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FINANCIAL STRUCTURE, CAPITAL REGULATION AND BANKING RISK IN THE ECONOMIC AND MONETARY COMMUNITY OF CENTRAL AFRICAN STATES (CEMAC): ANALYSIS BY SIMULTANEOUS EQUATIONS IN PANEL DATA

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ABSTRACT

The objective of this empirical work is to study the effectiveness of capital regulation and to identify the internal and external determinants of the behaviour of a panel of banks in Cameroon and Gabon, the two largest economies of CEMAC. To this end, we use a model of simultaneous equations to take into account the interrelationship between risk, capitalization and asset performance, as estimated by the system GMM method in Dynamic panel. Our results show that banks seem to have increased their capital and risk at the same time, but that this strategy has had the effect of diminishing their performance, given the low diversification of their portfolio. The regulatory pressure is not sufficient to influence the risk-taking behaviour of banks, which depends rather on the macroeconomic situation of the countries, in particular the level of growth and indirectly the situation of the oil sector. It hinders the capitalization of banks and acts positively on the return of assets.

Key Words: Banking Regulation, Capitalization, Asset Performance, Risk, Dynamic Model On Panel Data.

1. INTRODUCTION

The financial crisis of 2008 gave renewed interest to the analysis of the effects of capital regulation on the behavior of banks and in particular their risk taking. Stylized facts show that in general, when a bank is "well capitalized" it tends to increase the risk of its portfolio to improve its profitability or the return on its assets. On the other hand, if the capital requirements are too high, “badly calibrated”, the financing cost of banks is high, their profitability decreases and they will be forced to reduce loans to the economy (Rey H, (2014) .

It is therefore interesting for any supervisory authority, such as the Central African Banking Commission (COBAC) to know the determinants of the behavior of banks, in order to improve its regulation, and avoid the instability of the financial system, a source of problems. for a given economy or currency area.

Today, the COBAC is indeed working on adapting its banking risk monitoring and control system to the recommendations of Bale 1 and 2, in order to avoid bank failures such as those recorded in the 90s. to avoid taking excessive risks, the regulations in force limit the volume of loans they can grant according to their equity capital.

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However, in practice, we can see that the main prudential ratios relating to capital, in particular capital adequacy, have often been violated in CEMAC over the past 10 years by banks, including the largest. In 2015, for example, 15.36% of banks did not comply with this ratio, against 18% in 2014 and 16% in 2010. In 2013, the IMF report already highlighted that the banking sector appeared vulnerable to a series of risks, in particular credit and operational risks. The Fund reports that the exposure of banks due to loans to related parties is particularly important in three countries, Cameroon, Gabon and Equatorial Guinea, where a certain number exceed the prudential limit. The 2016 IMF report notes that vulnerability factors are increasing in the CEMAC due to late payments from the State to the private sector, in particular in the construction and public works sector, which is heavily indebted to national banks, and because of the risks taken by some banks which have financed insolvent SMEs. Today several banks are failing and are under provisional administration. This is the case of Postbank and the Gabonese Development Bank in Gabon.
The purpose of this reflection is precisely to study the determinants of the optimal decisions of capitalization, risk taking, and financial strategy of CEMAC banks. More specifically, we will mainly analyze what is the impact of regulatory pressure on the behavior of these banks? Does it encourage banks to adopt caution? Secondly, we will study what are the determinants of the level of capitalization of banks? Are there other factors specific to the macroeconomic environment or the banking market that explain the behavior of banks?

In the economic literature, the impact of regulatory pressure on the behavior of banks, the choice of a level of capitalization and risk taking are the subject of theoretical and empirical controversies without a consensus emerging.

Regarding the impact of regulatory pressure on the behavior of banks, two approaches clash in the theoretical literature.

The first argues that regulation has an impact on the behavior of banks. In fact, by forcing a bank to increase its capital, it is encouraged to reorganize the risky part of its portfolio by investing in riskier assets, thus increasing the probability of default (Koehn and Santomero, 1980). To avoid a distortion in the allocation of bank assets, according to Kim and Santomero, (1988), Rochet, (1992), it is necessary to evaluate the minimum required capital calculated taking into account the risk, the weightings of which must only be well chosen. . Calem and Rob (1999) qualify this negative effect. They believe that the impact of capital regulation depends on the level of ex-ante capital of the bank. Thus severely undercapitalized banks will necessarily take more risk when increasing their capital than overcapitalized banks. Along the same lines, Klomp and de Haan (2011) find that banking regulations reduce banking risk, but that this effect depends on the ownership structure and the size of the bank.

To reduce this negative impact, several authors believe that deposit insurance should be introduced into the objective function of the bank (Kim and Santomero, 1988; Furlong and Keeley 1989, 1990; Angeloni and Faia, 2013). These latter authors believe that when deposit insurance is rigorously implemented, the capital requirements lead to less risk taking.

