THE EFFECT OF BANKING COMPETITION ON FINANCIAL STABILITY IN CENTRAL AFRICAN ECONOMIC AND MONETARY COMMUNITY ZONE

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Abstract

The study investigates the effect of banking competition on financial stability in Central African Economic and Monetary Community. Financial stability is measured by bank Z-score and non-performing loans ratio. The Herfindahl Hirschman Index is used as a proxy of banking competition in both the loan and the deposit market. The study adopted the OLS, the Driscol/Kraay and the Newey-West Standard errors techniques. The results obtained in these techniques have provided a positive effect of banking competition on financial stability in the Central African Economic and Monetary Community zone. The findings of the study show that the banking sector in this region is more financially stable in competitive conditions than in highly concentrated conditions.

Keywords: banking industry; financial system; non-performing loans ratio; bank Z-score

JEL Classification: D41; E44; E51; G21; G24

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1. Introduction

Financial stability is increasingly an important goal for policymakers. The efficiency of the financial system is governed by the coherence and integrity of its core component in which the disruption of one will weaken its stability (Al Salamat and Al-Kharouf, 2021). It traces the importance of restructuring the global financial system by supporting its elements and strengthening precautionary measures at the macro and micro levels. The increasing number of financial institutions and the degree of banking competition in the Central African Economic and Monetary Community (CEMAC) zone banking sector has been a call for concern in recent years, following the 2007-2008 global financial crisis. This crisis reignited the interest of policymakers and financial analysts in examining the competition-stability nexus to set policies that could help to enhance financial stability and limit bank risk-taking (Batila Ngouala Kombo et al., 2021). It is set as a goal to avoid situations of any forms of financial crisis likely to arise from the non-abidance of prudential norms established by the banking commission of the Central African state, following uneven trends in financial sustainability and recent dynamisms in the financial market. The CEMAC banking sector has registered episodes of growth and at the same time episodes of fragilities coupled with high bank risk-taking in recent decades (Fiess et al., 2018, Batila Ngouala Kombo et al., 2021). This is interpreted to result from the non-abidance of the prudential standards put in place by the regulatory organ - Central African Banking Commission (COBAC).

Following the new reforms of the Central Bank of Central African States (BEAC) drafted in its 2017 strategic plans, the CEMAC banking commission (COBAC) aimed to establish strategic measures that could foster financial development while ensuring adequate oversight of risk factors. In this reform, COBAC (2017) highlighted the importance of maintaining an efficient risk management system that could ensure stability, following the rapid changes in the banking sectors' structure. The institutional framework for the macroprudential policy was set up in the CEMAC zone to promote financial stability following subsequent financial crises and the increase in the percentage of non-performing bank loans (Batila Ngouala Kombo et al., 2021). The establishment of the Financial Stability Committee of Central African States (CSF-AC) in 2012 was aimed at enhancing financial stability and preventing systemic risks and financial crises

(Fiess et al., 2018). This was followed by the adoption of the Rules and Procedures to run the committee of financial stability on the 17th of December 2014 in Douala. However, since 27 September 2018, these responsibilities have been transferred to the Directorate of Financial Stability, Banking Activities and Financial issues. The financial stability committee plays a regulatory and standard-setting role in the areas of public finance, credit, insurance, social welfare, capital markets and accounting. In addition, the Committee meets at least twice a year in ordinary sessions to discuss issues related to financial stability. The CEMAC banking sector has increased its bank risk, amplified by recent structural changes and a weak sectorial credit diversification. Only 18% of banks complied with the solvency ratio installed by the COBAC regulations (IMF, 2021) which act as a threat to the system's stability. The vulnerability to credit risk has been on a rise in the last two decades following an increase in unpaid debt throughout the region. The non-performing loans ratio increased from 9.1% in 2014 to 21.3% in June 2020 which it is expected to continue rising given the financial and economic challenges caused by the COVID-19 pandemic (BEAC, 2020).

Increasing non-performing loans ratio signifies high risk-taking and financial instability. Non-performing loans ratio in the assets portfolio of banks operating in the CEMAC banking sector has increased over the last two decades (Fiess et al., 2018). Following the COBAC implementation of solvency and liquidity prudential ratios as a measure of protecting the sector from crisis and instability, many banks have been reported to not abiding by the standards set by COBAC (IMF, 2017). Similarly, the CEMAC banking system has witnessed a decrease in its banks' loan portfolio quality. The sector has registered a great gap of deterioration in the quality of banks' loan portfolios, which was escalated by 189.7 billion FCFA an increase of 12.8% of outstanding receivables from 2015 to 2020 which was spurred by a rise in the rate of bad debts of 2% increase amounting to 150 billion FCFA (BEAC, 2020). Meanwhile, they registered an increase in long-term receivables by 21.1% or 69.7 billion FCFA. The CEMAC's banking sector has been struggling to a great effect with poor asset quality since the global decline of oil prices in its region in 2014 (World Bank, 2018).

The CEMAC banking sector is exposed significantly to systemic risk, both directly through banks' exposure to sovereign debt, reported having amounted to about 15% of total banking assets as of September 2020 and indirectly through government ownership of

banks (state-own banks) within the CEMAC zone which represents about 16% of total bank assets as of September 2020 (IMF, 2021). The CEMAC banking system faces an intensification of risk exposure factors related to political tensions and the fall in commodity prices due to the weak policy transmission channels in the system (Fiess et al., 2018). As part of the propositions made in the BEACs 2017-2021 strategic plan, measures have been taken to enhance risk-orientate supervision and address several banks in difficulty to ensure financial stability (Calderon et al., 2019). The CEMAC member countries have registered an unwanted debt over the years. Debt vulnerabilities have increased given the weakening of the system's fiscal position relative to the other banking sectors. The region's total public debt increased to an estimated 57% of GDP as of December 2020 from 52% in 2019 with a rise in its external debt to about 38% of GDP, from 32% in 2019. It has been forecasted by the international monetary fund that the CEMAC region's debt to GDP ratio will remain elevated at above 50% through 2024 due to the sector's financial difficulties. According to an IMF report (IMF, 2018), there are enormous disparities across the CEMAC banking sector on meeting the COBACs prudential ratios of which 4 banks in Cameroon with about 13% of their total bank assets are in distress and 3 of those banks have a negative capital.

The inefficiency in bank assets and liquidity management from individual banks has exacerbated bank risk due to the climate change of businesses, information asymmetry, and the lack of collateral which has contributed largely to the high lending rates and thus leads to financial instability in the system (Calderon et al., 2019). As a consequence, banks' inability to efficiently manage and access customers' default risk and the viability of the private-sector project before financing, has created a doubtful business environment in the CEMAC banking sector. The state’s medium and long-term debt sustainability requires a strong commitment to fiscal consolidation, effective resource allocation and mobilization, transparent debt management and good governance which is not the case with the CEMAC institution as they are reported not to be working in correspondence with the COBAC and the region’s policy objectives. COBAC (2017) reported that the irregularities in the financial sector are a result of fewer entry restrictions in the banking sector which has raised the level of competition and affected the quality of financial services offered. Therefore, the study has drawn inspiration from the structural changes in the CEMAC banking sector since the creation of

the regulatory body in 1992 to determine the effect of banking competition on financial stability.

This paper contributes to the field of research in the following ways: Firstly, to the best of our knowledge, this is the first research work to investigate precisely the effects of banking competition on financial stability in the CEMAC zone. Secondly, this study has taken a different dimension of measuring banking competition, which is done by computing the HHI in both the loan and the deposit market to have a proper measure of market concentration which is rare in literature as it is not the case in some studies (e.g., Moudud-Ul-huq et al., 2020 and Petria et al. 2015). Thirdly, the study has taken into account a historical dimension of the CEMAC member states by creating a dummy variable representing the different colonial masters that colonized the different states in the CEMAC zone to determine how colonization affects finances, which has not been seen in past studies. Lastly, the study has taken into account five dimensions of variables (System specific, Bank specific, Macroeconomic, Institutional variables and a Historical dimension) measuring their effects on financial stability unlike the three dimensions taken in most studies like that of Shair et al. (2019), Moudud-Ul-huq et al. (2020) and Jiménez et al. (2013).

