

# Regulations and banking crisis: lessons from the African context

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## Abstract

**Purpose** – This study aims to investigate the coordinated impact of regulations on the predicted probability of a banking crisis in Africa.

**Design/methodology/approach** – The study used the dynamic panel instrumental variable probit regression model of 52 African economies over the period 2006 to 2018.

**Findings** – The authors observe that banking crisis is persistent for few years but dissipates in the long run. The results show that board mechanism and ownership control are important in reducing the likelihood of banking crisis. The authors found a negative impact of regulatory capital and monetary policy on the predicted probability of a banking crisis while regulatory quality was not strong in reducing the likelihood of banking crisis. There was also evidence to support that regulatory capital and monetary policy augment the negative impact of board mechanism and ownership control on the predicted probability of a banking crisis.

**Research limitations/implications** – The limitation of the study is that it did not explore all measures of regulatory framework and how they impact banking crisis. However, it has an advantage of using alternative measures of regulations in a banking crisis probability model. Therefore, future studies should include other macro-prudential regulations, regulatory environments and supervision and observe how they are coordinated to reduce possible crisis in a robust methodological framework.

**Practical implications** – The research has policy implications for monetary authorities and policymakers to set coordinated regulations through internal banking mechanisms that are relevant in sustaining banking system stability goals. Countries in Africa should strengthen their quality of regulation in such a way that it can play a strong and complementary role to a robust internal control mechanisms, so as to maintain stability in the banking system. In general, regulators and policymakers should design greater coordination of external and internal regulations through a single regulatory framework and a common resolution mechanism that make the banking system more robust in curbing possible crisis.

**JEL classification** – E61, G21, L10, L51, M21

**Data availability statement:** The data that supports the findings of these studies are available from the corresponding author upon request. The data is publicly available, and the arrangement of the datasets used and/or analyzed during the current study are also available from the corresponding author upon request.

Citation for available data.

available at: [databank.worldbank.org/reports.aspx?source=global-financial-development](https://databank.worldbank.org/reports.aspx?source=global-financial-development).

available at: [databank.worldbank.org/source/world-development-indicators](https://databank.worldbank.org/source/world-development-indicators).

**Competing interests:** The authors declare that they have no competing interests.



**Social implications** – The policy implication of the study is to build banking confidence in the society.

**Originality/value** – This study analyses the interactions of different components of internal and external regulatory framework in helping to reduce the probability of a banking crisis in Africa.

**Keywords** Corporate governance, Banking crisis, Banking regulation, Regulatory policy, Predicted probability of banking crisis, Board mechanism, Board ownership, External regulations

**Paper type** Research paper

## 1. Introduction

During the financial crisis (popularly known as the credit crunch), which started in the summer of 2006 and continued into 2007, the speculation was that Africa was going to be affected only to a limited extent [[Institute of Development Studies \(IDS\), 2008](#)]. However, the crisis evolved with breakneck speed, affecting most financial markets around the African sub-region. For instance, Ghana, Nigeria, Ethiopia, South Africa and others have suffered some crises over the years ([Ladime et al., 2013](#); [Motsi et al., 2018](#)). This was clearly evidenced by the 2008/2009 banking crisis in Nigeria and the recent collapse of some banks in Ghana from 2017 to 2019. These crises could, however, be attributed to poor regulatory framework and macro-policies of government that eventually affect liquidity ([Egboro, 2016](#)).

According to the [World Bank \(2012\)](#), banking crisis occurs when many banks in a particular country are insolvent (have liquidity problems) at the same time – either because they are all hit by economic and financial shocks or because the failure of one or a group of banks spreads to other banks in the system. Banking crisis may also be triggered by depositors demanding their money from the bank, excessive lending or credit demand and increasing levels of banking competition ([Crotty and Epstein, 2008](#); [World Bank, 2012](#)). More so, the 2008/2009 global financial crisis posed challenges for economists, regulators and banks, not only in Africa but the world at large, causing liquidity problems, defaults and bailouts. The recent pandemic crisis presents even greater challenges than the financial crisis, but it also offers opportunities to build a resilient banking system under sound regulatory framework.

There is no doubt that banking crisis is a highly disruptive event that leads to sustained declines in economic activities, financial intermediation and ultimately in welfare. It further poses a challenge for academics, policymakers and practitioners. Although policymakers devote significant efforts to develop models to attempt to predict crisis and to design policies to mitigate its economic impact, the question, however, is:

- Q1. Is banking crisis inevitable for economies that wish to maintain a high level of financial development?
- Q2. Can we think of an optimal mix of regulations that will achieve financial development without much exposure to crises?
- Q3. Is the crisis itself sometimes a result of regulation and intervention in financial markets?

Most regulators and financial economists will probably agree that banking crisis is related to panics and externalities, and that some regulatory framework is needed to reduce their frequency and severity or stop it from occurring ([Goldstein and Razin, 2015](#)). The current study is critical as it seeks to gain a better understanding of banking crisis and to suggest an optimal response to it.

The fact that banking crises occur at unknown intervals has introduced complexities and uncertainties into the banking sector (Laeven, 2011). As a result, the task of regulators has become inevitably more complicated (Ping, 2014). Globalization, on the other hand, has also hastened the degree of convergence within the changing landscape of banking regulation. Thus, it is important to understand that, typically, regulators fall behind in making proactive changes in existing banking practices. In view of that, regulatory policies are mostly reactive in nature – they tend to respond to changes and developments of banking business. In view of the ever-changing nature of banking business, academics, policymakers and regulators are required to consistently re-examine current regulatory frameworks to help make informed policies to curb future banking problems.

Even though Africa is growing with markedly improved short-term macro policy responses over the past few decades, there is the need for more prudential reforms to transform their economies, of which the banking system is not an exception. This demands appropriate financial regulations and a greater focus on the readiness to prepare for the next crisis. According to Laeven and Valencia (2018), the implementation of post-crisis banking regulations has a great impact on the financial sector. In view of this, critically analyzing financial reforms has triggered great interest from key stakeholders.

In recent years, the number of studies that evaluate regulatory impacts on economies have grown, but mostly in developed countries (Musdholifah *et al.*, 2020; Ghardallou, 2021) and developing countries (Minogue, 2005; Kirkpatrick and Parker, 2005; Jalilian *et al.*, 2007). Key among the findings of these studies call for an empirical approach to understanding the role of regulations in reducing the possibility of banking crisis in Africa. For instance, Lu (2017) showed that capital regulatory stringency is positively correlated with lower likelihood of systemic banking crisis. This indicates that countries in stringent capital regulation are more likely to reduce a possible systemic crisis. Ghardallou (2021) revisited the causes of the 2008 global financial crisis by using a large sample of developed and developing countries. Surprisingly, Ghardallou (2021) found that good regulatory practices are likely to enhance the probability of banking crisis. However, these studies did not consider how specific regulations like regulatory capital, regulatory quality and monetary policy interact with internal mechanism to influence the probability of crisis in Africa. Despite the changes and adjustments in relation to regulatory framework among banks in Africa, it appears that there remain issues with how regulatory policies and the mix of several regulatory frameworks can be used to prevent the occurrence of possible future banking crises. Not only is there a lack of understanding of what triggers banking crisis and its prevention, but the failure of existing theories of regulation to incorporate coordination mechanism that will effectively curb possible banking crisis.

The current study investigates the role of internal and external regulations in curbing banking crisis. Drawing on the empirical evidence from a cross-section of studies (Calomiris, 2010; Caprio and Honohan, 2010; Ichiue and Lambert, 2016) as well as the theoretical contributions to the literature on economic theories of regulation (Ling, 2014), and an understanding of a country's specific regulations aimed at preventing banking crisis (Krugman, 2000; Dooley and Frankel, 2003) – the novelty of the current study lies on the fact that it investigates the interactions of different components of internal and external regulations in helping to curb the probability of a banking crisis in Africa.

Even though regulators and researchers pay much attention to individual macro-prudential regulations like monetary policy instruments and capital reserve requirement in preventing crisis, little attention is given to how both internal and external regulations explain banking crisis in Africa. More so, a review of extant literature reveals a limited contribution by scholars on the role regulations plays in the financial system, especially in

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reducing possible banking crisis in Africa. This paper seeks to fill this gap by providing empirical evidence of past banking crisis and how they affect the probability of the occurrence of future banking crisis. Another major contribution is to provide empirical support on how different internal and external regulatory policies can be coordinated to curb banking crisis. It also provides a fertile ground for the formulation of hypotheses for future research on how best regulatory framework can be coordinated to mitigate crisis and promote economic and financial development while suggesting that the major ingredient for successful regulatory outcomes is the development of models that allow early warning and crisis management. In this paper, we interact internal and external regulations and examine how they jointly reduce the possibility of banking crisis.

