

# Building a model to predict banking difficulties in Central Africa

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## **Abstract**

The present study aims to explore banking supervision and regulation in Central Africa and propose a model to predict banking difficulties. Such a model does not yet exist in the literature due to the difficult access to banking data. Inspiring by the methodology used in studies published by Martin (1977) and Godlewski (2004), we use a logit model and succeed to build a model with central African specificities. Used variables are a mixture of ratios drawn of literature and those which are related to banking management in CEMAC zone. The results of the model indicate that three variables are statistically significant for the model: the ratio of total of deposits to total of assets, the ratio of operating income to total of assets and the ratio of capital to total loans. One notes good statistics of total significance of the model, a good predictive capacity and a rate of reclassification of 85%.

**Keywords** : Banking regulation and supervision, Central Africa, Logit model

## 1. Introduction

The current banking crisis has brought back on track the issue about the necessity of a stricter supervision and regulation. One of the curses of the current financial crises or better still “the subprime” crisis is obviously the deregulation of American financial and banking system. This situation, though it originated from the US, has gotten repercussions in Europe and many countries around the world. Right after this financial panic, rulers of the planet are working towards the elaboration of a stricter banking regulation for the whole banking system. The European commission has announced that they wish to conduct long term changes in the regulation of banking system in order to stabilize it.

The banking regulation became the focus among researchers, professionals and managers of the sector; this was followed by several publications which all agree on the importance of banks supervision (see for example Santos (2000) Bart and Al. (2004), Patat (2000), Quintyn and Taylor 2000, Benston and AL 1996, Berger and Al. (1995), Besanko and Kanatas (1996), Blum (1999), Freixtas and Al. (2002)...). Yet there exist no unanimity on the level of regulation. Bart and Al (1999) ask therefore the question to know whether countries with more restrictive regulations have a low probability to suffer from the banking crisis. The negative reply to these questions is a contradiction to the argument that stricter restriction to bank authorized activities, reduces excessive chances taking on one part, facilitating control by monitoring authorities.

In central Africa, the banks supervision and regulation has grown up to be the solution to the banking crisis that prevailed in the CEMAC zone in the 1980s ending. Before the 1990s, banks of the CEMAC zone encountered severe difficulties among witch causes was the absence of regulation. This is how in 1990 the central African banks commission (COBAC) was created with as prime assignment the surveillance and control of credit institutions. Since January 17<sup>th</sup> 1992, when the central African states decided to harmonize their banking regulation, new caution rules where published so has to harmonize monitoring tools of the COBAC and to put them as much as possible in conformity with the basic principles has prescribed by the Bâle committee for the efficiency of banking supervision.

The purpose of this paper is to study the supervision system of banks applicable in the CEMAC zone; it also has as object to propose a pattern of forecasting banks difficulties in the CEMAC zone. For the development of this pattern, we have panel data, with 30 banks from the CEMAC zone countries in instant cuts and for five years period. All the restrained variables are a mixture of variables listed within purely practical literature on the forecasting of banking system failure and ratios we consider relevant for the management of central African banks. Taking into account the

availability of data, we were obliged to do without some of the variables especially those related to the performance of banks. The dependent variable Y is binary and gets value if the ratio “funds/ assets” is superior to 8% and 0 otherwise. Considering the quality of data, from the dependent variable and as we get inspired from earlier works, we will opt for a specific approach to develop our own pattern.

Bank difficulties alert models can be grouped into two categories: The parametric approach (logit or probit model) and the non parametric approach (Trait recognition Analysis) developed by two writers, Beaver (1966) and Altman (1968), referred to as pathfinders on the forecasting of companies’ bankruptcy. Within the frame of this work, we shall fall into step Martin (1977) who was the first to apply the Logit model to detect bank difficulties and Godlewski (2004) who is interested in the probability of banking system failure in developing countries. The uniqueness of this contribution comes from the fact that it fills a gap. There exists so far no bank difficulties and failure forecasting model in literature for CEMAC countries. This is obviously linked to bank data access difficulties. After overcoming this obstacle, we kept as our pattern variables that are both adequate with available data and banks management within the sub region.

This article is organized as follows: In section 2, we are presenting a literature review on the importance of banking supervision and regulation and on the evaluation of supervision in the CEMAC zone. The data and methodology are tackled in section 3. The results are presented in section 4 and section 5 concludes this paper.

## **2. The CEMAC banking supervision device**

### **2.1 The importance of banking supervision and regulation**

In the end of 1990s, banks of central Africa experienced serious banking difficulties, among which causes was absence of regulation. In central Africa as well as in other places, absence of bank regulation generally comes up as the cause of banks crisis. The absence of banks governance and supervision was designated as the origin of bank crisis that raged in Japan in the end of the 1990s. According to Horiuchi, “the malfunctioning of banks governance is at the origin of the deep crisis that strikes Japanese banks, leading the banking system into a critical state since 1997.” Japanese authorities later realized the importance of caution regulation for the bank system. We offer in this present document to examine issues related to the independence of the supervision of banks and the link between the surveillance and performance of banks. Before the current analysis, it would be suitable to examine the issue of the necessity or not of banks regulation.

