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Competition and Banking Efficiency in the CEMAC Zone

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Abstract

The objective of this study is to analyze the effect of competition on the cost and profit efficiency of banks in the Economic and Monetary Community of Central Africa (CEMAC), over the period 2003–2010. The analysis is done in two stages. First, the stochastic frontier approach (SFA) permits us to estimate the efficiency scores and the competition levels measured by the adjusted Lerner index. Second, the competition measures thus obtained, and a set of control variables are introduced into a panel model to explain the cost and profit efficiencies. The results show that competition has been favorable to the profit efficiency, but not to the cost efficiency. This is because the diversification and the debtors' prime rates have evolved in the expected way. However, the creditors' prime rate, bank loans, inflation and the Gross Domestic Product (GDP) have evolved in an unexpected way. We recommend promotion of growth and a better inflation control by the government. As to the banks, they will gain from greater diversification of their products.

Keywords: bank competition, cost efficiency, profit efficiency, adjusted lerner index

1. Introduction

Given that the capitals market is embryonic in the CEMAC zone, indirect funding including bank loans, remains the main means of financing its economy (Hicks, 1974; Fouda, 2009). The banking system therefore provides almost all the financial intermediation role in this zone. It is therefore of great interest to seek its efficiency because efficient banks have the capacity to increase their outputs without increasing inputs, or reduce their inputs without reducing outputs (Chen et al., 2005). They also have the capacity to make maximum profit for a given level of input and output prices (Claessens & Laeven, 2004). By these characteristics, an efficient banking system can stimulate economic growth in the region through technological innovation (Brou, 2010), financial innovation(Kane, 1988; Sobreira, 2004) and the effectiveness of production factors (Levine, 1997).

Competition is seen by many authors as the simplest way to ensure the efficiency of banks. According to them, it generates a low intermediation cost; which increases the volume of savings and investments, and revives the economic growth (Rhoades & Rutz, 1982). However, the banking market structure of CEMAC has been profoundly modified towards greater competition, due to the 1980s banking crisis. It manifested itself by a strong tension of treasury, an accumulation of deficit management balances, significant irrecoverable funds and an almost negative banking profitability ratio closer to zero in all the CEMAC States. Consequently, 9 out of 40 banks in this zone had stopped their activities: only one complied with all regulatory standards, 14 had precarious balances and 16 were insolvent (BEAC, 2002).

The measures taken to deal with this situation sought greater competition in the sector; not only through the number of banks, but also through the entry conditions which are the main indicators of competition in the banking industry according to Baumol and al. (1982). These measures were: (i) the removal of credit squeeze, (ii) the privatization or closure of public banks as well as the withdrawal of the State capital from the banking sector, (iii) the latitude granted to banks to negotiate prime rates with their clients within the Maximum Debtor prime Rate (MDR) and the Minimum Creditor prime Rate (MCR) adopted by the BEAC, (iv) the total liberalization of the inter-banking market rate, (v) free access into the national financial system through foreign participation to the capital of national banks, on the one hand, and through the establishment of foreign banks in the national financial system, on the other, (vi) the creation of COBAC followed by the Harmonization of the Banking Regulations in Central Africa, to control the banking activity and to provide a more reassuring legal environment. The implementation of all these measures was effective from 1993 with the start-up of COBAC.

Conversely, the theory of destructive competition supports that competition is incompatible with banking efficiency. According to Chiappori and Yanelle (1996), Pruteanu-Podpiera et al. (2008), and Casu and Girardon, (2009), by reducing prices, increasing creditors' prime rates and reducing debtors' prime rates reduces banks margin and constrains them to take excessive risks.

The objective of this research is to identify the relationships between banking concentration and the efficiency of banks in the CEMAC zone over the period 2003–2010. In effect, it is from 2003 that one notices an increase in the number of banks in the zone. The methodology consists of two parts. First, the stochastic frontier approach (SFA) is used to make estimates on the cost and profit functions, so as to obtain the efficiency scores and the levels of competition through the adjusted Lerner index. Second, the competition measures obtained and a set of control variables explain the cost and profit by panel regressions.

The rest of the work is articulated as follows: section 2 presents the different theoretical bases of the relationships between competition and efficiency. Section 3 discusses the competition and efficiency measures adopted. Section 4 presents the methodology. Section 5 presents the results and discussion and Section 6 is devoted to the conclusion with recommendations of policies.