## 2. Literature review and hypothesis development

### 2.1 Theoretical literature

Over the years, several theories have been developed to explain the crisis situation of the global financial system. These theories have been used to guide policymakers in their quest to curb and prevent possible crisis from occurring. For instance, Marx argues that “the credit system leads to a substantial aggravation of crises or can become a cause of crises, itself” (Marx, 2005, cited in [Dodig and Herr, 2015](#), p. 20). Excessive credit expansion in the form of loans mostly reaches its peak in the final stage of economic upturn and suddenly comes to a stop due to fears for their liquidity position. A crisis situation is usually characterized by the inability to sell goods and services, a breakdown in the credit market and a desperate need for credit to meet payment commitments. More so, the panic in the financial system and a general tendency to hoard money can lead to an escalation of a possible crisis. This can further lead to investment projects being abandoned, workers being laid off and a wave of bankruptcies flooding the market (Marx, 1984, 2005; cited in [Dodig and Herr, 2015](#), p. 20). In the absence of a lender of a last resort, a sharp economic downturn with declining wages and prices, and ultimately deflation, is inevitable.

According to the regulatory literature, the public interest regulation theory and private interest regulation theory are the two main theories that explain regulation ([den Hertog, 2012](#); [Gaffikin, 2005](#)). While the public interest theory assumes that regulations aim to protect and benefit the general public toward the best possible allocation of scarce resources to collective and individual goods ([Hantke-Domas, 2007](#)), the private interest theory of regulation argues that regulation is the interest in promoting dominant individuals and groups in society, but not the interest of the public ([Gaffikin, 2005](#)). From the theory of regulation, it can be deduced that regulation generally improves the interests of society as a whole or the interests of some individuals or groups. Several studies ([Leuz and Wysocki, 2016](#); [Avgouleas, 2009](#); [Tadesse, 2006](#)) report that regulations have economic and financial effects. Even if regulation does not always lead to the desired result, strong and effective institutions can use corporate governance to enhance the influence of effective financial regulation on bank stability. However, this claim still needs to be verified empirically.

The banking industry is unique, in the sense that failure in this industry due to various factors also has external consequences. For instance, the failure of individual banks involved in taking deposits from clients may lead to widespread deposit runs that could overflow to other depository institutions ([Uche, 2000](#)). This is so because there has been a steady rise in the entwinement of banks not just with their customers but with other banks. Thus, no matter how small or big a bank may be, the impact of its failure may be affecting the entire banking system. In certain circumstances, however, the collapse of a bank could, in the absence of regulations and any official action, lead to loss of confidence in the entire banking system and a subsequent mass withdrawal of funds by the public. Thus, the

introduction of new regulations or reformation in the past or even today had almost always followed some form of crisis or public dissent.

Schumpeter (1939) noted that it might be possible for the government in developed countries to recover from the impact of the 1929–1933-type crisis. In particular, monetary authorities across the globe would be able to improve it by acting as a lender of last resort. Given the repercussions of the 2007/2008 global financial crisis to the banking system, the Basel Committee for Banking Supervision introduced some reforms in different areas (known as Basel III). The purpose of these reforms was to strengthen the capital of banks globally, enhance liquidity position and develop a strong and resilient framework for banking systems. Even though these reforms are being adopted and implemented by many countries, it still not empirically clear that they can prevent future banking crises. More so, given the significant role that monetary policy and institutional quality play in the prediction of the probability of financial crisis (Svensson, 2017; Gerdrup *et al.*, 2017), the Basel Committee fails to consider monetary policy and regulatory quality in the framework. Based on this, the study hypothesizes that:

- H1. Different sets of regulatory framework (i.e. internal regulations and external regulations like regulatory capital, regulatory quality and monetary policy) are important in reducing the predicted probability of banking crisis.

### *2.2 Banking crisis situation in Africa*

Between 1985 and 1995, a severe banking crisis hit ten countries in Africa, which were endemic in nature. The first banking crisis occurred in Ghana, Guinea and Kenya in the early-mid 1980s, followed by the financial community of Africa (CFA) franc zone countries in the late 1980s, and then extended to Nigeria, Kenya, Uganda and Guinea in the early 1990s (Daumont, Le gall and Leroux, 2004). In fact, during these periods, non-performing loans in these countries far exceeded the threshold of 5%–10% of total assets. Moreover, it is shown that a few governments, which owned banks in these countries, managed to remain solvent, notably commercial banks in Nigeria and Kenya. During this era, local banks were highly vulnerable, resulting in about one-third of the local banks and non-bank financial institutions being closed or put under the management of the central banks, especially in Kenya between 1993 and 1994. Although foreign banks were seen as often profitable and outperforming their local counterparts, foreign capital participation in itself was no guarantee of good financial results in the banking system. The repercussions of the crisis were also profound in Benin, Cameroon, Tanzania, Senegal, Cote d'Ivoire and Uganda, where credit to the private sector dropped drastically (Daumont *et al.*, 2004). This persisted until the great recession in many developed economies emerged. Thus, the banking crisis in 2008 and 2009 resulted in a fall in bank risky lending and witnessed output growth falling into the negatives. Although the banking crisis in Africa has persisted over decades, it is purported that the 2008/2009 financial crash in some countries like Nigeria was as a result of the ripple effect of the 2007/2008 global financial crisis. According to the Growth Commission report of the World Bank (2010), the crisis was a destructive malfunction of the financial sectors in developed economies that spread rapidly to the rest of the globe.

Despite the implementation of several reforms in Africa, some countries still suffer or have suffered from periods of severe banking crises. Thus, the current study focuses on Africa, by empirically examining how regulatory capital, regulatory quality and monetary policy help explain banking crisis.

### 2.3 Empirical literature

A study of the predictors of banking crisis is important in understanding why the African banking system is often susceptible to crisis (Atoi, 2018; Ozili, 2018). For instance, Fernandes *et al.* (2017) have argued that the collapse of large number of banks throughout the world, including Africa, was as a result of poor governance practices (Fernandes *et al.*, 2017). Allen and Giovannetti (2011) analyzed the channels through which the financial crisis of 2008/2009 was transmitted to Sub-Saharan Africa. They found that the systems of many African countries were characterized by very low resilience and capacity to cope with shocks. Moreover, external factors like capital regulation and supervision have been found to influence banking system stability (Klomp and de Haan, 2014).

Oduor *et al.* (2017) used 162 bank data sets in 37 African countries from 2000–2011 to examine the impact of regulatory capital on stability and competition of the banking system. They found evidence of a positive impact on competition while raising the regulatory capital requirement increases instability in the African banking sector. Most studies viewed banking crisis from a credit risk perspective. Specifically, finance studies have documented that credit risk triggers banking crisis (Tan and Anchor, 2016; Tan, 2017; Lu, 2017). For instance, Lu, 2017 found that bank failure varies across bank types, and that when a threshold panel regression model is applied, the result confirms a moral hazard hypothesis. That is, where an increase in non-performing loans leads to higher lending risk and banking system instability.

Empirical evidence shows that on average, market discipline diminishes after a banking crisis. Moreover, the reduction in market discipline is greater in countries where bank regulation, supervision and institutions actively promote market discipline before the banking crisis (Cubillas *et al.*, 2012). Specifically, recapitalization is a key intervention reform that has the most negative effect on market discipline (Cubillas *et al.*, 2012). Fatima (2014) highlights the various components of regulatory capital and outlines the basics of Basel's norms with respect to the minimum capital requirements for banks. The study found that the capital adequacy of banks maintains financial soundness for banks. Dermine (2013) analyzed the impact of capital and liquidity regulations on possible crisis. The study shows that privately based mechanisms that put most creditors at risk are the best way to increase the soundness of banking markets. Lu (2017) conducted a cross-country analysis and examined whether specific regulatory and supervisory practices and intervention policies in the banking sector are associated with the possibility of the recent banking crisis. Lu explained that countries significantly increased restrictions on bank regulatory capital requirement after the global financial crisis, while others facing banking crises do not significantly change their regulatory and supervisory structure to minimize the impact of future crisis. He also found that greater restrictions on banking activities and supervisory practices strengthen the rights of private sector monitors of banks' regulations, thus decreasing the likelihood of banking crisis. Further, capital regulatory stringency is positively linked to the likelihood of banking crisis, and the impact is stronger for countries facing banking crises. Alstadheim *et al.* (2017) analyzed the strength of the impact of monetary policy shock on financial crisis probability in Norway. The study found that the impact of monetary policy shock on crisis probability is about ten times larger than what earlier studies suggest. Herrero and del Río (2003) used a sample of 79 countries and the period between 1970 and 1999 to establish the effect of the choice of bank objectives and the monetary policy strategy on the occurrence of banking crisis. They found that countries that focus on

price stability reduce the likelihood of banking crisis. Moreover, a large degree of independence of the central bank and locating regulatory and supervisory responsibilities at the central bank seem to reduce the likelihood of a banking crisis. After using data from 52 emerging and/or developing countries from 1996 to 2009, [Essid et al. \(2014\)](#) found that strengthening institutional quality is an essential condition to ensuring banking stability. [Musdholifah et al. \(2020\)](#) developed a model to discern a banking crisis prediction using crisis and default index. They showed that internal banking condition became the most influential determinants of the probability of existing banking crisis. They added that good corporate governance and management quality positively affected banking crisis. Similarly, [Ghardallou \(2021\)](#) used an assortment of financial, regulatory and macroeconomic variables to estimate a logit econometric model for a large sample of developed and developing countries. They found that good regulatory practices are likely to enhance the probability of banking crisis, which contradicts the theory prediction.

