Determinants of bank efficiency: Case of study: Algerian banks

MASSIF Ibrahim[1], ADEL Boubakre[2]

[1]PHD Student, International Finance Group, Tunisia, Massifibrahim@gmail.com

[2]PHD Professor, International Finance Group,Tunisia,Adel.boubaker@fsegt.utm.tn

Received: 10/10/2021 *Accepted: 02/03/2022* *Published: 15/09/2022*

Abstract:

This research deals with the determinants of efficiency of Algerian banks by employing the DEA method (Data Envelopment Analysis) and on the basis of the Tobit model and a set of variables derived from the CAMEL model and governance variables. With years of experience in the position of Managing Director of the Bank, Corruption and Gross Domestic Product. As for the quality of credit, operational efficiency, the size of the board of directors and the concentration of capital, they have no effect on the efficiency of Algerian banks.

Keywords: Banking efficiency, Capital adequacy, Liquidity, Credit Quality, Board size.

JelClassificationCodes: D61, E50,G24, H81

***Corresponding author**: massif brahim*

1. INTRODUCTION

The topic of efficiency evaluation is important and relatively new in performance measurement, as it helps to identify weaknesses and strengths and correct imbalances and gaps over time. The volume of resources used while providing the maximum amount of services, and one of the most important ways to achieve this skill is for managers to have basic management qualifications and skills and the ability to manage units and make decisions on a solid foundation.

For this reason, the study of the efficiency of banks is one of the most important methods in the study of banking performance, due to its quest for optimal use of available resources with reference to the main objective of maximizing profits, which translates into cost reduction. To reach the lowest possible level, as well as to allow knowledge of strengths and weaknesses and to correct discrepancies. This great importance has led to greater interest in tools for measuring banking efficiency, including the data envelope method and the random limit method.

Despite the achievements made by the Algerian banking sector in recent years in terms of increasing the number of branches and the size of its assets, the increase in challenges, especially in the context of the events taking place in the current stage, shows the need to pay more attention to the system of evaluation of banking practices ensuring the integrity of the system as a whole, gain the public's trust, research the causes of weakness and find solutions to them in order to achieve the optimal performance of Algerian banks.

Therefore, the issue of efficiency has acquired a more important dimension for Algerian banks, because standing on their status, evaluating them, and knowing their determinants is one of the important issues that the investor must worry about in order to put his money into an investment based on a good performance evaluation. From there, we can pose the following main research statement:

What are the determinants ofthe efficiencyof Algerian banks?

2. Literature review

In literary studies, there are many researchers who have studied the determinants of banking efficiency since the 80s and in many foreign and Arab countries, including:

2.1 The first study

HENNI AMINA, 2018. This study focused on evaluating and comparing the efficiency of Tunisian, Moroccan and Algerian banks during the period from 2004 to 2014, using the non-parametric DEA method, and then using the results of the Tobit regression model to determine the most important factors that can affect the efficiency of these banks. The results showed that Tunisian banks are the most efficient (in terms of technical efficiency), while Moroccan banks obtained the highest scores in terms of purely technical efficiency, and the results of the Tobit regression showed that public ownership of banks, bank size and liquidity as well as gross domestic product positively affect the efficiency of Algerian banks, Moroccan and Tunisian.

2.2 The second study

Touhami Abdelkader and Sanae Solhi, 2009. This study examined the measurement of the degrees of technical efficiency of five 05 Moroccan commercial banks during the period (1993-2006) using the Data Envelope Analysis (DEA) method The Return on Equity (ROE) index has a positive impact on the

efficiency of banks. , the loan quality index negatively affects the efficiency of banks and the internal product of the bank negatively affects the efficiency of banks.

2.3 The third study

Nefla and Neila, 2009. In this study, they conducted a two-stage analysis of the technical inefficiency of Tunisian banks during the period (2002-2006) during which the Tunisian banking sector was fragile. Efficiency modelling using the Simar and Wilson procedure, 2007, estimated the effect of some main variables of banking activity on the technical inefficiency of Tunisian banks. The results also show that large banks and public banks are the most efficient. They also indicate that insufficient capital and poor credit quality are the main sources of inefficiency for Tunisian banks. Indicators of private fund performance, loan quality, liquidity and size has a positive correlation with efficiency Indicators of capital adequacy, nature of ownership and economic growth have a negative correlation with the level of efficiency of Tunisian banks.