To the question to know whether banks need regulation? Santos (2000) answers that there are two reasons always set forth to justify regulation of banks: the risk of systemic crisis and inability of depositors to watch banks. The argument of systemic crisis risk, concerns propositions to isolate banks from bankruptcy, the assurance of deposit and moral hazards and the indicated price on deposits. Patat tackles the issue in the same line like Santos by stressing on the role of central banks in financial stability. According to him, the legitimacy of central banks responsibility in the regulation and control of banks, can originate from one of the 25 basic principles, according to which Banks control must be carried out by an independent body. He equally supports that: the independence of central banks vis-à-vis all interests both public and private, is generally indisputable; But their legitimacy comes also from their continuous knowledge of banks system and their expertise in the domain. More generally, the central bank in all countries possesses reliable funds that few organizations could raise. The concept of independence of banks supervision has equally been studied by other writers.

Quintyn and Taylor, (2002), took interest into the independence of regulation and supervision of banks by drawing a parallel with financial stability; they underline 4 dimensions namely: Regulation, Supervision, Institution and Finance they consider as indispensable in making operational the independent regulation and supervision system. They conclude as follows: "Autonomy in terms of caution rules setting and supervision is a crucial condition from all viewpoints; and compared to other forecasting systems, the independence of supervision is strongly wished in the light of specific function of public interest and fulfilling of financial stability. Meanwhile, the realization and preservation of integrity of the supervision requires a clear definition and important level of transparency." If it is easier for these writers to agree on the legitimacy of banks supervision regulation on the one hand, and the independence of the supervision body in caution rules setting on the other hand; What about the power to be granted to the supervisors?

In their numerous researches, Barth and Al (2004), examine the issue on the extent of the power to be granted to the banks supervision body. These writers underline the existence of theoretical patterns stressing on the benefits of an agreement on extended power for banks' supervisors. The reasons they give are many. First of all, banks are costly and difficult to watch, which leads to banks surveillance and increases banks performance and stability. Banks surveillance can as well improve market hazards. Secondly, due to informational asymmetries, banks are subject to the contagion effect and costly banks failure. Surveillance, in this kind of situation, plays a very social and effective role. Thirdly, choose to adopt insurance arrangements on deposit. This encourages excessive hazards taking by the banks and brings back incitation for depositors in monitor bank. Strict

and effective surveillance in this case, can help prevent banks from getting involved in excessive hazards taking and thereby improve bank development, execution and stability.

In a previous survey, Barth & Al, (1999), study the relationship between banks regulation and supervision and their performance. They ask the following questions:

- 1) Are countries with weak government system and bureaucracy imposing stricter and harder rules to banks activities? The answer is: Yes.
- 2) Do countries with more restricted regulation system have a malfunctioning banking system? The answer is: No, or at least it is not obvious.
- 3) Do countries with more restricted regulation system have a lower probability to suffer banking crisis? The answer is: No.

“The answer to the 3<sup>rd</sup> question contradicts those who believe that stricter restrictions on banks allowed activities, reduce excessive hazards taking habits, partly by facilitating the control by the authorities of surveillance and market stakeholders.” (Barth & Al., 1999)

Although there is no unanimity in literature on this topic, as far as level and extent of regulation powers of banks supervisors are concerned, they almost all agree the fact that banks activities should be regulated. The necessity to supervise and regulate, was also essential for banks in central Africa that experienced in the 1980s, a severe banking crisis. After this crisis, the member countries in the zone decided in the first place to create a banks supervision body and then to harmonize their policies concerning the exercise and control of bank profession.

## **2.2 Presentation of the COBAC supervision device**

Banks supervision in the CEMAC zone is ensured by Central Africa Banking Commission (COBAC). This commission has as prime assignment to control exploitation conditions of credit establishments, to watch the quality of their financial situation and to ensure the respect of moral rules of the profession. The regulation device adopted by the COBAC in 1993 is constituted of norms related to creditworthiness, to cash reserves and to internal control of credit establishments.

The rules of solvency are built on the bases of a standard definition of funds and the have to do with the covering of hazards, the division of hazard, and the covering of immobilization, the taking of participations, and the limitation of commitment on behalf of shareholders, managers and staff. These rules constitute many regulations and instructions and inspire adopted rules worldwide.

The COBAC rule R-93/02 related to net funds of credit establishments (modified by COBAC rule R-2001/01) is inspired from the definition of net funds as decreed by the Basel agreement in 1988. Net funds are constituted by the sum of basic funds (constituted of reserves funds of credit establishment) and additional funds.

