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ZSCORE AND ECONOMIC UNCERTAINTY: CASE OF TUNISIAN BANKS

Akram Ibrahim[1] and Mohamed Aymen Ben Moussa[2]

[1]Doctor in Finance, Faculty of Economic Sciences and Management of Tunis, University El Manar

[2]Doctor in Finance, Faculty of Economic Sciences and Management of Tunis, University El Manar

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ABSTRACT: *Zscore compares the buffer's of a country's commercial banking system (capitalisation and return) with the volatility of these returns . Also economic uncertainty refers to a situation in which the future economic environment is different to predict ; and there is a high degree of risk or unkowns involved . We used EPU (Economic policy uncertainty) as the unforseen changes that affect the economic system and that lead to changes in government policies. By appyling a model of panel statique for the sample of 11 banks in Tunisia through the period (2012-2021) , we found that EPU have negative effect on Zscore . But (ROA ; Size ; TLA , CAP , TPIB , TINF) have a positive effect on Zsocre .*

KEYWORDS: Zscore ; economic uncertainty ; Panel ; Banks ; ROA

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INTRODUCTION

Since the outbreak of the global financial crisis in 2008, the global economic and financial situation has become increasingly complicated. Uncertain events and risk events are also on the rise, such as the European sovereign debt crisis, Brexit, the spread of COVID-19 and more recently, the Russian-Ukrainian war. In addition, uncertainty surrounding global economic policies is also increasing. Economic policy uncertainty (EPU) relates to an inability to predict the future regarding the policies made by policy makers for an issue of concern. As a result, researchers have begun to examine whether policy uncertainty has economic and financial consequences. The main challenge is to find an appropriate proxy to measure the level of uncertainty. Previous literature uses different measures of uncertainty, such as stock market volatility, geopolitical risks, and other political risk indicators. Since its introduction by Baker et al. (2016), the index of economic policy uncertainty (EPU) was used as the main measure of uncertainty. In the United States, the EPU index is calculated as a weighted average of three components, including media coverage related to the EPU, the degree of uncertainty related to future tax code changes, and anticipated divergences in future monetary and fiscal policy, while the EPU indices of most other countries are tied to the news. Al-Thaqeb and Algharabali (2019) in their article defined Economic Policy Uncertainty (EPU) as the unforeseen changes that affect the economic system and that lead to changes in government policies. Economic policy uncertainty is caused by the complexity of the economic policy formulation process and the difficulties of government authorities and economic entities in accurately predicting the effects of policies (Baker et al., 2016). Pursuing the logic of the EPU, Ahir et al. (2018) developed the World Economic Uncertainty Index (WUI) using occurrences of the term “uncertainty” (and its derivatives) in Economist Intelligence Unit (EIU) country reports. Most existing studies point out that political uncertainty can lead to macroeconomic risks and financial instability (Baker et al. 2016; Wu et al., 2020; Nguyen, 2021), as banks and corporations will be more cautious about long-term investments in response to political uncertainty. In this part, various studies focus on bank credit, which is a key factor of economic growth.

They find that economic policy uncertainty exerts a strong adverse effect on bank credit growth (Bilgin et al., 2021; Bordo et al., 2016; Chi and Li, 2017; Danisman et al., 2020; Hu and Gong, 2019; Lee et al., 2017; Phan et al., 2021; Valence, 2017). The majority of previous literature on uncertainty focuses on its impact on real economic activities, suggesting that uncertainty is one of the main forces leading to the depth and duration of an economic crisis (Bachmann et al. al., 2013; Baker et al., 2016). The importance of the consequences of EPU is evident through a large body of literature that has studied its impact on economic and financial variables such as the reduction in the level of business investment (Gulen et al. 2016, Drobetz et al., 2018), reduced reactivity (R&D) (Bloom, 2007), moderation of mergers and acquisitions (Nguyen et al, 2017; Bonaime et al., 2018), reduced venture capital investment (Tian et al, 2018), the increase in the corporate credit spread (Kaviani et al., 2020). Additionally, studies have examined the effect of EPU on financial outcomes, such as stock market returns, bond prices (Gilchrist et al., 2014), oil prices (Balcilar et al., 2017) and the bitcoin market (Wang et al., 2020).

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Following the global financial crisis, this literature has been enriched by focusing on the impacts of EPU on the banking sector (Berger et al. 2022; Phan et al. 2021; Shabir et al. 2021, 2022). Despite the amount of literature on its influence on the real economy, the question of whether economic uncertainty affects the stability of banks has been relatively less explored. According to (Shabir et al. 2021), banking stability is defined by the absence of a banking crisis as well as by the individual soundness of all banks. The banking sector is also very sensitive to economic policy uncertainty as it directly affects the bank's ability and willingness to make lending decisions and indirectly affects the repayment of its creditors. Many EPU studies have emerged in the banking literature.