2. Bank Competition and Efficiency

The authors who establish the relationship between competition and banking efficiency generally draw inspiration from the model Structure-Behavior-Performance (SBP) (Dietsch, 1992; Neuberger, 1997), which has constituted for a long time the theoretical model of industrial organization in general; and in particular, of the banking industry. This model postulates that the structure of any market is characterized by the number of suppliers and buyers, the diversity of products, the forms of integration, the price structure and the entry barriers. This structure determines behaviors in terms of pricing, product selection and strategy. These behaviors in turn determine the results in terms of efficiency, margins and profits. But due to the peculiar nature of the banking market; characterized by the asymmetry of information and economies of scale, the SBP model could be reduced to the effects of the entry conditions on the degree of concentration, and the impact of concentration on the margins and on the prices (Dietch, 1992; Neuberger, 1997).

Drawing inspiration from the SBP paradigm, several authors have given diverse arguments to establish a positive theoretical relationship between competition and the efficiency of banks. Hart (1983) and Leibenstein (1966) show that competition implies greater efficiency because it helps to reduce mismanagement. Managers actually run the risk of being run over by their competitors or of being fired by the proprietors. Koetter and Vins (2008) explain that the greater the market power; that is lack of competition, the less will be the effort to maximize profits without necessarily having efficiency. According to Rhoades and Rutz (1982), Claessens and Laeven (2004), the existence of the market power in the banking sector generates a high intermediation cost. This leads to high prices, low volume of savings and investments; with a reduction in economic growth.

Empirical studies on the positive relationship between competition and efficiency of banks are those of: Berger and Hanan (1998) on a sample of 5,000 U.S. banks, Delis and Tsionas (2009) on a sample of banks from 11 countries of the European Union and the United States over the period 2000–2007, Koetter and Vins (2008) on a sample of 457 German banks over the period 1994–2006 and Cocoresse Pellechia (2010) on a sample of 714 Italian banks over the period of 1992–2007. These theoretical and empirical works explain that competition increases bank efficiency through a reduction in the prices of banking services, a rise in the creditors' prime rates, a drop in the rates of debtors with a consequent increase in bank contribution to the economy in form of loans (Berger & Hanan, 1998; Claessens & Laeven, 2004). These transmission channels will enable the authors to discuss the results of this research.

The SBP model was questioned in particular by the theory of contestable markets (Baumol et al., 982); which states that the level of competition is not determined by the number of firms present in the market, but by the entry and exit conditions of the industry. Thus, competitive prices can be practiced even in a market where there are only two companies, if potential entrants constitute a threat to these firms. Peltzman (1977) has also showed that efficiency can cause managers to reduce costs and not the concentration through market power. But the negative relationship between competition and bank efficiency was explicitly established by the theory of destructive competition (Baltensberger & Dermine, 1990; Diestsch, 1992, Chiappori & Yanelle, 1996). This theory explains that a drop in prices and of debtors' rates, a rise in creditors' prime rates resulting from bank competition benefit consumers, but are destructive to the banks. Thus, small banks go bankrupt and those that resist produce at a loss while waiting to use their excess capacity. Following this logic, Marquez (2002), Hauswald and Marquez (2006) show that competition has a negative effect on bank efficiency due to the specificity of the banking market. The bank's efficiency lies on the bank's capacity to collect information and

monitor at a low cost. Yet competition leads to dispersion of information and several banks have information on a little number of borrowers. This generates inefficiency because many people who are not qualified to borrow end up having access to credit, and lending decisions become less efficient.

Empirical works on the negative effects of banking competition in relation to efficiency are those of: Weill (2004) and Maudos and De Guevera (2007) on a sample of banks in the European Union over the periods 1994–1999 and 1993–2002, respectively, Pruteanu-Podpiera and al. (2008) on a sample of Czech banks between 1994 and 2005, Girardon and Casu (2009) on the banks of five European countries over the period 2000–2005, IdriesHishman (2009) on a sample of 16 banks operating in Jordan over the period 2001–2005, and Williams (2011) on a sample of 419 commercial banks in Latin America over the period 1988–2008 . Asma et al. (2012) establish the existence of a positive relationship between the increase of competition and efficiency (estimated by SFA) for the Tunisian banking industry, over the period 1990–2009, on a sample of Tunisian banks. For these works, it is the concentration; that is lack of competition, which increases efficiency for the following reasons: (i) it reduces transaction and monitoring costs with the firms, (ii) it allows banks to achieve more profit and thus have an incentive to act prudently (there is improvement in bank stability), (iii) it allows banks to be less under pressure to improve the quality of banking services: this reduces operational costs and increases their cost efficiency.

Whatsoever are the results at the end, the empirical studies measured competition by the Lerner index or the adjusted Lerner index. The efficiency frontier is estimated from two outputs (loans and deposits) and 02 inputs (labor and physical capital). At times, three inputs are considered (deposits, labor and capital) against a single output which is the value of total assets. The estimation method of this frontier is either parametric or nonparametric.

