or Z-score (ROE)), the results reported in Table 5 show that the stability of Tunisian conventional banks depended fundamentally on their specific factors. Liquidity risk (lr) and profitability (prof) variables were positively and significantly associated to Tunisian bank stability. Interaction of both credit and liquidity risks (cr * lr) and size variables are detrimental to their stability.

Profitability contributes to the stability of Tunisian banks. This finding was in line with those of Hakimi *et al.* (2017); Zaghdoudi *et al.* (2016) who found a positive but not significative effect. Profitability was mainly derived

from income from traditional activities, notably the granting of loans and the collection of deposits. That was why liquidity risk had a positive and significant impact on the stability of Tunisian conventional banks proxied both by Z-score (ROA) and Z-score (ROE). Our result confirmed those of Shoaib *et al.* (2018) who proxied bank stability by risk adjusted return on assets SHROA. This finding is in line with Ghenimi *et al.* (2017)'s work but not with Hakimi *et al.* (2017)'s who found a negative and significant effect. Our results contradict those of Adusei (2015) who stated an insignificant effect of liquidity risk on bank stability.

Tunisian conventional banks remained specialist banks despite the publication in the Official Journal of the Republic of Tunisia of the new banking law N° 2001-65 of 10 July 2001 on credit institutions as amended and supplemented by Law N° 2006-19 of 2 May 2006. This law allows banks to carry out related activities which extend the usual banking operations, non-banking activities (marketing of insurance and travel products) and equity investments in existing or new businesses while meeting certain conditions.

Different types of credits (consumer credits, home loans, car loans, etc.) have been made available by Tunisian banks to their customers composed mainly of private individuals, professionals and small and medium-sized enterprises (SMEs). Over the selected period 2005-2015, the average loan rate is 84% showing the significant weight of loans in the total assets of Tunisian conventional banks. This differentiation of products has enabled banks to earn interests that enhanced their incomes.

Additionally, Tunisian conventional banks continue to collect a significant portion of their resources in the form of deposits from their customers through a network of agencies which covers all regions of the country. According to the 2015 online annual report of Tunisia's Professional Association of Banks and Financial Institutions[5] the network of Tunisian banks is made up of 61 regional directorates, 1713 agencies, 16 branches, 16 business centers, 1 office and 58 exchange boxes. This dense geographical distribution of the network enabled banks to collect deposits which have an average rate equal to 79.19%. Unlike the granted credits, the collected deposits are low-paid. This has increased the net interest margin of the banks, thus contributing to the improvement of their performance and the support of their stability.

Results displayed in Table 5 show that the interaction of credit risk and liquidity risk (cr * lr) and size are factors that destabilize Tunisian conventional banks. The transformation of deposits into credits which improves banks' performance and ensures their stability was thwarted by credit risk which deprives banks of new investment opportunities. The negative joint impact of both credit and liquidity risks on bank stability was consistent with Ghenimi *et al.* (2017) and Imbierowicz and Rauch (2014). However, our result contradicts the finding of Hakimi *et al.* (2017) that the interaction between the two risks has a positive and insignificant impact.

The credit risk had no significant influence on the stability of Tunisian conventional banks when the latter was approximated by Z-score (ROE), but it became detrimental in the case of Z-score (ROA). This negative and significant impact of the credit risk on the survival of banks is in line with findings of several studies such as Ghenimi *et al.* (2017); Adusei (2015) and Imbierowicz and Rauch (2014). Tunisian banks have found difficulties in restituting the huge amounts of Non-Performing Loans (NPL) as illustrated in Figure 1.

On average, Non-Performing Loans as a percentage of total loans were 15.118% over the period 2005-2015. This high ratio slows down banking activities and undermines banks' stability.

The results displayed in Table 5 show that size destabilizes Tunisian conventional banks, since it had a negative and significant impact at the 1% level of significance on the two measures of bank stability. Our findings contradict those of Adusei (2015) and Mensi and Labidi (2015) who found a positive relationship between size and bank stability. Also, Djebali and Zaghdoudi (2017) and Hakimi *et al.* (2017) showed that size was not significant for Tunisian bank stability. Other authors found results similar to ours:Ghenimi *et al.* (2017); Köhler (2015).

[5] www.apbt.org.tn

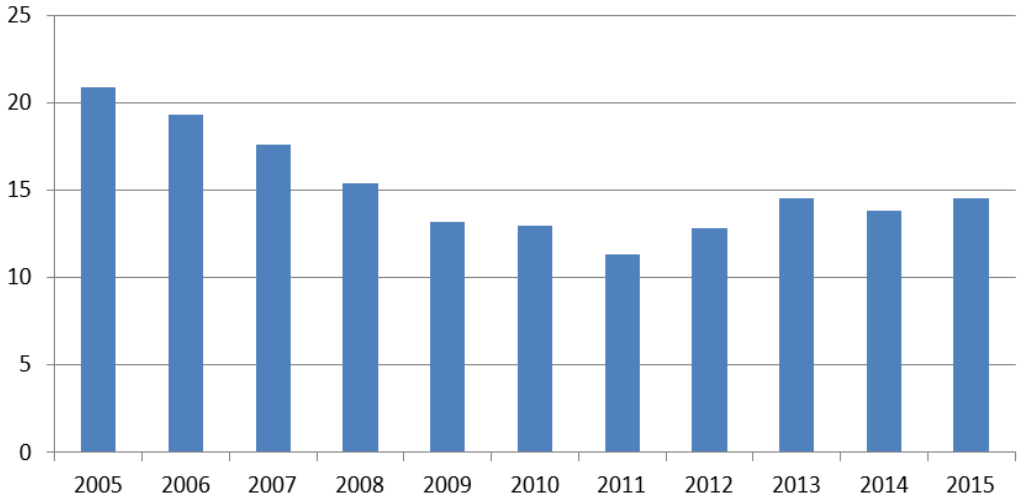

Figure-1. Evolution of Non-Performing Loans as a share of total loans (%) of Tunisian banks[6].
Source: Author's calculation based on World Bank Development Indicators (WDI) online database.

