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Does Bank Capital Increase the Productivity of the Banking Industry? A Critical Review[1]

Abstract: The purpose of this paper is to assess the level of productivity of the banking sector in the Central African Economic and Monetary Community based on the evolution of the level of minimum bank capital. This study used data from the annual reports and bulletins of the Central African Banking Commission, the database of the Bank of Central African States and the World Bank's Worldwide Government Indicators for 1998 to 2020. We opted for the estimation of the Malmquist index of total factor productivity based on data envelopment analysis on the one hand, and an estimation of the channels influencing productivity using the generalised method of moments in system on the other hand. This study finds that the minimum capital requirement for banks has a significant positive impact on industry productivity. In addition, the ownership structure and the socio-political framework influence the productivity of banks in the Central African Economic and Monetary Community.

Keywords: banking industry, generalised method of moments in system, Malmquist index, Minimum bank capital, Productivity.

JEL Classification: E58, G21, G24

[1] **Declaration of competing interest**:
This is to declare that the author does not have conflict of interest.

Introduction

The debate on the concept of bank capital has become increasingly important. This concept is attracting the attention of researchers and professionals. Bank capital is derived from two plural concepts which are not contradictory but complementary. These two terms are "economic capital" and "regulatory capital". Economic capital is the bank's own funds that enable it to finance what it has not borrowed. Typically, it takes into account shareholders' equity (i.e. common stock) and the bank's undistributed profits. According to Mishkin (2010), one of the main reasons for holding bank capital is that "the amount of bank capital affects the performance of banks". Bank capital in the Central African Economic and Monetary Community is in constant flux. However, a report by the International Monetary Fund (2012) on the state of the banking system in the Central African Economic and Monetary Community urges credit institutions to comply with new "minimum capital requirements". The first finding concerns the low level of minimum bank capital for credit institutions. Taking economies such as Tunisia, Nigeria, Algeria, Ghana and South Africa as a reference, we find that these countries have the highest levels of minimum bank capital on the continent. Moreover, for West Africa, the Banking Commission of West Africa sets the minimum capital of credit institutions at 10 billion CFA francs, a threshold far below that of the countries mentioned above.

However, according to Enguene and Noumba (2024), Enguene (2024) if we go back in time, we find that the countries of the Economic and Monetary Community of Central Africa did not have a uniform standard for minimum bank capital. For example, the national legislation of Cameroon and Gabon had set the minimum bank capital at one (1) billion CFA francs. However, the bank capital of credit institutions in other countries of the Central African Economic and Monetary Community varied from 150 million to 300 million CFA francs. In this context, the Central African Banking Commission decided in 2009 to define, standardise and harmonise the minimum capital of credit institutions in the Central African Economic and Monetary Community. In order to address this issue, the Banking Commission of Central Africa, the regulatory body, also decided to increase and harmonise the minimum level of bank capital in line with international banking regulations following the 2007/2008 financial crisis. The Central African Banking Commission now sets the minimum capital requirement for credit institutions at 10 billion CFA francs. This new standard is intended to make credit institutions more stable and sounder, and to increase the supply of bank financing to agents in need of financing.

Differences in bank capital requirements affect bank activity and productivity. This study is timely in two respects. It allows us to draw the main empirical lessons following the increase in the level of minimum bank capital of banks in the Economic and Monetary Community of Central Africa. It also allows us to make concrete proposals for strengthening the role of bank capital in improving bank productivity. What is the impact of minimum bank capital requirements on the productivity of the banking sector in the Economic and Monetary Community of Central Africa? Depending on the production technology, banks are indeed forced to maximise their profits while complying with certain regulatory requirements. This orientation leads to the search for the optimal combination of resources. It is therefore interesting to try to measure the technical efficiency of banks and to analyse the Malmquist index of total factor productivity at the same time, but also to analyse the factors that influence this productivity. The objective of this paper is to assess the level of productivity of the banking industry in the Economic and Monetary Community of Central Africa following changes in the minimum capital requirements for banks in the Economic and Monetary Community of Central Africa. Specifically, the objective is to assess, on the one hand, the level of total factor productivity and, on the other hand, to identify the channels through which minimum bank capital affects total factor productivity. Finally, the hypothesis underlying this study is that the level of minimum bank capital in the Economic and Monetary Community of Central Africa increases bank productivity.

This study of the effect of minimum bank capital on the productivity of the banking industry in the Economic and Monetary Community of Central Africa (CEMAC) is an issue in the development of macroprudential policies for credit institutions insofar as it could explain the differences in financial development across countries and provide keys for the development of macroprudential policies in the CEMAC countries.This article is structured as follows: after reviewing the theoretical and empirical literature (section 2), we present the econometric estimation methodology (section 3) as well as the results and their interpretations (section 4). The last section (5) concludes the paper and provides policy recommendations.

1. Literature review

One of the fundamental issues in the Basel (I, II, III) debate remains the definition of an optimal threshold for bank capital adequacy (Mishkin, 2010). Two trends are emerging. The first trend consists of supporters of bank lobbying. The second trend consists of proponents of the introduction of higher bank capital

thresholds, similar to the decisions taken during the implementation of Basel III. Proponents of the bank lobbying thesis argue that more bank capital in credit institutions reduces the expected return to shareholders on the one hand, and reduces the resources needed to finance the economy on the other. This thesis is defended by Mishkin (2010). who suggests that "for a given return on assets (ROA), the lower the bank capital, the higher the shareholders' return on equity (ROE). The requirement to hold bank capital thus reduces the resources that banks can devote to development finance". For the proponents of the bank lobbying thesis, one franc of bank capital is one franc less to keep the economy going. For the proponents of the second thesis, holding a large amount of bank capital has several virtues. The Basel Committee insists that holding bank capital protects banks in times of distress. For some, this is "precautionary saving". For others, such as Miles, Yang and Marcheggiano (2013), "capital is a source of funding". Ceteris paribus, "a financial institution with more bank capital has more financial resources to lend to economic agents in need of financing (...)".

A recent study by De Bandt, Camara, Pessarossi and Rose (2017) provides an answer to the question of high bank capital. This study was conducted after the implementation of the Basel III reforms at the level of large banking groups. According to these authors: "In addition to the trend in profitability, banks for which the book capital and supplementary capital ratios increase more than the average see an improvement in their profitability (ROA and ROE). Thus, ceteris paribus, an increase in the various measures of bank capital leads to an average increase in ROE of between 3 and 10%, depending on the type of bank capital ratio considered. The banks in this study show an average increase in ROA of between 7 and 30%. For them: "the positive effect of bank capitalisation on ROA is smaller in the case of equity issues (...)". According to Gherig (2013), return on equity (ROE) is defined as the income earned on a unit of capital. Maximising profit for a given level of capital is equivalent to maximising ROE. For De Bandt et al. (2017), the return on bank capital can also be increased by substituting bank capital with debt. Some studies argue that a sufficiently capitalised institution enjoys "strategic advantages" in its market in terms of increased competitive power (savings and deposit market). In other words, in terms of competitiveness, banks are engaged in a strategic game in which they have to compete on the basis of their size of bank capital. Size gives them a strategic advantage over smaller banks because of their risk aversion. Moreover, in an "ideal" world, competition should have a positive effect on well-capitalised banks compared to poorly capitalised banks (Pfeifer, 2023).