3. The Research Setting

3.1 Discussion of Competition Measures and Adopted Efficiency

The model of perfect competition which assumes among others the free entry and exit in a market is not applicable to the banking industry due to entry barriers (costs for new entrants or regulation) and non-recoverable costs (sunk costs). These are costs that will generate gains for the company over a long period, but that cannot be recovered if it decides to leave the market (Freixas & Rochet, 2010). It then becomes necessary to quantify the level of competition in a banking system so as to follow its evolution.

Structural measures of competition are based on the concentration indices. A concentration index is the weighted sum of the market shares of the different banks in a country by the weight of each bank. Because of this simplicity of calculation, the concentration indices are numerous and differ depending on the weights given (see Bikker & Haaf, 2002). Nevertheless, these measures are imperfectly related to competition because they are influenced by a number of factors such as the macroeconomic environment, the form and level of taxation of financial intermediaries and the bank specific factors such as the operation scale and the preference for risk (Claessens & Laeven, 2004).

Non-structural measures try to quantify the level of competition of each bank. There are of two types. In the first place, the model developed by Breshnahan (1989) uses the terms of profit maximization under perfect competition. The estimated parameter of this model provides a measure of the degree of competition, which varies from pure and perfect competition to monopoly. In the second place, there is the Panzar and Rosse model based on the extent to which a change in input prices influences the revenue obtained by a specific bank. The measurement of competition obtained; denoted (H), is between minus infinity and one. $H < 0$, we have a monopoly. $0 < H < 1$ is a monopolistic competition and lastly $H = 1$ we have a perfect competition. In the third place, we have the Lerner index of the market power (Lerner, 1934; Koetter et al., 2008); which is based on the social loss due to monopoly that is, the difference between prices and the marginal cost. On the algebraic level, it is defined as the ratio of the difference between the price charged by the firm and its marginal cost by the price. It is inversely proportional to the competition. This is the Lerner index that is applied in this research.

As to the concept of efficiency, it is broadly defined as the capacity of an organization, firm or decision unit, to increase its output without increasing inputs or to reduce its inputs without reducing its output (Chen et al., 2005). A bank will be said to be efficient if it best uses its resources to satisfy the needs of its customers. As the customers' needs and resources are diversified, one can distinguish several types of efficiency in the banking industry. The efficiency scale is related to the optimal choice of the output of the bank, while the efficiency range is related to the optimal choice of product mix (Berger et al., 1993). The efficiency- X (Berger, Hunter, & Timme, 1993) can be subdivided into cost efficiency, standard profit efficiency and alternative efficiency profit, considered as the three most important economic concepts of efficiency (Berger & Mester, 1997). Also called

economic efficiency, the cost efficiency is the capacity to produce a quantity of output at minimum cost; given the prices of input (Farrell, 1957). The efficiency scores are between 0 and 1.

A cost efficiency score of 0.75 or 75 % means that the bank uses 25% of cost more than the company with good practice confronted with the same conditions. It can therefore produce the same amount of output by performing a 25% reduction in costs. But by studying the cost efficiency only, inefficiency of the demand side is neglected. The profit function incorporates both the cost of input choice effect and the income effect of the choice of the output: hence the importance of efficiency profit (Berger & Mester, 1997).

Two types of efficiency profit are retained in the literature. The standard profit efficiency measures the ability of the bank to produce a maximum of possible profit for a given level of input and output prices. It thus takes into account the inefficiency that could come from the demand side (output prices). A score of 70 % indicates that the company loses 30 % of the profit which it could have obtained; due to excessive cost, low income, or both. Humphrey and Pulley (1997) propose alternative profit efficiency, which measures the ability of a firm to obtain the maximum possible profit, given the prices of inputs and the level of output; instead of the output price like in the standard profit. Alternative profit efficiency is more convenient to the situation of the CEMAC because it rests on the assumption that output prices are not accurately measured.

Whatever the efficiency adopted, its measure consists of placing the bank in relation to the frontier of good practices. This frontier can be estimated following the non-parametric approach and the parametric approach. The nonparametric approach has the advantage of not requiring a functional form of efficiency frontiers. As limit, the distance between the position of the bank and the frontier is attributed to inefficiency. All the same, there may be errors. Moreover, it is more suitable for small samples. The most widely used non-parametric method is the DEA (Data Envelopment Analysis) method (Farell, 1957; Charnel et al., 1978). It uses the technique of linear programming to determine a boundary so that firms located on the border are called efficient, while those found within the boundary are called inefficient. The parametric approach has for advantage the modeling of the term of inefficiency error. As limit, there is need of a functional form of production or of cost where choice does not cause unanimity.

