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Banking Competition, Efficiency and Stability in the MENA Region

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Abstract

The intensification of competition in the banking market following the adoption of financial liberalisation and deregulation policies all over the world has raised questions about their impact on the stability of the banking sectors. This study aims at participating in the continuous debate on how the competition conditions in the market affects the stability of banks in the MENA region. This study exploits a sample of 216 MENA banks operating over the period 1999-2019, and adopts the GMM method to detect the association between banking competition and stability. The empirical results show that market power has a negative effect on banking stability. This result has implications suggesting that the adverse effect of concentration on banking stability implies that regulators should be careful in pushing/encouraging banks consolidate, as this may reduce stability.

Keywords: banking competition, banking efficiency, banking stability, MENA region

1. Introduction

The intensification of competition in the banking market following the adoption of financial liberalisation and deregulation policies all over the world has raised questions about their impact on the stability of the banking sectors as a whole and the performance of individual banks. The market structure measured by the degree of competition and/or by market power can affect not only the behaviour of banks in terms of risk taking but also their efficiency (Yin, 2021). In addition, banking market structures, and in particular the resulting market power, is at the core of banking regulatory policy (Gonzalez, 2022).

The role played by the structure of banking markets – and more specifically the type of prevailing competition – in explaining the stability and efficiency has been the subject of continuous debate in the theoretical and empirical banking literature. In fact, there are two opposing points of view on this subject. The first view emphasises the competition-fragility relationship and argues that higher competition reduces bank market power and profit margins and induces banks to take on more risk and therefore, increases banking instability. On the other hand, a second point of view underlines the competition-stability relationship, and argues that the intensification of competition reduces lending interest rates, as well as moral hazard and adverse selection among borrowers and therefore, reduces loan default rates, which in turn boosts banking stability. Recently, Albaity et al. (2017) and Brei et al. (2020) combine these two views and argue that a U-shaped relationship between competition and stability might exist.

As for the impact of competition on the efficiency of banks, the results of studies tackling this subject diverge considerably. Some studies have concluded the existence of a negative relationship between competition and efficiency (e.g. Maudos and Fernández de Guevara, 2007; Yin, 2021), while conversely, other studies find an improvement in efficiency following the intensification of competition (e.g. Wu et al., 2020; Zarutskie, 2013).

The deregulation policies undertaken in several MENA countries during the 1990s have indeed resulted in an increase in competition in these banking markets. Moreover, the financial reforms adopted by MENA regulatory authorities have considerably altered the number of banks and market structure, where a parallel increase in the number of banks and market concentration has been witnessed. Additionally, the MENA banking sectors witnessed different evolution of banking stability and efficiency following the reform policies and banking and financial deregulations. Hence, the MENA region presents a good case study for examining the association between market structure and bank stability and efficiency, and a particular attention must be given to these changes in the structure of banking markets and the effect of competition on stability and performance of banks in the MENA region. Consequently, this study detects the impact of competition on the efficiency and stability in the MENA region using a sample of 216 banks over the period 1999-2019, and exploiting a system GMM method. The novelty of this research is that it links bank stability with operational efficiency and market power, and show that indeed, the latter are major determinant of the former.

The study continues as follows. The theoretical and empirical literature review is presented in Section 2. The methodology is illustrated in Section 3. The data and sources are presented in Section 4. Section 5 is devoted to the empirical results. Finally, the conclusion is presented in section 6.

2. Competition, Stability and Banking Efficiency: A Review of the Literature

2.1 Competition and Bank Efficiency

At the theoretical level, two competing models based on the industrial economics studies attempt to explain the effects of the structure of banking markets on the performance of the sector: The Structure-Conduct-Performance (SCP) model and The Efficient Structure Theory (ES). The SCP model predicts the behaviour of firms, determined by the structure of the industry, using key factors such as the number of market players, their size and the concentration of suppliers (Hicks, 1935; Bain, 1951; Delis and Tsionas, 2009). According to this model, the quantities and prices of banking products are determined by the degree of competition and concentration in the sector. Concentration reflects a situation of non-competition (or limited competition), which induces the same behaviour and results expected from monopoly or oligopoly markets. In a situation of limited competition or significant market power, some banks are able to extract monopoly rents while maintaining production and pricing levels that are socially suboptimal but compatible with maximum levels of profitability.

On the other hand, the ES hypothesis, attributed to Demsetz (1973) and Peltzman (1977), associates market concentration with greater efficiency of large banks rather than the exercise of market power. It is rather the efficient management of banks that gives them a larger market share and profitability and generates greater concentration (i.e. low competition). A positive relationship between concentration and performance is expected by both paradigms, but they diverge on the causal interpretation of this relationship. The link between the structure of banking markets and efficiency can also be analysed according to the Quiet Life Hypothesis (QLH) theory. The QLH theory, developed by Hicks (1935), assumes that managers will not exhibit profit maximising behaviour in a situation of limited competition. Without competitive pressure, managers are encouraged to reduce their efforts (Selten, 1986) and/or to divert part of the resources to other objectives (Hermalin, 1992). Therefore, according to the QLH, a concentrated market provides banks with monopoly power, which encourages suboptimal behaviour that is harmful to their performance.

The first empirical works analysing the role of market structure on banking efficiency were developed in the United States to support the SCP model (Gilbert, 1984; Gilbert and Zaretsky, 2003). These studies have shown that banks can improve their performance when the sector is concentrated. Other studies that have attempted to characterise the determinants of banking efficiency in certain developed countries have simply introduced a measure of concentration into their model. The conclusions drawn from these works are very contrasting, where some studies conclude a positive relationship between concentration and the cost efficiency of banks (Grigorian and Manole, 2002; Fries and Taci, 2005), while for others the link is rather negative (Dietsch and Lozano-Vivas, 2000). Empirical studies of the SCP paradigm in the case of developing countries are rare and the results are inconclusive. The empirical analysis of the relationship between profitability and the share of assets controlled by the three largest, proposed by Demirguç-Kunt and Huizinga (1999) is certainly the most important. The authors studied a sample of 80 developed and developing countries, over the period 1989 to 1995 and show that the banking concentration ratio is positively linked to bank profitability. Okeahalam (1998) also verifies the SCP hypothesis for a sample of African banks.

Regarding the QLH hypothesis, the empirical work is also marked by much controversy. For instance, Berger and Hannan (1998) find a negative link between market power and efficiency on a sample of American banks from 1980-1989, thus supporting the QLH hypothesis. Delis and Tsionas (2009) obtained the same results on a sample of European and American banks. On the other hand, Maudos and Fernandez de Guevara (2007) show, using a sample of banks from 15 countries of the European Union from 1993-2002, a positive link between market power and cost efficiency, thus rejecting the hypothesis of the QLH. Koetter et al. (2012) confirm the results of Maudos and Fernandez de Guevara (2007) on a sample of 4000 American banks from 1986 to 2006.

