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The Determinants of the Efficiency of Ivorian Commercial Banks: A Study Using the Non-Parametric Approach

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Abstract

The objective of this study is to analyze the determinants of banking efficiency in Côte d'Ivoire. To achieve this objective, we used annual data covering the period from 2004 to 2017, for fifteen Ivorian banks. Methodologically, we first used the non-parametric data envelopment analysis (DEA) method to determine the efficiency scores. The results show that Ivorian banks are technically inefficient. Second, we used a Tobit model to identify the determinants of bank efficiency. The Tobit regression identifies return on equity, regulatory capital, size, and credit as the main determinants of the technical efficiency of Ivorian banks. In addition, bank liquidity and ownership, GDP growth rate, and inflation are sources of inefficiency in Ivorian banks. The study recommends that banks manage their resources rationally to finance the economy efficiently. At the level of the monetary authorities, they should ensure that banks apply regulatory standards.

Keywords: technical efficiency, DEA method, Tobit model, bank

1. Introduction

The underdevelopment of domestic capital markets in developing countries is due, according to McKinnon (1973) and Shaw (1973), to nominal interest rate ceilings and state control over the financial system. The results of these policies led to low or even negative real interest rates. This practice, described by these authors as financial repression, was the main cause of the poor performance of the banking sector and ultimately of economic growth rates in developing countries. Under the aegis of the major international institutions, the majority of sub-Saharan economies have undertaken financial liberalization programs since the mid-1980s. In addition to interest rate liberalization, many other measures were implemented in Africa as part of financial reforms (bank restructuring, abolition of direct monetary control, strengthening of supervision). However, neo-liberal policies inspired by monetarism have not provided a miracle solution to economic development. Reinhart and Tokatlidis (2003), referring to sub-Saharan Africa, argue that financial reforms have had very little effect on economies. According to the IMF report (2013), the Ivorian banking sector remains underdeveloped. Bank credit to the economy related to GDP went from 14.20 in 1990 to 11.0 in 2000. In 2013, the ratio of credit to the private sector to GDP was around 18 percent, and access to financial services was limited (11 percent of the population, including microfinance) (IMF, 2013). In 2016, the credit to the economy ratio related to GDP settled at 27.60. Bank credit remains a secondary source of financing for small and medium-sized enterprises, with self-financing being the preferred method. Financial liberalization is necessary because of the mismatch between the volume of savings and the investment needs of developing countries. Moreover, McKinnon is part of a liberal approach, since the price determined the market because the increase in interest rates was to create a savings market. Implicitly, this meant that financial liberalization policies led to banking competition. The increase in interest rates (in the competitive market) is supposed to encourage savings, which will be used to increase bank credit and investment, and ultimately growth. The resulting competitive pressure should, in principle, increase the efficiency of the functioning of financial intermediation by reducing interest rate spreads. Prao and Kamalan (2019) show through a study of the effect of banking structure on interest rate margins of banks in WAEMU countries from 2005 to 2014 that in the short run, the share of the four largest banks positively influences bank interest rate margins. These results support the findings of Sharpe (1990) who highlighted an

informational monopoly power that banks hold over their customers, in particular, the old ones, known in the literature as the "hold-up problem".

In the current financial globalization, the constraints of progressive opening to the international market and the financing needs of national economies impose on financial institutions more sustained efforts in terms of governance and competitiveness. Indeed, subject to the requirements of globalization processes and operating in an uncertain environment, banks are required to improve their efficiency and increase their performance in order to preserve their sustainability. Consequently, Ivorian banks are now obliged to improve their productivity and efficiency by adopting several strategies, in particular by focusing on improving their productive efficiency, in order to face increasingly fierce competition both at the national and international levels. Given that Ivorian banks currently operate in a highly competitive environment, the long-term viability of this sector depends on its degree of efficiency. Furthermore, in African countries such as Côte d'Ivoire, where banks are the main sources of financing for the economy given the embryonic nature of the financial markets, the search for banking efficiency remains a necessity. To adequately finance the economy, banks must be efficient. Moreover, since the objective of any company is to maximize its profit, it is only natural that it should ask itself about the return on these factors (inputs). With a given quantity of available inputs, the firm must produce the maximum number of goods or achieve the highest level of profit per unit of goods produced, in the application of the strategies of economic calculation. If it is in this situation, it is said to be technically efficient.

According to Weil (2006), technical efficiency refers to the production frontier, in other words, a firm is technically efficient if its activities place it exactly on the frontier. This efficiency is "the ability to avoid losses by producing as much output as the use of inputs allows or by using as little input as the production of output allows" (Harold, Lovell, and Schmidt, 1993). Similarly, a firm can minimize its factor costs to maintain or obtain a given level of output. In this configuration, the firm operates at allocative efficiency. As for scale efficiency, it refers to the fact that the firm must ensure a perfect match between its marginal cost and the selling price of its product on the market, in a situation of pure and perfect competition.

With these different definitions, it appears that the search for efficiency is important for a bank. Indeed, according to Allen et al. (2007), an efficient bank contributes to the reliability and soundness of the financial system. An operationally efficient bank contributes to increased shareholder wealth by offering market shares to its investors. Banks have the onerous task of providing the capital necessary to finance the most profitable and safest investment projects. According to the authors, without an efficient allocation of capital, profitable projects cannot be undertaken, thereby reducing economic growth. Efficiency also helps to anticipate banking crises (De Lima, 2012). On the other hand, an inefficient bank can have several consequences for the bank and for the economy. For Sufian and Kamarudin (2013), one of the main reasons for bank failure is the decline in efficiency. In addition to making the bank unstable, inefficiency also limits their productive capacities (Gentier, 2003). In the economic literature, work has highlighted the factors that can influence bank efficiency. For some, bank efficiency could be determined by internal bank factors such as profitability, size, liquidity, and bank ownership (Berger et al., 1993; Gunes and Yilmaz, 2016). For others, on the other hand, external factors may influence bank efficiency through variables such as inflation and gross domestic product growth rate (Demirguç-Kunt and Detragiache, 1998).

Recent research suggests that both internal and external factors can explain banking efficiency (Pasiouras, 2008; Femise, 2011). Taktak (2010) conducted a study on the particularities of bank governance and the effect of internal governance mechanisms of Tunisian listed banks on their efficiency during the period 2002-2006. This study reveals that Tunisian listed banks, whether small, medium, or large, have an average efficiency level of 79.30% during the study period. Similarly, the analysis also shows that the deterioration of the efficiency level of Tunisian banks is mainly due to the failure of large public banks.

In Côte d'Ivoire, in 2004, bank deposits as a percentage of 2004 assets stood at 76.72%, and for bank loans, at 57.42%[1]. APBEF-CI[2] also revealed that bank deposits reached 8,350 billion CFA francs in 2018 against 7,480 billion in 2017. Credits disbursed by Ivorian banks, meanwhile, amounted to 7,006 billion CFA francs in 2018 against 6,280 billion in 2017.