2.4 The fourth study

Roland Banya and Nicholas Biekpe, 2016. This study focused on measuring the degree of efficiency of banks in ten African border countries, as well as on controlling the determinants of banking efficiency during the period (2008-2012) by the two-step method. As a first step, the data envelope analysis method was used to estimate the technical and volumetric efficiency of banks, when the degree of risk is positively related to the efficiency of banks.

2.5 The fourth study

Iveta Repkova, 2015. This research paper focuses on the study of the determinants of efficiency in the Czech banking sector during the period 2001-2012. The dataset used in this document was obtained from the Bank Scope database and annual business reports. The study used the data envelope analysis method to measure the efficiency levels of Czech banks according to the BCC and JRC model. The mediation approach was followed to determine inputs and outputs, and then sought to know its determinants using standard modelling by the data panel.

Capital adequacy, liquidity and loan quality have been found to have a positive impact on banks' efficiency, while return on assets (ROA), interest rate and GDP have a negative impact on the efficiency of the JRC model. With respect to efficiency under the BCC model, it was concluded that liquidity risks and loan quality have a positive effect on efficiency and GDP has a negative effect on efficiency, while the other variables were not statistically significant.

3. Data Envelopment Analysis Method (DEA)

DataEnvelopment Analysis is a mathematical programming technique that measures the efficiency of a decision-making unit (DMU) compared to other similar EMUs with the simple restriction that all EMUs are on or below the efficiency limit Seiford and Thrall (1990). DEA calculates the relative efficiency of each DMU compared to all other EMRs using the actual observed values of the inputs and outputs of each DMU.It also identifies, for inefficient EMUs, the sources and level of inefficiency for

inputs and outputs Charnes and all(1995). The term DEA was first introduced by (Charnes and all,1978) based on research by (Farrell,1957). The CCR model is the main DEA model as presented by (Charnes and all,1978). This model was modified by (Banker and all, 1984) and became the BCC model, which adapts to varying returns to scale. The JRC model assumes this (Iveta, 2015).

The DataEnvelopment Analysis Method (DEA) is unanimously defined as "a mathematical methodology that uses linear programming to evaluate the relative efficiency of a number of decision-making units by determining the optimal combination for an input group and an output group, based on their actual performance." These inputs are divided by the outputs. For each DUM installation or decision unit, these percentages are then compared by the fractional method. The unit that gets the best percentage is considered the effective limit, and the degree of inefficiency of other facilities is measured against the effective limit using linear programming methods, where the linear programming indicator is confined between the "1" indicator which represents the total efficiency and the "0" value which represents the total inefficiency (Yeh, 1996).

The CCR model, which was developed by Chaners, Copper, Rhodes, is considered the basic model of the DEA method, and is based on the premise that changing the amount of input used by an inefficient unit has a fixed effect on the amount of efficiency it provides when switching to the front efficiency belt (Frontier), and this feature It is known as CRS (Constant Return To Scale), and this feature is only appropriate when all the units compared are operating at their optimal size level, but in reality, there are many obstacles that prevent units from reaching these sizes such as competition, funding restrictions and others (2009 ،فهمي).

3.1The target function: (Sherman and Zhu, 2006)

We assume that there are n DMUj to be evaluated. Each DMU consumes varying amounts of m different inputs to produce s different outputs.

$$\text{Max}\theta = \frac{u_1 y_{1o} + u_2 y_{2o} + \cdots + u_s y_{so}}{v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo}} = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}}$$

Maxθ: Maximize the efficiency index of the decision unit, DMU0.

Yrj: the value of the output r by the unit of decision.

Xij: the value of input i used by the decision unit.

r: the number of outputs produced by each decision-making unit.

I: the number of entries used by each decision unit.

Ur: the modulus or weight assigned to the output r.

Vi: the module or weight assigned to input i.

