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Bank lending behaviour and systemic banking crisis in Africa: The role of regulatory framework

Daniel Ofori-Sasu | **Elikplimi Komla Agbloyor** | **Saint Kuttu** | **Joshua Yindenaba Abor**

University of Ghana Business School, Legon, Ghana

Correspondence
Elikplimi Komla Agbloyor, University of Ghana Business School, Legon, Ghana.
Email: ekagbloyor@ug.edu.gh

Abstract

We examine how regulatory framework shapes the impact of bank lending behaviour on the probability of systemic banking crisis by using data from 52 African countries over the period 2006–2018. The study found that banks that lend beyond a certain level of threshold have the greater probability of causing a systemic banking crisis. The study provides empirical evidence in support of the argument that above average lending behaviour reduces the predicted probability of a systemic banking crisis in the presence of audit independence, at stringent–capital regulatory requirement, central bank independence and monetary policy framework.

KEYWORDS
above lending behaviour, regulatory framework, systemic banking crisis

1 | INTRODUCTION

It is evident that the banking sector is one of the backbones of financial and economic systems that facilitate capital accumulation and economic growth, mostly through their core function of credit supply (Vo, 2018, 2020). However, over the years, many countries have experienced significant banking sector problems. Among these, episodes of systemic banking crisis seem to dominate, as shown in most developed (Laeven & Valencia, 2018; Romer & Romer, 2017) and developing economies (Egboro, 2016; Motsi et al., 2018). To that extent, some researchers and policymakers have shown interest in understanding the causes of the systemic banking crisis (Laeven & Valencia, 2018). The World Bank (2012) argues that a systemic banking crisis occurs when many banks in a particular country are

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insolvent (or have liquidity problems) at the same time. This could be 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.

Gleaning from the literature, although, many determinants of systemic banking crises have been established (Gorton, 2008; Laeven, 2011; Laeven & Valencia, 2018; Romer & Romer, 2017), one key determinant of a banking crisis that has increased attention is bank lending behaviour (Davis et al., 2014; Yasnur & Kurniasih, 2017). It is clear in the literature that lending of banks is good for stable banking systems and developments in the economy, particularly in developed economies (Yasnur & Kurniasih, 2017). However, a number of studies show that a banking crisis is typically preceded by excessive lending or credit demand (Allen & Giovannetti, 2011; Rajan, 2005). This suggests a positive relationship between higher credit advancement and a possible systemic banking crisis. The question, however, is, does the positive impact depend on the level of bank lending behaviour, especially in Africa?

This paper is one of the first to study bank lending behaviours and the likelihood of a banking crisis, and further, on the role of regulation in shaping this relationship. Africa remains one of the most financially under-developed parts of the world and this can be attributed to the lack of credit access, private sector financing problems, lack of creditworthy borrowers, problems of information barrier, moral hazard and adverse selection (Amidu, 2014; Andrianova et al., 2011; Honohan & Beck, 2007). These problems discourage banks from lending to domestic customers. However, there have been legal frameworks enforced to mitigate these problems. For instance, if legal systems allow banks to enforce loan contracts, borrowers are less likely to default deliberately and this helps banks to choose to engage in investments they know to be highly risky. Also, credit relations arise because banks, in their role as delegated monitors operate beyond passive lenders. Failure of the credit markets to function efficiently causes the government to set up regulations that encourage bank lending to meet excessive credit demand. According to Andrianova et al. (2011), there is a certain minimum standard of regulation that ensures that the credit market does not malfunction, and below this minimum standard, banks may be discouraged from lending to a degree that will trigger a possible banking crisis.

In dealing with the possible banking crisis in Africa, banks must have effective ways to determine the appropriate amount of credit to lend to mitigate unexpected losses arising from credit risk exposures, as well as a possible crisis. In this study, it is argued that bank lending behaviour has the predictive ability to influence the banking crisis in Africa. The study finds out the relationship between the lending behaviour of banks and banking crises. With the view that just establishing the relationship between lending and banking crisis may not be informative to policymakers, unless the level at which bank lending may trigger a banking crisis is established. The study fills this gap and contributes to empirical literature by finding the threshold point at which bank lending may trigger a banking crisis. We also test the impact of average, below average and above average lending on the predicted probability of a banking crisis, using a dynamic instrumental variables probit model.