Finally, for developing countries, some empirical studies carried out do not support the QLH hypothesis. For example, Williams (2012) finds a positive association between market power and efficiency in a sample of 419 Latin American banks over the period 1985-2010. In addition, Turk Ariss (2010) rejects the QLH hypothesis on a sample of 821 banks from 60 developing countries. Overall, the contradictory results on the link between market power and efficiency could be explained according to the specificities of the study often characterised by different banking structures, but also, according to the differences in the adopted competition indicators and/or market power (structural or non-structural indicators).

2.2 Competition and Bank Stability

The competition-stability relationship has been examined by many theoretical and empirical studies however, this question is still very controversial. The first theoretical stream emphasises the negative relationship between competition and banking stability known as competition-fragility hypothesis. This relationship is based on the franchise value hypothesis, which stipulates that banks are encouraged to reduce their risk taking in order to maintain their market share and therefore their performance (Keeley, 1990). The main argument is that increased competition in the banking market leads to lower intermediation margins, thus encouraging banks to increase their risk taking. (Keeley, 1990; Allen and Gale, 2004). In contrast to this view, the advocates of competition-stability criticise the competition-fragility hypothesis for not taking into account the effect of market shares. Thus, they advocate that a concentrated banking market strengthens market power, which allows banks to increase their interest rates, thus encouraging borrowers to take more risks via a moral hazard effect (Boyd and de Nicoló, 2005).

There is a large literature linking banking competition with measures of bank risk exposure, but the results do not reach consensus. Regarding the competition-fragility view, Beck et al. (2008) define the occurrence of banking crises as an indicator of fragility, and find that the banking concentration ratio (HHI) is negatively related to the probability of banking crisis. As bank competition lowers the profit margins of banks, they are encouraged to make riskier investments in order to increase their profits (Jimenez et al., 2007; Albaity et al., 2019). However, some empirical work suggests, on the contrary, that a more concentrated banking sector could aggravate the instability of the financial system. For instance, Berger et al. (2009) show from a study on Russian banks that a tightening of competition (measured by the Lerner index) increases the frequency of bank failures, which reinforces the view of competition-stability (Boyd and al., 2006; Boyd and De Nicolo, 2015; Anginer et al., 2013; Goetz, 2017). Thus, even at the empirical level, the results do not seem to confirm or invalidate of the two theories.

3. Methodology and Variables

3.1 Measurement of the Level of Competition and Market Power

Many studies linking market power to market concentration, adopt the Herfindahl-Hirschmann ratio (HHI), which is calculated as the sum of the squares of the market shares (ms) of bank (i) at the date (t) according to the following formula:

$$HHI = \sum_{i=1}^{m} (ms_{it})^2 \quad (1)$$

However, the HHI index has many shortcomings: for example, it does not does not take into account the average size of banks, the complexity of the banking sector in terms of varieties of products and activities, the elasticity of demand, among other issues (Ryan et al., 2014). Therefore, we use an alternative measure of market power, the Lerner index, in order to measure the level of competition prevailing in the banking sector, which takes into account the competitive banking environment and has the advantage of capturing the market power of each bank. Conventionally, Lerner's market power indicator is the difference between the price set by the bank (i) at the date (t) and the marginal cost relative to the price:

$$lerner = \frac{p_{it} - cm_{it}}{p_{it}} \quad (2)$$

The price p_{it} can be calculated by taking the ratio between the annual income and the total assets of the bank. The index takes values between 0 and 1. A value of 0 reflects pure and perfect competition since the prices of banking products and services are equal to the marginal cost. Conversely, the existence of market power for banks makes the value of Lerner index tend towards 1. Eventually, the Lerner index decreases with the increase in the degree of banking competition (Phan et al., 2019).

To estimate the marginal cost, we adopt the conventional approach proposed by the literature (Turk Ariss, 2010; Khan et al. 2017; Risfandy et al., 2020). Thus, assuming that the flow of banking products and services is proportional to the size of banks' total assets, we consider total assets as the only indicator of banking activity. The bank cost function used to calculate the Lerner index is based on a translog function taking the following form:

$$Ln(C_{it}) = \alpha_0 + \alpha_1 Ln(TA) + \sum_{j=1}^{3}\eta_j Ln\left(w_{j,it}\right) + \frac{1}{2}\sum_{k=1}^{3}\sum_{l=1}^{3}\phi_{kl} Ln\left(w_{k,it}\right) Ln\left(w_{l,it}\right) + \frac{1}{2}\alpha_2 Ln\left(TA_{it}\right)^2 + \sum_{k=1}^{3}\theta_k Ln\left(w_{k,it}\right) Ln\left(TA_{it}\right) + \varepsilon_{it} \quad (3)$$

Thus, a single output $\left(TA\right)$ and three inputs $\left(w_1, w_2, w_3\right)$ are used to estimate the translog cost function (Chen et al. 2005; Jiang et al. 2009; Turk-Ariss, 2010; Yin, 2021). In Equation (3), the variable $\left(TA\right)$ represents the bank's total assets and $\left(w\right)$ the prices of the various inputs or factors of production. The three inputs used are interest paid on deposits, staff costs and administrative costs. On the other hand, the prices of inputs are: the price of financial capital $\left(w_1\right)$ measured by the ratio between interest expenses and customer deposits; the price of labour factor $\left(w_2\right)$ is proxied by the ratio between personnel expenditure and total assets; finally, the price of physical capital $\left(w_3\right)$ is measured by the ratio between administrative expenses and total assets.

Restrictions on the parameters must be applied, so that the properties of the cost function (symmetry and linear homogeneity in prices) are respected:

$$\phi_{kl} = \phi_{lk}\,; \ \sum \eta_j = 1\,; \ \sum \phi_{kl} = 0$$

The estimation of the cost function, taking into account the conditions of symmetry and homogeneity for the price coefficients, allows calculating the marginal cost by deriving the total costs from the total assets (TA). The marginal cost $\left(cm\right)$ is given by Equation (4):

$$Cm_{it} = \frac{\partial C_{it}}{\partial TA_{it}} = \left[\alpha_1 + \alpha_2 Ln\left(TA\right) + \sum_{k=1}^{3}\theta_k Ln\left(w_{k,it}\right)\right] \times \frac{C_{it}}{TA_{it}} \quad (4)$$

Thus, the Lerner index that allows assessing the degree of competition and/or the market power of banks in the MENA region can be calculated as follows:

$$lerner = \frac{p_{it} - cm_{it}}{p_{it}}$$

Where p_{it} represents the ratio of annual income to total assets of bank $\left(i\right)$ and cm_{it} represents the marginal cost obtained from Equation (4).

3.2 Measurement of the Level of Efficiency

The studies on cost efficiency uses either linear programming approaches known as data envelopment analysis (DEA) or econometric approaches known as stochastic parametric frontiers. These two approaches are detailed respectively in the following sub-sections.

