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WHAT THREATENS TUNISIAN BANKING STABILITY? BAYESIAN MODEL VERSUS PANEL DATA ANALYSIS

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ABSTRACT

This paper aims to investigate the main determinants of Tunisian bank stability. To achieve this goal; we have used a dataset of ten (10) Tunisian banks during the period 1990-2015. These banks are the most dynamic and the most involved in the financing of the economy. The econometric strategy used in this paper was based on two approaches. The first one performed the Bayesian Model Average (BMA) to detect the most important indicators influencing bank stability. The second one was based on panel data analysis involving random effect regression. Results of these two methods have indicated that Tunisian bank stability is more sensitive to capital adequacy ratio, liquidity risk and the interaction between credit risk and liquidity risk. The capital adequacy ratio is positively and highly significantly associated with the dependent variable (Z-Score). However, liquidity risk and interaction variables exert a negative and significant effect on bank stability. These results have important policy implications. Banks and policy makers should continue to strengthen the capital adequacy ratio since it significantly contributes to improving bank stability. However, they should pay attention to liquidity risk as the main determinant of bank instability.

JEL: C63, E44, G21, G28

KEYWORDS: Bank Stability, Bank Specifics, Industry Specifics, Macroeconomics, Bayesian Model, Panel Data, Tunisia

INTRODUCTION

Banks play a major role on the real economy. They are considered as the main sources involved in financing the economy. There is a long-debated issue involving the association between financial development and economic growth. This relation has been dealt with in several aspects: positive or negative relation, unidirectional or bidirectional causality, and complementary or substitution relationship. (King and Levine, 1993; Levine, 1997, 2005; Wachtel, 2001; Petkovski and Kjosevski,2014). Most empirical results of these studies have supported the positive association between financial development and banks with economic growth. They have reported that finance promotes growth. In some credit-based economies, the performance of the real economy depends on banking system performance. Also, the stability of each economy is more sensitive to banking system stability. Hence specific emphasis has been granted to the stability question. Academics, policymakers and international agencies have tried to respond to some of these principal questions: What enhances or threatens bank stability? Is bank stability ~~is~~ more sensitive to bank, industry or macroeconomic specifics?
Several studies have investigated the determinants of bank stability. Like determinants of bank performance, empirical results have shown that bank stability can be explained by bank specific characteristics (size, capital adequacy ratio, credit risk, liquidity risk), by industry specific characteristics (competition/concentration relationship) and by macroeconomic conditions (GDP growth, inflation rate).

A significant impact of bank specific characteristics on bank stability has been confirmed by Uhde and Heimeshoff (2009), Mirzaei et al.(2013), Laeven et al., (2014), Cooke and Koch (2014), Adusei (2015), and Köhler (2015). However, an important part of literature has shown that industry specific characteristics (competition/concentration relationship) can affect bank stability (Allen and Gale, 2004; Boyd and De Nicolò, 2005; Martinez-Miera and Repullo,2010; Beck et al., 2013).

Besides bank and industry specifics, the macroeconomic conditions in which the bank operates can affect bank stability (Calza et al., 2003; Athanasoglou et al., 2008; Adusei, 2015) The Tunisian banking system is considered as the main source of firm financing. For example, in 2015, the total credit provided by the financial sector as % of GDP is about 94.214%. It dominates economic financing since the financial market is underdeveloped. The number of listed companies in the Tunisian stock market covers only 78 firms with a market capitalization of 24% as share of GDP. Following the revolution of 2011, the Tunisian banking system has suffered from many weaknesses. The most important are insufficient liquidity, deterioration of the business environment and the increase of unpaid debts. All these risks have certainly threatened bank stability. The aim of this paper is to empirically analyze the main factors that threaten Tunisian bank stability. To this end, we have used a dataset of ten (10) Tunisian banks during the period 1990-2015. The econometric strategy used in this paper was based on two approaches; the Bayesian Model Average (BMA) and panel data analysis. Empirical results have shown that Tunisian bank stability is positively and significantly associated with the capital adequacy ratio. However, liquidity risk increases bank instability. This paper contributes to the existent literature in several ways. First, there are few papers that seek the determinants of Tunisian bank stability. Second, two econometric approaches have been used to detect these determinants. Third, in the literature and empirical analysis, we have tried to classify these possible determinants in three groups that cover bank specific characteristics, industry specific characteristics and macroeconomic conditions. The remainder of this paper is articulated as follows. Section 2 presents the literature review on the determinants of bank stability. An overview of bank stability credit risk and liquidity risk is given in section 3. Data and methodology are presented in section 4. Sections 5 and 6 respectively show results of the BMA model and panel data analysis. We conclude in section 7.

LITERATURE REVIEW AND HYPOTHESES

Banking literature is focused on three main topics that can influence bank survival. The concepts of performance, risk and stability are these topics investigated by bankers, researchers and policy makers. Over the past two decades, the worldwide banking system has experienced several periods of instability that were followed by banking crises and banking failures. Hence, banking stability has been perceived as a necessary pillar to bank performance and survival. Supervisory authorities and central banks have adopted prudential regulatory policy in order to have sound banking systems which are able to ensure the optimal allocation of capital resources. This is considered as a necessary condition to manage risks well and to prevent crises. Before reviewing the main determinants of bank stability, we will focus on the principal indicators used to measure financial and/or bank stability. According to Segoviano and Goodhart (2009), there is no such widely accepted measure for measuring either financial or banking stability. The most popular measure of bank stability is the Z-Score which captures the probability of the default of a banking system. The Z-score compares the capitalization and returns of a country's banking system with the volatility of those returns. The Z-Score is the inverse of the probability of insolvency. A higher Z-Score indicates higher stability and vice versa. Several studies carried out on bank stability have used this indicator (Demirgüç-Kunt and Huizinga, 2010; Anginer et al., 2014; Williams, 2014; Köhler,2015; Adusei,2015). The second indicator used to measure bank stability is distress dependence among banks. Based on this indicator, the analyze of distress risk, credit risk and probability of default should not be limited only to specific banks, but it should take in consideration the effect of this event on the entire banking system. The third indicator of bank stability is banking system multivariate density. This indicator includes both individual and joint asset value movements of the portfolios of banks. This

measure captures the linear and non-linear distress dependencies among banks which is able to detect change throughout the economic cycle. This allows one to conclude that in a period of distress, dependence increases (Segoviano and Goodhart, 2009).