Tunisian banks are mostly small. This smallness contributes to their stability. This result can be explained by the quality of the leaders who lack the culture and competence required to manage large banks. In the short term, we could accept the positive and significant impact of small size on the stability of Tunisian banks. But, in the very near future when Tunisia fulfills its financial commitments to European countries under the partnership agreement signed in 1995, this small size could, on the contrary, lead to the bankruptcy of Tunisian banks which will compete with large European banking and non-banking financial institutions. This is why Tunisian banks were called upon to find solutions and make adequate restructurings to loosen the size constraint.

Findings also show that operational risk (or) and diversification of activities (divers) did not exert any significant effect on the stability of Tunisian conventional banks. This bank stability does not depend on the structure of the Tunisian bank market. The macroeconomic and institutional environments also do not affect the stability of Tunisian banks. Which do not depend on the structure of their market and both macroeconomic and institutional environments in which banks operate.

5. CONCLUSION AND POLICY IMPLICATIONS

The environment in which the bank operates has become highly competitive and open to the outside world. The bank suffers from four main types of competition: competition between domestic banks, competition from foreign banks, market competition and changing customer behavior. To counter the decline in their profitability and ensure their longevity, banks have developed risky activities.

The objective of this paper was to study the impact of risks on bank stability focusing on credit risk, liquidity risk and operational risk. These risks are considered major risks for Tunisian banks which continue to rely on basic traditional activities. We used all the non-Islamic Tunisian banks operational during the period 2005-2015 and we used panel data analysis. As far as we know, there are no published empirical studies which combine these three major risks in the same econometric model for the Tunisian case.

The empirical results indicate that the stability of Tunisian conventional banks is closely linked to factors specific to them. Whatever the measure of the bank stability (Z-score (ROA) or Z-score (ROE)), the stability of banks depends positively and significantly on their performance and their liquidity risk and negatively and

[6] According to the World Bank Development Indicators (WDI) online database, the value of 2008 does not exist. We calculated the corresponding percentage by linear interpolation; and it is equal to 15.4%.

significantly on their size and the interaction of both credit and liquidity risks (cr * lr). As for the credit risk, it had no significant impact on the stability of Tunisian conventional banks when the latter was proxied by Z-score (ROE), but it becomes detrimental in the case of Z-score (ROA).

The estimation results also show that the operational risk and diversification of activities did not have a significant influence on the stability of Tunisian banks. Neither the structure of the Tunisian banking market, nor the macroeconomic environment, nor the institutional environment in which banks operate act significantly on their stability.

Our findings have some interesting policy implications. Tunisian banks should improve their performance by targeting other customers and developing new businesses. They are also encouraged to manage the liquidity risk well and to tap into the various capital markets to collect their resources based until now on deposits. Bank managers need also to know how to manage credit risk through the use of new management techniques including securitization and defeasance.

According to the econometric results, it is true that the small size of Tunisian banks was a factor ensuring their stability. But, in the very near future with the entry into force of Tunisia's financial commitments to European countries in the framework of the partnership agreement signed in 1995, this small size could lead, on the contrary, to the bankruptcy of Tunisian banks which will compete with large European banking and non-banking financial institutions. This is why Tunisian banks are called upon to follow appropriate consolidation and restructuring strategies to loosen the size constraint. For larger sizes to not destabilize Tunisian banks, the latter must rely on highly qualified managers and staff who know how to coordinate various actions and manage large institutions.

Funding: This study received no specific financial support.
Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.

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APPENDIX

Table-1a. Conventional Banks.

Banks	Creation Date
International Banking Union	1963
Banking Union For Trade And Industry	1961
Tunisian Qatari Bank	1982
Stusid Bank	1981
Tunisian Banking Company	1957
Citibank	1978
Tuniso-Libyan Bank	1984
Tuniso-Kuwaiti Bank	1980
Tunisian Solidarity Bank	1997
National Agricultural Bank	1959
Arab International Bank Of Tunisia	1976
Franco-Tunisian Bank	1964
Tunisia And Emirates Bank	1982
Bank Of Tunisia	1884
Bank Of Housing	1973
Bank For Financing Small And Medium Businesses	2005
Attijari Bank Of Tunisia	1968
Arab Tunisian Bank	1982
Arab Banking Corporation	1980
Amen Bank	1967

Source: Online Annual reports of Tunisia's Professional Association of Banks and Financial Institutions (www.apbt.org.tn).

Table-2b. Islamic Banks.

Banks	Creation date
ZITOUNA BANK	2010
AL BARAKA BANK	2014
EL WIFACK INTERNATIONAL BANK	2015

Source: Online Annual reports of Tunisia's Professional Association of Banks and Financial Institutions (www.apbt.org.tn).