The first so-called “non-parametric approach” stems from the work of Farrell (1957). It has the advantage of not imposing a functional form on the production or cost function defining the efficiency frontiers. According to this approach, the frontiers are constructed using linear programming to solve the primal and dual optimisation problems.[1] Two versions of the DEA method are proposed in the literature (Charnes et al., 1978; Banker et al., 1984). The first version makes the assumption of constant returns to scale while the second assumes variable returns to scale. However, the DEA method suffers some criticism because random errors on the data can make the estimation of the frontier biased (Coelli et al., 2005). Moreover, it is difficult to perform statistical tests when calculating the level of efficiency using this approach. This is why we will use in our work the parametric approach of stochastic cost frontier in order to measure the cost efficiency of banks in the MENA region. This approach makes it possible to distinguish the effects of measurement errors from the effects of inefficiency and

[1] The primal problem aims at optimally increasing the volume of output, while the dual problem aims to reduce the relative prices of the inputs used to obtain the optimal volume of output.

thus, takes into account the presence of exogenous shocks (Stevenson, 1980; Battese and Coelli, 1988; Kumbhakar and Lovell, 2000). Hence, the error is broken down into two terms: a component that reflects inefficiency and a random component that combines measurement errors and exogenous shocks (Battese and Coelli, 1988). On the other hand, the method is less sensitive to outliers. However, this approach suffers from two drawbacks. The first concerns the choice of functional function adopted to measure the cost efficiency of banks (arbitration between less flexible functional forms such as the Cobb-Douglas function and the CES function) and more flexible forms (Leontief and Translog). The second drawback concerns the sample size: this approach often gives biased results when applied to small samples (Coelli et al., 2005). To ensure the flexibility of our cost function, we adopt a functional form of the Translog type very close to that of Equation 3.

The empirical literature offers two types of approaches to define the production activity of banks: the production approach and the intermediation approach. The production approach considers that banks produce various categories of deposits, loans and other services using factors such as physical capital, labour, etc. (Benston, 1965; Bell and Murphy, 1968). On the other hand, the intermediation approach considers banks to transform short-term resources (bank deposits) into long-term assets (loans) using labour, physical capital and sometimes equity (Sealey and Lindley, 1977; Berger and Mester, 1997). Following Berger and Mester (1997), DeYoung et al. (2001), Phan et al., (2019), we use the intermediation approach to estimate the cost function. Our choice is justified by the fact that, in the MENA region, banks use the available deposits to engage in loan activity. In addition, the intermediation function is more conclusive in the MENA region, as evidenced by the credit/deposit ratio or the net interest margin.

The stochastic cost function can be specified as follows:

$$\begin{aligned} Ln(C_{it}) = \alpha_0 + \sum_{i=1}^{3}\beta_i Ln(y_{it}) + \sum_{j=1}^{3}\eta_j Ln\left(w_{j,it}\right) + \frac{1}{2}\sum_{k=1}^{3}\sum_{l=1}^{3}\phi_{kl} Ln\left(w_{k,it}\right) Ln\left(w_{l,it}\right) + \\ \frac{1}{2}\sum_{i=1}^{3}\sum_{m=1}^{3} Ln\left(y_{it}\right) Ln\left(y_{mt}\right) + \sum_{k=1}^{3}\theta_{ij} Ln\left(w_{it}\right) Ln\left(_{jt}\right) + \varepsilon_{it} \end{aligned} \tag{5}$$

where:

C_{it} represent the bank total cost;

y_{it} represents the outputs of the bank;
w_{it} represents the prices of the factors of production;

$\varepsilon_{it} = u_{it} + v_{it}$ represents the error term.

The error term includes two components: u_{it} reflects the inefficiency factor that increases the cost above the minimum cost and v_{it} designates the error term not controllable by the banks.

Based on the work of Berger and Mester (1997), Turk-Ariss (2010), Rakshi and Bardhan (2022), three outputs are retained to define the production activity: total earning asset $\left(y_1\right)$, other earning asset $\left(y_2\right)$ and off balance sheet activities $\left(y_3\right)$. These three outputs are achieved from the use of three inputs, namely interest expenses, personnel expenses and administrative expenses. The prices of these three inputs are: the price of financial capital $\left(w_1\right)$ measured by the ratio between interest expenditure and consumer deposits; the price of the labour factor $\left(w_2\right)$ approximated by the ratio between personnel expenditure and total assets; finally, the price of physical capital $\left(w_3\right)$ measured by the ratio between administrative expenses and total assets.

3.3 Measurement of Banking Stability

This study resort to exploiting a widely used risk measure in the literature, which is the Z-score that measures the likelihood of a bank becoming insolvent. In this case, bankruptcy is only a probability. The Z-score is defined as the sum of the return on assets and the ratio of equity to total assets, divided by the standard deviation of the return on assets (Boyd et al., 2006). A high Z-score implies a low probability of bankruptcy and, conversely, a low Z-score means a higher probability of bank instability. According to Schaeck and Cihak (2008), measuring bank insolvency risk using bank data such as Z-score improves statistical power compared to other indicators. The Z-score is also preferred because it reflects the overall level of risk covering the level of profitability, the level of capitalisation and the variability of asset returns (Beck et al., 2008). In addition to all these advantages, this indicator being a probabilistic method is more suited to our time horizon.

Following Boyd et al. (2006), Uhde and Heimeshoff (2009), Lepetit et al. (2021), we use the Z-score to approach banking stability. Formally, it is defined by the following formula:

$$Z-score=\frac{\left(ROA+CAR/TA\right)}{\sigma_{ROA}}$$

where (ROA) designates the return on assets, (CAR/TA) represents the ratio of equity to total assets and (σ_{ROA}) the standard deviation of ROA. The Z-score increases with profit and capitalisation level and decreases with return on assets volatility. Thus, a higher value of Z-score indicates a lower risk profile for the bank and higher banking stability.

The model used to establish the link between competition, risk and efficiency is based on the work of (Jimenez et al., 2007; Corbae and Levine, 2018; Albaity et al., 2019; Yin, 2021) and can be written as follows:

$$Z_{it}=\alpha_0+\alpha_1 Z_{it-1}+\alpha_2 Lern_{it}+\alpha_3 Eff_{it}+\alpha_4 X_{it}+\alpha_5\Gamma_{it}+\varepsilon_{it} \quad (6)$$

where Z_{it}, $Lern_{it}$ and Eff_{it} represent the banking stability, market power and efficiency score of banks operating in the MENA region, respectively. We introduce into Equation (6) control variables specific to the banking firm (X) and variables reflecting the macroeconomic and institutional environment (Γ). The choice of these variables is based on empirical work that has studied the relationship between stability, competition and banking efficiency (e.g. Jimenez et al., 2007; Corbae and Levine, 2018; Albaity et al., 2019; Yin, 2021). The specific variables used are the following: the equity ratio, the liquidity ratio, size, profitability and diversification. On the other hand, the economic and environmental variables are represented by the inflation rate, economic growth rate, the control of corruption, political stability and the quality of regulation. Tables 1 presents the definition of the variables used to test the relationship between stability, competition and efficiency of banks in the MENA region.