The target function operates under the constraint of the efficiency index for all decision-making units including DMU, which does not exceed the value "1", which means full efficiency

The BCC model appeared in 1984 and is attributed to Banker, Charnes, Cooper, which is a development and improvement of the original model (CCR) that assumes constant returns to scale. The returns to scale of institutions, whether increasing, decreasing or constant, and the latter is the one in which the same efficiency indicator appears, whether in the CCR or BCC model.

To form the BCC model, we assume the same data as the CCR model, and by adding the size constraint$\sum_{J=1}^{\infty} \lambda J = 1.$ This constraint makes the reference units for incompetent units similar to them in size, neither larger nor smaller than them.

The CCR model is valid in the case of the valuation of companies that operate at their ideal size, but competition, government policy, financial constraints, etc..., make it impossible for companies to operate at this size, so the BCC model is used, and this model distinguishes between two types of efficiency, these are technical efficiency and volumetric efficiency. When comparing the efficiency index with the CCR model and the efficiency index with the BCC model for the same unit, and there is a difference, it means that this unit is inefficient in terms of size, but if the two indicators are equal, it means that the evaluated unit is characterized by the stability of yields in volume.

The relationship between the three types of efficiency is as follows (Sultan and Crispim, 2018):

CCR score = Bcc X score of scale efficiency score

TE = PTE X SE

4.Study sample

In the applied study, we rely on financial and accounting data extracted from the annual reports of the banks studied, where the sample of the study was limited to 05 five national banks, which are the Algerian Foreign Bank BEA, the Algerian National Bank BNA, the Popular Credit Bank of Algeria CPA, the BDL Local Development Bank and the Bank of Agriculture and Rural Development BADR and six foreign private banks represented at BNP Paribas, Société Générale Algeria SG, Fransabank, Arab Gulf Bank AGB, Arab Banking Corporation ABC and AL Baraka Bank. The study period included 10 years, from 2010 to 2017, the selection of these banks for the study was made according to their significant weight in the national economy and also according to the availability of data.

In the absence of a database on banking activity in Algeria, the available data and information were obtained from the banks' reports downloaded from their websites, and from data subject to the interests of the Algiers Commercial Register .

In order to make a DEA estimate, inputs and outputs must be determined. Four main approaches (intermediation, production, assets and profit) have been developed to determine the input-output relationship in the behaviour of a financial institution. We have taken a brokerage approach and, in line with this approach, we assume that banks collect deposits to convert them, using work, into loans. We used two inputs (employment and deposits) and two outputs (loans and net interest income). Furthermore,

we measure employment by the total salary costs covering salaries and all associated expenses and deposits by the sum of demand deposits, customer term deposits, interbank deposits and sources obtained from issued bonds. Loans are measured by the net worth of loans to customers and other financial institutions, and net interest income is the difference between interest income and interest expense (Iveta, 2015).

5. Study model

Based on several research studies on the determinants of banking efficiency, we use the Tobit regression model, which first appeared in the econometric literature in 1958 by Nobel prize-winning economics winner JAMES TOBIN.

It is known as the Finite Regression Model (Tobit), which is a linear model on panel data that is used in the case of the dependent variable between the values 0 '0' and '1'. This allows us to process the characteristics of the efficiency distribution and for this we use this model to clarify the relationship between dependent variables (efficiency) with a set of independent variables.

$\boldsymbol{Y_{it}}$**:** Represents the efficiency variable of the bank i during the period t.

$\boldsymbol{B_{it}}$: Represents the variables related to bank i during period t.

$\boldsymbol{M_t}$: Represents macroeconomic variables in period t.

$\boldsymbol{S_t}$: Represents variables related to the banking sector in which banks are active during period t.

6.Study Variables

6.1 The dependent variable

It is represented in the efficiency variables whose results are sought to be explained, which are:

6.1.1 Efficiency according to the CCR model

This indicator reflects the efficiency of banks in the fixed economies of scale model.

6.1.2 Efficiency according to the BCC Variable Economies Model

This indicator shows the efficiency of banks in the Variable Economies of Scale model.

6.1.3 Efficiency of scale

This indicator reflects the ratio of efficiency of variable economies of scale to fixed economies of scale.