The rest of the paper is organized as follows: Section 2 reviews the relevant theoretical literature and empirical findings on the relationship between banking competition and financial stability, Section 3 presents research methodology, Section 4 presents the study results and discussion, and Section 5 presents the conclusion and policy recommendations.

2. Literature review

Several works on banking competition have focused on both the structural measures used in the traditional industrial theories of market power and competition and the non-structural approaches of the New Industrial Organization framework to assess the relationship between banking competition and financial stability. Following the opposing results obtained from different research works, the relationship between banking competition and financial stability remains unclear and inconclusive according to Boyd and De Nicolo (2005). They also developed a model challenging the previous researchers on the franchise paradigm value. According to Boyd and De Nicolo (2005), the degree of banking competition ramifications on

financial stability depends on different bank-specific and system-specific factors which can either have a positive or a negative relationship on bank risk-taking and financial stability.

Primarily, the structure of the banking system determines banking concentration and competition which in turn tends to determine banks' performance and bank risk-taking as viewed in the works of Boyd et al. (2009) integrating the SCP paradigm into the study of banking competition and its impact on bank risk-taking. Due to the differences in the banking industry market structures, banking sectors in the developing countries have seen the level of their banking competition change as a result of increased financial innovation and market structural changes which has had a great impact on bank risk-taking (Gonzalez et al., 2017). From the inconclusive theoretical review on banking competition, it can be viewed that structural changes have different effects on developing countries' banking sectors as compared to the developed economies since they differ in terms of competition and concentration. According to the SCP paradigm, bank risk-taking behaviour is influenced by its conduct, since the bank's conduct is highly determined by its structure and its performance. According to Pricillia (2015) the relationship between market structure, banks conduct and performance led to the conclusion that bank risk-taking behaviour is determined by its structure and performance which to a greater extent determines banking competition and financial stability.

Some substantial empirical works emerged in recent decades examining the relationship between competition and financial stability across countries but still with the volume of studies carried out, there is still no consensus on the nature of the relationship between competition and financial stability. The main idea in the competition-stability paradigm or hypothesis is that banking competition could enhance financial stability and reduce bank risk-taking while competition-fragility is the contrary which signifies that competition increases bank risk-taking and renders the system unstable.

Bașar et al. (2021) conducted a study on the impact of competition on financial stability by assessing bank risk-taking in 10 Latin American countries between 2003 and 2008. The authors adopted the Boone indicator (Boone, 2008) as a measure of competition and concluded that there is a linear relationship between competition and financial stability. Maji and Hazarika (2018) in a study conducted in the Indian banking sector for 15 years used secondary data from banks' "Capitaline Plus" corporate database collected on 39

listed Indian commercial banks and found out that there is a linear relationship between banking competition and financial stability.

Alhassan and Biekpe (2018) employed annual bank-specific data for 79 banking firms to estimate the Lerner index as a measure of competition, whereas the bank z-score is employed as a proxy for financial stability and obtained results showing a positive relationship between competition and financial stability. Similarly, Kasman and Kasman (2015) analyzed the impact of banking competition on financial stability in the Turkish banking industry over the period 2002-to 2012. They obtained results showing a positive relationship between banking competition and financial stability. Schaeck and Cihák (2014) conducted a study on banking competition and its effect on financial stability and risk-taking in the Eurozone from 1995 to 2005 and obtained a positive relationship between competition and financial stability. They also argued that banking competition and financial innovation improve the efficiency of customer screening and monitoring which enhances financial stability.

Contrary to studies in support of the competition-stability paradigm, some researchers have obtained results supporting the SCP paradigm. Among such studies is the study carried out by Tongurai and Vithessonthi (2020) in the Japanese banking system from 1993−to 2016 with a case study on 1461 financial institutions where they obtained results showing that higher levels of competition in the Japanese banking system are associated with bank loan growth and increase bank risk. Similarly, Turusbekova et al. (2020) examine the relationship between competition and stability in the Kazakh banking sector using quarterly bank-level data of private commercial banks from 2007-to 2013 and found that competition between Kazakh banks deteriorates banks stability. Likewise, Albaity et al. (2019) in a study carried out on 276 banks in the Middle East countries from 2006 to 2015, showed that there is a negative relationship between competition and financial stability. According to the findings of Moudud-Ul-Huq et al. (2020), in a study carried out on several banks in newly industrialized countries precisely BRICS banks, banking competition in BRICS countries (Brazil, Russia, India, China and South Africa) decreases banks' profit margin and erodes bank’s franchise value which is an obvious indication of risk exposure. Similarly, Li et al. (2019) in a study carried out in 118 countries between 2001 and 2016 utilizing financial information of 7620 banks, find that banks exhibit lower risk-taking as a result of high market power (low level of

competition) which increases financial stability. According to Degl'Innocenti et al. (2019) in a study conducted on 116 investment banking firms operating in five developed countries including France, Germany, Italy, Switzerland, England, Japan and US, investment banks in these countries are faced with higher risk exposures when the banking sector is more competitive, and which leads to instability.

3. Research methodology

3.1. Model specification

The study assesses the effect of banking competition on financial stability in the CEMAC zone. The study employs panel data for a period of 11 years and a linear econometrics model. Four categories of independent variables are employed which are the banking competition, bank-specific, macroeconomic, and institutional variables with a dummy variable of colonization. The dimension of institutional and a dummy variable of colonization are added to the three dimensions of variables used in the works of Jiménez et al. (2013).

$$\begin{aligned} &Stability_{it} \\ &= f(Competition_{it}, Bank\ specific\ variables_{it}, Macroeconomic\ variables_{it} \\ &+ institutional\ variables_{it}, dummy_{it}\ variables) \end{aligned} \quad (1)$$

The variables of these dimensions are presented in equation 2.

$$\begin{aligned} FS_{it} = \beta_0 &+ \beta_1 HHI_{it} + \beta_2 Size_{it} + \beta_3 ROA_{it} + \beta_4 Loan_{it} + \beta_5 Cap_{it} \\ &+ \beta_6 GDPPC_{it} + \beta_7 INF_{it} + \beta_8 CCR_{it} + \beta_9 CDM1_{it} \\ &+ \beta_{10} CDM2_{it} + V_{it} \end{aligned} \quad (2)$$

Where: i and t - individual countries and time, respectively; FS - financial stability measured by bank z-score and non-performing loans ratio; *HHI* - Herfindahl index, *Size* - bank size; *ROA* - return on assets, *Loan* - loans ratio; *INF* – inflation rate; *GDPPC* - gross domestic product per capita; *CCR* - control of corruption; *CDM1* and *CDM2* - the French and the Portuguese colonization dummy variables, respectively; *V* - the error term.

3.2. The choice and justification of variables

The selected variables used in this study are inspired from the available empirical works carried on the relationship between competition and financial stability. Different indicators have been used to measure banking competition and financial stability depending on the banks specific and the banking sector features.

Dependent variable

- ***Bank z-score*** measures financial stability and is computed as (Return on asset + Return on equity) / (Standard deviation of return on assets). A higher Z-score implies a lower probability of insolvency and high stability. Bank Z-score is widely used in literature to measure financial stability. The measure of financial stability used here is inspired from the works of Fang et al. (2014), Boyd and De Nicolo (2005) and the works of Jiménez et al. (2013).
- ***Non-performing loans ratio*** is the ratio of non-performing loans to gross loans. It is a loan that is subjected to late repayment or is unlikely to be repaid due to customers default either partly or in full. Non-performing loans is mostly used in literature as an indirect measure of financial stability and a direct measure of risk-taking. The inspirations of adopting non-performing loans ration as an indicator of financial stability are from the works of Schaeck and Cihák (2014), Kasman and Kasman (2015).