Using data from 2994 US commercial banks for the period 2017-2019, Cruz et al. (2021) showed that EPU has a significant positive effect on credit risk. Zhang et al. (2022) study the impact of EPU on Chinese banking risk for the period 2005-2018. They show that economic uncertainty significantly increases banking risk and reduces profitability. Theoretically, the way uncertainty shapes banking risk is ambiguous. On the one hand, the literature relies on the "real option" theory to explain that uncertainty can mitigate banking risk. This theory developed by McDonald and Siegel (1986), Pindyck (1988) states that the lack of complete information in uncertainty leads to an increase in the probability of making bad decisions. Thus, banks are likely adopting a "wait and see" strategy and postponing lending until the uncertainty subsides. This leads to a restriction of the credits granted and to an increase in the number of solvent borrowers.

Wu et al., (2020), using data from over 1500 banks in 34 emerging economies over the period 2000-2016, they showed banking risk increases as the level of economic uncertainty increases. In addition, the authors show that the uncertainty-banking risk link is more attributable to the option value of waiting and yield-seeking strategies and to the herd behavior of banks than to various effects on the demand side. If the limited amount of lending targets creditworthy borrowers at such times, then the stability of banks might improve (Wu et al., 2020). On the other hand, in times of high EPU, companies can postpone their investments or their expenses until the uncertainty disappears (Bloom, 2009), leading to lower overall demand for loans and downward pressure on loan rates.

In addition, the narrowing of interest rate spreads due to the reduction in demand for corporate financing and the increase in the cost of bank financing, can encourage the incentive to "seek yield" (Wu et al. 2021) when the return objective of banks is rigid, and therefore induce them to lend to "high risk and high return" projects (Rajan, 2006; Dell'Ariccia et al., 2014). Using a sample of 568 banks from 20 countries between 2009 and 2018, Bilgin et al. (2021) examine the impact of the WUI uncertainty index on the default risk of Islamic and conventional banks. The results show that economic uncertainty increases the default risk of conventional banks, the default risk of Islamic banks is not affected. Indeed, some studies find that economic policy uncertainty has a strong adverse effect on bank credit growth.

Using data from several decades, including the Great Recession, Bordo et al. (2016) examine the impact of EPU on overall bank credit growth. They find that EPU has a significant negative effect on bank credit growth. Their results suggest that elevated political uncertainty due to the Great Recession is dampening overall credit growth through the bank lending channel. Chi and Li (2017) study the impacts of EPU on credit risk and lending decisions of Chinese banks for the period 2000 to 2014. They showed that increasing economic policy uncertainty increases bank credit risks through various channels and negatively affects loan size.

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Danisman et al (2020) explore the impact of economic policy uncertainty on credit growth and find that economic policy uncertainty hampers European bank credit growth. Using data from 2439 banks in 19 countries over the period 2010-2019, Demir et al. (2021) found that economic uncertainty leads to a significant decrease in bank credit growth. In addition, higher EPU is often linked to higher bank loan loss provisioning and liquidity hoarding and lower derivatives hedging (Berger et al., 2020; Danisman et al., 2020; Tran et al., 2020). al., 2021; Wang et al., 2022). Moreover, there is also evidence that banks tend to raise loan prices when political uncertainty is higher. One explanation for this is that their decisions today take into account various unknown outcomes of future political events (Valencia, 2016).

This uncertainty can arise due to various unexpected sources, for example, non-performing loans can suddenly increase (Karadima et al., 2021). Therefore, banks charge more as compensation for their higher risk taking. Some research has recently found a positive link between EPU and bank loan prices. Ashraf et al. (2019) who investigated bank loan pricing in 17 countries over the years 1998-2012 and found that economic policy uncertainty is associated with higher average loan prices. Tiwari et al. (2020) showed loan prices are higher during periods of strong economic conditions. As banks impose additional costs on loan contracts to protect their profitability, credit risks will be higher due to the higher burden on their borrowers. In times of high economic policy uncertainty, the tendency for herd behavior, i.e. homogeneous lending behavior in the banking system, can threaten banking stability (Wu et al., 2020).