Table 1. Definition of variables

Variables	Definition	Sources
$Ln(C)$	Logarithm of total cost of the bank	Orbis Bank
TA	Total assets of the bank	Orbis Bank
y_1	Total earning asset	Orbis Bank
y_2	Other earning asset	Orbis Bank
y_3	Off Balance Sheet	Orbis Bank
w_1	Price of deposits measured by the ratio between interest paid and total deposits	Orbis Bank
w_2	Price of the labour factor approximated by the ratio between staff costs and total assets	Orbis Bank
w_3	Price of physical capital measured by the ratio between administrative expenses and total assets	Orbis Bank
Banking stability (LNZ)	$Z-score=\frac{\left(ROA+CAR/TA\right)}{\sigma_{ROA}}$	Orbis Bank. Author calculation
Market power (LER)	$Lern=\frac{p-cm}{p}$ computed through the estimation of the cost function	Orbis Bank. Author calculation
Cost efficiency (EFF)	Computed through the estimation of a cost function	Orbis Bank. Author calculation
Equity ratio (CAR)	Measured by the ratio between equity and total assets	Orbis Bank. Author calculation
Banking liquidity (LIQ)	Measured by the ratio between liquid assets and total assets	Orbis Bank. Author calculation
Size of the bank (SIZE)	Measured by the logarithm of the bank's total assets	Orbis Bank. Author calculation
Banking profitability (ROA)	Measured by the ratio between net profit and total assets	Orbis Bank. Author calculation

Banking diversity (DIV)	Approximated by the ratio between non-interest income and total income	Orbis Bank. Author calculation
Inflation (INF)	Measured by the growth rate of the consumer price index	World Bank
Economic growth(GDPG)	Measured by the growth rate of gross domestic product	World Bank
Control of corruption (COC)	Index that ranges between -2.5 (weak) and +2.5 (strong)	World Bank
Political stability (POS)	Index that ranges between -2.5 (weak) and +2.5 (strong)	World Bank
Quality of regulation (QOR)	Index that ranges between -2.5 (weak) and +2.5 (strong)	World Bank

3.4 Model Specification

The estimation of Equation 6 expressing the relationship between competition, efficiency and banking stability is performed using the system GMM method. This method has the advantage of taking into account the correlation between the endogenous variable and the error term. Panel data econometrics offers two versions of generalised moments. The generalised moments in first difference of Arellano and Bond (1991) and the estimator of the GMM in system of Blundell and Bond (1998). The first estimator is based on the first difference of the variables and thus eliminates the specific effects of the firms, which makes it possible to solve the problems of existence of the associated estimation biases. Although this first difference GMM technique is widely used, it faces the problem of weak instruments. To remedy this problem, Blundell and Bond (1998) proposed the system GMM method, which provides relatively more robust estimates. The econometric quality of the model estimated by the system GMM method is evaluated using two tests, namely the Sargan and/or Hansen instruments validity test, and the test for the absence of second-order autocorrelation of the error terms.

Note that the traditional econometric methods such as the least squares method (e.g. fixed effects model and quasi-generalized least squares) do not allow us to obtain efficient estimates of such a model. In contrast, the generalized panel method of moments (GMM) allows providing solutions to the problems of simultaneity bias, inverse causality between certain variables and possible omitted variables. Moreover, it controls the specific individual and temporal effects. In addition, the use of the GMM and TSLS methods allows solving the problem of endogeneity not only at the level of the dependent variable but also at the level of the other explanatory variables by using a series of instrumental variables generated by the lags of the variables. Finally, it should be noted that both methods have another advantage over traditional regression methods. Indeed, they make it possible to generate the instruments used in the regressions from the explanatory variables, which is not possible with the panel models with fixed or random effects.

Although the estimates made with the GMM method and the TSLS method give robust and efficient parameters in the presence of the dependent variable lagged by a single period, it is necessary to verify the absence of a significant dependence of the errors between the banks of the sample. Hence, we perform the Pesaran (2015) test to analyse the inter-individual dependence of errors between the banks in our panel. The results presented in Table 2 clearly show that, regardless of the used variable, there is an absence of a dependence of the terms of errors between the banks of our sample.

Table 2. Cross-Sectional dependence test

	Statistic	Probability
LNZ	37.64***	0.0000
CAR	28.16***	0.0000
LIQ	52.71***	0.0000
ROA	31.18***	0.0000
SIZE	190.63***	0.0000
LER	78.35***	0.0000
EFF	38.27***	0.0000
NPL	40.37***	0.0000
INF	82.04***	0.0000
GDPG	117.28***	0.0000
COC	79.15***	0.0000
POS	109.17***	0.0000
QOR	89.13***	0.0000

Note: *** denotes significant at the 1% level.

4. Data

This study exploits a sample formed of an unbalanced panel dataset of 216 commercial banks operating in the MENA region over the period 1999-2019. The countries included in the sample are, Algeria, Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Malta, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates. Table 3 presents the descriptive statistics of the variables used to test the relationship between stability, competition and efficiency of banks in the MENA region. Table 4 presents the variables correlation matrix. This matrix reveals the existence of a weak correlation between the variables, suggesting that the inclusion of all these variables in the same model will not pose a multicollinearity problem. With regard to the institutional variables, we note that the correlation is strong between corruption, political stability and the quality of regulation. It is therefore preferable not to include the three institutional variables at the same time in the econometric model.

Table 3. Variables descriptive statistics

	Observations	Mean	Standard Deviation	Minimum	Maximum
LNZ	4324	3.4539	0.8092	1.3075	4.8335
LER	4329	0.0525	0.0349	0.0115	0.2322
EFF	4299	0.3440	0.2310	0.0136	0.9881
CAR	4331	15.1570	1.8372	10.6273	18.8143
LIQ	4323	0.0129	0.0133	-0.0458	0.0582
SIZE	4323	0.0183	0.0152	-0.0109	0.0961
INF	4299	0.0540	0.0835	-0.0248	0.5602
GDPG	4299	0.0420	0.0351	-0.0722	0.2669
COC	4210	-0.0823	0.6437	-1.0579	1.2579
POS	4210	-0.5702	0.8882	-2.0493	1.3201
QOR	4210	0.0692	0.5815	-1.2891	1.3430

Source: Orbis Bank and author calculation.