Several empirical studies have used the financial stress index as a measure of bank or financial stability. Financial stress indexes are widely used by policymakers as an instrument for monitoring financial stability. This index measures the current state of stress in the financial system by combining several indicators of stress into a single statistic (Bordo et al., 2001; Hanschel and Monnin, 2005; Illing and Liu, 2006;Puddu, 2008;Borio and Drehmann, 2009). Like bank performance, bank stability has been explained by bank specific characteristics (size, capital, liquidity, credit risk) industry specific characteristics (competition/concentration relationship) and macroeconomic conditions (GDP growth and inflation rate). As for bank characteristics, bank size can differently affect bank stability. Several studies have supported the positive relationship between bank size and bank stability. According to Uhde and Heimeshoff (2009), in a concentrated banking sector, large banks are not exposed to financial fragility. Large banks record high profit and avoid the possibilities of liquidity or macroeconomic shocks. Larger banks enjoy higher economies of scale and scope. They have the potential to diversify loan-portfolio risks (Mirzaei, Moore and Liu, 2013). Size promotes better diversification which reduces risks and allows banks to operate in a different market segment. Also, large banks may have a comparative advantage in market-based activities which require significant fixed costs and enjoy economies of scale (Laeven et al., 2014). Adusei (2015) investigated the effect of bank size and funding risk on bank stability. He used a dataset of 112 rural banks in Ghana over the period 2009Q1- 2013Q3. Results of fixed and random effects indicate that an increase in the size of a rural bank results in an increase in its stability.

To the contrary, other literature defends the negative association between size and bank stability. For example, Laeven et *al*. (2014) analyzed the relationship between bank size and bank stability using data from 52 countries. Results showed that on average larger banks create more risks than smaller banks. Based on a data set of the EU banking sector during the period 2001-2011, Köhler (2015) studied the impact of business models on bank stability. Major findings of this study indicate that large banks are less stable than smaller banks. The absence of a significant relation between size and bank stability is verified by Altaee, et *al*. (2013) in the Gulf Cooperation Council countries. They found that size does not exert any significant effect on bank stability.

Capital and liquidity are two necessary pillars to ensure the stability, persistence and survival of each bank. It is obvious that bank capital is perceived as one of the most important targets of micro- and macro-prudential banking regulation. Several contributions have reported that a better capitalized bank should be more profitable and more stable. Showing high level of capital adequacy ratios, banks tend to face lower funding costs and they are able to support unexpected losses (Abreu and Mendes, 2002; and García-Herrero et al., 2009). Also, Banks with sufficient capital can easily avoid the shocks that may precipitate crises (Thakor, 2014). Coval and Thakor (2005) argue that better capitalized banks have stronger screening incentives and monitoring incentives. Also, they can speed up the post-crisis recovery of the economy. To the contrary, Cooke and Koch (2014) reported that despite the large size, banks with low capital ratios slowed down the lending recovery after the subprime crisis. A part from the importance of capital for bank solvency and bank stability, liquidity received great attention especially after the 2008 international financial crisis. Traditional banking activities are based on liquidity. It is for this reason that banks with sufficient level of liquidity are seemed profitable, stable and have constantly maintained the trust and reputation of the customer, following the 2008 crisis. To the contrary, banks with a weak level of liquidity experienced instability and fragility which finished either by merger acquisition or by bank failure. The third bank specific characteristic that threatens bank stability is credit risk. Credit risk results when borrowers are unable to honor their commitments. Non-reimbursement is equivalent to a loss, which incontestably reduces profitability and stability. Credit risk measures differ from one study to another. The most useful measures are that of nonperforming loans (Miller and Noulas, 1997; Alper and

Anbar, 2011), loan loss provisions and reports of total credit to total assets (Hakimi et al., 2011; Hamdi et al, 2013). In a comparative analysis over the period 2006-2009, Rajhi and Hassairi (2013) suggested that credit risk decreases bank stability for the MENA region and South Asian countries. Using quarterly data (2009Q1–2013Q4) from the rural banking industry in Ghana, Adusei (2015) reported that credit risk exerts a negative but insignificant effect on bank stability measured by the Z-score. In this study, credit risk is measured by total loans to total assets. The increase of total credit normally leads to an increase in the interest margin as a necessary condition for bank stability. Bank activities are accounted for loan specialization, so it's not the growth of granted credit that threatens bank stability but its quality (Bad or good credit). From the development presented above, we can form the following hypothesis:

(H1): Bank specific characteristics affect bank stability.

With regard to industry specific characteristics, we will focus our interest on the competition and/or concentration stability relationship. Is a concentrated banking system more stable than a competitive banking sector? The link between competition and financial stability remains a widely debated and ambiguous issue, both among policymakers and academics. There are two parts of the literature regarding this subject. The first one supports the concentration-stability relation and the second one defends the competition- stability association. In a concentrated banking system, supervision and monitoring seem to be easier than in a competitive banking system. Good supervision and monitoring can avoid the probability of the occurrence of banking fragility and banking crises (Beck et al., 2013). In a competitive banking system, banks earn fewer informational rents from their relationship with borrowers. This ~~is~~ can reduce their incentives to properly screen borrowers. Also, it leads to bad credit decisions which increase the fragility risk (Allen and Gale, 2000; Allen and Gale, 2004).The positive association between bank competition and bank stability is confirmed by Boyd and De Nicolò (2005). These authors, less competition allows banks to charge higher interest rates for loans. This behavior increases the probability of default due to the borrowers' moral hazard. Along the same line of thought, Martinez-Miera and Repullo (2010) revealed a non-linear relationship between competition and banking risk. The competitive banking system may reduce the borrower's probability of default. Following this development, we can form the hypothesis:

H (2): Banking stability can be influenced by the competition/concentration level.

Banks operate in a macroeconomic environment, so macroeconomic conditions are considered as an important key for banking performance and banking stability. GDP growth and inflation are the two macro indicators most popularly used in empirical literature to explain the change of performance and stability. GDP is used to measure the overall health of the economy. However, inflation is used to measure macroeconomic stability. (Adusei, 2015).An economic slowdown can decline the quality of the loan, increasing nonperforming loans and provisions, thereby reducing bank profitability and threatening bank stability. However, an improvement in economic conditions leads to an increase of the solvency of borrowers which positively affects the profitability of banks (Athanasoglou et al., 2008; Calza et al., 2003).About the effect of inflation, Revel (1979) suggested that bank profitability and stability was dependent on the level of inflation. A high level of inflation results in an increase in operating costs and consequently a decrease of bank profitability. On the contrary, weak inflation decreases operating expenses which improve the level of performance. Generally, the effect of inflation on bank activities depends on whether inflation is fully anticipated or not. Using a sample of 112 rural banks in Ghana during the period 2009Q1 – 2013Q3, Adusei (2015) reported that macroeconomic conditions measured by inflation rate and GDP improve bank stability. Results show, that inflation is positively and statistically significant with the Z-Score suggesting that inflation supports rural bank stability. Also, findings indicate that GDP positively and significantly impacts bank stability. Following this development, we can put forward the third hypothesis:

H (3): Macroeconomic conditions can determine bank stability.

