Evaluation of Banking Fragility: Evidence from Banks in the MENA Region

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Abstract

This paper aimed to detect the impact of changes in the landscape of the banking sectors in 12 MENA countries on the fragility of banks over the period 2005-2011, using the Z-score indicator introduced by Scott (1981) and developed by Goyeau and Tarazi (1992). The empirical results show that Egypt, Jordan, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, UAE and Lebanon witnessed a decline in their fragility over the studied period. Conversely, Bahrain, Kuwait, and Turkey have experienced a worsening in their fragility. Secondly, the Z' indicator shows that Morocco, Tunisia and Lebanon recorded less risk exposure than other countries, which can be explained by a lower risk exposure and more sufficient levels of equity. Moreover, the results show that Jordan, Saudi Arabia and Lebanon have witnessed a decrease in their risk level, while other countries have experienced a deterioration of their fragility such as Bahrain, Oman, Qatar the UAE and Tunisia. Finally, the paper tested the impact of some micro- and macroeconomic factors on bank fragility, and found that the probability of default decreases with higher bank capital and with an increase in inflation rates, whereas it increases with higher bank liquidity, credit risk, and profitability.

Keywords: Probability of default; Banking risk; Z-score; MENA banks.
JEL classification: G21; D24.

1. Introduction

The considerable changes witnessed by the banking sectors of the MENA region over the past few years resulted in changing the landscape of these banking sectors. These changes represented mainly by the implementation of reform processes, restructuring and privatising state banks, resolving insolvent banks,

and adopting tighter supervisory and regulatory rules. This was also accompanied with a wave a deregulation represented mainly by the liberalisation of interest rates and allowing foreign bank entry. Moreover, the MENA banking system observed a decrease in the number of banks due to a wave of bank mergers and acquisitions and closing down troubled banks, which contributed in a significant increase in concentration. This phenomenon has raised concerns about competition and financial stability, since there is a trade-off between the costs and benefits of competition.

Competition could have an unfavourable impact on stability if it causes banks' charter value to drop, which reduces the incentives for prudent risk-taking behaviour by banks. Moreover, a concentrated banking system dominated by few large banks, may exhibit a too-big-to-fail problem where large banks increase their risk exposure anticipating the unwillingness of supervisors to allow them to fail. Moreover, despite that competition may decrease the costs of financial intermediation and improve economic efficiency, it could reduce the market power of banks and their profitability, which may weaken their ability to withstand adverse shocks.

This paper addresses the impact of all the above changes (and mainly increasing concentration) witnessed by the MENA banking sectors on bank fragility using the Z-score indicator introduced by Scott (1981) and developed by Goyeau and Tarazi (1992). The Z-score methodology has captured a wide attention by academics and practitioners because it provides a thorough assessment of bank fragility risk. This methodology is based on computing a "risk indicator" for a bank or for the entire banking system. Besides, the Z-score indicator measures the bank's probability of default and bases on the bank's earnings level and volatility.

The paper proceeds as follows. The empirical methodology is illustrated in section 2. We present and explain the data and the used variables in section 3. The empirical results are presented and analyzed in section 4. Finally, the general conclusions are presented in section 5.

2. Methodology

Risk analysis and the prediction of bank failure has been for forty years, since the work of Beaver (1966) and Altman (1968), the subject of a large body of literature that focused on the empirical method called "Discriminate Analysis".

Beaver (1966) has been the first to present a modern model for predicting the default of firms. He utilised a series of 30 ratios, where he determined for each one, a critical value extracted from a sample of 79 failed firms. To establish this critical value, the author compared the average value of each ratio for the sample of failed firms with that of non-failed ones. His results were quite satisfactory and led to believe that simple ratios do have some "predictive power", and allow predicting the default five years prior to its occurrence. However, this "Univariate Discriminate Analysis" contained several weaknesses because it does not permit identifying the common impact of many ratios, nor well understanding which indicator should be taken to predict the probability of this default, since some indicators may provide contradictory results.

Altman (1968) utilised a more sophisticated statistical method: the "Multivariate Discriminate Analysis", which allows overcoming the weakness of Beaver (1966) model. Altman (1968) criticised the univariate models and argued that the exploited ratios can be divided into three major categories: ratios that measure profitability, ratios that measure liquidity, and ratios that measure solvency. Thus, a firm with low profitability and solvency could be considered as a high probability of default. Nevertheless, what can be said if, for instance, the firm has excellent liquidity? Therefore, it was necessary to assign a weight for the different ratios in order to obtain a less ambiguous image about of the probability of default. For that reason, the Multivariate Discriminate Analysis is more appropriate.