It appears from the COBAC rule R-2001/02 concerning the covering of hazards by credit establishments (canceling the COBAC rule R-93/03 and modified by the COBAC rule R-2003/06) that “credit establishments are requested, as stipulated in the present rule, to permanently respect a ratio of hazards covering, report between their net fund and those of the whole of credit hazards by operations, at least equal to eight percent”.

The COBAC rule R-93/05 concerning the immobilization of credit establishment (modified by the COBAC rule R-2001/06), defines the ratio of the covering of immobilization. According to this rule, the immobilization should be financed to the minimum of a hundred percent by permanent resources. The goal is to avoid credit establishments to finance the acquisition of immobilization with the deposits of customer.

The COBAC rule R-93/11 concerning the participation of credit establishments in cooperative capital limits the takings of participation of credit establishments. It appears that: “the participation of credit establishments in corporations must respect either of the following limits:

- Each participation will not exceed 15% of the net funds of the establishment;
- The whole participations will not exceed 75% of net funds of the establishment; this limit will be gradually brought back to 45% as from January the first 1996”.

Finally, the COBAC rule R-93/13 concerning the commitment of credit establishments on behalf of shareholders and associates, directors, managers and personnel (modified by the COBAC rule R-2001/05) limits the support granted by credit establishments to shareholders, directors, managers and personnel: the global outstanding loans by signature or by funds from credit establishments to the above people can not exceed 15% of net funds of credit establishments.

The banking commission has also instituted two equality norms: one written in the COBAC rule R-93/06 on cash reserves in credit establishments (modified by the COBAC rule R-94/01) and the other one in the COBAC rule R-93/07 on transformation made by credit establishments. It appears from the first and the fifth articles of the regulation that, the credit establishments of the CEMAC zone must at any time present a cash reserves report at least equal to 100%. The cash report is defined as the report between their availabilities and requirements in less than one month. The second rule on

the long term transformation of credit establishments underlines that these must at any time present “a long term transformation coefficient” equal to at least 50%.

The “long term transformation coefficient” is defined as been the report between employment and commitments over more than five years period and their resources within the same period. “The banking commission equally requested from banks, by the COBAC rule R-93/08, to institute an internal control system so as to:

- Verify the conformity of operations, of organization and internal procedures to the regulation, to professional and ethical norms and practices, and to the orientations by executive organ;
- Verify the respect of limits set in matter of hazards takings, especially for credits to customers and operations with other credit establishment;
- Watch the financial and accountable information quality, particularly to conditions of conservation and availability of this information”. We note that the COBAC rule R-93/08 was cancelled by the COBAC rule R-2001/07 on internal control in credit establishment.

The latter comes in fulfillment to the first and concerns:

- The control system of operations and hazards;
- The manuals of internal procedures;
- The accountable organization;
- The information processing system;
- The results and hazard measuring system;
- The surveillance and hazards mastering system;
- The reporting system.

After this short presentation of the COBAC supervision device, one should ask the following question: what is the level of conformity of this device with the supervision principles published by the Bâle committee?

### **2.3. The evaluation of banks regulation in respect with the principles decreed by the Basel Committee**

The Basel Committee published in October 2006 a document entitled “Fundamental principles for effective banking control”; this document is the revision of the one with the same title published

in September 1997. These principles, attached with *“La methodologies des principes fondamentaux”*, have served as reference to various countries to evaluate the quality of their control systems as well as to improve the quality of their banking regulation. “The principles have equally been used by the World Bank and the IMF within the framework of evaluation programs of the financial sector (PESF) to evaluate banking control practices and systems of countries”. This is how in 2000 and 2001, a conformity evaluation of the CEMAC supervision device in light with the principles published by the bâle committee, was carried out both by the COBAC it-self and joined missions of IMF and World Bank. We propose in this part to review the result of the first two joined mission of IMF and World Bank, which took place in March 2000 and May/June 2001; then we shall examine the COBAC supervision device as presented today.

At the end of may/June 2001 joined mission, IMF and World Bank evaluators deemed the COBAC supervision device not globally conform to 6 principles and conform or globally conform to 15 principles. The evaluators acknowledged at the end of the mission that the application of 4 principles (namely the principles 11, 20, 23 and 24) did not meaning in the situation at that time. Among grey areas identified by the IMF and World Bank evaluators, was well placed the operational independence of COBAC supervisors. The joined mission judged the human and material resources put at the disposal of COBAC insufficient and likely to compromise the objectives assigned to it. During the evaluation, the COBAC supervision device had no regulation or chart relating to market risks. The COBAC did not make it a priority to provide a regulation to this regard, deeming the market risks quasi inexistent in the sub region. In 2001, the supervision in the COBAC zone was about to put in place dispositions aiming to reinforce the change hazards surveillance. The device concerning internal control of credit establishments was in the process of revision to specify among other things, the powers and responsibilities delegation regime.