6.2 Independent variables

These are the set of variables through which we try to explain the indicators of efficiency, and these are:

6.2.1 Return on asset (ROA)

The Return on asset is typically used as a measure of bank performance, and this indicator measures the net income for each monetary unit of the average assets held by the bank. Indeed, it is natural that the most profitable banks are the most efficient.

$$\textbf{Return on assets } ROA_{it} = \frac{\textbf{Net profit }_{it}}{\textbf{Total assets}_{it}}$$

6.2.2 Capital adequacy

The capital adequacy index is equal to the ratio of equity to the bank's total assets and reflects the bank's ability to increase deposit acceptance, taking into account the size of the capital.

$$\textbf{CapitalAdequacy } C_{it} = \frac{\textbf{Equity }_{it}}{\textbf{Total assets}_{it}}$$

6.2.3 Liquidity

This ratio measures the share of credit in total assets, as it shows the percentage of assets employed by the bank, and liquidity reflects the bank's ability to repay and meet its obligations, which can increase the volume of deposits with the bank, This indicator is calculated for the bank i during period t as follows (Bahyaoui, 2017) :

$$\textbf{Liquidity}L_{it} = \frac{\textbf{Current assets}_{it}}{\textbf{Current liabilities}_{it}}$$

6.2.4 Credit Quality

This indicator is calculated by calculating the ratio of provisions on doubtful accounts receivable to total receivables. It is considered an indicator for measuring credit risk. The importance of this indicator reflects the quality of loans and the primary function of the bank, which is to grant loans with bank interest generated (Bahyaoui, 2017).

When banks grant a large percentage of their assets in the form of bank credit, they increase the amount of risk, regardless of their income.

$$\textbf{Credit Quality}A_{it} = \frac{\textbf{Impaired Credit}_{it}}{\textbf{Gross Credit }_{it}}$$

6.2.5 Management

We express this indicator as the ratio of operating costs to operating income. The indicator is considered recent in studies assessing the efficiency of banks , which reflects the bank's operating costs relative to net bank output (Sahajwala et Van, 2000).

$$\textbf{Management } M_{it} = \frac{\textbf{Operational costs}_{it}}{\textbf{Net income}_{it}}$$

6.2.6 Size of the Bank

This indicator is used to assess the efficiency of banks, as it provides an overview of the volume of credit and the ease of access to financial markets.

6.2.7Size of the board of directors

The board of directors manages the bank and sets its policy The size of the board of directors represented by the number of its members is an important factor for the proper functioning of the board Algerian commercial law, according to Article 610, limits the number of directors for companies to between at least 03 members and does not exceed 12 members at most, and according to article 611, the term of office may not exceed six years, and he may be re-elected.

6.2.8 Seniority in the position of Managing Director

This indicator reflects the period that the manager's experience.

The major indicator in the position of Managing Director is considered an important indicator of institutional governance mechanisms, which is expressed by the total number of years during which the CEO of the bank has worked in his position, and the experience of the Director generally has a positive impact on the financial performance of banks. We find that (Ghabri and Xavier, 2008) recommended that the CEO remain in his position is due to the will of the shareholders, who generally seek the greatest return.

6.2.9 The principal ownership ratio

The principal owner ratio reflects the bank's power to make strategic decisions and is represented by the person who owns the largest percentage of the bank's capital.

Property owners represent the value and percentage of their share in the institution. The ownership structure of the bank is useful for determining which parties have decision-making power in the bank, as often those who control the institution have the largest share of ownership. The effect of capital concentration on a bank's financial performance is complex in theory and ambiguous in practice.

6.2.10 Corruption

The corruption index is a qualitative variable that is difficult to measure. In 1995, the non-governmental organization Transparency International developed a corruption index that ranged from "0" to "10". This indicator focuses on corruption in the public sector.

(Kauffmann and all, 2005) They studied this indicator and concluded that this indicator increases with the lack of transparency and the lack of respect for the force of the law.

6.2.11 Gross internal output (GDP)

It is often used as an external variable to measure the determinants of banks ' efficiency. The GDP index of Algeria was obtained from Data from the World Bank and we chose GDP at current prices, which is the most appropriate for our study, and it was calculated by the Siberian logarithm of the Lnpib gross domestic product and this in order to facilitate the study.