Despite the many empirical studies on the impact of regulation on banking crisis, few studies have been done on how internal regulations and different sets of external regulations jointly determine predicted probability of banking crisis. This motivates the current study to hypothesize the following:

- H2.* Different sets of regulatory framework (internal and external regulations) jointly help to reduce the possibility of banking crisis in Africa.

### 3. Data and methodology

The study uses a panel data set of 52 African economies from the year 2006 to 2018. The motivation for the selection of the study countries and period is based on data availability at the time of the study.

The baseline model estimation for our study is specified as:

$$\text{Banking Crisis} = f(\text{Regulations, Control Variables}) \quad (1)$$

We use the dynamic panel instrumental variable probit (ivprobit) regression method (two-step estimator) to analyze the predictive ability of banking crisis in Africa since the dependent variable takes the value of 0 and 1. Consistent with recent banking crisis literature ([Laeven and Valencia, 2018](#)), the dependent variable is banking crisis. African countries that have experienced banking crisis over the period include Ghana Guinea-Bissau, Mauritania, Mauritius, Nigeria, Seychelles, South Africa and Zambia. Data on banking crisis is a dummy variable and was obtained from the World Bank Global Financial Development Database as well as [Laeven and Valencia \(2018\)](#) showing the dating of banking crisis [1].

The dynamic panel ivprobit regression method offers us the opportunity to observe the dynamic behavior of the determinants of banking crisis probabilities and possible endogeneity that may arise. It fits models for binary dependent variables where one or more of the covariates are endogenous and errors are normally distributed ([Amemiya, 1978](#)). Moreover, it helps us to analyze the predictive ability of the banking crisis in Africa as the dependent variable takes the value of 0 and 1. Although the logit and probit models give the same outcome and partial effects, the probit regression is used over the logit. For robustness checks, ordinary least squares (OLS) underestimates the speed of adjustment while generalized least squares (GLS) overestimates the speed of adjustment ([Arellano and Bover, 1995](#)). We use the dynamic ivprobit regression

because it provides consistent parameter estimates by adjusting for all of the characteristics of the variables used in the estimation, and it corrects for endogeneity issues. This also allows us to accommodate different levels of change in the data-generating mechanism at different times. Prior to using the dynamic panel probit regression, we conducted an endogeneity test, which revealed that endogeneity is not a problem in the model estimations. To provide meaningful estimates and robust results, we use the ivprobit regression to deal with possible endogeneity in the model. The lag of the dependent variable also helps us to control for omitted variable biases.

### 3.1 Impact of regulations on banking crisis

Following the baseline model, we analyze the effect of regulations on banking crisis using the dynamic ivprobit regression. This is specified as:

$$\begin{aligned} \text{BankCrisis}_{jt} = & \alpha \text{BankCrisis}_{jt-1} + \beta_1 \text{Internal Regulations}_{jt} + \beta_2 \text{External Regulations}_{jt} \\ & + \beta_3 \text{Bank Specific Variables}_{jt} + \beta_7 \text{Macroeconomic Variables}_{jt} + \delta_j \\ & + \mu_t + \varepsilon_{jt} \end{aligned} \quad (2)$$

where subscript  $i$  denotes the cross-sectional dimension (bank),  $i = 1, \dots, N$ ;  $j$  denotes the cross-sectional dimension (country specifics),  $j = 1, \dots, M$ ;  $t$  denotes the time-series dimension (time),  $t = 1, \dots, T$ ;  $\alpha$  is the coefficient of the lag of the dependent variable.  $\beta_i$ ,  $i = 1, \dots, 7$ , are regression parameters to be estimated;  $\lambda_i$  is the bank fixed effect  $i$ ;  $\delta_j$  is the country fixed effect;  $\mu_t$  is the time fixed effect  $t$ ; and  $\varepsilon_{ijt}$  is an idiosyncratic error term, which controls for unit-specific residual in the model for the  $i$ th bank in the  $j$ th country at *period*  $t$ .

The error term of the model was tested for their assumptions of normality, autocorrelation and homoscedasticity. The coefficient variables were tested to address the presence of multicollinearity among the predictors. Before including the time- and country-fixed effects, we performed some tests to confirm whether they are needed in the dynamic ivprobit model [2]. These tests were done based on the assumption that the time effects are likely to absorb the effects of global financial events, while the country effects are likely to capture the differences in regulatory environments across countries, which might explain different frequencies of banking crises in different countries. Therefore, we introduce some lags of banking crisis, time- and country-fixed effects to observe the behavior of the impact.

**3.1.1 Impact of past banking crisis.** First, we expect the impact of banking crisis to persist in the long term. Thus, the lag of banking crisis is expected to be positively linked to a current banking crisis. This is possible because an event such as banking crisis is bound to affect the probability of banking crisis in the next few years. However, the next few years may just be the continuation of the same crisis, but once that crisis is over, another may be less likely to occur a few years after. Therefore, we introduce the first, second and third lags of banking crisis, and we expect the positive impact to be reduced in the long term.

**3.1.2 Impact of regulations.** We decompose internal regulations into two: board mechanism and board ownership. Board mechanism is a composite index of five indicators: CEO duality (a dummy variable equal to 1 if the roles of chairman and chief executive are combined, 0 otherwise), board independence (a dummy variable equal to 1 if half or more of the directors are independent non-executive directors, 0 otherwise),

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audit independence (a dummy variable equal to 1 if the bank is audited by independent auditor, particularly the top four auditing firms) in the bank and board size (measured as the total number of board members) and accounting standards (a dummy variable equal to 1 if a bank follows accounting standards, 0 otherwise). These variables were obtained from the Bank Scope database and the audited report of the banks. The estimated composite index helps to capture the dynamics in measuring the internal regulations of the banks. The index ranges between 0 and 1, where higher values suggest healthy board mechanism.

We expect an overall negative impact of board mechanism on the predicted probability of banking crisis. This suggests that banks that have a strong board mechanism enforce measures that reduce the possibility of banking crisis from occurring. For instance, chief executive officers (CEOs) who have the experience and expertise to serve as both a director and a chairperson (CEO duality) are able to efficiently monitor banking activities to reduce banking crisis. Outside directors and external auditors are also expected to bring their diverse knowledge and expertise to enhance effective banking supervision, to mitigate banking crisis. Large board size suggests an increasing participation of diverse technical know-how that is needed to reduce crisis.

Board ownership is the proportion of executive share ownership to total share of the bank, with higher values indicating healthy board ownership. Data is obtained from the Bank Scope database and the audited report of the banks. We expect a negative impact of board ownership on the predicted probability of banking crisis. This implies that ownership control by board member helps to reduce manager's abuse of power, agency cost and provides greater incentives to reduce possible banking crisis.

We decompose external regulations into three variables: capital regulation, regulatory quality and monetary policy. Capital regulation is the regulatory oversight of bank capital. It measures the extent of regulatory requirements regarding the amount and the source of capital and whether the authorities verify the source of capital. It is measured as the ratio of bank regulation capital to risk-weighted assets. It ranges between 0 and 100, with higher values indicating greater stringency. Regulatory quality is an index capturing the perception of the ability of the government to formulate and implement sound policies and regulations. It ranges between  $-3$  and  $3$ , with higher values indicating strong regulatory quality. Monetary policy is measured as monetary policy rates. We obtained data on capital regulation and regulatory quality from the Global Financial Development database, while monetary policy (proxied as monetary policy rates) was obtained from the database of IMF (International Financial Statistics).

We expect a negative relationship between capital regulation and banking crisis. This is because higher regulatory capital may put pressure on managers of the banks to work efficiently to increase the value of the firm and eventually reduce possible banking crisis. We expect a negative impact of regulatory quality on banking crisis. This indicates that the quality of regulation instills effective supervision and discipline in the banking system, and thus, helps in reducing the probability of banking crisis. We expect a negative relationship between monetary policy rates and the next banking crisis. This is because a strict monetary policy (contractionary policy) reflects higher interests rates and lower credit supply. This may lead to lower credit risk exposure and higher margins and thus, reducing the possible crisis situation in the banking system (Table 1).