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The second approach (Blum, 2003; Demirgüç-Kunt et al. 2010; Delis and Staikouras, 2011; Borio and Zhu, 2012) argues that the effectiveness of capital regulations is not guaranteed even if the weights reflect the 'evaluations made by the market. Delis and Staikouras (2011), for example, believe that capital requirements, even when reinforced with supervisory activities, are not effective in reducing bank risks. Borio and Zhu (2012), and Demirgüç-Kunt et al. (2010) even find that capital regulation rather increases the risk of bank default.

Based on the theory of incentives in an environment of imperfect information, other authors (Barth et al, 2008; kopecky and van Hoose, (2012) believe that banks will not increase their risk taking as a result of increased capital requirements, as the value of the option decreases when capital increases. For this to be the case, capital regulations must be binding, that is, accompanied by incentives (Blum, 2003).

One of the limitations of this work is econometric. Most authors try to estimate the risk based on variables whose exogenous character poses a problem. In addition, many of these works come up against a problem of causality. Risk can be a function of capitalization, just as capital can be a function of risk. The model of Shrieves and Dhal (1992) makes it possible to take into account this interrelation with simultaneous equations. Indeed, this model starts from the assumption that the two decisions are taken simultaneously, and depend on the one hand on a discretionary adjustment and on external factors on the other. The empirical verifications carried out with this model seem to confirm this interrelation for American banks (Jacques and Nigro, 1997) and Aggarwal and Jaques, 1997) and for banks in emerging countries (Zied Saadaoui, 2010).

The advantage of this model of Shrieves and Dhal (1992), is the possibility of introducing other variables including regulatory pressure, competition, market pressure and pro-cyclical behavior (Flannery and Ragan, 2008; Jokipii and Milne , 2008) to better show how banks adjust their capital ratio and how they choose the level of risk. Ait Bihi Abdelhamid, (2016), in his

study of a sample of 255 banks from G8 countries, takes into account liquidity as an explanatory variable. The results obtained show a positive relationship between risk taking and the level of capital of the banks studied. However, estimating this model remains tricky. The use of simultaneous equations and the presence of lagged variables as explanatory variables in some equations and which are variables to be explained in others, generate estimation biases that cannot be eliminated by ordinary least squares and even doubles least. squares. The Arellano - Bond estimator circumvents this problem.

When it comes to the regulatory - bank profitability relationship, the commonly held view is that regulation has a negative effect on profitability. By forcing them to increase the level of their own funds, regulations reduce their profitability, via a reduction in risk. However, empirical verifications do not seem to arrive at the same conclusions. A recent ACPR study carried out on a sample of French banks over the period 1993-2012 evaluated the impact of a capital increase on the return on equity and the return on assets. The results show a positive economic effect of capitalization on both fronts. Better capitalized banks appear to be more profitable than the others. The same positive results have been found in studies of US banks where greater efficiency has been observed for banks that have experienced increased capital. Sanae Solhi and

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Medhi (2012) take into account this relationship between risk and profitability mentioned above to introduce a third equation in the model of Shrieves and Dhal (1992). Their results show that the power of the supervisory authorities has no effect on either the capital or the risk of banks in the MENA region. On the other hand, these banks experience an increase in their profitability and their risk as and when the capital ratio is important.

This review of the literature shows that the behavior of banks can change from one region to another. Specific factors explain why regulations may or may not have an effect on risk taking in one area and not in another. These specific factors explain the profit maximization strategy used by banks and in particular the return on their assets.

Our hypothesis in this study is that capital regulation does not influence the capitalization and risk taking of CEMAC banks. These two behaviors are rather influenced by the economic situation of these countries and in particular, the situation of the oil sector, the main engine of their growth.

To test these hypotheses, we start from the basic model of Shrieves and Dhal (1992) according to which there is an interrelation between risk and the capital ratio. We therefore use, like these two authors, simultaneous equations to model this interrelation. However, we extend this basic model of Shrieves and Dhal (1992) by adding a third relationship: that which links the return on assets (ROA) to risk and capital. In addition, like Ait Bihi Abdelhamid, (2016), we introduce into each relationship, factors specific to the banking market, and factors relating to the macroeconomic situation of CEMAC. For our estimation, we use Arrelano-Bond's generalized momentum method (GMM system) in a dynamic panel, which allows us to circumvent the potential biases of this type of interrelation.

The remainder of this article reads as follows: section 2 presents the development of the current CEMAC prudential system; Section 3 presents the methodology used to study the impact of

capital regulation on the risk-taking behavior of banks. In section 4, the results of this estimation and their interpretation are summarized. Finally, we conclude in section 5.

2. THE PRUDENTIAL SYSTEM IN THE CEMAC ZONE

In view of the numerous bank failures that occurred in the 1980s, the CEMAC countries decided to create, by an agreement signed on October 16, 1990, the Central African Banking Commission (COBAC). Since then, its prudential system has undergone profound changes taking into account the specificity of the economies of the sub-region on the one hand, and international regulations, in particular the Bale agreements, on the other. We will only recall here that undergone by the regulation of capital and the definition of risks, the subject of this study, before analyzing their relative effectiveness through the intensity of violation of prudential criteria and the rating of the various banking systems of the countries. of CEMAC.