Another breach identified in the COBAC supervision device has to do with the principle 22 (requirement in matter of financial and accountability information). This principle states that: “Banking control authorities must have the assurance that every bank keeps adequate accountability according to conventions and practices known worldwide, and they should regularly publish information faithfully reflecting the financial situation and its profitability.” The current applicable accountable framework, though applicable to banking activities, did not sufficiently take in account the specificities and particularities of banking activities. Moreover, accounting practices far off known internationally. Concerning the COBAC banking regulation conformity to the fundamental principles, the IMF and World Bank evaluators judged during the first joined mission these either non applicable, or globally conform or conform.

In June 2006, another joined IMF and World Bank mission evaluated the central African financial system. The results of their evaluation on the aspect of banks supervision reflects quite well the reality the banking system and the COBAC banking supervision system as presented now and can be summarized as follows:

- The CEMAC financial sector lacks insight, is greatly fragmented, its stability is exposed to significant hazards. The banking sector is vulnerable to credit hazards. A number of banks are undercapitalized, their exposure to hazards concerns a few sectors and borrowers as well, the legal framework is not favorable to debts recovering.
- Banks supervisors are well trained, but interference of national administrations in some aspects of banking surveillance, as well as acute lack of staff limit global effectiveness of surveillance management.
- The regional legal framework of OHADA has provided a number of improvements, but credit activities remain hindered by insignificant deficiencies at the level of implementing the framework.
- An extended agenda of amendment of the banks supervision is needed for the CEMAC to take up the current challenges such as the stability of the banking sector (solvability ratio), access to diverse financial services and management of cash reserves.
- Serious deficiencies found in the business, accountable and legal environment, discourage banks to develop their financial services with SME; this prods the latter to hold on to services of micro finance sector. In addition to what is already mentioned above, it is proper to add that there exist no communication requirements of evaluation norms and credits granting to different bank borrowers. The COBAC has no prerogative in matter of publishing and no initiative has been taken to subdue banks to publishing norms.

Despite these deficiencies, it is noteworthy that since 2001, a number of reforms have been implemented with a view to improving the CEMAC banking supervision device and to adjusting to international requirements. These reforms entail:

- The adoption by the CEMAC members countries of 2 statutes, the first one prescribing diligences to be accomplished by supervisors of financial institutions, and the second one empowering the COBAC (Banking Commission of Central African States) to determine and set a model and the content of the accounts to be published by financial institutions;

- The adoption by the COBAC of statutes and instructions pertaining to the structure of financial institutions' accounts, to the publishing by these institutions of their accounts, to their publishing of consolidated financial accounts and statements, to the prudential supervision on a consolidated basis, to the exchange position supervision.
- The elaboration of a law pertaining to micro-financial institutions. The texts governing this sector and the applicable prudential norms were finalized in the course of the year 2002.
- The effective introduction by the COBAC of a new electronic data transmission system relating to financial institutions (CERBER) and of a Rating System of Financial institutions.

With the help of the two assessments conducted by the CEMAC and the World Bank on the CEMAC financial environment, the prospect of reforming the COBAC supervision system based on a revision of the basic principles lays the foundation for a successful implementation of the new Basel Agreements on equity within the CEMAC. Since one of the Base Agreement recommendations revolves around prudential supervision, a predictive model of banking issues would undoubtedly be play a key role in the COBAC assignment.

### **3. Methodology and data**

#### **3.1 Data description**

In the present study, we analyzed the banking difficulties the CEMAC member countries will be faced with within one year. We will for the moment being confine this study to this time period, like in the empirical literature. The statistical data used in quantitative analyses emanate from the CERBER system. Though this new system data may not be yet published, we have, with the assistance of the COBAC personnel, managed to garner some of the information we needed. The information we received relate to monthly balance sheets, annual profit and loss accounts, for the period 01.01.2002 to 31.12.2007. For the purpose of this study, only data relating to the period 2003– 2007 will be exploited, as they are bearing a higher consistency than the ones relating to the first two years. Besides, only annual data are used to compute balance sheet or annual profit and loss accounts ratios.

We can, in a final analysis, aver that we have a “balanced” data panel, with 30 units (that is the CEMAC area banks) in instant cut and time periods. These data allow a valuable tool for detecting and measuring effects in such a way as would not be possible with chronological series.