The Cobb Douglas specification assumes homogeneity of aggregate output and the constant return to scale. These restrictions explain why it is abandoned in favor of the translog specification, which does not necessitate a prior recourse to particular hypotheses (Dem, 2003). It corresponds to the need of the banking industry, which is a multiproduction and where there is a growing yielding scale (From Devezeaux Lavargne et al., 1990; Heyer et al., 2004). For this reason, the translog specification is adopted in this research. Once the functional form is specified, the problem of estimation method appears. One has the choice between the Thick Frontier Approach, the Distribution Free Approach and the Stochastic Frontier Approach (SFA). Only the latter method namely SFA permits estimates of the efficiency of each bank (and thus, of each country) using its own inputs and outputs. As this is approach is more appropriate for the pursuit of our goals, we have adopted it.

3.2 The CEMAC Banking System

Table 1 presents some characteristics of the banking system of the CEMAC and their evolution during the period of study. The upward trend in the number of banks is related to the measures taken by the monetary authorities to encourage banking competition.

Table 1. Some indicators of the characteristics of the banking system

	2003±	2004	2005	2006	2007	2008	2009	2010
Nets Loans	1481483	1515302	1654258	1833138	2068968	2653211	2933754	3542050
Deposits	2105033	2357745	2912665	3399840	4418279	4684350	5078062	6163329
Banking Net Proceeds	255000	258030	284296	314414	378659	483588	478191	478909
General Expenses	75423	77716	87628	93998	106805	134674	152471	156610
PersonnalExpenses	65500	66295	69104	75946	87307	104293	108917	107346
Net Operating Profit after Tax	65730	83793	101714	106782	144671	159828	118273	123234
Number of Banks	32	33	33	38	39	43	45	43

Sources.Authorsfrom BEAC Documents. ± *all other data but the 'numer of banks' are in millions of CFA francs (Communauté Financière Africaine).*

We note that the netope rating profit after taxand the banking net proceedshave the same trend of evolution. It is

translated by apositive growth rate of 7 to 8 years of study. But it was negativein 2009. During this period, the operating expenses including the general expenses and salaries and fringe benefits experienced a positive growth. On the other hand, the ratio netloans/deposits; which is an indicator of the strength of the banking intermediation ratio, has steadily declined from 70.3% in 2003 to 57% in 2010. All these finding sunderp in the study of the influence of competition on the efficiency of banks in the CEMAC.

4. Research Methodology

4.1 Efficiency Scores Measurement

To measure the efficiency scores, there is need first of all to identify the inputs and outputsof the banking system of the CEMAC banking system, and calculate their prices. To this effect, we have followed the intermediation approach developed by Sealey and Lindley (1997); according to which the banking activity isa process of qualitative transformation of assets. Thus, the bank transforms the deposits of agentswith financing capacity into loans for agents in need of funding. Following this approach, one identifies 03 inputs namely, capital, labor, deposits and an outputconsisting of the total assets (Coccorese & Pellecchia, 2010; Färeet et al., 2010; Koetter et al., 2011). Table 2 shows the prices of inputs and outputs as well as the total cost and profit before tax. These all form variables measuring efficiency scores.

Table 2. Variables for calculating efficiency scores

Wording	Price	obs	average	minimum	maximum
Labor (W1)#	Personnel expenses / Number of employees	48≠	11,65	5,723	21,772
Deposits(W2)#	Interestexpenses / Total deposit	48	0,01367	0,0033	0,03844
Capital (W3)#	Other operational costs / Immobilization costs	48	0,1513	0,0042	1,1367
Total assets (Y)±	Interest revenue and out of interest / Total assets	48	818837,5	49000	291650
Total cost		48	35743,73	2887	141185
Profit		48	17986,27	1050	60025

Source: Authors from COBAC Database. *# inputs, ± output, ≠ 48 = 6 countries under the CEMACx 8years! in millions.*

The translog specification of ourcost function with three inputs and one outputis as follows (Devezeaux et al., 1990; Heyer et al., 2004):

$$ln\, C_{it}=\alpha_0+\alpha_1 ln\, Y_{it}+\sum_{h=1}^{3}\alpha_h lnw_{hit}+\alpha_T ln\, Trend+\frac{1}{2}\left\{\alpha_{YY}(ln\, Y_{it})^2+\sum_{h=1}^{3}\sum_{K=1}^{3}\alpha_{hK} ln\, W_{hit} ln\, W_{Kit}+\alpha_{TT}(lnTrend)^2\right\}$$
$$+\sum_{h=1}^{3}\alpha_{Yh} ln\, Y_{it} ln\, W_{hit}+\alpha_{TY} ln\, Trend\, ln\, Y_{it}+\sum_{h=1}^{3}\alpha_{Th} ln\, Trend\, ln\, W_{hit}+v_{it+} \quad (1)$$

