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EFFICIENCY OF COMMERCIAL BANKS IN DEMOCRATIC REPUBLIC OF CONGO: AN APPLICATION OF DATA ENVELOPMENT ANALYSIS

By

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ABSTRACT

Utilizing the Data Envelopment Analysis (DEA), this study is an analysis of the impact of reform process undertaken on the efficiency of commercial banks across their ownership operating in Democratic Republic of Congo (DRC) during 2012-2018. Fifteen banks were involved in the study. The key findings of this analysis suggest that foreign banks tend to outperform local banks in terms of efficiency. The reform process improved the efficiency of Congolese banking system during the study period. The lack of innovation, quality governance and other new methods in collecting deposits and granting loans explains the poor productivity of local banks compared to their international counterparts.

Keywords: *Banking system, Bank, efficiency, Data Envelopment Analysis, Malmquist Index.*

RESUME

Ce papier s'est proposé d'analyser l'efficience des quinze banques congolaises tout au long de la période s'étalant de 2012 à 2018. Quinze banques étaient impliquées dans cette étude. 2En vue d'évaluer l'efficience de ces banques, nous avons utilisé les méthodes non paramétriques plus spécifiquement l'analyse par enveloppement des données (DEA). Nos résultats permettent de conclure que les banques étrangères réalisent les meilleurs scores d'efficience par rapport à leurs homologues congolaises. La détérioration de l'efficience de ces dernières tient notamment à la faiblesse de l'innovation, la prédominance des crédits dirigés et à la lenteur des reformes structurelles qui fait obstacle au développement du secteur privé. En conséquence, la modernisation des systèmes d'information, la gestion des compétences et la réduction des coûts opérationnels devraient être privilégiés par les banques congolaises.

Mots clés : *Système bancaire, Banque, efficience, Analyse par Enveloppement des Données, Indice de Malmquist.*

I. INTRODUCTION

Before the onset of the reform process, Congolese banking was operating in a relatively regulated and protected environment. The banking industry grew at a fast pace after 2002, but it was felt that the efficiency of the financial system was not to be measured only by quantitative growth in terms of branch expansion and growth in deposits and advances. In the Democratic Republic of Congo (DRC), it is evident that some banks have suffered considerable losses as a result of start-up and development costs.

This may explain the high concentration of banking activities in Kinshasa because most banks' operating offices are in the capital to minimize certain costs such as electricity in order to maximize their profitability. Indeed, electrical energy and internet are cheap and available in capital of DRC whereas they may cost a lot in provinces.

The Congolese financial sector has recovered from the global financial crisis of 2009 but is at a crossroads. Although reforms have been initiated, the system remains shallow, highly dollarized, and characterized by balance sheet fragilities. The authorities have announced a de-dollarization process, but greater progress on reforms to strengthen the financial system is needed to support financial deepening and economic growth.

The financial sector reforms undertaken in the early 2000s of the twenty first century paved way for remarkable changes in the functioning of the Congolese banking business.

With the entry of Pan-African banks and the foreign banks, the local banks have to face more competition. The reforms have been taking place in a phased manner since the year 2002.

It has been observed that those banks that are more efficient will perform better in the long term.

Further, there has been always a notion on the differential performance of banks across different ownerships. It is generally felt that the ownership should be affecting the efficiency of the respective bank as the incentives for managers to efficiently allocate resources might differ under different ownership arrangements. If owners do not have the incentive or if they lack the required capability and skills to monitor the activity of management, then it might increase the agency problems and subsequent costs are thought to increase. In particular it is felt that international-owned banks will be relatively more efficient as compared to Pan-African banks as well as Congolese local banks as their corporate governance is of international standards. Also, it is expected that local banks are relatively inefficient due to complacency and seniority

(rather than performance) based promotions, poor governance, mismanagement, lack of technology and connected lending.

Foreign banks are generally placed higher than local banks in these regards. Thus it will be of great importance to study how banks are performing across the different ownership structures in a competitive arena following continuous efforts on the part of the regulators to strengthen the ongoing phase of reforms.

Thus, this study will study the impact of reform process on the Congolese banking sector in terms of identifying those banks which are doing well in the competition created by liberalization. It will help the decision makers to evaluate that how are the banks performing in increased competitive pressures following reform process. This study will also be helpful in taking decisions on closure of non-performing banks or merging them with more efficient banks. The policy makers can assess how the local banks are performing relative to their Pan-African and foreign counterparts. Knowledge of efficient banks is equally important for consumers as efficient banks tend to have lower service charges, better loan, deposit rates as well as quality services to offer.

Though many research studies have been conducted in the West on the efficiency of the banks, few empirical studies have been done in the emerging economies. There is no studies carried out to evaluate the impact of reform process on efficiency of the banks in the Congolese context.

The objectives of this study are as under:

- Analyze for the first time the efficiency and the productivity of Congolese banks across their ownership;
- Use for the first time the non-parametric method to measure bank efficiency across their ownership in DRC;
- Provide some fresh insights with respect to the Congolese environment.

The rest of the paper is organised as follows. Section Two discusses the literature review. Data and methodology are presented in section Three. The results are discussed in Section Four. The paper closes with Concluding remarks and policy recommendations.

II. LITERATURE REVIEW

The need to evaluate efficiencies is highlighted in wake of ongoing reforms initiated in the Congolese banking sector since early 2000s. An in-depth understanding of experiences and findings of other researchers would be quite useful in streamlining the framework of the current study.

Nițoia and Spulbar (2015) has used the heteroscedastic stochastic frontier model to investigate the commercial banks cost efficiency differences in six emerging countries from Central and Eastern Europe over the period 2005 to 2011. Also, they highlight the determinants of banks cost efficiency.