Since the work of Altman, similar studies have been developed. For instance, Deakin (1972), Sinkey (1975), and Santomero and Vinso (1977) have included technical enhancements, but often were offset by the emergence of new problems. Santomero and Vinso (1977) based on the "Gambler's Ruin Theory" to estimate the probability of default for commercial banks. In their model, the bank is seen as a

gambler, and the default occurs when the net worth of the bank becomes zero or negative. The empirical application of this model was in general little satisfactory and the probability of default of the most risky bank in the sample studied by Santomero and Vinso (1977) was equal to 0.0000003. This result obviously underestimates considerably the probability of default of banks and the fragility of the (American) banking system. Consequently, the model employed by Santomero and Vinso (1977) was not able to explain the defaults observed shortly after their study.

The study of Scott (1981) bases also on the gambler's ruin theory and allows estimating the probability of default of firms. But this model relies on a very strong assumption: the firm does not have access to the financial market. Thus, the firm has to finance its losses through selling assets because it cannot issue debt or equity. This firm has a given amount of capital, *K*, where its variations are random, whether a gain or a loss. To cover the loss, the firm has to sell its assets, and when the value of *K* becomes negative, the firm defaults. The model was as follows: *K* is the liquidation value of the firm's total assets and *Z* is the variability of *K*. Then, the firm defaults in the following period if:

$$K + Z < 0 \tag{1}$$

Scott (1981) postulates that – in general – the book (accounting) values are good substitutes for the liquidation value. Then *K*, the liquidation value of the shareholder's investment could be represented by the accounting value of shareholders' wealth (i.e. the shares) and *Z* by the variability of net income (less dividends and stock repurchase).

Then, if μ_z and σ_z are the average and the standard deviation of *Z*, inequality (1) could be written (by normalizing) as:

$$\frac{(Z - \mu_z)}{\sigma_z} < -\frac{(\mu_z + K)}{\sigma_z} \tag{2}$$

Scott (1981) showed that when we divide the inequality (2) by total assets, *TA*, and when we multiply by -1, we obtain the following "fragility indicator":

$$\left(\frac{\mu_z}{TA} + \frac{K}{TA}\right) / \left(\frac{\sigma_z}{TA}\right) \tag{3}$$

And when this indicator increases, the probability of default increases.

The model presented by Goyeau and Tarazi (1992) to study the banking fragility in Europe divide this fragility indicator and allows creating several indicators to estimate the probability of default of banks. The authors consider that the probability of default is the probability that losses exceed the value of equity, i.e. when the net worth becomes negative. Goyeau and Tarazi (1992) base on the principle that a bank defaults whenever its market value becomes negative, i.e. when:

$$V = \hat{A} - D \times (1 + \hat{u}) < 0 \tag{4}$$

where $\hat{A}$ is the market value of assets, *D* is the value of deposits, and $\hat{u}$ is the cost of deposits. $\hat{A}$ and $\hat{u}$ are random variables.

If $\hat{A} = (E + D) \times (1 + \hat{i})$, where *E* is the equity, $\hat{i}$ is the future return on assets (assumed random), Equation (4) becomes:

$$\pi = \left(\hat{i} + \hat{u}\right) \times D + \hat{i} \times E < -E \tag{5}$$

where π is the net profit of the bank (assumed random).

Then, Goyeau and Tarazi (1992) transformed this condition in a way to obtain an indicator of fragility of banks. If the probability of default = Prob $(\pi < -E)$, then by dividing the 2 terms by *E*, we obtain:

$$\text{Prob}\left(\frac{\pi}{E} < -\frac{E}{E}\right) = \text{Prob}\left(\frac{\pi}{E} < -1\right) \tag{6}$$

If similarly for the model of gambler's ruin, we normalize the previous equation by proposing $\frac{\pi}{E} = ROE$ (where *ROE* is the return on equity), and μ_{ROE} and σ_{ROE} are the average and standard deviation of *ROE* respectively, then Equation (6) becomes:

$$\text{Prob}\left[\frac{\left(ROE - \mu_{ROE}\right)}{\sigma_{ROE}} < \frac{\left(-1 - \mu_{ROE}\right)}{\sigma_{ROE}}\right] = \text{Prob}\left[\frac{\left(ROE - \mu_{ROE}\right)}{\sigma_{ROE}} < -Z\right] \tag{7}$$

where $Z = \frac{\left(1 + \mu_{ROE}\right)}{\sigma_{ROE}}$ is the indicator of fragility.