Where ln is the logarithm, Cit the total cost, i = 1, ..., N is the country index, t = 1, ..., T the time index, Y is the output, W_h the price factors of the inputs and the Trend. Measured by the funds themselves, the trend permits the account of changes in production techniques. v_ (it) u_{it} represent the random error and inefficiency term. The estimated profit efficiency follows the same logic, except that you write $ln(\pi_{it}+\theta)=ln\, C_{it}$; with θ > 0. The estimation of efficiency is equivalent to maximizing the function of the following probability (Aigner et al., 1977):

$$ln\, L=\frac{N}{2}ln\frac{2}{\pi}-N ln\,\sigma-\frac{1}{2\sigma^2}\sum_{i=1}^{N}\varepsilon_i^2+\sum_{i=1}^{N}ln\left[\Phi\left(\frac{\varepsilon_i\lambda}{\sigma}\right)\right] \quad (2)$$

N is the number of countries, $\varepsilon_i=v_i+u_i$, $\sigma^2=\sigma_v^2+\sigma_u^2$, $\lambda=\frac{\sigma_u}{\sigma_v}$, $\Phi(.)$ is the repartition function. The parameterization $\lambda=\frac{\sigma_u}{\sigma_v}$ is considered as a measure of the relative variability of the two sources of inefficiency. The efficiency scores are calculated with the help of the efficiency residual term u_i by using the average (Jondrow et al., 1982).

Table 3. The functions of cost and profit

	parameters	lnC_{it}	lnP_{it}
lny_{it}	α_Y	4.5542	-2.9102
		(0.000)	(0.631)
lnW_1	α_1	-2.4418	7.5651
		(0.077)	(0.469)
lnW_2	α_2	-0.2443	-6.9114
		(0.711)	(0.155)
lnW_3	α_3	-0.6192	2.5821
		(0.030)	(0.229)
Lntrend	α_t	-1.1009	3.8098
		(0.104)	(0.416)
$(lny_{it})^2$	α_{YY}	-0.5643	-0.9561
		(0.022)	(0.517)
lny_{it} lnW_1	α_{Y1}	-0.2451	-3.2916
		(0.316)	(0.095)
lny_{it} lnW_2	α_{Y2}	0.1624	1.2413
		(0.202)	(0.156)
lny_{it} lnW_3	α_{Y3}	-0.0636	-0.5253
		(0.376)	(0.335)
$(lnW_1)^2$	α_{11}	-2.0286	11.3955
		(0.011)	(0.035)
lnW_1 lnW_2	α_{12}	-0.4309	2.2881
		(0.005)	(0.024)
lnW_1 lnW_3	α_{13}	-0.018	0.5485
		(0.851)	(0.488)
lnW_2 lnW_3	α_{23}	-0.0957	0.0965
		(0.039)	(0.770)
$(lnW_2)^2$	α_{22}	-0.0243	0.8805
		(0.878)	(0.229)
$(lnW_3)^2$	α_{33}	0.0664	-0.0481
		(0.055)	(0.857)
$(lntrend)^2$	α_{tt}	-0.5993	-4.0924
		(0.021)	(0.018)
$lntrendlny_{it}$	α_{tY}	0.4418	2.5474
		(0.059)	(0.091)
lntrend lnW_1	α_{t1}	0.7908	1.8401
		(0.000)	(0.297)
lntrend lnW_2	α_{t2}	-0.0568	-0.9662
		(0.634)	(0.153)
lntrend lnW_3	α_{t3}	0.1317	0.3175
		(0.110)	(0.584)
cons	A	-16.18051	-18.2631
		(0.000)	(0.292)
	σ	-2.947	5.4914
		(0.008)	(0.000)
	λ	3.6651	7.83334
		(0.002)	(0.000)
Log Likelihood Wald chi2(20)		77.988	-18.007
		8677.51	305.69
		(0.0000)	(0.0000)

Source. Authors with Stata 11.

The average level of inefficiency is measured as the average of u_i, which is estimated as the average of $\hat{\varepsilon}_i$; with $\hat{\varepsilon}_i$ the estimated residue of the firm *i:* since *u* is independent of *v* and *v* follows a normal distribution with zero

mean. The estimates give the functions of cost and profit in Table 3.

What interests us most is λ parameter; which is significantly different from zero forcost and profit efficiency with the SFA method. Due to its statistical properties, it indicates that thecost and profit inefficiencies exist. It then only remains toestimate it for each bank (country) using the equation (2). This phase isperformed automatically by Stata11andthe results are shownin Table4.