The results showed that a high macroeconomic stability supports the efficiency of commercial banks. Also, banks which undertake higher risks are more inefficient. Therefore, banks with less liquidity, with a lower solvency rate and a higher credit risk are more inefficient than more cautious credit institutions.

Maria Chelo V. Manlagnit (2015) examined the impact of Basel II on the cost efficiency of Philippine commercial banks from 2001 to 2011 using stochastic frontier analysis. The overall mean cost efficiency estimate was 0.75, indicating substantial inefficiencies in the banks averaging to 25% of total costs. The findings showed that higher capital requirement tends to improve the cost efficiency but more powerful supervisors can adversely affect the efficiency of the banks. The other explanations of the efficiency of the banks were risk, asset quality and bank-specific variables.

Samina Riaz (2016) carried out the study on factors affecting the efficiency of risk management in the Pakistani banking industry using a panel regression analysis for the period covering 2009 to 2013. He found a positive relationship between the liquidity, profitability, operating efficiency, merger and economic growth with capital adequacy ratio while the asset portfolio risk and inflation rates have the opposite effect.

Barros et al (2016) studied the technical efficiency of Angolan banks from 2005 to 2012 using a Bayesian stochastic frontier model. The results revealed that Angolan banks were very efficient and that efficiency varies little among the banks analyzed. Furthermore, the differences in efficiency between foreign banks, public banks, large sized banks and banks that belong to a local conglomerate were examined. It was concluded that the greatest efficiency was to be found in the case of foreign banks. Since size and conglomerate membership did not seem to lead to greater bank efficiency, it was proposed that Angolan policymakers should promote competition in the banking sector.

S. Abel (2017) estimated the profit efficiency of the commercial banks in Zimbabwe using Data Envelopment Analysis method. His results suggested that Commercial Banks in Zimbabwe are profit inefficient. The average profit efficiency of the banks for the period was 80 per cent. This implied that the best performing bank used fewer resources in generating profits compared to the average bank in the sample. The lowest level of inefficiency during the study period was experienced in the first half of 2009 as a result of the challenges banks experienced in transitioning from hyperinflation to stable economic environment.

Fukuyama and Matousek (2017) developed a bank network revenue function to evaluate Japanese banks' network revenue performance from September 2000 to March 2013. Their findings showed that Japanese Regional

Banks have not achieved the optimal levels in their production processes and the main source of bank inefficiency came from allocative efficiency.

They concluded that Regional Banks, and in particular Regional Banks II, should expand their activities in securities and other earning assets.

Thi Lam Anh Nguyen (2018) examined the impact of diversification on cost and profit efficiency of commercial banks from six ASEAN countries over the period 2007–2014. Measured using the stochastic frontier approach (SFA), the average cost efficiency scores for these countries ranged from 0.7922 to 0.8108 and the average profit efficiency scores range from 0.3009 to 0.3385. The regression results indicated that more income-diversified banks have lower cost efficiency while more asset-diversified banks have only lower persistent cost efficiency. More funding-diversified banks enjoyed higher profit efficiency, while more asset-diversified banks enjoyed only higher persistent profit efficiency. Funding-diversified banks with majority government ownership demonstrated higher cost efficiency but lower profit efficiency than other banks, while both funding and asset diversification made foreign banks less profit efficient.

Adesina (2019) examined the effects of intellectual capital (IC) on technical, allocative and cost efficiencies for a panel of 339 commercial banks operating in 31 African countries over the

2005–2015 period. Their findings, which are based on Tobit and one-step system GMM regressions, provided evidence that IC exerts positive effects on bank technical, allocative and cost efficiencies.

Thus, it may be observed that reform process literature from the rest of the world provides no conclusive findings to suggest Congolese policy makers to foresee the impact of the new banking law (Law n° 003/2002 of 2002, February, 2nd) and reform process. Hence this study will provide some fresh insights with respect to the Congolese environment.

None of studies have considered different ownership amongst banks in Congo. Thus, it leaves a wide scope to evaluate efficiency of banks operating in Congo over a period of time and across different ownership structures.

III. OBJECTIVES AND HYPOTHESES

3.1. Objective: To measure the efficiency of commercial banks across different ownership structures operating in Democratic Republic of Congo for the seven years period 2012-2018.

To study this objective, the following hypotheses are formulated.

3.2. Hypotheses

Hypothesis 1

H_0: The efficiency of the commercial banks operating in Congo has not changed over the seven years period 2012-2018.

H_1: The efficiency of the Commercial Banks operating in Congo has improved over the seven-year period 2012-2018.

Hypothesis 2

H_0: The local owned banks are as efficient as compared to their pan-African and international counterparts.

H_1: The local owned banks are less efficient as compared to their pan-African and international counterparts.

Hypothesis 3

H_0: The local banks are as productive as their international counterparts

H_1: The local banks are less productive compared to their international counterparts

For these hypotheses, the inputs and outputs are chosen and the data is analysed using the DEA VRS model.

IV. DATA AND METHODOLOGY

4.1. Data Collection

The study incorporates all the commercial banks that are operating in Congo during the period 2012-2018 in the sample. The choice of the commercial banks was based on the availability of data for the whole study, those commercial banks which had missing data were dropped. The sample comprises 15 commercial banks across the three ownership structures that operate in Congo: local banks, Pan-African banks and the international owned banks.

The data has been collected from secondary sources. The data used is based on financial information published in the annual reports of the banks and Congolese Central bank publications.

4.2. Methodology

As highlighted in literature review, efficiency of banking institutions has been developed a lot in last few years. A lot of approaches have been employed to measure the efficiency of the banks. These approaches broadly fall into two types: Non parametric approaches and parametric approaches.