These figures show that banks operate in an environment where the need for investment is not entirely satisfied by bank production, yet banks have an abundance of resources. The question that challenges us then is to know if, in this context of excess liquidity, the banks exploit in an optimal way the resources at their disposal. In other

[1] Balance sheet of WAMU banks and financial institutions

[2] Professional association of banks and financial institutions of Côte d'Ivoire

words, are the banks technically efficient in transforming their resources into credits? Are public banks more efficient than private banks in Côte d'Ivoire? Do the internal factors of Ivorian banks influence their efficiency? Based on these questions, the central question that the study attempts to answer is the following: What are the factors likely to influence the efficiency of banks in Côte d'Ivoire? Thus, the general objective of this study is to analyze the factors influencing the efficiency of banks in Côte d'Ivoire. To do this, this study has the following specific objectives:

Specific objective 1: Determine the internal factors influencing banking efficiency in Côte d'Ivoire

Specific objective 2: Identify the type of banking efficiency in Côte d'Ivoire

In relation to our objectives, we postulate the following hypotheses:

Hypothesis 1: Return on equity, size, regulatory capital, and credit ratio positively influence the efficiency of Ivorian banks.

Hypothesis 2: Ivorian banks are more efficient at scale than at the technical level

The interests of this study are multiple and are integrated into the objectives of economic growth in Côte d'Ivoire. The concept of efficiency occupies an important and crucial place in economics. The examination of the determinants of banking efficiency will make it possible to propose solutions that will help improve the performance of banks in Côte d'Ivoire. In addition, the study will contribute to making the banking system more competitive.

From a methodological point of view, we will study the technical efficiency of the Ivorian banking sector, based on a sample of fifteen banks. The analysis of the determinants of banking efficiency is done in two stages. First, using the non-parametric method of data envelopment analysis, we determine the efficiency scores of the banks. This score is analyzed at three levels: technical efficiency, pure technical efficiency, and scale efficiency. On the other hand, we use these scores to evaluate the determinants using a Tobit regression.

This paper is organized as follows: Section 2 is devoted to a review of the literature on banking efficiency. Section 3 will present the methodology of the study. Section 4 will present the data source and the description of the variables. Section 5 will discuss the empirical results, particularly the econometric analysis of the determinants of banking efficiency in Côte d'Ivoire. Section 6 is reserved for the conclusion of the study.

2. Review of Littérature on Bank Efficiency

This literature review is structured as follows. First, we discuss the theoretical contributions on banking efficiency and second, the empirical work.

2.1 Theoretical Contributions on Banking Efficiency

With regard to theoretical contributions, it is possible to distinguish between factors endogenous to the banking firm and exogenous or environmental factors.

Regarding the factors internal to the banking firm, several variables can influence banking efficiency. To this effect, we have first the size of the bank which is perceived as a strategic factor of the efficiency of banks. According to Goddard and Mester (2004), small banks are more efficient than large ones because they can achieve relatively large financial margins especially when they operate in a weakly developed and uncompetitive banking system. This is a structural advantage that they enjoy. Small banks also have an advantage in managing agency problems because of their proximity and friendly relationships with small and medium-sized enterprises (informational advantage and relational advantage). On the other hand, Becker et al. (2003) believe that a large bank is able to reduce costs because of its expertise and risk diversification. However, according to De Jonghe (2010), size has a neutral effect on bank efficiency. Second, regulatory capital has been identified in the theoretical literature as affecting the efficiency of banks. Theoretically, a highly capitalized bank faces crises better than a poorly capitalized bank. Moreover, highly capitalized banks operate more efficiently than less capitalized ones (Hughes and Mester, 1998). But a high level of regulatory capital can encourage excessive risk-taking (Altunbas et al. (2007). Good bank risk management is also a factor in bank efficiency. Indeed, an increase in the credit risk borne by the bank can have negative repercussions on bank profitability. For Gabriel-Jiménez et al (2007), the problem of bank insolvency is mainly the consequence of the non-control of credit risk and the accumulation of non-performing loans. In addition to credit risk, liquidity problems can also influence bank efficiency. According to Ben Naceur et al (2011), most liquid banks tend to focus on short-term financing and refuse to finance risky projects, which makes them more efficient. Finally, diversification has been linked to bank efficiency. Banks with significant diversification can reduce the average cost of funding, shifting resources from inefficient operations to more profitable activities (Stomper, 2006). In this way, they are able to

achieve economies of scale and benefit from tax advantages. In the same vein, Jiang et al. (2003) points out that more diversified banks can generate more sources of income, thereby reducing their dependence on interest income, which is easily affected by the adverse macroeconomic environment.

With regard to external factors, market structure is often cited. For Bain (1951), there is a positive link between market structure and banking efficiency. Through the Structure-Comport-Performance hypothesis, he links market structure to firm performance. In other words, market structure affects the behavior of firms in an industry and this in turn affects performance. Neuberger (1998) transposes this analysis to the banking firm, where he shows that the performance of a firm depends on the behavior (pricing, quantity) of the industry, which then depends on its structure (the number of buyers and sellers, concentration). In contrast, for Demsetz (1973) and Peltzman (1977), it is the efficiency of a firm that shapes the structure of the market. Thus, banking efficiency is not the result of the structure of the banking market. Apart from market structure, banking regulation is considered to contribute to efficiency (Humphrey, 1993; Jayaratne and Strahan, 1998). Good regulation of the banking sector promotes financial stability and allows for control of corruption contributing to improved bank efficiency (Barth et al. 2013). But the doctrine of financial liberalization has emphasized the positive effects of banking deregulation on banking efficiency (Fethi et al. 2011). Financial liberalization would reduce government intervention and make the banking market conducive to competition, which reduces costs, improves bank management, reduces risk, and offers new financial services. The macroeconomic environment, namely GDP and inflation, is related to banking efficiency. It is recognized that periods of expansion are synonymous with periods of profitability for banks, while periods of economic downturn increase bank lending problems (Berger and De Young, 1997). For example, Bolt et al. (2012) show that adverse economic conditions such as a recession in economic activity can cause deposits and loans to decline, as well as household debt. But economic boom times can lead banks to misjudge credit risks, control their costs less, and thus become inefficient (Berger et al. 2000; Chortareas et al. 2012). Besides GDP, other macroeconomic variables can influence bank efficiency, in this case, inflation. According to Revell (1979), variations in bank profitability are largely explained by the level of inflation. Indeed, there is an important indirect influence on commercial banks as inflation changes their customers' demand for financial services. In addition, unexpected increases in inflation lead to cash flow difficulties for borrowers, which can result in the premature termination of loan contracts and precipitate loan losses. In addition, inflation is one channel through which bank operations and margins can be influenced through interest rates, making it difficult to assess lending decisions (Hoggarth et al. 1998). After this brief review of theoretical contributions, proper treatment of the study merits a discussion of the empirical work on the determinants of bank efficiency.

2.2 Empirical Work on the Determinants of Banking Efficiency

This empirical review addresses, on the one hand, the external factors and, on the other, the internal factors of banking efficiency in both developed and developing countries.