In addition, Berger, Herring and Szegö (1995) conducted an empirical analysis of the relationship between capital and ROE for US banks. They find that banks

with high levels of capital have higher ROE. Similarly, highly capitalised banks have fewer solvency problems. Empirical analyses contradict the thesis of the "banking lobby". Indeed, bank capital has a comparative advantage in building "resilience" (Gehrig, 2013). It even has a strategic advantage in funding markets. Still talking about the impact of bank capital on bank performance, Berger and Bowman (2011) study the impact of bank capital over the period 1984-2009, taking into account various financial crises. They conclude that "in developed countries, bank capital increases resilience to crises". However, under normal conditions, small banks benefit most from their capitalisation and not the largest banks. More specifically, Philippon (2015) questions whether the US banking industry has become more efficient. Moreover, the relationship between capitalisation and ROE is not statistically significant for large and medium-sized banks. Nevertheless, there is a stronger positive influence of higher capitalisation of US banks compared to European banks. This raises the question of the persistence of profits in banking systems (Goddard, Liu, Molyneux and Wilson, 2011).

Furthermore, Modigliani and Miller (1958) assume that the banking industry is a perfect market. According to this observation, the capital structure of a firm has no effect on its value. However, the underlying idea according to Miles et al. (2013) is that bank capital is not neutral. There is an optimal level of bank capital at the bank level. These analyses do not rule out that there is a level of bank capital that maximises bank performance. At the optimum, the net marginal effect of capital on bank profitability should be zero. A positive relationship between bank capital and performance would thus be a long-term catching-up objective. According to Osborne, Fuertes and Milne (2012), bank capital has a positive effect on profitability, provided it is during a crisis. This increases the level of economic growth in a country (Martynova, 2016). Other studies, however, show possible negative effects of high capitalisation on bank performance. This research offers a threefold explanation. First, there is a preference for debt financing of banks. Second, debt has an informational advantage over capital due to information asymmetries. Finally, bank managers have private information about the evolution of corporate profits or about future investment opportunities. Thus, issuing debt is a way to signal the financial strength of the bank (Leland and Pyle, 1977). Moreover, banks can reduce liquidity creation if bank capital is too high (Diamond and Rajan, 2000). These factors help to reduce the marginal effects of bank capital on performance. In addition, the imposition of regulatory bank capital is an impediment to bank performance "if it turns out to be binding" (Goddard et al. 2011). Other authors, such as Naceur and Kandil (2009), refute the above analyses.

In fact, an increase in capital reduces the risk premium, which increases cash flows. Bank capital affects bank risk on the one hand and bank efficiency on the

other (Miah and Sharmeen, 2015). Similarly, bank capital provides a buffer for portfolio risk (Shim, 2013). In addition, it is easier to monitor financial institutions when their capital levels increase. From this mechanism, bank capital structure has a positive effect on asset cash flows because monitoring affects the performance of the bank's loan portfolio (Mehran and Thakor, 2011). In addition, Veselinović, Fabijan and Vadnjal (2023), Frank and Goyal (2009) base their analysis on the trade-off theory. They highlight the marginal costs and benefits of the non-monotonic relationship between capital and performance. In economic terms, banks need to increase their level of capital in order to operate optimally. For these authors, marginal costs and benefits cancel each other out. However, when there is excess capital, this optimum has a negative marginal effect on performance. Moreover, according to Mehran and Thakor (2011) and Gropp and Heider (2010), the performance of a financial institution depends on "the internal characteristics of the bank such as: its business model, its size (...) and the market structure such as transparency, competition, number of banks in operation". According to optimisation theory, regulatory capital requirements affect performance. However, Admati and Hellwig (2013) find a unique condition for the above developments. Bank capital has a negative effect on performance only if its holding is binding.

Finally, De Bandt, Camara, Maitre and Pessarossi (2016) and Noss and Toffano (2014) in their respective studies distinguish between capital increases voluntarily decided by the bank and those imposed by the regulator. Their studies try to understand the correlation between the positive effects of capital on performance and regulatory capital or "voluntary capital". Indeed, banks that voluntarily increase their capital levels benefit from relatively larger positive marginal effects on return on assets (ROA) than do banks that increase their capital in response to regulatory requirements. This positive effect is interpreted, according to De Bandt et al. (2016), as "a situation in which banks are temporarily below their optimal capital level and, faced with investment opportunities, banks improve their profitability by increasing their optimal bank capital level". In this sense, increases in regulatory capital are not found to have a significant impact on performance. Therefore, the increase in the level of bank capital by the banking authorities of the Economic and Monetary Community of Central Africa over the last decade invites us to examine the contribution of this increase to bank productivity. Thus, following the methodology of analysing total factor productivity, in particular the capital factor, we present in the following section our methodology for analysing the impact of minimum bank capital on the productivity of the banking sector in the Economic and Monetary Community of Central Africa.

2. Data and methodology of the study

In this study, we present a dual methodology. On the one hand, we present the empirical framework of the Malmquist total factor productivity (TFP) index. On the other hand, we also present the empirical model for the analysis of the channels affecting the productivity of banks in the Economic and Monetary Community of Central Africa.

2.1. Decomposition of efficiency by the Malmquist TFP index

The data and their sources, as well as the variables mobilised in this reflection, are presented before the empirical framework itself.

2.1.1. Data

The data we use are taken from the COBAC annual reports and bulletins and the data from the database of the Bank of Central African States, in which we find the accounting data of the six banking systems of the Economic and Monetary Community of Central Africa. The minimum bank capital (MBC) is included as an input. The data on outputs are those that measure the level of performance of the banking activity of the Economic and Monetary Community of Central Africa. Moreover, the empirical analysis covers the period 1998 to 2020. This time horizon is optimal for analysing the effects of the minimum bank capital before and after the new regulatory thresholds are set.

2.1.2. Variables

As Hubrecht and Guerra (2005) and Villarmois (2001) point out, "the choice of variables and their measurement is a complex problem." Indeed, this is a common difficulty in any empirical application, a difficulty that increases with the number of observations. Furthermore, the choice of inputs and outputs in the empirical application was defined on the basis of previous studies. Its theoretical justification can be found in the theory of bank production. This theory views the bank as a producer of goods, services and wealth, in contrast to the intermediation theory, which emphasises the bank's role as a financial intermediary. In this study, we assess the productive capacity of the banking system of the Economic and Monetary Community of Central Africa. The choices made seem to us to be consistent with the objective sought. In the remainder of this study, we

will analyse the outputs and inputs of the banking system. Four variables can be used to measure a bank's performance. These are ROA, ROE, net banking income (NBI) and net interest margin (NIM). These variables can be divided into two categories. The first category includes productivity ratios (ROA, ROE, NIM) measured in percentage (%). The second category, GNP, is measured in millions of CFA francs. These outputs correspond to the evaluation of the different levels of wealth produced by a bank during a year. Thus, for Naceur and Kandil (2009), wealth is evaluated either in terms of the profitability of assets or equity, or in terms of the actual income produced or the income from productive activity.