Table 4. Average levels of cost and profit efficiency

	Cameroon	Central Africa Republic	Congo	Gabon	Guinea	Chad	CEMAC
Profit efficiency	32.84	40.97	78.34	24.23	24.46	25.63	37.74
Cost efficiency	97.29	96.95	81.84	97.73	98.68	83.16	92.60

Source: Authorswith Stata11.

According to these results, it is possible for the CEMAC banks to reach their current level of production by reducing costs by 7.4% (from 100–92.60). Similarly, they may obtain additional profits of 62.26% (from 100–37.74) without changing the quantities of inputs and outputs. These inefficiency scores are slightly higher than those obtained by Koetter and Vins (2008) for German banks, Koetter et al. (2011) for the U.S., Florian (2012) for the UEMOA.

4.2 Competition Measurement

The Lerner index that we have used is defined as the difference between the average revenue, generally estimated by the output price and the marginal cost divided by the price. The price P*it* is given by the price of output (total assets). It is biased because it assumes that banks are perfectly efficient against costs (Koetter et al., 2008). It is thus necessary to estimate the Lerner index from the average revenue and from the marginal cost obtained from an SFA analysis of the cost function. It is said to be adjusted that is, adjusted to the inefficiency.By definition,$L_{it} = \frac{P_{it} - \widehat{CM}_{it}}{P_{it}} = \frac{RM_{it} - \widehat{CM}_{it}}{RM_{it}}$. Where L_{it} is the adjusted Lernerindex, Pitthe output price =average income RM_{it} $\widehat{CM}_{it} = \frac{\partial C_{it}}{\partial Y_{it}}$ is the marginalcost; estimated by the SFAmethod. The total revenue = total cost + profit ($R_{it}=\pi_{it}+C_{it}$) andthe average total income=income/outputthe ($RM_{it} = \frac{R_{it}}{Y_{it}} = \frac{\pi_{it}+C_{it}}{Y_{it}}$) . Thus the adjusted Lernerindex:

$$L_{it}^{A} = \frac{\frac{\pi_{it}+C_{it}}{Y_{it}} - \widehat{CM_{it}}}{\frac{\pi_{it}+C_{it}}{Y_{it}}} \quad (3)$$

Where L_{it}^{A} is the adjusted Lerner index, Y_{it} the total output, $\pi_{it} + C_{it}$ and $\widehat{CM}_{it}$ the cost, profit and margina lcost values estimated from the SFA approach. All these values are estimated automatically by Stata 11 and the results are shown in Table 5.

Table 5. Average level of adjusted lerner index

	Cameroon	Central African Republic	Congo	Gabon	Guinea	Chad
The Lerner adjusted	42.29	65.25	46.89	75.645	69.68	71.73

Source: Estimates with Stata 11.

Cameroon is acountry in which competition is very high; followed by the Congo. But our main concern is to assess to what extent this competition explains efficiency.

4.3 Competition and Efficiency

Apart from competition, several other variables are susceptible to influence banking efficiency. They are of two types: variables specific to banks and variables related to their environment. Variables specific to banks include: (i) diversification (DIV), which measures the effect of the extension of the scale of products offered by the bank on its efficiency.Its measure as proposed by Laeven and Levine (2007) is $DIV = 1 - \left|\frac{RI-RHI}{RT}\right|$ with RT the total income, RI the interest income and RHI the out interest income; (ii) the ratio of credits to total assets (CD_AS) measures the difference between the products and services offered by a bank and reflects the preference of investment of the bank between loans and yielding assets (Chen, 2009), (iii) the risk (RISK) is measured by loan

intermediation ratio to deposits because the more a bank will have a significant intermediation activity, the more it will be exposed to the risk of non-recovery of loan funds.

Variables related to the environment of banks are: (i) the growth rate of GDP per capita (GDP) to reflect the general level of income. The expected sign is positive on the cost efficiency because countries with high per capita income may have more customers using banking products (Chen, 2009). (ii) The density of the population (POP_DEN) is captured by the number of inhabitants per square kilometer. The higher the density of the population, the less costly it becomes to offer banking services due to proximity: hence the positive effect on efficiency (Cocoresse & Pellechia, 2010). (iii) Inflation (INF), which is an indicator of macroeconomic stability, affects the performance of the banking sector negatively (Chen, 2009) by an increase in costs: hence the reduction in cost efficiency. But its effect on profit is positive because it increases the interest revenues.