7. Studying the correlation between independent variables

Before applying the Tobit model, the correlation between the study variables must be tested, as we will rely on the Pearson correlation test.

Table 1. Pearson correlation matrix among study variables

	ROA	CAP	LIQ	QUAL	M	SIZE	CA	DUR DG	MAJOR	COR	PIB
ROA	1,0000										
CAP	0,1302	1,0000									
LIQ	0,1233	-0,5963	1,0000								
QUA	0,2392	0,0818	-0,2715	1,0000							
M	-0,2883	0,5485	-0,5589	-0,1686	1,0000						
SIZE	-0,4123	-0,7498	0,4609	-0,0435	-0,3299	1,0000					
CA	-0,0175	-0,4108	0,1967	0,3017	-0,2048	0,2349	1,0000				
EXP D	-0,0467	-0,0462	-0,2896	0,0933	0,0906	-0,0171	0,1933	1,0000			
MAJO	-0,3462	-0,6439	0,6314	-0,1169	-0,3110	0,7089	0,2633	-0,2674	1,0000		
COR	0,1915	0,0837	-0,0790	0,0929	-0,0006	-0,1153	0,0440	0,1890	-0,0780	1,0000	
PIB	0,0508	-0,0899	0,1520	0,1164	-0,1911	0,2172	-0,0006	-0,1565	0,0736	-0,1947	1,0000

Source: The researcher using the Eviews10 program

The correlation level is 80%.

From the table, the correlation matrix indicates that not all independent variables are correlated with each other, which mathematically means that all study variables are acceptable.

8. Drafting the study model

After accepting all the variables, we can write the main model for measuring the determinants of efficiency as follows:

σ=f(Cap,Liq,Qua,M,SB,CA,EXP,PRO,Cor,GDP)

Since we focus in our study on the interpretation of efficiency results according to the CCR-I model, the efficiency according to the BCC-i model, and volumetric efficiency, and therefore we can deduce from the main efficiency model the following models:

8.1 Model 1

Competency according to the CCR-I model.

EF CCR-i=f(ROA,Cap,Liq,Qua,M,SB,CA,EXP,MAJ,Cor,GDP)

8.2 The second model

Competence according to the BCC-I model.

EF BCC-i=f(ROA,Cap,Liq,Qua,M,SB,CA,EXP,MAJ,Cor,GDP)

8.3 The third model

Scale efficiency

Scale-eff=f(ROA,Cap,Liq,Qua,M,SB,CA,EXP,MAJ,Cor,GDP)

9. Results and discussion

The results of the study obtained can be summarized in the following table:

Table 2. Determinants of the efficiency of Algerian banks

	CCR-i		BCC-I		Scale-eff	
	Coef	**Prob**	**Coef**	**Prob**	**Coef**	**Prob**
ROA	3.275282	0.0568**	0.360921	0.8210 Insig	2.386081	0.0066***
CAP	0.699312	0.0000***	0.926194	0.0000***	-0.138896	0.0901*
LIQ	0.854041	0.0000***	0.548016	0.0000***	0.287192	0.0002***
QUA	0.200735	0.8315 Insig	-0.502214	0.5761 Insig	0.047134	0.9227 Insig
M	-0.086599	0.1760 Insig	-0.071435	0.1288 Insig	0.005499	0.8491 Insig
S – B	0.067912	0.0000***	0.052261	0.0001***	0.023115	0.0008***
S-CA	0.008838	0.2644 Insig	0.010275	0.1753 Insig	0.004734	0.2210 Insig
EXP-D	-0.009884	0.0151***	-0.012415	0.0013***	-0.001524	0.4538 Insig
Major	0.133331	0.2605 Insig	0.168447	0.1363 Insig	-0.076471	0.1528 Insig
COR	-0.257929	0.1067*	-0.264420	0.0802**	-0.022913	0.7624 Insig
PIB	-0.086939	0.0781**	-0.164643	0.0004***	0.076075	0.0054***

Source: The researcher from the results of the Tobit model using the Eviews10 program

Indicates a moral level at 1%, **indicates a moral level at 5%,* indicates a moral level at 10%. Insig: indicates a lack of morale.

