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Prudential Regulation and Banking Efficiency in MENA Countries

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For this reason, we used a sample of 146 conventional banks in MENA countries during the 2003-2014 period, whose purpose was to determine the specificities of these countries concerning the determinants of profit efficiency.

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Prudential Regulation and Banking Efficiency in MENA Countries

Nadia Mansour [α] & Ezzeddine Zouari [σ]

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I. Introduction

In recent years, financial crises have multiplied, affecting more and more the financial stability and economic performance of many countries.

In this context, history has shown that the banking system can not remain immune to this instability. Indeed, the financial liberalization, the decommissioning of the credits, the variation of the interest rates has been at the origin of new threats. Also, these developments pose a challenge for both supervisors and banks.

Indeed, since the 1990s, the banking systems have undergone many restructuring resulting in concentration operations. Along with this, they also experienced a significant increase in competition, especially following the deregulation movement and liberalization, Berger and Mester, (1997). Increasingly subject to the different demands of globalization processes and surrounded by an uncertain environment, banks are forced to increase their efficiency to enhance their performance and preserve their sustainability.

As a result, the efficiency of intermediation has become a key element in the success of financial liberalization movements.

Indeed, in a context in which the liberalization of economies has widened the scope and manifestations of competition, banking firms are increasingly subject to the need to improve their productive behavior, Lesueur and Plane (1997).

As is the case with businesses, some banks are considered better than others. Banks' efficiency depends on the quality of their organization, as this allows them to manage effectively the flows where the operations involve transformation. In this context, banks were considered "efficient" when they have a good command of the technical aspects of their activities and therefore come up with the maximum number of services from a minimum level of resources.

Indeed, efficiency was defined as: "An internal measure of company performance, it is very frequently appreciated regarding production, profit or productivity costs and was measured by the number of resources used to produce a unit of goods or services," Johnson & Scholes, (1997). Thus, the analysis of this notion makes it possible to make comparisons between the competitiveness of the banks.

However, this is only the first notion of efficiency in the banking business, as only physical quantities of resources were taken into account. Indeed, a bank was considered technically efficient when it comes to adapting to different constraints that surround it, taking into account risks. Thus, the efficiency of a bank is measured in two ways, firstly, the quality of the organization and position, and secondly, market knowledge.

In recent years, MENA countries have adopted new reforms in the context of financial liberalization and restructuring of the banking system. Therefore, the overarching goal of financial regulation is to push banks to improve the level of liquidity and solvency, Lee and Chih, (2013). To this end, banks are required to put in place strategies involving the optimal allocation of resources and effective monitoring of environmental changes.

Hence the question arises as to the impact of prudential regulations on banks' profit of these countries and the relationship between bank risk and efficiency.

This situation leads us to ask the following questions: *What is the relationship between profit efficiency and banking risks? What is the impact of prudential regulation on bank efficiency?*

The problem developed is that of assessing *the impact of banking regulation in the MENA countries on bank efficiency.*

II. Literature Foundation

There are many researches focus on the determinants of bank efficiency. Among the first studies, there are those of Miller and Noulas (1996), Dietsch and Lozano – Vivas(2000), Grigorian and Manole (2002)...all

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aim to study the effects of environmental variables on bank efficiency.

However, there are other studies more recent, such as the example of Halkos and Salamouris (2004), Fries and Taci (2005), Havrylchyk (2006). The purpose of these latest studies is to explain, from internal and bank-specific variables, the various efficiencies between banks compared to other environmental variables.

Also, as a result of increased globalization and the opening of financial frontiers, banks are continually trying to diversify their income while maintaining a defined level of capital.

The notion of efficiency explains the presence of excessive profits. When firms are efficient, they can gain market share while increasing concentration. As with businesses, bank efficiency could be measured at different levels. However, it is essential to present the concept of profit efficiency.

a) Profit efficiency (Berger and Mester, 1997)

Profit is the broadest concept of efficiency. Maudos and al. (2002) indicate that the profit efficiency calculation offers a source of information for the management of a bank more than the partial vision of the cost efficiency. This type of efficiency refers to the maximization of value while accounting for errors in outputs and inputs. Profit efficiency requires a great deal of managerial attention from the banks, especially about increasing or decreasing the marginal price of income.

There are usually two types of profit boundary modeling in the banking literature. The first type of modeling is the standard profit function (Berger and al, 1993). This function was based on determined product prices, so each bank offers products without reducing them, to increase quantities. However, this assumption is not sufficient when competition is imperfect in banking markets. Indeed, according to Berger and Mester (1997), banks that carry out an activity are obliged to reduce prices and cannot maximize profits.

To solve this problem, other authors like Humphrey and Pulley (1997) proposed an alternative profit function. In this alternative model, the prices of banking products were no longer considered given; it is the quantities that are. As a result, under this approach, banks are expected to have the market power to set their prices. Thus, alternative-profit efficiency incorporates the differences in market power between banks and their ability to exploit them.

The function of the standard profit efficiency is as follows:

$$Ln(\pi + \theta) = f(W, Y, Z, V) + ln\, u_r + ln\, \varepsilon_r \quad (1)$$

With:

The variable π: The price vector of variable outputs

$\ln u_r$: Inefficiency that reduces profit

$\ln \varepsilon_r$: The error variable.

Berger and Mester (1997) take into account all the interests and revenues obtained from the outputs.

In this function, it should been noted that the concept of profit assumes that all banks implement the same type of technology. However, at the practical level, this is unworkable given that foreign banks use more sophisticated than domestic banks. In this context, profit efficiency is the ratio between the current profits of the banks studied and the maximum that can be made by the banks if they are as efficient as the best bank of the sample studied.

This function makes it possible to consider the bank profit efficiency as a portion of the maximum profit generated by the bank that is the best on the market.

Unlike cost efficiency, profit efficiency can be negative, since it is possible that firms waste more than 100% of their substantial profits.

b) Prudential regulation and banking efficiency

Public authorities intervene in the banking field in three forms: prudential regulations, deposit insurance, and central bank interventions as lender of last resort. The adjustments made by these different interventions are often controversial. However, they all revolve around the fragility of banks.