2.1. The main measures

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The prudential framework includes quantitative solvency and liquidity standards and qualitative standards relating to risk management which are supposed to ensure the stability of the banking system as a whole.

2.1.1. Solvency and liquidity standards

These are firstly the regulations relating to net capital, coverage and the division of risks of credit institutions. These solvency standards were drawn up taking into account, on the one hand, the directives of the Basel Committee on the subject and, on the other hand, the specific features of the Community banking systems, characterized at the time by the financial situation. acute crisis that the banking system had just gone through.

Thus, the COBAC R-93/02 regulation modified by the R-2001/01 regulation gives the method of determining the own funds. It distinguishes between basic own funds, details of which are given in article 2, and additional own funds (article 4) including, in particular, revaluation reserves, profits closed at intermediate dates, funds from partners' accounts. , borrowing or issuing securities, etc.

Since 2004, COBAC has decided to comply with international standards. Thus, the concept of own funds on which all the solvency ratios are based and their content have given rise to a redefinition to bring them closer to the standards of the Basel Committee currently in force.

The concept of "additional own funds" has been substituted for that of "resources assimilated to own funds" and its content as well as that of "basic own funds" have been brought into conformity with international standards. Thus, the calculation of net equity takes into account the share capital, the regulatory minimum required of which is set by COBAC R2009 / 01 regulation.

This new definition of equity gave rise to the construction of new ratios, the two main ones of which are:

- The risk coverage ratio calculated with a weighting taking into account the rating of credit institutions. It was set at a minimum of 5% against 8% internationally. Since 2004, COBAC has set it at 8%.

- The risk division ratio, which obliges credit institutions to avoid concentrating their risks too much on a small number of signatures whose final or even partial insolvency could shake them. It limits the weighted risks borne to the same beneficiary to 45% of net equity, while the international standard is set at 25%.

As for the COBAC R93 / 10 regulation modified by the COBAC R2001 / 04 regulation, it sets the rules for the representation of the minimum capital of credit institutions. In its article 2, it obliges credit institutions to justify at all times that their net internal liabilities are equal to or greater than the minimum required capital.

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2.1.2. Qualitative standards

Alongside these quantitative standards, COBAC also emphasizes the qualitative aspects of the management of credit institutions. In reality, this concerns everything relating to the internal control of banks carried out by the social bodies of the establishments and which aims to improve risk management and prevention. This is particularly the case with the rules for recognizing and provisioning bad debts which are supposed to improve financial stability by limiting factors of uncertainty and volatility. In this sense, the Banking Commission has set up a Collection, Operation and Restitution System to Banks and Financial Institutions of Regulatory States (CERBER), which contributes to the diagnosis of the probable evolution of an institution's solvency or of the quality of its loan portfolio. This system makes it possible to better appreciate the financial ratios coming from the balance sheets and profit and loss accounts of banks.

2.2. Situation of banks with regard to capital regulations

Have the current regulations avoided bank failures or the deterioration of the situation of banks? To answer this question, we take stock of compliance with prudential standards based on the classification carried out by the COBAC on the basis of the rating system that it developed and which now includes 7 degrees.

We will mainly analyze here compliance with solvency standards, namely the representation of minimum capital, the risk coverage rule and that of the limitation of fixed assets and holdings, in conjunction with the level of regulatory capital as defined by the COBAC Regulation R-2010/01 which requires credit institutions to hold a sufficient level of own funds to cover their weighted risks.

The COBAC annual reports show that out of a total of forty-three banks analyzed at the end of 2010, thirty-six posted a risk coverage ratio weighted by net equity greater than or equal to the minimum. regulation of 8%, against thirty-two banks in 2009. It is also noted that seven banks are in violation or 16.3% of all banks in the sub-region. The seven banks in violation with respect to the risk coverage ratio are active in Cameroon (three banks), Chad (two banks), Central African Republic (one bank) and Equatorial Guinea (one bank) respectively.

Table 1A: Number of banks violating the main prudential ratios from 2010 to 2015

	Capital adequacy						Liquidity					
	8%						Min 100%					
	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
Cameroun	3	3	5	5	4	3	0	0	1	2	3	3
Congo	0	0	2	1	0	1	0	0	1	0	0	4
Gabon	0	0	0	1	3	3	1	1	2	1	3	2
Tchad	2	2	0	0	1	1	1	1	0	1	0	1
Guinea	1	1	0	0	1	0	0	0	0	0	0	0

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RCA	1	1	0	0	0	0	1	1	1	1	1	0
Total CEMAC	7	7	7	7	9	8	3	3	5	5	7	10
% of number of banks	16,27	15,55	14,58	14	18	15,38	6.97	6.66	11.1	10.41	14.5	19,23