If we adopt an approach based on the return on assets (*ROA*) instead of *ROE*, then Equation (6) will be re-written by dividing by *A* instead of *E*:

$$\text{Prob}\left(\frac{\pi}{A} < -\frac{E}{A}\right) = \text{Prob}\left(ROA < -\frac{E}{A}\right) \tag{8}$$

where *ROA* is the return on assets, μ_{ROA} and σ_{ROA} are the average and standard deviation of *ROA* respectively.

Finally, if we propose $\lambda = \frac{E}{A}$ (the equity-to-asset ratio), equation (8) will be:

$$\text{Prob}\left[\frac{\left(ROA - \mu_{ROA}\right)}{\sigma_{ROA}} < \frac{\left(-\lambda - \mu_{ROA}\right)}{\sigma_{ROA}}\right] = \text{Prob}\left[\frac{\left(ROA - \mu_{ROA}\right)}{\sigma_{ROA}} < -Z'\right] \tag{9}$$

where $Z' = \frac{\left(\lambda + \mu_{ROA}\right)}{\sigma_{ROA}}$ is the indicator of fragility.

Additionally, the indicator Z' could be split as follows:

$Z' = Z_1' + Z_2'$, where $Z_1' = \frac{\mu_{ROA}}{\sigma_{ROA}}$ and $Z_2' = \frac{\lambda}{\sigma_{ROA}}$.

This is precisely the division of Z' in Z_1' and Z_2' which makes the interest of the study, because Z_1' could be represented as the risk of portfolio, and Z_2' as the degree of coverage of this risk. In fact, Z_1' is the traditional measure of risk taking into consideration the volatility of returns and the level of this return.

Nevertheless, if the volatility of return increases at the same time with the level of return, then the risk does not necessarily change. Z_2' is a measure that approaches to the Cook ratio, but has an advantage over the later because it does not weight the different categories of assets in an arbitrary way, and values the risk according to the variability of portfolio's returns.

3. Data and Variables Specification

3.1 Data

The evaluation of the fragility of commercial banks operating in the MENA region is conducted on 12 banking systems: Lebanon (with a sample of 39 banks), Saudi Arabia (12 banks), Qatar (5 banks), Kuwait (8 banks), Jordan (14 banks) , United Arab Emirates (16 banks), Tunisia (19 banks), Bahrain (8 banks), Oman (8 banks), Morocco (10 banks), Egypt (24 banks), and Turkey (24 banks) .

We exploit accounting data taken from the Bankscope banking database, covering seven years of annual data (2005-2011).

3.2 Variables Specification

For the reasons explained previously, we will utilise the fragility indicator Z' since it allows decomposing the risk into: (1) a risk-adjusted performance component and (2) a portfolio risk hedging component.

Three variables are necessary to calculate the fragility indicator: (1) bank equity, (2) bank net profits, and (3) bank total assets.

After calculating the fragility indicator for each banking system in our sample, we will study the link between default risk and a number of control variables that are relevant in explaining the risk taking of banks. In particular, we test whether the observed differences among banks in terms of capitalization, asset structure and cost of funds lead to significant differences in risk.

The explanatory variables used to explain the variability of default risk are chosen based on the work of Boyd and Runkle (1993), Shrieves and Dahl (1992), Bourke (1989), Molyneux and Thornton (1992), and Bikker and Hu (2002). These variables are:

- The size of the bank measured by the natural logarithm of total assets (*LnAssets*). This variable is used to identify the presence (or absence) of economies of scale and/or scope in the banking industry, and also to take into account the "too-big-to-fail" hypothesis and the possible contagion following the failure of large banks.
- Bank profitability measured by the ratio of net income to total assets (*ROA*).
- The capital ratio measured by the equity-to-total asset ratio (*CAP*).
- Bank liquidity approximated by the ratio of liquid assets to total assets (*LIQ*).
- The quality of management measured by the ratio of staff expenses to total operating expenses (*MAN*).
- The asset quality measured by the ratio of provisions for doubtful loans to total assets (*PROV*).
- The growth of economic activity measured by the growth rate of Gross Domestic Product (GDPG).
- The inflation rate measured by the change in the consumer price index (*INF*).

Tables 1 and 2 present the descriptive statistics of the used variables in 2005 and 2011. They include the averages, the standard deviations and the coefficient of variations of these variables.