Indeed, most regulatory systems require financial institutions to transfer financial information to supervisory bodies. This situation needs a permanent and high quality work. However, complying with different regulatory rules makes it easier for financial institutions to access external sources of financing such as equity or debt.

In this perspective, several banks have seen an improvement in their financial structure, including an increase in equity. Prudential regulation programs are an external governance system designed to compensate for failures, valuation systems and internal control of banks.

Under this prudential regulation, information asymmetry allows banking organizations and borrowers, regardless of size, institutional form and function in the economy, to behave opportunistically.

In this case, the delegation of control to a regulatory body has the main effect of improving banking efficiency.

Thus, prudential regulations allow all financial institutions to be protected from relative risks because of the nature of their activities while allowing them to avoid the advent of a systemic crisis. The different regulations require them to maintain a certain level of equity and liquidity.

In other words, prudential regulation aims at optimizing the soundness of the banking system to encourage financial institutions to efficiently and

effectively assume the risks related to their activities while having a solid base concerning the different banking risks.

In this framework, economic theory provides many forecasts on the impact of regulatory and supervisory policies on bank efficiency.

Some studies show that a low level of capital increases the risk of bank failure, while a high level can cause unnecessary costs to banks and, as a result, reduce the efficiency of the banking system.

Bath and al. (2006) studied how banking regulation works and how it can affect banking activity. Their research in most countries shows that standard regulation does not improve the efficiency of banks.

However, according to Awdeh and al. (2011), there is a positive correlation between bank profitability and capital increase. For Beltratti and Stulz (2009), banks with higher capital and more stable financing would obtain better results.

Altunbas and al. (2007), Hughes and Mester (1998), emphasized the importance of analyzing the impact of efficiency on risk and capital. They conclude a positive relationship between risk and capital level, which reflects the preference of regulators for a high level of this last by limiting risk-taking activities.

Shepherd and De Young (1997) and Williams (2004) indicated that a decrease in efficiency increases costs because banks do not adequately monitor credits and control expenditures effectively.

Regarding Maudos et al. (2002), higher risk banks present a higher level of profit efficiency. Banks with higher deposit credit ratios are therefore more profitable and less under pressure to control costs.

According to Berger et al. (1993), big banks tend to be closer to the efficient frontier than smaller banks. Indeed, big banks generally have high market power and can, therefore, have their inputs cheaply (Hauner, 2005). However, Cook et al. (2000) found a different result by analyzing the effects of financial liberalization on the efficiency of Tunisian banks. According to this study, big banks are created, first, for political purposes. From where they will grant credits without taking into account their profitability.

For the ratio of costs to revenues, it could be used as a tool in bank performance analyzes when reviewing its operational efficiency. Francis (2004) has shown an inverse relationship between this ratio and profit efficiency. Shehzada and De Haan (2012) found that if the ratio of costs to revenues decreases, managerial efficiency will improve.

Regarding the macroeconomic variables, Athanasoglou et al. (2008), Perry (1992) argued that the variables used are inflation, interest rate, and GDP rates. Revell (1979) introduced the relationship between efficiency and benefit inflation banks. An inflation rate fully anticipated by the bank's management implies that banks can adjust interest rates appropriately to increase their revenues faster than their costs and thus gain higher economic profits. Most studies (Bourke, (1989), Molyneux and Thornton, (1992)) have shown a positive relationship between inflation and long-term interest rate and profit efficiency.

Recently, Demirguc-Kuntand Huizinga (2000) tried to identify the effect of annual GDP growth rates and GDP per capita of bank efficiency. They found a positive relationship between this last and these two macroeconomic indicators.

Regarding the governance indicator developed by Kaufmann and al., (2008) and Kaufmann and al., (2012), the studies conducted by Ciancanelli and Reys (2001) and Lassoued and al. (2015) found a positive relationship between this indicator and the efficiency level of banks.

Also, these studies have focused on developed countries. This observation leads us to propose, on the one hand, a new light on the relationship between banking regulation and banking efficiency, and on the other hand, a relationship between banking efficiency and risks by studying the banking sector in the MENA zone.

c) Measure of efficiency

Generally, banking efficiency could be determined by two types of methods: parametric methods and non-parametric methods (Berger and al., 1993). These two methods were distinguished by the assumptions imposed on the data. A first difference was observed at the modeling level. Then there are the differences in whether random errors were taken into account or not.

On the other hand, non-parametric models were based on the production boundary using linear programming on which all observations were made without necessarily taking into account the functional form of the production function.

Indeed, the DEA or Data Envelopment Analysis approach is one of the nonparametric methods. It was Farell's (1957) work that highlighted this method of measuring bank performance. In recent years, the DEA method has been highly successful, particularly after development and the various modifications made to it, Seiford and Thrall, (1990).

The DEA method of measuring bank efficiency gives banks the opportunity to evaluate their performance by the efficiency frontier. Its purpose is to determine a synthetic and comprehensive measure of the performance of financial institutions that use various resources to create different results.

The purpose of the DEA approach is to synthetically and comprehensively calculate the performance of an organization that implements a multitude of resources with the goal of producing multiple outcomes. As part of a financial institution, the DEA method is used to identify best practices. The

purpose of this is to set the target values and the indicators that will have to appear in the banks' dashboards. Among the main advantages of this approach, we can distinguish:

- The method suitable for a small sample, and that does not require a cost specification a priori,
- The method to ensure simultaneous management of inputs and outputs, and that can distinguish between technical and scale inefficiency.

The DEA model is in the form of a ratio maximization program, as follows, Charnes and al., (1978):

$$Maxw_0 = \frac{u_t Q_0}{V_t X_t} \quad (2)$$

Under the constraints:

$Maxw_0 = \frac{u_t Q_0}{V_t X_t} \leq 1$: For any DMU (Decision Making Units), k = 1, … n.

$u_t, V_t \geq 1$

With

W_0, Q_0, X_t : They represent respectively the efficiency score of the DMU 0, the output vector of the DMU k and the input vector of the DMU k.