Source: COBAC, IMF, IMF Report No. 14/252 2014, IMF Report No. 14/222, 2015 IMF Report, August 16/277, 2016

Table 1B: Number of banks violating the main prudential ratios from 2010 to 2015

	Fixed assets					**Minimum capital**					
	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
Cameroun	5	8	5	4	4	4	4	5	5	3	1
Congo	0	1	1	1	5	2	2	1	3	1	0
Gabon	0	1	2	4	4	1	1	0	3	1	1
Tchad	3	0	0	2	2	4	4	2	3	2	1
Guinée	0	1	0	1	0	0	0	0	0	0	0
RCA	2	0	0	0	0	2	2	1	2	0	0
Total CEMAC	10	11	8	12	15	9	9	8	11	4	3
% of number of banks	23,2	24,4	16,6	24	28,8	23,07	20,9	17,7	22,9	8	5,7

Source: COBAC, IMF, IMF Report No. 14/252 2014, IMF Report No. 14/222, 2015 IMF Report, August 16/277, 2016

The 2011 report notes that out of a total of forty-five banks in operation, thirty-eight have a risk coverage ratio weighted by net equity greater than or equal to the regulatory minimum of 8%, against thirty-six out of forty-three . banks for the year 2010. Of the seven banks in violation, five banks are active in Cameroon and two banks in Congo. These banks represent about 15.6% of the banks present in the CEMAC and 10% of the total assets of the banking system. The COBAC notes that between 2010 and 2011, the share of accounting capital in the total cumulative situation of CEMAC banks has deteriorated relatively, going from 8.54% in 2010 to 8.23% in 2011. In addition, due to the high concentration of loans on a few large clients, the banking commission emphasizes risk division standards which remain to be perfected (Gulde-Wolf and Ghura, 2013). In 2015, 10 banks recorded a liquidity ratio below the minimum of 100%. These banks are mainly found in Cameroon, Gabon and Congo. Of the 8 banks in breach of the risk coverage ratio, three are in Cameroon and three others in Gabon.

Eight banks, which represent 18% of the system's assets, have a ratio below the minimum ratio of 8%, and 5 of them have negative capital.

This worrying situation is confirmed by the evolution of bank ratings. They are 15 in 2015 or 28.8% to have a solid or satisfactory situation. 23 or 44% have a situation not entirely

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satisfactory and 26.92% have a fragile and critical situation. In comparison, they were 37 to have a solid or satisfactory situation in 2012, ie 74.08% and 16% were in a fragile and critical situation.

Table 2: Bank ratings in 2013

	1	2	3a	3b	3c	4a	4b	Non classées
Cameroun	1	7	-	-	-	1	2	2
RCA	-	1	2	-	-	-	-	1
Tchad		3	1	2	1	-	-	1
Gabon	1	5	-	-	-	-	1	3
Congo	-	4	-	-	-	-	-	6
Guinée	1	2	-	-	1	-	-	1

1 Notation: 1 = solid; 2 = good; 3A = fragile; 3B = moderately fragile; 3C = very fragile; 4A = critical; and 4B = very critical. Source: IMF, 2013 report

All in all, the prudential situation of CEMAC banks is deteriorating for the "liquidity" and "fixed assets" criteria and to a lesser extent for the "capital adequacy" criterion. Only the "minimum capital" criterion is relatively respected. These banks seem to behave relatively cautiously in financing the economy. Is this behavior due to risk or to regulatory pressure? The empirical analysis that follows answers this question.

3. MODELING OF THE RELATIONSHIP BETWEEN CAPITALIZATION, RISK AND RETURN ON ASSETS

To model the interrelation between capitalization, risk and return on assets, we start from the basic model of Shrieves and Dhal (1992), which we extend and adapt to the context of the CEMAC, before its estimation by the Arrelano-Bond methodology. .

3.1. The basic model and its extension

According to the basic model of Shrieves and Dhal (1992), there is a correlation between capital and risk, because these two decisions are taken simultaneously, and depend on the one hand on a discretionary adjustment, and on external factors, on the other hand. We can therefore write:

$$\Delta CAP_{i,t} = \Delta^d CAP_{i,t} + B_{i,t} \quad (1)$$

$$\Delta RSK_{i,t} = \Delta^d RSK_{i,t} + D_{i,t} \quad (2)$$

Où $\Delta CAP_{i,t}$ et $\Delta RSK_{i,t}$ Where and represent successively the change in equity and the change in the level of risk, from bank i to time t. and t. $\Delta^d CP_{i,t}$ et $\Delta^d RSK_{i,t}$ correspond respectively to discretionary capital and risk adjustments which, according to Rime (2001), only occur after a

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certain time. These are therefore partial adjustments that depend on desired levels of capital and risk. So we can write:

$$\begin{cases} \Delta^d CAP_{i,t} = \alpha(CAP_{i,t}^{\ *} - CAP_{i,t-1}) & (3) \\ \Delta^d RSK_{i,t} = \beta(RSK_{i,t}^{\ *} - RSK_{i,t-1}) & (4) \end{cases}$$