Indeed, there has been no consensus on the preferred method for measuring the relative efficiency of financial institutions.

At least five different methods have been used in assessing the efficiency of financial institutions.

These approaches differ as explained by Berger and Humphrey[1] (1997) in the assumptions imposed on the data in terms of (a) the functional form of the best-practice frontier (a more restrictive parametric functional form versus a less restrictive nonparametric form), (b) whether or not account is taken of random error that may temporarily give some production units high or low outputs, inputs, costs, or profits, and (c) if there is random error, the probability distribution assumed for the inefficiencies (e.g., half-normal, truncated normal) used to disentangle the inefficiencies from the random error. "Both require the specification of a cost or production function or frontier, but the former (parametric) involves the specification and econometric estimation of a statistical or parametric function/frontier, while the non-parametric approach provides a piecewise linear frontier by enveloping the observed data points"[2].

During the last decades, many studies used non-parametric methods to conduct meaningful researches in the banking area. Frontier efficiency is one of the best quantitative measure of the banking performance because it removes the effects of market prices and other exogenous factors. The current study uses the DEA model in measuring the performance of Banks in DRC. This mathematic model has appeared to be, in the existing literature, one of the great tool to use in financial sector. It is a way to compare the relative efficiency of Decision Making Units (DMU).

According to the definitions of both technical and allocative efficiency when using the DEA model, the current study will be focused on the technical efficiency rather than the allocative efficiency.

This study is concerned in how well the inputs are utilized in order to have the outputs. This is measured by the technical efficiency. The current study determines the technical efficiency of banking system in Democratic Republic of Congo (DRC).

It is convenient noting that the production possibility set of the DEA non-parametric efficiency model to be estimated is as the following algebraic form:

$$T = \left\{(Y, X): Y \leq \sum_{J=1}^{n} Y_j \lambda_j \,, X \geq \sum_{J=1}^{n} X_j \lambda_j \,, \sum_{J=1}^{n} \lambda_j = 1, \lambda_j \geq 0\right\} \quad (1)$$

Where the scalar variables λ_j are called "intensity weights" in the DEA literature.

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[1] Berger, A., Humphrey, D. "Efficiency of financial institutions: International survey and directions for further research", *in European Journal of Operational Research 98*, Special Issue on "New Approaches in Evaluating the Performance of Financial Institutions, 1997, P.188.

[2] L. Drake and J.B. Hall "*Efficiency in Japanese, banking: An empirical analysis*", Journal of Banking and Finance, volume 27, issue 5, 2003, p.902.

The primal linear programming based on the set T in (1) to estimate efficiency scores for a unit j_o, using the variable return to scale and output orientation, is:

$$\frac{1}{E_{yj_0}} = Max\lambda_j\theta_{j_0}$$
$$s.t.$$
$$\sum_{J=1}^{n}\lambda_j y_{rj} \geq \theta_{j_0} y_{rj_0}, r = 1, \dots, s$$
$$\sum_{J=1}^{n}\lambda_j x_{ij} \leq x_{ij_0}, i = 1, \dots, m \qquad (2)$$
$$\sum_{J=1}^{n}\lambda_j = 1, \lambda_j \geq 0, \theta_{j_0}\ sign\ free$$

The dual problem to this problem will be as under:

$$\text{Min}\left(\sum_{i=1}^{m} v_{ij_0}x_{ij_0} + u_{j_0}\right)$$
$$subject\ to$$
$$\sum_{r=1}^{s} u_{rj_0}y_{rj_0} = 1 - \sum_{r=1}^{s} u_{rj_0}y_{rj} + \sum_{i=1}^{m} v_{ij_0}x_{ij} + u_{j_0} \geq 0, 1, \dots, j_0, \dots, n \qquad (3)$$
$$v_{ij_0}, u_{rj} \geq 0, u_{j_0}\ sign\ free$$

The variables v_{ij_0}; u_{rj_0}; u_{j_0} in (3), the input constraints, the output constraints and the convexity constraint, respectively. It is convenient to call these variables as multipliers or weights. We have the fundamental duality result for a unique optimal solution: $\theta_{j_0} = \sum_{i=1}^{m} v_{ij_0}x_{ij0} + u_{j_0}$. In addition to the weighted sum of inputs, expressed in dimensionless efficiency measure units, there is a new constraint u_{j_0}, which is the convexity constraint in the case of variable returns to scale (Finn R. Førsund, 2017)[3].

In order to interpret the dual variables, the Lagrangian function for the primal problem will be used. The optimisation problem for unit j_0 can be written:

$$L = \theta_{j_0} - \sum_{r=1}^{s} u_{rj_0}\left(\theta_{j_0}y_{rj_0} - \sum_{J=1}^{n}\lambda_j y_{rj}\right) - \sum_{i=1}^{m} v_{ij_0}\left(\sum_{J=1}^{n}\lambda_j x_{ij} - x_{ij_0}\right) - u_{j_0}\left(\sum_{J=1}^{n}\lambda_j - 1\right) \qquad (4)$$

[3] F. R. Førsund, "Economic interpretations of DEA", *in Socio Economic Planning Science*, volume 61, 2017, p.11