An Overview of Bank Stability, Credit Risk and Liquidity Risk in Tunisia

The stability of the financial system in general and the banking system in particular is considered as the main economic concern of any government. The bankruptcy of a large bank or several bank failures in any country causes a sudden contraction of the money supply and a failure of the payment system. Also, banking instability can lead to a loss of trust in the whole system. On the contrary, a stable banking system provides a sound security to depositors which positively affect the level of investment and economic growth. Consequently, the topic of financial and banking stability is considered greatly important for governments, policy makers and bankers. The Tunisian banking sector is composed of 29 institutions, including 11 listed banks, with a market capitalization of 8 billion dinars in 2015.The banking sector is the primary market force, accounting for 41% of total capitalization. There are three public banks with 38% of the total assets. These three banks are considered as the most involved in the financing of the economy. Following the revolution of 2011, the Tunisian banking system has suffered from many weaknesses. The most important have been insufficient liquidity, deterioration of the business environment and the increase of unpaid debts. All these risks have certainly threatened bank stability. In this article, we have analyzed the annual evolution of bank stability and the two main risks that can threaten this stability. Table 1 presents an annual average evolution of some basic indicators concerning Tunisian banking sector over the period 1990-2015. We focus on credit risk, liquidity risk and bank stability. Tunisian banks are still relying on credit activities and their functioning is also based on liquidity which threatens their stability.

Table 1: Annual Average Evolution of Bank Stability, Liquidity Risk and Credit Risk Over the Period 1990-2015

1990-2002				2003-2015			
Years	**ZSCORE**	**LIQR**	**RCDR**	**Years**	**ZSCORE**	**LIQR**	**RCDR**
1990	4.279	119.602	60.985	2003	7.773	108.791	73.219
1991	4.221	126.991	61.674	2004	7.209	105.220	71.674
1992	4.247	133.890	65.152	2005	7.377	102.766	70.408
1993	4.422	131.270	64.994	2006	7.397	94.444	69.301
1994	6.392	124.028	64.302	2007	7.476	168.582	74.440
1995	6.747	132.671	66.837	2008	7.408	187.745	75.443
1996	8.129	119.607	65.640	2009	7.714	191.462	77.016
1997	8.969	104.862	71.562	2010	7.074	106.364	85.805
1998	6.676	113.118	52.112	2011	6.514	102.417	82.691
1999	8.144	95.686	64.915	2012	6.487	109.576	85.718
2000	7.954	106.068	69.352	2013	9.938	107.348	85.347
2001	7.802	109.494	70.271	2014	9.498	101.049	83.344
2002	7.689	108.959	73.973	2015	9.543	103.088	79.414

Table 1 presents average annual evolution of Z-Score measured by $\left(\frac{E(ROA)+CAP}{\rho\,(ROA)}\right)$ *which reflects bank stability. Also, Table 1 indicates the main determinants which threaten or enhance this stability. The first determinant is credit risk measured by total credit to total assets and the second one is liquidity risk measured by total deposit to total credit. Statistics used in this table are drown from annual reports of the most involved Tunisian banks during the period 1990-2015.*

The most remarkable observation from Table 1 and figure 1below is that there was an improvement in Tunisian banking stability during the period 1990-2015. On average, the Z-score increased from 4.279 % in 1990 to reach 9.543% in 2015. However, some fluctuations characterized the evolution of bank stability. The Z-Score recorded a downward trend during the period 2010-2012. Banking stability improvement can be explained by the sufficient capital adequacy ratio. Tunisian banks have respected the recommendation of the Basel Accords to reinforce the level of equity. For example, in 1996, following the calculations of the Cooke ratio, there was an increase in banking stability from 6.392% in 1995to8.129% in 1996.The stability of Tunisian banks recorded an up down trend during the two years 2011 and 2012. This decrease is due to the low level of return on assets registered during this period. It is

worth recalling that in 2011 the Tunisian revolution caused disequilibrium in all sectors. During the period of the revolution, banking activities were in decline. The level of deposit ~~is~~ decreased and there was a weak level of trust and reputation toward banking establishments. Also, the level of credit granted was not sufficient. Consequently, the level of income seemed to have decreased.

Figure 1: Annual Evolution of Z-Score, Liquidity and Credit Risks

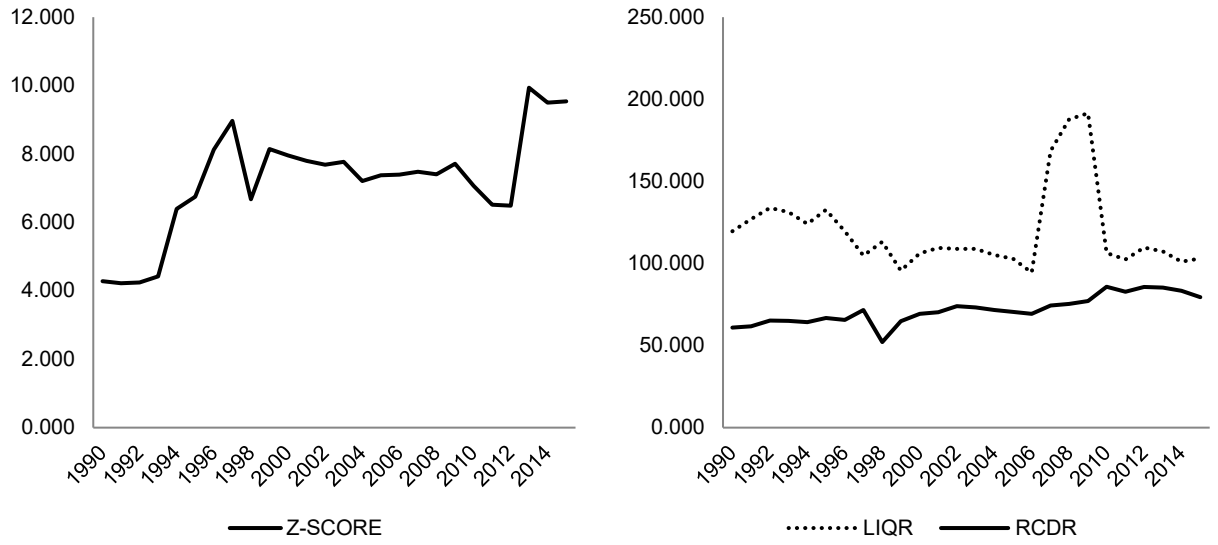

Figure 1 describes average annual evolution of bank stability measured by Z-Score ($\frac{E(ROA)+CAP}{\rho\,(ROA)}$), credit risk (total credit to total assets) and liquidity risk (total deposit to total credit). Values used in this figure are related to 10 Tunisian banks over the period 1990-2015.