Some empirical studies show that banks can behave homogeneously when uncertainty increases (Calmès and Théoret, 2012). As part of this strategy of "herding", banks will follow in the footsteps of those who are more informed, in order to resist risks together. However, the asymmetry in the transmission of information could lead to the classification of banks into two categories: those which are optimistic and those which are pessimistic. As a result, they operate in diverse ways, which manifests in reduced interconnection (Lan et al. 2021). Shabir et al. (2021) found that economic policy uncertainty will have a negative effect on banking stability. This effect can be explained by the increased motivation of banks to engage in risky activities, and the herd behavior of banks.

Khalfaoui et al. (2022) examined the effect of economic policy uncertainty (EPU) on credit risk, lending decisions and banking performance of listed Tunisian banks over the period 1999-2019. The results show a significant positive effect of EPU on credit risk and a significant negative effect on loan size and performance.

The article is organized as follows. Section 2 presents our research sample and data collection source, empirical models, and description of variables. Section 3 describes the main empirical results, while section 4 gives the conclusion.

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DATA, VARIABLES AND METHODOLOGY

Data:

The sample is composed of 12 banks listed in Tunisia over the period 2012 to 2021, i.e. a total of 120 observations. The data is collected from the web site of professional association of Tunisian banks and the web site of Tunisian institute of statistics .

Variables:

- Credit risk: We follow the literature and measure banking risk using the Z-Score. The Z-score has become a popular measure of bank stability because it is inversely related to a bank's likelihood of insolvency. The Z-score is equal to the return on assets (ROA) plus each bank's financial assets ratio (CAR) divided by the standard deviation of the banks' ROAs.

- Economic uncertainty: Economic uncertainty is represented by the World Uncertainty Index (WUI), which is constructed by Ahir et al. (2018). The WUI index is available on a quarterly basis and since our analysis requires annual variables, we use the simple average of the four quarters and generate an annual variable. We then take the natural logarithm of this mean.

- Bank performance: ROA is used to analyze financial performance. ROA is the ratio of net income divided by the bank's total assets.

- Bank size: To measure the size of the bank, we will use the natural logarithm of total assets.

- Capital adequacy: CAP is used to analyze financial performance. CAP is the ratio of equity divided by total assets.

- Liquidity: TLA is used to measure the liquidity of the bank. TLA is the ratio of total loans divided by total assets.

- Tdeposit: T deposit indicate the share of deposits in relation to total assets.

Table 1: Variable definition

Variable	Notation	Definition	Sources
Dependant variable			
Credit risk	z_score	$(\mathrm{CAP} + \mathrm{ROA}/\sigma\mathrm{ROA})$	Calcul des auteurs
Independant variables			
Word Uncertainty Index	WUI	World Uncertainty Index (WUI)	www.policyuncertainty.com
Bank Performance	ROA	Net income/Total assets	Web site of bank
Bank size	Size	Logarithm of Bank Assets	Web site of bank
Capital adequacy	CAP	Equity/Total assets	Web site of bank
Liquidity	TLA	Total loans/Total assets	Web site of bank
Deposit	TDEPOSIT	Total deposit/Total assets	Web site of bank
Gross domestic product	GDP	growth rate of gross domestic product	Web site of bank
Inflation	INF	Inflation rate measured by consumer price index (%)	Web site of bank

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Methodology:

Model:

To examine the effect of WUI on Tunisian bank credit risk we use the following model:

$$Z\_score_{it} = \beta_0 + \beta_1 WUI_t + \beta_2 ROA_{it} + \beta_3 SIZE_{it} + \beta_4 CAP_{it} + \beta_5 TLA_{it} + \beta_6 TDEPOSIT_{it} + \beta_7 PIB_{it} + \beta_8 INF_{it} + \varepsilon_{it}$$

Where i represents individual banks and t represents years, β_i are the coefficients of the explanatory variables.

2.3.2. Hausman test: We apply the Hausman test to determine whether a fixed or random effect is more appropriate in our research. A fixed-effect model is useful if the null hypothesis is rejected; otherwise, a random-effects model should be used.

In our model Pv = 0.000, we choose the model with fixed effects:

Test of hétéroscédasticité :

There is heteroscedasticity of the residuals if they do not all have the same variance. To detect heteroscedasticity, we apply the Breush Pagan test, the general idea of this test is to check if the square of the residuals can be explained by the explanatory variables of the model. The Breush Pagan test allows us to detect heteroscedasticity which supposes a different variance between the error terms in the same individual. P value is greater than 1%, there is no heteroscedasticity problem.