With $CAP_{i,t}^{*}$ et $RSK_{i,t}^{*}$ which are the desired levels of capital and risk, respectively. By substituting equations (3) and (4) in (1) and (2), the equations of observed changes in capital and risk can be written as follows:

$$\begin{cases} \Delta CAP_{i,t} = \alpha(CAP_{i,t}^{*} - CAP_{i,t-1}) + B_{i,t} & (5) \\ \Delta RSK_{i,t} = \beta(RSK_{i,t}^{*} - RSK_{i,t-1} + D_{i,t} & (6) \end{cases}$$

To these two basic relationships, we can add a third relationship between risk on the one hand, capitalization and profitability on the other, in accordance with the analyzes of Demirguc-Kunt and Huizinga (1999, 2001) and Guru et al (2002) and Hélène Rey (2014). Indeed, based on the theory of financial markets, J. Petty (2001) estimates that the choice of risk is associated with the expected return. The risk-return ratio reflects the ability of each bank to implement effective risk management. Therefore, a bank is considered efficient if it achieves a sufficiently high level of profitability in relation to the overall risk it bears.

Therefore, we can write, using the same reasoning as Shrieves and Dhal (1992), that the variation in the return on bank assets depends on the desired level of unobserved ROA *:

$$\Delta ROA_{i,t} = \gamma(ROA_{i,t}^{*} - ROA_{i,t-1}) + C_{i,t}$$

The levels of capital, risk and return desired, $CAP_{i,t}^{*}$ $RSK_{i,t}^{*}$ et $ROA_{i,t}^{*}$ are not observable. However, we can estimate them because they depend on several factors, depending on the country.

In the context of this study, we will retain the following factors relating to the behavior of banks and to the micro and macroeconomic environment. Those are :

Regulatory pressure on the level of equity (REGLFP). It will take the value of the unit, if the regulatory capital adequacy ratio is below the minimum requirement of 8% and zero otherwise. The sign and significance of the coefficient of this variable will make it possible to assess the effectiveness of the regulation.

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The levels of existing provisions on the total credits designated by (PROETCR) will capture the degree of prudence of the bank in relation to its risk profile. We would expect a negative relationship between this variable and risk.

The Total loans / total deposits ratio (TCRDEP), which captures the liquidity risk resulting from a mismatch between the maturities of uses and bank resources. In CEMAC, this risk is framed by two regulations: COBAC Regulation R-93/06 relating to the liquidity of credit institutions and COBAC Regulation R-93/07 relating to the long-term transformation carried out by credit institutions. COBAC Regulation R-93/06 relating to liquidity requires banks to have a minimum liquidity coefficient of 100% at all times. Thus, their availability on sight or at less than one month must fully cover their liabilities for the same term.

The size of banks measured by the natural logarithm of total assets (LnTAB); it is taken into account here because the sector is dominated by 4 large banks owned by local and foreign financial holding companies. This is the case of BGFI in Gabon and Afriland First Bank in Cameroon, Société Générale in Cameroon, and BICIG in Gabon (BNP group). In theory, the size of bank assets could influence capitalization decisions and the risk of default Beck et al. (2013). large banks can be considered to diversify and manage risk better than small ones. However, recent empirical studies indicate that size induces a higher risk (Dinamona and Fortin, 2008) because they can benefit from implicit insurance because they are perceived as too big to fail, and therefore increase the risk of their active.

As for the efficiency of banks, it will be captured by the return on assets (ROA). According to Altunbas et al, (2007) a less efficient bank may tend to take more risks to compensate for its losses in terms of profitability. This will lead him to not comply with the prudential regulations in force.

The ratio of bad debts / total loans (PNPTP) which captures the quality of loans.

Taking into account the structure of the economies concerned, in particular their dependence on oil, and the procyclical nature of credit, we also considered the influence that the macroeconomic situation of the country and the dependence on it could have. petrol. When this is good, banks can take more risk by choosing riskier assets. We take this specificity into account by introducing the country's growth rate (TXCR), the TINF inflation rate and the share of oil in GDP (PPPIB). Likewise, we take into account the level of competition in the two markets of Cameroon and Gabon. It will be taken into account by the Boone indicator (DGCONC)

3.2. Model specification

Taking into account the hypothesis of the interrelation between risk, the level of capital and the level of profitability, the variables ΔRSK and ΔROA are introduced in relation 7; ΔCAP and ΔROA in relation 8, ΔCAP and ΔRSK in equation 9. Our simultaneous equations are therefore as follows