U_t, V_t: Represent respectively the weights relating to Q_k, X_k.

n: is the number of DMUs.

Among these various advantages, some authors note that the application of this approach is also appropriate for point-of-sale networks since it had generally based on the principle of comparison. Thus, it gives financial institutions the opportunity to realize the " benchmarking "Internally within the distribution network. Thus, the gap between inefficient banks and the efficiency frontier had determined from an efficiency score. In this context, the efficiency measure is the comparison between the observed values and the optimal values of inputs and outputs, Lovell and al., (1980).

Moreover, this approach is the most used at the level of the banking sector by making it possible to calculate a synthetic measure of performance, Berger and Mester, (1997).

The results of the DEA method could be considered according to two hypotheses: the assumption of constant returns to scale (CRS model) or variable returns to scale (VRS model).

- CRS model (Kalaitzandonakes and al., 1992) considers a sample of K firms, each of which uses M inputs to have N different outputs. The baskets of inputs and outputs are reduced by the DEA method to a couple: fictitious input and fictitious output (Charnes and al., 1978). Hence, for a company in the sample, the mathematical programming model of this measure is as follows:

$$Max_{\alpha,\beta} \ \alpha Y_i / \beta X_i \quad (3)$$

Under constraint: $\alpha Y_i / \beta X_i \leq 1$

For: j = 1.2 ... K

With:

α and β: vectors of the coefficients to be estimated

Y_i and X_i : vectors of inputs and outputs of the company "i".

For each company, this program maximizes the virtual output / virtual input ratio without exceeding 1. Thus, the companies in the sample were necessarily located on or below the efficiency frontier.

According to Coelli and al. (2005), this method assumes that all firms operate on an optimal scale. However, imperfect competition may be, for example, a constraint for this kind of operation.

- VRS model: This method represents an extension of the CRS method. It had first proposed by Banker et al. (1994). The VRS model takes into consideration the assumption of variable returns to scale. Hence, for a company in the sample, and adding a constraint on the intensity parameters of the CRS model, the mathematical programming model of this model is as follows:

$$Min\ \theta \quad (4)$$

Under constraint: $Y\lambda \geq Y_i$ and $\theta X_i - X\lambda \geq$

With:

any θ

λ ≥ 0 and λ is a vector of N * 1 units.

Moreover, in this work, we will use the DEA method according to the VRS model since it makes it possible to test the hypothesis with variable returns of scale. This method is more consistent with the imperfectly competitive environment in which banks operate in the MENA zone.

III. Methodology

From the 1980s, MENA countries began implementing financial liberalization policies as part of

the adjustment plans put in place by the Bretton Woods institutions. These reforms had based on the improvement of monetary policy, the establishment of a prudential framework and the restructuring of the banking system (Touhami and Solhi, 2009).

However, few studies have examined the determinants of bank efficiency in developing countries, particularly countries in the MENA region. Also, it is interesting to study the banking system, which is an essential element in the growth and sustainable development of this area, for many reasons. On the one hand, it is a bridge between Europe and Asia, and on the other hand, the region is experiencing rapid growth regarding population and wealth with a relatively young banking sector.

Also, the selection is focused exclusively on conventional banks, at the level of this study, to avoid the difficulties due to the lack of homogeneity of banking practices (Cihak and Hesse, 2010).

Our sample will cover 146 conventional banks in 17 MENA countries (Algeria, Saudi Arabia, Bahrain, Djibouti, Egypt, United Arab Emirates, Jordan, Kuwait, Lebanon, Malta, Morocco, Oman, Palestine, Qatar, Syria, Tunisia, Yemen) over the period 2003-2014, which gives a panel of 1752 observations.

Indeed, this period is rich in events in the MENA zone going from the Iraq war to The Arab Spring While going through the global financial crisis of 2009. Hence the motivation to work in the MENA zone.

a) Presentation of the model and definition of the variables

Over the last twenty years, the majority of MENA countries have gradually implemented policies to transform their financial and banking landscape with the goal of modernizing their systems to make them more efficient and dynamic. In this framework, and to evaluate the profit-making efficiency of the banks, we used the quality of the assets, the capital ratio, the liquidity ratio, the size and the age of the bank as a control variable.

Thus, the models used for the study of banking risk, inspired by the research of Lee and Chih (2013) and Klomp and Hann (2012), take the following forms:

$$Y = a\,X_t + b\,Y_t + \varepsilon_t\,,\varepsilon_t \sim (N, \sigma_t^2)$$

With:

X_t : Financial determinants

Y_t : Macroeconomic determinants

And:

$$Y\ (\text{profit efficiency}) = a_0 + b_1 * Res_{NPL} + b_2 * CIR + b_3 * LIQ + b_4 * CAR + b_5 * Size + b_6 * Time + b_7 * LDR + b_8 * Res_{LOAN} + b_9 * GDPGR + b_{10} * GDPPC + b_{11} * GDP\ Deflator + b_{12} * Interest\ Rate + b_{13} * Governance + \varepsilon_t$$

Table 1: Description of the variables

		variables	Variable codes	Description	sources
Financial determinants	**Asset quality**	Provision coverage ratio	Res_NPL	Non-performing loans / Gross loan	Bankscope
		Loan loss provision ratio	Res_LOAN	Loan-loss reserves / Gross loan	Bankscope
	Benefit and efficiency	Cost to income ratio	CIR	Costs to Income Ratio	Bankscope
	Liquidity	Current ratio	LIQ	Liquid asset / Short-term funding	Bankscope
		Loan to deposit ratio	LDR	Loans / Deposits & Short-term funding	Bankscope
	Size	Ln (total assets)	SIZE	Ln (total assets)	Bankscope
	Capital adequacy	Capital ratio	CAR	Total regulatory Capital Ratio%	Bankscope
	Variable control	Time	TIME	It is the cumulative year of the establishment time	Bankscope
economic determinants	Macroeconomic variables	Real GDP Growth	GDPGR	Real GDP Growth	World Bank
	Macroeconomic variables	Real GDP per Capita	GDPCP	Real GDP per Capita	World Bank
	Macroeconomic variables	Real Interest Rate	INTEREST RATE	Real Interest Rate	World Bank
	Macroeconomic variables	Inflation	GDP DEFLATOR	Inflation	World Bank
	Macroeconomic variables	Governance Indicator	GOVERNANCE	Average of 6 Governance Indicator (Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption)	World Bank

At the level of this study, we will use the DEA method to calculate profit efficiency. It is based on different inputs and generates several outputs. (Berger and Mester, 1997).