Table 4. Variables correlation matrix

	CAR	Eff	DIV	INF	LERN	LNZ	LIQ	ROA	SIZE	GDPG
CAR	1									

Eff	0.018	1								
	0.259	-----								
DIV	0.322	-0.039	1							
	0.000	0.006	-----							
INF	0.038	-0.096	-0.007	1						
	0.006	0.000	0.634	-----						
LERN	0.022	-0.148	0.113	0.107	1					
	0.316	0.000	0.000	0.000	-----					
LNZ	0.182	0.176	-0.068	-0.285	-0.117	1				
	0.000	0.000	0.000	0.000	0.000	-----				
LIQ	0.091	-0.127	-0.149	0.092	-0.019	0.061	1			
	0.000	0.000	0.000	0.000	0.079	0.001	-----			
ROA	0.271	0.109	0.347	0.002	-0.062	0.085	-0.082	1		
	0.000	0.000	0.000	0.845	0.000	0.000	0.000	-----		
SIZE	-0.158	0.272	-0.082	0.024	-0.137	0.029	-0.406	0.021	1	
	0.000	0.000	0.000	0.471	0.000	0.025	0.000	0.261	-----	
	0.064	0.028	-0.137	-0.082	-0.019	0.084	0.027	0.028	0.036	1
GDPG	0.127	0.001	0.328	-0.01	0.257	0.003	0.106	0.01	0.05	-----
Correlation between the institutional variables										
COC	1									

QOR	0.793	0.852	1							
	0.000	0.000	-----							
POS	0.775	0.697	0.638	1						
	0.000	0.000	0.000	-----						

Source: Orbis Bank and author calculation.

5. Empirical Results and Analysis of Results

5.1 Analysis of Efficiency and Competition in the MENA Banking Sectors

The analysis of cost efficiency scores from the parametric method (Table 5) shows a degree of cost efficiency of 85% on average in the entire sample over the period 1999-2019. This means that on average, banks in the MENA region could produce the same amount of output by reducing their costs by 15%. This score is close to that found previously in the MENA region by Olson and Zoubi (2011), Otero et al. (2020) and Chaffai (2020). On the other hand, a certain disparity is observed on the average levels of cost efficiency depending on the country. Indeed, banks operating in Jordan, Kuwait, Oman, Saudi Arabia, Tunisia and Qatar record the highest cost efficiency scores (over 90% on average). On the other hand, the weakest performance is recorded in the Egyptian, Lebanese and Algerian banking sectors (nearly 68% on average). This divergence in the level of efficiency can be explained by factors specific to each bank but also by environmental factors beyond the control of managers, which translates for some banks into good cost control and for others into misallocation of resources (Haque and Brown, 2017; Phung, 2022; Anh, 2022).

The analysis of average levels of market power over the studied period reveals that the banking sector of all MENA countries is close to a monopolistically competitive market structure with an estimated Lerner index of 0.15 (Table 6). These results are consistent with those obtained in the empirical literature on market power (Mirzaei, 2013; Yin, 2021; Mateev and Bachvarov, 2021). On country level, the figures reveal that the banking sectors in our sample are also close to a non-competitive market structure with scores that vary from an average of 0.05 to 0.32. However, the degrees of market power vary between different countries. Specifically, the banking sectors of the United Arab Emirates, Algeria, Israel, Jordan, Lebanon, Morocco, Saudi Arabia and Tunisia are on average the most competitive markets in our sample (with Lerner index varying between 0.05 and 0.09). On the other hand, the lowest level of competition was recorded by Bahrain, Kuwait, Malta, Oman and Turkey (with market power index varying between 0.18 and 0.32).

Table 5. Evolution of cost efficiency of the MENA banks (1999-2019)

	BH	AL	EG	IS	JO	KU	LB	MR	MA	ML	OM	QA	SA	TN	TR	UAE	Sample mean
1999	0.86	0.68	0.72	0.85	0.86	0.84	0.73	0.86	0.88	0.89	0.73	0.98	0.96	0.86	0.74	0.73	0.82
2000	0.85	0.73	0.73	0.86	0.86	0.81	0.71	0.80	0.88	0.89	0.74	0.99	0.90	0.85	0.82	0.68	0.82
2001	0.84	0.61	0.70	0.82	0.85	0.89	0.70	0.80	0.81	0.84	0.83	0.99	0.92	0.86	0.78	0.73	0.81
2002	0.71	0.58	0.64	0.82	0.87	0.81	0.69	0.84	0.70	0.80	0.90	0.98	0.94	0.86	0.71	0.74	0.79
2003	0.68	0.52	0.60	0.83	0.90	0.96	0.66	0.85	0.63	0.83	0.89	0.94	0.94	0.87	0.73	0.73	0.78
2004	0.74	0.54	0.63	0.86	0.90	0.87	0.64	0.82	0.74	0.82	0.84	0.93	0.96	0.84	0.79	0.76	0.79
2005	0.75	0.57	0.61	0.89	0.89	0.91	0.62	0.85	0.88	0.84	0.79	0.91	0.99	0.87	0.69	0.75	0.80
2006	0.74	0.56	0.62	0.88	0.90	0.97	0.60	0.89	0.91	0.86	0.87	0.94	0.97	0.87	0.86	0.77	0.83
2007	0.73	0.54	0.62	0.80	0.91	0.96	0.63	0.83	0.93	0.82	0.89	0.99	0.98	0.85	0.82	0.75	0.82
2008	0.77	0.57	0.69	0.88	0.87	0.94	0.64	0.83	0.87	0.81	0.88	0.87	0.96	0.87	0.85	0.71	0.81
2009	0.81	0.55	0.65	0.78	0.87	0.96	0.49	0.76	0.90	0.93	0.93	0.91	0.96	0.91	0.91	0.84	0.82
2010	0.92	0.54	0.73	0.76	0.88	0.97	0.71	0.78	0.91	0.97	1.01	0.94	0.94	0.96	0.85	0.81	0.86
2011	0.97	0.58	0.83	0.78	0.85	0.98	0.69	0.87	0.81	0.95	0.97	0.98	0.92	0.95	0.74	0.82	0.86
2012	0.98	0.51	0.70	0.95	0.90	0.95	0.66	0.85	0.92	0.93	0.98	0.97	0.99	0.94	0.84	0.85	0.87
2013	0.97	0.68	0.70	0.95	0.93	0.96	0.63	0.86	0.94	0.94	0.94	0.99	0.96	0.94	0.79	0.87	0.88
2014	0.93	0.81	0.69	0.71	0.94	0.98	0.64	0.95	0.92	0.90	0.99	0.93	0.97	0.91	0.76	0.91	0.87
2015	0.96	0.95	0.72	0.86	0.91	0.99	0.68	0.86	0.83	0.94	0.97	0.93	0.94	0.96	0.67	0.83	0.87
2016	0.98	0.89	0.87	1.01	0.99	0.98	0.78	0.93	0.98	0.96	0.93	0.98	0.96	0.99	0.72	0.92	0.93
2017	0.98	0.91	0.87	0.95	1.00	0.94	0.82	0.82	0.95	0.99	0.95	0.95	0.98	0.98	0.84	0.90	0.93
2018	0.97	0.97	0.87	0.95	0.97	1.00	0.78	0.84	0.95	0.95	0.97	0.95	0.97	0.95	0.81	0.93	0.93
2019	0.98	0.92	0.87	0.97	0.98	0.97	0.79	0.87	0.96	0.95	0.97	0.97	0.97	0.97	0.79	0.92	0.93
Mean	0.86	0.68	0.72	0.87	0.91	0.94	0.68	0.85	0.87	0.89	0.90	0.95	0.96	0.91	0.79	0.81	0.85
SD	0.12	0.23	0.15	0.11	0.12	0.13	0.06	0.00	0.07	0.06	0.24	0.03	0.01	0.11	0.05	0.19	0.10