Regarding factors internal to the banking firm, diversification appears to be one of the determinants of banking efficiency. In a study for Austria, Rossi et al. (2009) analyzed the effect of banking diversification and bank regulatory capital on risk, cost and efficiency. Using the SFA method, the results indicate that diversification has a negative effect on cost efficiency and a positive effect on efficiency-profit. In addition, diversification reduces risk and increases the capitalization level of banks. Analyzing the determinants of profitability of Japanese banks between 2000 and 2007, Liu and Wilson (2010) find that highly capitalized banks are efficient, as credit risks are lower, which ensures good profitability. Yet, the results of Deelchand and Padgett (2009) indicated that over the period from 2003 to 2006, Japanese banks, the least efficient, were the most capitalized. With respect to size, using a sample of 19 Nigerian banks in 2009, Eriki (2015) shows that bank size is positively related to bank efficiency. In this sense, Cook et al. (2005), specify, for Tunisian banks, that small size banks are more efficient and perform better than other banks. On the other hand, Ramadan et al. (2011) find no link between bank size, and bank efficiency for Jordanian banks. Apart from diversification, regulatory capital and size, other internal factors influence banking efficiency, in this case, return on equity. On a sample comprising 17 Libyan banks during the period from 2004 to 2010, using the DEA method, Khalad et al. (2014) indicate that Libyan banks record profitability of equity capital. Moreover, this profitability has a positive impact on bank efficiency, size of operations, and capital adequacy. On the other hand, in the case of Maghreb countries, over the period from 2003 to 2015, Henni (2018) reveals that the profitability of equity has a significantly negative impact on banking efficiency. We also note that bank efficiency can be influenced by liquidity. Studying the determinants of the efficiency of commercial banks in Nepal, Jha et al. (2013) come to the conclusion that liquidity has a significant influence on the efficiency of commercial banks. Kamarudin et al (2019), arrive at similar results in the case of Malaysian banks.

Regarding external factors, for developed countries, Berger and Humphrey (1997) find that banking regulation positively influences bank efficiency. Using the DEA method to estimate the efficiency of a sample of banks in 22 European Union countries over the period 2000-2008, Chortareas et al. (2012) indicate that tighter capital restrictions and supervisory powers improve bank efficiency. In the African case, Nyantakyi and Mouhamadou (2015) show that only strong regulation can make banks efficient. In this sense, Mehdian et al (2007), show that deregulation and financial globalization are at the root of the deterioration of the efficiency of commercial banks in the United States, during the period from 1990 to 2003. But for the period 1984 to 1990, again in the United States, Mukherjee et al. (2001) show that financial liberalization had a positive impact on the efficiency and productivity of banks. As for the structure of the banking market, in Germany, Eber (2000) shows that banking efficiency can be influenced by bank concentration. For their part, using a sample of 4050 banks from 72 countries, Barth et al. (2013) indicate that competition is positively related to banking efficiency.

Competitive pressure would encourage bankers to be more vigilant and improve their performance. However, in Central and Eastern European countries, from 1999-2006, Lapteacru and Nys (2011), find that increased competition has increased the risk-taking of investment banks, thus reducing their solvency. The implication is that strong competition in the banking market is not necessarily associated with greater efficiency. In a study of the determinants of commercial bank efficiency in European transition countries (Czech Republic, Hungary, Poland, Slovakia, and Slovenia), Grigorian and Manole (2006) find that over the period 1995-1998, bank efficiency is positively related to several factors, including GDP per capita. In a sample of 7,000 banks in 11 European Union countries over the period 1996-2004, Hasan et al. (2009) show that economic growth positively influences efficiency in periods of expansion or contraction. In Africa, Kablan (2010) also reports that economic growth positively influences the efficiency of 137 banks in 29 African countries between the years 2000 and 2004. In contrast, Řepková (2014) finds a negative influence of GDP growth on Czech bank efficiency from 2003 to 2012. Similarly, Chortareas et al. (2012) find a negative and significant relationship between economic growth and bank efficiency, in 11 European countries during the period from 2000 to 2006. This is explained by the fact that during economic booms, banks have difficulty controlling their costs and granting more credit without controlling risks, thus generating bank inefficiency.

3. Model and Methodology

In this section, we will present the specification of the basic model on which this study is based and the estimation process.

3.1 Model Specification

Our study is based on Henni (2018). After a redesign, our specified model takes the following functional form:

$$DEA = f(ROE, LIQ, TAL, PROPR, CRD, CAP, TXPIB, INFL) \quad (1)$$

The regression model takes the following explicit form:

$$DEA_t = \alpha_i + \beta_1 ROE_{it} + \beta_2 LIQ_{it} + \beta_3 TAL_{it} + \beta_4 PROPR_{it} + \beta_5 CRD_{it} + \beta_6 CAP_{it} + \beta_7 TXPIB_{it} + \beta_8 INFL_{it} + \varepsilon_{it} \quad (2)$$

Where DEA is the technical efficiency that will denote (ET) in the first model, in the second, the pure and technical efficiency (ETP) and in the third, the scale efficiency (EE).

Thus, the models tested are the following:

$$f(ROE, LIQ, TAL, PROPR, CRD, CAP, TXPIB, INFL) = \begin{cases} ET\ (1) \\ ETP\ (2) \\ EE(3) \end{cases}$$

With ETG: overall technical efficiency score, ETP: pure technical efficiency score and EE: scale efficiency score.

The choice of inputs and outputs is a delicate operation. Indeed, in order to determine the components of inputs and outputs, one must first know the nature of the banking technique. In the literature, there are two main approaches: the production approach and the intermediation approach. The first focuses on the operating costs of banks. It considers banks as entities that combine their resources to achieve the maximum possible transaction. The second approach considers the bank as a financial intermediary that collects resources, mainly in the form of deposits, in order to grant credits. In our case, the intermediation approach is adopted. In this approach, the bank uses three inputs: physical capital, represented by fixed assets, financial capital, represented by deposits, and labor, represented by general operating expenses. Since data for personnel costs are not available for all banks,

the general operating expenses consider that a large part of the costs is personnel costs.

Outputs are composed of the total loans that banks make to their customers. This output fits the traditional activity of banks and the main services that banks offer. The return on assets is used as the second output. Thus, note ROE is the return on equity (net income to equity), LIQ the bank liquidity (cash and reserves in banks divided by total assets), $TAL,$, the size of the bank (logarithm of Total Assets), $PROPR$ the ownership of the bank (1 if the bank is public and 0 if it is a private bank), CRD the bank credit ratio (bank claims divided by total assets), CAP the banks regulatory capital (capital divided by total assets), $TXPIB$ the growth rate of gross GDP, $INFL$, the inflation rate calculated with consumer price indices, and ε_it the residual term of the model. α_i is a constant and β_1,……, β_8, the coefficients of the regression to be estimated.

We can now proceed to the choice of the study model and the appropriate estimation technique.

3.2 The Estimation Process

The choice of the model to be estimated cannot be made a priori without first conducting econometric tests. In the following lines, we first present the preliminary econometric tests and the estimation technique.