Retur on Asset

The Return on asset affects the efficiency index in the case of fixed economies of scale and volumetric efficiency, but it does not affect efficiency in the case of variable economies of scale, which means that the most profitable banks are the most efficient banks in light of economies of scale as well as banks that produce at an optimal level of production.

Capital Adequacy

The capital adequacy of the banks studied positively affects the efficiency of banks in the case of fixed and variable economies of scale and negatively affects volumetric efficiency, which is consistent with the impact of this indicator on the efficiency of Algerian banks.

Liquidity

The results showed that bank liquidity is a very important indicator of efficiency in fixed and variable economies of scale and volumetric efficiency. These results explain why banks are using pooled deposits to extend credit more efficiently, with this type offering a good reputation that allows it to raise funds at a lower cost.

Credit quality

According to the results presented in the table, all different degrees of efficiency are not affected by loan quality and the size of banking risks. This is because efficiency generally seeks the lowest use and the highest production, as it is concerned with the return on investment aspect and ignores the risk.

Management

The results of the table showed that operational efficiency negatively affects, to a small extent, the efficiency of Algerian banks in the case of variable economies of scale, while in the case of fixed economies and volumetric efficiency, they are not affected by operational efficiency. This may explain why operating expenses approved as inputs in the study constitute a small percentage of total bank assets.

Bank size

The results of the table show a positive effect of bank size on all types of efficiency,which indicates the bank's strongest strategy by managing its main activity, which is accepting deposits and granting loans.

Size of board members

The results of the table show that the number of board members does not affect the different levels of efficiency of Algerian banks, including management and management control.

The experience of the Managing Director in the position

The experience factor of the Managing Director in his position does not affect volumetric efficiency and is considered an important determinant of efficiency in light of constant and changing economies of scale, as it affects them negatively, which is why Algerian banks do not benefit positively from the experience of their Managing Directors based on the management of their affairs.

The principal ownership rate

The capital concentration indicator does not affect bank efficiency in view of fixed and variable economies of scale and volumetric efficiency, and it can be interpreted that the principal owner seeks to improve efficiency, but the public administration implements management procedures to achieve efficiency.

Corruption

The corruption that prevails in the Algerian state has a negative impact on the efficiency of banks given the fixed economies of scale and the efficiency of banks given the changing economies of scale. It can be interpreted that the State protects the financial results of public banks, but does not seek to achieve the optimal exploitation of resources by financing non-profit projects or interfering with the access of certain parties to loans, and as for volumetric efficiency, it is not affected by the percentage of corruption.

Gross Domestic Product (GDP)

The results showed that the Gross Domestic Product (GDP) negatively affects the efficiency of Algerian banks given the fixed and variable economies of scale, represented by the return on equity (ROE), which is explained by the instability of the national economy due to its association with oil prices, and during the study period its prices increased and improved And the weakness of the cash flow, and the financing of projects became dependent on it, which led to a decline in banking activity and a decrease in efficiency given the fixed and changing economies of scale. As for volumetric efficiency, it has a positive relationship with gross domestic product.

10. CONCLUSION

Banks seek to provide services to various economic operators, in light of many internal and external pressures and challenges, which can make them vulnerable to failure, which affects their continuity and ability to develop in a market where competition between different banking institutions is intense, and with the rapidly changing economic and technological conditions, banks have become forced to look for advanced management methods that allow additional profits to be made, rationalizing the use of available resources to provide the best services in terms of quantity and quality.

The asset return index, capital adequacy, liquidity, bank size and gross domestic product have a positive impact on the efficiency of Algerian banks, while the manager's years of experience and the corruption index have a negative impact. However, the quality of loans, operational efficiency, board size and capital concentration index have no effect on the efficiency of Algerian banks.

5. Bibliography List :

1. Books

- Gitman. L. J, **"Principles of Managerial Finance. 8th Addition."** (1997): 482.

- Hair، J.، Anderson، R.، Tatham، R.، and Black، W. (1995). **Multivariate Data Analysis.** 4th Ed.،Prntice-Hall، Inc.، Englewood Cliffs، New Jersey.