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$$\begin{cases} \Delta CAP_{i,t} = \alpha_0 + \alpha_1 TAB_{i,t} + \alpha_2 \Delta ROA_{i,t} + \alpha_3 REGLFP_{i,t-1} + \alpha_4 \Delta RSK_{i,t} + \alpha_5 CAP_{t-1} \\ + \alpha_6 PNPTP_{i,t} + \alpha_7 TCRDEP_{i,t} + \alpha_8 PROETCR_{i,t} + \alpha_9 LnTAB_{i,t} + A_{i,t} \end{cases} \quad (7)$$

$$\begin{cases} \Delta RSK_{i,t} = \beta_0 + \beta_1 LnTAB_{i,t} + \beta_2 \Delta ROA_{i,t} + \beta_3 REGLFP_{i,t} + \beta_4 RSK_{i,t-1} + \beta_5 \Delta CAP_{i,t} + \\ \beta_6 TCRDEP_{i,t} + \beta_7 PROETCR_{i,t} + \beta_8 DGCONC_t + \beta_9 TXCR_t + \beta_{10} TINF + \beta_{11} PPPIB + B_{i,t} \end{cases} \quad (8)$$

$$\begin{cases} \Delta ROA_{i,t} = \gamma_0 + \gamma_1 \Delta CAP_{i,t} + \gamma_2 \Delta RSK_{i,t} + \gamma_3 LnTAB_{i,t} + \gamma_4 TCRDEP + \gamma_5 ROA_{i,t-1} + \gamma_6 PROETCR_{i,t} \\ + \gamma_7 DGCONC_{i,t} + \gamma_8 TXCR_{i,t} + \gamma_9 PPPIB_{i,t} + \gamma_{10} TINF_{i,t} + \gamma_{11} PNPTP_{i,t} + C_{i,t} \end{cases} \quad (9)$$

The risk is captured by the Z-score as in Dinamona and Fortin, (2008); Laeven and Levine, (2009); Houston et al, (2010); Delis and Staikouras, (2011); Solhi and Mehdi, (2012). It is a measure of distance to default or more precisely a measure of how close each bank is to bankruptcy. Z-score is defined as follows:

$$Z - score = \frac{(ROA + EQTA)}{\sigma ROA}$$

For the capital equation, we use here a measure of capital which is also an indicator of the financial effect of the ratio of equity to total assets which also reflects the level of capitalization of the bank. Finally, as a measure of bank efficiency, we use the return on ROA assets.

3.3. Model estimation methodology

First, we individually assess the effect of risk and return on capitalization; the effect of capitalization and profitability on risk; and the effect of capitalization and risk on the return on bank assets. To estimate these three equations, we use the method of generalized dynamic panel moments (GMM) of Arellano and Bover (1995) and Blundell and Bond (1998). This method is justified by the fact that the OLS do not provide reliable estimates in the presence of the lagged explanatory variables as in the equations above. According to Arellano and Bover (1995), using GMM as a system provides solutions to the problems of simultaneity bias, reverse causality and omitted variables. It also makes it possible to deal with the problem of endogeneity of variables.

Secondly, we assess the interrelationships between the three variables. For this purpose, we estimate the equations simultaneously using the SUR method (Seemingly unrelated regression), so the advantage is to take into account the possible correlations between the residuals of the different equations.

4. PRESENTATION AND INTERPRETATION OF THE RESULTS

4.1. Estimation of equations with the dynamic panel GMM method

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The estimate below is made on a balanced panel of 7 banks in Gabon and 10 banks in Cameroon observed over the period 2006 -2013. The choice of this period is justified by the fact that it was not until 2005 that COBAC really changed its way of calculating equity in accordance with Bale's standards. In addition, in 2005 it changed the way it weighs risks. We consider here only the banks which exist since 2005 date of the promulgation of the regulation R-2001/01 which changed the method of calculation of the own funds. In this panel, the 7 banks of Gabon represent on average 95% of the deposits of the banking system of this country during the period studied. Those of Cameroon had on average 85% of the deposits of its banking system over the period studied. For the whole of CEMAC, the 17 banks in the panel have 63% of the zone's deposits, 65% of the total bank assets during this period. The panel also includes all of the major CEMAC banks.

The estimation by the dynamic panel GMM system method of the three relationships considered gives the results summarized in Table 5: We applied the Sargan / Hansen overidentification test to our dynamic panel GMM estimator, in order to assess the validity of lagged variables as instruments. The results of this test are shown at the bottom of Table 5.

For all the estimated equations, we can accept the assumption of validity of the instruments, since the p-values in all cases exceed 10%.

Regarding the first equation where the risk is the variable to be explained, and the capital and the performance of the explanatory variables (instrumentalized), ΔCP positively influences ΔRSK. The relationship is statistically significant. The banks seem to have increased their capital and their risk simultaneously. This result is compatible with those of Koehn and Santomero (1980), Ait Bihi Abdelhamid (2016) who claim that an increase in capital will encourage the bank to increase the risk of its portfolio of assets in order to maximize its profit. However, the negative and significant relationship between risk and performance proves that this risk-taking remains dangerous, thus confirming the conclusions of the IMF for which the factors of vulnerability increase in the CEMAC because they mainly financed the building and public works, two sectors largely dependent on public procurement and therefore state revenue. On the other hand, regulations seem to have no significant effect on banks' risk-taking. Although this variable has the expected sign, we can say that regulatory pressure is not sufficient to influence the risk-taking behavior of banks.