3.2.1 Preliminary Economic Tests

The econometric approach begins with descriptive statistics. Indeed, the main purpose of two-dimensional descriptive statistics is to examine whether there is some form of association between two variables. The purpose of descriptive statistics is to structure and represent the information contained in the data. In our study, it will consist of presenting the means of the effectiveness scores and the correlation between our study variables. Let us recall that an average is a calculation tool allowing to summarize a list of numerical values in a single real number. Its incompleteness leads to the standard deviation, which is an indicator of dispersion. It informs us about the way individuals are distributed around the mean. In addition, the correlation coefficient is an index that measures the intensity of the linear association between two variables. A positive correlation coefficient indicates a positive linear dependence, while a negative coefficient indicates a negative linear dependence.

3.2.2 The Estimation Technique

Our study uses a non-parametric efficiency estimation method. In general, non-parametric methods, the FDH (Free Disposal Hull) and the DEA (Data Envelopment Analysis) are based on data envelopment techniques. The economic approach of these analyses is linked to the notion of X-efficiency (Leibenstein, 1966), and the central hypothesis is that a producer is relatively inefficient if he uses more resources than another producer, for a given value added. Efficient production, thus located on the efficiency frontier, defines the relationship between inputs and outputs by depicting the maximum value obtained from the inputs consumed. In doing so, it is linked to the current state of technology available to the entity. Ignoring all links between actors and decision levels, an entity is considered efficient only if it operates on the efficiency frontier. The estimation technique adopts two steps: the identification of the frontier and the measurement of the efficiency factor. The first step is dedicated to the identification of the frontier. According to the hypothesis postulated on returns to scale, there are essentially two categories of DEA models, namely the DEA-CCR situation (de Charnes, Cooper, and Rhodes, 1978) linked to constant returns with a constant frontier, and the so-called DEA-BCC situation (de Banker, Charnes and Cooper, 1984) allowing for variable returns to scale. The BCC models are therefore more flexible in the sense that they allow the model to determine the returns to scale by itself. In addition, among the different techniques for measuring efficiency, there are, among others, input-oriented and output-oriented measures. Indeed, efficiency can be measured through the distance between the observed DMU and the production frontier, either horizontally (input-oriented) or vertically (output-oriented). We will focus on the output-oriented BCC model, as this is the one we have chosen to use in this study. We determine the efficiency scores under the constant and variable efficiencies of scale. Once the efficiency scores have been calculated, it is useful to look for the sources of productive inefficiencies. This is the purpose of the second step, which is carried out through an econometric regression of efficiency scores. At this level, the estimation technique used is Tobit regression. In theory, Tobit regression gives more consistent estimates of the coefficients of the regression when the dependent variable is limited. It is suitable for data in the interval [0 - 1]. The Tobit model is an extension of the Probit model, developed by Tobin (1958). For panel data, the Tobit model is based on a random effects model. Indeed, the absence of sufficient statistics does not allow the fixed effects to be conditioned outside of probability. Formally, the Tobit regression model can be presented as follows. A variable called $Effic^*$ is assumed to depend on a number of independent variables clustered in the vector X, whose effects are clustered in the vector β. The observed values of $Effic^*$, the $Effic_i^*$, are assumed to be the combination of the value predicted by the deterministic component of the model $X_i\beta$, and a residual, ε_i, whose value varies randomly for each individual. However, it is assumed that the variable $Effic^*$ is not directly observable, but rather the variable $Effic$ is

observed. The Tobit model can be written:

$$Effic_i^* = \alpha + X_i\beta + \varepsilon_i \quad (3)$$

Where $Effic_i^*$ is the latent variable of efficiency scores and X_i is the vector of explanatory variables.

$$Effic_i = 0 \; si \; Effic_i^* \leq 0$$

$$Effic_i = Effic_i^* \; si \; 0 \leq Effic_i^* \leq 1$$

$$Effic_i = 1 \; si \; Effic_i^* \geq 1$$

The random-effects Tobit model first includes an equation that relates the model's dependent variable, $Effic_i^*$, to the independent variables, to which both a random effect and a residual are added:

$$Effic_{it}^* = \alpha + X_{it}\beta + v_i + \varepsilon_{it} \quad (4)$$

$$\forall \; i = 1, \ldots\ldots\ldots\ldots, N, \qquad \forall \; t = 1, \ldots\ldots\ldots\ldots\ldots, n_i$$

In equation (4), $Effic_{it}^*$ represents the value that the continuous latent variable can take for the observation of individual i at time t, α represents the value of the intercept, Xit denotes the set of independent variables as measured at time t for individual i, β is the vector of coefficients affecting these variables to be estimated, vi represents the random effect size associated with individual i, and ε_{it} is the error of the model, which differs for each observation. Note also that v_i is distributed according to the N (0, σ_v^2) distribution and ε_i also follows an N (0, σ_v^2) distribution. From the above, our model can therefore be written as follows:

$$Effic_{it}^* = \alpha + \beta_1 ROE_{it} + \beta_2 LIQ_{it} + \beta_3 TAL_{it} + \beta_4 PROPR_{it} + \beta_5 CRD_{it} + \beta_6 CAP_{it} + \beta_7 TXPIB_{it} + \beta_8 INFL_{it} + v_i + \varepsilon_{it}$$

4. Data, Sources and Descriptive Statistics

In this section, we present, first, the source of the data and the definition of the variables and indicators, and second, the statistics of the variables.

4.1 Data Sources and Key Variable Definitions and Indicators

For this study, we use annual data from the World Bank databases (WDI, 2018) and the Central Bank of West African States' (2018) bank balance sheets and income statements. The study covers the period from 1986 to 2016, given the availability of data. The sample of banks is composed of 12 foreign private banks, one domestic private bank, and two public banks. The foreign private banks are: Afriland First, BACI, BICICI, BHCI, BOA-CI, BRIDGE BANK, CITIBANK ECOBANK, ORABANK, SGBCI, SIB and STANDARD CHARTED BANK. The national private bank is NSIA BANK and the two public banks are BNI and VERSUS BANK. These banks can be grouped into three categories:

- 8 large banks with a balance sheet of more than 500 billion FCFA. These are SGBCI, Ecobank, BACI, NSIA Bank, SIB, BICICI, BOA and BNI;

- 4 medium-sized banks with balance sheets between 100 and 500 billion FCFA. These are Bridge Bank, Citibank, Orabank and Standard Chartered Bank;

- 3 small banks with balance sheets of less than FCFA 100 billion. These are BHCI, Versus Bank and Afriland First Bank.

Table 1 below provides information on the variables used and the expected effects.

Table 1. Table of expected signs

Explained variable: bank efficiency score.		
Explanatory variables	Notation	*Sign expected*
Regulatory capital	CAP	+
Return on equity	ROE	-
Bank liquidity	LIQ	+
Credit ratio	CRD	+
Bank size	TAL	+
Bank ownership	PROPR	-
Inflation	INFL	-
The growth rate of the Gross Domestic Product	TXPIB	+/-

Source: Author, based on literature review

Having presented our data sources and sample, we can now make a brief descriptive statistics to better understand the evolution of the data.