Independent variables reflect the different variables that can have an influence on banks financial stability which will be divided into banking competition, bank specific, macroeconomic, institutional variables and a dummy variable of colonization.

- ***Banking competition*** is the main independent variable which the study is aimed at determining its effects on financial stability. The study employs the measure of competition both in the loan and the deposit market inspired from the works of Tan et al. (2017) and Akins et al. (2016) by employing the Hirschman Herfindahl index (HHI); it is a direct measure of market concentration and an inverse measure of banking competition. It is calculated as the square root of the market share of all banks in the banking industry or the ratio of the highest market share in an industry to the total market share (Akins et al., 2016). Market share in the banking industry is either calculated by using bank loans or deposit. The study applies bank deposit to measure market share in the deposit market inspired from the works of Bahri and Hamza (2020), Akins et al. (2016), Adjei-Frimpong et al. (2016) and Petria et al. (2015) and loans in the loan market inspired from the works of Tan et al. (2017).

35. $HHIdeposit = \sum_{j=1}^{J} \frac{Deposit_{z,j}}{Deposit_z}$ (3)

36. $HHIloans = \sum_{j=1}^{J} \frac{Loans_{z,j}}{Loans_z}$ (4)

Where: *HHIdeposit* is the Herfindahl index in the deposit market and *HHIloans,* in the loan market; $Deposit_{z,j}$ - the highest deposit of a bank in the deposit market (z) by an individual bank *j*; $Deposit_z$ - the total deposit of all the banks; $Loans_{z,j}$ - the highest loan of a bank in the loan market (z) by an individual bank *j*; $Loans_z$ - the total loans of all the banks in market z.

- ***Banks specific variables*** are banks' control variables that might affect financial stability and since a bank business model may influence the banking sector stability. We included a number of bank-level variables which are widely used in literature.

Bank Size is measured as the natural logarithm of the value of total assets. Bank size can either have a positive or negative relationship on financial stability. It has been used by Tongurai and Vithessonthi (2020) to measure its effects on financial stability.

Return on assets (ROA) shows the percentage of how profitable bank's assets are in generating revenue. ROA is computed as: ROA= (Net Income)/ (Average Total Assets). It is inspired from the works of Tongurai and Vithessonthi (2020).

Loans ratio is measured by the ratio of total loans to total assets. The loan ratio measures total loans outstanding as a percentage of total assets. The coefficient of this factor is expected to be either negative or positive. It is inspired from the works Athari and Bahreini (2021).

Capitalization. The ratio of shareholders' equity to total assets is considered as a proxy of capitalization. It is also calculated as banks capital divided by the current market value of banks asset. There are no exact prior expectations regarding the sign of the capitalization coefficient. Its inspirations are drawn from the works of Tan et al. (2017), Athari and Bahreini (2021).

- ***Macroeconomic variables.*** To control for business cycle variables that can have an influence on financial stability, we include two variables which are gross domestic product per capita and inflation.

Gross domestic product per capita (GDPPC) is used to capture income levels and economic growth of an economy. It can influence financial stability depending on the economy in which the banking

sector belongs. According to Liu et al. (2011), GDPPC is employed to capture movements in business cycle.

Inflation is used as a macroeconomic variable to capture the effects of macroeconomic shocks on financial stability and banks' balance sheets. Inflation is measured as the percentage change in consumer prices and also as GDP deflator. The study employs GDP deflator as a measure of inflation inspired from the works Petria et al. (2015).

- ***Institutional variables***

***Corruption*.** Control of corruption is a governance indicator which captures the perception of the extent to which public power is being exercised for private gain, including all petty and grand forms of corruption. It also captures the state of elites and private interests, irregular payments in public utilities, tax collection in public contracts, corruption between administrations and businesses. Its inspiration is drawn from Yin and Zhang (2019).

Historical dimension

A dummy variable of colonization. All countries in the CEMAC zone were colonized by France except for Equatorial Guinea that was colonized by Portugal and Cameroon jointly colonized by the French and the British. All former French colonies take the value 1 while the Portuguese territory takes the value 0 for the first dummy variable of the study. The second dummy variable of colonization is that of the Portuguese colony where Equatorial Guinea takes the value 1 and the French colonies take the value. The inspirations to determine the effect of colonization on financial stability is drawn from the work of EbereNwazonobi et al. (2020).

3.3. The nature and source of data

The study employs secondary data obtained from IMF database, World Development Indicators (WDI), Worldwide Governance Indicators (WGI) and BEAC data on bank's financial statement. The study is carried out in the CEMAC zone. The data collected on variables used in the study is consistent from 2010 to 2020. A dummy variable of colonization is added to the secondary data collected. The dummy values are 1 for the required character and 0 if not. The study is limited to the specified period due to the unavailability of data.

Table1

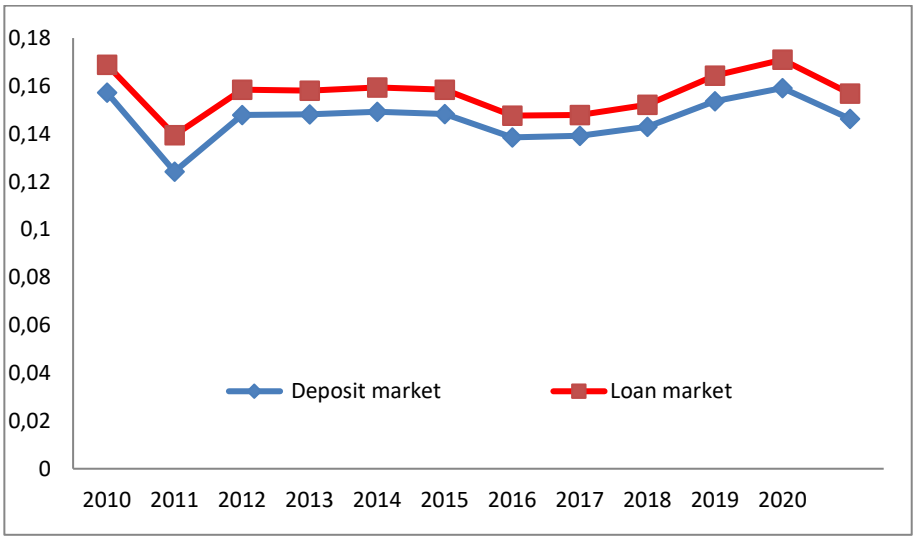
Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Z-score	66	6.261	2.861	0.658	15.256
NPL	66	0.165	0.098	0.015	0.465
HHIloans	66	0.228	0.101	0.032	0.456
HHIdeposit	66	0.15	0.097	0.028	0.364
ROA	66	0.019	0.01	-0.013	0.05
size	66	14.166	1.016	11.951	15.623
Loan	66	0.671	0.157	0.4	1.4
Cap	66	0.175	0.098	-0.028	0.422
CCR	66	-1.233	0.279	-01.83	-0.66
GDP	66	-1.635	6.873	-36.557	9.826
INF	66	142.337	22.271	108.438	193.364
CDM	66	0.54	3.56	0	1

Source: Analysed using STATA (14)

Bank Z-score that measures financial stability ranges between 0.658 and 15.256. The highest Z-scores values belong to countries that are more competitive while the highest NPL ratio whose values ranges between 16% and 9% belong to the countries whose markets are less competitive. The Herfindahl index is a direct measure of market concentration. Low values of the Herfindahl index signify high levels of competition and higher values signify low levels of competition. The average evolution of the Herfindahl index (HHI) in both the loan and the deposit market in the CEMAC zone has shown an averagely decreasing trend from 2010 to 2011, 2013 to 2016 and 2019 to 2020 (see Figure 1). The decreasing HHI shows that banking competition is rising in the CEMAC region within the observed period from 17% averagely in 2010 to below 15% in 2020 in the loan market and 15.8% to 14.2% in the deposit market. This has been confirmed with the statistics provided by the regulatory body COBAC in 2017 with an increasing number of banking firms from 30 in 1999 to 48 in 2012 and to 53 in 2017 which is an obvious indicator of an increased banking competition. The CEMAC banking sector has realized an increase in its banking firms from 30 in 1999 to 53 in 2017 (COBAC, 2017 report).