EMPIRICAL RESULTS AND DISCUSSION:

Descriptive statistics:

Table 2 below presents the descriptive statistics including the mean, median, minimum, maximum and standard deviation values for all the variables used during the period 2012-2021. The average Z_score was 27.70916 with a maximum value of 65.42016 and a minimum value of 1.959021. The WUI related to the Tunisian context has an average of about 0.385. Focusing on the bank's profitability indicator, the descriptive statistics show that the average ROA is low (0.99%), indicating that the net income is on average 0.099% of total assets.

Regarding the size of banks, Tunisian banks record an average value of 15,476. The minimum and maximum sizes are 13.470 and 16.770 respectively. The average level of the capital ratio is around 9.78%. On average, it can be concluded that Tunisian banks are moderately capitalized. As a macroeconomic variable, GDP registers an average of 6.83% with a maximum value of 10.75% and a minimum of -2.71%. The second variable is the inflation rate. The average of this variable is 5.52% and the maximum level is 7.31%.

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Table 2: Descriptive statistics

	Z_SCORE	WUI	ROA	SIZE	CAP	TLA	TDEPOSIT	PIB	INF
Mean	27.70916	0.385903	0.009997	5.47649	0.097810	0.788194	0.755077	0.068337	0.055280
Median	26.61503	0.355885	0.011000	15.68875	0.089500	0.791350	0.762950	0.074789	0.056150
Maximum	65.42016	0.702641	0.025049	6.77000	0.225400	0.945000	0.896300	0.107576	0.073100
Minimum	1.959021	0.127083	-0.024850	13.47000	0.041950	0.122720	0.525200	-0.027128	0.038000
Std. Dev.	15.07605	0.176855	0.008939	0.774520	0.033218	0.091841	0.082421	0.035483	0.010203
Observations	120	120	120	120	120	120	120	120	120

After giving some statistics on all the variables of our study, the correlation matrix for the main variables is also reported in Table 3. In this table, we notice that the correlations between the independent variables are weak, the model n is not multicollinear because none of the coefficients exceeds 60%. Except for the correlation coefficients between Z_score and ROA (69%) which poses no problem during model estimation. Table 3 summarizes the correlation results.

Table 3: Correlation matrix

	Z_SCORE	WUI	ROA	SIZE	CAP	TLA	TDEPOSIT	PIB	INF
Z_SCORE	1.000000								
WUI	-0.065371	1.000000							
ROA	0.693049	-0.097364	1.000000						
SIZE	0.390621	-0.164668	0.412303	1.000000					
CAP	0.538836	0.005912	0.306958	-0.315873	1.000000				
TLA	-0.047210	0.082544	0.003250	-0.330208	0.144412	1.000000			
TDEPOSIT	-0.006983	0.105757	0.160099	0.214560	-0.303030	-0.034901	1.000000		
PIB	-0.012383	0.336764	0.071801	-0.045230	0.013987	0.061466	-0.034671	1.000000	
INF	0.071924	-0.251964	-0.039384	0.094593	0.105811	-0.075518	-0.084279	0.335168	1.000000

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Empirical Results

Table 4 presents the results of the estimation of our regression model.

Table 4: Estimation results

	Coefficient	Z-stat	P-value
WUI	-4.63266	-2.97	0.004
ROA	26.79589	0.79	0.432
SIZE	2.505503	2.08	0.040
CAP	215.275	21.64	0.0000
TLA	-7.364729	-2.54	0.013
TDEPOSIT	10.64161	2.53	0.013
TPIB	0.1094233	0.02	0.985
TINF	37.39234	1.54	0.126
CONST	-34.90833	-1.86	0.066

-There is a positive relationship between Z score and ROA (if ROA increase by 1% Z score increase by 26.79%). This result is similar to result found by (Hamdi and Hakimi (2019) ; Abbas and al (2021), Ratchvalishvili and al (2023)), Kasri and Azzahra (2020), Mkadmi and al (2021)). The increase of return on assets has a positive effect on Zscore. This relationship is attributed to fact that a higher level of profitability means banks have less incentives to invest in risky investments; which drives the Zscore and thus maintain bank stability. According to Delis and Kouretas (2011) profitability has a mixed effect on bank risk taking and vice versa. High level of risk assets can in good time lead to greater earnings; which can then be used to fund further loans. In contrast the excessive risk may result in problematic loans and decreased profitabilty; which will eventually mean fewer risk assets in the next quarter. ROA reflects how bank manage their assets to minimize non performing assets and improve bank stability . (Kasri and Azzahra (2020)

-There is a positive relationship between Z score and Size (if Size increase by 1% Z score will increase by 2.50%) . The increase of Z score has a positive effect on Size. This result is similar to result found by (Afzal and Mirza (2012), Pham and al (2021), Nguyen (2020),Ratchvelshvili and al (2023)), Kasri and Azzahra (2020), Mkadmi and al (2021)) but contrary to result found by Eldomiaty and al (2023).