The first risk to which a bank is exposed is credit risk. Table 1 and figure 1 indicate that the evolution of this risk was almost stable over the whole period. It increased from 60.98% in 1990 to reach 79.41% in 2015. Some worrying values were recorded in2010-2013. During this period, the level of credit risk was around 85%. As measured by total credit to total assets, the increase of this ratio is explained either by the increase of total granted credit or by the decrease of total assets. Generally, an increase in total credit leads to an increase in total assets, so we can eliminate the hypothesis that the decrease of total assets leads to an increase of credit risk. There is a weakness concerning this measure. Banking activities and banking performances are based on loan specialization. So, it is very important to be precise at what level and under what condition an amount of credit can be considered as risky. About liquidity risk evolution, it can be described in three phases. For the first one covering the period 1990-2006, liquidity risk decreased. It was around 120% in 1990 andbecame94.44% in 2006. During this period, Tunisian banks tried to adjust the level of deposit and the level of granted credit. From 2000 to 2005, the level of liquidity risk was around 100%. This means that deposits were nearly equal to the amount of credit. Even in 2006, on average, Tunisian banks recorded a liquidity risk lower than the unit. As measured by total credit to total deposit, the liquidity ratio recorded a level of 94.44%. This leads us to conclude that the total deposit was greater than the total credit.

The second phase covered the period 2007-2013.Duringthis period, there was an increase in the level of liquidity risk. For example, in 2008, liquidity risk recorded a high level compared to 2006; this risk doubled. It was 94.44% and became187.745%. The increase of this risk is not explained by the high level of credit. On the contrary, it can be justified by the weak level of deposit received by banks. The

international financial crisis of 2008 was followed by a decrease in the level of trust of depositors toward banking institutions. Also, the reputation of these banks decreased and depositors were not motivated to keep their capital in banks. They were afraid of banking fragility and failure. For this reason, they preferred to withdraw and/or keep their capital outside of the banking establishment. Liquidity risk continued to record high levels reaching a high of 191.46% in 2009. However, in the third phase which began from 2010 to 2015, descriptive statistics indicate a satisfactory level of liquidity risk around 100%. We can consider that the granted credits were covered by the collected deposits. After analyzing our three based indicators, we aim in this paragraph to detect if there is any association between bank stability, credit risk and liquidity risk. Regarding figure 1, a reverse trend between liquidity risk and bank stability can be seen. For the evolution of credit risk, it seemed almost stable. An increase in the liquidity risk leads to a decrease in banking stability. We can conclude that Tunisian banking stability is more dependent on liquidity risk rather than credit risk.

DATA AND METHODOLOGY

To empirically analyze the main factors that threaten or enhance banking stability, we used in this study a sample of ten (10) Tunisian banks over the period 1990-2015. These banks are considered as the most dynamic and the most involved in the financing of the economy. So, the investigation of the stability of this sample is very important since they play a major role in promoting economic growth. We used annual data over the period 1990-2015.Variables used in the model are divided into two groups: some are internal that reflected bank specifics and others are external that are related to macroeconomic environment. As for bank characteristics, variables are collected from annual reports of each bank, however macroeconomic variables are drown from the World Development Indicators database (WDI).
In this paper we used two different econometric approaches. The first one is based on the Bayesian model average (BMA) which predicts the main indicators that determine bank stability either positively or negatively. The second involves panel data analysis. Using this method, we have tested our models *pre*-indicators selection based on the BMA model and the *post*-indicators selector. This was to compare results of these two approaches. In other words, is there a similarity between the results of BMA and panel data analysis?

Model Specification and Variable Definitions

With reference to previous studies related to bank stability, we presented the following econometric model. Like bank performance, bank stability can be explained by bank specific characteristics (Size, net interest margin, capital adequacy ratio, liquidity risk and credit risk), bank industry (banking concentration, banking crises) and the macroeconomic context (inflation and economic growth). The basic econometric model used in this study can be written as follows:

$$Z - SCORE_{i,t} = \beta_0 + \beta_1 SISE_{i,t} + \beta_2 RCDR_{i.t} + +\beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 LIQR_{i,t} + \beta_6 IHH_{i,t} + \beta_7 LIQR * RCDR_{i,t} + \beta_8 CRISE_{i,t} + \beta_9 GDPG_{i,t} + \beta_{10} INF_{i.t} + \varepsilon_{i,t}$$

Where;

(Z-SCORE) is the measure of bank stability. It is equal to $\frac{E(ROA)+CAP}{\rho\,(ROA)}$. A higher Z-score indicates that the

bank is more stable (Laeven and Levine, 2009; Chalermchatvichien et al., 2014; Demirgüç-Kunt and Huizinga, 2010; Stiroh, 2004a, 2004b). *(NIM)*is the bank performance measured by the net interest margin which is equal to the ratio of interest margin to total assets. In a previous study, performance was measured by ROA (Curak et al., 2012; Adusei, 2015). In this study, we used the net interest margin to

avoid the problem of autocorrelation with the Z-Score measure. As this variable contains E (ROA) and ρ (ROA), *(LIQR)* is the liquidity risk measured by the ratio of total credit to total deposit (Fiordelisi and Mare, 2014; Rose and Hudgins, 2008).*(CRDR)* represents the credit risk which is measured by total credit to total assets (Curak et al., 2012; Adusei, 2015). *(LIQR*RCDR)* is the interaction between the two risks. We introduced this variable in our model to explore the combined effect of liquidity and credit risk. *(CAP)* is the capital adequacy ratio measured by the report of total equity to total assets (Adusei, 2015). *(SIZE)* represents the bank size which is measured by the Naperien logarithm of total assets. (Pasiouras and Kosmidou, 2007; Barros et al., 2007;Adusei, 2015).*(IHH)* is the Hirshmen Herfindahl index measured by the squared sum of the market share. In this study, we used total assets to calculate the market share. (CRISE) is a dummy variable which takes 0 before 2008 and 1 otherwise. Banks operate in an environment which is influenced by some macroeconomic indicators. For this reason, we introduced to our model *(GDP)* and *(INF)* as macroeconomic variables.GDP is used to measure the overall health of Tunisia's economy, and inflation is used to measure macroeconomic stability in Tunisia (Adusei 2015). This econometric model was tested within four (4) steps. In the first step, we only checked the effect of liquidity risk on bank stability. Banking activities are principally based on liquidity, consequently bank performance and/or (in) stability is dependent on the level of liquidity. The econometric model can be presented as follows:

$$Z-SCORE_{i,t} = \beta_0 + \beta_1 SISE_{i,t} + \beta_2 LIQR_{i.t} + \beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 IHH_{i,t} + \beta_6 CRISE_{i,t} + \beta_7 GDPG_{i,t} + \beta_8 INF_{i.t} + \varepsilon_{i,t} \quad \text{Model (1)}$$

In the second step, we only checked the effect of credit risk on bank stability. So, we eliminated the variable of liquidity risk. Credit risk can decrease bank performance and enhance the stability of the credit establishment. The second model can be written as follows:

$$Z-SCORE_{i,t} = \beta_0 + \beta_1 SISE_{i,t} + \beta_2 RCDR_{i.t} + \beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 IHH_{i,t} + \beta_6 CRISE_{i,t} + \beta_7 GDPG_{i,t} + \beta_8 INF_{i.t} + \varepsilon_{i,t} \quad \text{Model (2)}$$