Moreover, to produce a banking good or service, a credit institution needs a combination of resources. According to the production approach described above, the resources are capital and labour. In this study, however, we only consider the minimum bank capital in order to isolate its influence on total factor productivity (TFP). The level of minimum bank capital (MBC) is measured in millions of CFA francs (See table 1 in appendix).

2.1.3. Presentation of the empirical framework

The aim is to present the Malmquist TFP index based on Data Envelopment Analysis (DEA). A global overview of this approach is provided. At the theoretical level, the Malmquist TFP index, according to Pompei (2013) and Casu, Girardone and Molyneux (2004), defines the change in productivity as the geometric mean of the indices based on production technologies in the period t and t+1, i.e :

$$M_t(H_i^{t+1}, Y_i^{t+1}, H_i^t, Y_i^t) = \left[\left(\frac{\Delta_i^{t+1}(H_i^{t+1}, Y_i^{t+1})}{\Delta_i^{t+1}(H_i^t, Y_i^t)}\right)\left(\frac{\Delta_i^t(H_i^t, Y_i^t)}{\Delta_i^t(H_i^{t+1}, Y_i^{t+1})}\right)\right]^{1/2} \quad (1)$$

Where X_i^t and X_i^{t+1} are vectors of inputs in years t and t+1; Y_i^t and Y_i^{t+1} are vectors of outputs in years t and t+1.

Each distance function D_i is estimated using a DEA-type linear programming method in the context of an output orientation (Coelli, Rao, O'donnell and Battese, 2005). Assuming that banking systems can be inefficient and that returns to scale are variable, we can identify three different sources of TFP growth: technological change (TECHch), pure efficiency change (PEch) and scale efficiency change (SEch). We can rewrite equation (1) as follows:

$$M_t(H_i^{t+1}, Y_i^{t+1}, H_i^t, Y_i^t) = \frac{\Delta_i^{t+1}(H_i^{t+1}, Y_i^{t+1})}{\Delta_i^t(H_i^t, Y_i^t)} \times \left[\left(\frac{\Delta_i^t(H_i^{t+1}, Y_i^{t+1})}{\Delta_i^{t+1}(H_i^{t+1}, Y_i^{t+1})}\right)\left(\frac{\Delta_i^t(H_i^t, Y_i^t)}{\Delta_i^{t+1}(H_i^t, Y_i^t)}\right)\right]^{1/2} \quad (2)$$

Where: $\frac{\Delta_i^{t+1}(H_i^{t+1},Y_i^{t+1})}{\Delta_i^{t}(H_i^{t},Y_i^{t})}$ is the ratio of distance functions and thus measures the overall change in efficiency; and $\left[\left(\frac{\Delta_i^{t}(H_i^{t+1},Y_i^{t+1})}{\Delta_i^{t+1}(H_i^{t+1},Y_i^{t+1})}\right)\left(\frac{\Delta_i^{t}(H_i^{t},Y_i^{t})}{\Delta_i^{t+1}(H_i^{t},Y_i^{t})}\right)\right]^{1/2}$ represents measures of change in technological efficiency (TECHch). The overall efficiency change can in turn be decomposed into pure efficiency (PEch) and scale efficiency (SEch). The TFP index for the period t and t+1 results from three sources of growth defined in equation (3) below:

$$M_t(H_i^{t+1}, Y_i^{t+1}, H_i^t, Y_i^t) = (CT) \times (ETP) \times (EE) \tag{3}$$

The above equation can be further written in the form:

$$M_t(H_i^{t+1}, Y_i^{t+1}, H_i^t, Y_i^t) = (TECH.ch) \times (PE.ch) \times (SE.ch) \tag{4}$$

Finally, note that any Malmquist index $M_t \epsilon]0\ x]$, $x > 1$. If $M_t > 1$. The firm has improved it productivity over of study. If $M_t < 1$, the firm's productivity has deteriorated.

2.2. Empirical analyses of the determinants of TFP

This section focuses on the second stage of the empirical analysis. This consists of analysing the impact of minimum bank capital requirements on TFP. We concentrate on the econometric strategy. The use of the Malmquist TFP index as the dependent variable in the specification below (equation 4) poses an econometric problem. This model suffers from the endogeneity problem. However, it can be solved in a classical way using either a difference GMM or a system GMM. Thus, the specification of Pompei (2013), based on the model of Arellano and Bond (1991), with the CBM as the main control variable, is as follows:

$$PTF.ch_t = \alpha PTF.ch_{t-1} + \beta CBM_t + \gamma_j \sum_{j=1}^{n} X_{j,it} + \eta_i + \theta_i + \xi_i \tag{5}$$

Where: i = 1…6 countries; t = 1998 to 2020; j = 1...10 the number of control variables.

$TFP_{i,t}$ is the endogenous variable; $TFP_{i,t-1}$, is the lagged endogenous variable of the TFP; $CBM_{i,t}$ is the minimum bank capital, expressed in millions of CFA francs; $\sum_{j=1}^{n} X_{j,it}$, is the set of control variables. These different equations above represent, respectively, the technological efficiency, the pure efficiency, the scale efficiency and the technical efficiency. These control variables are of three types.

First, there are variables related to banking activity, namely: the share of share capital held by the State (PCSE), the share of share capital held by the private sector (PCSP), provisions (PROV) expressed in millions of CFA francs and the total effective rate (TEG). Secondly, there are variables related to macroeconomic activity, namely the GDP growth rate (TCPIB) and the inflation rate (INF). Finally, there are variables related to the institutional environment, which in this study can be approximated by three indicators: control of corruption (CC), quality of regulation (QR) and political stability, absence of violence/terrorism (SPAVT). η_i, is the country fixed effect; θ_i, specific effects of weather and $\xi_{i,t}$ is the idiosyncratic error. A good summary of the variables and data sources used in this study can be found in Table 1 in the Annex. We regress the three components of Malmquist total factor productivity. We then regress the technical efficiency index on all the control variables mentioned above. Finally, we regress the different components of TFP in order to observe their different contributions to the productivity of the banking system. The various empirical models are as follows:

$$PE.ch_t = \alpha PE.ch_{t-1} + \beta CBM_t + \gamma_j \sum_{j=1}^{n} X_{j,it} + \eta_i + \theta_i + \xi_i \quad (6)$$

$$SE.ch_t = \alpha SE.ch_{t-1} + \beta CBM_t + \gamma_j \sum_{j=1}^{n} X_{j,it} + \eta_i + \theta_i + \xi_i \quad (7)$$

$$EFF.ch_t = \alpha EFF.ch_{t-1} + \beta CBM_t + \gamma_j \sum_{j=1}^{n} X_{j,it} + \eta_i + \theta_i + \xi_i \quad (8)$$

To solve the above endogeneity problem, Arellano and Bond (1991) proposed to instrument the explanatory variables in the first difference equation with their level values lagged by one or more periods (Leroy, 2014). This is known as estimating the GMM model in difference. However, another potential problem may arise. This problem is due to the fact that the level lags may be weak instruments. Arellano and Bover (1995) and Blundell and Bond (1998) have developed the GMM estimator in system. This estimator ensures that the variables in the first-differenced equation are instrumented by the lags of the level equation and that the lags of the variables from the level equation are used as valid instruments for the first-differenced equation. In this study, we retain the system GMM method to meet the econometric requirements.