Leaven and al (2014) state that large banks have more systemic risks due to their variety of activity . De Jonghe (2010) ; Uhde and Heinshoff (2009) found larger banks tend to take on more risk due to the moral hazard problems . They define that larger companies may be more likely to be tempted to increase risk taking; lower market discipline; and produce competitive

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distributions since they are aware that they would be bailed out in the event of a problem. Larger banks have a lower risk profile (Salas ; Saurina (2002)).

Too big to fail theory states that larger banks are more likely to take on more risk and consequently; larger banks have a greater probability of failure. In this context; the bank size decreases banking stability and Zscore (Dawood and al (2016) ; Ghenim and al (2017) ; Ghassan and Gendouz (2019))

This implies that the greater the size of bank indicates that the bank has well diversified portfolios and is more efficient because of economies of scale; which drives Zscore up and enhance stability.

-There is a positive relationship between Zscore and CAP (if CAP increase by 1% Zscore will increase by 215.75%). The increase of Zscore has a positive impact on CAP. This result is similar to result found by Rim (2001),Ayiar and al (2015), Ratchveishvili and al (2023)) but contrary to result found by Calem and Rob (1999). Rime (2001) used data from swiss banks to analyze the influence of regulatory capital requirements on bank risk taking behavior. Their findings revealed that banks have boosted their capital because of regulatory pressures. In addition they found no correlation between regulatory pressure and risk.

Hovarth and al (2014) argued that high capital increases stability through the availability of final support in case of unexpected loss or financial crisis.

-There is a negative relationship between Zscore and TLA (if TLA increase by 1%; Z score will decrease by 7.36%) . The increase of total credits have a negative effect on Zscore.

-There is a positive relationship between Tdeposit and Zscore (if Tdeposit increase by 1%; Zscore will increase by 10.64%) The increase of deposits by total assets has a positive impact on Zscore.

-There is a negative relationship between WUI and Zscore (if WUI increase by % Zscore will decrise by4.63%

-There is a positive relationship between TPIB and Z score (if TPIB increase by 1% Zscore will increase by 0.109%) . The increase of economic growth has a positive impact on Zsore . This result is similar to result found by (Hamdi and Hakimi (2019) , De Ramon and al (2020) ; Pham and al (2021), Ratchvelishvili and al (2023) , Eldomiaty and al (2023), Mkadmi and al (2021) but contrary to result found by (Imbierovicz ; Rauch (2014) ; Ghenimi and al (2017) ; Chen (2018) ; Ghassan and Gendouz (2019) ; Rahman and al (2021), Kasri and Azzahra(2020)).

-There is a positive relationsip between TINF and Z score (if TINF increase by 1% Zscore will increase by 37.19%). The increase of inflation has a positive impact on Zscore . This result is similar to result found by (Ghenim and al (2017) ; Abbas and al (2021) , Socbyakto and al (2020) ; Pham and al (2021) Kasri and Azzahra(2020), Eldomiaty and al (2023) but contrary to result found by (Ghassan ; Geuendoug (2019) ; De Ramon and al (2020) ; Rahman and al (2012), Ratchvelishvili and al (2023)).

These authors have argued when that when countries face inflationary pressures; they weaken the borrowers repayment capacities and thus; the credit risk rises and leads to a rise in the overall of the bank risk; Zscore decreases.

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Higher inflation level reduced the value of loans over the years, which strenghted the borrower repayment capacity; thus increasing the stability of bank; which drove the Zscore up.

CONCLUSION:

Zscore capture the probability of default of a country's banking system . Z score can be interpreted as an accounting base measure of the distance to default . The main consequence of its measure that a low risk bank will have a high volume of Zsocre indicating that a large number of standard deviation of a bank asset return have to drop the become insolvent . The counterpart is that a lower value of Zscore indicates higher risk of the bank . (Li ; al (2017))

The Zscore measure is still relevant in evaluating banking stability (Hafeez and al (2022)

The Zscore can predict 76% of bank failure (Chiaramonte and al (2016)).

On the other hand economic uncertainty refers a situation in which the future economic environment is different to predict and there is a high degree of risk or unknowns involved

We used WPU (economic policy uncertainty) as the unforcseen changes that affect the economic system and that lead to changes in government policies .

By applying a panel static for the sample of 11 banks in Tunisia through the period (2012---2021) we found that WPU have a negative impact on Zscore . But the other variable such as ROA ; Size ; CAP ; economic growth ; inflation have a positive impact on Zscore.

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