Source: Orbis Bank and author calculation. Notes: SD = standard deviation. BH = Bahrain, AL = Algeria, EG = Egypt, IS = Israel, JO = Jordan, KU = Kuwait, LB = Lebanon, MR = Morocco, MA = Mauritania, ML = Malta, OM = Oman, QA = Qatar, SA = Saudi Arabia, TN = Tunisia, TR = Turkey, UAE = United Arab Emirates.

Table 6. Evolution of market power in the MENA banks (1999-2019)

	BH	AL	EG	IS	JO	KU	LB	MR	MA	ML	OM	QA	SA	TN	TR	UAE	Sample mean
1999	0.11	0.05	0.16	0.05	0.09	0.06	0.10	0.07	0.08	0.04	0.06	0.07	0.04	0.09	0.16	0.06	0.08
2000	0.11	0.04	0.14	0.05	0.08	0.05	0.10	0.08	0.08	0.05	0.06	0.05	0.04	0.08	0.13	0.05	0.08
2001	0.11	0.04	0.11	0.05	0.07	0.05	0.09	0.08	0.09	0.05	0.05	0.05	0.05	0.08	0.12	0.05	0.07
2002	0.12	0.04	0.11	0.05	0.08	0.04	0.09	0.08	0.08	0.05	0.05	0.03	0.04	0.08	0.12	0.05	0.07
2003	0.12	0.04	0.11	0.06	0.08	0.04	0.09	0.08	0.07	0.05	0.05	0.04	0.03	0.08	0.12	0.05	0.07
2004	0.12	0.04	0.12	0.07	0.08	0.04	0.09	0.09	0.07	0.05	0.05	0.94	0.03	0.07	0.11	0.05	0.13
2005	0.12	0.04	0.11	0.08	0.07	0.04	0.08	0.09	0.07	0.05	0.05	0.04	0.03	0.07	0.13	0.06	0.07
2006	0.06	0.05	0.11	0.10	0.07	0.05	0.08	0.08	0.07	0.06	0.05	0.04	0.03	0.06	0.13	0.05	0.07
2007	0.06	0.05	0.09	0.06	0.07	0.05	0.08	0.09	0.07	0.07	0.06	0.06	0.04	0.06	0.12	0.06	0.07
2008	0.07	0.05	0.10	0.08	0.08	0.06	0.09	0.08	0.08	0.06	0.06	0.07	0.04	0.07	0.15	0.06	0.08
2009	0.09	0.06	0.12	0.08	0.09	0.96	0.08	0.08	0.09	0.09	0.06	0.07	0.07	0.08	0.18	0.05	0.14

2010	0.10	0.05	0.13	0.07	0.09	0.09	0.10	0.08	0.10	0.07	0.06	0.06	0.08	0.07	0.19	0.06	0.09
2011	0.97	0.05	0.13	0.07	0.08	0.98	0.09	0.07	0.08	0.95	0.06	0.06	0.08	0.07	0.17	0.06	0.25
2012	0.06	0.05	0.13	0.11	0.06	0.96	0.08	0.08	0.09	0.93	0.06	0.98	0.06	0.07	0.18	0.05	0.25
2013	0.05	0.06	0.12	0.09	0.06	0.06	0.08	0.09	0.94	0.94	0.06	0.03	0.05	0.07	0.22	0.04	0.19
2014	0.05	0.06	0.12	0.09	0.07	0.07	0.09	0.09	0.10	0.06	0.07	0.04	0.05	0.07	0.27	0.04	0.08
2015	0.09	0.08	0.14	0.08	0.08	0.08	0.10	0.10	0.10	0.06	0.98	0.05	0.06	0.08	0.34	0.04	0.15
2016	0.98	0.11	0.16	0.14	0.10	0.99	0.11	0.10	0.12	0.96	0.94	0.08	0.08	0.07	0.68	0.06	0.35
2017	0.11	0.09	0.15	0.12	0.12	0.94	0.12	0.11	0.13	0.07	0.96	0.95	0.09	0.07	0.30	0.08	0.28
2018	0.10	0.08	0.14	0.12	0.13	0.12	0.12	0.12	0.13	0.95	0.97	0.95	0.09	0.07	0.47	0.07	0.29
2019	0.10	0.09	0.15	0.13	0.12	0.98	0.12	0.11	0.13	0.96	0.98	0.98	0.09	0.07	0.49	0.07	0.35
Mean	0.18	0.06	0.13	0.08	0.08	0.32	0.09	0.09	0.13	0.31	0.27	0.27	0.06	0.07	0.23	0.06	0.15
SD	0.01	0.05	0.02	0.07	0.03	0.92	0.01	0.04	0.04	0.91	0.92	0.91	0.04	0.02	0.32	0.01	0.21

Source: Orbis Bank and author calculation. Notes: SD = standard deviation. BH = Bahrain, AL = Algeria, EG = Egypt, IS = Israel, JO = Jordan, KU = Kuwait, LB = Lebanon, MR = Morocco, MA = Mauritania, ML = Malta, OM = Oman, QA = Qatar, SA = Saudi Arabia, TN = Tunisia, TR = Turkey, UAE = United Arab Emirates.

5.2 Relationship between Efficiency, Competition and Banking Stability

Firstly, the results included in Table 7 show that the non-significant values of the Sargan test suggest the validity of the used instruments. In addition, the Arellano and Bond autocorrelation test indicates the absence of second-order autocorrelation. In addition, the significant values of the one period lagged banking stability confirm the persistence of banking soundness and the dynamic nature of the model exploited to establish the relationship between stability, efficiency and market power of banks operating in the MENA region.