3. Results of the study

In the first part of this section, we present the results of the decomposition of the Malmquist TFP index. The second part analyses the determinants of TFP.

3.1. Analysis of the results of the Malmquist TFP index and its components

The decomposition of the Malmquist TFP index is shown in Table 1. The table shows that the banking system of Equatorial Guinea has the highest productivity (1.035). In second place is the banking system of Gabon with a score of (1.031). In third place is the banking system of the Congo with a score of 1.022. The other banking systems (Chad, Central African Republic and Cameroon) have low productivity levels compared to the top three banking systems. They are 1.005, 0.983 and 0.966, respectively.

Table 1: Average Malmquist TFP Index

Country's banking system	TFP.ch = TECH.ch* PE.ch* SE.ch 1998 to 2020				
	EFF.ch	TECH.ch	PE.ch	SE.ch	TFP.ch
Cameroon	1.000	0.966	1.000	1.000	0.966
Central African Republic	0.999	0.984	0.999	1.000	0.983
Congo	1.009	1.014	1.009	1.000	1.022
Gabon	0.999	1.031	1.000	0.999	1.031
Equatorial Guinea	1.001	1.034	1.000	1.001	1.035
Chad	1.003	1.003	1.000	1.003	1.005
Average	1.002	1.005	1.001	1.001	1.007

EFF.ch (technical efficiency change), TECH.ch (technological change) PE.ch (pure efficiency change), SE.ch (scale efficiency change) et TFP.ch (total factor productivity change).

Source: Author

There are indeed several possible explanations for these results. One of them is the restructuring of the banking industry in terms of MBC. Indeed, the decomposition analysis reveals several factors that explain the TFP index. First, technological efficiency explains most of the TFP level of the Equatorial Guinean banking system (1.034). Second, the level of technological change also explains the TFP scores of the banking systems of Gabon (1.031), Congo (1.022) and Chad (1.005). Third, the banking systems of Cameroon and the Central African Republic have low technological change scores. These are 0.996 for Cameroon and 0.983 for the CAR. These low scores relative to others indicate that these two banking systems

have low technology in banking production, especially since they are below the average productivity of the CEMAC. Moreover, with the exception of the Central African Republic, all banking systems score the same or better in terms of pure efficiency (1,000). These banking systems have therefore adopted good banking practices over the period. In terms of scale of production (change in scale efficiency), only the Gabonese banking system scores low (0.999). However, the scores for change in technical efficiency do not follow the same pattern as those for TFP. For example, Congo's banking system is technically more efficient. It has a score of 1.009. This is followed by Chad's banking system (1.003) and finally Equatorial Guinea's (1.001).

In sum, the high MBC scores of Gabon and Cameroon do not seem to guarantee strong growth in TFP levels. The differences in productivity measurement effects can be explained by different factors in each country. In Cameroon, for example, technological change reduces the level of TFP. In Equatorial Guinea, on the other hand, the same component increases it. It is tempting to conclude that countries with a high level of MBC have low productivity. However, as can be seen, the level of TFP depends on the level of technological change for Cameroon and on the change in scale for Gabon. Other explanations allow us to justify the impact of the MBC on the productivity of banking systems. We therefore present the results of the channels influencing TFP in the CEMAC banking industry.

3.2. TFP determinants: analysis of results

Before discussing the results of our estimations, it is useful to examine the descriptive statistics of the variables used for the econometric analysis.

3.2.1. Presentation of descriptive statistics and stationarity tests

Table 1 in the Appendix presents a set of descriptive statistics for all variables used in the econometric analysis. We have a total of 138 observations for a panel of six (6) countries over 23 periods of annual data (1998-2020). Our panel is cylindrical for the purposes of this study. The descriptive analysis of the data shows us that the variation in the standard deviation is significant for both the minimum bank capital and the other control variables. This suggests that there are significant unobserved effects at the country level. Variability across banking systems is also significant for the TFP index. This index has an overall average of 1.007 and varies between 1.711 and 0.54. From this table we can see that countries with high TFP and countries with high technical efficiency do not overlap perfectly. In other words, there is a strong relationship between these two components.

In addition, the last two columns of Table 2 in the Appendix show the results of the first- and second-generation stationarity tests in panel data. For our data, these are the Levin-Lin-Chu (LLC) and the Im-Persaran and Shin (IPS) tests. The null hypothesis of these two tests is the absence of unit roots. Both tests are applied to all variables in our model. The p-values < 5% indicate the stationary state of the series. In this table, stationary series in level are indicated (*) and stationary series in first difference are indicated (**). Then, in Table 2, we see that the specification test rejects the homogeneous effect of our series. It is therefore useful to carry out a panel regression. Table 3 shows the level of correlation between the different variables at input and output level. It can be seen that there is a strong correlation between the level of minimum bank capital (CBM) and net banking income (PNB), net interest margin (NIM), return on assets (ROA) and return on equity (ROE). Finally, the concept of cointegration is defined as a systematic long-run co-movement between two or more economic variables. Two variables are said to be cointegrated if there is at least one combination of them such that the combination of these two variables gives a stationary variable. The approach to cointegration tests varies according to the homogeneous or heterogeneous nature of the panel. In our case, as we shall see, our panel is heterogeneous. We therefore use the cointegration tests of Pedroni (2004) (see Table 3). The null hypothesis of the test is that there is no cointegration. The alternative hypothesis is that there is a cointegrating relationship for each country. This test has the peculiarity of presenting seven tests. From the results we can say that our series are cointegrated.

Table 2: Specification test (homogeneity of constants α_i)

$H0 : \alpha_i = \alpha$ $\forall i \in [\![1.6]\!]$ Homogeneity	Regression (dependent variables)	$F_{(5, 94)}$	Prob. > F	Conclusion	Type of effect
	Total factor productivity (TFP)	1.53	2.1582	Reject H_0	Heterogeneous effect
Décision : if Prob. < $F_{(5, 94)}$, then accept H0, i.e. the different specifications are homogeneous					

Source: Author

Table 3: Pedroni Co-integration Test

	Pedroni's test	Beta	t-stat.
H0 : No co-integration relationship	Panel v	0.9685	0.0222
	Panel rho	-0.0263	-0.0056
	Group rho	0.0493	2.113
	Panel t (non parametric)	-0.0214	-1.785*
	Group t (non parametric)	-0.0215	-0.2151
	Panel ADF (parametric)	-0.0229	-1.003
	Group ADF (parametric)	-0.0046	-0.4614

If t - stat < -1.64, for the other tests, implies the rejection of H0; If Si t - stat > 1.64, for the v-test, implies rejection of H0 ; *indicates rejection of the null hypothesis of non-cointegration.

