

Foreign Banks Efficiency in Algeria: An Application of a nonparametric method

Amina HENNI*

Fadloun CHACHOUA**

University of Mostaganem, Algeria

ملخص :

خلال السنوات الأخيرة، شهد الجهاز المصرفي الجزائري دخولا منقطع النظير لعدد من البنوك الأجنبية. بحيث أنه إلى حد الساعة لم تساهم هذه الأخيرة في تمويل الاقتصاد الوطني بفعالية. وهنا يأتي السؤال حول ما مدى كفاءة البنوك الأجنبية في الجزائر. يشمل هذا المقال على دراسة مقارنة بين البنوك الأجنبية و البنوك الوطنية بالاعتماد على طريقة غير معلمية و هي التحليل عن طريق تغليف البيانات (DEA). تتكون عينة الدراسة من 9 بنوك تعمل في الجزائر خلال الفترة من 2009 إلى 2013. تظهر النتائج أن البنوك الوطنية هي أكثر كفاءة من البنوك الأجنبية. علما أنه ابتداء من 2012، عرفت البنوك الأجنبية تحسنا ملحوظا في تنقيط الكفاءة.

الكلمات المفتاح : بنوك أجنبية، الجهاز المصرفي الجزائري، كفاءة البنك، DEA.

Abstract:

In recent years, a number of foreign banks enter in the Algerian banking system. Up to now, those banks do not finance the economy efficiently. Thus, it becomes important to ask about the efficiency of foreign banks in Algeria. In this article, a comparative study between foreign banks and domestic banks in Algeria is done using a nonparametric method that is data envelopment analysis (DEA). The sample includes 9 banks operating in Algeria from 2009 to 2013. Results show that domestic banks are more efficient than foreign banks. However, foreign banks know an improvement in the efficiency score since 2012.

Keywords: foreign banks, Algerian banking system, bank efficiency, DEA.

Introduction

Since primal banking reforms of 1990, Algeria experiences a gradual financial liberalization. One aspect of this financial liberalization is the entry of foreign banks that appear very later in Algeria with the first bank implanted in 1998.

Thus, the principal roles of foreign banks in the Algerian banking system are to improve, to modernize and to implement more competition to this system. In addition, foreign banks have to develop the Algerian financial market that still primitive. However, in practice, these banks do not play an active task in the

*henni_amina@yahoo.fr

**fad_chachoua@yahoo.fr

Algerian economy. In addition, very few studies have examined the phenomena up to now.

Today, Algerian banking system count 14 foreign banks that control about only 14.1% of the total banking asset. However, these banks know a very quick development recently. In fact, the number of foreign banks agencies passed from 274 agencies in 2011 to 315 agencies in 2013. That is an increase of 41 agencies while domestic banks grow only with 8 additional agencies in the same period.

As mentioned by Delis & Papanikolaou (2009), foreign ownership affects bank efficiency due to several causes: First, the capital brought in by foreign banks decrease fiscal costs of banks restructuring. Second, foreign banks may bring experiences in management and a better culture of corporate governance that increase bank efficiency. Third, foreign bank presence improve competition, driving domestic banks to be more challengers. Finally, domestic banks can benefit from technological spillovers brought about by their foreign competitors.

In other words, foreign banks have great capacity to allocate and monitor credit and therefore they participate to increase the supply of funds and credits in their host countries. At this point, it can be expected that foreign banks are more efficient than domestic banks. However, foreign banks have to be integrated in a new geographical, cultural and institutional environment that can restrict and hamper their activities. Also, domestic banks can acquire information much more easily than foreign banks. Therefore, foreign banks have difficulties to collect and interpret the information.

Research Problem

With the new challenge of Algerian economy after oil prices drop, and the necessity to finance the real economy in order to diversify it, the banking system must deal efficiently. In addition, the very quick development known by foreign banks that should be maintained in the coming years drive us to ask the following question:

Do foreign banks operate efficiently in Algeria?

In order to answer this problem, we ask the following questions: How efficient are banks operating in Algeria? Are foreign banks more or less technical efficient than domestic banks in this country? Are domestic banks more or less scale efficient than domestic banks?

Research hypothesis

To answer the question, we develop two hypotheses:

-The first one supposes that the efficiency of the banking system in Algeria is growing during the period of study. In fact, the entry of foreign banks in a banking system brings competition, knowledge and technological innovation that should improve the overall efficiency.