Table 1: Descriptive statistics of the sample (in $ million) – 2005

		Total Assets	Total Loans	Liquid Asset	Total Equity	Loan Losses Reserves	Personnel Expenses	Other Operating Expenses	Net Income
BAH	Average	7,962.5	3,057.7	2,422.2	817.7	97.8	48.3	28.8	89.4
	SD	8,861.6	3,029.7	2,945.7	818.9	132.9	49.6	29.9	79.8
	CV	1.11	0.99	1.22	1	1.36	1.03	1.04	0.89
EGY	Average	3,841.3	1,737.9	1,071.9	225.6	246.7	20.9	47.8	14.3
	SD	6,400.0	2,863.9	2,012.3	252.2	414.9	32.9	61.6	35.3
	CV	1.67	1.65	1.88	1.12	1.68	1.58	1.29	2.47
JOR	Average	3,179.1	1,396.1	1,176.7	427.7	71.0	31.9	31.6	64.8
	SD	6,828.2	3,020.6	2,481.3	967.2	115.4	64.8	69.7	123.8
	CV	2.15	2.16	2.11	2.26	1.62	2.03	2.21	1.91
KUW	Average	8,725.4	5,091.5	2,765.1	1,269.6	267.6	63.1	52.6	262.8
	SD	6,732.1	3,902.9	2,113.6	867.2	181.2	54.2	52.0	224.2
	CV	0.77	0.77	0.76	0.68	0.68	0.86	0.99	0.85
LEB	Average	1,888.5	378.8	1,419.3	144.8	2,192.6	13.9	10.4	17.5
	SD	2,911.2	550.0	2,268.9	250.9	13,176.8	19.3	13.9	35.9
	CV	1.54	1.45	1.6	1.73	6.01	1.39	1.34	2.05
MOR	Average	8,932.3	3,893.5	1,790.7	708.5	160.3	89.8	76.5	91.1
	SD	5,023.8	2,433.7	1,050.0	631.5	211.4	55.7	47.4	156.6
	CV	0.56	0.63	0.59	0.89	1.32	0.62	0.62	1.72
OMA	Average	1,687.6	1,236.5	373.1	261.4	85.3	21.8	15.8	40.0
	SD	1,604.2	1,160.1	327.7	231.5	79.6	20.8	14.9	38.0
	CV	0.95	0.94	0.88	0.89	0.93	0.95	0.94	0.95
QAT	Average	5,401.8	3,176.6	78.1	181.7	85.1	116.0	37.8	182.2
	SD	5,059.8	3,278.3	61.5	161.8	67.0	100.0	39.0	162.5
	CV	0.94	1.03	0.79	0.89	0.79	0.86	1.03	0.89
SAU	Average	16,517.7	10,243.6	1,781.5	2,167.4	314.2	142.2	111.0	605.6
	SD	11,246.7	7,224.1	898.3	1,525.5	268.5	100.4	81.1	489.2
	CV	0.68	0.71	0.5	0.7	0.85	0.71	0.73	0.81
TUN	Average	1,100.8	811.5	196.1	151.4	125.7	17.4	11.8	7.3
	SD	1,151.1	859.1	225.2	150.3	175.7	20.3	14.1	9.8
	CV	1.05	1.06	1.15	0.99	1.4	1.17	1.19	1.33
TUR	Average	10,471.4	4,858.4	2,144.2	1,225.5	217.3	147.9	203.1	231.6
	SD	14,995.2	6,552.9	3,104.9	1,854.1	342.3	187.7	284.8	347.7
	CV	1.43	1.35	1.45	1.51	1.58	1.27	1.4	1.5
UAE	Average	5,679.0	3,559.0	1,605.4	870.7	98.1	40.0	25.3	192.0
	SD	6,403.9	4,136.4	1,743.5	788.7	86.6	38.5	25.4	209.9
	CV	1.13	1.16	1.09	0.91	0.88	0.96	1	1.09

Notes: BAH: Bahrain, EGY: Egypt, JOR: Jordan, KUW: Kuwait, LEB: Lebanon, MOR: Morocco, OMA: Oman, QAT: Qatar, SAU: Saudi Arabia, TUN: Tunisia, TUR: Turkey, and UAE: United Arab Emirates.

Table 2: Descriptive statistics of the sample (in $ million) – 2011

		Total Assets	Loans	Liquid Asset	Total Equity	Loan Losses Reserves	Personnel Expenses	Other Operating Expenses	Net Income
BAH	Average	10,989.5	5,548.4	3,057.9	1,371.8	280.5	84.6	49.8	119.5
	SD	10,982.1	5,951.5	2,690.5	1,440.8	265.2	95.6	49.3	122.8
	CV	1	1.07	0.88	1.05	0.95	1.13	0.99	1.03
EGY	Average	7,050.0	2,717.1	2,118.7	508.2	256.1	52.8	59.0	61.4
	SD	11,373.4	3,562.2	2,980.9	508.3	385.9	87.8	89.2	103.5
	CV	1.61	1.31	1.41	1	1.51	1.66	1.51	1.69
JOR	Average	5,593.1	2,677.9	1,439.7	859.1	160.2	52.4	45.4	49.9
	SD	11,332.3	5,522.9	3,090.9	1,913.9	340.8	97.0	80.0	79.1
	CV	2.03	2.06	2.15	2.23	2.13	1.85	1.76	1.59