Source: Author

3.3. Analysis of econometric results

Table 4 shows the impact of the CBM and other control variables on TFP. We ran five regressions (a, b, c, d and e). It is important to note that MBC is always positive and significant (except in regression b, where it is not significant). The recent empirical literature suggests that the level of MBC increases bank productivity. We find that a one-point increase in the MBC index leads to an increase in the level of bank productivity between 0.058 (5.8%) and 0.088 (8.8%). In addition, four variables are statistically positive and significant (CBM, PCSE, PCSP, TCPIB). On the other hand, the level of corruption affects productivity. This variable is negative and significant at the 5% level. Similarly, the regulatory quality and the socio-political environment of the CEMAC countries negatively affect bank productivity. However, these effects are not significant. However, the phenomenon of "persistence" in this context also indicates a low level of competition within the banking sector. Secondly, a low value close to zero is interpreted as "no profit persistence". It can therefore be concluded that there is strong competition within the CEMAC banking industry. Overall, these results confirm our working hypothesis. Minimum bank capital increases the productivity of the CEMAC banking industry.

Several previous papers like Enguene and Noumba (2024) have highlighted the paradox of profitability in the CEMAC banking industry. They have raised the question of the failure to finance economies despite the observed profitability of banking systems. Others have assessed the impact of banking restructuring. But they have not asked the question of how to make banking systems more productive. A start was made in the wake of the 2007/2008 financial crisis. With the

Basel III Accord, the Basel Committee has put the level of bank capital back at the centre of the debate. The Committee is tightening regulatory standards for bank capital. An increase in the level of bank capital will be imposed on the largest banking institutions. In this context of uncertainty, the CEMAC regulators are thus following the new international regulatory standards. The Banking Commission of Central Africa (COBAC) is implementing a single uniform minimum bank capital standard. According to them, the new minimum capital thresholds are designed to create the most stable and sound banks.

But there is another question. This is the question of the profitability of banking systems. The new minimum capital requirements for banks are important. It goes without saying that the current thresholds, compared with the previous ones, can act as a catalyst for banking activity. The above results are important in several respects. They justify the theoretical basis for the importance of bank capital for a credit institution. The productivity level of banks has increased in recent years. Thus, the possession of a significant amount of bank capital by a credit institution tends to have a positive effect on its productivity. Thus, bank capital is important because it acts as a catalyst for bank production activity. Without bank capital, a bank cannot be licensed. Without bank capital, a bank cannot engage in the lending activity that creates wealth. Without bank capital, a bank cannot be structurally viable, because bank capital enables a bank to be sound and to withstand external or internal shocks. A significant level of bank capital is also a source of confidence for potential savers. Indeed, the level of bank capital gives a positive or negative signal about a bank's ability to withstand potential losses (Noumba and Enguene 2022). In this study, we have demonstrated the ability of new bank capital thresholds to increase the productivity of CEMAC banking systems. This is probably the first study to focus on this theoretical relationship in this sub-region. In our view, banking activity is strongly influenced by the level of resources available to a credit institution. Indeed, without significant and optimal financial resources, it is generally difficult for a bank to establish and maintain prudential standards. In short, bank capital allows banks to be more competitive at national and international level. It enables banks to be stable and productive.

Table 4: Effects of minimum bank capital on total factor productivity

Variables	Total factor productivity change ($TFPch_t$)				
	a	b	c	d	e
($TFPch_{t-1}$)	0.395 (3.30)***	0.001 (0.01)	0.007 (0.05)	0.206 (2.08)**	-0.293 (2.11)**
logCBM (minimum bank capital)	0.058 (4.92)***	0.026 (1.30)	0.088 (7.06)***	0.076 (7.95)***	0.038 (2.41)**
Variables related to the banking activity					
PCSE (share of share capital held by the State)		0.006 (3.43)***			0.008 (3.62)***
PCSP (share of share capital held by the private sector)		0.007 (4.21)***			0.009 (4.44)***
logPROV (provisions)		0.002 (0.14)			-0.043 (1.09)
TEG (overall effective rate)		0.009* (1.70)			-0.003 (0.64)
Variables related to macroeconomic activity					
TCPIB (GDP growth rate)			0.005 (1.78)*		0.005 (1.95)*
INF (inflation rate)			0.007 (0.96)		0.006 (1.01)
Variables related to the institutional environment					
CC (control of corruption)				0.046 (0.25)	-0.377 (2.01)**
QR (regulatory quality)				-0.095 (0.51)	-0.169 (1.05)
SPAVT (political stability, absence of violence/terrorism)				-0.158 (1.40)	-0.062 (0.64)
Times dummies	Yes	Yes	Yes	Yes	Yes
Observations	108	108	108	108	108
Instruments	93	93	93	93	93
Overall	chi2	2252.35	3176.34	3157.91	2689.81
	p-value	0.000***	0.000***	0.000***	0.000***
A-B Test H0 no auto correlation					
AR (1) p-values	0.002***	0.107	0.000***	0.125	0.000
AR (2) p-values	0.053*	0.335	0.032**	0.142	0.015**
Sargan test	p-values	1.000	0.133	0.990	0.071*
	chi2	chi2(91) 50.22	chi2(87) 101.77	chi2(79) 52.57	chi2(88) 108.24

*, **, *** represents the significance levels at 10%, 5% and 1% respectively. The test statistics for the significance of the coefficients are in brackets. The table presents the results of the estimations by the Arellano Bover / Blundell-Bond method. It also includes the Sargan over-identification test and the Arellano and Bond auto-correlation test. The specification takes into account the effect of the lagged endogenous variable.

Source: Author

In the light of the above results, the increase in the regulatory thresholds for minimum bank capital of CEMAC credit institutions has undoubtedly increased their productivity. The positive impact of minimum bank capital on bank productivity has also been demonstrated. However, despite the profitability of banks in recent years, the problem of the lack of financing of the CEMAC economies remains unresolved (Enguene and Noumba, 2024). In other words, how does the level of minimum bank capital affect the supply of credit by banks in the CEMAC?