We investigated the effect of the combined two risks in the third step. For this reason, we introduced an interactive variable which is LIQR*RCDR and we eliminated credit and liquidity risk. The third model is presented below:

$$Z-SCORE_{i,t} = \beta_0 + \beta_1 SISE_{i,t} + \beta_2 \text{LIQR} * \text{RCDR}_{i.t} + \beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 IHH_{i,t} + \beta_6 CRISE_{i,t} + \beta_7 GDPG_{i,t} + \beta_8 INF_{i.t} + \varepsilon_{i,t} \quad \text{Model (3)}$$

The fourth and the last step consisted of testing the model after the selection of principal indicators affecting bank stability. The selection of these indicators was done by the Bayesian Model Average. The fourth model is presented below:

$$Z-SCORE_{i,t} = \beta_0 + \beta_1 SISE_{i,t} + \beta_2 CAP_{i,t} + \beta_3 CRISE_{i,t} + \beta_4 CRISE_{i,t} + \beta_5 \text{LIQR} * \text{RCDR}_{i,t} + \varepsilon_{i,t} \quad \text{Model (4)}$$

Bayesian Model Average (BMA) Regression

We chose the BMA model to detect the most robust indicators affecting bank stability from among a panel of 10 potential variables. We considered the following linear regression model:

$$y = \alpha_i + X_i\beta_i + \varepsilon \sim (0, \sigma^2 I) \quad (5)$$

Where y represents bank stability, $\alpha_i$the constant, β_i the vector of coefficients and ε the error term. X_i, denotes a subset of all relevant explanatory variables available. In our case study they represent potential early warning indicators. The number k of potential explanatory variables gives 2^kpotential models. The index i is used to refer to a specific model of these 2^k models. The information from the models is then moderately distributed using the posterior probabilities of the model given by Bayes theorem:

$$p(M_i \mid y,X) \propto p(y \mid M_i,X)p(M_i) \quad (6)$$

Where $p(M_i \mid y,X)$ is the posterior probability which is relative to the marginal probability of the model $p(y \mid M_i,X)$ multiplied by the apriori probabiliy of the model $p(M_i)$.The robustness of a variable in the explanation of the dependent variable can be captured by the probability that a given variable is included in the regression. To do this we calculated the posterior probability of inclusion (PPI), which is given by:

$$PIP = p(\beta_i \neq 0 \mid y) = \sum_{\beta_i} p(M_i \mid y) \quad (7)$$

The PIP captures the indicator that can evaluate the robustness of the relationship of a potential explanatory variable with the dependent variable. Variables with a large PIP can be considered as robust determinants of the dependent variable, whereas variables with a low PIP seem not to be robustly related to the dependent variable. Moreover, it is impossible to go through all possible models if we have a very high number of potential explanatory variables. For this raison, we used the Monte Carlo Markov chain (MC^3) method of model comparison developed By Madigan and York (1995). The (MC^3) method is able to focus on the part of the model where there is a strong probability of posterior model. Hence, it can approximate the exact posterior probability in a more efficient way.

Selection of Variables That Affect Bank Stability Via the Bayesian Model

Figure 2 below helps us to detect the main variables that affect positively or negatively bank stability and this with reference to the color relative to each variable.

Figure 2 : Model Inclusion Based on Best 152 Models

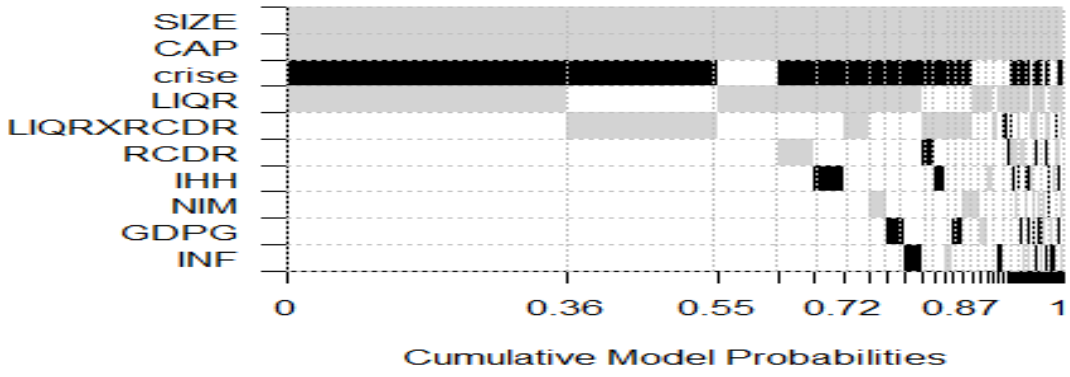

Figure 2 shows the 152 best models resulting from the Bayesian model. These models are ranked per their probabilities of posterior models. Subsequently, the best models are displayed on the left. Blue indicates a positive coefficient, while the colored indicates a negative coefficient. However, the white color indicates that the variable is not included in the respective model. It can be seen that a small part of the model includes variables that have a posterior inclusion probability (PIP) greater than 0.5.

Table 2 shows the results of the estimation of the Bayesian model, mainly the posterior probability included for each indicator, the posterior average, the standardized standard deviation and the posterior conditional sign.

Table 2 : Estimated Coefficients of BMA

	PIP	Post Mean	Post SD	Cond.Pos.Sign	Idx
SIZE	1.0000	5.6172	1.0763	1.0000	5
CAP	1.0000	84.245	14.920	1.0000	6
Crise	0.8492	-3.6183	2.0333	0.0000	7
LIQR	0.7120	4.7825	3.4496	1.0000	2
LIQRXRCDR	0.3407	2.3274	3.9053	0.9610	4
RCDR	0.0957	0.2463	2.3817	0.6676	3
IHH	0.0847	-3.7610	31.648	0.1752	8
GDPG	0.0698	0.2433	7.8971	0.2488	9
NIM	0.0647	1.3489	14.532	0.9835	1
INF	0.0580	-0.1737	9.3209	0.3792	10

Within a set often (10) explanatory variables, only four (4) variables have a posterior probability of inclusion greater than 0.5. These variables are the most important indicators of bank stability. These potential indicators are bank size (SIZE), capital adequacy ratio (CAP), crisis dummy variable (CRISE) and liquidity risk (LIQR).

The results of the BMA model show that the highest inclusion probability is recorded by bank size (SIZE). This variable shows a positive sign, consequently an increase of bank size leads to an improvement of bank stability. Also, the capital adequacy ratio (CAP) is positively associated with the dependent variable Z-Score. Well capitalized banks are the most stable. Liquidity risk also indicates a surprisingly positive association with bank stability. This means that an increase in this risk implies an increase in the probability of bank stability. Moreover, the crisis variable admits a negative sign and therefore negatively affects banking stability.

Panel Data Analysis

Table 3 below presents descriptive statistics of all variables served in this study. For each variable, we give average value, standard deviation, minimum and maximum values. Descriptive statistics are presented to describe the basic characteristics of the data used in this study concerning ten banks over the period from 1990 to 2015.