KUW	Average	19,322.3	12,170.9	3,244.6	2,669.1	655.8	144.4	143.9	209.7
	SD	18,690.1	11,178.1	2,927.5	2,735.3	644.9	155.7	218.4	360.5
	CV	0.97	0.92	0.9	1.02	0.98	1.08	1.52	1.72
LEB	Average	4,307.4	1,243.4	2,861.8	359.6	8.5	33.8	22.6	55.7
	SD	6,709.4	1,920.7	4,543.2	573.4	15.2	54.0	35.3	103.8
	CV	1.56	1.54	1.59	1.59	1.79	1.6	1.56	1.87
MAR	Average	17,523.1	12,443.4	2,792.0	1,522.9	434.5	206.1	155.5	198.8
	SD	11,805.2	8,081.1	2,555.0	1,218.0	303.2	150.2	113.3	187.0
	CV	0.67	0.65	0.92	0.8	0.7	0.73	0.73	0.94
OMA	Average	5294799	3826821	1118433	682510	135468	53576	39630	78739
	SD	5701341	3933025	1381943	654855	145597	50852	43494	94318
	CV	1.08	1.03	1.24	0.96	1.07	0.95	1.1	1.2
QAT	Average	25,870.2	16,463.4	246.6	642.5	237.5	228.9	108.2	640.4
	SD	32,435.9	21,241.9	281.4	816.4	232.8	223.2	78.0	822.0
	CV	1.25	1.29	1.14	1.27	0.98	0.98	0.72	1.28
SAU	Average	32,809.3	19,089.6	4,320.0	4,623.3	598.2	258.0	202.4	697.4
	SD	23,966.1	13,020.3	2,423.6	3,196.8	412.0	187.5	168.5	630.1
	CV	0.73	0.68	0.56	0.69	0.69	0.73	0.83	0.9
TUN	Average	1,892.6	1,408.4	325.9	231.0	270.0	27.5	15.5	5.0
	SD	1,851.8	1,442.7	298.9	278.9	364.6	29.9	17.1	4.3
	CV	0.98	1.02	0.92	1.21	1.35	1.09	1.1	0.87
TUR	Average	22,324.3	13,696.5	2,502.3	2,521.2	442.9	258.5	312.2	382.1
	SD	29,742.4	17,499.9	3,181.8	3,361.0	546.5	304.7	382.1	546.7
	CV	1.33	1.28	1.27	1.33	1.23	1.18	1.22	1.43
UAE	Average	16,605.5	11,077.5	2,984.6	2,327.4	477.5	131.5	91.2	277.5
	SD	19,531.9	13,004.8	3,564.6	2,316.1	483.8	127.3	90.0	337.9
	CV	1.18	1.17	1.19	1	1.01	0.97	0.99	1.22

Notes: BAH: Bahrain, EGY: Egypt, JOR: Jordan, KUW: Kuwait, LEB: Lebanon, MOR: Morocco, OMA: Oman, QAT: Qatar, SAU: Saudi Arabia, TUN: Tunisia, TUR: Turkey, and UAE: United Arab Emirates.

4. Empirical Results

4.1 Evolution of fragility indicators

Table 3 presents the evolution of the fragility indicator Z, for each banking sector. We observe that Qatar, Morocco, Kuwait and Lebanon have recorded lower fragility risk than the remaining of the sample. Besides, the evolution of the Z indicator over time shows that some countries, such as Egypt, Jordan, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, UAE and Lebanon witnessed a decline in their fragility over the period 2005-2011. Conversely, the other countries in the sample experienced a worsening in their fragility. Thus, in general, it appears that during the period 2005-2011, the fragility of the banking systems of the MENA region has decreased.