Variables	Definition/description and measurement	Sources	Expectations
Banking crisis	Dummy variable for the presence of banking crisis (1 = banking crisis, 0 = none)	Laeven, L. And Valencia, F. (2013), "Systemic Banking Crises Database: An Update," IMF WP/12/163 Global Financial Development Database of the World Bank	–
Board mechanism	A composite index of six indicators. This includes CEO duality (a dummy variable equal to 1 if the roles of chairman and chief executive are combined, 0 otherwise), board independence (a dummy variable equal to 1 if half or more of the directors are independent non-executive directors, 0 otherwise), audit independence (a dummy variable equal to 1 if the bank is audited by independent auditor, particularly the top 4 auditing firms) in the bank and board size (measured as total number of board members) and accounting standards (a dummy variable equal to 1 if a bank follows accounting standards, 0 otherwise)	Bank Scope Database, published audited financial report of a bank by its central bank	–ve
Board ownership	Proportion of executive share ownership to total share of the bank, with higher values indicating healthy board ownership	Bank Scope database, published audited financial report of a bank by its central bank	–ve
Regulatory capital	Ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions and valuation adjustments. Capital includes Tier 1 capital (paid-up shares and common stock), which is a common feature in all countries' banking systems, and total regulatory capital, which includes several specified types of subordinated debt instruments that need not be repaid if the funds are required to maintain minimum capital levels (these comprise Tiers 2 and 3 capital)	Global Financial Development database	–ve
Regulatory quality	Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a	Worldwide Governance Indicators	–ve

(continued)

**Table 1.**  
Description of  
variables

Variables	Definition/description and measurement	Sources	Expectations
	standard normal distribution, i.e. ranging from approximately -2.5 to 2.5		
Monetary policy rate	Measured as monetary policy rates of a country's central bank	International Monetary Fund (IMF)	
Bank funding	Ratio of total deposits to total asset		-ve
Credit risk	Ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio). The loan amount recorded as non-performing includes the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue	Global Financial Development database of the World Bank	+ve
Bank concentration	Assets of three largest commercial banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax assets, discontinued operations and other assets	Global Financial Development database of the World Bank	-ve
Private credit to GDP	The financial resources provided to the private sector by domestic money banks as a share of GDP. Private credit by deposit money banks and other financial institutions to GDP	Global Financial Development database of the World Bank	+ve
Exchange rate	Natural logarithm of a country's currency rate to the dollar	Global Financial Development database of the World Bank	+ve
GDP per capita	Natural logarithm of GDP per capita	Global Financial Development database of the World Bank	-ve
Inflation	Consumer price index [average consumer price index (2010 = 100)]	Global Financial Development database of the World Bank	-ve
Institution	Measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability)	Global Financial Development database of the World Bank	-ve

**Table 1.**

In [equation \(2\)](#), the control variables are bank funding (ratio of total deposit to total asset); bank size (natural logarithm of total assets); credit risk (ratio of nonperforming to gross loan); bank concentration (the ratio of asset of the three largest commercial banks to total commercial banking assets in a country); private credit as a ratio of GDP, GDP per capita; exchange rate (natural logarithm of real exchange rate), inflation (consumer price index). Institution is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and

accountability). Data on these control variables were obtained from the World Bank Global Financial Development database.

We expect a negative relationship between deposit funds of banks and banking crisis. This suggests that banks with greater funding sources are able to reduce the probability of banking crisis. We expect a negative relationship between bank size and banking crisis, in the sense that larger banks have the incentive to take excessive risk, which can enhance the stability of the bank. We expect credit risk to positively affect banking crises. We expect a negative relationship between bank concentration and banking crises. We expect a positive relationship between private credit to GDP and banking crisis probability. GDP per capita is expected to negatively affect banking crisis. This is because banks operating in high-income countries are more likely to reduce the impact of banking crisis. Inflation rate is expected to negatively affect banking crisis. This suggests that banks that face greater inflationary regimes may increase prices (interest rates) for greater profit margins. This may reduce the possibility of banking crisis. We expect a positive relationship between exchange rate and banking crisis. This is because banks in high exchange rate countries may be exposed to greater exchange risks, which may endanger the banking system and probably lead to banking crisis. We expect a negative relationship between institution and banking crisis. This is because countries with strong institutions have robust mechanisms that are able to reduce possible banking crisis.

### 3.2 Coordination impact of regulatory framework on banking crisis

We specify a model that explains the coordination impact of different sets of regulatory framework on banking crisis. In this case, we interact internal regulations (board mechanism and board ownership) with external regulations (capital regulation, regulatory quality and monetary policy) and show how they affect the predicted banking crises probability.

To capture possible unobserved heterogeneity, and the impact of internal regulations on predicted probability of banking crisis, the study includes the interaction terms.

This is specified as follows:

$$\begin{aligned} BankCrisis_{jt} = & \alpha BankCrisis_{j,t-1} + \beta_1 Internal\_Regulations_{jt} + \beta_2 External\_Regulations_{jt} \\ & + \beta_3 (Internal\_Regulations * External\_Regulations)_{jt} + \beta_4 Bank\ Specific\ Variables_{ijt} \\ & + \beta_5 Macroeconomic\ Variables_{jt} + \delta_j + \mu_t + \varepsilon_{ijt} \end{aligned} \quad (3)$$

The coordination role (interaction effect) of regulatory framework can be estimated using the marginal effect, given as:

$$\text{Marginal Effect} \Rightarrow \frac{\partial BankCrisis_{j,t}}{\partial Internal\_Regulations} = \beta_1 + \beta_3 External\_Regulation_{i,t} = 0 \quad (4)$$

The variable of interest is internal regulations, while the mediator variable in the study is the mean of external regulations.  $\beta_1$  and  $\beta_3$  are the coefficients of internal regulations and the interaction terms, respectively.

We have argued for a negative relationship between internal regulations (board mechanism and board ownership) and banking crisis. In [equation \(3\)](#), we expect either a

positive or a negative marginal effect of external regulation variables. For instance, a positive marginal effect of internal regulation variables (board mechanism and board ownership) implies that capital regulation alters the negative impact of internal regulations (board mechanism and board ownership) on the possibility of banking crisis. This suggests that board mechanism and board ownership are likely to lead to possible banking crisis in a well-capitalized banking system. The implication is that stringent capital regulation may restrict internal control activities (such as, excessive risk taking behavior) in a way that may lead to possible banking crisis. A negative marginal effect indicates that capital regulation magnifies the negative impact of internal regulations (board mechanism and board ownership) on the possibility of banking crisis. Thus, capital regulation and internal control mechanisms complement each other to reduce the possibility of banking crisis. Similarly, a positive marginal effect when internal regulations are interacted with regulatory quality indicate that regulatory quality alters the negative impact of internal regulations (board mechanism and board ownership) on the possibility of banking crisis. Thus, countries in better regulatory quality environment interfere with internal mechanism that may endanger the banking system and lead to a possible banking crisis. A negative marginal effect suggests that regulatory quality amplifies the negative impact of internal regulations (board mechanism and board ownership) on the possibility of banking crisis. This means that regulatory quality has a significant moderating impact in reducing banking crisis through internal regulations. A positive marginal effect when internal regulations and monetary policy are interacted indicates that the inverse relationship between internal regulations (board mechanism and board ownership) and the possibility of banking crisis is reversed. A negative marginal effect suggests that a monetary policy amplifies the negative impact of internal regulations (board mechanism and board ownership) on the possibility of banking crisis.

In equation (3), we expect similar signs associated with the control variables as explained in equation (2).

#### 4. Empirical results and discussion

##### 4.1 Data, descriptive statistics and correlation matrix

The study presents descriptive statistics of the explanatory variables. Summary statistics are used to screen the data to determine if there are outliers and to better understand the data. Table 2 reports the descriptive statistics for the variables used in the study. The summary statistics do not show any evidence of outliers and the Shapiro–Wilk (SWILK) normality test indicates that the variables are normally distributed around their mean. Tables 3 and 4 report the Pearson correlation coefficient matrix to check for possible multicollinearity between the explanatory variables. From the matrix, there is no evidence of multicollinearity.

From Table 2, board mechanism (an index) recorded a mean of 0.388. This suggests that banks in Africa have lower governance index relative to the governance index constructed by Akbar *et al.* (2016) for developed economies. Board ownership recorded a mean of 0.519, indicating that on average, more than half of the board members hold shares in the bank.