Table 2: Definition of variables "inputs" And "outputs"

variables	Definitions of variables	Descriptions
Input	Fixed asset	Fixed asset
	Funds	Deposits & short-term funding
Input Price	Price of fixed assets	Other operating expenses / fixed assets
	Price of FUNDS	Total interest expenses / Deposits & short-term funding
Output	Total loans	Net loans
	Investment	Other earning assets
Output price	Price of loans	Interest income of loans /
	Price of investment	Other operating income / other earning assets

At this level, it should been mentioned that there are many ways to define and categorize the variables " inputs" And "outputs" in the banking literature for the DEA method. In this study, we adopt the intermediation

approach, Subhass and Abhiman, (2010); Dasa and Ghosh, (2009); Hassan, (2008) to define the inflow and outflow of financial institutions. This approach is best for assessing the importance of efficiency frontier for the profitability of financial institutions, since minimizing total costs and not only those of production is necessary to maximize profits, Iqbal and Molyneux, (2005).

At this level, it should been mentioned that our study consists of estimating models by the Tobit regression method to determine the relationship between financial regulation and profit efficiency since the dependent variable (profit efficiency) is a binary variable.:

$$\begin{cases} 0 : non\ efficient\ bank \\ 1 : efficient\ bank \end{cases}$$

So, the model proposed by Tobin is the following:

$$y_i^* = X_i\beta + \varepsilon_i, \forall_i = 1, \dots N \tag{5}$$

$$y_i \begin{cases} y_i^* & Si\ y_i^* > 0 \\ 0 & Si\ y_i^* \leq 0 \end{cases} \tag{6}$$

With:

$$x_i = \left(x_i^1 \dots x_i^k\right), \quad \forall\, i = 1, \dots, N : A\ vector\ of\ observable\ characteristics$$

$$\beta = (\beta_i \dots \beta_k)' \in R^k : A\ vector\ of\ unknown\ parameters$$

$$\varepsilon_i : \text{Disturbances distributed according to } N(0, \sigma_\varepsilon^2).$$

The model estimates will be made, therefore, by the Tobit model using the maximum likelihood method. The latter is the most used today. We will begin by defining the log-likelihood associated with the simple Tobit model (Bourbonnais, 2015):

$$y_i \begin{cases} y_i^* & Si\ y_i^* = X_i\beta + \varepsilon_i \geq 0 \\ 0 & ifnot \end{cases}, \forall_i = 1, \dots N \tag{7}$$

With:

$$x_i = \left(x_i^1 \dots x_i^k\right), \quad \forall\, i = 1, \dots, N$$

$$\beta = (\beta_i \dots \beta_k)' \in R^k$$

ε_i : Disturbances distributed according to $N(0, \sigma_\varepsilon^2)$.

Consider a sample of N observations yi, denoted y = (y 1 ..., yN). The likelihood of this model is defined by:

$$L(y, \beta, \sigma_\varepsilon^2) = \prod_{i:y_{i=0}} \left[1 - \Phi\left(\frac{x_i\beta}{\sigma_\varepsilon}\right)\right] \prod_{i:y_i>0} \left(\frac{1}{\sigma_\varepsilon}\right) \emptyset\left(\frac{y_i - x_i\beta}{\sigma_\varepsilon}\right) \tag{8}$$

Indeed, the values of the efficiency scores resulting from the DEA method are between 0 and 1, and, consequently, the dependent variable can not follow a normal distribution. Thus, the MCO method will result in biased and inconsistent estimates of parameters, Greene, (1981). In this study, we will, therefore, use the simple and censored Tobit regression model, Fried, Schmidt, and Yaisawarng, (1999), Lin, (2002), Coelli and al., (2005).

In economics, this model had developed by James Tobin (1958), but the term Tobit only appeared in an article by Goldberger and al., (1964).

The first product is similar to that obtained by the Probit model since the two modelizations are identical for the event Y i = 0. Indeed, if one defines a dichotomous variable probit zi such that:

$$z_i \begin{cases} 1 & \text{Si } y_i^* = X_i\beta + \varepsilon_i \geq 0 \\ 0 & \text{ifnot} \end{cases}, \forall_i = 1, \dots N \quad (9)$$

Then, the probability that the variable yi takes positive values takes the following form:

$$Prob(z_i = 1) = Prob\left(\frac{\varepsilon_i}{\sigma_\varepsilon} < \frac{x_i\beta}{\sigma_\varepsilon}\right) = \Phi\left(\frac{x_i\beta}{\sigma_\varepsilon}\right)$$

Hence, the probability that yi takes a value of zero was written as follows:

$$Prob(y_i = 0) = Prob\ (z_i = 0) = 1 - \Phi\left(\frac{x_i\beta}{\sigma_\varepsilon}\right)$$

The second product corresponds to that obtained by the linear model since it is the likelihood of a Gaussian sample. Therefore, the Log-Likelihood was written as follows:

$$Log\ L(y, \beta, \sigma_\varepsilon^2) = \sum_{i:\, y_{i=0}} \log\left[1 - \Phi\left(\frac{x_i\beta}{\sigma_\varepsilon}\right)\right] - \frac{N_1}{2}\log(\sigma_\varepsilon^2) - 1/2\sigma_\varepsilon^2 \sum_{i:\, y_{i>0}} (y_i - x_i\,\beta)^2 \quad (10)$$

To achieve these goals, we adopted the STATA software in its 13th release.

a) The hypotheses

In recent years, the banking environment in the MENA zone has undergone a series of restructuring programs aimed at improving the level of efficiency to align with the international financial landscape.

Indeed, with the succession of financial crises, it is necessary to find indicators capable of measuring the banking efficiency and in particular "profit efficiency" which is the object of this study. At this level, one must also consider an essential element which is the size of the bank and its effect on the level of profit efficiency.