Table 3: Evolution of default indicator Z over the period 2005-2011

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Average 2005-2011**
BAH	73.59	80.13	31.49	55.69	66.27	47.96	109.3	66.35	66.35
EGY	18.12	57.2	65	44.09	60.6	56.85	70.2	53.15	53.15
JORD	57.18	89.41	68.71	236.43	284.08	126.54	167.95	147.19	147.19
KUW	142.31	126.56	139.75	30.83	108.04	158.95	140.81	121.04	121.04
MOR	33.58	201.71	268.49	259.05	234.99	235.31	238.78	210.27	210.27
OMA	25.48	33.34	33.56	48.29	53.42	96.7	146.9	62.53	62.53
QAT	81.28	195.91	194.82	191.92	209.85	356.42	337.33	223.93	223.93
SAUD	54.27	35.6	83.07	109.14	74.05	106.14	155.96	88.32	88.32

TUN	31.11	52.82	28.89	88.98	84.91	7.75	7.75	43.17	43.17
TUR	93.69	19.93	73.07	81.59	63.21	111.86	120.61	80.57	80.57
UAE	51.69	18.41	110.77	85.16	74.5	83.58	69.58	70.53	70.53
LEB	112.45	138.2	176.98	31.05	197.77	171.32	140.32	138.3	138.30
Average	64.56	87.44	106.22	105.19	125.97	129.95	142.12	108.78	108.78

Notes: BAH: Bahrain, EGY: Egypt, JOR: Jordan, KUW: Kuwait, LEB: Lebanon, MOR: Morocco, OMA: Oman, QAT: Qatar, SAU: Saudi Arabia, TUN: Tunisia, TUR: Turkey, and UAE: United Arab Emirates.

In the following, we will try to detect if the observed changes in the fragility indicators are rather the result of an exposure to the various risks which banks face. More specifically, does the risk exposure increases in the 12 studied countries with the emergence and development of new risks (market risk, sovereign risk...)? Or is it the evolution of equity or risk hedging that differentiates the degree of fragility of banks operating in the MENA region?

To answer these questions, we calculate the Z' indicator in order to reflect the volatility of returns on one hand, and the level of returns and the coverage capability of bank equity for a given level of risk on the other. Table 4 presents the values of Z' indicator by country, and their changes during the studied period. The results show that Morocco, Tunisia and Lebanon recorded less risk exposure than other countries since they had a fragility indicator higher than 38%. This would result in a lower fragility of the banking systems of these countries, which can be explained by a lower risk exposure and also more sufficient levels of equity.

Table 4: Evolution of default indicator Z' over the period 2005-2011

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average (2005-2011)**	**Variation (2005-2011)**
BAH	37.54	34.43	35.74	29.69	32.28	34.32	34.63	34.09	-3.64*
EGY	21.64	20.66	18.05	19.35	21.64	21.53	21.27	20.59	-1.99*
JOR	29.15	31.49	32.57	33.38	33.27	31.98	32.07	31.99	5.25*
KUW	19.06	18.45	18.27	16.69	16.81	19.25	19.18	18.24	-1.98*
MOR	42.59	46.53	47.69	49.12	51.77	55.64	43.25	48.09	3.14*
OMA	30.28	27.73	30.92	28.72	28.15	27.98	26.34	28.59	-2.86*
QAT	15.1	14.28	13.84	13.43	12.81	13.65	13.91	13.86	-4.6*
SAU	19.45	19.15	17.67	17.72	20.49	22.37	22.57	19.92	0.61
TUN	55.63	53.96	49.9	46.76	46.68	43.96	43.01	48.56	-3.78*
TUR	30.28	29.1	31.13	31.43	34.26	33.07	31.01	31.47	1.83
UAE	24.91	22.29	20.12	18.88	20.87	21.11	20.59	21.25	-5.05*
LEB	34.11	37.81	36.85	39.46	40.49	40.92	39.05	38.38	4.79*
Average	29.98	29.66	29.40	28.72	29.96	30.48	28.91	29.59	

Notes: BAH: Bahrain, EGY: Egypt, JOR: Jordan, KUW: Kuwait, LEB: Lebanon, MOR: Morocco, OMA: Oman, QAT: Qatar, SAU: Saudi Arabia, TUN: Tunisia, TUR: Turkey, and UAE: United Arab Emirates. Variations significant at the 5% level.

We also note that the evolution of the fragility indicator Z' was not uniform in all countries over the period 2005-2011. Some banking systems have experienced a decrease in their risk level such as Jordan, Saudi Arabia and Lebanon, while other countries have experienced a deterioration of their fragility

such as Bahrain, Oman, Qatar the UAE and Tunisia. The other countries such as Egypt, Kuwait and Turkey have shown some stability in their indicator of fragility.

A negative (positive) change in the Z' indicator means an increase (decrease) in the probability of default of banks. Thus, Bahrain, Kuwait, Oman, Qatar, Tunisia and the UAE have experienced deterioration in their fragility during the period 2005-2011. Conversely, Jordan, Morocco and Lebanon reported an improvement in their Z'-score. Finally, it should be noted that the variation of the fragility indicator Z' is significantly different from zero at the 5% level in all countries with the exception of Saudi Arabia and Turkey.