In terms of banking regulations, capital regulation (or regulatory capital) recorded a mean of 16.16. Monetary policy rates recorded a mean of 8.54%. This suggests that countries in Africa have relatively low monetary policy rates compared to an average of 13% central bank policy rate of developed countries (IMF report, 2019). The mean of regulatory quality is  $-0.38$ . From the World Bank database, negative values show weak regulatory quality, while positive values depict strong regulatory quality. This suggests

Variable	Mean	SD	Min	Max	SWILK
Board mechanism	0.388	0.207	0	0.875	0.000***
Board ownership	0.519	0.499	0	1	0.000***
Regulatory capital	16.158	6.412	1.11	39.861	0.000***
Regulatory quality	-0.383	0.608	-2.162	1.305	0.000***
Monetary policy rate	8.535	5.683	4.129	26.000	0.000***
Bank funding	0.752	0.218	-0.465	2.608	0.000***
Bank size	6.416	1.818	2.924	12.001	0.000***
Credit risk	9.96	7.44	0.08	45.3	0.000***
Bank concentration	55.32	27.69	0.28	100	0.000***
Private credit to GDP	22.875	23.372	9.122	94.519	0.000***
GDP per capita	2.760	4.043	-17.473	24.215	0.000***
Inflation rate	8.862	5.529	-1.801	33.224	0.000***
Exchange rate	6.644	7.810	0.916	10.266	0.000***
Institutions	-0.483	0.545	-0.853	1.660	0.000***

**Notes:** Computed by authors based on data from Bank Scope of the audited banks and Global Financial Development database of the World Bank Board mechanism is a composite index of five indicators (i.e. absence of CEO duality, presence of board independence, audit independence, small board size and accounting standards). These variables were obtained from the Bank Scope of audited banks. Board ownership is the proportion of executive share ownership to total share of the bank. Data is obtained from bank scope database. *Regulation capital* is the ratio of bank regulation capital to risk weighted assets; *Regulatory quality* is an index for the ability of government to formulate sound financial policy regulation or effective supervision; *Monetary policy rate* is the central bank policy rate of a country; *Bank funding* is the ratio of total deposits to total ratio; *Bank size* is the natural logarithm of total assets; *Credit risk* is the ratio of non-performing to gross loan; *Bank concentration* is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; *Private sector credit* is the ratio of private credit of deposit money banks to GDP; *Exchange rate* is the natural logarithm of a country's currency rate to the dollar; *lnGDP per capita* is the natural logarithm of GDP per capita; *Inflation* is measured as consumer price index; *Institution* is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability). bank-level data were obtained from Bank Scope of the audited banks; country-level data were obtained from the Global Financial Development database of the World Bank

**Table 2.**  
Summary statistics

that most countries in Africa have weak regulatory quality compared with most developed countries that range between -2.5 and 2.5.

On the bank-specific variables (control variables), bank funding from deposits recorded a mean of 75.2%; bank size recorded an average of 6.41; credit risk (non-performing loans) recorded a mean of 9.96% of gross loans; bank concentration recorded a mean of 55.32%; private credit to GDP recorded an average of 22.87% of GDP; GDP per capita recorded a mean of 2.76; inflation rate has an average value of 8.86; exchange rate recorded an average of 6.64 and institution recorded a mean of -0.483.

#### 4.2 Regression results and discussion

First, the regression results depict the role of regulations in explaining the predicted probability of banking crisis by presenting the individual effect of internal regulation variables and external regulation variables on banking crisis. Second, we find the interactive effect of internal and external regulatory frameworks in explaining the banking crisis. We use the logistic model estimation for all analyses due to the nature of the dependent variable.

**4.2.1 Internal regulations and banking crisis.** In this section, we present the impact of internal regulations on the predicted probability of banking crisis. Internal regulation was

**Table 3.**  
Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
(1) Board mechanism	1.000										
(2) Board ownership	-0.020	1.000									
(3) Bank funding	0.100	0.210	1.000								
(4) Bank size	0.140	0.050	-0.020	1.000							
(5) GDP per cap	0.040	0.040	0.000	-0.210	1.000						
(6) Exchange rate	-0.100	0.110	0.100	-0.300	0.020	1.000					
(7) Inflation rate	0.150	0.130	0.050	-0.100	0.110	-0.050	1.000				
(8) Private credit to GDP	0.050	-0.150	-0.240	0.530	-0.270	-0.330	-0.050	1.000			
(9) Credit risk	-0.210	0.030	-0.080	-0.360	0.200	-0.080	0.010	-0.140	1.000		
(10) Bank concentration	0.130	-0.170	-0.030	0.180	-0.310	0.110	-0.250	0.390	-0.280	1.000	
(11) Institutions	0.180	-0.006	0.050	-0.038	0.101	0.042	-0.114	-0.184	0.007	-0.051	1.000

**Notes:** Computed by authors based on data from Bank Scope of the audited banks and Global Financial Development database of the World Bank. *Board mechanism* is a composite index of five indicators (i.e., absence of CEO duality, presence of board independence, audit independence, small board size and accounting standards). These variables were obtained from the Bank Scope of audited banks. *Board ownership* is the proportion of executive share ownership to total share of the bank. Data is obtained from the Bank Scope database. *Bank funding* is the ratio of total deposits to total ratio; *Bank size* is the natural logarithm of total assets; *Credit risk* is the ratio of nonperforming to gross loan; *Bank concentration* is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; *Private sector credit* is the ratio of private credit of deposit money banks to GDP; *Exchange rate* is the natural logarithm of a country's currency rate to the dollar; *lnGDP per capita* is the natural logarithm of GDP per capita; *Inflation* is measured as consumer price index; *Institution* is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability. Bank-level data were obtained from the Bank Scope of the audited banks; Country-level data were obtained from the Global Financial Development database of the World Bank

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
(1) Regulatory capital	1.000											
(2) Regulatory quality	0.500	1.000										
(3) Monetary policy	-0.060	-0.040	1.000									
(4) Bank funding	-0.140	-0.120	-0.020	1.000								
(5) Bank size	-0.080	-0.050	0.090	0.090	1.000							
(6) GDP per cap	0.140	0.070	0.220	0.000	-0.150	1.000						
(7) Exchange rate	0.120	-0.080	-0.300	0.040	-0.330	0.020	1.000					
(8) Inflation rate	-0.300	-0.170	0.350	0.070	-0.020	0.100	-0.100	1.000				
(9) Private credit to GDP	-0.330	0.030	0.170	-0.180	0.460	-0.260	-0.350	0.020	1.000			
(10) Credit risk	0.490	0.380	-0.100	-0.120	-0.330	0.150	0.010	-0.120	-0.190	1.000		
(11) Bank concentration	-0.560	-0.300	-0.080	0.020	0.160	-0.290	0.060	-0.130	0.420	-0.390	1.000	
(12) Institutions	-0.098	-0.173	0.348	0.050	-0.038	0.101	0.042	-0.114	-0.184	0.007	-0.051	1.000

**Notes:** Computed by authors based on data from the Bank Scope of the audited banks and Global Financial Development database of the World Bank. *Regulatory quality* is an index for the ability of government to formulate sound financial policy regulation or effective supervision; *Monetary policy rate* is the central bank policy rate of a country; *Bank funding* is the ratio of total deposits to total ratio; *Bank size* is the natural logarithm of total assets; *Credit risk* is the ratio of non-performing to gross loan; *Bank concentration* is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; *Private sector credit* is the ratio of private credit of deposit money banks to GDP; *Exchange rate* is the natural logarithm of a country's currency rate to the dollar; *lnGDP per capita* is the natural logarithm of GDP per capita; *Inflation* is measured as consumer price index; *Institution* is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability). Bank-level data were obtained from Bank Scope of the audited banks; country-level data were obtained from the Global Financial Development database of the World Bank

**Table 4.**  
Correlation matrix

decomposed into two: board mechanism and board ownership. Throughout our models, we observed an interesting but consistent results when we introduced the first, second and third lags of banking crisis into the model. This is consistent across all the models. We found that the first lag of banking crisis was positively linked to current banking crisis. Similarly, the impact of the second lag of banking crisis was positively linked to current banking, but the positive impact was reduced compared to the impact of the first lag. This suggests that previous years' impact of banking crisis is less likely to affect subsequent banking crisis in the long term. This is confirmed by a negative but insignificant coefficient between the third lag of banking crisis and current banking crisis events. Thus, we observe that the positive impact of banking crisis is persistent for some few years but dissipates in the long run (i.e. after two years). From [Table 5](#), board mechanism has a negative impact on the predicted probability of banking crisis (Model 1). This suggests that strong board characteristics provide effective monitoring and supervision on management and banking operations to save the banking sector from any possible crisis. Thus, board directors are expected to act independently to protect the interest of shareholders and the organization, as indicated by [Nicholson and Kiel \(2007\)](#). This implies that an effective control mechanism helps protect the interest of shareholders in achieving business success. This reduces the agency cost ([Abor, 2007](#)) and decreases the possibility of a banking crisis. Our results disagree with the negative impact of board composition on bank performance, as observed in the works of [Fernandes et al. \(2017\)](#), [Pathan and Faff \(2013\)](#) and [Erkens et al. \(2012\)](#). In Model 3, board ownership of banks decreases the predicted probability of banking crisis. This implies that majority of shares owned by board members provide effective control mechanism by way of aligning their interest with managers of the firm to ensure that firms operate efficiently for the benefit of all stakeholders. This situation has a greater tendency to reduce banking crisis in Africa. Further, CEO and shareholders maintain a significant level of control. This has a positive effect on banking business by ensuring an alignment of interest with one another (both CEO and majority shareholders), discouraging the extraction of private funds and positively impacting the profit of the banks and eventually preventing banking failure or crisis. The study contradicts the work by [Musdholifah et al. \(2020\)](#) that management quality and good corporate governance practices positively affect the probability of banking crisis.