4.2 Descriptive Statistics of the Variables and Efficiency Scores

In the following, we will perform a descriptive analysis of the variables and the correlation matrix. The descriptive analysis consists in making a synthetic and explicit description of the observed data, in order to better analyze them. Thus, for this work, the study of the variables will focus on their average, their standard deviation, as well as their minimum and maximum. For the evaluation of the inputs and outputs used on average by the banks, the measurement of their efficiency scores will be done using the non-parametric method (DEA). Each observation is considered independent and has an appropriate efficiency score. The descriptive statistics of the data are reported in Table 2 below.

Table 2. Descriptive analysis of variables

Variables	Mean	Max	Min	Standard deviation
ET	0.533	1	0	0.1851396
ETP	0.649	1	0	0.2297914
EE	0.836	1	0	0.1611295
ROE	0.693298	19.74344	-27.1085	2.469821
LIQ	0.0388805	0.1311986	0	0.0265637
CRED	0.7296691	0.9525641	0.291	0.1450177
TAL	5.076752	6.220789	3.342	0.958201
PROPR	0.1333333	1	0	0.3407469
CAP	9.704674	179.0564	0.935	18.43053
TXPIB	4.492857	10.7	-4.4	4.202095
INFL	2.154633	6.308528	0.4486821	1.683644

Source: Author, using data from BCEAO (2018) and WDI (2018)

From Table 2, it appears that the average pure technical efficiency during the study period is 0.694, i.e., an estimated pure technical inefficiency of 0.306, while the scale efficiency has an average of 0.836. It follows that the losses in pure technical inefficiency of Ivorian banks are counterbalanced by the efficiency of scale. Similarly, the return on equity recorded its maximum value with Versus-Bank (2009) and the minimum value with BACI (in 2011). In addition, on average, the size of banks is 5.076, corresponding to that of Orabank (in 2005) which has the lowest size and maximum size of 6.22 corresponding to that of SGBCI in 2017. However, this bank has the lowest regulatory capital of the sample at the same period, while in 2011, Afriland has the highest regulatory capital. Note also that the lowest credit ratio of 0.291 is BNI in 2006 and the highest 0.952 is Versus-Bank in 2004. On the other hand, the least liquid bank during the study period was Orabank in 2005 and the most liquid was SIB in the same period.

In terms of statistics, the correlation matrix provides important information because it summarizes the degree of correlation between our variables. Table 3 allows us to appreciate the degree of relationship between the variables.

Table 3. Correlation matrix

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
[1]ET	1								
[2]ROE	0.154	1							
[3]LIQ	-0.153*	-0 .081	1						
[4]CRED	0.378*	0,114	-0.043	1					
[5]TAL	0.195*	-0.037	0.534*	0.224*	1				
[6]PROPR	-0.078	0.107	-0.180*	-0.025	-0.117	1			
[7]CAP	0.042	-0.023	-0.208*	-0.096	-0.319*	-0.064	1		
[8]TXPIB	0.066	0.093	-0.065	-0.152*	0.182*	0.000	0.039	1	
[9]INFL	-0.056	-0.125	0.029	0.111	-0.079	0.000	0.046	-0.576*	1

Source: Author, based on data from BCEAO (2018) and WDI (2018)

Note: * significance at the 5% level.

Table 3 reveals that size and liquidity are moderately correlated (0.5340); however, technical efficiency and credit ratio are moderately correlated (0.3781). So are size and credit ratio (0.224), GDP growth rate and size (0.182) and then inflation and credit ratio (0.111). On the other hand, inflation and liquidity are very weakly related (0.0299). Apart from these relationships, there is a weak correlation between the other variables.

Now we can make some comments on the efficiency scores which are recorded in Table 4.

Table 4. Decomposition of the technical efficiency of Ivorian banks

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MOY	0.637	0.594	0.478	0.493	0.519	0.530	0.469	0.483	0.463	0.564	0.587	0.562	0.559	0.560
MAX	1	1	0.729	0.807	1	1	0.887	1	1	1	1	0.805	0.803	0.840
MIN	0.402	0.419	0.207	0.254	0.259	0.230	0.219	0.213	0.211	0.333	0.286	0.379	0.385	0.424
ETYP	0.173	0.160	0.159	0.157	0.197	0.211	0.182	0.176	0.196	0.227	0.186	0.116	0.124	0.105
NBE	1	1	0	0	1	1	0	1	1	2	1	0	0	0

Source: Author, using data from BCEAO (2018) and WDI (2018)

Max: refers to the highest efficiency score in the sample during the year under study.

Min: refers to the minimum efficiency score in the sample during the year under study.

Etyp: refers to the standard deviation

NBE: denotes the number of 100% efficient banks in the sample during the year under study

Table 4 shows that the efficiency of Ivorian banks declined over the period 2004 to 2017. Indeed, over this period, the average efficiency of banks fell by 13.75% (0.637 in 2004 and 0.560 in 2017). In 2004, the inefficiency rate of Ivorian banks was 37% (1-0.637), which implies that some expenses could be avoided. The least efficient bank in that year was SIB with a score of 0.402. This score reflects the inefficiency of the bank, which uses 60% of its resources during its production process for unproductive expenses. In 2005, the efficiency score decreased by 6.75% compared to the previous year. Nevertheless, the bank furthest from the border is the public bank BHCI with a score of 0.419. In 2006, there was a deterioration of 19.52%. The closest score to the efficiency frontier is 0.729 (Citibank) and the least close is 0.207 (Bridge Bank). This could be explained by the fact that Bridge Bank started operations during this year. However, in the two years that followed (2006 and 2007), none of the banks in the sample managed to be fully efficient. It is from 2008 onwards that an improvement in efficiency scores is recorded. In 2009, the average efficiency of Versus-Bank increased to 2.11%. However, in 2010, there was a drop in average efficiency to 0.469, certainly due to the socio-political crisis that shook the country, paralyzing the economy from the last quarter of 2010 to early 2011. In 2011 and 2012, the only fully efficient bank was CITIBANK (a foreign bank) and the less efficient Orabank (formerly BRS), which was in deficit, not making a profit. The pivotal year is 2013, when an increase in banking efficiency was recorded. This is probably due to the recovery from the political crisis, which led to the arrival of new investors on the banking market. Moreover, in 2013, there were two fully efficient banks (Orabank and Afriland first Bank), the least efficient was the BHCI. In 2014 the improvement benefited the public bank BNI, which was a completely efficient bank. But from 2015 to 2017, it was Orabank that recorded the technical efficiency scores closest to the efficiency frontier (0.80 in 2015, 2016 and 0.84 in 2017). These different results indicate that large banks do not do better in terms of efficiency than small banks. Our results are consistent with those obtained previously by other authors who clearly indicate that large banks have diseconomies of scale (Vettori, 2000; Rouabah, 2006). We find that small banks in Côte d'Ivoire make more efforts to reduce input consumption than large banks. Moreover, the efficiency of scale is higher the closer the bank is to its optimal size.

To better appreciate the efficiency of banks, it is necessary to analyze the pure technical efficiency and the scale efficiency that make up the technical efficiency. Indeed, the technical efficiency of a bank is the product of pure technical efficiency and scale efficiency. Pure technical efficiency reflects the way in which a bank's resources are managed, and scale efficiency characterizes banks that operate at an optimal scale, which allows them to proportionally increase the quantity of all their factors. Ivorian banks operate differently as shown in Table 5.