4.2 Factors explaining default risk

Table 5 presents the results of the tests performed on the panel data over seven years for the set of commercial banks in each country. A fixed effect model was estimated to determine the correlation between the default indicator Z' and the internal and external variables presented previously. Two models are estimated. The first model includes only variables corresponding to the CAMEL model. The second model includes all variables defined above.

The results show that the explanatory power of the estimated models is very strong since the coefficient of determination is very high. Moreover, the Fisher test concludes the rejection of the null hypothesis of all coefficients and the significance of the estimates.

Table 5: Factors affecting the fragility indicator Z – Method Fixed Effects

Variables	Model 1	Model 2
C	22.21*	0.76
CAP	75.14*	82.09*
LIQ	-0.77*	-1.005*
PROV	-0.77*	-0.74*
MAN	-0.41	0.07
ROA	-43.32*	-45.63*
LnAsset		1.36*
GDPD		-0.01
INF		0.12*
Adjused R-squared	0.98	0.98

Notes: BAH: Bahrain, EGY: Egypt, JOR: Jordan, KUW: Kuwait, LEB: Lebanon, MOR: Morocco, OMA: Oman, QAT: Qatar, SAU: Saudi Arabia, TUN: Tunisia, TUR: Turkey, and UAE: United Arab Emirates. Student-t in parentheses. (∗) statistically significant at the 1% level.

The results show a strong relationship between the level of bank capitalization and the Z' indicator. Looking at both Model 1 and Model 2, we observe a significant positive association at the 1% level, which is consistent with the results of Van Roy (2003) and Godlewski (2005). Conversely, this result does not support the theoretical work of Koehn and Santomero (1980) and Kim and Santomero (1988) who show that a strengthening of capital leads to a more aggressive behaviour by banks. Thus, our results show that the strengthening of capital results in lower risk and probability of default of banks operating in the MENA region.

The relationship between liquidity and Z' is negative and statistically significant at the 1% level. Thus, more liquid banks do not record lowest risk. This result contradicts our predictions regarding the impact of liquidity on banking risk and can be interpreted as follows. Several MENA banking systems are characterised by very high liquidity levels (e.g. Lebanon, Egypt, Tunisia, and Morocco, etc…), and hold large amount of liquid assets. Since this liquidity results into a loss of income (opportunity cost), banks

tend to use part of their “available for use” funds in high-risk-high-return investments to compensate the income loss. This behaviour increase bank risks and consequently, the probability of default.

The relationship between the Z' indicator and *PROV* that reflects the quality of assets is negative and statistically significant at the 1% level in the two estimated specifications. Thus, an increase in the provisions for doubtful loans results in a decrease of Z' indicator and thus, an increase in default risk of banks operating in the MENA region.

The explanation of risk by the quality of management variable is much less compelling and no conclusion seems to emerge from the estimates since the coefficients obtained from in the two models have opposite signs and are insignificant.

The link between profitability and the Z' indicator is negative and statistically significant at the 1% level. This result can be explained by the fact that the anxious to increase their profitability push banks to take more risk, which could be interpreted in two ways. On one hand, since capital is costly, banks are tempted to take on more risk when the level of capital is high in order to obtain a sufficient return on investment. Consequently, the probability of default may increase. On the other hand, an increase in bank capital may increase the risk through the incentives to reduce effort in the selection and the monitoring of projects by the bank. Many authors explain this reduction in effort through the issuance of new shares resulting in the reduction of the value owned by old shareholders.

The link between bank size and the Z' indicator is positive and significant at 1%. This result confirms that large banks appear to have better ability to manage their risks. Another possible explanation for this link is that big banks are subject to more frequent monitoring by the supervisory authorities. A third possible interpretation of this result is related to diversification where large banks often have a greater capacity of risk diversification than smaller ones. Most of the work on the asymmetric information problem (e.g. Leland and Pyle, 1977; Campbell and Kracaw, 1980 Diamond, 1984; Ramakrishnan and Thakor, 1984) show that the moral hazard problem and therefore risk, decrease with the size of the intermediary and disappears completely if the banks are fully diversified.

The results also reveal a negative link between the growth rate of the economy and the banking fragility indicator, though insignificant. Finally, the relationship between the Z' indicator and inflation is positive and significant at the 1% level. This result suggests that during a period of recovery of economic activity (often accompanied by a rise in inflation) the probability of default of borrowers decreases (and credit risk for banks), and consequently, the risk of bank default.