Table 3 : Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Z-score	260	7.195	9.393	0.180	47.967
Nim	260	0.028	0.012	-0.030	0.059
Liqr	260	1.198	0.377	0.551	2.597
Rcdr	260	0.718	0.142	0.030	1.501
Liqrrcdr	260	0.871	0.346	0.025	1.969
Size	260	14.779	0.623	13.475	16.169
Cap	260	0.081	0.037	-0.016	0.249
Crise	260	0.308	0.462	0	1
Ihh	260	0.111	0.009	0.088	0.123
Gdpg	260	0.040	0.023	-0.024	0.079
Inf	260	0.042	0.015	0.020	0.082

The average Z-score was 7.195% with a maximum value of 47.967% and a minimum value of 0.180%. The net interest margin recorded a mean value of 2.8% and 5.9% as a maximum value. The average value of liquidity risk is about 119.8% with a minimum of 55.1% and a maximum of 259.7%. This means that total credit is more than double than that of total deposit. For credit risk, the average value is 71.8%, with a minimum value around 30% and a maximum of 150.1%. The average level of the capital adequacy ratio

is about 8.1%. On average, we can conclude that Tunisian banks are moderately capitalized. However, we find that the minimum value of CPA is -1.6% indicating that some banks are poorly capitalized. As a macroeconomic variable, the GDPG records an average of 4% with a maximum value of 7.9 % and a minimum of -2.4%. The second variable is the inflation rate. The average of this variable is 4.2% and the maximum level is 8.2%. After giving some statistics about all the variables of our study, the following table gives the level and nature of correlation that exists between the variables used in the econometric model. Table 4 below presents the correlation matrix which gives information on the level and the nature of linkages between variables by determining the coefficients of linear correlations of them taken two by two.

Table 4: Correlation Matrix

	z-score	**Nim**	**Liqr**	**rcdr**	**liqrrcdr**	**Size**	**Cap**	**crise**	**Ihh**	**gdpg**	**inf**
z-score	1.0000										
Nim	-0.0408	1.0000									
Liqr	0.2567	-0.2091	1.0000								
rcdr	0.2003	-0.1042	0.2129	1.0000							
liqrrcdr	0.2832	-0.2120	0.8906	0.6126	1.0000						
size	0.2122	-0.3238	-0.1709	0.1625	-0.0832	1.0000					
Cap	0.3395	0.1385	0.1907	0.3330	0.3075	-0.1103	1.0000				
crise	0.0588	-0.4305	0.1119	0.4762	0.2974	0.4858	0.0758	1.0000			
Ihh	-0.0686	0.2429	0.2482	-0.4506	0.0088	-0.4687	-0.1172	-0.6504	1.0000		
gdpg	-0.0370	0.1793	0.0878	-0.2915	-0.0538	-0.3541	-0.0397	-0.5379	0.4732	1.0000	
Inf	-0.0670	-0.3379	0.1095	-0.0186	0.0894	0.0915	-0.2768	0.1923	0.1240	0.0529	1.0000

From Table 4, it can be seen that the net interest margin, the Hirshmen Hirfendhal index and the two macroeconomic variables decrease bank stability. However, the rest of the variables such as liquidity risk, credit risk, the interaction between liquidity and credit risk, bank size, capital adequacy ratio and crises are positively associated with banking stability. The second observation that can be drawn from this table is that there is no high correlation between the variables. The only exception is the high level of correlation between liquidity risk, credit risk and the interactive variable. This leads to confirm the absence of the multicollinearity problem.

Table 5 below presents the results of the regression of the three models before the selection of indicators that affect bank stability. For the three models, we applied the random effect regression since the Hausman test for the 3 models indicated probabilities of chi-squared which are higher than 5%.

Results of the first three models indicate that the main factors affecting banking (in) stability are capital adequacy ratio, international financial crises, liquidity risk and the interaction between liquidity risk and credit risk. The most surprising is that the effect of credit risk is not significant. For the other bank specific variables (Size and net interest margin), industry specific variables and macroeconomic variables, their effect does not seem to be significant. The capital adequacy ratio (CAP) is positively and highly significantly associated with bank stability. For the three models, this variable has the same effect and level of significance. Banks with sufficient capital can manage their risks well and easily prevent financial crises in the future. A higher ratio of capital adequacy decreases the level of bank risk taking. As for the three Basel Accords, there was an appeal to strengthen the quantity and quality of capital since it was the best way to cover bank risks, as the fundamental hypothesis for bank performance and bank stability. Banks with higher capital ratios tend to face lower costs of funding due to lower prospective bankruptcy

costs. This result is in line with Chalermchatvichien et al. (2014), Abreu and Mendes (2002), Goddard et al. (2004), Ben Naceur and Goaied (2008) and García-Herrero et al. (2009)).

Table 5: Results of Regression *Pre*- Indicators Selection

Results of Pre-Indicator Selection						
	Model (1)		**Model (2)**		**Model (3)**	
Z-score	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**
Nim	15.959	0.65	36.151	1.58	26.807	1.13
Size	0.550	1.17	0.748	1.67*	0.562	1.21
Cap	64.339	9.88***	57.338	8.62***	64.656	9.77**
Crise	-1.329	1.74*	-0.374	0.53	-1.188	1.55
Ihh	31.636	0.89	-3.034	-0.10	5.632	0.17
Gdpg	4.132	0.38	1.543	0.15	2.444	0.23
Inf	-1.632	-0.10	1.877	0.12	2.095	0.13
Liqr	-1.969	-2.74***	–	–	–	–
Rcdr	–	–	2.570	1.31	–	–
Liqrrcdr	–	–	–	–	-1.483	-1.89*
_cons	-8.285	-0.96	-11.317	-1.27	-7.020	-0,81
Hausman test	2.115		1.32		1.53	
prob chi 2	0.977		0.995		0.992	
Wald chi 2	124.36		124.64		123.69	
prob chi 2	0.000		0.000		0.000	
R-squared	0.364		0.34		0.348	
N of Obs.	260		260		260	

This table shows the regression estimates of the three equations:
Z-SCORE $_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 LIQR_{i,t} + \beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 IHH_{i,t} + \beta_6 CRISE_{i,t} + \beta_7 GDPG_{i,t} + \beta_8 INF_{i,t} + £_{i,t}$
Model (1) Z-SCORE $_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 RCDR_{i,t} + \beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 IHH_{i,t} + \beta_6 CRISE_{i,t} + \beta_7 GDPG_{i,t} + \beta_8 INF_{i,t} + £_{i,t}$
Model (2) Z-SCORE $_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 LIQR*RCDR_{i,t} + \beta_3 CAP_{i,t} + \beta_4 NIM_{i,t} + \beta_5 IHH_{i,t} + \beta_6 CRISE_{i,t} + \beta_7 GDPG_{i,t} + \beta_8 INF_{i,t} + £_{i,}$
Model(3).
****, ** and * denote significance level respectively at 1%, 5% and 10%*

The findings also indicate that bank stability is negatively and significantly associated with liquidity risk. Banking activities are based on liquidity since it is the basic "product". So, banks with sufficient liquidity are less prone to crises, which impose substantial losses in terms of forgone economic output. The recent financial crisis has shown the importance of liquidity. Banks with sufficient liquidity and especially own equity, were more stable during the period of crises. In the cases of unexpected financial shock or unexpected and massive withdrawal of deposit, banks with higher levels of liquidity are more efficient and stable. However, banks with higher liquidity risk are prone to banking fragility and failures (Athanasoglou et al., 2008; Bourke, 1989; Demirguc-Kunt and Huizinga, 1999).