-The second Hypothesis indicates that foreign banks are more efficient than domestic banks. Thus, foreign banks have more experience than domestic banks and should outperform the banking system.

Importance of the research

Problem examined in this research is of great importance since very little studies have been conducted to measure foreign banks efficiency in Algeria.

In addition, it is very important to know how foreign banks perform in Algeria and their impact (either positive or negative) on domestic banks performance and efficiency. Therefore, the effort of this country to develop an efficient financial system and to bring more competition to the banking system by implementing foreign banks in the economy could be justified.

Research objectives

The objective of this research is to measure the technical efficiency of both conventional domestic banks and foreign banks in Algeria by using a non-parametric frontier approach that is "Data Envelopment Analysis". Thus, we aim to compare the performance of foreign banks with the performance of domestic banks, and then, we could decompose banks technical efficiency to pure technical efficiency and scale efficiency. Hence, we could conclude which banks have higher pure technical efficiency scores and which have higher scale efficiency scores.

Research limitations

This research studies the efficiency of the banking system in Algeria during the period from 2009 to 2013. It covers seven foreign banks and two domestic banks. The research is limited to non-parametric methods to measure banks technical efficiency.

Research methodology

In order to measure bank efficiency, we use a statistical method. In fact, a nonparametric method is employed which is Data Envelopment Analysis (DEA). This method is widely employed in developed countries to measure the relative bank efficiency. In fact, DEA permits to identify in a set of decision-making units (DMUs), units that are efficient and those that are not by attributing a score to each unit. The main purpose to use this method is that it gives robust results even when the size of sample is small. In addition, DEA allows us to compare DMUs with different size.

Structure of the research

The reminder of this article is organized as follow. The section presents the bank efficiency while the second one review some last studies about foreign banks efficiency. The third section introduces the data used in the study and the methodology. Section four discusses the results and the last section concludes.

I. Bank efficiency: Background

Studies about economic efficiency appear very later in the literature. According to neoclassical point of view, all decision-making units are assumed to employ resources efficiently. In 1951, Koopmans gave a formal definition of technical efficiency. Later, Debreu (1951) and Farrell (1957) introduced a measure of efficiency.^{ix}

I.1. Bank efficiency definition

If the definition of Farrel (1957)^{lxii} is hold, the efficiency of bank means its success in producing as large as possible an output (credit for example) as possible from a given set of inputs (that can be personnel expenses, fixed assets...etc.). In other word, a bank is said to be efficient, if and only if, it can generate output level and mix that maximizes profits and minimizes costs.

Habitually, bank efficiency can be decomposed into *allocative efficiency* and *technical efficiency*. The first occurs when a bank is able to use optimum inputs in optimal proportion to produce the desired level of outputs at specific prices and production technology^{lxiii}, while the latter refers to the ability of a bank to transform inputs into outputs optimally with no waste. It seems obvious that the product of allocative and technical efficiency forms what is known as cost, overall or productive efficiency.^{lxiii}

On the other hand, the technical efficiency is composed of *pure technical efficiency* and *scale efficiency*. A bank is said to be pure technical efficient when it can optimizes its production for a certain level of inputs. However, scale efficiency measures the impact of scale size on the productivity of a bank.^{lxiv}

I.2. Methods used to measure bank efficiency

There are different methods that can be used to measure bank efficiency. These methods belong to two categories of frontier analysis approach:^{lxv}

- Parametric methods: these methods have to previously specify a functional form for the efficiency frontier, as well as making assumptions on the distribution of the error term and the inefficiency. There are three main parametric methods used conventionally to measure bank efficiency: *Stochastic Frontier Approach* (SFA), *Thick Frontier Approach* (TFA), *Distribution Free Approach* (DFA).

-Nonparametric methods: the biggest advantage of nonparametric methods is their flexibility, since no functional form has to be specified for the frontier or the error term. However, due to their deterministic nature, they cannot separate inefficiency from random error. They include approaches such as Data Envelopment analysis and Free Disposal Hull.

No consensus exists as to which method is most appropriate to determine the efficiency. However, Stochastic Frontier Approach is the most popular technique for parametric methods while Data Envelopment analysis still the most accepted technique for nonparametric methods.

I.3. Approaches to determine bank inputs and outputs

In most industries, it is easy to identify inputs and outputs of firms. However, in the banking sector, it is difficult to choose which factors can be considered as inputs and which factors can be viewed as outputs. To determine bank inputs and outputs, two methods coexist; the *production approach* and the *intermediation approach*.