Table 3: Results of the estimations by the dynamic panel GMM method

	Eq 1:ΔRSK	**Eq 2 ΔCAP**	**Eq 3 ΔROA**
ΔRSK L1.	-0,1283476 (-1,42)		
ΔCAP L1.		-0,0883577 (-1,15)	
ΔROA L1			0,1019809 (1,31)

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ΔRSK		0,13658 (3,02)***	(-0,1332322)** (-2,75)
RSK-1	0,0072736 (0,11)		
ROA-1			-0,7406399 (-6,43)***
ΔCAP	0,9394431*** (3,96)		0,3579944*** (3,94)
CAP-1		-0,1103636 (-1,31)	
LnTAB	0,0462846 (0,60)	-0,0338117 (-1,60)	-0,0523752 (-1,54)
REGLFP	-0,0644301 (-0,59)	-0,1071652 (-2,25)**	0,1627854** (3,28)
TCRDEP	0,0383668 (0,88)	0,0191696 (0,81)	-0,0155024 (-0,58)
PROETCR	-0,0033784 (-0,01)	0,1448879 (0,80)	-0,6297438 (-3,44)**
ΔROA	-0,8073577*** (-4,66)	0,3424968 (4,32)***	
TINF	0,0077048 (0,34)		0,0151528 (1,55)
DGCONC	-1,196955 (-0,51)		-1,117599 (-1,07)
TXCR	-0,0169501 (-1,10)	0,017657*** (2,97)	-0,0023047 (-0,33)
PPPIB	-0,0027943 (-0,30)		-0,0080588** (-2,50)
PNPTP		-0,0982777 (-0,69)	0,1065758 (0,62)
cons	-.5830309 (-0,63)	0,38 (0,127)	0,2845542*** (3,73)
	Wald chi2(12) = 55,82 Prob > chi2 = 0,0000	Wald chi2(10)= 82,42 Prob > chi2 = 0,0000	Wald chi2(13) = 191,34 Prob > chi2 = 0,0000
SARGAN TEST	chi2(26 = 43,55 Prob > chi2 = 0,0169	chi2(26) = 145,80 Prob > chi2 = 0,000	chi2(26) = 70,51841 Prob > chi2 = 0,0000

Legend: * p <0.05; ** p <0.01; *** p <0.001

In the second equation, capitalization is positively and significantly influenced by risk, the return on bank assets and the rate of economic growth. This therefore assumes that in times of growth, banks increase their risk by granting more loans. They increase their profit in this way. However, regulation hinders this capitalization and is effective.

Finally in the third equation, the performance of banks through the return on assets is negatively influenced by risk taking and the previous level of this variable as well as by the share of oil in

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the GDP of the countries concerned. On the other hand, it is positively influenced by capitalization and regulatory pressure. Our results therefore confirm the interrelation that would exist between risk, return on assets and the capital ratio.

4.2. Estimation with simultaneous equations

To estimate the three equations simultaneously, we use the method "Seemingly unrelated regression" (SUR) with the option "corr" which allows to have the correlation matrix of the adjusted residuals, useful for the test of independence of the errors in the. three equations. The results of this estimate are summarized in the table below:

Table 4: The results of the "Seemingly unrelated regression" estimate

Equation	RMSE	"R-sq"	chi2	p
ΔROA	0,1431203	0,2145	193,36	0,0000
ΔCAP	0,1240239	0,1375	167,52	0,0000
ΔRISK	0,251764	0,1490	178,66	0,0000

	Eq ΔROA	**Eq ΔCAP**	**Eq ΔRISK**
ROA-1	-0,0435755 (-0,87)		
ΔCAP	0,8212038*** (9,66)		1,468044*** (10,04)
ΔRISK	-0,41287*** (-9,84)	0,3600843*** (9,77)	
RISK-1			-0,0023394 (-0,20)
LnTAB	0,0047891 (0.58)	-0,0044613 (-0,64)	0,0019789 (0,13)
PNPTP	0,3070418** (2,56)	-0,1696809 (-1,63)	
REGLFP	0,056237* (1,96)	-0,0445976* (-1,84)	0,0527112 (1,00)
TINF	0,0107154 (1.40)		0,0132809 (0,99)
ΔROA		0,6224214*** (9,49)	-1,261685*** (-10,55)
TCRDEP	-0,0022836 (-0,19)	-0,0029156 (-0,29)	-.0074109 (-0,37)
PPPIB	-0,0008839 (-0,43)		-0,002543 (-0,69)
TXCR	-0,0109999 (-1,74)	0,0143362** (2,75)	-0,0221678*