Hence the question underlying this study is whether there is a significant link, on the one hand, between banking regulation and efficiency and, on the other hand, between this last and bank risks for big and small banks in the MENA zone between 2003 and 2014.

- The relationship between asset quality and profit efficiency:

Lee and Chih (2013): The higher the quality of assets, the higher the efficiency level of banks.

H1: Improving the quality of assets has a positive influence on the profit efficiency of banks.

- The relationship between liquidity and banking efficiency:

Ayadi and Pujals (2005), Caprio, D'Apice and al. (2014) and Lee and Chih (2013): liquid assets tend to have low returns. An increase in liquidity ratio may imply a decrease in profit efficiency.

H2: Liquidity has a negative influence on profit efficiency.

- The relationship between the ratio of costs to revenues and "profit efficiency":

Francis (2004), Ghosh and al. (2003) and Shehzada and Haan (2012): an inverse relationship between the cost/income ratio and profit efficiency.

H3: A decrease in the cost/income ratio positively influences banking efficiency.

- The relationship between capital ratio and profit efficiency:

Pessarossi and Weill (2015): A positive relationship between the ratio of capital and profit efficiency. Hence, the capitalized banks are more efficient.

H4: The variable «capital ratio» has a positive influence on "profit efficiency".

- The relationship between macroeconomic variables and "Z-score":

Ciancanelli and Reys (2001) and Lassoued and al, (2015): Global governance indicator developed by Kaufmann et al, (2008.) That refers to the government's ability to formulate and effectively implement of approved policies, has a positive effect on the level of efficiency banks profit.

Demriguc and al., (2000); Athanasoglou and al., (2008): GDPGR and GDPPC have a positive impact on banking efficiency in developed markets.

Lee and Hsieh (2013): A positive relationship between inflation and bank profit efficiency. Indeed, an increase in the rate of inflation pushes banks to charge more profits to customers. Also, the interest rate is positively related to the profit efficiency of the banks. Also, the latter will adjust their interest rates in response to the increase in the general price level to mitigate the negative effect of inflation.

H5: Macroeconomic variables significantly influence profit efficiency.

IV. Empirical Results

This study involves presenting the results of the analysis to examine the impact of asset quality, efficiency, liquidity, prudential regulation, size and time factor on profit efficiency.

Also, we present the significant statistics followed by the models constructed concerning the regression of the variables defined previously on

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conventional banks of the MENA zone with the empirical results obtained and their interpretations.

a) Descriptive analysis of variables and econometric tests

i. *Descriptive statistics*

This study will expose the descriptive analysis of the different variables. The table below gives the mean, the standard deviation, the maximum and the minimum of the variables studied during the study of the previously defined models (see appendix 1).

Indeed, we notice the disparity of the average values of the explanatory variables and their standard deviations. These two variables suggest that the sample structure is not homogeneous and that additional tests are required to select the appropriate estimator.

b) Econometric Tests

We will rely on econometric following: Multicollinearity test, stationarity test, and heteroscedasticity test.

i. *Multicollinearity test*

According to Bourbonnais (2009) to decide on a problem of collinearity between the independent variables included in a regression model, it is necessary that the correlation coefficient exceeds the order of 0.7.

Examination of the correlation matrix and the VIF test (see Appendix 2 and 3) highlights the absence of a multicollinearity problem.

ii. *Stationarity test*

To do this, we would be based on the Dickey-Augmented Float (ADF) and Phillips-Perron (PP) tests.

Table 3: ADF & PP tests

Variables	ADF		PP	
	In level	Indifference	In level	Indifference
Vrs (profit efficiency)	0.0197 ** (With variation)			0.0146 **
RES_NPL	0.0064 ***		0.0072 ***	
RES_Loan	0.0002 ***		0.0002 ***	
CIR	0.0271 ** (with variation)			0.02 ** (with trend)
LIQ		0.02011 ** (With trend)	0.02507 **	
LDR	0011 **		0011 **	
CAR	0.0244 **		0.0220 **	
SIZE		0.0763 *		0.08 099 *
GDPGR	0.0127 ** (with trend)		0.0127 ** (with trend)	
GDPPC	0.02163 **		0.02163 **	
INTEREST RATE	0.0009 ***		0.0002 ***	
GDP DEFLATOR	0.0021 ***		0011 **	
GOVERNANCE	0.0000 *** (with trend)		0.0535 * (with trend)	

*Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.*

This results show that some of the variables were stationary in level for the two tests ADF & PP and others were stationary in difference.

iii. *Heteroscedasticity test*

This is to test the variance of the standardized residuals is constant or homosedasticity, Evrard and al., (2003).

To do this, we adopted the "Breush-Pagan" test, the value of chi2 displays a value of 101.05 having a level of significance of 0.000 below the critical threshold of 5% (see Appendix 4). This leads us to reject the hypothesis of homoscedasticity and to confirm the presence of a problem of heteroscedasticity. To solve this problem, the estimation of the model will be carried out by the Robust command.

c) The results of the estimates

The results of the Tobit model estimation using the maximum likelihood method, with the Robust command, are:

Table 4: The results of the estimates

variables	Global Model				Big Banks				Small Banks			
	Coefficient	dy / dx	T-statistic	p-value	Coefficient	dy / dx	T-statistic	p-value	Coefficient	dy / dx	T-statistic	p-value
TIME	0.0005756	0.0005738	0.82	0. 410	-0.000258	-0.000258	-0.59	0. 555	0.0008325	0.0008299	1.16	0246
CAR	-0.001186	-0.001183	-0.66	0. 510	-0.000551	-0.000551	-0.73	0. 46 5	-0.00180	-0.001802	-1.02	0310
RES-NPL	0.0014884	0.0014838	0.69	0. 490	0.0032729	0.0032729	2.18	0.0 29	0.001292	0.001288	0.61	0542
RES-LOAN	-0.009154	-0.009126	-2.64	0008	-0.001306	-0.001306	-0.71	0. 478	-0.009424	-0.009395	-2.70	0007
CIR	0.0013378	0.0013337	3.19	0001	-0.002048	-0.002048	-1.84	0.0 67	0.0011982	0.0011944	3.20	0001
LDR	0. 1185905	0.1182257	1.91	0056	-0.017611	-0.017611	-0.36	0. 722	0. 1281606	0.1277617	2.05	0041
LIQ	-0.002101	-0.002095	-2.57	0011	-0.000317	-0.000317	-0.36	0. 716	-0.002187	-0.002180	- 2.72	0007
size	0.0196312	0.0195708	2.35	0019								
Interest Rate	0.001875	0.0018693	0.70	0. 486	0.0020501	0.0020501	2.04	0.0 42	0.0018739	0.0018681	0.69	0489
Inflation	0.0006727	0.0006706	0.23	0. 819	0.0029005	0.0029005	2.04	0.0 42	0.0005569	0.000552	0.19	0850
GDPGR	0.0118787	0.0118422	3.11	0. 002	-0.000074	-0.000074	-0.09	0. 925	0.0114105	0.11375	2.98	0003
GDPPC	-1.13e-06	-1.13e-06	-1.25	0.21 2	5.21e-07	5.21e-07	0.87	0385	-7.22e -07	-7.20e-07	-0.80	0424
Governance	-0.000904	-0.000901	-0.03	0.976	-0.034845	-0.034845	-0.78	0. 436	-0.010577	-0.010544	-0.36	0719
Constant	0.6845371		6.10	0.000	1.055496		15.73	0.0000	0.842538		10.81	0.000

For the global model:

The size variable was positively related to profit efficiency. This result corroborates with the studies of Altunbas et al. (2007) who argue that big banks are more efficient than small banks. Indeed, the largest banks have better asset portfolio management as well as better performance when choosing investment projects. Any increase of one unit of this variable, will increase the probability that the bank will be efficient of 1.96312%.

For the RES-LOAN variable, it had negatively related to the profit efficiency score. This result contrasts the findings of Lee and Chih (2013). This result means that any decrease of one unit of the variable RES-LOAN will generate a decline in the bank chance that it is efficient at 0.9126%. Indeed, the higher the ratio, the higher the amount of non-performing loans, which will degrade the efficiency of the bank.

For the LIQ variable, it was negatively related to the profit efficiency of the global sample, according to the findings of Lee and Chih (2013). This result means that any decrease in a unit of the general liquidity ratio will generate a decline of the bank chance that it is efficient at 0.2095%. As a measure of liquidity, this ratio may reflect the proper use of funding sources. Indeed, the increase in this ratio can significantly impact the efficiency of banks through inactive funds.

However, the LDR ratio was positively related to profit efficiency. This result means that any increase in this ratio will improve the level of banking efficiency. Indeed, a high LDR ratio reflects, on the one hand, efficient banking intermediation and, on the other hand, loans financed by unregistered sources, which can affect banks' financial stability (Caprio, D'Apice and al., (2010)). Any increase of one unit of this variable will increase the probability that the bank will be efficient at 11.82257%.

The CIR variable was positively related to profit efficiency, which puts into question the efficiency level of banks in the MENA zone. Any increase of one unit in the ratio of costs to revenues, will increase the probability that the bank will be efficient of 0.13337%. Indeed, according to the study conducted by Girardone et al. (2004) on Italian banks during the period 1993-1996, inefficient banks tend to have high-interest margins and extended branch networks compared to efficient banks.

For macroeconomic conditions, the GDPGR had positively related to the efficiency of banks. Any increase of one unit of this rate will increase the probability that the bank will be efficient at 1.18422%. Banks in countries with higher levels of economic development are more efficient. Our results are in agreement with the results of Johnes, Izzeldin and Pappas (2013), and Barth and al. (2013).

Comparison between big and small banks:

Concerning the variable RES_NPL, it has a significant positive effect on profit efficiency in the big banks. This result means that as the ratio increases, the level of profit efficiency increases. Any raise of one unit of this ratio will augment the probability that the bank will be efficient at 0.32729 %. However, this ratio has no significant effect on profitability in small banks.

For the CIR variable, it was negatively related to profit efficiency for big banks, according to the results of Lee and Chih (2013) who argue that a decrease in this ratio positively influences banking efficiency. Hence, the big banks in the MENA countries are more efficient. Indeed, a decrease of one unit of the variable CIR will generate an increase of the chance that the bank is efficient at 0.2048 % for the big banks and a decrease at 0.11944 % for the small banks.

The LIQ ratio has a significant negative effect on the efficiency of small banks. Indeed, the higher the ratio, the lower the score efficiency because of inactive funds in these banks. This result means that any decrease of one unit of the LIQ variable generates a decrease at 0.2180 % of the chance that the bank is efficient.

Regarding the LDR ratio, it only affects small banks. Indeed, it is positively related to bank efficiency in the latter. This result means that any one-unit increase in the LDR variable will generate an increase in the probability that the bank will be efficient at 12.77617 % in profit efficiency. The higher the ratio, the higher the level of bank efficiency is improved which means that funds are financed, firstly, by deposit O costs and therefore ensures the stability of funding. This result corroborates with the findings of Caprio, D'Apice and al., (2014). However, this ratio does not affect big banks because their sources of financing are more stable.

For the variable RES-LOAN, it had negatively related to the efficiency score of small banks. Any increase in this ratio will worsen the efficiency of the bank. This result means that any decrease of one unit of the variable RES-LOAN will generate a decline of the bank chance that it is efficient at 0.9395 %. Indeed, the higher the ratio, the higher the number of bad debts, which will degrade the efficiency of the bank.

On the macroeconomic determinants, the results showed a positive relationship between inflation and profit efficiency of the big banks, which marginally supports thefindings of Lee and Hsieh (2013) who argue that when the inflation rate increase, banks tend to charge more to customers. Any raise of one unit of this variable will increase the probability that the bank will be 0.20501% efficient. Also, the interest rate is positively related to the profitability of small banks. Any increase of one unit of this variable will increase the probability that the bank will be efficient at 0.29005%. This result means that the latter can adjust their interest rates in response

to the increase in the general price level to mitigate the effect of inflation.