- حاكم محسن الربيعي وحمد عبد الحسين راضي، **حوكمة البنوك وأثرها في الأداء والمخاطرة**، دار اليازوري العلمية للنشر والتوزيع، الطبعة الأولى، عمان_ الأردن، 2011.

2. Theses:

- HENNI.A **, Les déterminants de l"efficience des banques des trois pays du Maghreb,** thèse de doctorat, université de tlemcen 2018.

3. Journal article

- Bahyaoui.S, **Les Déterminants Idiosyncratiques De La Performance Bancaire Au Maroc : Analyse Sur Donnée De Panel,** European Scientific Journal,Vol 13.N°13/2017.

- Banker. R. D, Charnes. A., & Cooper. W. W, (1984), **Some models for estimating technical and scale inefficiencies in data envelopment analysis,** *Management science*, *30*(9), 1078-1092.

- Banya.R, Biekpe.N, **Banking efficiency and its determinants in selected frontier africain marktes**, Econ Change Restruct, south Africa, 51.1 (2017): 69-95.

- Charnes.A., Cooper. W. W., & Rhodes. E , (1978), **Measuring the efficiency of decision making units.** *European journal of operational research*, *2*(6), 429-444.

- Farrel. M. J**, "The Measurement of Productive Efficiency,"** Journal of the Royal Statistical Society, Series A, Part 3." (1957).

- Gharbi.H, Xavier. L, **"Actionnariat salarié et enracinement des dirigeants: Un essai de compréhension."** *Innovations* 1 (2008): 121-146.

- Kaufmann. D., Kraay. A., & Mastruzzi, M, (2005), ***Governance matters IV: governance indicators for 1996-2004***, The World Bank.

- Nefla, A., & Taktak, N. B. (2009), **Inefficience des banques dans un pays en mutation : cas tunis** Revue de libanaise de gestion d'économie N° 02, 100-127.

- Nikhat .F, **"Capital adequacy: A financial soundness indicator for banks."** *Global Journal of Finance and Management* 6.8 (2014): 771-776.

- Řepková.I, (2015), **Banking efficiency determinants in the Czech banking sector**, *Procedia Economics and Finance*, *23*, 191-196.

- Sahajwala. R., dreh den Bergh. P. (2000). ***Supervisory risk assessment and early warning systems*,** Basle Committee on Banking Supervision, working paper N°4, Bank for international settlements, Basel, Switzerland.

- Sherman. H. D, & Zhu. J, (2006), ***Service productivity management: Improving service performance using data envelopment analysis (DEA)*,** Springer science & business media.

- Wasim I. M. Sultan and José Crispim, **Measuring the efficiency of Palestinian public hospitals during 2010-2015 : an application of a two-stage DEA method**, BMC Health Services Research,18.1 (2018).

-Touhami.A and sanaesolhi, **Efficience et productivité des banques commerciales marocaine : Approche non parametrique, Working paper No.466, February 2009.**

-Yeh. Q. J, (1996), **The application of data envelopment analysis in conjunction with financial ratios for bank performance evaluation,** *Journal of the Operational Research Society*, *47*(8), 980-988.

- فهمي محمد شامل بهاء الدين ،**قياس الكفاءة النسبية للجامعات الحكومية بالمملكة العربية السعودية**، مجلة جامعة أم القرى للعلوم التربوية والنفسية، المجلد الأول –العدد الأول، 2009.

4. Laws and instructions

- Ordinance 75 / 59 of September 1975 containing the amended and supplemented commercial law, the Official Gazette of the Algerian Republic. Issue 101, dated December 19, 1975

5. Web sites:

- **https://donnees.banquemondiale.org:**

6. Appendices

Appendice 1

Dependent Variable: CCR_I
Method: ML - Censored Logistic (Newton-Raphson / Marquardt steps)
Date: 02/05/20 Time: 10:48
Sample: 2008 2017
Included observations: 110
Left censoring (value) at zero
Convergence achieved after 5 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
ROA	3.275282	1.719395	1.904903	0.0568
CAP	0.699312	0.145249	4.814579	0.0000
LIQ	0.854041	0.135606	6.297983	0.0000
QUALIT	0.200735	0.943179	0.212828	0.8315
EF_OP	-0.086599	0.063999	-1.353124	0.1760
TAILLE	0.067912	0.014416	4.710977	0.0000
CA	0.008838	0.007920	1.115959	0.2644
EXP__DG	-0.009884	0.004068	-2.429395	0.0151
MAJOR	0.133331	0.118495	1.125198	0.2605
COR	-0.257929	0.159887	-1.613192	0.1067
LN_PIB	-0.086939	0.049341	-1.761996	0.0781
C	0.870915	1.431636	0.608335	0.5430
Error Distribution				
SCALE:C(13)	0.056125	0.004495	12.48723	0.0000