The production approach considers the bank as a firm that uses inputs (as costs of labor and physical capita) to produce outputs that are measured by the

number of each type of account, such as commercial and industrial loans, mortgages, and deposits. On the other hand, the intermediation approach considers a bank production process to be one of financial intermediation, that is, the borrowing of funds and the subsequent lending of those funds^{lxvi}. Under this approach, bank inputs could be fixed assets, personnel expenses and deposits (deposits and short-term funds) where outputs could be net loans, other earning assets and non-interest income^{lxvii}. Most studies use the latter method to specify the bank inputs and outputs, and this study is not an exception.

II. Foreign banks efficiency: Related Literature Review

Generally, the literature argues that foreign banks are more efficient in developing countries than in developed ones. In fact, foreign banks can use their experiences and their high technologies for risk pricing, screening and monitoring of loans granted to minimize risks and losses. As a result foreign banks can achieve their objectives at lower cost and outperform domestic banks in developing countries. However, in developed countries, foreign banks face a strong competition that can hamper their efficiency. In this section a brief literature about foreign banks efficiency is given.

DeYoung and Nolle (1996)^{lxviii} and Berger *et al.* (2000)^{lxix} find that foreign banks are less efficient than domestic banks in developed countries. Later, Claessens *et al.* confirm this fact. (2001)^{lxx}. However, for developing countries the reverse is true. The study done by Claessens *et al.* (2001) shows that foreign banks are more profitable and efficient than domestic banks in developing countries.

Cook *et al.* (2001)^{lxxi} use panel data covering the period 1992-1997 of Tunisian banking system. They focus specially on the effect of financial liberalization on the efficiency of Tunisian banks. The relative efficiency of banks is assessed using the non-parametric technique Data Envelopment Analysis (DEA). The results show that foreign banks outperform domestic banks and private banks are more efficient than public banks.

Weill (2003)^{lxxii} examines the effect of the increasing share of the banking sector controlled by foreign capital on the performance of the banking system in Czech Republic and Poland. He finds that foreign banks are more efficient than domestic banks. However, the source of this efficiency is not from differences in the scale of operations or the structure of activities. On the other hand, Yildirim and Philippatos (2003) conclude that foreign banks are more cost efficient but less profit efficient relative to domestically owned private banks and state-owned banks.

Sturm and Williams (2004)^{lxxiii} use panel data of banks operating in Australia during the time period of 1988 to 2001. The sample is constituted of 14 domestic banks (from which four banks dominant called big four) and 18 foreign banks. Using DEA method to measure bank efficiency, two models are developed. Results show that the average technical efficiency varies from 0.73 to 0.94. The technical inefficiency is essentially due to scale efficiency. Big four banks has higher level of pure technical efficiency but suffer from lower scale efficiency. Thus, big four banks are not operating at the optimum scale. Other results show that

foreign banks are more input efficient than domestic banks. One explanation to this fact is the superior scale efficiency attributed to foreign banks. However, model 2 indicates that foreign banks are less profitable than domestic banks, which is consistent with the findings of Claessens *et al* (2001).

Fang, Hasan and Marton (2011)^{lxiv} study the cost and profit efficiency of banking sectors in six South-Eastern Europe countries over the period 1998–2008. The analysis shows that banks in SEE are more cost efficient than profit efficient. In addition, foreign banks are associated with higher profit efficiency but moderately lower cost efficiency. On the other hand, publicly owned banks are associated with lower profit efficiency. Further, the efficiency gap between foreign banks, domestic private banks and government banks is narrowing over time.

III. Data and methodology

In order to measure foreign banks efficiency in Algeria, we use the sample and the methodology introduced in the following subsections.

III.1. Sample presentation

To compare the bank efficiency of foreign and domestic banks in Algeria, a sample of 9 banks (seven foreign banks and two publicly owned banks) operating during the period of 2009 to 2013 is used. The data employed to specify the DEA inputs and outputs is obtained from annual reports of banks. The list of banks used in the sample is presented in table 1 in the appendix.

We choose the intermediation approach to specify bank inputs and outputs. Because of limitations in data available, inputs selected are: fixed assets, general operating expenses and deposits. On the other hand, outputs chosen are : net loans, other earning assets and noninterest income.