Figure 1
The evolution of banking competition in the CEMAC zone measured by the HHI[1]



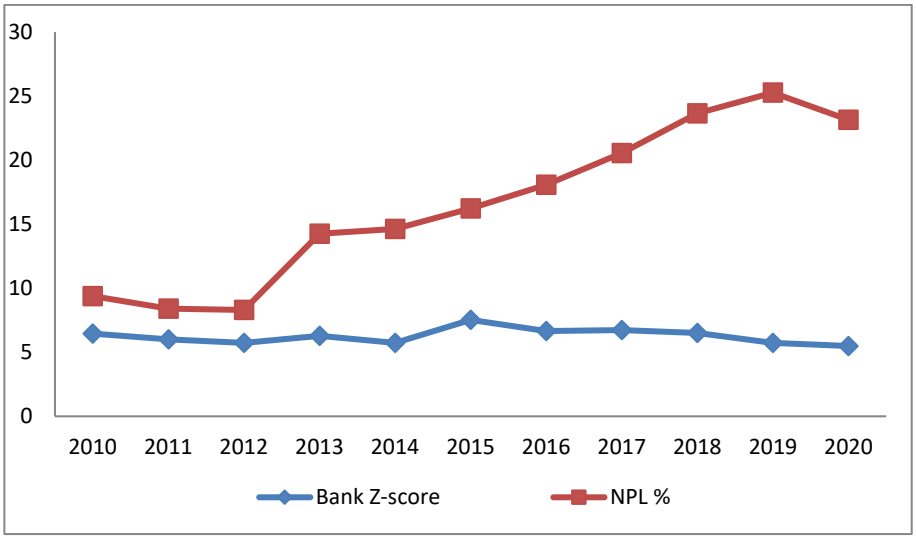
Source: Authors' compilation from BEAC data, 2021

The evolution of financial stability measured by bank Z-score and the non-performing loans is shown in Figure 2. Figure 1 also depicts similar trends of the Herfindahl concentration index in both the loan and the deposit market. The statistics provided by BEAC database shows fluctuations in the Herfindahl index. The HHI of the loan market decreases from 0.1689 in 2010 to 0.1565 in 2020. Similarly, the concentration ratio of the deposit market decreases from 0.1572 in 2010 to 0.1461 in 2020. According to the BEAC Report (BEAC, 2020), the CEMAC banking sector has become less concentrated in recent years due to the increasing number of financial institutions in the financial sector. According to this same report, CEMAC countries whose markets are less concentrated (e.g. Cameroon, Gabon and Congo) are more financially stable than countries whose markets are highly concentrated (e.g. Central African Republic and Equatorial Guinea).

[1] *The study employs data collected from the Central Bank of Central African States to compute the Herfindahl index both in the loan and the deposit market as seen in the works of Bahri and Hamza (2020) and Akins et al. (2016).*

Figure 2

The evolution of financial stability[2] in the CEMAC zone



Source: Authors' compilation from BEAC and IMF (2021) data

3.4. Estimation technique

This section presents the method and the techniques of analysis. The econometric model is estimated using the ordinary least square (OLS). Due to the limitations of the OLS not addressing the concern of causality, cross-sectional dependence and the problems related to the error term, the Driscoll/Kraay is adopted to address the potential problem of cross-sectional dependence identified by the Frees test presented in Table 2. The Newey-west standard errors (NWSE) technique accounts for autocorrelation of errors and heteroscedasticity (Bertrand et al., 2004, Kolokotrones and Stock, 2019). The autocorrelation of errors and heteroscedasticiy are identified by the Wooldridge and Breusch-Pagan test presented in Table 3. For the robustness analysis, the sample size is reduced by selecting the countries belonging to the lower-income distribution group as classified by the World Bank in 2020: Cameroon, Chad, Central African Republic and Congo while excluding Gabon and

[2] *Financial stability is measured by Bank Z-score as its direct measure and the Non-performing loans as its inverse measure. Financial stability increases with an increasing Z-score and a decreasing NPL ratio.*

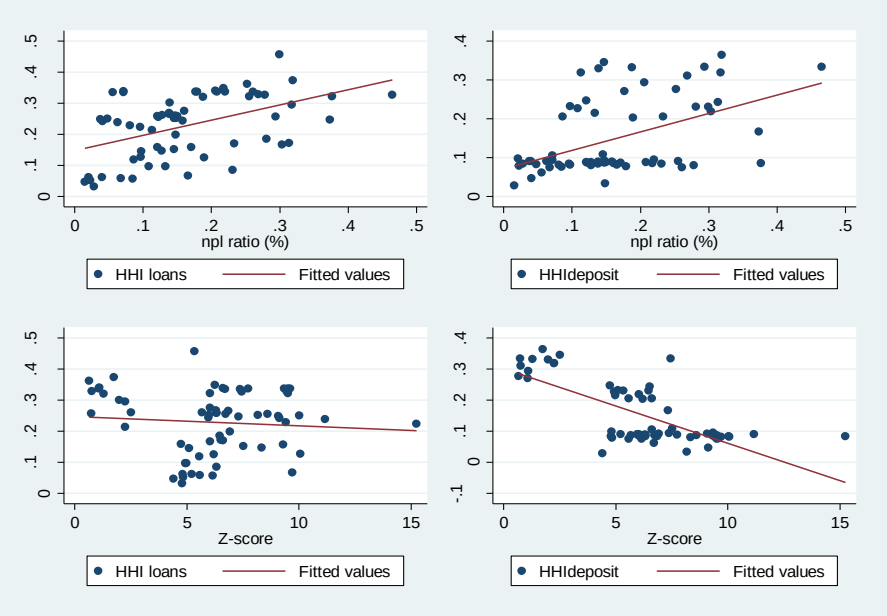
Equatorial Guinea who belong to the high income and middle-income countries respectively. The OLS and the 2SLS techniques are applied with the latter aimed to address the potential endogeneity problem that may arise as a result of the correlation between bank-specific and industry variables. It also takes into account a potential correlation between the error term and the study variables.

4. Results and Discussion

The Herfindahl index (HHI) is employed as an inverse proxy of banking competition in both the loan and the deposit market. Financial stability is measured by the bank's Z-score and the NPL ratio. Bank Z-score has a negative relationship with HHI in both the loan and the deposit market, while HHI has a positive relationship with the NPL ratio in both markets as presented on the scatter plot below**.**

Figure 3

The relationship between financial stability and banking competition in the CEMAC zone (graphical presentation)



Source: Author's compilation from BEAC's and IMF (2021) data

This negative relationship shows that banks in the CEMAC zone within the study period are more financially stable when the banking sector is less concentrated**.** This signifies that financial stability increases with an increasing banking competition and decreases with an increasing market concentration. NPL is an indirect measure of financial stability. It is computed as the ratio of non-performing loans to total loans. This relationship has given a hint on a positive effect of competition on financial stability in the CEMAC banking sector but will be confirmed as well in the estimated results.