Table 7. Results of the estimation of the relation between stability, efficiency and market power of MENA banks

	MODEL 1	MODEL 2	MODEL 3
LNZ(-1)	0.447***	0.586***	0.638***
CAR	0.372***	0.483***	0.528***
EFF	0.053**	0.047**	0.043**
LIQ	0.0017	0.0037	0.0056*
DIV	-0.074**	-0.059**	-0.082**
ROA	0.219***	0.371***	0.357***
SIZE	-1.397***	-0.985***	-1.207***
LERN	-0.386**	-0.295**	-0.377**
GDPG	0.013	0.059*	0.048*
INF	0.0172	-0.0155	-0.0186
COC	0.078**		
QOR		0.065**	
POS			0.083**
Sargan test (P-Value)	0.275	0.457	0.428
AR (1)	0.027**	0.018	0.025**
AR (2)	0.38 †	0.42 †	0.37 †
Number of observations	3815	3827	3769

Note: see Table 1 for variable definitions. ***, **, and * denote significant at the 1%, 5% and 10% levels respectively. (? denotes non-rejection of the hypothesis of absence of second-order autocorrelation.

Regarding the bank-specific variables, the results obtained are mostly as expected. We note, in fact, that the capital adequacy ratio (CAR) has a positive and significant effect on banking stability. This result is consistent with those obtained by Fang et al. (2014), Ozili (2018) and Al Shboul et al. (2020). Thus, banks operating in the MENA region must maintain a high capital adequacy ratio in order to reduce the risk of insolvency. Berger (1995), Pasiouras and Kosmidou (2007) and Dietrich and Wanzenried (2014) argue that more capitalised banks are stronger and operate more efficiently than poorly capitalised ones. In line with our expectations, the results indicate a positive and significant relationship between cost efficiency (EFF) and banking stability. This result is explained by the fact that the efficient use of factors of production and the proper monitoring of the activity of granting credits should result in a control of production costs, a reduction in risk-taking, an improvement in cost efficiency and eventually, an increase in banking stability, which is in line with the results of Berger and Deyoung (1997), Fiordelisi et al. (2011) and Tan and Floros (2013).

Bank liquidity (LIQ) measured by the liquid assets-to-total assets ratio is positively associated with banking stability in the three estimated specifications. However, it is only significant in the third regression. This result is consistent with those of Berger et al. (2009) and Berger and Bouwaman (2013) and indicates that a high level of liquidity should be accompanied by a drop in liquidity risk and an increase in bank stability. In other words, holding a high level of liquidity can decrease liquidity risk and help banks reduce the probability of failure.

The results in Table 7 also reveal the existence of a negative and significant relationship between diversification (DIV) and banking stability. Thus, an increase in diversification can result in a reduction in banking stability due, on the one hand, to the volatility of income from diversification, and on the other hand, to the composition of riskier loan portfolios (Stiroh and Rumble, 2006; Acharya et al., 2006; Baele et al., 2007). In fact, the literature on the impact of diversification on banking stability leads to ambiguous results. For example, Rossi et al. (2009) and Kohler (2015) revealed a negative relationship between risk and income diversification, while Shaban et al. (2014) and Baek et al. (2018) found opposing results where income diversification does not seem to have a positive impact on bank stability.

Regarding bank profitability, the various estimated specifications led to a positive and significant relationship between bank stability and the ROA variable. Thus, banks seeking to increase their profitability must reduce their risk taking. This result is consistent with those obtained by Jeon and Lim (2013) and Gupta and Kashiramka (2020).

In contrast to our expectations, the obtained results show a negative and significant link between size and bank stability. This relationship shows that large banks are encouraged to take more risk than small and medium banks, which corroborates the results obtained by Stern and Feldman (2004), Uhde and Heimeshoff (2009), De Jonghe (2010) and Liu et al., (2012). This incentive to risk taking by large banks may result from the problem of moral hazard, which characterises the MENA banking sectors, but also from the “Too Big to Fail” phenomenon highlighted by the concentration observed in the MENA banking sectors. Moreover, we note that the relationship between market power (Lerner) and banking stability is negative and significant, which supports the results obtained by Boyd and De Nicoló (2015), Schaeck and Cihak (2012) and Elfeituri (2022). Thus, this negative relationship between market power and banking stability provides support to the hypothesis destabilising concentration (or stability-competition) and shows that banks are encouraged to finance risky investment projects in order to preserve their market share. To verify the non-linearity between banking stability and market power, we integrated a quadratic term of the Lerner index into the regressions. The results presented in Table 8 show that in the three estimated specifications, a negative relationship of the linear term of market power (Lerner) is observed, while the quadratic term (Lern^2) is positive but not significant. This result suggests the absence of a nonlinear relationship between market power and banking stability, which is not consistent with the results obtained by Boyed and De Nicoló (2005) and Martinez-Miera and Rupello (2010). Thus, an increase in market power (i.e. less competition) reduces banking stability, which validates the concentration-fragility hypothesis, but the non-significant results obtained do not make it possible to determine a threshold from which the relationship between market power and stability banking becomes positive and significant.

Table 8. Verification of the non-linear relationship between competition and banking stability of the MENA banks

	MODEL 1	MODEL 2	MODEL 3
LNZ(-1)	0.439***	0.431***	0.702***
CAR	0.428***	0.429 ***	0.327***
EFF	0.057**	0.049**	0.051**
LIQ	0.0023	0.0016	0.0042*
DIV	-0.058**	-0.049**	-0.073**
ROA	0.197***	0.318***	0.259***
SIZE	-0.937***	-0.985***	-1.207***
LERN	-0.403**	-0.392**	-0.295**
LERN^2	0.004	0.005	0.003
GGDP	0.019*	0.036*	0.052*
INF	0.005	-0.003	-0.007
COC	0.069**		
QOR		0.072**	
POS			0.065**
Sargan test (P-Value)	0.317	0.369	0.377
AR (1)	0.018**	0.029*	0.019**
AR (2)	0.47 †	0.39 †	0.56 †
Number of observations	3815	3827	3769

Note: see Table 1 for variable definitions. ***, **, and * denote significant at the 1%, 5% and 10% levels respectively. (? denotes non-rejection of the hypothesis of absence of second-order autocorrelation.

Concerning the macroeconomic variables, the results highlight the existence of a positive and significant relationship between the growth rate of the economy, which confirms the results obtained in the empirical literature (Pasiouras and Kosmidou, 2007; Kosmidou, 2008; Dietrich and Wanzenried, 2014; Elfeituri, 2022). On the other hand, the results fail to highlight a significant relationship between inflation and banking stability since the three estimated specifications lead to contradicting, yet insignificant, coefficients as shown in Tables 7 and 8.

Finally, the results obtained show the importance of institutional quality in explaining banking stability. Indeed, the three estimated specifications reveal that control of corruption (COC), political stability (POS) and quality of regulation (QOR) affect positively and significantly banking stability. This result confirms the results obtained by Demirgüç-Kunt and Detragiache (1998), Beck et al. (2008), Klom and de Haan (2015) and Elfeituri (2022) and shows that a reduction in corruption, an increase in political stability and an improvement in the quality of regulation positively affect economic growth and banking stability. In other words, an improvement in institutional quality is a necessary condition to ensure a good allocation of resources in order to channel them towards profitable investment projects with low probability of default.