The real GDP growth was positively related to the efficiency of small banks. Any increase of one unit of this rate will increase the probability of the bank being efficient at 11.375%. Also, in countries with higher levels of economic development, small banks are more efficient.

V. Conclusion

Regarding financial profitability, the introduction of the various regulatory requirements aims to reduce exposure to different banking risks. However, most regulatory arrangements require financial institutions to transfer financial information to supervisory bodies.

In this context, we have tried throughout this work to highlight the relationship between profit efficiency, as a means of assessing bank performance, and banking risks. Also, the link between profit efficiency and prudential regulation.

We found a lack of relationship between prudential regulation and bank efficiency in MENA countries.

During the last twenty years, the majority of the countries in this zone have progressively transformed their financial and banking landscape with the aim of modernizing their systems. They were involved in the implementation of a reform to liberalize their banking and financial system. It also allows them to encourage competition and open their financial system to foreign investors (Solhi and Mehdi, 2012).

However, improvements in the context of financial and banking reforms are irregular. Hence, the governments of this region are called upon to lighten the legal system to give more opportunities to the banks to diversify their activities, to satisfy better their customers while keeping a well-defined level of the capital to face the possible ones financial crises.

It is also important to note that for the majority of MENA countries, the banking sector is an axis of the financial system. Indeed, the region was weakly exposed to many financial crises, but with a financial area characterized by increasing openness to investment and foreign players, the contagion effect continues to amplify. As a result, banking systems are forced to put in place early warning indicators to prevent any possible banking crisis.

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Appendix

Appendix 1: Descriptive statistics

	Global sample				Small banks				Big banks			
Variables	Mean	Std-Dev	Min	Max	Mean	Std-Dev	Min	Max	Mean	Std-Dev	Min	Max
Vrs (profit efficiency)	0.9086057	0.2882651	0	1	0.98434	0.1242951	0	1	0.8695238	0.3369871	0	1
RES_NPL	9.345712	13.15162	0	124.04	12.03333	15.42619	0	124.04	4.86837	5.72872	0.05	41.57
RES_ Loan	7.579532	8.872731	-0.843	76.961	9.027488	10.17074	-0.843	76.961	4.52418	3.59050	0.436	27.542
CIR	49.56357	48.47783	0	950	54.66419	56.66731	0	950	37.71177	12.27384	15.751	80.337
LIQ	38.88159	31.64643	0.855	555.703	43.96369	35.6368	0.855	550.703	26.97772	13.09279	3.384	63.479
LDR	0.5910021	0.771078	0	25.25	0.5580059	0.90957	0	25.25	0.66680	0.22856	0.15746	1.68264
CAR	20.75376	14.50058	-13.1	285.4	22.49277	17.34757	-13.1	285.4	17.41534	4.41639	0.65	38.1
SIZE	8.003754	1.764696	1.8453	14.97227								
TIME	34.07437	25.84404	0	195	31.78076	26.97058	0	195	40.13333	21.47599	0	103
GDPPC	16699.14	18100.23	607.9158	96732.41	13052.7	14942.62	607.9158	96732.4	26339.41	21820.74	1071.323	96732.4
GDPGR	4.920161	3.860769	-15.0883	26.17025	4.571108	3.39394	-15.0883	26.17025	5.84296	4.76715	-7.07610	26.17025
INTEREST RATE	2.360264	8.932278	-19.9269	43.50116	2.75136	8.073605	-19.9269	43.50116	1.32630	10.82271	-19.9269	43.50116
INFLATION	6.382923	7.663647	-25.1281	33.75154	6.385414	6.970905	-25.1281	33.75154	6.37633	9.25694	-25.1281	33.75154
GOVERNANCE	-0.137037	0.630294	-1.76	5.171667	-0.178118	0.6811279	-1.76	5.171667	-0.02826	0.45278	-0.92166	0.79

Annexe 2: Correlation matrix

	Time	CAR	ResNPL	Resloan	CIR	LDR	Liq	GDPdef~r	Size	intere~e	GDPper~h	GDPper~a	Governance
Time	1.0000												
CAR	-0.1256	1.0000											
ResNPL	-0.0028	0.1549	1.0000										
Resloan	-0.0007	0.1983	0.7570	1.0000									
CIR	0.0514	-0.1066	0.1065	0.0450	1.0000								
LDR	-0.1627	0.0909	-0.2611	-0.3337	-0.1345	1.0000							
Liq	-0.3314	0.3828	0.1515	0.1247	0.0656	0.0354	1.0000						
GDPdeflator	-0.0842	0.0529	-0.0520	0.0044	-0.0511	-0.0119	-0.0337	1.0000					
Size	0.2111	-0.2604	-0.2930	-0.2546	-0.2274	0.1577	-0.3315	-0.0002	1.0000				
interestrate	0.0488	0.0277	0.1421	0.1191	0.0480	-0.1144	0.0525	-0.8297	-0.0527	1.0000			
GDPpergrowth	-0.0973	0.0069	-0.0803	-0.0661	-0.0145	0.0294	0.0429	0.1062	-0.0263	-0.1747	1.0000		
GDPpercapita	-0.1962	-0.0010	-0.2346	-0.2047	-0.1953	0.3819	-0.1288	0.0090	0.2048	-0.1360	0.2336	1.0000	
Governance	0.0128	-0.0802	-0.3425	-0.3576	-0.0918	0.5233	-0.1671	-0.0322	0.1364	-0.1308	0.1253	0.5705	1.0000

Appendix 3: Test VIF

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
interestrate |      3.71    0.269202
 GDPdeflator |      3.62    0.275884
     Resloan |      2.34    0.426853
      ResNPL |      2.23    0.447713
  Governance |      2.06    0.484738
GDPpercapita |      1.81    0.553459
         LDR |      1.62    0.619053
         Liq |      1.45    0.689645
        Size |      1.40    0.716704
         CAR |      1.35    0.739616
        Time |      1.33    0.749893
         CIR |      1.12    0.889268
GDPpergrowth |      1.11    0.904866
-------------+----------------------
    Mean VIF |      1.94
```

Appendix 4: Test of heteroskedasticity

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of VRS
         chi2(1)      =   101.05
         Prob > chi2  =   0.0000
```