Table 5: Contribution of TFP components to TFP

Total factor productivity change ($TFPch_t$)		Components of total factor productivity		
($TFPch_{t-1}$)		TECHch	PEch	Sech
-0.375 (4.12)***		0.465 (4.36)***	0.730 (1.76)*	0.190 (0.47)*
Times dummies		Oui	Oui	Oui
Observations		108	108	108
Instruments			80	
Overall	chi2		6015.15	
	p-value		0.000***	
A-B Test H0 no auto correlation				
AR (1) p-values			0.005	
AR (2) p-values			0.944	
Sargan test	p-values		0.384	
	chi2		chi2(76) = 79.03	

*, **, *** represents the significance levels at 10%, 5% and 1% respectively. The statistical test for the significance of the coefficients are in brackets. The table presents the results of the estimations by the Arellano Bover / Blundell-Bond method. It also includes the Sargan over-identification test and the Arellano and Bond auto-correlation test. The specification takes into account the effect of the lagged endogenous variable.

Source: Author

Table 5 also shows the contribution of the different TFP components to bank productivity. It can be seen that the highest and most significant contribution at the 10% threshold is that of the change in pure efficiency (0.730). This is followed by technological change (0.465) and the change in scale efficiency with a contribution of 0.190. According to these results, a one percentage point increase in technological change increases TFP by 46.5%. A one percentage point increase also increases TFP by 73.0% for pure efficiency and 19.0% for scale efficiency. However, the negative and significant value of the lagged endogenous variable may have a double explanation. Athanasoglou, Brissimis and Delis (2008) argue that the absolute value of this coefficient can be interpreted in two ways.

First, a high value close to 1 confirms the phenomenon of "profit persistence". In the context of the CEMAC, this value effectively confirms the persistence of the profit level for credit institutions operating in this geographical area (Noumba and Enguene 2022). In the light of the above results, the increase in the regulatory thresholds for minimum bank capital of CEMAC credit institutions has undoubtedly increased their productivity. The positive impact of minimum bank capital on bank productivity has also been demonstrated. However, despite the profitability of banks in recent years, the problem of the lack of financing of the CEMAC economies remains unresolved.

3.3.1. Impact of minimum bank capital requirements on the components of banking system productivity in the CEMAC region

An analysis of the results in Tables 6, 7 and 8 allows us to make a triple analysis. This analysis is a function of the different components of Malmquist total factor productivity. First, the effect of minimum bank capital on technological change (Table 6) can be analysed as follows. First, the level of minimum bank capital increases the index of technological efficiency. This variable is positive and significant at the 1% level for the "a, c and d" regressions. For example, in these regressions, an increase in the level of minimum bank capital increases the level of technological change by 6.9%, 4.1% and 6.8%, respectively. In addition, the ownership structure of the banking system has a positive effect on the same variable at the 1% threshold. However, the regulatory quality index has a negative impact. Other things being equal, a decrease in the index of regulatory quality increases the level of the index of technological change and vice versa.

Table 6: Impact of miniumm bank capital requirements on technological change ($TECHch_t$)

Variables		Technological change $TECHch_{t-1}$				
		a	b	c	d	e
$TECHch_t$		0.293 (3.04)***	0.066 (0.65)	0.576 (4.88)***	0.297 (3.09)***	0.069 (0.65)
logCBM (minimum bank capital)		0.069 (7.21)***	0.008 (0.37)	0.041 (3.59)***	0.068 (7.17)***	0.020 (1.39)
Variables linked to banking activity						
PCSE (State shareholding)			0.007 (3.59)***			0.006 (3.08)***
PCSP (private shareholding)			0.007 (4.31)***			0.007 (3.69)***
logPROV (provisions)			0.009 (0.47)			0.012 (0.25)
TEG			0.005 (0.95)			0.008 (1.39)
Variables related to macroeconomic activity						
TCPIB (GDP growth rate)				0.003 (1.06)		0.001 (0.40)
INF (inflation rate)				-0.000 (0.07)		0.002 (0.28)
Variables related to the institutional environment						
CC (control of corruption)					0.124 (0.64)	0.031 (0.15)
QR (regulatory quality)					-0.528 (2.81)***	-0.458 (2.45)**
SPAVT (political stability. absence of violence/terrorism)					0.050 (0.41)	0.030 (0.26)
Times dummies		Yes	Yes	Yes	Yes	Yes
Observations		108	108	108	108	108
Instruments		93	93	99	93	93
Overall	chi2	2567.54	3006.82	2502.55	2656.04	3083.82
	p-value	0.000***	0.000***	0.000***	0.000***	0.000***
A-B Test H_0 non auto corrélation						
AR (1) p-values		0.047**	0.062*	0.028*	0.023*	0.043*
AR (2) p-values		0.467	0.433	0.363	0.256	0.386
Test de Sargan	p-values	0.249	0.360	0.929	0.291	0.350
	chi2	chi2 (91) 99.73	chi2 (87) 91.14	chi2 (95) 75.59	chi2 (88) 94.81	chi2 (82) 86.35

Standard deviations in parentheses; *** $p < 0.001$; ** $p < 0.005$; *$p < 0.1$

Source: Author

Next, looking at the effect of CBMs on the change in net efficiency (Table 7), it can be seen that CBMs have a positive and significant effect on net efficiency. The results obtained are small but significant at the 10% level for the "c and d" regressions. As mentioned above, we also find that ownership structure has a positive and significant effect at the 10% level. However, this effect is not robust given the result obtained (0.002). Furthermore, variables related to the socio-political environment have very little impact on banking practices in the CEMAC banking system. Only the level of corruption has a negative impact on banking practices (pure efficiency). We also find that the destabilising effects of the different countries do not allow the different banking sub-systems to improve their practices. However, these different effects are not significant. Finally, as regards the impact of the MBC on scale efficiency (Table 8), three conclusions can be drawn at this level. First, the MBC has a positive and significant effect on the "c" and "d" regressions at the 10% threshold. For the other regressions, the effect is positive but insignificant.

Table 7: Effects of minimum bank capital on the change in pure efficiency ($PEch_t$)

Variables	Pure efficiency change ($PEch_t$)				
	a	b	c	d	e
($PEch_{t-1}$)	0.917 (17.61)**	0.821 (10.07)***	0.912 (16.40)***	0.919 (17.51)***	0.778 (7.91)***
logCBM (minimum bank capital)	0.008 (1.58)	0.004 (0.60)	0.008 (1.62)*	0.008 (1.52)*	0.006 (1.16)
Variables linked to banking activity					
PCSE (State shareholding)		0.001 (1.53)			0.002 (1.72)*
PCSP (Private shareholding)		0.001 (1.65)*			0.002 (1.83)*
logPROV (Provisions)		0.002 (0.42)			-0.002 (0.19)
TEG		-0.001 (0.36)			-0.001 (0.52)
Variables related to macroeconomic activity					
TCPIB (GDP growth rate)			0.000 (0.60)		0.001 (1.05)
INF (Inflation rate)			-0.001 (0.31)		-0.000 (0.00)
Variables related to the institutional environment					
CC (control of corruption)				0.011 (0.22)	-0.041 (0.68)
QR (regulatory quality)				-0.014 (0.30)	0.016 (0.33)
SPAVT (political stability. absence of violence/terrorism)				0.011 (0.37)	0.006 (0.21)