In order to solve this problem, the first-conditions order are:

$$\begin{gathered}\frac{\partial L}{\partial \lambda_j} = \sum_{r=1}^{s} u_{rj_0} y_{rj} - \sum_{i=1}^{m} v_{ij_0} x_{ij_0} - u_{j_0} \leq 0 \left(= 0 \; for \; \lambda_j > 0 \right), j = 1, \dots, n \\ \frac{\partial L}{\partial \theta_{j_0}} = 1 - \sum_{r=1}^{s} u_{rj_0} y_{rj0} = 0 \\ u_{rj_0} \geq 0 \left(= 0 \; for \; \theta_{j_0} y_{rj_0} < \sum_{j=1}^{n} \lambda_j y_{rj}\right), r = 1, \dots, s \\ v_{ij_0} \geq 0 \left(= 0 \; for \; \sum_{j=1}^{n} \lambda_j x_{ij} < x_{ij_0} \right), i = 1, \dots, m \end{gathered} \tag{5}$$

It may be assuming that we have an optimal solution, then we are getting:

$$\begin{gathered}\frac{\partial \theta_{j_0}}{\partial x_{ij_0}} = \frac{\partial L}{\partial x_{ij_0}} = v_{ij_0}\left(1 - \lambda_{j_0}\right) = v_{ij_0}, i = 1, \dots, m \\ \frac{\partial \theta_{j_0}}{\partial y_{rj_0}} = \frac{\partial L}{\partial y_{rj_0}} = -u_{rj_0}\left(\theta_{j_0} - \lambda_{j_0}\right) = -u_{rj_0}\theta_{j_0} \\ \Rightarrow \frac{\partial \theta_{j_0}}{\partial\left(\theta_{j_0} y_{rj_0}\right)} = -u_{rj_0}, r = 1, \dots, s \end{gathered} \tag{6}$$

It is important to highlight that the additional constraint u_{j_0} ensures that an inefficient firm will be only benchmarked against firms of similar size.

The value obtained for θ will be the efficiency for the j-th Decision Making Unit (DMU).

The linear programming problem would be solved for each DMU taken in the study.

θ =1 will identify the technically efficient DMU and all other DMUs would have θ < 1, implying that the efficiency scores of all other DMU will be measured relative to the technically efficient units that have a score of θ =1. Each bank is considered in this study as a Decision Making Unit (DMU).

This study is using the variable return to scale (BCC) model and the input orientation.

The choice of outputs and inputs is based on the theoretical conceptualization of banking business. It is also depending on many factors which are the availability of data, the policies undertaken in the country and so on. The current study adopts the intermediation approach. The model used in this paper can be considered as a business model. We specify two outputs and three inputs. The output variables are: total loans (TL) and other earning

assets[4]. These outputs have been taken in some recent studies such as Asimakopoulos[5]. The input variables[6] chosen in this model are: labour, physical capital and deposits. The same inputs have been chosen in some recent studies[7].

In this model, we will see how well the banks are using deposits, labour and physical capital in order to convert them into loans and other earning assets.

Model

Inputs: Labour (X_1), Physical capital (X_2) and Deposits (X_3)
Outputs: Loans (Y_1) and other earning assets (Y_2).

V. RESULTS AND DISCUSSION

It may be recollected that this study attempts to measure the efficiency of the commercial banks operating under three different ownerships existing in the Congolese banking industry: local banks, pan-African banks and international owned. A non-parametric approach called Data Envelopment Analysis (DEA) has been used. There is one objective of the current research.

5.1. Hypothesis 1

5.1.1. Temporal pattern

The banks show, in general, an increase in efficiency over the study period. Thus, the impact of reform process has been observed to be positive in the Congolese context. The efficiency has shown a clearly increasing trend for the first four years though it has shown a slight decline with respect to the best performing year (2015) (see table 1). These results are consistent with findings of other studies considering a temporal trend carried out by Gunay, et al.

[4] T. Nguyen. "Diversification and bank efficiency in six ASEAN countries", *in Global Finance Journal, volume* 37, 2018, P.67.

[5] G. Asimakopoulos, G. Chortareas and M. Xanthopoulos, "The eurozone financial crisis and bank efficiency asymmetries: Peripheral versus core economies", *in The Journal of Economic Asymmetries*, volume 18, 2018, p.

[6] B. Diallo. "Bank efficiency and industry growth during financial crises", *in Economic Modelling Journal,* volume 68, 2017, P.16.

[7] S. Abel. "The profit efficiency of commercial banks in Zimbabwe: an application of data envelopment analysis", *in J. STUD.ECON. ECONOMETRICS*, volume 41(2), 2017.

(2013)[8], in which he reported the efficiency over the period 2002-2010, Roman and Sargu (2013)[9], Kablan (2010)[10].

Table 1: Average efficiency of commercial banks operating in DRC

MEASURE/YEAR	2012	2013	2014	2015	2016	2017	2018
MEAN EFFICIENCY	0.384	0.562	0.590	0.593	0.554	0.519	0.518

***Source**: Results provided by software DEAP-xp1*

In many economies, liberalization has been found to benefit the efficiency of banking sector. The improvements in case of the following countries have been reported: Tanzania (Abdallah et al, 2014)[11], Portugal (Canhoto and Dermine, 2003)[12]. In case of Turkish banks, over the period 2002 to 2010, efficiency of the banking system experienced an increase under the study period. These empirical results indicate that regulatory policies have a positive effect on the efficiency of Congolese banks. The major factors affecting the improvement in the efficiency of banks might be reduction in operating expenses. The decline of efficiency after the year 2015 may be explained by the increase of operating expenses due to the Congolese economic situation. Indeed, the price of raw materials, which are the main source of the Congolese economic stability, experienced a decrease leading to a drop of the entire economy. Thus, the operating costs of banks increased while both interest income and non-interest income didn't increase in the same proportion due to the main clients of banks which are mining companies.