In terms of the controls, we found a negative relationship between bank funding and banking crisis ([Table 7](#)). This shows that banks with greater funding sources are able to reduce the probability of banking crisis. Bank size has a positive impact on banking crisis. This implies that banks that are too large are not good for the banking system due to greater risk-taking behaviors on their part.

Credit risk was positively and significantly linked to predicted probability of banking crises. This is because banks that have higher levels of non-performing loans (credit risk exposures) are more prone to suffer when there are banking crises. We found a negative relationship between bank concentration and banking crises. This is because a concentrated banking system has the incentive to make profits, decrease insolvency risk and reduce the likelihood of a banking crisis ([Shehzad et al., 2009](#)). From Model 5, private sector credit had a negative and significant effect on probability of banking crisis. This suggests that rapid growth in private sector credit is good for curbing banking crisis in the future. We found a negative effect of GDP per capita on probability of banking crisis (Model 3). This suggests that banking crisis is likely to be reduced by countries with higher income levels. We found a mixed relationship between exchange rate and banking crises due to the volatilities in exchange rates. We found inflation to have a negative impact on banking crisis.

Variables	Model 1	Model 2	Model 3
Banking Crisis <sub>t-1</sub>	0.844*** (0.021)	0.773*** (0.029)	0.772*** (0.029)
Banking Crisis <sub>t-2</sub>	0.199** (0.085)	0.218** (0.091)	0.198** (0.082)
Banking Crisis <sub>t-3</sub>	-0.010 (0.009)	-0.011 (0.010)	-0.011 (0.011)
Board mechanism	-0.582* (0.316)		-0.066** (0.029)
Board ownership		-0.740*** (0.176)	0.045*** (0.017)
Bank funding	-2.830*** (0.428)	-1.798*** (0.611)	-0.104*** (0.027)
Bank size	0.217*** (0.053)	0.297*** (0.049)	0.011** (0.005)
Credit risk	0.036*** (0.002)	0.033*** (0.002)	0.001*** (8.91e-05)
Bank concentration	-0.019*** (0.001)	-0.019*** (0.0004)	-0.0006*** (3.75e-05)
Private credit to GDP	-0.009 (0.006)	-0.0176*** (0.005)	-0.002*** (0.001)
GDP per capita	-0.012 (0.027)	0.0125 (0.026)	-0.003** (0.002)
Exchange rate	7.92e-05 (6.44e-05)	0.0002*** (6.79e-05)	-2.63e-05*** (6.79e-06)
Inflation rate	-0.106*** (0.024)	-0.102*** (0.0234)	-0.001 (0.001)
Institutions	-0.037*** (0.009)	-0.058*** (0.012)	-0.058*** (0.012)
Constant	36.130 (32.540)	43.670 (37.070)	-0.725 (1.291)
Time effect	Yes	Yes	Yes
Country effect	Yes	Yes	Yes
Observations	391	474	333
Wald $\chi^2$ (9)	123.65	127.86	142.34
Pseudo $R^2$	0.823	0.952	0.842
Prob > $\chi^2$	0.000	0.000	0.000

**Notes:** Table 5 shows the impact of internal regulations (board mechanism and board ownership control) on predicted probability of banking crisis using the dynamic ivprobit regression while controlling for past banking crisis events. Computed by the authors based on data from Bank Scope of the audited banks and Global Financial Development database of the World Bank. Banking crisis is a dummy variable and was obtained from the World Bank Global Financial Development database as well as Laeven and Valencia (2018). The first, second and third lags of banking crisis were introduced. *Board mechanism* is a composite index of five indicators (i.e. absence of CEO duality, presence of board independence, audit independence, small board size and accounting standards). These variables were obtained from the Bank Scope of audited banks. *Board ownership* is the proportion of executive share ownership to total share of the bank. Data is obtained from the Bank Scope database. *Bank funding* is the ratio of total deposits to total ratio; *Bank size* is the natural logarithm of total assets; *Credit risk* is the ratio of nonperforming to gross loan; *Bank concentration* is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; *Private sector credit* is the ratio of private credit of deposit money banks to GDP; *Exchange rate* is the natural logarithm of a country's currency rate to the dollar; *lnGDP per capita* is the natural logarithm of GDP per capita; *Inflation* is measured as consumer price index; *Institution* is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability). Bank-level data were obtained from Bank Scope of the audited banks; country-level data were obtained from the Global Financial Development database of the World Bank. Robust standard errors in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

**Table 5.**  
Effect of internal  
regulations on  
banking crisis

**4.2.2 External regulations and banking crisis.** Next, the study looks at the effect of external regulations on predicted probability of banking crisis. From Table 6, regulatory capital has a negative impact on the predicted probability of banking crisis (Model 4). Thus, countries that enforce stringent capital regulation help banks to reduce excessive risk-taking that may endanger the banking system, and therefore reduce banking crisis occurrence. Regulatory capital requirement exerts pressure on managers of the banks to work efficiently in maintaining bank system stability and hence reduce the possibility of crisis. Moreover, we observe that regulatory capital requirements are too high for the banks in Africa to meet causing banks to take excessive risk that will generate sufficient funds to curb the possibility of banking crisis.

Variables	Model 4	Model 5	Model 6	Model 7
Banking Crisis <sub>t-1</sub>	0.832*** (0.023)	0.795*** (0.023)	0.833*** (0.022)	0.763*** (0.026)
Banking Crisis <sub>t-2</sub>	0.204** (0.088)	0.146 (0.128)	0.012 (0.067)	0.336*** (0.107)
Banking Crisis <sub>t-3</sub>	-0.009 (0.009)	-0.013 (0.009)	-0.011 (0.009)	-0.012 (0.009)
<i>Regulatory capital</i>	-0.002*** (0.0003)			0.001** (0.000)
<i>Regulatory quality</i>		0.004*** (0.001)		0.002*** (0.001)
<i>Monetary policy</i>			-0.002*** (0.000)	-0.003*** (0.000)
Bank funding	-0.256*** (0.050)	-0.201*** (0.047)	-0.199*** (0.047)	-0.161*** (0.024)
Bank size	0.037*** (0.006)	0.031*** (0.006)	0.027*** (0.005)	0.013*** (0.003)
Credit risk	0.001*** (9.01e-05)	0.001*** (0.000)	0.001*** (9.20e-05)	-0.0003*** (5.83e-05)
Private credit to GDP	-0.001** (0.001)	-0.001* (0.001)	-0.000 (0.001)	-0.001** (0.000)
GDP per capita	-0.009*** (0.003)	-0.008*** (0.003)	-0.004 (0.003)	0.012*** (0.002)
Exchange rate	1.40e-05*** (4.68e-06)	5.14e-06 (6.60e-06)	-6.81e-06 (5.64e-06)	5.60e-06 (5.47e-06)
Inflation rate	-0.002 (0.002)	0.005*** (0.002)	0.006*** (0.002)	0.005*** (0.002)
Institutions	-0.041*** (0.009)	-0.040*** (0.009)	-0.042*** (0.009)	-0.048*** (0.009)
Constant	-1.093 (1.397)	-2.180 (1.807)	-0.855 (1.359)	0.573 (0.730)
Time effect	Yes	Yes	Yes	Yes
Country effect	Yes	Yes	Yes	Yes
Wald $\chi^2$	130.750	64.930	74.150	176.600
Pseudo $R^2$	0.530	0.513	0.529	0.837
Prob > $\chi^2$	0.000	0.000	0.000	0.000

**Notes:** Table 6 shows the impact of external regulations (regulatory capital, regulatory quality and monetary policy) on predicted probability of banking crisis using the dynamic ivprobit regression while controlling for past banking crisis events. Computed by authors based on data from Bank Scope of the audited banks and the Global Financial Development database of the World Bank. Banking crisis is a dummy variable and was obtained from the World Bank Global Financial Development database as well as Laeven and Valencia (2018). The first, second and third lags of banking crisis were introduced. *Regulation capital* is the ratio of bank regulation capital to risk weighted assets; *Regulatory quality* is an index for the ability of government to formulate sound financial policy regulation or effective supervision; *Monetary policy rate* is the central bank policy rate of a country; *Bank funding* is the ratio of total deposits to total ratio; *Bank size* is the natural logarithm of total assets; *Credit risk* is the ratio of nonperforming to gross loan; *Bank concentration* is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; *Private sector credit* is the ratio of private credit of deposit money banks to GDP; *Exchange rate* is the natural logarithm of a country's currency rate to the dollar; *GDP per capita* is the natural logarithm of GDP per capita; *Inflation* is measured as consumer price index; *Institution* is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability). Bank-level data were obtained from Bank Scope of the audited banks; country-level data were obtained from the Global Financial Development database of the World Bank. Robust standard errors in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