To check the combined effect of the two risks (liquidity and credit risk) we introduced an interactive variable LIQRRCDR. The effect of this variable was tested in the third model. Results show that this variable decreases bank stability. It is worth recalling that the individual effects of credit risk are not significant. On the contrary, liquidity risk significantly decreases bank stability. When, we combined the effect of these two risks, it became negative and significant. This means, that the insignificant effect of credit risk was absorbed by the negative effect of the liquidity risk. Table 6displays the results of the regression of the fourth model that only retained significant variables that threaten or enhance banking stability based on BMA. For this model, we applied also the random effect regression since the Hausman test indicated probabilities of chi-squared which are higher than 5%.

Table 6: Results of Regression Post-Indicators Selection

Results of Post-Indicators Selection		
Model (4) Z-score	**Coef.**	**Z**
Nim	–	–
Size	0.544	1.15
Cap	61.592	9.250***
Crise	-0.325	0.53
Ihh	–	–
Gdpg	–	–
Inf	–	–
Liqr	-3.072	-2.230**
Rcdr	–	–
Liqrrcdr	1.904	1.15
_cons	-3.939	-0.54
Hausman test	2.807	
prob chi 2	0.729	
Wald chi 2	118.14	
prob chi 2	0.000	
R-squared	0.364	
N of Obs.	260	

This table shows the regression estimates of the equation: $Z\text{-}SCORE_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 CAP_{i,t} + \beta_3 CRISE_{i,t} + \beta_4 LIQR_{i,t} + \beta_5 LIQR*RCDR_{i,t} + £_{i,t}$ **** and ** denote significance level respectively at 1% and 5%*

After testing the three models based on the effect of liquidity risk, credit risk and the interaction between these two risks, we discuss findings of the fourth model. It is worth recalling that this model is based on selected indicators by the BMA model. This is to compare findings of the random effect regression of the three models with all indicators (bank specific variables, industry specific variables and macroeconomic specific variables) and the results of the indicators selected by the BMA approach. Results of regression using indicators selected by the BMA approach are only like the findings of the three models in regards to capital adequacy ratio and liquidity risk. Hence, we can conclude that these two indicators are the main determinants of Tunisian banking stability. Sufficient capital and liquidity make banks more sound stable when facing banking risks, fragilities and crises. However, in the fourth model we noticed that the effect of the interaction between liquidity risk and credit risk becomes insignificant. Like the results of models 1, 2 and 3, bank size does not exert any significant effect on bank stability in model 4. To summarize, we can conclude that Tunisian banking stability depends on the level of capital adequacy ratio. The higher the ratio is, the stronger bank stability is. An increase in this ratio leads to more bank stability. However, a decrease in this ratio can threaten bank stability. The second determinant of Tunisian bank stability is liquidity risk. Results confirm that an increase in this risk significantly decreases bank stability. On the contrary, a low level of this risk is associated to a more stable banking system.

CONCLUSION AND POLICY RECOMMENDATIONS

Bank stability is considered as important since it reflects the soundness of the banking system and reinforces the level of trust toward this system. Also, bank stability is a necessary condition for more performance in particular and for bank survival in general. The crucial role of banks in the real economy, on the one hand and the close dependence between finance, banks and growth, on the other hand has spurred both academics and policymakers to seek the main determinants of bank stability. Banking literature focused on financial/banking stability has ranged their determinants in three main groups. Bank specific variables, industry specific variables and macroeconomic conditions are considered as the main relevant indicators. Based on a sample of 10 Tunisian banks over the period 1990-2015, we investigated the main factors that affect bank stability in the Tunisian context. Contrary to previous studies, two econometric approaches were used. The first one is the Bayesian Model Average (BMA) to detect the most important indicators that influence bank stability. The second one is based on the panel data analysis performed to check the results of the first approach. The empirical analysis is based on four steps.

The first step consisted of testing the model after the selection of the principal indicators that affect bank stability. The selection of these indicators was done by the Bayesian Model Average. In the second step, we only checked the effect of liquidity risk on bank stability. In the third step, we only checked the effect of credit risk on bank stability. So, we eliminated the liquidity risk variable and introduced the second risk. We investigated the effect of the two combined risks in the fourth step. For this reason, we introduced an interactive variable (LIQR*RCDR) and we eliminated the credit and liquidity risk. Results of these two approaches indicate that Tunisian bank stability is more sensitive to capital adequacy ratio, liquidity risk and the interaction between credit risk and liquidity risk. The capital adequacy ratio is positively and highly significantly associated with the dependent variable (Z-Score). However, liquidity risk and the interaction variables exert a negative and significant effect on bank stability. As for the other bank specifics (net interest margin and credit risk) their effect is not significant. Similarly, macroeconomic conditions and industry specific variables did not exert any significant effects.

Results of this study have some limitations. First, they are based only on ten banks. This sample appears very limited to generalize these findings. Actually, Tunisian banking sector covers twenty three banks. In this research, we retained the most dynamic and the most involved banks in the financing of the economy. Second, we did not introduce other variables that threaten bank stability such as nonperforming loan (NPL) and loan loss provisions (LLP). Not taking this into consideration is due to the lack of information concerning these variables over the whole period. These results have important policy implications. Governments, banks and policymakers should continue to strengthen the capital adequacy ratio since it greatly contributes to improving bank stability. However, they should pay attention to liquidity risk as the main determinant of bank instability. In this study, liquidity risk was the most disruptive of bank stability. So, banks are invited to manage this risk by reinforcing their own resources since depositors could at any time, for any unexpected reason, withdraw their capital and seek to invest in new activities with higher returns. The Basel Accords recommend the reinforcement of equity to manage risk well, prevent fragility and crises and have a sound banking system. Hence, in future research we will be interested in the effect of strengthening of equity on the credit activity in the Tunisian context. So, what is the optimal level of equity that ensures the reconciliation between the provision of loans and banking stability?

REFERENCES

Abreu. M. and Mendes. V. (2002) “Commercial Bank Interest Margins and Profitability: Evidence from E.U. Countries” University of Porto Working Paper n°245.

Adusei., M (2015) “The impact of bank size and funding risk on bank stability” *Cogent Economics & Finance*, 3,p. 1-19.

Allen, F. and D. Gale (2000a). “Bubbles and Crises,” *Economic Journal*, 110, p. 236-255.

Allen, F. and D. Gale (2004). “Financial Intermediaries and Markets,” *Econometrica*,72, p. 1023-1061.