In few countries, it is observed that the results obtained are not favourable: Spain (Grifell-Tatje and Lovell, 1996)[13] where liberalization appeared to have decreased efficiency. Cook et al (2001)[14] found similar results for Tunisian

[8] E. Nur Özkan-Günay, Z.N. Günay, and G. Günay. "The Impact of Regulatory Policies on Risk Taking and Scale Efficiency of Commercial Banks in an Emerging Banking Sector", *in Emerging Markets Finance & Trade*, Vol. 49, Supplement 5, 2014, pp. 93.

[9] A. Roman, and, A.C. Sargu, "Modelling Banks Efficiency of the New EU Member States: A Non-Parametric Frontier Approach, Transformations" *in Business & Economics*, Vol. 12, No 2B (29B), 2013, pp.490.

[10] Sandrine Kablan. Banking Efficiency and Financial Development in Sub-Saharan Africa. Working Paper, IMF, 2010, p.16.

[11] Z. M. ABDALLAH, M. A. AMIN, N. A. SANUSI and S. KUSAIRI, "Impact of Size and Ownership Structure on Efficiency of Commercial Banks in Tanzania: Stochastic Frontier Analysis", *in International Journal of Economic Perspectives*, Volume 8, Issue 4, 2014, p.73.

[12] A. Canhoto, and J. A. Dermine, "note on banking efficiency in Portugal: New vs. Old banks", *Journal of Banking and Finance*, volume 27, 2003, p. 2094.

[13] E. Grifell-Tatje, and C. Lovell, "Deregulation and productivity decline: The case of Spanish savings banks", in *European Economic Review*, volume 40, 1996, p.1295.

[14] D. Cook, M. Hababou, and G. S. Roberts, "The effects of financial liberalization on the Tunisian banking industry: a non-parametric approach", *in Topics in Middle Eastern and North African economies*, volume 3, September 2001, pp. 12.

banks that there was no improvement in the overall intermediary efficiency of the Tunisian banking system over time.

Moreover, in some cases, deregulation appears to have led to a reduction in measured productivity rather than an improvement. The implication for government policy is that the conventional wisdom which holds that reforms always improves efficiency and productivity may be incorrect. Industry conditions prior to deregulation and other incentives may intervene. Measurement over longer time periods may eventually show a net improvement in both efficiency and productivity but this has not yet been demonstrated (Berger and Humphrey, 1997)[15].

Nitoi and Spullbar (2015)[16] have noticed that the all banking systems increased their level of efficiency until 2008 in the central and Eastern Europe from 2005 to 2011. After 2008, the level of efficiency decreased due to the global financial crisis.

5.1.2. Ownership analysis

The local banks and pan-African banks have shown an increasing trend over the study period. The international banks indicate also an important increasing trend over the study period as may be observed in table 2. It is convenient to highlight that all banks experienced an upward trend in their technical efficiency scores although the international banks outperformed their pan-African or local counterparts. The regulatory process implemented by the central bank seems to have improved the efficiency of Congolese banking sector even if this efficiency is still less sufficient particularly for the local banks. The figure 1 shows an increasing trend of efficiency scores for the whole banking system.

Table 2: Average efficiency scores of local, pan-African and international banks

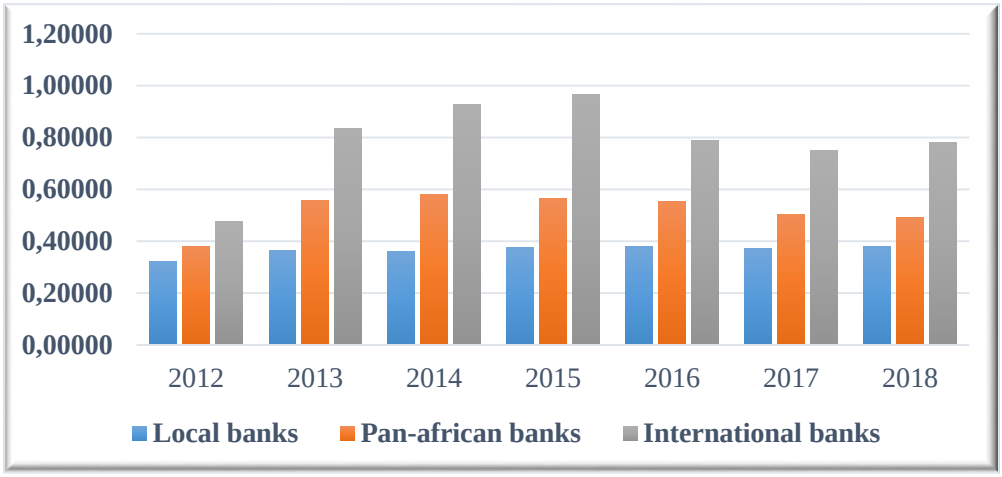
Measure/Year	2012	2013	2014	2015	2016	2017	2018	Average
Local banks	0.32225	0.36475	0.35925	0.37375	0.38175	0.37325	0.37950	0.36493
Pan-African banks	0.37988	0.55825	0.57988	0.56325	0.55125	0.50413	0.49025	0.51813
International banks	0.47533	0.83600	0.92733	0.96367	0.78900	0.75233	0.77867	0.78890

Source: Results provided by software DEAP-xp1

[15] A. Berger, and D. Humphrey, *Op.cit*, p.196.

[16] M. Niţoia and C. Spulbar, "An Examination of Banks' Cost Efficiency in Central and Eastern Europe", *in Journal of Procedia Economics and Finance*, volume 22, 2015, p.549.

Figure 1: Average efficiency scores of local, pan-African and international banks



***Source**: Author, Results provided by software DEAP-xp1*

5.2 Hypothesis 2

5.2.1 Temporal pattern

The efficiency scores clearly indicate that in each of the years during the study period, foreign banks have outperformed both pan-African and local banks. Pan-African banks get a second position and local banks rank the last in all the seven years.