With 6 countries, 8 periods of observations and 6 variables, the panel model is strongly indicated. We formulate two equations corresponding to the cost efficiency and profit efficiency, successively.

$$efficout_{it}=a_0+a_1L^A{}_{it}+\sum_{i=1}^{6}\beta_i Z_{it}+\omega_{it} \quad (4)$$

$$effiprofit_{it}=a_0+a_1L^A_{it}+\sum_{i=1}^{6}\beta_i Z_{it}+\omega_{it} \quad (5)$$

Where $efficout_{it}$ is thecostefficiencyof the country i in the year t; $efficout_{it}$ is theprofitefficiency of the country i and the year t; Z_{it} is the vector of variables of six variables identified above; $L^A{}_{it}$ is the measure of competition or the adjusted Lerner index; ω_{it} the error term. But before estimating (4) and (5), two tests need to be carried out.

The first is that of the stationarity of the variables. We consider the unitary root test of the panel of Levin et al. (2002). It is based on the following two hypotheses. H_0: the panel contains a unitaryroot and H_1: the panelis stationary. The series is stationary if the p-value <10%. These tests show that the two panel sare stationary. The second test is that of the specification of errors ω_{it}. In the first step, Fisher's statistic permits the testing of the homogeneity; which is to determine whether it is reasonable to assume that the model (4) and (5) are exactly the same for all countries, or otherwise if there are specificities related to each country. To this end, we specify that $w_i = u_i + e_{it}$ and test the two hypotheses, H_0: $u_i = 0$ against H_1: $u_i \neq 0$. With Stata, these hypotheses are tested by effecting a regression of fixed effect models. If the p-value <5%, we reject H0. This was the case and we retained that there are country-specific individual effects. In the second step, we test whether these individual effects are fixed or random. We test the two hypotheses, H_0: $= 0$ against H_1: $\sigma_u^2 \neq 0$; where σ_u^2 denotes the variance of the error specific to the individual, $u_i \rightarrow N(0, \sigma_u^2)$. The test statistic is that of Breusch-Pagan. If Prob> Chi2 > 5%, we accept thenull hypothesis. In ourcase, the assumption of random individual effects is validated. The method of panels' estimation (4) and (5) is the Tobit regression.

5. Results and Discussion

The regression results between competition and cost efficiency, on the one hand, and between competition and efficiency profit, on the other, is shown on the annexes 2 and 3. The adjusted Learner index has a positive and significant effect (coef = 0.002, p -value = 0.000) on the efficiency cost. This result shows that competition has a negative effect on cost efficiency. On the other hand, it has a negative and significant effect on profit efficiency (-0.0087, 0.000).

So, competition has a positive effect on profit efficiency. These results show that the effects of competition on efficiency are mixed in the CEMAC zone because they have an unexpected direction regarding cost efficiency. To explain these results, we are going to analyze how the theoretical transmission mechanisms of competition worked in the banking efficiency. They are either related to the environment of banks, or specific to those banks.

With regard to environmental variables, the actual GDP evolved in a decreasing rate of 6.6% in 2004 to 1.8 % in 2009. Since it is a market variable, we are more interested in profit efficiency. One notes that a drop in the purchasing power has affected the efficiency profit negatively (-0.0043, 0.398); certainly by a drop in the consumption of banking products and economic activities in general. As we shall see it in the next paragraph, the ratio of credit/deposit went descending. Inflation on its part increased during the period of the study: its rate increased from 0.6 % in 2004 to 4.2% in 2009. As indicated in by literature, such a development plays against cost efficiency by a growth in bank costs (-0.0028, 0.34). But it works in favor of profit efficiency by an increase in the interest incomes (0.020; 0.057).

The variable density of the population shows that in the most populated CEMAC countries, it is cheaper for banks to offer their services, but they have difficulty in satisfying the needs of all customers. For this reason, the high density of the population is in favor of cost efficiency (0.00042, 0.000), but unfavorable to the profit efficiency (- 0.002, 0.000).

As to the mechanisms specific to each bank, the strategy of diversification adopted in the CEMAC in the face of competition was to integrate the quality of loan applicants in the debtors' rates rather than sticking only to the duration. Thus the Global Effective Prime Rate of all the loans to the economy; according to the duration as wellas the quality of beneficiaries, was 7.31 % for large enterprises, 12.36% for the Small and Medium enterprises (SMEs) and 14.91% for individuals (COBAC, 2010). This strategy favors the efficiency of banks and DIV variable positively explains profit efficiency (0.0007095, 0.801). In addition to diversification, the debtors' rates have generally increased from 14.5% in 2006 to 12.8 % in 2008, to 9.8% in 2009 and to 11.02 in 2010: thus a general downward trend. Meanwhile, deposit rates remained almost constant between 4.25% and 3.25 %. This situation is favorable to the profit efficiency, because it signifies that banks have made benefits even though they gave loans at lower prices against the costs which remained constant. But the constant rate of creditors reflects the inability of banks to reduce other operating expenses to attract more savings: it thus plays against the efficiency cost.