Alper, D. and Anbar, A. (2011). “Bank Specific and Macroeconomic Determinants of Commercial bank profitability: Empirical Evidence from Turkey”. *Business and Economics Research Journal*, 2, p.139-152.

Altaee, H. H. A., Talo, I. M. A., and Adam, M. H. M. (2013). Testing the financial stability of banks in GCC countries: Pre and post financial crisis. *International Journal of Business and Social Research*, 3, p. 93–105.

Anginer.D, Demirg¨uc-Kunt, A and Zhu. M (2014) “How does competition affect bank systemic risk?” *Journal of Financial Intermediation*, 23(1), p. 1–26.

Athanasoglou, P. Brissimis, S. and Delis, M. (2008) "Bank-specific. industry-specific and macroeconomic determinants of bank profitability". *Journal of International Financial Markets. Institutions and Money*18 (2), p. 121-136.

Beck, T., De Jonghe, O and Schepens, G. (2013). Bank competition and stability: Cross-country heterogeneity. *Journal of Financial Intermediation, 22*, p. 218–244.

Ben Naceur, S. and Goaied, M. (2008) "The Determinants of Commercial Bank Interest Margin and Profitability: Evidence from Tunisia" *Frontiers in Finance and Economics*5 (1), p. 106-130.

Bordo, M., B. Eichengreen, D. Klingebiel and M. Martinez-Peria (2001). "Is the Crisis Problem Growing More Severe?" *Economic Policy*, p. 53-82.

Borio, C and M Drehmann (2009) "Assessing the risk of banking crises – revisited", *BIS Quarterly Review*, p. 29-46.

Boyd, J.H., and De Nicolò. G, (2005) "The Theory of Bank Risk Taking and Competition Revisited," *Journal of Finance*, 60 (3), p. 1329-343.

Calza, A., C. Gartner, and J. Sousa, (2003) "Modeling the demand for loans to the private sector in the euro area" *Applied Economics*35, p. 107–117.

Chalermchatvichien, P., Jumreornvong, S., Jiraporn, P., & Singh, M. (2014a). The Effect of Bank Ownership Concentration on Capital Adequacy, Liquidity, and Capital Stability. *Journal of Financial Services Research*, 45, pp. 219–240.

Cooke. J-B and Koch. C (2014) "weakly capitalized banks slowed lending recovery after recession, *Economic Letter*, Federal Reserve Bank of Dallas, January 2014, p. 1-4.

Coval, J.D. and Thakor A.V. (2005), "Financial Intermediation as a Beliefs-bridge between optimists and Pessimists", *Journal of Financial Economics*, 75, p. 535-569.

Demirgüç-Kunt, A., Huizinga, H., (2010). "Bank activity and funding strategies: The impact on risk and returns". *Journal of Financial Economics*, 98(3), p.626–650.

Demirguc-Kunt, A. and Huizinga, H. (1999) "Determinants of commercial bank Interest margins and profitability: some international evidence" *World Bank Economic Review*13 (2), p. 379-408.

García-Herrero, A., S. Gavila´, and D. Santaba´rbara, (2009) "What explains the low profitability of Chinese banks?" *Journal of Banking and Finance* 33, p. 2080–2092.

Goddard, J. Liu, H. Molyneux, P. and Wilson, J. (2009) "Do bank profits converge?" Working Paper.

Hakimi, A. Djelassi, M and Hamdi, H. (2011). "Financial Liberalization and Banking Profitability: A Panel Data Analysis for Tunisian Bank". *International Journal of Economics and Financial Issues*, 1(2), p. 19-32.

Hamdi, H, Hakmi, A and Djelassi. M (2013) "Did financial liberalization lead to bank fragility? Evidence from Tunisia" *International Journal of Business and Finance Research*, 7 (5), p. 77-88.

Illing, M., and Y. Liu. (2006). "Measuring Financial Stress in a Developed Country: An Application to Canada."*Journal of Financial Stability*, 2 (3), p. 243–65.

King, R-G., and Levine. R(1993) "Finance and Growth: Schumpeter Might Be Right." *Quarterly Journal of Economics*, 108, p. 717–738.

Köhler, M. (2015). Which banks are more risky? The impact of business models on bank stability. *Journal of Financial Stability, 16*, p. 195–212.

Laeven, L., Ratnovski, L. and Tong, H. (2014). "Bank size and systemic risk: Some international evidence". International Monetary Fund, Mimeo. Retrieved from https://www.imf. org/external/pubs/ft/sdn/2014/sdn1404.pdf.

Levine, R., (1997). "Financial development and economic growth: views and agenda". *Journal of Economic Literature*, 35, p. 688-726.

Levine, R. (2005),"Finance and Growth: Theory and Evidence", in: Handbook of Economic Growth, Eds. Philippe Aghion and Steven N. Durlauf, Elsevier North Holland, p. 866-934.

Madigan,D.andYork,J. (1995). "Bayesian graphical models for discrete data" .*International Statistical Review*, 63, p. 215-232.

Martinez-Miera, D., and R. Repullo, (2010), "Does Competition reduce the risk of Bank Failure?", *Review of Financial Studies*, 23, pp. 3638-3664.

Miller S., and A. Noulas, (1997), "Portfolio Mix and Large-Bank Profitability in the USA", *Applied Economics,* 29, p. 505-512.

Mirzaei, A., Moore, T. & Liu, G. (2013), "Does market structure matter on banks profitability and stability? Emerging vs. advanced economies", *Journal of Banking and Finance*, 37(8), p. 2920-2937.

Petkovski, M. and Kjosevski, J., (2014). "Does banking sector development promote economic growth? An empirical analysis for selected countries in Central and South Eastern Europe."*Economic Research – Ekonomska Istraživanja*, 27(1), p. 55-66.

Puddu, Stefano (2008). "Optimal Weights and Stress Banking Indexes". HEC-Université de Lausanne.

Rajhi, W., Hassairi, S, A., (2013), "Islamic Banks and Financial Stability: A Comparative Empirical Analysis between Mena And Southeast Asian Countries", *Région et Développement,* p. 149-177.

Revell, J., (1979) "*Inflation and Financial Institutions"* (Financial Times, London).
Segoviano, M. and C.A.E. Goodhart, (2009), "Banking Stability Measures," IMF Working Paper, No. 09/4.

Thakor A.V. (2014), "Bank capital and financial stability: An economic Trade-off or a Faustian Bargain?" *Annual Review of Financial Economics*, 6, p. 185-223.

Uhde, A., Heimeshoff, U. (2009) "Consolidation in Banking and Financial Stability in Europe: Empirical Evidence." *Journal of Banking and Finance*, 33, p. 1299–1311.

Wachtel, P.,(2001). "Growth and finance: what do we know and how do we know it?" *International Finance*, 4 (3), p. 353–362.

Williams, B., (2014). "Bank risk and national governance in Asia". *Journal of Banking and Finance*, 49, p. 10–26.

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