The Wooldridge test of autocorrelation shows that errors are correlated in both equations of the bank's Z-score and NPL. The result of the test is presented in Table 3. The null hypothesis of no autocorrelation is rejected which signifies the existence of autocorrelation of errors. The result obtained after carrying out the Breusch-Pagan test shows that there is the presence of heteroskedasticity in all the equations of Z-score except for NPL equations. The presence of autocorrelation and heteroskedasticity justifies the adoption of the Newey-West Standard errors technique to address the error term related problems. The result of the heteroskedasticity test is presented in Table 3. Multicollinearity is examined using the Variance inflation factor (VIF) which measures the degree of multicollinearity in a set of multiple variables. There is evidence of the multicollinearity problem if the average VIF for all variables is greater than 6 and the largest individual VIF is greater than 10 (Saadi, 2020). Determining the problem of multicollinearity of the whole model, we can conclude that there is no multicollinearity since all the mean VIF values are less than 6 as recommended by Saadi (2020). Based on the Frees (1995) cross-sectional dependence test, reported in Table 2, we reject beyond the critical value (1%) with the assumptions of cross-sectional independence. From the results obtained after carrying out the Frees test of cross-sectional dependence, we reject the null hypothesis of cross-sectional independence. Based on the Frees (1995) cross-sectional dependence judgment, it, therefore, implies that there is the presence of cross-sectional dependence in the model which can be addressed by the Driscoll/Kraay estimator.

Table 2

The effect of banking competition on financial stability in the CEMAC zone (Driscoll/Kraay)

Variables	(1) LnZscore	(2) LnZscore	(3) LnNPL	(4) LnNPL	(5) LnZscore	(6) LnZscore	(7) LnNPL	(8) LnNPL
LnHHIloan	-0.222**		0.657***		-0.226**		0.482***	
	(0.0995)		(0.118)		(0.0898)		(0.117)	
LnHHIdep		-0.385***		0.653***		-0.369***		0.688***
		(0.0926)		(0.123)		(0.0936)		(0.117)
LnROA	-0.166	-0.124	-0.158	-0.324***	-0.190*	-0.119	-0.200	-0.356***
	(0.103)	(0.0893)	(0.123)	(0.118)	(0.104)	(0.0903)	(0.135)	(0.113)
Lnloan	0.493*	0.763***	1.090***	0.709**	0.455*	0.727***	1.081***	0.589*
	(0.271)	(0.258)	(0.321)	(0.341)	(0.268)	(0.263)	(0.349)	(0.328)
Size	-0.712***	-0.738***	0.0243	0.184	-0.703***	-0.702***	0.215*	0.230**
	(0.108)	(0.0922)	(0.128)	(0.122)	(0.0987)	(0.0902)	(0.128)	(0.113)
Lncapit	0.0872***	0.0590***	-0.00634	0.0442***	0.0878***	0.0590***	-0.00826	0.0463***
	(0.0108)	(0.0117)	(0.0129)	(0.0154)	(0.0107)	(0.0118)	(0.0139)	(0.0147)
CCR	2.650***	1.942***	-1.815***	-0.673	2.719***	1.983***	-1.844***	-0.474
	(0.291)	(0.321)	(0.346)	(0.425)	(0.290)	(0.330)	(0.377)	(0.413)
GDPPC	-0.0153	-0.0111	-0.0363***	-0.0354***	-0.0188*	-0.00914	-0.0227*	-0.0400***
	(0.0113)	(0.0103)	(0.0135)	(0.0137)	(0.0105)	(0.0102)	(0.0137)	(0.0128)
inflation	-0.0855***	-0.0764***	-0.000552	-0.0217	-0.0825***	-0.0795***	-0.0140	-0.0198
	(0.0186)	(0.0168)	(0.0220)	(0.0223)	(0.0179)	(0.0167)	(0.0233)	(0.0209)
CDM1	-0.322	0.194	0.946***	-0.364				
	(0.254)	(0.188)	(0.301)	(0.249)				
CDM2					0.397*	-0.0420	-0.248	0.645***
					(0.221)	(0.183)	(0.288)	(0.229)
Constant	12.68***	11.68***	-3.667**	-3.445*	12.31***	11.50***	-5.348***	-4.142**
	(1.460)	(1.346)	(1.733)	(1.782)	(1.451)	(1.376)	(1.886)	(1.719)
Obs	64	64	64	64	64	64	64	64
R-squared	0.770	0.810	0.725	0.716	0.776	0.806	0.679	0.742
Number of ID	6	6	6	6	6	6	6	6
Frees test	0.077	0.187	0.293	0.074	0.041	0.632	0.032	0.716
thta_95	0	0	0	0	0	0	0	0

*Notes: Standard errors in parentheses; ***, ** and * Denote significance level at 1%, 5% and 10%. Zscore= Bank z-score, NPL= non-performing loans ratio, HHIloan and HHIdep represent the Herfindahl Index in the loan and the deposit markets respectively, SIZE= bank size measured by banks' assets, ROA= return on assets, Loan= loans ratio, INF- the rate of inflation, GDP= gross domestic product per capita, CCR= control of corruption, CDM1 and CDM2: represents the French and the Portuguese colonization dummy variables respectively.*

The results presented in Table 2 are that of the Driscoll/Kraay estimator which takes into consideration the potential cross-sectional dependence problem indicated by the Frees (1995) test presented in Table 2. From the Frees test of cross-sectional dependence, we reject the null hypothesis of cross-sectional independence. The problems of

heteroscedasticity and autocorrelation of errors tested by the Wooldridge and Breusch-Pagan tests led to the application of the Newey-West Standard Errors (NWSE, Table 3 results) technique which addresses problems related the error term (Bertrand et al., 2004, Kolokotrones and Stock, 2019). The techniques of estimation applied in the study addressed the different related estimation issues that could cause the biasness of the results.

Table 3

The effect of banking competition on financial stability in the CEMAC zone (NWSE)

Variables	(1) Ln Z-score	(2) Ln Zscore	(3) LnNPL	(4) LnNPL	(5) Ln Zscore	(6) Ln Zscore	(7) LnNPL	(8) LnNPL
LnHHIloan	-0.222*		0.657***		-0.226**		0.482**	
	(0.121)		(0.135)		(0.0997)		(0.188)	
LnHHIdep		-0.385***		0.653***		-0.369***		0.688***
		(0.0833)		(0.157)		(0.0815)		(0.164)
LnROA	-0.166	-0.124	-0.158	-0.324***	-0.190	-0.119	-0.200*	-0.356***
	(0.119)	(0.108)	(0.103)	(0.0906)	(0.121)	(0.108)	(0.102)	(0.0999)
Lnloan	0.493*	0.763***	1.090***	0.709**	0.455*	0.727***	1.081**	0.589**
	(0.280)	(0.257)	(0.310)	(0.283)	(0.265)	(0.250)	(0.425)	(0.281)
Size	-0.712***	-0.738***	0.0243	0.184	-0.703***	-0.702***	0.215	0.230*
	(0.175)	(0.152)	(0.137)	(0.133)	(0.146)	(0.146)	(0.212)	(0.127)
Lncapit	0.0872***	0.0590***	-0.00634	0.0442**	0.0878***	0.0590***	-0.00826	0.0463**
	(0.0135)	(0.0136)	(0.00995)	(0.0181)	(0.0133)	(0.0132)	(0.0108)	(0.0183)
CCR	2.650***	1.942***	-1.815***	-0.673	2.719***	1.983***	-1.844***	-0.474
	(0.363)	(0.389)	(0.505)	(0.544)	(0.348)	(0.376)	(0.516)	(0.551)
GDP	-0.0153	-0.0111	-0.0363***	-0.0354***	-0.0188	-0.00914	-0.0227*	-0.0400***
	(0.0127)	(0.0127)	(0.0112)	(0.0116)	(0.0127)	(0.0113)	(0.0129)	(0.0107)
inflation	-0.0855***	-0.0764***	-0.000552	-0.0217	-0.0825***	-0.0795***	-0.0140	-0.0198
	(0.0138)	(0.0119)	(0.0234)	(0.0226)	(0.0129)	(0.0118)	(0.0287)	(0.0176)
CDM1	-0.322	0.194	0.946***	-0.364				
	(0.382)	(0.230)	(0.300)	(0.306)				
CDM2					0.397	-0.0420	-0.248	0.645**
					(0.304)	(0.203)	(0.468)	(0.285)
Constant	12.68***	11.68***	-3.667*	-3.445*	12.31***	11.50***	-5.348*	-4.142**
	(2.046)	(1.946)	(2.098)	(2.051)	(1.919)	(1.977)	(3.086)	(2.024)
Observations	64	64	64	64	64	64	64	64
Wooldridge	0.0092	0.0029	0.0005	0.0050	0.0071	0.0020	0.0005	0.0051
Breusch-Pagan test	0.0125	0.0024	0.3383	0.2050	0.0127	0.0021	0.569	0.0574
Rank	10	10	10	10	10	10	10	10

*Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10. CDM1 and CDM2 signify the dummy variable of the French and the Portuguese former colonies respectively. The first four equations contain the French former colonies while the last four represents that which takes into account the Portuguese former colony.*

The result presented in Table 3 according to Kolokotrones and Stock (2019) is one of the best techniques to address the error term related problems like autocorrelation and heteroscedasticity.