Moreover, the first variable (CD_AS) which gives account of the performance of the channel by the volume of loans to the economy explains, but in a marginal way, cost efficiency (-0.0001246, 0.45) and profit efficiency (0.00007095, 0902). This means that competition has not significantly changed the preference of banks for loans, in relation to other asset items. It rather led banks to intensify asset items in relation to the modernization of the means of communication and payment (COBAC, 2010). The ratio of loans/deposits has continued to deterioratein this zone; and its value which was 0.73 in 2003, was only 0.57 in 2010. This explains the over-banking liquidity in this zone. Because of this evolution, the variable RISK is unfavorable to the profit efficiency (-0.013, 0.000) because banks had opportunities to increase their profits by granting more credits.

6. Conclusion and Recommendations

The objective of this study was to analyze the effect of competition on cost efficiency and profit efficiency of banks in the CEMAC zone over the period 2003–2010. The stochastic frontier approach (SFA) has enabled the authors to estimate the cost and profit functions, and to obtain the efficiency scores and the levels of competition by the adjusted Lerner index. The Tobit regression shows that a high level of competition is rather related to inefficiency cost, while it is on the contrary associated with greater profit efficiency.

The analysis shows that the decline in the rates of debtors and the diversification of banking products are the mechanisms of the transmission effects of competition which worked during the period of this study. Notwithstanding, the ratios loans / deposits and deposit rates decreased. This was contrary to expectations. Inflation increased and GDP per capita decreased. This phenomenon penalized the transmission of the effects of competition on efficiency. We recommend a better control of inflation, policies to promote economic growth, and a greater diversification of banking products such as accompanying measures of banking competition in the CEMAC zone.

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Appendix A

Competition and Cost Efficiency

```
Random-effects tobit regression                 Number of obs      =        48
Group variable: pays                            Number of groups   =         6

Random effects u_i ~ Gaussian                   Obs per group: min =         8
                                                               avg =       8.0
                                                               max =         8

                                                Wald chi2(7)       =   1857.63
Log likelihood  =  247.14933                    Prob > chi2        =    0.0000
```

costeffi	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
POP_DEN	.000427	.0000125	34.21	0.000	.0004026	.0004515
GDP	.0001702	.0016368	0.10	0.917	-.0030379	.0033782
INF	-.0028974	.003077	-0.94	0.346	-.0089283	.0031334
CD_AS	-.0001314	.0001682	-0.78	0.435	-.000461	.0001982
DIV	-.0010669	.0007832	-1.36	0.173	-.0026019	.0004681
RISK	.0048853	.0005113	9.56	0.000	.0038832	.0058873
ajust_lerner	.0023391	.0007482	3.13	0.002	.0008727	.0038056
_cons	.866378	.0008521	1016.77	0.000	.864708	.8680481
/sigma_u	.0855965	.0247099	3.46	0.001	.037166	.1340269
/sigma_e	.0006997	.000072	9.72	0.000	.0005586	.0008407
rho	.9999332	.0000409			.999787	.9999807

```
Observation summary:         0  left-censored observations
                            48     uncensored observations
                             0 right-censored observations
```

Source: Estimates with Stata11.

Appendix B

Competition and Profit Efficiency

```
Random-effects tobit regression                 Number of obs      =         48
Group variable: pays                            Number of groups   =          6

Random effects u_i ~ Gaussian                   Obs per group: min =          8
                                                               avg =        8.0
                                                               max =          8

                                                Wald chi2(7)       =    3635.84
Log likelihood  =  185.15932                    Prob > chi2        =     0.0000
```

profiteffi	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
POP_DEN	-.0020171	.0000395	-51.08	0.000	-.0020944	-.0019397
GDP	-.0043189	.0051122	-0.84	0.398	-.0143386	.0057008
INF	.0194549	.0102161	1.90	0.057	-.0005683	.039478
CD_AS	.0000743	.0006002	0.12	0.902	-.0011022	.0012507
DIV	.0007095	.0028135	0.25	0.801	-.0048049	.0062239
RISK	-.0131314	.0017163	-7.65	0.000	-.0164954	-.0097674
ajust_lerner	-.0087015	.0024369	-3.57	0.000	-.0134778	-.0039253
_cons	.6264634	.0030866	202.96	0.000	.6204137	.6325131
/sigma_u	.2776451	.0801494	3.46	0.001	.1205551	.4347351
/sigma_e	.0024938	.0002609	9.56	0.000	.0019824	.0030051
rho	.9999193	.0000495			.9997425	.9999768

```
Observation summary:         0  left-censored observations
                            48     uncensored observations
                             0 right-censored observations
```

Source: Estimates with Stata11.