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			(-1,99)
PROETCR	-0,4709296** (-2,98)	0,2258882 (1,55)	-0,1445512 (-0,76)
DGCONC	-0,4269385 (-0.51)		-0,7841072 (-0,53)
CAP-1		0,0103601 (0,19)	
CONS	-0,0635689 (-0.57)	0,0345255 (0,40)	0,0169611 (0,09)

Correlation matrix of residuals:

	ΔROA	ΔCAP	ΔRISK
ΔROA	1.0000		
ΔCAP	-0.3971	1.0000	
ΔRISK	0.4211	-0.4078	1.0000

Breusch-Pagan test of independence: chi2(3) = 68,173 Pr = 0.0000

Legend: * p <0.05; ** p <0.01; *** p <0.001

The top of the table indicates the goodness of fit for each equation. For the dependent variable ΔRISK, we have. The joint significance test of all the regressors in this equation has a value of 178.56 with a probability of p = 0.000. The regressors are therefore jointly significant in each equation. A good part of the variables have the coefficients with the expected sign. Most regressors are statistically significant at the 5% level.

The rest of the results are generated by the "corr" option. The errors in the three equations are positively correlated for the variables ΔRISK and ΔROA, with R1.3 = 0.42. They are negatively correlated for the variables ΔRISK and ΔCAP (R1.2. = -0.39) and for ΔCAP and ΔROA (R2.3 = - 0.40). The Breusch-Pagan error independence test gives a Lagrange multiplier = 68.17% with a p = 0.000. This indicates a statistically significant correlation between the errors in the three equations. Which was to be expected because it shows the interrelation between risk, capitalization and bank efficiency.

The results of this estimation of the simultaneous equations confirm the first results. The relationship between the capital ratio and the risk is positive, since in times of growth banks also increase their risk by granting more loans. This increase in the volume of credits is largely explained by the abundance of the money supply caused by the increase in oil revenues which are redistributed indirectly to economic agents, either through the wages paid or through public markets. . In such a context, banks also take advantage of economic growth to recapitalize. Therefore, the increase in risky assets in the banking portfolio is offset by an increase in capital because in times of growth, increasing equity does not seem expensive at all. Such a result also assumes that in times of economic downturn, banks will not take any risk penalizing all economic activity. In the event of financial distress due to the decline in growth, the banks,

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although no longer taking any risk, nevertheless manage with the margins on the commissions. Growth has a positive effect on capitalization and a negative effect on risk.

Bank size seems to have no effect on risk, capitalization, or even return on assets, unlike the results of Ait Bihi Abdelhamid (2016). This result shows that the big banks do not take more risks than the small banks, which is comforting for the authorities of the COBAC who could fear a negative influence of the banks supposed to be systemic banks in the zone.

The quality of the portfolio has a negative influence here on the return on assets. Banks tend to devote their funding only to certain profitable sectors, notably mining and oil. In addition, the positive relationship between capitalization and return on assets shows that banks finance their activity through the profits previously earned. In times of weak economic growth, they can therefore continue to play part of their financial intermediation role for non-risk clients not with inevitably declining deposits, but with past profits.

Finally, the results of the estimation of the simultaneous equations make it possible to verify the impact of regulation on the relationship between capital and risk. Regulation does not have a significant effect on risk, but has a significant negative effect on bank capitalization. It is in fact the economic conditions that push banks to simultaneously increase the risk and the capital ratio to take advantage of the opportunities offered by economic growth. The relationship is positive between the change in risk and the change in capital. Therefore, the effectiveness of imposing a minimum capital ratio will only be effective when growth weakens. This result shows that additional constraints, such as deposit insurance, must be imposed on banks in the event of economic growth.

5. CONCLUSION

The purpose of this reflection was to study the impact of prudential regulations on the behavior of CEMAC banks, through the interrelation between the variation in their level of capitalization, their risk taking and the return on their investments. active. For this purpose, we used an augmented version of the model of Shrieves and Dahl (1992), which also takes into account the specificities of the CEMAC countries and in particular their relative dependence on oil. Our results show that the macroeconomic environment pushes banks to respond to an increase in capital requirements with a corresponding increase in the credit risk of their portfolio. Our initial hypothesis is partly confirmed. Regulatory pressure is insufficient to curb the risk-taking behavior of banks. It has a significant effect on the level of capitalization and on the return on assets. The influence of the economic growth rate on return on assets and risk, when using the Arellano-Bond estimator, shows that the banks behave pro-cyclically here. This result justifies the implementation of macro prudential regulations which would complement the existing micro prudential measures.

Pro-cyclical behavior does not allow banks to fully play their role of financial intermediation in the event of an economic crisis as at present. The low diversification and quality of their portfolio constitutes a source of permanent vulnerability which can be detrimental to all the CEMAC economies. Instead of trying to diversify their portfolio, they settle for commission

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margins by taking advantage of asymmetric information. In our opinion, these margins should henceforth be subject to increased control by COBAC, by strengthening quality standards.

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