Table 5. Breakdown of the efficiency of Ivorian banks

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MOY ETP	0.724	0.625	0.551	0.617	0.607	0.621	0.560	0.582	0.554	0.661	0.707	0.762	0.772	0.780
MOY EE	0.886	0.833	0.900	0.880	0.874	0.869	0.867	0.857	0.864	0.854	0.836	0.761	0.756	0.754

Source: Author based on data from BCEAO (2018) and WDI (2018)

From 2004 to 2014, banks achieve a scale efficiency that is more than pure technical efficiency. It is only from 2015 that the pure technical efficiency of Ivorian banks gains momentum and becomes higher than their scale efficiency. Moreover, the pure technical efficiency of Ivorian banks was constantly declining. This decline could

be due to a general decline in liquidity, as the majority of Ivorian banks are experiencing a decline in liquidity, which may have forced them to reduce lending. This situation has caused the liquidation of several banks such as the Agricultural Finance Bank (BFA) and the COFIPA Investment Bank Côte d'Ivoire (CIBCI) has seen its license withdrawn. At the same time, mergers and absorption of other banks such as BRS, Omnifinance, Access Bank are recorded. It is remarkable to note that the measures aimed primarily at improving the supervision of the banking sector by the Banking Commission, enacted by Law No. 2009-385 of December 1, 2009, have produced their effects from 2013 where we note a clear increase in pure technical efficiency, standing at 78%, in 2017. From these findings, it follows that the efficiency of Ivorian banks is leaning towards scale efficiency than pure technical efficiency (from 2004 to 2015). This could be explained by bank concentration. In most cases, the banks with the highest degree of scale efficiency are those with the largest size and market share. The oligopolistic nature of the Ivorian banking market remains a valid explanation. Its relative decline since 2013 could be explained by the renewed competition in the Ivorian banking sector

After these various descriptive statistics, we can now present the results of our estimations.

5. Results and Analysis

To examine the factors that influence bank efficiency, a two-step approach is used. The first step is to obtain efficiency scores using the DEA method. The efficiency scores calculated (first step), are not only explained by managerial errors attributable to managers or maladjusted productive structures, but they can also be influenced by the structural environment specific to each country. This is why Ray, S. C. (1988) proposes to look for the sources of productive inefficiencies through an econometric regression of efficiency scores (second step). The second stage consists of using the scores obtained previously as the dependent variable, and factors specific to macroeconomic or sectoral conditions at the bank are presented as independent variables. We now present the results of the Tobit model estimates before making the economic interpretations.

5.1 Results of the Estimations with the Tobit Model

The regression of the explanatory variables on the dependent variable (technical efficiency, pure technical efficiency and scale efficiency), using the Tobit method, gives the results reported in Table 6. From this table, we can say that the three models (ET, ETP and EE) are all statistically validated. Indeed, for each of the estimated models, the P-value associated with the LR-stat is less than 0.05. This means that there is at least one variable with a non-zero coefficient, in other words, there is at least one variable that explains the efficiency of banks in Côte d'Ivoire. In addition, the probabilities of Lr test being lower than the critical threshold of 5%, it follows that the random effect model is appropriate for the estimation of coefficients and the results are robust to the quadrature test.

Table 6. Regression results

Variables	Model (1) : ET	Model (2) : ETP	Model (3) :EE
Constant	-1.095***	-2.077***	1.979***
	(0.000)	(0.000)	(0.000)
Return on equity (ROE)	0.008**	0.009**	-0.001
	(0.022)	(0.005)	(0.320)
Credit Ratio (CRED)	0.745***	0.871***	-0.0787*
	(0.000)	(0.000)	(0.067)
Liquidity (LIQ)	-2.343***	-2.800***	-0.265
	(0.000)	(0.000)	(0.383)
Property (Propr)	-0.046	-0.093	0.038
	(0.502)	(0.180)	(0.240)
Capitalization (CAP)	0.003***	0.004***	-0.0005*
	(0.000)	(0.000)	(0.056)
Size (TAL)	0.222***	0.420***	-0.205***
	(0.000)	(0.000)	(0.000)
Growth rate of the GDP (TXPIB)	-0.002	-0.003	0.0001
	(0.289)	(0.205)	(0.928)
Inflation (INFL)	-0.0002	-0.002	0.0009
	(0.971)	(0.626)	(0.721)
Lr test	49.05***	49.87***	44.41***
	(0.000)	(0.000)	(0.000)

Source: Author, using data from BCEAO (2018) and WDI (2018)

With all these precautions regarding the robustness of the results, it is possible to give economic interpretations to our results.

5.2 Economic Interpretations of Results and Validation of Assumptions

With respect to bank size, it has a positive effect on technical efficiency and pure technical efficiency. These results could be explained by the fact that large banks can take advantage of economies of scale to control their costs. These results are similar to those of Becker et al (2003). On the other hand, bank size negatively influences the scale efficiency of banks. This counterintuitive result could be explained by the heterogeneity (different sizes) of banks in the sample.

As for the influence of bank liquidity, it has a negative effect on bank efficiency according to the three measures of bank efficiency retained. This could be explained by the fact that in situations of uncertainty, banks' preference for liquidity increases. This could lead to opportunity costs as banks do not benefit from the income generated by loans. For a given level of burden, this may create banking inefficiencies. Our results are consistent with those of Femise (2011).

As for the effect of return on equity, it positively influences technical efficiency and pure technical efficiency. This result could be explained by the fact that banks with high levels of equity manage risks better, thus increasing their performance. It also indicates optimism that banks will overcome their profitability problems after the socio-political crisis of 2011. These results are similar to those of Khalad et al. (2014).

As for the influence of regulatory capital, the results indicate that it has a positive effect on technical efficiency and pure technical efficiency, but negatively influences scale efficiency. The likely reason is that bank deposits are high in highly capitalized banks, thus reducing agency problems between managers and shareholders. In addition, a highly capitalized bank increases its ability to make loans. Moreover, managers are able to better control performance management, thus ensuring the efficiency of the bank. These results are similar to those of Liu and Wilson (2010).

Regarding the influence of the credit ratio, it has a double effect on the banking sector. It stimulates technical efficiency and pure technical efficiency. By lending to several sectors of the economy, banks manage to accumulate a quantity of information that allows them to reduce costs. In contrast, the credit ratio reduces scale efficiency. This can be explained by the fact that Ivorian banks grant a large proportion of their assets in bank loans, they maximize their revenues but incur more risk and are therefore not very efficient. They do not manage risk very well in an environment where information asymmetries are high. These results are similar to those of Stomper (2006).

These results allow us to verify our initial hypotheses. In view of the low-efficiency scores, we can say that our first hypothesis, which postulates that Ivorian banks are not technically efficient, is verified. Indeed, technical efficiency evolves in a decreasing manner. This result can be explained by the fact that banks do not use their available resources efficiently to finance profitable projects. Banks probably use some of the resources for unproductive expenditures instead of financing the activity. This conclusion is similar to that of Benzai (2016) who found the same phenomenon regarding commercial banks in Algeria.