## ***Description of banks in financial predicament and sound banks***

The Basel Agreement, in his text over the international convergence of measurement and norms”, reaffirms the preponderant role played by equity in detecting banking difficulties. In defining equity, the Basel Committee distinguishes level 1, level 2 and level 3. “Level 1 is, according to the Basel Agreement, the key component of equity as it is the most stable and the most likely to absorb the losses incurred by the bank.” According to the COBAC, regulatory equity is composed of basic equity coupled with additional equity. Basic equity in their definition bears propinquity to that of level 1 and is essentially made up of capital and reserves. On account of the propinquity of the 2 definitions, equity can be described as the aggregate amount of banking capital and reserves. It is therefore important to set a level of equity that would allow a clear distinction between sound banks and banks in a financial predicament so as to conceive a predictive model of banking difficulties.

Within the framework of this study, we consider a bank in a financial predicament when it is undercapitalized, with a ratio of “equity/total assets” lower than 8%. This ratio corresponds to the regulatory standards issued by the Basel Agreement, working upon the assumption that all assets have a 100% ponderation.

**Table 1: Number of banks used in this study**

<b>Country</b>	<b>Number of active banks as at 31.12.2007</b>	<b>Number of banks in this study</b>	<b>Number of sound banks</b>	<b>Number of banks in a financial predicament</b>
<b>Cameroon</b>	11	9	7	2
<b>Central African Republic</b>	3	2	1	1
<b>Congo</b>	5	4	2	2
<b>Gabon</b>	6	5	4	1
<b>Equatorial Guinea</b>	4	4	3	1
<b>Chad</b>	6	6	5	1
<b>Total</b>	<b>35</b>	<b>30</b>	<b>22</b>	<b>8</b>

## 3.2. Variables description

### *The dependent variable*

The dependent variable can be defined based on the above mentioned data as follows:

Y = 1 if capital/total assets < 8%, the bank is considered to be in a difficult financial situation;

Y = 0, otherwise, the bank is considered to be in a sound shape.

### *The explanatory variables*

We have made a list of the variables frequently used in the specialized literature relating to the predictive models of banking failures.<sup>1</sup> We have been compelled to dispense with some variables more particularly the ones relating to the banking net results as they were not available. And we have compiled a number of ratios which we deem pertinent as explanatory variables. The retained variables have been combined into a panel of CAMEL-type<sup>2</sup> mixed variables and the ones pertaining to banking management within the CEMAC area.

The first 2 variables that are FPTA and FPTCR represent the capital/credit portfolio adequacy. The second allow the potential losses to be absorbed. As the bank core activity is to lend credits, we have found it pertinent to include the second ratio into our model. The 2 ratios have a negative impact on the default likelihood within one year.

The second group of variables (CRSCRB, CREDTA, PROCRED and CRENETA) allows a measure of the banks' asset quality, and more particularly of its credits. An increasing number of credits can reveal difficulties within the bank.

The following group of variables (PROECRED, RVDTA, PRVECREB, ) relates to the banking management quality. Unlike other ratios found in the specialized press, these ratios are built from elements deemed pivotal by regulating agencies. These variables have also been considered pertinent for this study.

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<sup>1</sup> We worked on Atman and Al. (1977, 2001) , Bardos (2005), Barth and Al. (2001a, 2001b, and 2004), Godlewki (2004a, 2004b and 2004c), Grice and Ingran (2001), Jagtiani and Al. (2000),.

<sup>2</sup> CAMEL : Capital Adequacy, Asset Quality, Management, Earnings, Liquidity.

The CREDDEP and DEPTA variable measure how exposed the bank is to the liquidity risk, based upon cash at hand, and quasi liquidities of the bank. These 2 variables afford a positive impact on the likelihood for a bank to default within one year.

The last 3 ratios, PRODEXTA, PRODEXFP, and REIMPREX, are linked to profitability. We have built ratios based on operating results and interest revenues. In Appendix 1 we describe each of the variables used in this study.

### 3.3. The econometric model

Bank difficulties alert models can be grouped into two categories: The parametric approach (logit or probit model) and the non parametric approach (Trait recognition Analysis). For the purpose of this study, we chose the parametric approach. We shall fall into step, Martin (1977) who was the first to apply the logit model to detect bank difficulties and Godlewski (2004) who is interested in the probability of banking system failure in developing countries. The logit model has also been used in many researches with very good results.

If  $Y_{it}$  is the dependent variable,  $X_{it}$  the explanatory variables

$P(Y_{it}=1)$  is the default probability

Then:  $Y_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}$  with  $i = 1, \dots, 30$  banks ;  $t = 1, \dots, 5$  years

$\alpha_i$  is the intercept, we assume that the intercept is constant over time and for all the banks

$\beta_i$  are model coefficients

$\varepsilon_{it}$  is the error term

We will follow three steps for the selection of significant variables for our model.

- We first analyze the different correlation ratios between the different variables and the default variable;
- then we use the Kolmogorov-Smirnov test to study the relationship between the dependent variable and the explanatory variables;
- In the last step, we apply the logistical regression to select the variables which are really statistically significant for the model.