- In 2013, 33% banks were found to be efficient, out of which 40% are the international banks, 40% are pan-African banks and 20% local bank. It is worth noting that 80% of efficient banks are foreign (international and pan-African).
- In 2014, 26.6% banks were found to be efficient, out of which 75% are the foreign banks, 25% are local banks.
- In 2015, 40% banks were found to be efficient, out of which 83% are the foreign banks (both international and pan African), 17% are local banks.
- In 2016, 40% banks were found to be efficient, out of which 50% are pan-African banks, 33% are international banks and 17% local banks.
- In 2017, 20% banks were found to be efficient, out of which 67% are the pan-African banks, 33% are international banks and 0% local banks.
- In 2018, 26.67% were found to be efficient out of which 50% are international banks, 25% are pan-African banks and 25% local banks.

It is also relevant to note that the average score of technical efficiency of international, pan-African and local banks for the seven years is respectively 0.79, 0.51 and 0.36.

Thus every year dominance of foreign banks (international and pan-African banks) in terms of efficiency can be observed. The local banks have little presence amongst the most efficient banks and their score in average is very low. These results are summarized in table 3.

Table 3: Number of fully efficient banks across three ownerships

Year/Ownership	Local banks	Pan-African banks	International banks	Total
2012	1	1	1	3
2013	1	2	2	5
2014	1	2	1	4
2015	1	3	2	6
2016	1	3	2	6
2017	0	2	1	3
2018	1	1	2	4

***Source**: Author, Results provided by software DEAP-xp1*

Only one local bank have been found to be fully efficient across the period 2012-18, except the year 2017. More than four foreign banks are fully efficient out of eleven foreign banks in the sample. Therefore, it is observed that the both pan-African and international banks have dominated the list of the highly efficient banks in comparison to local banks.

5.2.2 Ownership analysis

The top seven performers, on basis of average efficiency scores, are

Table 4: Most efficient banks on basis of average efficiency over period 2012-2018

N°	Banks	Ownership	Average efficiency
1	ADVANS BANQUE CONGO	International	1
2	UNITED BANK FOR AFRICA	Pan-African	1
3	AFRILAND FIRST BANK	Pan-African	0.925
4	SOFIBANQUE SARL	Local	0.992
5	ACCESS BANK DRC	Pan-African	0.795
6	CITI GROUP CONGO	International	0.778
7	STANDARD BANK	International	0.589

***Source**: Author, using results from software*

As may be observed, 86% of the banks falling in this category are the foreign banks. There are three international banks and three pan-African banks. There is only one local bank amongst the seven top performers during the period 2012-2018.

The eight worst performers during the study period are.

Table 5: Least efficient banks on basis of average efficiency over period 2012-2018

N°	Banks	Ownership	Average efficiency
8	BANK OF AFRICA	Pan-African	0.443
9	BGFI BANK DRC	Pan-African	0.328
10	EQUITY BANK CONGO	Pan-African	0.257
11	TRUST MERCHANT BANK	Local	0.237
12	ECOBANK RDC SARL	Pan-African	0.222
13	FBN BANK SA	Pan-African	0.174
14	RAWBANK SARL	Local	0.131
15	BCDC	Local	0.100

Source: Author, using results from software

All the worst performers are either local or pan African banks. There is no international bank among the worst performers' banks. This may reflect the fact that local banks and some pan-African banks are not able to obtain the maximal output from a set given of inputs. It is observed that between the three different ownership structures, the local banks and a number of pan-African banks are less efficient compared to the international owned banks.

The current results are consistent with findings of other studies conducted by Fries and Taci (2005)[17]. It is worthwhile noted that Barros et al. (2016)[18] revealed, examining the Angolan case, that the local banks were less efficient than foreign owned banks. Bouzgarrou et al (2018)[19] have found that on average the foreign banks, operating in French market over the period 2000-2012, are more efficient than the domestic banks, especially during the financial crisis. Similar results were obtained by Fujii et al (2014)[20] in their study on Indian banks for the period 2004-2011. In case of Sub-Saharan countries, foreign banks tend to outperform local banks in terms of profit efficiency. In Tanzania, Abdallah et al (2014) [21]proved in their results that foreign banks are revenue efficient than local banks. They also noticed that the foreign banks were cost

[17] S. Fries and A. Taci, "Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries", *in Journal of Banking & Finance*, volume 29, 2005, p.71.

[18] C.P. Barros, R. L. Emanuel, P.J. Macanda and Z. Mendes, "A Bayesian Efficiency Analysis of Angolan Banks", *in South African Journal of Economics*, Volume 84:3, 2016, p.

[19] H. Bouzgarroua, S. Jouidaa and W. Louhichi, "Bank profitability during and before the financial crisis: Domestic versus foreign banks", *in Research in International Business and Finance*, volume 44, 2018, p.34.

[20] H. Fujii, S. Managi, and R. Matousek, "Indian bank efficiency and productivity changes with undesirable outputs: A disaggregated approach" *in Journal of Banking & Finance,* volume 38, 2014, p.46.

[21] Z. M. ABDALLAH, M. A. AMIN, N. A. SANUSI and S. KUSAIRI, Op.cit, p.74.

inefficient than the local banks. They highlighted that the liberalization policy has improved the level of efficiency through the learning process and new challenges created. In case of Turkish banks, the foreign banks are performing efficiently compared to their Turkish counterparts (Partovi and Matousek, 2019)[22]. Domestic banks experienced a higher inefficiency compared to their foreign counterparts in 72 countries from 2003 to 2012 (Doan et al, 2018)[23]. Sturm and Williams[24] (2010) conducted a study in Australia from 1988 to 2001. They revealed that the efficiency of foreign banks decrease compared to their local counterparts.