Times dummies		Yes	Yes	Yes	Yes	Yes
Observations		108	108	108	108	108
Instruments		83	83	83	83	83
Overall	chi2	44270.89	46656.77	44491.51	44761.97	46191.59
	p-value	0.000***	0.000***	0.000***	0.000***	0.000***
A-B Test H_0 non auto corrélation						
AR(1) p-values		0.000***	0.000***	0.000***	0.000***	0.000***
AR(2) p-values		0.065*	0.079*	0.063*	0.055*	0.070*
Test de Sargan	p-values	0.996	0.990	0.994	0.990	0.980
	chi2	chi2(81) 51.46	chi2(77) 51.23	chi2(79) 51.20	chi2(78) 51.74	chi2(72) 49.51

Standard deviations in parentheses ; ***p < 0.001 ; **p < 0.005 ; *p < 0.1

Source: Author

Moreover, as in most regressions, the ownership structure has a positive effect on the banking system's output. On the other hand, the socio-political environment hinders the development of productive structures. Indeed, the level of corruption, the quality of laws or political instability, violence and the development of terrorist acts in recent years do not allow the scale of the productive structures of this sector of activity to increase, as it is difficult to invest in an unstable environment.

Table 8: Changes in scale efficiency due to minimum bank capital requirements ($SEch_t$)

Variables	Scale efficiency change ($SEch_t$)				
	a	b	c	d	e
($SEch_{t-1}$)	0.943 (23.88)***	0.826 (11.02)***	0.920 (21.60)***	0.924 (18.81)***	0.747 (8.53)***
logCBM (minimum bank capital)	0.005 (1.43)	0.003 (0.57)	0.007 (1.79)*	0.007 (1.52)	0.006 (1.13)*
Variables linked to banking activity					
PCSE (State shareholding)		0.001 (1.56)			0.002 (2.23)**
PCSP (Private shareholding)		0.001 (1.73)			0.002 (2.30)*
logPROV (Provisions)		0.002 (0.39)			0.004 (0.40)
TEG (totale effective rate)		0.001 (0.39)			-0.000 (0.08)
Variables related to macroeconomic activity					
TCPIB (GDP growth rate)			0.001 (1.00)		0.001 (0.97)
INF (inflation rate)			0.001 (0.76)		0.002 (1.24)

Variables related to the institutional environment						
CC (control of corruption)					0.051 (1.10)	-0.093 (1.69)
QR (regulatory quality)					-0.025 (0.60)	-0.009 (0.21)
SPAVT (political stability. absence of violence/terrorism)					-0.016 (0.57)	-0.018 (0.65)
Times dummies		Yes	Yes	Yes	Yes	Yes
Observations		108	108	108	108	108
Instruments		93	83	93	83	83
Overall	chi2	58682.78	54685.76	60967.67	51825.87	52311.71
	p-value	0.000***	0.000***	0.000***	0.000***	0.000***
A-B Test H_0 non auto corrélation						
AR(1) p-values		0.007***	0.000***	0.019**	0.000***	0.000***
AR(2) p-values		0.047**	0.106	0.132	0.018**	0.181
Test de Sargan	p-values	0.986	0.993	0.975	0.997	0.999
	chi2	chi2(91) 64.02	chi2(77) 49.78	chi2(89) 64.79	chi2(78) 47.94	chi2(72) 41.19

Standard deviations in parentheses; *** p < 0.001 ; **p < 0.005 ; *p < 0.1

Source: Author

3.3.2. Impact of minimum bank capital requirements on the technical efficiency of the banking system in the CEMAC region

In contrast to some recent empirical studies, we have measured the impact of minimum bank capital on the technical efficiency of the banking system in the CEMAC zone. Table 9 shows that minimum bank capital has a positive and significant impact on the technical efficiency index of the banking system in the CEMAC region. The ownership structure also has a positive and significant effect. However, the level of provisioning and the TEG reduce the technical efficiency of the banking system. However, these effects are insignificant. In addition, the level of corruption also affects the index of technical efficiency of the banking system in the CEMAC zone. In short, we can say that the level of minimum bank capital has a positive and significant effect on the different components of TFP. However, it also has the same effect on the technical efficiency of the different banking subsystems. Furthermore, the ownership structure has a significant and positive effect in all these regressions. However, the socio-political environment is a major constraint on the productivity of the banking sub-systems. Political instability, the level of corruption or the inability of governments to enact and enforce good quality legislation all hinder the harmonious development of the banking system in the CEMAC zone and thus its productivity.

Table 9: Impact of bank capital requirements on changes in technical efficiency ($EFFch_t$)

Variables		Technical efficiency change ($EFFch_t$)				
		a	b	c	d	e
($EFFch_{t-1}$)		0.808 (12.34)***	0.594 (5.60)***	0.795 (10.48)***	0.816 (11.09)***	0.503 (4.65)***
logCBM (minimum bank capital)		0.018 (2.90)**	0.009 (1.04)	0.019 (2.74)***	0.017 (2.47)**	0.012 (1.85)*
Variables linked to banking activity						
PCSE (State shareholding)			0.003 (2.52)**			0.004 (3.40)***
PCSP (Private shareholding)			0.003 (2.84)***			0.004 (3.75)***
logPROV (provisions)			0.002 (0.36)			-0.017 (1.01)
TEG (total effective rate effectif global)			-0.000 (0.05)			-0.002 (0.91)
Variables related to macroeconomic activity						
TCPIB (GDP growth rate)				0.001 (0.95)		0.001 (1.66)*
INF (inflation rate)				-0.001 (0.25)		-0.001 (0.40)
Variables related to the institutional environment						
CC (control corruption)					0.026 (0.35)	-0.084 (1.20)
QR (regulatory quality)					-0.023 (0.35)	0.052 (0.75)
SPAVT (political stability. absence of violence/terrorism)					0.026 (0.60)	0.003 (0.09)
Times dummies		Yes	Yes	Yes	Yes	Yes
Observations		108	108	108	108	108
Instruments		93	83	83	83	93
Overall	chi2	23682.70	22639.58	21897.28	21203.24	25072.03
	p-value	0.000***	0.000***	0.000***	0.000***	0.000***
A-B Test H_0 non auto corrélation						
AR(1) p-values		0.041**	0.000***	0.000***	0.000***	0.019**
AR(2) p-values		0.461	0.576	0.337	0.217	0.826
Test de Sargan	p-values	0.950	0.974	0.946	0.953	0.985
	chi2	chi2(91) 69.97	chi2(77) 54.80	chi2(79) 59.95	chi2(78) 58.40	chi2(82) 56.66

Standard deviations in parentheses ; *** p<0.001 ; ** p<0.005 ; * p<0.1

Source: Author

4. Conclusion and policy recommendations

In addition, and in support of the above findings, other estimates provide us with some very revealing and important results. For example, these estimates show that minimum bank capital has a positive and significant effect on bank productivity. In addition, the ownership structure has a positive and significant effect on bank productivity. Finally, the current socio-political environment, characterised by political instability, multiple crises, governance and corruption problems, has a negative and significant impact on the productivity of CEMAC banks. It is timely to remind CEMAC regulators and bank managers and owners of the importance of increased bank capitalisation. It is also important to remind policymakers of the importance of fighting corruption, enacting good laws and maintaining the socio-political stability of countries. These factors also improve the productivity of banks. Finally, COBAC, in consultation with researchers, should define an optimal minimum level of bank capital to enable the banking industry to be more productive. Similarly, COBAC should encourage voluntary capital increases as outlined by De Bandt et al. (2016).