## 4. Results

### 4.1 Descriptive statistics

We will at first present the descriptive statistics of the major variables used in this model.

**Table 3: Descriptive statistics**

Defaulting banks						
Variables	N	Moy	Std dev	Min	Max	Normality (p-value)
FPTA	40	0,04	0,0468	-0,1819	0,0796	<0,05
FPTCR	40	0,1465	0,256	-0,2288	1,616	<0,05
CRSCRB	40	5521,7209	5716,5104	0	20716	<0,05
CREDTA	40	0,0086	0,0093	0	0,0378	<0,05
CRENETTA	40	0,4864	0,2586	0,0235	0,9687	<0,05
CREDCRB	40	17,8	15,8086	0,1139	58,3832	<0,05
PROECRED	40	15,4879	15,1729	0	54,3012	<0,05
PRVETA	40	0,2134	0,3824	0	1,4037	<0,05
PRVECREB	40	0,2772	0,4072	0	1,7631	<0,05
PROCCRED	40	88,6409	57,4872	0	376,6827	<0,05
CREDDEP	40	3,2736	10,4432	0,0471	60,8889	<0,05
DEPTA	40	0,7694	0,2197	0,0174	0,9697	<0,05
PRODEXTA	40	0,1119	0,2251	0,0045	1,0441	<0,05
PRODEXFP	40	1,9235	7,0148	-10,9446	25,7556	<0,05
REINPREX	40	0,9065	0,094	0,5724	0,9958	<0,05
Non Defaulting banks						
Variables	N	Moy	Std dev	Min	Max	Normality (p-value)
FPTA	110	0,173	0,1663	0,0811	0,7274	<0,05
FPTCR	110	0,4307	2,6103	0,1092	11,7344	<0,05
CRSCRB	110	7458,5545	6943,9153	0	38188	<0,05
CREDTA	110	0,0092	0,0302	0	0,1081	<0,05
CRENETTA	110	0,4268	0,2884	0,0367	0,9833	<0,05
CREDCRB	110	14,7555	11,9455	0	43,688	<0,05
PROECRED	110	12,5878	11,9777	0	40,3512	<0,05
PRVETA	110	0,1584	0,686	0	2,1093	<0,05
PRVECREB	110	0,2152	0,8543	0	2,7034	<0,05
PROCCRED	110	87,7938	47,2605	0	284	<0,05
CREDDEP	110	5,9148	4,0844	0,1287	390,2632	<0,05
DEPTA	110	0,6654	0,2089	0,0025	0,9031	<0,05
PRODEXTA	110	0,1275	1,163	0,0001	5,0341	<0,05
PRODEXFP	110	0,7117	2,7018	0,0003	11,6937	<0,05
REINPREX	110	0,9094	0,0855	0,225	1	<0,05

These statistics bring about a series of comments. The value of the following variables, FPTA, FPTCR, CRSCRB, PRODEXTRA, REINPREX, for non defaulting banks is conspicuously higher to the ones of defaulting banks. Conversely, the value of these variables is largely lower in average than the ones for defaulting banks, that is CRENETTA, CREDCRB, PROECRED, PREVETA.

## 4.2 Correlation analysis and selection significant attributes

We have studied the link between potential explanatory variables and the recoded default variable.

$$ratio = \begin{cases} 1; & si FPTD \geq 8\% \\ 0; & sinon \end{cases}$$

At first, we analyzed the different correlation ratios between the different variables and the default variable.

**Table 4 : Résultats de l'analyse des corrélations**

Variables	Correlation ratio
FPTCR	0,3392
CRSCREB	0,0377
CREDTA	0,3034
CRENETTA	0,1713
CREDCRB	0,1573
PRVECRED	0,1368
PRVETA	0,3522
PRVECREB	0,3351
PRVE	-0,0345
CREDDEP	0,0165
DEPTA	-0,6152
PRODEXTA	0,1734
PRODEXFP	-0,0371
REINPREX	0,1051

The first comment is that most correlation ratios display expected signs. The normality test in table 2 shows that no variable has a normal distribution.

We will thus establish the links between all the explanatory variables of the model and then select attributes or significant variables for the model. Results of these correlations can be seen in table 4.