In addition, the second hypothesis which stated that profitability, bank size, regulatory capital, and credit ratio positively influence bank efficiency, is confirmed.

6. Concluding Remarks

The objective of this study was to analyze the variables likely to influence banking efficiency in Côte d'Ivoire. To achieve this objective, the non-parametric DEA method was used on annual data from 15 Ivorian banks covering the period 2004 to 2017.

The estimates show that the technical efficiency of Ivorian banks is decreasing, but the scale efficiency and the pure technical efficiency are increasing from year to year. Applying the Tobit method to the efficiency scores, we find two major results. The first is that bank size, regulatory capital, credit ratio and return on equity positively influence efficiency. On the other hand, liquidity negatively influences bank efficiency. The second is that macroeconomic variables (inflation and GDP growth rate) and bank ownership do not have a significant impact on the efficiency of Ivorian banks.

In terms of economic policy implications, these results raise questions for monetary authorities about the measures to be adopted to make these banks efficient. Indeed, since regulatory capital increases the efficiency of Ivorian banks, it would be wise for the monetary authorities to ensure that regulatory standards are respected. Given that the size of banks influences the efficiency of Ivorian banks, banks should optimize their balance sheet. They would benefit from balancing their balance sheet through optimal management of the liquidity they possess. Banks should grant more credit to the economy while optimizing the management of risks related to the supply of credit. Banks could put in place robust methods to reduce risk, which will allow them to increase profits,

equity and reduce costs. Ultimately, concerted action is needed between the monetary authorities and the Ivorian banks. The banks must adopt a rational management style that would enable them to finance the economy efficiently. At the level of the monetary authorities, they must ensure that the banks apply the standards.

The results of our study suggest further research opportunities. An in-depth analysis of the role of ownership on efficiency and productivity differences deserves to be addressed. Instead of the distinction between public and private banks, a future study could include a distinction, this time, between domestic and foreign banks. It is also important to identify the factors that explain the efficiency or inefficiency of Ivorian banks since the advent of financial reforms and, more specifically, to analyze the role of governance mechanisms in the performance levels recorded. In addition, it is well known in the recent literature on efficiency that, as noted (Simar & Wilson, 2011), the Tobit estimation in the second phase produces biased and inconsistent estimates. The work of Simar & Wilson (2000) provides a bootstrap method to eliminate the bias of such coefficients. A subsequent study will be conducted taking into account the criticisms and innovations in the works of Simar & Wilson (2007) and Daraio et al., (2016).

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Appendix 1. Efficiency scores of some Ivorian banks

Année	Banques	ET	ETP	EE
2004	Afriland First Bank	0.743555	0.743555	1
	BACI	0.585446	0.604981	0.967710
	Bridge Bank Group	inexistant	Inexistent	inexistant
	BICICI	0.516911	0.710730	0.727295
	BHCI	0.509083	0.509083	1.000000
	BNI	0.705621	1.000000	0.705621
	BOA-CI	0,761513	0,825660	0,922309
	ORABANK	inexistant	Inexistent	inexistant
	CITIBANK-CI	0,862149	0,882762	0,976649
	ECOBANK	0,489944	0,587428	0,834050
	NSIA-Bank	0,454957	0,538213	0,845311
	SGBCI	0,595428	0,876749	0,679131
	SIB	0,402973	0,468501	0,860133
	Standard Chartered	1	1	1
	VERSUS-BANK	0,664320	0,668672	0.993491
2005	Afriland First Bank	0.466676	0.504297	0.925400
	BACI	0.548570	0.566082	0.969066
	Bridge Bank Group	inexistant	inexistant	inexistant
	BICICI	0.480616	0.641568	0.749128
	BHCI	0.419402	0.420132	0.998264
	BNI	0.637634	0.828197	0.769906
	BOA-CI	0.687001	0.746357	0.920473
	ORABANK	1	1	1
	CITIBANK-CI	0.838562	0.838562	1
	ECOBANK	0.478924	0.593018	0.807606
	NSIA-Bank	0.468143	0.551720	0.848516
	SGBCI	0.570235	0.825322	0.690923
	SIB	0.548376	0.667580	0.821438
	Standard Chartered	0.636789	0.636789	1
	VERSUS-BANK	0.542980	0.549581	0.987990
2006	Afriland First Bank	0.469133	0.504713	0.929505
	BACI	0.567181	0.612895	0.925412
	Bridge Bank Group	0.207887	0.207887	1
	BICICI	0.491539	0.691455	0.710877
	BHCI	0.396154	0.396154	1
	BNI	0,214806	0,22398	0.959042
	BOA-CI	0.663592	0.736067	0.901538
	ORABANK	0.257414	0.257414	1
	CITIBANK-CI	0.729392	0.729392	1
	ECOBANK	0.6429	0.877278	0.732835
	NSIA-Bank	0,460276	0,543466	0,846928
	SGBCI	0,604586	0,865811	0,698289
	SIB	0,572923	0,706449	0,81099
	Standard Chartered	0,474317	0,474317	1
	VERSUS-BANK	0,429417	0,436897	0,982878
2007	Afriland First Bank	0.390676	0.415154	0.941039
	BACI	0.572304	0.666080	0.859213
	Bridge Bank Group	0.339666	0.339666	1
	BICICI	0.483826	0.668956	0.723255
	BHCI	1	1	1
	BNI	0.254086	0.273219	0.929971
	BOA-CI	0.807800	0.974547	0.828897
	ORABANK	0.404793	0.404793	1
	CITIBANK-CI	0.685426	0.685426	1
	ECOBANK	0.630777	0.903221	0.698364
	NSIA-Bank	0.444112	0.527514	0.841895
	SGBCI	0.589338	0.816207	0.722045
	SIB	0.519032	0.651628	0.796516
	Standard Chartered	0.516396	0.516396	1
	VERSUS-BANK	0.269837	0.269992	0.999426
2008	Afriland First Bank	0.319239	0.348369	0.916381
	BACI	0.414652	0.523634	0.791873