III.2. Statistical analysis of data

Table 2 to table 7 resume average inputs and outputs of whole sample and for foreign banks and domestic banks of the sample separately. The first comment is about the size of banks. In fact domestic banks are larger and should use more inputs to produce more outputs. For example, the size of fixed assets for domestic banks is about five times fixed assets of foreign banks. Thus, a fair comparison between foreign and domestic banks in Algeria appears to be difficult if not impossible. However, the use of data envelopment analysis makes the study feasible.

Another remark is about the tendency of inputs and outputs for foreign and domestic banks. Note that foreign banks fixed assets knows an augmentation of 193%, they passed from 1252 millions of dinars in 2009 to 3675 millions of dinars in 2013. However, domestic banks fixed assets know a decline of 14.5%, that is, they passed from 22110 millions of dinars in 2009 to 18895 millions of dinars in 2013.

For deposits and loans, it is important to mention that domestic banks have the great part. However foreign banks know a very quick development. Thus, foreign banks deposits get an augmentation of 155% during the period of study

against an increase of 82% for domestic banks deposits. In addition, foreign banks loans grow about 128% against an augmentation of only 59% for domestic banks loans.

III.3. Methodology

As mentioned earlier, the literature uses two different methods: parametric method and nonparametric method in order to measure bank efficiency. The first one uses a set of specifications for inputs and outputs and uses econometric methods in order to know how much the bank is far from the efficiency frontier. While the second method presents some merits and is more appropriate to this study.^{lxv}

One nonparametric method that can be used to measure bank efficiency is Data Envelopment Analysis (DEA). The roots of this method go back to primary Farrel researches that introduced the efficiency concept^{lxvi}. However, the first DEA model is developed by Charnes, Cooper and Rhodes (1978)^{lxvii}. DEA is a linear programming technique that produces a best-practices frontier composed of efficient Decision-Making Units. It is important to mention that DEA is an extreme point method and compares each producer with only the "best" producers therefore the data envelopment analysis estimates are relative estimates and not absolute estimates.

The DEA model introduced by Charnes, Cooper and Rhodes (1978), usually called CCR model, assumes constant return to scale (CRS). Constant return to scale presumes that all DMU's are operating at the optimum scale. It permits to evaluate efficiency of DMUs especially when they differ in size.

Suppose that every DMU uses "m" inputs to produce "s" outputs. Thus, if there are n DMU_j (where j = 1, 2, ..., n), the DMU_j has outputs and inputs value as follow :

$$\left. \begin{aligned} X_j &= (x_{1j}, x_{2j}, \dots, x_{mj}) > 0, j = 1, 2, \dots, n \\ y_j &= (y_{1j}, y_{2j}, \dots, y_{sj}) > 0, j = 1, 2, \dots, n \end{aligned} \right\} \quad (1)$$

For these inputs and outputs, the weights vector of input and output are : $(v = v_1, v_2, \dots, v_m)$ and $(u = u_1, u_2, \dots, u_s)$.

The efficiency of each DMU is the ratio of sum of weighted outputs to sum of weighted inputs. Let's "h_j" the efficiency of DMU_j and equals to:

$$h_j = \frac{u' y_j}{v' x_j} = \frac{\sum_{k=1}^s u_k y_{kj}}{\sum_{i=1}^m v_i x_{ij}}, j = 1, 2, \dots, n \quad (2)$$

The larger h_{j_0} , the more efficient is DMU j_0 and more able to produce higher level of outputs using the same (even less) level of inputs. In order to determine if this DMU is the best efficient one in the sample, our initiative is to

maximize the ratio h_j . Charnes, Cooper and Rhodes (1978) develop the following model:

$$\max h_{j0} = \frac{\sum_{k=1}^s u_k y_{kj}}{\sum_{i=1}^m v_i x_{ij}}$$

Subject to:

$$\frac{\sum_{k=1}^s u_k y_{kj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \quad (3)$$

$$u_{ik}, v_{im} \geq 0$$

where :

$$j = 1, 2, \dots, n$$

$$k = 1, 2, \dots, s$$

$$m = 1, 2, \dots, m$$

This can have an infinite number of solution this is why a constraint $v'xi = 1$ should be introduced. The linear programming problem is developed into:

$$\text{Max } h_{j0} = \sum_{k=1}^s u_k y_{kj0}$$

Subject to:

$$\sum_{i=1}^m v_i x_{ij0} = 1$$

$$\sum_{k=1}^s u_k y_{kj} - \sum_{i=1}^m v_i x_{ij} \leq 0, j = 1, \dots, n$$

$$u_k \geq 0, k = 1, \dots, s$$

$$v_i \geq 0, i = 1, \dots, m$$

(4)

By solving the linear programming (4) for different " j_0 ", the efficiency scores " h_j " relative to each DMU are obtained. The efficiency value " h_j " lies between the value of "0" and "1". An efficient DMU has an efficiency value of "1", meaning that the DMU is positioned on the efficient frontier. However, if h_j is less than "1" the DMU is less efficient.