**Table 5 : Correlation matrix**

	FPTA	FPTC R	CRSC RB	CRED TA	CREN ETTA	CRED CRB	PROE CRED	PRVE TA	PRVE CREB	PROC CRED	CRED DEP	DEPT A	PRO DEXT	PRO DEXF	REIN PREX
FPTA	1	0,34	0,04	0,3	0,17	0,16	0,14	0,35	0,34	-0,03	0,02	-0,62	0,17	-0,04	0,11
FPTCR	0,34	1	-0,1	-0,03	-0,23	-0,01	0	-0,02	0,01	-0,19	-0,03	-0,14	0,89	0,18	-0,05
CRSCRB	0,04	-0,1	1	0,09	0,29	0,36	0,4	0,21	0,22	0,13	-0,08	0,15	-0,11	-0,12	0,15
CREDTA	0,3	-0,03	0,09	1	0,39	0,48	0,32	0,73	0,7	0,08	0,11	0,33	0	0,07	0,1
CRENET TA	0,17	-0,23	0,29	0,39	1	0,6	0,6	0,59	0,44	0,11	0,25	-0,41	0	0,17	0,27
CREDCR B	0,16	-0,01	0,36	0,48	0,6	1	0,96	0,68	0,69	-0,01	0,02	-0,19	0,06	0,05	0,24
PROECR ED	0,14	0	0,4	0,32	0,6	0,96	1	0,64	0,63	-0,05	0,03	-0,18	0,08	0,04	0,23
PRVETA	0,35	-0,02	0,21	0,73	0,59	0,68	0,64	1	0,92	0,01	0,07	-0,36	0,02	0,05	0,18
PRVECR EB	0,34	0,01	0,22	0,7	0,44	0,69	0,63	0,92	1	-0,03	0,04	-0,27	0,02	0,03	0,17
PROCCR ED	-0,03	-0,19	0,13	0,08	0,11	-0,01	-0,05	0,01	-0,03	1	-0,1	0,14	-0,17	0,03	0,06
CREDD P	0,02	-0,03	-0,08	0,11	0,25	0,02	0,03	0,07	0,04	-0,1	1	-0,42	0,13	0,2	-0,08
DEPTA	-0,62	-0,14	0,15	0,33	-0,41	-0,19	-0,18	-0,36	-0,27	0,14	-0,42	1	-0,28	-0,43	0,03
PRODEX TA	0,17	0,89	-0,11	0	0	0,06	0,08	0,02	0,02	-0,17	0,13	-0,28	1	0,46	-0,05
PRODEX FP	-0,04	0,18	-0,12	0,07	0,17	0,05	0,04	0,05	0,03	0,03	0,2	-0,43	0,46	1	-0,22
REINPR EX	0,11	-0,05	0,15	0,1	0,27	0,24	0,23	0,18	0,17	0,06	-0,08	0,03	-0,05	-0,22	1

We will then use the Kolmogorov-Smirnov test to study the relationship between the dependent variable and the explanatory variables.

**Table 6 : Selection of significant variables**

	Kolmogorov-Smirnov Z	P-Value
<b>FPTCR</b>	<b>2,89</b>	<b>0,0000</b>
CRSCRB	0,67	0,7547
<b>CREDTA</b>	<b>1,13</b>	<b>0,1533</b>
CRENETTA	0,95	0,3335
CREDCRB	0,84	0,4745
PROECRED	0,87	0,4322
PRVETA	0,96	0,3177
PRVECREB	1,01	0,2609
PROCCRED	0,86	0,4548
<b>CREDDP</b>	<b>1,27</b>	<b>0,0787</b>
<b>DEPTA</b>	<b>2,20</b>	<b>0,0001</b>
<b>PRODEXTA</b>	<b>1,24</b>	<b>0,0934</b>
<b>PRODEXFP</b>	<b>2,16</b>	<b>0,0002</b>
REINPREX	0,59	0,8801

Comments: The variables showing a p-value over 0,2 have been retained for the logistical regression.

### 4.3. Results of logistical regression and interpretations

Following the various results obtained, we have made several logistical regressions, and we have excluded the variable with the higher p-value. We have also obtained a model essentially comprising significant variables. In the following lines, we will interpret the results:

**Table 7 : Evaluation of the model ratios**

	B	E.S.	Wald	ddl	Signif.	Exp(B)	IC pour Exp(B) 95,0%		
							Inf	Sup	
Etape	FPTCR	5,144	2,197	5,483	1	0,019	171,446	2,312	12711,219
	DEPTA	-8,406	3,012	7,787	1	0,005	0,000	0,000	0,082
	PRODEXTA	-7,535	3,404	4,898	1	0,027	0,001	0,000	0,422
	<b>Cameroon</b>			11,300	5	0,046			
	<b>Central African Republic</b>	-2,671	1,094	5,961	1	0,015	0,069	0,008	0,591
	<b>Congo</b>	-2,741	1,306	4,406	1	0,036	0,064	0,005	0,834
	<b>Gabon</b>	-3,803	1,214	9,810	1	0,002	0,022	0,002	0,241
	<b>Equatorial Guinea</b>	-2,953	1,210	5,956	1	0,015	0,052	0,005	0,559
	<b>Chad</b>	-2,033	1,236	2,704	1	0,100	0,131	0,012	1,477
	Constante	9,325	2,921	10,194	1	0,001	11215,651		

B : coefficient

ES : standard error

A synthesis of our results is offered in this table which shows our predictive model for banking difficulties within one year. Based on the information in this table, we can infer the default likelihood within one year.