5.3 Robustness Test

Several robustness tests are conducted to test the stability of the results (see Appendix A). The first test (Table 9) consists of estimating the base model using the two-stage least squares (TSLS) method. We then examine the robustness of the results by replacing the Lerner index by the concentration index (C3) and estimating the model using the system GMM method (Table 10). Finally, the last robustness test (Table 11) consists of replacing the Z-score indicator with credit risk measured by the ratio between non-performing loans and the bank's total assets. The results obtained are consistent with those highlighted previously. Overall, we note that concentration (efficiency) negatively (positively) affects banking stability. On the other hand, the results reveal that the index of market power and efficiency affect positively and negatively credit risk, respectively. We also note that the equity ratio has a negative effect on credit risk. Finally, we observe that the TSLS method leads to results similar to those included in Tables 7 and 8, especially with regard to the relationship between market power, efficiency and banking stability.

6. Conclusion, Policy Implications, and Limitations

The objective of this article was to empirically analyse the relationship between efficiency, competition and stability of banks operating in the MENA region. To achieve such an objective, we used the “two-step” approach, which consists firstly of evaluating the cost efficiency scores, the levels of competition and banking stability, and then followed by regression analysis. In the first step, we used the stochastic frontier approach (SFA) to calculate, via a cost function, the efficiency scores and the levels of market power of banks (Lerner index). In the second step, we established a relationship between the selected variables using the system GMM method. Our results show that efficiency, capital ratio, liquidity, profitability and economic growth positively affect banking stability. In contrast, market power, diversification, size and inflation have a negative effect on banking stability. Finally, the results revealed that the improvement of institutional quality leads to an increase in banking stability.

These results have implications for regulatory policy. The adverse effect of concentration on banking stability implies that regulators should be careful in pushing/encouraging banks to adopt consolidation policies as this may reduce banking stability. Consolidation allows banks to acquire more market power and may increase their chances of survival; nevertheless, in order to avoid excessive concentration in the banking sector, regulators must exercise caution when approving these mergers not to set up systemically important banks (Too Big to Fail banks). Second, in an economic and financial environment characterised by high volatility, regulatory authorities must revise the regulations put in place in order to take into account the impact of competition on the fragility of banks. Finally, our results showed that efficiency is considered a determining factor of banking stability. Consequently, the authorities should take into account agency issues that may arise between the different relevant parties. Indeed, the separation between ownership and control of the company generates agency problems. In the banking sector, the opportunistic behaviour of internal stakeholders can be exacerbated by the presence of deposit guarantees, which reduce the incentives for creditors to monitor the management of banks, resulting in a possible fall in performance and excessive risk taking.

This study has a number of limitations. Firstly, we were unable to take into account the effects of the financial liberalisation, which took place in the 1990s on the behaviour of banks in MENA countries. In fact, the individual banking data for the period 1990-1998 are not available, which made it difficult to study the effects of banking reforms on the stability and performance of banks. Secondly, we could not take into account the impact of stock price generation on banking stability due to the absence of market data. Finally, the unavailability of data prevented measuring the insolvency of banks using other methods such as the distance to default.

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Appendix A

Table A.1: Estimation of relationship between competition, efficiency, and banking stability using the TSLS method

	MODEL 1	MODEL 2	MODEL 3
LNZ(-1)	0.424***	0.563***	0.614***
CAR	0.350***	0.460***	0.505***
EFF	0.033**	0.027**	0.023**
LIQ	0.022*	0.024	0.025*
DIV	-0.093**	-0.079**	-0.101**
ROA	0.198**	0.349***	0.335***
SIZE	-1.409***	-0.999***	-1.220***
LERN	-0.404**	-0.313**	-0.395**
LERN^2	0.024	0.025	0.024
GGDP	0.043	0.088*	0.078*
INF	-0.003	-0.035*	-0.038*
COC	0.058**		
QOR		0.045**	
POS			0.063**
Sargan test (P-Value)	0.357	0.387	0.381
AR (1)	0.032**	0.027**	0.031**
AR (2)	0.43 †	0.46 †	0.29 †
Number of observations	3815	3827	3769

Note: see Table 1 for variable definitions. ***, **, and * denote significant at the 1%, 5% and 10% levels respectively. (? denotes non-rejection of the hypothesis of absence of second-order autocorrelation.

Table A.2. Estimation of relationship between competition, efficiency, and banking stability using the GMM method

	MODEL 1	MODEL 2	MODEL 3
LNZ(-1)	0.372***	0.509***	0.560***
CAR	0.298***	0.407***	0.452***
EFF	0.017**	0.023***	0.027***
LIQ	-0.028*	-0.026*	-0.024
DIV	-0.142**	-0.128*	-0.150**
ROA	0.147**	0.297***	0.283***
SIZE	-1.448***	-1.042***	-1.261***
C3	-0.450***	-0.361**	-0.442***
(C3)^2	-0.004	0.002	0.006
GGDP	0.012	0.138*	0.127*
INF	-0.052*	-0.085*	-0.088*
COC	0.107**		
QOR		0.094**	
POS			0.013**
Sargan test (P-Value)	0.28	0.37	0.32
AR (1)	0.022**	0.015**	0.029**
AR (2)	0.45 †	0.39 †	0.42 †
Number of observations	3815	3827	3769

Note: see Table 1 for variable definitions. ***, **, and * denote significant at the 1%, 5% and 10% levels respectively. (? denotes non-rejection of the hypothesis of absence of second-order autocorrelation.

Table A.3. Estimation of relationship between competition, efficiency, and credit risk using the GMM method

	MODEL 1	MODEL 2	MODEL 3
NPL(-1)	-0.320***	-0.456***	-0.507***
CAR	-0.246***	-0.355***	-0.399***
EFF	-0.017*	-0.026*	-0.022*
LIQ	-0.038**	-0.018*	-0.034**
DIV	0.093**	0.066*	0.072**
ROA	-0.096**	-0.105**	-0.127**
SIZE	0.418***	0.384***	0.502***
LERN	0.497***	0.408***	0.488***
LERN^2	0.002	-0.005	0.003
GGDP	0.009	0.087*	0.076*
INF	0.102*	0.134*	0.137*
COC	-0.156**		
QOR		-0.143**	
POS			-0.062*
Sargan test (P-Value)	0.35	0.42	0.57
AR (1)	0.035**	0.028**	0.049**
AR (2)	0.39 †	0.42 †	0.48 †
Number of observations	3815	3827	3769

Note: see Table 1 for variable definitions. ***, **, and * denote significant at the 1%, 5% and 10% levels respectively. (? denotes non-rejection of the hypothesis of absence of second-order autocorrelation.