5. Conclusion

This paper tried to detect the impact of changes recorded by the banking sectors in the MENA region over the past few years on the fragility of banks. The paper adopted the Z-score indicator introduced by Scott (1981) and developed by Goyeau and Tarazi (1992), which proxies the probability of default by a fragility indicator.

The empirical results show that Qatar, Morocco, Kuwait and Lebanon recorded lower fragility risk than the remaining of the sample over the period 2005-2011. Besides, the evolution of the Z indicator over time shows that Egypt, Jordan, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, UAE and Lebanon witnessed a decline in their fragility over the studied period. Conversely, the other countries in the sample experienced a worsening in their fragility.

Secondly, we calculated the Z' indicator in order to reflect the volatility of returns and the level of returns and the coverage capability of bank equity for a given level of risk. The results show that Morocco, Tunisia and Lebanon recorded less risk exposure than other countries, which can be explained by a lower risk exposure and more sufficient levels of equity. We also found that some banking systems have experienced a decrease in their risk level (i.e. an increase in Z') such as Jordan, Saudi Arabia and Lebanon, while other countries have experienced a deterioration of their fragility such as Bahrain, Oman, Qatar the UAE and Tunisia, whereas Egypt, Kuwait and Turkey have shown some stability in their indicator of fragility.

Finally, we tested the impact of several micro- and macroeconomic factors on bank fragility, and found that the probability of default decreases with higher bank capital and with an increase in inflation rates. Conversely, this probability of default increases with higher bank liquidity, credit risk, and profitability.

References

[1] Altman, E., 1968, "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy", *Journal of Finance,* 23, pp. 589-609.

[2] Beaver, W., 1966, "Financial Ratios as Predictors of Failure", *Journal of Accounting Research*, 4, pp. 71-111.

[3] Bikker, J. and Hu, H., 2002, "Cyclical patterns in profits, provisioning and lending of banks and procyclicality of the new Basel capital requirements", *BNL Quarterly Review*, 221, pp. 143-175.

[4] Bourke, P., 1989, "Concentration and other determinants of bank profitability in Europe, North America and Australia", *Journal of Banking and Finance*, 13, pp. 65-79.

[5] Boyd, J. and Runkle, D., 1993, "Size and performance of banking firms", *Journal of Monetary Economics*, 31, pp. 47-67.

[6] Campbell, T. and Kracaw, W., 1980, "Information production, market signalling, and the theory of financial intermediation", *Journal of Finance*, 35, pp. 863-882.

[7] Diamond, D., 1984, "Financial Intermediation and Delegated Monitoring", *Review of Economic Studies*, 51, pp. 393-414.

[8] Deakin, E., 1972, "A discriminant analysis of predictors of business failure", *Journal of Accounting Research*, pp. 167-79.

[9] Godlewski, C., 2005, "Bank capital and credit risk taking in emerging market economies", Journal of Banking Regulation, 6, pp. 128-145.

[10] Goyeau, D. et Tarazi, A., 1992, "Evaluation du risque de défaillance bancaire en Europe", *Revue Economique*, 102, pp. 250-280, mars.

[11] Kim, D. and Santomero, A., 1988, "Risk in banking and capital regulation", Journal of Finance, 43, 5, pp. 1219-1233.

[12] Koehn, M. and Santomero, A., 1980, "Regulation of bank capital and portfolio risk", Journal of Finance, 35, 5, pp. 1235-1244.

[13] Leland, H. and Pyle, D., 1977, "Information asymmetries, financial structure, and financial intermediation", Journal of Finance, 32, 371-387

[14] Molyneux, P. and Thornton, J (1992): Determinants of European bank profitability: A note, Journal of Banking and Finance, 16, pp. 1173-1178.

[15] Ramakrishnan, R. and Thakor, A., 1986, "Information Reliability and a Theory of Financial Intermediation", *Review of Economic Studies*, 51, pp. 415-432.

[16] Santomero, A. and Vinso, J., 1977, "Estimating the probability of failure for commercial banks and the banking system", *Journal of Banking and Finance*, 2, pp. 185-205.

[17] Scott, J., 1981, "The Probability of Bankruptcy: A comparison of Empirical Predictions and Theoretical Models", *Journal of Banking and Finance*, 5, pp. 317-344.

[18] Shrieves, R. and Dahl, D., 1992, "The relationship between risk and capital in commercial bank", *Journal of Banking and Finance*, 16, pp.439-457.

[19] Sinkey, J., 1975, "A multivariate statistical analysis of the characteristics of problem banks", *Journal of Finance*, 30, pp. 21-36.