	Bridge Bank Group	0.452184	0.452184	1
	BICICI	0.503849	0.720370	0.699431
	BHCI	0.372508	0.372508	1
	BNI	0.316131	0.363875	0.868790
	BOA-CI	0.844308	0.997401	0.846508
	ORABANK	0.259838	0.259838	1
	CITIBANK-CI	1	1	1
	ECOBANK	0.583089	0.776013	0.751390
	NSIA-Bank	0.473842	0.584717	0.810379
	SGBCI	0.519972	0.726076	0.716140
	SIB	0.593099	0.832885	0.712102
	Standard Chartered	0.621778	0.621778	1
	VERSUS-BANK	0.519860	0.520277	0.999199
2009	Afriland First Bank	0.230083	0.246479	0.933478
	BACI	0.358377	0.447824	0.800263
	Bridge Bank Group	0.488918	0.488918	1
	BICICI	0.513570	0.771127	0.665998
	BHCI	0.430439	0.430439	1
	BNI	0.285556	0.328648	0.868880
	BOA-CI	0.651062	0.756444	0.860687
	ORABANK	0.262406	0.262406	1
	CITIBANK-CI	0.834727	0.834727	1
	ECOBANK	0.590294	0.809610	0.729109
	NSIA-Bank	0.535604	0.682815	0.784405
	SGBCI	0.521775	0.790631	0.659947
	SIB	0.559248	0.770012	0.726285
	Standard Chartered	0.697298	0.697298	1
	VERSUS-BANK	1	1	1
2010	Afriland First Bank	0.219355	0.227421	0.964537
	BACI	0.313226	0.389025	0.805158
	Bridge Bank Group	0.424871	0.424871	1
	BICICI	0.548339	0.750795	0.730344
	BHCI	0.350205	0.359992	0.972813
	BNI	0.268715	0.313747	0.856473
	BOA-CI	0.608232	0.708817	0.858095
	ORABANK	0.228766	0.228766	1
	CITIBANK-CI	0.887424	0.903666	0.982026
	ECOBANK	0.583812	0.870427	0.670719
	NSIA-Bank	0.488529	0.621061	0.786603
	SGBCI	0.503616	0.758349	0.664095
	SIB	0.577542	0.795823	0.725717
	Standard Chartered	0.651827	0.651827	1
	VERSUS-BANK	0.394459	0.397379	0.992652
2011	Afriland First Bank	0.439857	0.483888	0.909007
	BACI	0.328301	0.405937	0.808749
	Bridge Bank Group	0.468913	0.4689135	1
	BICICI	0.531137	0.746543	0.711461
	BHCI	0.353138	0.362977	0.972892
	BNI	0.366398	0.448842	0.816318
	BOA-CI	0.577049	0.685285	0.842057
	ORABANK	0.213447	0.213447	1
	CITIBANK-CI	1	1	1
	ECOBANK	0.600546	0.897979	0.668775
	NSIA-Bank	0.451931	0.568837	0.794482
	SGBCI	0.483381	0.755298	0.639987
	SIB	0.542801	0.790363	0.686774
	Standard Chartered	0.508747	0.508747	1
	VERSUS-BANK	0.385445	0.386037	0.998466
2012	Afriland First Bank	0.211517	0.215514	0.981453
	BACI	0.356602	0.442644	0.805618
	Bridge Bank Group	0.496699	0.498268	0.996853
	BICICI	0.474774	0.652178	0.727983
	BHCI	0.313592	0.320738	0.977720
	BNI	0.304170	0.370783	0.820346

	BOA-CI	0.568223	0.717763	0.791659
	ORABANK	0.219663	0.219663	1
	CITIBANK-CI	1	1	1
	ECOBANK	0.697995	1	0.697995
	NSIA-Bank	0.452360	0.577173	0.783752
	SGBCI	0.470613	0.737801	0.637859
	SIB	0.487182	0.652957	0.746117
	Standard Chartered	0.472399	0.472399	1
	VERSUS-BANK	0.426015	0.426910	0.997905
2013	Afriland First Bank	1	1	1
	BACI	0.519323	0.716720	0.724583
	Bridge Bank Group	0.452732	0.494072	0.916328
	BICICI	0.447162	0.584325	0.765262
	BHCI	0.333874	0.341245	0.978400
	BNI	0.455812	0.571472	0.797611
	BOA-CI	0.504642	0.621874	0.811485
	ORABANK	1	1	1
	CITIBANK-CI	0.964183	0.964183	1
	ECOBANK	0.586188	0.845431	0.693360
	NSIA-Bank	0.452833	0.591653	0.765368
	SGBCI	0.432407	0.669267	0.646091
	SIB	0.517886	0.721523	0.717768
	Standard Chartered	0.402746	0.402746	1
	VERSUS-BANK	0.390698	0.390698	1
2014	Afriland First Bank	0.286807	0.295112	0.971857
	BACI	0.546373	0.826219	0.661293
	Bridge Bank Group	0.527407	0.651439	0.809603
	BICICI	0.473918	0.656744	0.721618
	BHCI	0.835678	0.835678	1
	BNI	1	1	1
	BOA-CI	0.548284	0.728777	0.752335
	ORABANK	0.709739	0.709739	1
	CITIBANK-CI	0.865137	0.901122	0.960067
	ECOBANK	0.509641	0.776824	0.656058
	NSIA-Bank	0.496465	0.708203	0.701020
	SGBCI	0.453093	0.727797	0.622554
	SIB	0.520974	0.740369	0.703668
	Standard Chartered	0.574262	0.587154	0.978042
	VERSUS-BANK	0.461313	0.461313	1
2015	Afriland First Bank	0.455288	0.472536	0.963500
	BACI	0.551488	0.910138	0.605938
	Bridge Bank Group	0.556206	0.806505	0.689650
	BICICI	0.491237	0.715137	0.686914
	BHCI	0.379434	0.387692	0.978701
	BNI	0.497438	0.737797	0.674221
	BOA-CI	0.691328	0.927373	0.745470
	ORABANK	0.805855	0.904193	0.891242
	CITIBANK-CI	0.763834	1	0.763834
	ECOBANK	0.591284	0.955622	0.618743
	NSIA-Bank	0.512501	0.780699	0.656464
	SGBCI	0.468151	0.760333	0.615718
	SIB	0.575804	0.916645	0.628164
	Standard Chartered	0.605035	0.671911	0.900468
	VERSUS-BANK	0.486033	0.486033	1
2016	Afriland First Bank	0.452532	0.471927	0.958902
	BACI	0.557693	0.961621	0.579951
	Bridge Bank Group	0.524660	0.728831	0.719865
	BICICI	0.531002	0.777887	0.682621
	BHCI	0.385083	0.406428	0.947482
	BNI	0.442874	0.706773	0.626613
	BOA-CI	0.795625	1	0.795625
	ORABANK	0.803369	0.919951	0.873274
	CITIBANK-CI	0.693341	0.960518	0.721841
	ECOBANK	0.599922	0.972159	0.617103

	NSIA-Bank	0.551163	0.85172	0.647112
	SGBCI	0.486995	0.873251	0.557681
	SIB	0.615129	1	0.615129
	Standard Chartered	0.433188	0.433188	1
	VERSUS-BANK	0.517076	0.517076	1
2017	Afriland First Bank	0.429354	0.448632	0.957029
	BACI	0.570822	1	0.570822
	Bridge Bank Group	0.538779	0.689055	0.781911
	BICICI	0.498399	0.728279	0.684352
	BHCI	0.424364	0.447750	0.947769
	BNI	0.414364	0.606773	0.636613
	BOA-CI	0.578895	0.861200	0.672195
	ORABANK	0.840189	1	0.840189
	CITIBANK-CI	0.671859	0.829665	0.809796
	ECOBANK	0.605510	1	0.605510
	NSIA-Bank	0.545554	0.875198	0.623349
	SGBCI	0.539676	1	0.539676
	SIB	0.602274	1	0.602274
	Standard Chartered	0.476898	0.518714	0.919386
	VERSUS-BANK	0.524004	0.524282	0.999470