In terms of macroeconomic and monetary policy, the banking supervisor needs to proceed with a new recapitalisation of banks in the sub-region. As mentioned above, the optimal capital threshold still needs to be defined. In fact, the threshold set by the COBAC/001 regulation, which determines the minimum capital of CEMAC credit institutions (currently 10 billion), remains below the expectations of the various economies. The aim of this new increase in minimum bank capital is first to clean up and consolidate the banking sector, which will be easier to supervise. Second, it will increase the activity of credit institutions, which will ipso facto lead to a significant increase in their productivity. Third, increasing the level of bank capital of CEMAC credit institutions will increase the financing capacity of the local banking sector, which currently seems to be holding back the development of the economy of the CEMAC sub-region.

Moreover, by defining an optimal framework for the management of these surplus funds, this new strategy will allow for a radical transformation of the banking sector in the CEMAC sub-region. In functional terms, the new thresholds will first increase the competitiveness of banks. Second, they will ensure a significant increase in the density of the banking network and banking services. Third, they will encourage the internationalisation of local banks. Finally, with a doubling of the current minimum capital requirements for banks, the CEMAC banking industry will be able to finance most major local infrastructure development projects without recourse to external financing. This banking industry will be able to adequately support the emergence of these economies. Therefore, the

development of the CEMAC banking industry and its capacity to finance major infrastructure projects and enterprises requires a strengthening of its minimum capital requirements. The low level of minimum bank capital observed risks limiting the ability of this banking industry to fully benefit from the opportunities offered by the numerous future investments in these countries. This is particularly the case for the bond financing that the CEMAC countries have received in recent years to increase their own resources deficit.

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Appendix

Table 1: Definition of variables and data sources

Variable	Definition	Source	Expected sign
CBM (10^6)	Minimum capital is the capital required by the regulatory authorities before a credit institution can be opened.	COBAC	+
PROV (10^6)	Provisions represent a portion of the funds set aside to cover probable losses on loans and advances.	COBAC	-
TEG (%)	The total effective interest rate represents the real cost of the loan to the borrower.	BEAC	+
PCSE (%)	Share of capital held by the government.	COBAC	-
PCSP (%)	Proportion of share capital held by the private sector.	COBAC	+
TCPIB (%)	GDP growth rate measures the change in the total wealth of an economy between two consecutive periods.	BEAC	+
INF (%)	Inflation rate measures the degree of fluctuation in the prices of goods and services at a given point in time.	BEAC	-
QR	Regulatory quality measures the perceived ability of the government to formulate and implement sound policies and rules that enable private sector development. The score for this measure ranges from -2.5 (weak/poor) to +2.5 (strong/better).	WGI	+
CC	Control of corruption reflects perceptions of the extent to which public power is used for private ends, including petty and grand corruption and the capture of the state by elites and private interests. Estimates of this measure range from -2.5 (low/poor) to +2.5 (high/better).	WGI	-
SPAV/T	Political stability, absence of violence/terrorism measures the perceived likelihood of political instability and/or politically motivated violence, including terrorism. The estimate of this measure ranges from -2.5 (low/poor) to +2.5 (high/better).	WGI	-
PTF.ch	The change in total factor productivity measures the productivity achieved by a production unit at a given point in time.	Auteur	
TECH.ch	Technological change highlights the quality of the technology used to increase the productivity of a production unit.	Auteur	+
EFF.ch	The change in technical efficiency measures the ability of a production unit to make optimum use of the inputs needed to produce an optimum level of output.	Auteur	+
SE.ch	The change in scale efficiency measures the efficiency of the size of the production unit/scale inefficiency indicates a suboptimal size of the production unit (a score < 1).	Auteur	+
PE.ch	Pure efficiency change measures how close or far an industry is from the best practice boundary. Pure technical inefficiency indicates a misuse of resources by managers (a score < 1).	Auteur	+

Source: Author

Table 2: Descriptive statistics of variables 1998 to 2020

Variables	Observations	Mean	Standard deviation	Min.	Max.	LLC test		IPS test	
						Adj t	P-value	Adj t	P-value
Malmquist total factor productivity index									
TFPch*	132	1.017	0.153	0.54	1.711	-4.07	0.00	-6.57	0.00
Components of the Malmquist total factor productivity index									
TECHch*	132	1.001	0.160	0.54	1.69	-7.49	0.00	-6.18	0.00
PEch*	132	1.001	0.024	0.891	1.166	-4.69	0.00		
SEch*	132	1.001	0.018	0.951	1.051	-5.65	0.00	-6.59	0.00
EFFch*	132	1.002	0.033	0.865	1.157	-6.29	0.00	-6.91	0.00
Explanatory variables related to banking activity									
logCBM**	132	10.351	1.108	8.411	12.08	-0.73	0.00	-4.48	0.00
PCSE*	132	25.912	15.000	1.6	56.5	-4.63	0.00	-4.56	0.00
PCSP*	132	73.166	16.320	1.6	90	-4.52	0.00	-4.70	0.00
logPROV**	132	10.17	1.31	6.84	13.80	-4.81	0.00	-4.34	0.00
TEG*	132	9.47	3.65	1.07	16.46	-4.99	0.00	-4.13	0.00
Explanatory variables related to the macroeconomic environment									
INF*	132	2.97	3.06	-8	12.4	-7.46	0.00	-5.21	0.00
TCPIB*	132	5.50	8.77	-11.3	62.5	-30.03	0.00	-4.65	0.00
Explanatory variables related to the institutional environment									
CC**	132	-1.13	0.33	-.2.51	-41.90	-2.61	0.00	-5.33	000
QR**	132	-1.03	0.36	-1.72	0.14	-6.81	0.00	-5.99	0.00
SPAVT**	132	-1.14	0.38	-1.83	-0.05	-1.68	0.00	-5.77	0.00

* Stationary variables in level. **Stationary variables in first difference at the 5% threshold.

Source: Author

Table 3: Partial Correlation Matrix of Inputs and Outputs

	CBM	PNB	MNI	ROE	ROA
CBM	1.0000				
PNB	0.7699	1.0000			
MNI	0.6765	-0.2047	1.0000		
ROE	0.5110	0.1118	-0.1516	1.0000	
ROA	0.6361	-0.0085	0.1569	0.2390	1.0000

Source: Auteur