La default probability is then:

$$P = 1 / (1 + \exp^{(-(-9,325 + 5,144 * \text{FPTCR} - 8,40 * \text{DEPTA} - 7,53 * \text{PRODEXTA}) + \varepsilon_p)})$$

$$\varepsilon_p = \left\{ \begin{array}{l} 0; \text{ if } \mathbf{Cameroon} \\ -2,671; \text{ if } \mathbf{Central African Republic} \\ -2,741; \text{ if } \mathbf{Congo} \\ -3,803; \text{ if } \mathbf{Gabon} \\ -2,953; \text{ if } \mathbf{Equatorial Guinea} \\ -2,033; \text{ if } \mathbf{Chad} \end{array} \right\}$$

From this model, three variables appear statistically significant for this model: FPTCR, DEPTA, PRODEXTA.

The **FPTCR** ratio shows how much credits are covered by equity. This variable can be reckoned as one of the major ones considering the core activity of the bank which is to grant credits. No wonder this variable is found in our model. As shown in this formula, this variable has a negative impact on the likelihood for a bank to default within one year. The higher this ratio is, the lower the banks vulnerability is.

The **DEPTA** ratio shows the part of total deposits as opposed to total assets. This ratio is a part of the CAMEL panel which measures the bank's exposure to liquidity risk based on cash at hand. The presence of this variable is the proof that this model is different from the one developed by Godlewki in 2004 relating to the prediction of banking defaults in emerging countries. The higher the ratio is, or the lesser Important total amounts of assets are as compared to deposits, the more it will be difficult for the bank to live up to its commitments towards depositors especially in case all of them happened to turn up to withdraw all their funds.

The **PRODEXTRA** ratio assesses the bank's performance. This ratio cannot be found as such in the specialized literature. Though we have not obtained the net results of CEMAC zone banks, we could substitute the "net result/total assets" ratio with Operating profits/total assets ratio. This variable is statically significant at the 1 percent level. The higher this ratio, the likelier the bank is to face up difficulties within one year.

## 5. Conclusion

The main purpose of this article was to suggest a predictive model for banking difficulties within the CEMAC zone. We have first reviewed the banking regulation applicable in the CEMAC zone.

From what has been demonstrated and in the wake of the 2 assignments conducted by the World bank and the IMF, reforming the COBAC supervision system as per the revised basic principles lays a solid foundation for a successful implementation of the Basel Accords on equity in CEMAC. Some issues identified by supervisors remain, such as the practical independence of CEMAC supervisors, the lack of material and financial means the COBAC suffers from and which hinders them from fully carrying out their assignments, the inconsistency between the CEMAC zone banking accountancy and the largely recognized and accepted conventions and practices at the international level.

Besides, the results relating to the predictive model of banking default appear satisfying. Three variables, FPTCR, DEPTA and PRODEXTRA appear statistically pertinent for the model, as the first one negatively influences the model whereas the two other ones have a positive impact on the model.

In the course of our study, we suggest an improvement of the model by including cultural and institutional variables; this can only be achieved if we have extensive data on banks and financial institutions in the CEMAC zone. It is noteworthy that the lack of financial communication within the CEMAC area significantly hampers the full blossoming of the banking system in the area and of researchers in management sciences.

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## **Appendix 1: Variables description**

<b>N°</b>	<b>Variables</b>	<b>Description</b>	<b>Type</b>	<b>Predicted sign</b>
1	FPTA	Fonds propres/ Total Actifs	C	-
2	FPTCR	Fonds propres/Total des crédits	C	-
3	CRSCRB	Créances en souffrance / Crédits bruts	A	+
4	CREDTA	Créances douteuses / Total Actifs	A	+
5	CRENETTA	Crédits nets/Total Actifs	A	+
6	CREDCRB	Créances douteuses / Crédits bruts	A	+
7	PROECRED	Provisions existantes / créances douteuses	M*	+
8	PRVETA	Provisions existantes / Total Actifs	M*	+
9	PRVECREB	Provisions existantes / Crédits bruts	M*	+
10	PROCCRED	Provisions à constituer / créances douteuses	M*	+
11	CREDDEP	Total des crédits/Total des dépôts	L	+
12	DEPTA	Total des dépôts/Total Actifs	L	+/-
13	PRODEXTA	Produits d'exploitation/Total actifs	E	+/-
14	PRODEXFP	Produits d'exploitation/Fonds propres	E	+
15	REINPREX	Résultat des intérêts/produits d'exploitation	E	+

The variables C, A, L, E are referred to CAMEL type

The variables M\* are related to banks management in CEMAC'S zone