**Table 6.**  
Effect of external regulations on banking crisis

Our findings are, however, different from the work by Zina and Plihon (2014) for emerging countries and the work by Oduor *et al.* (2017) – who explained that increasing regulatory capital ratios increases instability in the African banking sector, making banks hold more risky assets. Surprisingly, the work by Oduor *et al.* (2021) showed that good regulatory practices are likely to enhance the probability of banking crisis, which disagrees with our findings. We found a positive effect of regulatory quality on the likelihood of banking crisis occurring (Model 5). This is not surprising because Africa presents a weak regulatory quality environment (as shown in the descriptive statistics), and thus, extreme cases of over monitoring will interfere with banks' objective of ensuring business success. Thus, the implication is that supervision of banks in Africa is weak to be able to cause an increase in the predicted probability of crisis. This confirms the work by Zina and Plihon (2014) who observed that institutional factors like supervisory regulations weaken the banking system

and eventually trigger crisis. We found a negative impact of monetary policy on banking crisis probability (Model 6). It shows that increasing monetary policy rates reduces competition among banks, limits the demand for funds from the deficit units. On the other hand, it increases banks pricing policy (market power) such that banks can lend to risky borrowers to attract higher returns. This supports the risk-return theory and reduces the possibility of crisis.

*4.2.3 Coordination impact of internal regulation and external regulations on banking crisis.* In this section, we expect internal and external regulatory framework to jointly curb possible banking crisis situation in Africa. It is in this light that our study tries to explain the interactive effect of external regulations in explaining the impact of internal regulations on the predicted probability of banking crisis.

Consistent with Brambor *et al.* (2006) on pitfalls of interaction regressions, we cannot establish regulation implications exclusively on direct impacts. Hence, there is the need to compute the overall effect or marginal effects based on the interaction terms. Our interpretation is based on the marginal effects. We found that board mechanism is negatively linked to the predicted probability of banking crisis. The conditional effect is also negatively linked to banking crisis and is consistent across the models in Table 7, except Model 9. In Model 9, there was an insignificant conditional effect of board mechanism on banking crisis. In Model 8, we computed a negative marginal effect of  $-0.00044 [(-0.012 + (0.0005 \times \text{regulatory capital})]$  when regulatory capital has an average of 16.158. The negative marginal effect implies that regulatory capital magnifies the negative impact of board mechanism on the predicted probability of banking crisis. The implication is that board mechanism and regulatory capital requirement are jointly important in reducing the likelihood of banking crisis.

While the unconditional effect of board mechanism was negatively linked to banking crisis, the conditional effect was positive and insignificant in the presence of regulatory quality (Model 9). However, we estimated a negative marginal effect of  $-0.055[-0.056 + (-0.0006 \times \text{regulatory quality})]$  when the mean regulatory quality is  $-0.383$ . This suggests that regulatory quality augments the negative impact of board mechanism on the predicted probability of banking crisis. In Model 10, the conditional marginal effect was estimated to be  $-0.023[-0.022 + (-0.000139 \times \text{monetary policy})]$  when monetary policy assumes a mean of 8.535. This suggests that the negative impact of board mechanism is magnified at higher levels of monetary policy.

In general, the conditional marginal effects of board mechanism imply that board mechanism further reduces the predicted probability of banking crisis at greater levels of capital regulation, regulatory quality and monetary policy.

Similarly, we found that board ownership was negatively and significantly linked to the predicted probability of banking crisis. The conditional effect is also negatively and significantly linked to banking crisis and is consistent across the models in Table 8, except Model 12. In Model 12, there was positive and significant conditional effect of board ownership on banking crisis. In Model 11, we computed a negative marginal effect of  $-0.167 [(-0.137 + (-0.0002 \times \text{regulatory capital})]$  when regulatory capital has an average of 16.158. The negative marginal effect implies that regulatory capital magnifies the negative impact of board ownership on the predicted probability of banking crisis. The implication is that board ownership and regulatory capital requirement are jointly important in reducing the likelihood of banking crisis.

While the unconditional effect of board ownership was negatively and significantly linked to banking crisis, the conditional effect was positive and significant in the presence of regulatory quality (Model 12). Moreover, we estimated a positive marginal effect of 0.109

Variables	Model 8	Model 9	Model 10
Banking Crisis <sub>t-1</sub>	0.833*** (0.023)	0.792*** (0.023)	0.835*** (0.023)
Banking Crisis <sub>t-2</sub>	0.042*** (0.005)	0.051*** (0.014)	0.046*** (0.009)
Banking Crisis <sub>t-3</sub>	-0.009 (0.009)	-0.012 (0.009)	-0.012 (0.009)
Board mechanism	-0.012*** (0.002)	-0.056*** (0.023)	-0.022*** (0.002)
Regulatory capital	-0.005*** (0.0003)		
Regulatory quality		0.013*** (0.002)	
Monetary policy			0.001*** (0.000)
Board mechanism * Regulatory capital	0.0005*** (5.33e-05)		
Board mechanism * Regulatory quality		-0.0006*** (0.0002)	
Board mechanism * Monetary policy			-0.000139* (8.31e-05)
Bank funding	-0.059** (0.023)	-0.105*** (0.022)	-0.093*** (0.025)
Bank size	0.015*** (0.004)	0.020*** (0.004)	0.020*** (0.004)
Credit risk	0.001*** (9.99e-05)	0.001*** (9.47e-05)	0.001*** (5.48e-05)
Bank concentration	-0.000*** (3.11e-05)	-0.001*** (4.90e-05)	-0.001*** (4.72e-05)
Private credit to GDP	-0.002*** (0.0004)	-0.002*** (0.004)	-0.002*** (0.000)
GDP per capita	0.000112 (0.00101)	-0.002*** (0.001)	-0.002 (0.001)
Exchange rate	-8.86e-06*** (2.36e-06)	-1.23e-05*** (3.19e-06)	5.35e-06** (2.55e-06)
Inflation rate	0.00233*** (0.000719)	-0.001 (0.001)	-0.000 (0.001)
Institutions	-0.0407*** (0.00941)	-0.038*** (0.009)	-0.042*** (0.009)
Constant	-1.063 (1.597)	-0.291 (1.415)	-0.404 (1.305)
Time effect	Yes	Yes	Yes
Country effect	Yes	Yes	Yes
Observations	473	474	474
Wald $\chi^2$	116.35	114.19	118.260
Prob > $\chi^2$	0.0000	0.0000	0.000
Pseudo $R^2$	0.852	0.847	0.839
Marginal effect	-0.0004***	-0.055***	-0.023***

**Notes:** Table 7 shows the interaction effect of internal regulation (board mechanism) and external regulations (regulatory capital, regulatory quality and monetary policy) on the predicted probability of banking crisis using the dynamic ivprobit regression while controlling for past banking crisis events. Computed by authors based on data from Bank Scope of the audited banks and the Global Financial Development database of the World Bank. Banking crisis is a dummy variable and was obtained from the World Bank Global Financial Development database as well as Laeven and Valencia (2018). The first, second and third lags of banking crisis were introduced. Board mechanism is a composite index of six indicators (i.e. absence of CEO duality, presence of board independence, audit independence, small board size and accounting standards). These variables were obtained from the Bank Scope of audited banks. Regulation capital is the ratio of bank regulation capital to risk weighted assets; Regulatory quality is an index for the ability of government to formulate sound financial policy regulation or effective supervision; Monetary policy rate is the central bank policy rate of a country; Bank funding is the ratio of total deposits to total ratio; Bank size is the natural logarithm of total assets; Credit risk is the ratio of nonperforming to gross loan; Bank concentration is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; Private sector credit is the ratio of private credit of deposit money banks to GDP; Exchange rate is the natural logarithm of a country's currency rate to the dollar; GDP per capita is the natural logarithm of GDP per capita; Inflation is measured as consumer price index; Institution is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability). Bank-level data were obtained from Bank Scope of the audited banks; country-level data were obtained from the Global Financial Development database of the World Bank. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

**Table 7.**  
Moderating the effect  
of board mechanism  
on banking crisis  
with external  
regulation

[0.108 + (-0.002\*regulatory quality)] when the mean regulatory quality is -0.383. This suggests that regulatory quality alters the negative impact of board ownership control on the predicted probability of banking crisis. This is possible because of the weak regulatory quality environment in Africa, indicating a negative value, as seen in the summary