The new banks are able to adopt and implement best practice techniques without being overburdened by overheads of less efficient historical investments.

As even today the local sector banks are dominated banking business in the Congolese environment. The following section discusses in detail the productivity and its components of the three categories of banks.

5.3 Hypothesis 3

5.3.1 Decomposition of efficiency by the Malmquist productivity index

The table 6 provides the results, by bank, of the technical efficiency TE (efficiency change) relating to the model and the associated productivity measures: the Malmquist index, the pure technical efficiency PTE (pure efficiency change), and the technological progress TP (technological efficiency change). The values above unity indicate an improvement in productivity while those below unity indicate deterioration or negative variation.

The table shows that overall technical efficiency (OTE) experienced an increase in terms of change of 6.7% for all banks over the study period. This increase is due to the improvement in both pure technical efficiency (+6.2%) and efficiency scale (+0.004%).

In general, Congolese banking sector recorded a fairly decrease in the total factor productivity index (-3.5%) dragged by the drastic fall in the Malmquist index from the pan-African (Eco bank and UBA mainly) and the local banks. This deterioration is mainly due to the fact that banks do not take advantage of technological progress in the Congolese banking industry. It is relevant to note

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[22] Elmira Partovi and Roman Matousek, "Bank efficiency and non-performing loans: Evidence from Turkey", *in Research in International Business and Finance, volume* 48, 2019, p.303.

[23] A.T. Doan, K. Lin and S. Doong, "What drives bank efficiency? The interaction of bank income diversification and ownership", *in International Review of Economics and Finance*, volume 55, 2018, p.214.

[24] J.E. Sturm and B. Williams, "What determines differences in foreign bank efficiency? Australian evidence", *in Journal of International Financial Markets, Institutions and Money*, volume 20, 2010, p.304.

that the reform process implemented by central bank seems to have improved both pure technical efficiency and scale efficiency of Congolese banks because their level of productivity is explained by efficiency and not by technological developments. It can also be noted that the scale efficiency change of almost banks have remained constant. City group bank experienced the highest productivity driven by both overall technical efficiency and the technological change. The scale efficiency of banks remained constant except for the Trust Merchant Bank (TMB) where the scale efficiency increased during the study period.

5.3.2 Temporal pattern of total factor productivity and its components.

The results of the decomposition of the evolution of productivity are presented in table 7. The total factor productivity decreased significantly during all the years in the order of 3.5%, which is mainly due to the negative variation in technological progress, especially during the period 2016- 2018.

Table 6: Decomposition of efficiency

Bank	effch	techch	pech	sech	tfpch
1	1.111	0.956	1.111	1	1.061
2	1	0.934	1	1	0.934
3	1.005	0.994	1.005	1	0.999
4	1.052	0.946	1.052	1	0.995
5	1.18	0.983	1.18	1	1.159
6	1.133	0.922	1.133	1	1.044
7	1.296	1.125	1.296	1	1.457
8	0.716	0.955	0.716	1	0.684
9	1.097	0.856	1.097	1	0.94
10	1.228	0.873	1.228	1	1.073
11	1.065	0.896	1.065	1	0.954
12	1	0.813	1	1	0.813
13	1.073	0.861	1.078	0.996	0.924
14	1.173	0.812	1.1	1.066	0.952
15	1	0.717	1	1	0.717
mean	1.067	0.905	1.062	1.004	0.965

***Source**: Results from software*

Table 7: Decomposition of efficiency over time

year	effch	techch	pech	sech	tfpch
2	1.641	0.696	1.693	0.969	1.143
3	1.133	1.033	1.07	1.058	1.17
4	0.989	1.151	0.998	0.99	1.137
5	0.947	0.934	0.94	1.008	0.885
6	0.939	0.771	0.937	1.002	0.724
7	0.901	0.921	0.902	0.998	0.829
mean	**1.067**	**0.905**	**1.062**	**1.004**	**0.965**

Source: *Results from software*

5.3.3 Analysis of efficiency and productivity according to ownership structure

The tables 8 traces the evolution of productivity and its components by structure of ownership. According to the analysis of this table, the results suggest that the overall technical efficiency (OTE) experienced a positive variation of 12.9%, 11.69% and 27.99% for local, pan African and international banks respectively. This increase is mainly due to pure technical efficiency change (PTE). Moreover, the technological progress experienced a decrease in both local and pan-African banks. Pan-African banks got a slight decrease than local banks. Meanwhile the technological progress experienced an increase of 4.78% for the international banks during the period under study. The malmquist index (Total factor productivity) experienced a decrease in change of 1.5% for local banks. This decrease is mainly due to the drop of technological progress. The lack of innovation, quality governance and other new methods in collecting deposits and granting loans explains the poor productivity of local banks compared to their international counterparts. The local banks need to emphasize in management aspects and innovation in order to shift their production frontier ant thus their productivity. In the other hands, the pan African banks recorded a small increase of 1.3% of their total factor productivity change. The increase of efficiency change explains mainly this level of productivity. Finally, the total factor productivity change recorded an important increase of 15.22% for international banks. Both overall technical efficiency and technological progress explain the level of international banking productivity. Indeed, innovation, quality governance and other best practices are used by international banks compared to local and pan African banks.

These results corroborate with several studies (Sturm & Williams, 2005)[25] which have shown in the specific case of Australia that foreign banks are more productive than domestic banks. Assaf et al (2013)[26] confirmed that the productivity growth of Turkish banks was positive over the study period, and is explained by the improvement in technology, while efficiency growth continued to be negative over the same period. They also showed that the highest efficiency change and productivity change scores are achieved by foreign banks. They notice that there is strong empirical evidence that foreign banks, particularly in developing economies are more productive.