Appendix 5: Global sample

```
. tobit VRS Time CAR ResNPL Resloan CIR LDR Liq Size interestrate  GDPdeflator GDPpergrowth GDPpercapita
Governance, ll vce(robust)

Tobit regression                                  Number of obs   =        611
                                                  F(  13,    598) =       3.71
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -253.54648                 Pseudo R2       =     0.1358

------------------------------------------------------------------------------
             |               Robust
         VRS |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        Time |   .0005756   .0006978     0.82   0.410    -.0007948     .001946
         CAR |  -.0011869   .0017988    -0.66   0.510    -.0047197    .0023459
      ResNPL |   .0014884   .0021547     0.69   0.490    -.0027432       .00572
     Resloan |  -.0091549   .0034639    -2.64   0.008    -.0159577   -.0023521
         CIR |   .0013378   .0004193     3.19   0.001     .0005144    .0021613
         LDR |   .1185905   .0620315     1.91   0.056    -.0032356    .2404165
         Liq |  -.0021018   .0008191    -2.57   0.011    -.0037105   -.0004931
        Size |   .0196312   .0083361     2.35   0.019     .0032596    .0360027
interestrate |    .001875   .0026922     0.70   0.486    -.0034122    .0071623
 GDPdeflator |   .0006727   .0029447     0.23   0.819    -.0051105    .0064559
GDPpergrowth |   .0118787   .0038239     3.11   0.002     .0043687    .0193886
GDPpercapita | -1.13e-06   9.06e-07    -1.25   0.212    -2.91e-06    6.49e-07
  Governance |  -.0009045    .030305    -0.03   0.976    -.0604217    .0586127
       _cons |   .6845371   .1122961     6.10   0.000     .4639945    .9050797
-------------+----------------------------------------------------------------
      /sigma |   .3218608   .0200913                      .2824027     .361319
------------------------------------------------------------------------------

  Obs. summary:         65  left-censored observations at VRS<=0
                       546     uncensored observations
                         0 right-censored observations
```

Big banks

```
. tobit VRS Time CAR ResNPL Resloan CIR LDR Liq interestrate GDPdeflator GDPpergrowth Governance GDPpercapita, ll
vce(robust)

Tobit regression                                Number of obs   =        420
                                                F(  12,     408) =       0.60
                                                Prob > F        =     0.8399
Log pseudolikelihood =  248.79318               Pseudo R2       =    -0.0422

------------------------------------------------------------------------------
             |               Robust
         VRS |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        Time |  -.0002587   .0004383    -0.59   0.555    -.0011203    .0006029
         CAR |  -.0005518   .0007542    -0.73   0.465    -.0020345    .0009309
      ResNPL |   .0032729   .0014979     2.18   0.029     .0003283    .0062176
     Resloan |  -.0013061   .0018409    -0.71   0.478     -.004925    .0023128
         CIR |  -.0020484   .0011149    -1.84   0.067    -.0042401    .0001432
         LDR |  -.0176119   .0495206    -0.36   0.722    -.1149593    .0797356
         Liq |  -.0003172   .0008715    -0.36   0.716    -.0020305     .001396
interestrate |   .0020501   .0010065     2.04   0.042     .0000715    .0040286
 GDPdeflator |   .0029005   .0014212     2.04   0.042     .0001068    .0056942
GDPpergrowth |  -.0000741   .0007848    -0.09   0.925    -.0016168    .0014687
  Governance |  -.0348458   .0447027    -0.78   0.436    -.1227221    .0530306
GDPpercapita |   5.21e-07   5.99e-07     0.87   0.385    -6.57e-07    1.70e-06
       _cons |   1.055496   .0670869    15.73   0.000     .9236171    1.187375
-------------+----------------------------------------------------------------
      /sigma |   .1270885   .0231737                      .0815337    .1726433
------------------------------------------------------------------------------

  Obs. summary:          7  left-censored observations at VRS<=0
                       413  uncensored observations
                         0  right-censored observations
```

Small Banks

```
. tobit VRS Time CAR ResNPL Resloan CIR LDR Liq interestrate GDPdeflator GDPpergrowth GDPpercapita Governance, ll
vce(robust)

Tobit regression                                Number of obs   =        612
                                                F(  12,     600) =       3.80
                                                Prob > F        =     0.0000
Log pseudolikelihood = -254.92177               Pseudo R2       =     0.1308

------------------------------------------------------------------------------
             |               Robust
         VRS |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        Time |   .0008325   .0007167     1.16   0.246    -.0005751    .0022402
         CAR |   -.001808   .0017794    -1.02   0.310    -.0053027    .0016867
      ResNPL |    .001292   .0021189     0.61   0.542    -.0028692    .0054533
     Resloan |  -.0094246   .0034868    -2.70   0.007    -.0162723   -.0025769
         CIR |   .0011982   .0003739     3.20   0.001     .0004639    .0019324
         LDR |   .1281606   .0625288     2.05   0.041     .0053586    .2509626
         Liq |  -.0021876   .0008042    -2.72   0.007      -.003767   -.0006082
interestrate |   .0018739    .002707     0.69   0.489    -.0034424    .0071902
 GDPdeflator |   .0005569   .0029509     0.19   0.850    -.0052384    .0063522
GDPpergrowth |   .0114105   .0038299     2.98   0.003     .0038888    .0189322
GDPpercapita |  -7.22e-07   9.02e-07    -0.80   0.424    -2.49e-06    1.05e-06
  Governance |  -.0105775   .0294047    -0.36   0.719    -.0683261    .0471712
       _cons |   .8425386   .0779091    10.81   0.000      .689531    .9955463
-------------+----------------------------------------------------------------
      /sigma |   .3223983    .020231                      .2826661    .3621304
------------------------------------------------------------------------------

  Obs. summary:         65  left-censored observations at VRS<=0
                       547     uncensored observations
                         0 right-censored observations
```