Equivalently, using the duality property to solve this linear programming problem, the following envelopment can be derived:

$$\min \theta_i \quad \text{Subject to :} \quad (5)$$

$$- y_{kj} + \sum_{j=1}^n \lambda_j y_{jk} \geq 0, k = 1, \dots, s$$

$$\theta_j x_{ij} - \sum_{j=1}^n \lambda_j x_{ij} \geq 0, i = 1, \dots, m$$

$$\lambda_i \geq 0$$

Where: λ is an N by 1 vector of constants and θ , a scalar, is the efficiency score for the *i*th DMU. The above formulas assume constant returns to scale (CRS) when all DMUs are presumed to operate at the optimal scale.

Banker, Charnes and Cooper(1984)^{lxviii} suggested an extension of the CRS DEA model and develop the BCC model. By adding a convexity constraint $\sum \lambda_j = 1$ to the previous problem (where $\mathbf{1}$ is N by 1 vector of one), the BCC model accounts for variable returns to scale (VRS). Therefore, by adding restriction on λ_j , Banker, Charnes and Cooper transform constant returns to scale model to variable returns to scale. Scores from BCC model also called "pure technical efficiency score" eliminate scale efficiency from the analysis. It is obvious that efficiency values obtained from CCR model are equal to or less than efficiency values obtained from BCC model. The reason for this is that the BCC model compares each DMU to a subset of DMUs operating in the same region of returns to scale while the CCR model deal with subset of DMUs from different scales.

IV. Results and Discussion:

When using the CCR model, the results (as indicated in table 8 and figure 1) show that, on average, domestic banks are more efficient than foreign banks in Algeria during the period of 2009 to 2013. This finding is opposite to the results of Cook et al. (2001) or Grigorain & Manole (2002)^{lxvix}. In fact, domestic banks in Algeria are subsidized by the government. According to Bank of Algeria data, Public Treasury repurchases non-performing loans of 125 687 milliards of dinars for public banks during the year of 2011. This intervention of the government in the banking system impedes the competition in this market.

Note that there is an improvement in the efficiency of the whole sample from 2009 to 2011. This may be explained by the introduction of new foreign banks that facilitate the overall efficiency advancement by bringing technological innovations and new managerial practices. This is the same point of view of Delis & Papanikolaou (2009)^{lxvix}. However, the efficiency of the whole sample knows a certain decline since 2011.

Another result is the inversed tendency between domestic banks efficiency and foreign banks efficiency from 2012 to 2013. In fact, domestic banks know a reduction in the efficiency score while foreign banks experience an improvement. The decrease in the efficiency score of domestic banks can be justified by the

decrease of oil deposits compared to term deposits that are more costly for banks. In addition, The Treasury does not repurchase any non-performing loans in 2013. For foreign banks, deposits continue to improve. They attain 33.3% and 12% of growth in 2012 and 2013 respectively against - 4% and 5.4% for domestic banks. In addition, foreign banks in Algeria have a very small percentage of nonperforming loans (about 4.8% in 2013).^{lxxxii}

By decomposing the technical efficiency obtained previously into pure technical and scale efficiency (as presented in table 9), the following findings can be discussed:

First, for the whole sample, banks are more pure technical efficient than scale efficient. It does mean that banks in Algeria are more able to produce at minimum level of input as the certain level of output allows than cooperate at the most productive scale to achieve higher returns at lower costs.

Second, Domestic banks attains higher pure technical efficiency scores. One exception is for the year 2013 when foreign banks attains a pure technical efficiency score of 92% against only 88% for domestic banks. This confirms the effect of government intervention in the public banks.

Third, domestic banks operate at a more convenient scale. Those banks obtained higher scale efficiency scores than foreign banks during all the period of study.

Forth, two of the seven foreign banks succeed to obtain the score of 100% for both pure technical and scale efficiency during the period of study. Thus, foreign banks can achieve higher efficiency scores despite barriers carry out by the state.