It is known for instance that foreign banks usually obtain cheaper financial resources from their mother companies or via international inter-banking market. They are not dependent on the domestic inter-banking markets or the central bank lending facilities. This is an important advantage compared with domestic banks.

Table 8: *Trend of productivity by ownership*

Local banks

Period	effch	techch	pech	sech	tfpch
2012-2013	1.492	0.750	1.547	0.966	1.111
2013-2014	1.154	0.982	1.003	1.176	1.114
2014-2015	1.044	1.004	1.085	0.967	1.040
2015-2016	1.099	0.796	1.068	1.032	0.863
2016-2017	1.012	0.779	1.005	1.006	0.789
2017-2018	0.972	1.025	0.972	1.000	0.996
Average	**1.129**	**0.889**	**1.113**	**1.024**	**0.985**

Source: Results from software

Pan-African banks

Period	effch	techch	pech	sech	tfpch
2012-2013	1.692	0.747	1.721	Jan-00	1.249
2013-2014	1.130	1.080	1.092	1.038	1.201
2014-2015	0.956	1.211	0.955	1	1.146
2015-2016	0.973	0.958	0.973	1	0.935
2016-2017	0.929	0.735	0.929	1	0.676
2017-2018	1.022	0.863	1.022	1	0.872
Average	**1.11692**	**0.93252**	**1.11540**	**1.0014792**	**1.01300**

Source: Results from software

[25] J.E. Sturm and B. Williams, "Foreign Bank Entry, deregulation and bank efficiency: lessons from the Australian experience", *in Journal of Banking and Finance*, volume 28, 2005, p.1789.

[26] A. Assaf, R. Matousek and G. Tsionas, "Turkish bank efficiency: Bayesian estimation with undesirable outputs", *in Journal of Banking & Finance, 2013, p.402*.

International banks

Period	effch	techch	pech	sech	tfpch
2012-2013	2.605	0.821	2.685	Jan-00	1.513
2013-2014	1.216	1.030	1.199	1.018	1.258
2014-2015	1.041	1.297	1.041	1	1.357
2015-2016	0.830	1.171	0.830	1	0.855
2016-2017	0.903	0.903	0.903	1	0.804
2017-2018	1.084	1.067	1.095	0.9916667	1.125
Average	**1.27994**	**1.04789**	**1.29211**	**0.9987222**	**1.15222**

***Source**: Results from software*

VI. CONCLUSION

Subjected more to the requirements of globalization processes and the intensification of competition, the banks are required to improve their efficiency and strengthen their competitiveness in order to preserve their sustainability. Congolese banks, with the reform process are concerned to this reality and need to focus on improvement of their productivity and efficiency. In this context, the key words of Congolese Banks must be: optimization, organization, innovation, quality governance and efficiency. In short, technological progress.

The results show that the impact of reform process has been positive on the efficiency of the Congolese banks. The average efficiency scores have, generally, shown an upward trend over the study period. Although the Congolese banking sector is shallow and under-developed, liberalization as mentioned earlier is specifically undertaken to improve the performance. As it is found out that the efficiency has generally improved following reform implementation, the improvement in the resource allocation will benefit the masses and it subsequently lead to price reductions and expansion for consumers if competition is sufficient.

Foreign banks have emerged as the most efficient banks as compared to the pan-African bank and the local banks as far as utilization of, personnel expenses, operating expenses and deposits to generate loans and other earning assets is concerned. The distinction between the efficiency scores obtained for banks belonging to different sectors is quite distinct for each year.

Thus, the study concludes that the local sector banks are inefficient as compared to their pan-African and international counterparts in usage of personnel expenses, operating expenses and deposits to generate a certain level of loans and other earning assets.

The deterioration in the efficiency of domestic banks is due to several combined factors. The poor quality of assets, the high operating costs, and an unexploited excess liquidity are the main causes.

The deterioration in efficiency is also due to the slow pace of structural reforms, which hinders the development of the private sector, of a regulatory framework for the financial sector that is still evolving, of an underdeveloped infrastructure and the lack of supervision of Congolese central bank.

The most profitable banks, particularly the local banks, are not motivated to reduce their management costs. Indeed, when the banks dominate the market in terms of size, they operate in an oligopolistic market, of imperfect competition, become profitable and then, care less about their cost-efficiency. That's the Congolese case.

In terms of productivity, we found that, Congolese banks show a fairly decrease in their total factor productivity index, a deterioration which is explained by the fact that local banks are not getting benefit from the technological progress which prevails in the banking industry. The decrease of productivity of local banks is mainly explained by the lack of technology. The introduction of new technologies and the development of electronic banking in Congo has remained at a primitive stage compared to international standards. Thus, the modernization of the banking system by the introduction of new information technologies is more than necessary for local and pan-African banks.

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APPENDIX

List of Bank considered in the study

N°	BANKS
1	ACCESS BANK R.D.CONGO SARL
2	ADVANS BANQUE CONGO SARL
3	AFRILAND FIRST BANK CD SARL
4	BANK OF AFRICA RDC SA
5	COMMERCIAL BANK OF CONGO
6	BGFIBANK RD CONGO S.A.R.L.
7	CITIGROUP CONGO SARL
8	ECOBANK RDC SARL
9	EQUITY BANK CONGO SARL
10	FBNBANK DRC SA
11	RAWBANK SARL
12	SOFIBANQUE SARL
13	STANDARD BANK
14	TRUST MERCHANT BANK SARL
15	UNITED BANK FOR AFRICA