The application of the Dricoll/Kraay and the Newey-West Standard errors as techniques of estimations is guided after carrying out Frees tests of cross sectional dependence in Table 2, realizing that there exist a cross sectional dependence, Breusch-Pagan test for heteroskedasticity (Table 3), the multi-colinearity test in appendix 5 and the Wooldridge autocorrelation tests presented in Table 2 whose results indicated some problems related to the error term. The various coefficients of determination of the model in appendix 1 as well as in Table 2 are between 68% and 81% suggesting a good quality adjustment of the model. The Probability associated with the values of Fisher for both equations are significant at 1% which shows that the model is well estimated and globally significant.

The Herfindahl index is a direct measure of market concentration and an inverse measure of banking competition. It is statistically significant at 1% and 5% levels and affects financial stability negatively in both the loan and the deposit markets. From the results obtained above, the bank z-score decreases with an increasing HHI in both equations of Z-score in the loans and the deposit market, and NPL increases with an increasing HHI in both equations of NPL. It signifies that financial stability in the CEMAC zone decreases with an increasing market concentration and a decreasing banking competition. The negative relationship between the Herfindahl index and financial stability measured by the bank Z-score indicates that banking competition is positively related to financial stability which is accredited to the recent financial development in the CEMAC zone. The result is in conformity with the findings of Akins et al. (2016), and Turk-Ariss (2010) and contradicts that of Fang et al. (2014). The HHI has a positive and a statistically significant effect on non-performing loans at a 1% significance level. It is employed in literature as an inverse measure of financial stability. This signifies that the ratio of non-performing loans increases with an increasing market concentration and a decreasing banking competition which renders the CEMAC banking sector unstable. It, therefore, signifies that banking competition is preferable in the CEMAC zone since an increased market power increases the ratio of non-performing loans. This result is in conformity with the results of Akins et al. (2016) and contradicts that of Fang et al. (2014). The positive relationship between banking

competition and financial stability is in conformity with the results obtained in some studies such as in the works of Kasman and Kasman (2015), Fiordelisi and Mare (2014) Turusbekova et al. (2020) and Başar et al. (2021). These results support the competition-stability view of Boyd and De Nicoló (2005). The finding of the study shows that financial stability in the CEMAC zone increases with an increasing degree of competition. The result contradicts the findings of Fang et al. (2014) and Hope et al. (2013).

Bank return on assets is used in literature as a measure of a bank's profitability. It has a positive and statistically significant effect on financial stability at a 1% level for equations 5 and 6 of the bank Z-score. This finding is consistent and in line with the literature and the argument behind the negative relationship between return on assets and financial stability is based on the fact that a bank's profitability leads to individual bank stability which brings about financial stability to the banking sector. There is a negative relationship between non-performing loans and return on assets at a 1% significance level for both equations on non-performing loans. It implies that the ratio of non-performing loans to total loans of banks in the CEMAC zone falls as their returns on assets increase. Bank size is measured by the natural logarithm of total assets. Bank size has a negative and statistically significant effect at 1% as seen in Equations 1 and 2 of bank Z-score but appeared to be insignificant on other equations of Z-score. According to the competition-stability advocates, bank size decreases in competitive markets which are likely to be more financially stable than in the less competitive market. Banks increase their risk-taking when they grow large in size seeking high profit which can lead them to engage in risky activities and thus putting the aspects of the sector stability into perspective. The coefficient of bank size is statistically significant at 1% and positively affects non-performing loans which imply that the non-performing loan ratio in the CEMAC zone increases with increasing bank assets. This result is consistent with the findings in the literature and is in conformity with the findings of Yin (2019), Hope et al. (2013), Kasman and Kasman (2015).

The rate of inflation harms financial stability at 1% significance level for bank Z-score and non-performing loans equations. The negative effects of inflation on financial stability is justifiable in literature based on the stand that an increase in lending rate leads to a reduction in the value of money as it increases the cost of capital which may lead to a decrease in the demand for money bringing about financial panic

to banks mostly depending on interest paid on loans to finance their activities. The result of Doan et al. (2020) and Fang et al. (2014) supports the findings of the study. Conversely, inflation has a negative and significant effect on the ratio of non-performing loans which signifies that the ratio of non-performing loans increases with an increasing rate of inflation and thus renders the economy unstable if measures are not taken to resolve its effects. The negative relationship between non-performing loans and the inflation rate is supported with the findings of Fang et al. (2014). Economic growth measured by gross domestic product per capita has a negative and statistically significant effect at a 1% for equation 5 of bank Z-score. This signifies that the CEMAC zone becomes more financially stable when gross domestic product decreases and less stable when it increases. Conversely, there is also a negative effect of GDPPC on non-performing loans at 1% significance for all its equations except equation 8, which shows that non-performing loans increases with a decrease in gross domestic product per capita. This contradicts the results of the first equation but is justifiable if banks charge higher rates in periods of economic boom that could cause customers inability to refund their loans at the maturity date and otherwise if bank customers fulfill their commitments during or before the maturity date. This result conforms to the findings of Fang (2014), Kasman and Kasman (2015).

The findings on the positive effects of corruption control on financial stability shows that the CEMAC banking system becomes more stable when the anti-laws of corruptions are implemented and put into practice. Control of corruption shows a 1% significant effect on bank Z-score and a negative statistically significant effect at 1% level for both equations of NPL ratio. The findings are supported by the works of Yin (2019) and Yin and Zhang (2019) whose findings reveal a positive relationship between control of corruption and financial stability. The dummy variable of French colonization (CDM1) is negatively related to financial stability measured by bank-score, but appeared to be insignificant and has a statistically significant positive effect on non-performing loans at a 1% in equation 3. Relatively, the dummy variable of the Portuguese colonization affects financial stability negatively as shown by its positive and significant effect on NPL at 1%. The CEMAC countries that were colonized by the French are more financially stable than Equatorial Guinea colonized by the Portuguese as shown by the Z-score values provided by the World Bank Z-score which presents Cameroon and Gabon with the highest

score. It shows that the colonial rule in the CEMAC zone has brought about stability in the French colonies than in the Portuguese colony. The finding of the positive effect of colonization is supported with the works of EbereNwazonobi et al. (2020) who argued that colonialism was a mix blessing to the African economy and is the reason behind African financial development and integration to the world financial system.

Robustness analysis of the study is done by using the recent World Bank classification of countries (in 2021) into different income groups. The CEMAC states that belong to the high and the middle-income groups are Gabon and Equatorial Guinea respectively. Cameroon, Congo, Chad and the Central African Republic belong to the low-income groups. The robustness analysis is conducted in the low-income countries by applying the ordinary least square (OLS) and the 2SLS to take into consideration the potential problem of endogeneity which may occur as a result of the correlation between the predictor and bank specific variables. The result of the robustness analysis is presented in Table 4.