Mean dependent var	0.757290	S.D. dependent var	0.170924
S.E. of regression	0.113760	Akaike info criterion	-1.505196
Sum squared resid	1.255313	Schwarz criterion	-1.186048
Log likelihood	95.78576	Hannan-Quinn criter.	-1.375748
Avg. log likelihood	0.870780		
Left censored obs	0	Right censored obs	0
Uncensored obs	110	Total obs	110

Appendice 2

Dependent Variable: BCC_I
Method: ML - Censored Logistic (Newton-Raphson / Marquardt steps)
Date: 02/05/20 Time: 10:49
Sample: 2008 2017
Included observations: 110
Left censoring (value) at zero
Convergence achieved after 5 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
ROA	0.360921	1.595161	0.226260	0.8210
CAP	0.926194	0.128662	7.198662	0.0000
LIQ	0.548016	0.135114	4.055960	0.0000
QUALIT	-0.502214	0.898324	-0.559057	0.5761
EF_OP	-0.071435	0.047037	-1.518688	0.1288
TAILLE	0.052261	0.013187	3.962917	0.0001
CA	0.010275	0.007581	1.355252	0.1753
EXP__DG	-0.012415	0.003871	-3.207571	0.0013
MAJOR	0.168447	0.113085	1.489558	0.1363
COR	-0.264420	0.151132	-1.749600	0.0802
LN_PIB	-0.164643	0.046477	-3.542474	0.0004
C	3.888026	1.376011	2.825577	0.0047
Error Distribution				
SCALE:C(13)	0.053547	0.004341	12.33655	0.0000

Mean dependent var	0.803605	S.D. dependent var	0.152461
S.E. of regression	0.112034	Akaike info criterion	-1.570110
Sum squared resid	1.217515	Schwarz criterion	-1.250962
Log likelihood	99.35603	Hannan-Quinn criter.	-1.440662
Avg. log likelihood	0.903237		
Left censored obs	0	Right censored obs	0
Uncensored obs	110	Total obs	110

Appendice 3

Dependent Variable: Scale-eff
Method: ML - Censored Logistic (Newton-Raphson / Marquardt steps)
Date: 02/05/20 Time: 10:49
Sample: 2008 2017
Included observations: 110
Left censoring (value) at zero
Convergence achieved after 6 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
ROA	2.386081	0.877993	2.717653	0.0066
CAP	-0.138896	0.081941	-1.695069	0.0901
LIQ	0.287192	0.076908	3.734204	0.0002
QUALIT	0.047134	0.485797	0.097024	0.9227
EF_OP	0.005499	0.028896	0.190291	0.8491
TAILLE	0.023115	0.006909	3.345459	0.0008
CA	0.004734	0.003868	1.223845	0.2210
EXP__DG	-0.001524	0.002034	-0.749035	0.4538
MAJOR	-0.076471	0.053489	-1.429670	0.1528
COR	-0.022913	0.075786	-0.302344	0.7624
LN_PIB	0.076075	0.027370	2.779474	0.0054
C	-2.133390	0.843275	-2.529885	0.0114
Error Distribution				
SCALE:C(13)	0.028733	0.002345	12.25250	0.0000

Mean dependent var	0.941060	S.D. dependent var	0.090269
S.E. of regression	0.064326	Akaike info criterion	-2.784182
Sum squared resid	0.401365	Schwarz criterion	-2.465034
Log likelihood	166.1300	Hannan-Quinn criter.	-2.654734
Avg. log likelihood	1.510273		
Left censored obs	0	Right censored obs	0
Uncensored obs	110	Total obs	110