V. Conclusion

This article is one of the first studies about bank efficiency in Algeria. The aim of the study is to examine foreign bank efficiency compared to domestic publicly owned banks. For the purpose of the study, data envelopment analysis is used to measure bank efficiency scores of 9 banks operating from 2009 to 2013.

The intermediation approach is used to identify bank inputs and outputs. The analysis of these variables indicates that foreign banks are too small compared to domestic banks. Further, the results show that domestic banks are more technical efficient than foreign banks. One explication can be the government help for publicly owned banks by the repurchase of nonperforming loans. In 2013, the domestic banks efficiency decrease when the government does not intervene. On the other hand, foreign banks efficiency is increasing as their part in the market. Effectively, foreign banks presence in the economy and in the banking system is growing very quickly.

The first hypothesis is somewhat maintained. Certainly, the bank efficiency of the whole sample grows positively from 2009 to 2011. However, the second hypothesis is rejected by the effect of government intervention. Note that data envelopment analysis proves another time that it is a useful tool to measure bank efficiency and should be employed to evaluate the efficiency of banking industry.

Finally we develop the following recommendations:

- Foreign banks have to increase their size to approach domestic banks sizes. This can improve foreign banks scale efficiency in order to get more technical efficiency.
- In addition, government must implement more liberalization in the banking system in order to achieve benefits from fair competition;
- Data Envelopment Analysis should be used more frequently in order to measure the efficiency of decision-making units (and therefore, the efficiency of banks).

Appendices

Table 1: List of banks used in the sample

Bank name	Foreign/domestic
Arab Bank Corporation ABC	Foreign
Algeria Gulf Bank AGB	Foreign
BNP Paribas El Djazaïr	Foreign
Fransabank El Djazaïr SPA	Foreign
Housing Bank For Trade and Finance – Algeria	Foreign
Société générale Algérie	Foreign
Trust Bank Algeria	Foreign
Banque Extérieur d'Algérie	Domestic
Banque Nationale d'Algérie	Domestic

Table 2: Average Banks Inputs from 2009 to 2013 for the whole sample (in millions dinars)

Year	2009	2010	2011	2012	2013
Fixed assets	4 728	6 148	6 327	6 750	5 849
General operating expenses	4 894	3 666	396 743	5 431	4 850
Deposits	182 324	374 003	396 743	415 786	314 049

Source: Computed by authors using Excel program

Table 3: Average Banks Inputs from 2009 to 2013 for domestic banks of the sample (in millions dinars)

Year	2009	2010	2011	2012	2013
Fixed assets	22 110	21 976	21 464	21 318	18 895
General operating expenses	8 866	9 655	12 956	15 791	16 196
Deposits	925 048	1 523 506	1 608 372	1 648 942	1 680 611

Source: Computed by authors using Excel program

Table 4: Average Banks Inputs from 2009 to 2013 for foreign banks of the sample (in millions dinars)

Year	2009	2010	2011	2012	2013
Fixed assets	1 252	1 625	2 002	2 588	3 675
General operating expenses	1 765	1 954	2 244	2 471	2 959
Deposits	33 780	45 573	44 243	63 455	86 289

Source: Computed by authors using Excel program

Table 5: Average Banks outputs from 2009 to 2013 for the whole sample (in millions dinars)

Year	2009	2010	2011	2012	2013
Net loans	176 083	350 025	386 686	397 946	269 922
Other earning assets	23 007	54 073	58 378	52 007	30 435
Noninterest income	7 610	28 173	25 131	23 842	9 321

Source: Computed by authors using Excel program

Table 6: Average Banks outputs from 2009 to 2013 for domestic banks of the sample (in millions dinars)

Year	2009	2010	2011	2012	2013
Net loans	876 073	1 387 776	1 544 118	1 567 338	1 394 534
Other earning assets	131 365	240 946	260 347	231 654	208 109
Noninterest income	27 306	112 918	97 406	89 691	40 126

Source: Computed by authors using Excel program

Table 7: Average Banks outputs from 2009 to 2013 for foreign banks of the sample (in millions dinars)

Year	2009	2010	2011	2012	2013
Net loans	36 084	3 666	55 991	63 835	82 487
Other earning assets	1 335	681	673	680	822

Noninterest income	3 671	3 961	4 480	5 218	4 186
---------------------------	-------	-------	-------	-------	-------