VARIABLES	Model 11	Model 12	Model 13
Banking Crisis <sub>t-1</sub>	0.785*** (0.029)	0.696*** (0.032)	0.762*** (0.029)
Banking Crisis <sub>t-2</sub>	0.0420*** (0.005)	0.042*** (0.005)	0.043*** (0.004)
Banking Crisis <sub>t-3</sub>	-0.009 (0.010)	-0.014 (0.009)	-0.011 (0.010)
Board ownership	-0.137*** (0.034)	0.108*** (0.019)	-0.037*** (0.012)
Regulatory capital	-0.002*** (0.000)		
Regulatory quality		-0.014*** (0.002)	
Monetary policy			-0.0001*** (2.58e-05)
Board ownership * Regulatory capital	-0.002*** (0.001)		
Board ownership * Regulatory quality		-0.002** (0.001)	
Board ownership * Monetary policy			-0.009* (0.005)
Bank funding	-0.280*** (0.053)	-0.076*** (0.022)	-0.148*** (0.025)
Bank size	0.032*** (0.006)	0.018*** (0.004)	0.020*** (0.004)
Credit risk	0.001*** (0.000)	0.001*** (7.16e-05)	0.001*** (7.99e-05)
Bank concentration	-0.001*** (5.19e-05)	-0.001*** (3.39e-05)	-0.001*** (3.59e-05)
Private credit to GDP	-0.001 (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
GDP per capita	-0.008*** (0.003)	-0.004** (0.001)	-0.003*** (0.002)
Exchange rate	6.91e-06 (6.52e-06)	-1.24e-05*** (4.19e-06)	-1.07e-05*** (3.99e-06)
Inflation rate	-0.003 (0.002)	0.001 (0.001)	-0.003*** (0.001)
Institutions	-0.071*** (0.012)	-0.052*** (0.011)	-0.070*** (0.012)
Time effect	Yes	Yes	Yes
Country effect	Yes	Yes	Yes
Constant	-2.023 (1.429)	-0.692 (1.378)	-0.967 (1.447)
Observations	392	391	391
LR $\chi^2$	123.410	113.94	110.240
Prob > $\chi^2$	0.000	0.000	0.000
Pseudo $R^2$	0.602	0.863	0.830
Marginal effect	-0.167***	0.109***	-0.114***

**Notes:** Table 7 shows the interaction effect of internal regulation (board ownership control) and external regulations (regulatory capital, regulatory quality and monetary policy) on predicted probability of banking crisis using the dynamic ivprobit regression while controlling for past banking crisis events computed by authors based on data from Bank Scope of the audited banks and the Global Financial Development database of the World Bank. Banking crisis is a dummy variable and was obtained from the World Bank Global Financial Development database as well as Laeven and Valencia (2018). The first, second and third lags of banking crisis were introduced. Board ownership is the proportion of executive share ownership to total share of the bank. Data is obtained from bank scope database. *Regulation capital* is the ratio of bank regulation capital to risk weighted assets; *Regulatory quality* is an index for the ability of government to formulate sound financial policy regulation or effective supervision; *Monetary policy rate* is the central bank policy rate of a country; *Bank funding* is the ratio of total deposits to total ratio; *Bank size* is the natural logarithm of total assets; *Credit risk* is the ratio of non-performing to gross loan; *Bank concentration* is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; *Private sector credit* is the ratio of private credit of deposit money banks to GDP; *Exchange rate* is the natural logarithm of a country's currency rate to the dollar; *lnGDP per capita* is the natural logarithm of GDP per capita; *Inflation* is measured as consumer price index; *Institution* is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability). Bank-level data were obtained from Bank Scope of the audited banks; country-level data were obtained from the Global Financial Development database of the World Bank. Robust standard errors in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

**Table 8.**  
The interaction effect  
of external regulation  
on the relationship  
between board  
ownership and  
banking crisis

statistics. The interaction between board ownership control and monetary policy was negative and significant, and the marginal effect was  $-0.114[0.037 + (-0.009*\text{monetary policy})]$  when monetary policy assumes a mean of 8.535. The implication is that monetary policy enhances the negative impact of board ownership control on the predicted probability of banking crisis.

## 5. Conclusion and implications

The purpose of the study is to investigate whether internal and external regulatory frameworks jointly play a significant role in controlling the predicted probability of banking crisis in Africa. The study used the dynamic panel ivprobit regression model for a dataset of banks in 52 African countries from the year 2006 to 2018. First, we examine the effect of internal regulations on the predicted probability of banking crisis. We use board mechanism and board ownership control to proxy internal regulations. We observe that the positive impact of banking crisis is persistent for some few years but dissipates in the long run (i.e. after two years). Thus, previous banking crisis is less likely to impact the next crisis after few years. We show that board mechanism and board ownership are important in reducing the likelihood of banking crisis. The implication is that board characteristics and ownership structure of banks should continue to exert greater control on the opportunistic behavior of managers and thereby enforce stricter discipline that may enhance a stable banking system and reduce possible banking crisis.

Second, we analyze the impact of external regulations on banking crisis. We used regulatory capital, regulatory quality and monetary policy to proxy external regulations. We found evidence to support a negative impact of regulatory capital and monetary policy on the predicted probability of banking crisis. Thus, stringent capital requirement and tight monetary policy aid in mitigating possible banking crisis. However, regulatory quality was positively linked to banking crisis due to the nature of regulatory quality exhibited in Africa. By introducing the interaction terms between internal and external regulations into the model, we found that regulatory capital enhances the negative impact of board mechanism on banking crisis. Monetary policy augments the negative impact of board mechanism on predicted probability of banking crisis. Similarly, regulatory capital magnifies the negative impact of board ownership on banking crisis. Again, we found that monetary policy magnifies the negative impact of board ownership control on the predicted probability of banking crisis. Thus, capital regulation and internal regulations are jointly important in reducing possible banking crisis. Similarly, monetary policy and internal regulations are complements in reducing possible banking crisis in Africa. However, regulatory quality alters the negative impact of board mechanism and board ownership on the predicted probability of banking crisis.

The results of the study have important policy implications. First, countries in Africa should strengthen their quality of regulation in such a way that it can play a strong and complementary role to a robust internal control mechanisms so as to maintain stability in the banking system. Second, regulators and policymakers should design greater coordination of external and internal regulations through a single regulatory framework and a common resolution mechanism that make the banking system more robust in curbing possible crisis.

The limitation of the study is that it did not explore all measures of regulatory framework and how they impact banking crisis. However, it has an advantage of using alternative measures of regulations in a banking crisis probability model. We recommend that future studies should include other macro-prudential regulations, regulatory environments and supervision and observe how they are coordinated to reduce possible crisis in a robust methodological framework.

## Notes

1. Appendix shows a table of banking crisis dates of countries in Africa over the period under study.
2. Test results can be found in Appendix II. The results confirm that time- and country-fixed effects are needed in the models.

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Country	Banking crisis	Currency crisis	Sovereign crisis
Algeria	X	X	X
Angola	X	2015	X
Benin	X	X	X
Botswana	X	X	X
Burkina Faso	X	X	X
Burundi	X	X	X
Cabo Verde	X	X	X
Cameroon	X	X	X
Central African Republic	X	X	X
Chad	X	X	X
Comoros	X	X	X
Congo, Dem. Rep.	X	2009,2016	X
Congo, Rep.	X	X	X
Côte D'Ivoire	X	X	2010
Djibouti	x	X	X
Egypt, Arab Rep.	X	2016	X
Equatorial Guinea	x	X	X
Eritrea	X	X	X
Eswatini	X	X	X
Ethiopia	X	X	X
Gabon	X	X	X
Gambia	X	X	X
Ghana	2017, 2018	2009, 2014	X
Guinea	X	X	X
Guinea Bissau	2014, on going	X	X
Kenya	X	X	X
Lesotho	X	2015	X
Liberia	X	X	X
Libya	X	X	X
Madagascar	X	X	X
Malawi	X	2012	X
Mali	x	X	X
Mauritania	2009, 2011	X	x
Mauritius	2011	X	X
Morocco	X	X	X
Mozambique	X	2015	X
Namibia	X	2015	X
Niger	X	X	X
Nigeria	2009, 2010, 2011, 2012	2016	X
Rwanda	X	X	X
Sao Tome and Principe	X	X	X
Senegal	X	X	X
Seychelles	2007	2008	2008
Sierra Leone	X	X	X
South Africa	2015	2015	2015
South Sudan	X	2015	X

**Table A1.**  
Banking crises dates  
in Africa between  
2000–2018 periods

(continued)

Country	Banking crisis	Currency crisis	Sovereign crisis
Sudan	2012	2012	X
Swaziland	X	2015	X
Tanzania	X	X	X
Togo	X	X	X
Tunisia	X	X	X
Uganda	X	X	X
Zambia	2009,2015	2009, 2015	X
Zimbabwe	x	X	x

**Notes:** NB: This table shows dates of banking crisis episodes covering our sample period; X denotes no crisis.

**Source:** [Laeven and Valencia \(2018\)](#) and [World Bank \(2012\)](#), Global Financial Development of the World Bank, 2018

**Table A1.**

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