From observations, the signs of the explanatory variables remained consistent with the two techniques of estimation (OLS in appendix 2 and the 2SLS in Table 3). The only change is the significance level. There still remained a negative effect of HHI on Z-score in both the loan and the deposit market, and a positive effect between the HHI and the NPL ratio in both the two markets. It therefore confirms the findings of the previous results with the full sample of six countries and 66 observations (Table 2 and Table 3) that banking competition has a positive effect on financial stability since the HHI is an inverse measure of banking competition.

Table 4

The effect of banking competition on financial stability in the CEMAC zone (2SLS)

Variables	(1) LnZscore	(2) LnZscore	(3) LnNPL	(4) LnNPL
LnHHIloans	-0.0788		0.563***	
	(0.0913)		(0.134)	
LnHHIdeposit		-0.148		0.637***
		(0.114)		(0.207)
LnROA	-0.123	-0.0758	-0.0209	-0.295***
	(0.102)	(0.0849)	(0.103)	(0.0830)
LnLoan	-0.369	-0.0924	2.033***	1.168*
	(0.321)	(0.443)	(0.368)	(0.621)
Size	-0.935***	-0.955***	0.225	0.522***
	(0.135)	(0.119)	(0.159)	(0.133)
Cap-ratio	0.106***	0.0920***	-0.0155*	0.0411*
	(0.00847)	(0.0140)	(0.00835)	(0.0208)
CCR	2.479***	2.214***	-2.994***	-2.390***
	(0.573)	(0.603)	(0.631)	(0.846)
GDPPC	-0.000844	0.00190	-0.0276**	-0.0380***
	(0.00891)	(0.00906)	(0.0104)	(0.00939)
INF	-0.0588***	-0.0565***	-0.00356	-0.0252
	(0.0149)	(0.0135)	(0.0191)	(0.0179)
Constant	14.32***	14.36***	-6.332**	-9.859***
	(2.143)	(1.965)	(2.537)	(2.428)
Observations	42	42	42	42
R-squared	0.877	0.879	0.869	0.841
r2_a	0.847	0.850	0.838	0.803
df_m	8	8	8	8

*Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10 ***, ** and * denote significance level at 1%, 5% and 10% respectively.*

Also addressing the problems related to the error term as depicted in Table 3 result of the NWSE and that of the cross-sectional dependence problem as in Table 2 (Driscoll/Kraay estimated results), the findings remained consistent.

5. Conclusion and policy recommendations

The study assesses the effect of banking competition on financial stability in the CEMAC banking sector over the period 2010 to 2020. The data on different variables were collected from IMF (2021), WGI (2021), World Development Indicators (2021) and BEAC (2021)

data on banks financial statement. Empirical evidence in support of the competition-fragility and competition-stability views is rather mixed in literature. Supporting the arguments of Boyd and De Nicolo (2005), the study findings reveal a positive effect of competition on financial stability and are in line with the competition-stability paradigm. The study employs the Drsicoll/Kraay and the Newey-West standard errors (NWSE) techniques of estimation and the 2SLS of selected lower income countries analysis with the 2SLS for robustness analysis. The main idea in the competition-stability hypothesis supported by the results obtained in the study is that less competition leads to higher lending rate, which could increase the possibility of customers default due to borrowers' moral hazard and the inability to withstand high cost of funds. Hence, banks end up dealing with increased non-performing loans as shown by a positive relationship between market power, concentration and non-performing loans.

The result of the study is in support of the competition-stability relationship consistent in literature. There is a significant and a negative relationship between market concentration and financial stability in the CEMAC zone measured by the Herfindahl index in both the loan and the deposit market. The finding of the study shows that the CEMAC banking system is more financially stable in competitive conditions showed by the negative relationship between the Herfindahl index (HHI) and bank Z-score. The CEMAC banking system is financially stable when banks have less market power and operating in a competitive system. This result is in line with the findings of many prior studies, such as the works of Maji and Hazarika (2018), Alhassan and Biekpe (2018), Kasman and Kasman (2015), Schaeck and Cihák (2014) and Jiménez et al. (2013). The result confirms the competition-stability hypothesis.

The findings of this study have broader implications to policymakers in the CEMAC member states whose targets are aimed at ensuring competition that ensures financial stability, helping them devise appropriate regulations, particularly on private monitoring and setting efficient risk management systems that would spawn a righteous cycle that enhances financial stability of the banking sector. The study recommends the committee of financial stability to work in collaboration with COBAC to ensure the internal control of banks and the follow-up of prudential ratios established to ensure the system stability. The financial stability committee of Central African states (CSF-AC) is recommended to optimize competition intensity and

embrace a relatively cautious strategy for assessing and approving mergers and acquisitions at an indigenous level. The government of the various six member states should work in collaboration with the CEMAC regulatory body and the central bank to ensure stability at individual bank level and the sectorial level, and also to ensure competition that brings about financial stability. The government is recommended to focus on integrating the banking sector to the economic sector to contribute enormously to economic, financial and political stability of the CEMAC zone and to improve the state of development in the region.

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Appendix 1

The effect of banking competition on financial stability in the CEMAC zone (OLS)

Variables	(1) LnZscore	(2) LnZscore	(3) LnNPL	(4) LnNPL	(5) LnZscore	(6) LnZscore	(7) LnNPL	(8) LnNPL
LnHHIloan	-0.222**	------	0.657***	-------	-0.226**	------	0.482***	------
	(0.0995)		(0.118)		(0.0898)		(0.117)	
LnHHIdep	------	-0.385***	-------	0.653***	-------	-0.369***	------	0.688***
		(0.0926)		(0.123)		(0.0936)		(0.117)
LnROA	-0.166	-0.124	-0.158	-0.324***	-0.190*	-0.119	-0.200	-0.356***
	(0.103)	(0.0893)	(0.123)	(0.118)	(0.104)	(0.0903)	(0.135)	(0.113)
Lnloan	0.493*	0.763***	1.090***	0.709**	0.455*	0.727***	1.081***	0.589*
	(0.271)	(0.258)	(0.321)	(0.341)	(0.268)	(0.263)	(0.349)	(0.328)
Size	-0.712***	-0.738***	0.0243	0.184	-0.703***	-0.702***	0.215*	0.230**
	(0.108)	(0.0922)	(0.128)	(0.122)	(0.0987)	(0.0902)	(0.128)	(0.113)
LnCap	0.0872***	0.0590***	-0.00634	0.0442***	0.0878***	0.0590***	-0.00826	0.0463***
	(0.0108)	(0.0117)	(0.0129)	(0.0154)	(0.0107)	(0.0118)	(0.0139)	(0.0147)
CCR	2.650***	1.942***	-1.815***	-0.673	2.719***	1.983***	-1.844***	-0.474
	(0.291)	(0.321)	(0.346)	(0.425)	(0.290)	(0.330)	(0.377)	(0.413)
GDP	-0.0153	-0.0111	-0.0363***	-0.0354**	-0.0188*	-0.00914	-0.0227	-0.0400***
	(0.0113)	(0.0103)	(0.0135)	(0.0137)	(0.0105)	(0.0102)	(0.0137)	(0.0128)
inflation	-0.0855***	-0.0764***	-0.000552	-0.0217	-0.0825***	-0.0795***	-0.0140	-0.0198
	(0.0186)	(0.0168)	(0.0220)	(0.0223)	(0.0179)	(0.0167)	(0.0233)	(0.0209)
CDM1	-0.322	0.194	0.946***	-0.364	-------	-------	-------	-------
	(0.254)	(0.188)	(0.301)	(0.249)				
CDM2	-------	-------	---------	--------	0.397*	-0.0420	-0.248	0.645***
					(0.221)	(0.183)	(0.288)	(0.229)
Constant	12.68***	11.68***	-3.667**	-3.445*	12.31***	11.50***	-5.348***	-4.142**
	(1.460)	(1.346)	(1.733)	(1.782)	(1.451)	(1.376)	(1.886)	(1.719)
Observations	64	64	64	64	64	64	64	64
R-squared	0.770	0.810	0.725	0.716	0.776	0.806	0.679	0.742
r2_a	0.732	0.778	0.679	0.669	0.739	0.774	0.625	0.699

*Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10; ***, ** and * denote significance level at 1%, 5% and 10% respectively.*

Appendix 2

The effect of banking competition on financial stability in the CEMAC zone (OLS results of low income countries analysis)

Variables	(1) Ln1Zscore	(2) Ln1Zscore	(3) lnnNPL	(4) lnnNPL
LnHHIloans	-0.0788	--------	0.563***	--------
	(0.108)		(0.115)	
LnHHIdeposit	--------	-0.148	-------	0.637***
		(0.144)		(0.171)
LnROA	-0.123	-0.0758	-0.0209	-0.295**
	(0.102)	(0.0971)	(0.109)	(0.116)
LnLoan	-0.369	-0.0924	2.033***	1.168*
	(0.373)	(0.507)	(0.400)	(0.603)
LnAsset	-0.935***	-0.955***	0.225	0.522***
	(0.154)	(0.126)	(0.165)	(0.150)
LnCap	0.106***	0.0920***	-0.0155	0.0411**
	(0.00921)	(0.0164)	(0.00987)	(0.0195)
CCR	2.479***	2.214***	-2.994***	-2.390***
	(0.629)	(0.720)	(0.675)	(0.857)
GDP	-0.000844	0.00190	-0.0276**	-0.0380***
	(0.0101)	(0.0105)	(0.0108)	(0.0125)
inflation	-0.0588***	-0.0565***	-0.00356	-0.0252
	(0.0183)	(0.0174)	(0.0197)	(0.0207)
Constant	14.32***	14.36***	-6.332**	-9.859***
	(2.574)	(2.280)	(2.760)	(2.714)
Observations	42	42	42	42
R-squared	0.877	0.879	0.869	0.841
R2_adjusted	0.847	0.850	0.838	0.803

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10*

Appendix 3

Abbreviations of variables, measures, sources and their expected signs

Variables	Acronym	Measures	Source	Expected signs
Dependent variables				
Bank Z-score	Zscore	(ROA + capitalization ratio)/δ_{ROA}	Calculated from BEAC data on financial statement, 2021	
Independent variables				
Herfindahl index loan	HHI loans	The highest bank loan /Total loan		
Herfindahl index deposit	HHI deposit	The highest bank deposit/Total deposit	Calculated from BEAC data, 2021	-/+
Loan ratio	LOAN	Loan to asset ratio	Calculated from BEAC data, 2021	-/+
Capitalization ratio	Cap	Equity/ total asset	IMF data, 2021	+
Bank size	SIZE	Natural logarithm of total asset	IMF data, 2021	+
Returns on asset	ROA	Net income/ Total asset	IMF data, 2021	+
Inflation	INF	GDP deflator	IMF data, 2021	-
Gross domestic product per capita	GDPPC	GDP per capita (%)	WDI, 2021	-/+
Control of corruption	CCR	Corruption control index	WGI, 2021	-/+
Dummy variable of CEMAC colonization	CDM1, CDM2	1 if colonized by French and 0 if not (CDM1). 1 if colonized by the Portuguese and 0 if not (CDM2)		?

Source: Constructed by the author from literature

Appendix 4

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) LnNPL	1.000												
(2) LnZscore	-0.195	1.000											
(3) LHHIloan	0.523	-0.215	1.000										
(4) LnHHidep	0.461	-0.746	0.237	1.000									
(5) LROA	-0.445	0.197	-0.363	-0.296	1.000								
(6) LLoan	-0.308	-0.018	0.101	-0.141	-0.022	1.000							
(7) Lnsize	-0.225	0.814	-0.208	-0.865	0.201	-0.075	1.000						
(8) Lncap	0.266	-0.561	0.303	0.391	-0.254	0.221	-0.637	1.000					
(9) LnCCR	-0.459	0.018	-0.255	-0.115	0.176	-0.322	0.091	-0.233	1.000				
(10) LnGDP	-0.389	-0.270	-0.079	0.140	0.297	0.156	-0.166	-0.128	0.416	1.000			
(11) LnINFL	-0.071	-0.265	0.113	0.007	-0.051	0.060	-0.119	0.232	0.056	-0.037	1.000		
(12) CDM1	-0.234	-0.283	-0.461	0.186	0.077	-0.400	-0.115	-0.146	0.641	0.451	-0.142	1.000	
(13) CDM2	0.259	0.273	0.402	-0.147	-0.011	0.371	0.114	0.096	-0.624	-0.363	0.103	-0.896	1.000

Appendix 5

Variance Inflation Factor (VIF)

1st equation	VIF	1/VIF	***2nd equation***	VIF	1/VIF	***3rd equation***	VIF	1/VIF	***4th equation***	VIF	1/VIF
Lnsize	6.078	0.165	Lnsize	5.354	0.187	Lnsize	6.078	0.165	Lnsize	5.354	0.187
CDM1	5.085	0.197	CCR	5.066	0.197	CDM1	5.085	0.197	CCR	5.066	0.197
CCR	3.462	0.289	CDM1	3.366	0.297	CCR	3.462	0.289	CDM1	3.366	0.297
LnHHIloans	1.904	0.525	LnHHIdeposit	1.937	0.516	LnHHIloans	1.904	0.525	LnHHIdeposit	1.937	0.516
LnGDP	1.882	0.531	LnCap	1.894	0.528	LnGDP	1.882	0.531	LnCap	1.894	0.528
Lnloan	1.461	0.684	LnGDP	1.877	0.533	Lnloan	1.461	0.684	LnGDP	1.877	0.533
LnCap	1.356	0.737	Lnloan	1.599	0.625	LnCap	1.356	0.737	Lnloan	1.599	0.625
LnROA	1.353	0.739	LnROA	1.219	0.821	LnROA	1.353	0.739	LnROA	1.219	0.821
LnINF	1.092	0.916	LnINF	1.084	0.923	LnINF	1.092	0.916	LnINF	1.084	0.923
Mean VIF	***2.63***	.	*Mean VIF*	***2.599***	.	*Mean VIF*	***2.63***	.	*Mean VIF*	***2.599***	.
5th equation	VIF	1/VIF	**6th equation**	VIF	1/VIF	**7th equation**	VIF	1/VIF	**8th equation**	VIF	1/VIF
Lnsize	5.216	0.192	CCR	5.277	0.189	Lnsize	5.216	0.192	CCR	5.277	0.189
CCR	3.536	0.283	Lnsize	5.023	0.199	CCR	3.536	0.283	Lnsize	5.023	0.199
CDM1	3.435	0.291	CDM2	2.722	0.367	CDM2	3.435	0.291	CDM2	2.722	0.367
LnGDP	1.669	0.599	LnHHideposit	1.942	0.515	LnGDP	1.669	0.599	LnHHIdeposit	1.942	0.515
LnHHIloans	1.594	0.627	LnCap	1.9	0.526	LnHHIloans	1.594	0.627	LnCap	1.9	0.526
LnLoan	1.476	0.677	LnGDP	1.818	0.55	Lnloan	1.476	0.677	LnGDP	1.818	0.55
LnROA	1.399	0.715	Lnloan	1.629	0.614	LnROA	1.399	0.715	Lnloan	1.629	0.614
LnCap	1.353	0.739	LnROA	1.226	0.816	LnCap	1.353	0.739	LnROA	1.226	0.816
LnINF	1.046	0.956	LnINF	1.048	0.954	LnINF	1.046	0.956	LnINF	1.048	0.954
Mean VIF	**2.303**	.	Mean VIF	**2.509**	.	Mean VIF	**2.303**	.	Mean VIF	**2.509**	.