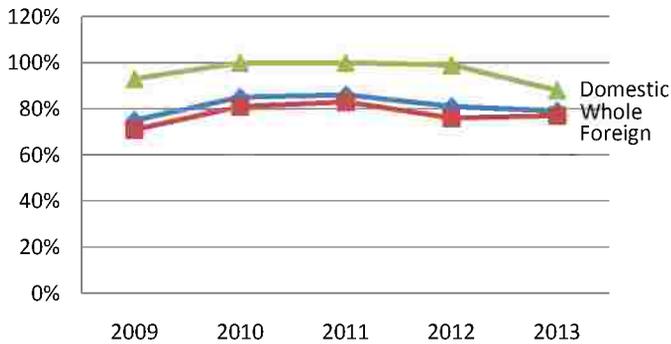
Source: Computed by authors using Excel program

: Banks technical efficiency from 2009 to 2013

RTS	Constant Return to Scale Technical Efficiency				
Year	2009	2010	2011	2012	2013
Whole	75%	85%	86%	81%	79%
Foreign	71%	81%	83%	76%	77%
Domestic	93%	100%	100%	99%	88%

Source: Computed by authors using MaxDEA Basic 6.4 program

Figure 1: Banks Efficiency from 2009 to 2013



Source: Computed by authors using Excel program

Table 9: Decomposition of bank technical efficiency

Efficiency	2009		2010		2011		2012		2013	
	PT E	S E	PT E	SE						
whole	86%	87%	99%	86%	96%	90%	90%	90%	91%	86%
foreign	83%	85%	98%	86%	95%	87%	87%	88%	92%	84%

	%	%	%	%	%	%	%	%	%	%
domestic	96 %	96 %	100 %	100 %	100 %	100 %	100 %	99 %	88 %	100 %

Source: Computed by authors using MaxDEA Basic 6.4 progra

¹Fried, H., Lovell, C., Schmidt, S., "The measurement of productive efficiency and Productivity growth", Oxford University Press, USA, 2008, p20

¹Farrell M., "The Measurement of Productive Efficiency", Journal of the Royal Statistical Society, Series A, Part III, 1957,pp: 253-281.

¹Yi-Kai C., "Three Essays on Bank Efficiency", Doctoral thesis, Drexel University, United States of America, 2001, p26.

¹IBID, p27.

¹Thanassoulis, E., "Introduction to the theory and application of Data Envelopment analysis", Kluwer Academic Publishers, USA., 2001, p140

¹Monsalvez J., Tortosa-Ausina E., "Social Capital and bank performance: an international comparison for OECD countries", BBVA foundation's working paper, Rogar edition, Spain, 2007, p15

¹Thakor, A., Boot, A., "Handbook of Financial Intermediation and Banking", Elsevier, USA, 2008, pp: 151-152.

¹Falzon, J., "Bank performance, risk and securitization", Edition Illustrée, Palgrave Macmillan, 2013, p196

¹DeYoung, R. &Nolle, D., "Foreign-owned banks in the US: Buying market share of earning it? ", *Journal of Money, Credit, and Banking* 28, 1996, pp: 622-636.

¹Berger, A., Deyoung, R., Genay, H., Udel, G.,"Globalization of financial institutions: Evidence from cross-border banking performance", Brookings-Wharton Papers on Financial Services 3, 2000, pp: 23-158.

¹Claessens, S., Demirguc-Kunt, A., Huizinga, H., "How does foreign entry affect the domestic banking market?", *Journal of Banking and Finance* 25, 2001, pp: 891-911.

¹ Cook, W., Hababou, M. and Roberts G.,"The Effects of Financial Liberalization on the Tunisian Banking Industry: A Non-Parametric Approach", Presented at: INFORMS national meeting [in Risk management I], San Antonio, United States of America, 5/11 to 8/11/ 2001

¹Weill L., "Banking efficiency in transition economies: The role of foreign ownership", *The Economics of Transition* 11, 2003, pp: 569-592.

¹Sturm, J. & Williams, B., "Foreign Bank Entry, Deregulation and Bank Efficiency: Lessons from the Australian Experience", *Journal of Banking & Finance* 28, 2004, pp: 1775-1799.

¹Fang, Y., Hasan, I., Marton K. (2011), "Bank efficiency in transition economies: recent evidence from South-Eastern Europe",*Bank of Finland Research Discussion Papers* 5, 2011

¹For a comprehensive literature and further comparison between the two methods see Berger, A., & Humphrey, D. (1997)

¹Farrell M., OP-CIT, pp: 253-281.

¹Charnes, A., Cooper, W., Rhodes, E., "Measuring Efficiency of Decision Making Units", *European Journal of Operations Research* 2, 1978, pp: 429-444.

¹Banker, R., Charnes, A., Cooper, W., "Some Models for Estimating Technical and Scale Efficiencies in Data Envelopment Analysis", *Management Science*, Vol. 30, No. 9, 1984, pp: 1078-1092.

¹Grigorian, D. and Manole V., "Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis", World Bank Policy Research Working Paper 2850, 2002.

¹ Delis, M. & Papanikolaou, N., "Determinants of bank efficiency: Evidence from a semi-parametric methodology," MPRA Paper 13893, University Library of Munich, Germany, 2009, p18.

¹ These statistics are brought from Bank of Algeria annual reports for 2012 and 2013.

References

Bank of Algeria annual report, 2012.

Bank of Algeria annual report, 2013.

Banker, R., Charnes, A., Cooper, W., "Some Models for Estimating Technical and Scale Efficiencies in Data Envelopment Analysis", *Management Science*, Vol. 30, No. 9, 1984, pp: 1078-1092.

Berger, A., Deyoung, R., Genay, H., Udel, G., "Globalization of financial institutions: Evidence from cross-border banking performance", *Brookings-Wharton Papers on Financial Services* 3, 2000, pp: 23–158.

Berger, A., & Humphrey, D., "Efficiency of Financial Institutions: An International Survey and Directions for Future Research", *European Journal of Operational Research* 98, 1997, pp: 175-212.

Charnes, A., Cooper, W., Rhodes, E., "Measuring Efficiency of Decision Making Units", *European Journal of Operations Research* 2, 1978, pp: 429–444.

Claessens, S., Demircuc-Kunt, A., Huizinga, H., "How does foreign entry affect the domestic banking market?", *Journal of Banking and Finance* 25, 2001, pp: 891–911.

Cook, W., Hababou, M. and Roberts G., "The Effects of Financial Liberalization on the Tunisian Banking Industry: A Non-Parametric Approach", Presented at: INFORMS national meeting [in Risk management I], San Antonio, United States of America, 5/11 to 8/11/2001.

Delis, M. & Papanikolaou, N., "Determinants of bank efficiency: Evidence from a semi-parametric methodology," MPRA Paper 13893, University Library of Munich, Germany, 2009.

DeYoung, R. & Nolle, D., "Foreign-owned banks in the US: Buying market share of earning it? ", *Journal of Money, Credit, and Banking* 28, 1996, pp: 622-636.

Falzon, J., "Bank performance, risk and securitization", Edition Illustrée, Palgrave Macmillan, England, 2013

Fang, Y., Hasan, I., Marton K., "Bank efficiency in transition economies: recent evidence from South-Eastern Europe", *Bank of Finland Research Discussion Papers* 5, 2011.

Farrell M., "The Measurement of Productive Efficiency", *Journal of the Royal Statistical Society, Series A, Part III*, 1957, pp: 253-281.

Fried, H., Lovell, C., Schmidt, S., "The measurement of productive efficiency and Productivity growth", Oxford University Press, USA, 2008.

Grigorian, D. and Manole V., "Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis", World Bank Policy Research Working Paper 2850, 2002.

Monsalvez J., Tortosa-Ausina E., "Social Capital and bank performance: an international comparison for OECD countries", BBVA foundation's working paper, Rogar edition, Spain, 2007.

Sturm, J. & Williams, B., "Foreign Bank Entry, Deregulation and Bank Efficiency: Lessons from the Australian Experience", *Journal of Banking & Finance* 28, 2004, pp: 1775–1799.

Thakor, A., Boot, A., "Handbook of Financial Intermediation and Banking", Elsevier, USA, 2008, pp: 151-152.

Thanassoulis, E., "Introduction to the theory and application of Data Envelopment analysis", Kluwer Academic Publishers, USA, 2001.

Weill L., "Banking efficiency in transition economies: The role of foreign ownership", *The Economics of Transition* 11, 2003, pp: 569-592.

Yi-Kai C., "Three Essays on Bank Efficiency", Doctoral thesis, Drexel University, United States of America, 2001.

Yildirim, S. & Philippatos, G., "Competition And Contestability In Central And Eastern European Banking Markets", *Finance* 0310004, EconWPA, 2003.