Studies have shown the relationship between bank lending behaviour and banking crisis (Boissay et al., 2016; Dang, 2019; Hahm et al., 2011; Yasnur & Kurniasih, 2017) in developed countries. For instance, Yasnur and Kurniasih (2017) found that bank lending has a significant role in financing the national economy; however, excessive credit expansion or lending below credit standards triggers a banking crisis (Dang, 2019). Moreover, significant efforts have been devoted towards understanding bank lending behaviour (Vo, 2018, 2020; Vo et al., 2021); and how banking regulation (Gersbacha & Rochet, 2017) and governance structure (Faleye & Krishnan, 2017; Vo, 2018) influence bank lending. However, less attention is given to the role of regulation in shaping the relationship between bank lending behaviour and predicted banking crisis, particularly in Africa. A regulatory framework is a set of financial regulations and policies officially developed and approved by the government to regulate the financial sector (Shahchera & Jouzdani, 2011), and internal regulatory policies that control the actions and operations of banks. Along with the importance of regulations, Laeven and Valencia (2013) as well as Lu (2017) provide a review of the literature on systemic banking crises and suggest that banking system stability can be enhanced by making banking regulations more macro-prudential. However, this claim remain an assertion that needs to be empirically tested from the African context. Our study differs from the work of Lu (2017) in the view that while he examines the impact of specific regulatory (capital regulation) and supervisory practices and intervention policies on banking crisis, we consider the bank

lending channel through which different set of regulations like audit independence, regulatory capital, central bank independence and monetary policy can affect systemic banking crisis.

Beyond the investigation of Lu (2017), we investigate how different sets of regulations interact with bank lending behaviour to influence systemic banking crisis. It is against this backdrop that we aim at contributing to the extant literature. Banks that provide average lending have the likelihood of reducing banking crisis. However, banks that lend aggressively or those who lend above the average have the possibility of increasing banking crisis. These will mean that banks should determine the threshold level of lending that will not trigger banking crisis, thus, lending beyond this level will positively affect systemic banking crisis. This advances the argument that regulatory framework will be needed to control the likelihood of banking crisis through bank lending behaviour. Thus, stringent regulatory framework may induce a greater reduction of the positive impact of above average lending on the likelihood of systemic banking crisis, hence mitigate banking crisis.

Moreover, Africa presents a fine case because a systemic banking crisis occurs at unknown intervals throughout history in some African countries (Laeven & Valencia, 2013). Moreover, there have been changes and adjustments to lending standards and regulatory frameworks among African countries (Allen & Giovannetti, 2011; Egboro, 2016). It is within this context that we provide an empirical examination of how regulatory frameworks impact bank lending behaviour and systemic banking crisis relationship.

Therefore, our aim is to contribute to the literature by establishing the threshold level at which bank lending behaviour will lead to a crisis and how different sets of regulatory framework will alter the relationship between above average lending behaviour and the likelihood of a systemic banking crisis.

The rest of this paper is organised as follows. The next section briefly reviews the literature. The third section details the data and methods employed for the study. Section 4 presents and discusses the results. The final section concludes and provides the policy implication of the study.

2 | LITERATURE REVIEW

The study draws inspiration from existing literature that posits that crisis is triggered by a moderate negative productivity shock towards the end of an unusual boom in credit. In theory, Boissay et al. (2016) explained that an increase in the productivity of capital leads to a demand-driven expansion of credit. Such a situation pushes interest rates above steady states. As productivity turns back to normal, credit demand by firms declines, whereas households continue to accumulate assets. This feeds into supply-driven credits by banks, leading to a fall in interest rates below steady states. This gives banks the incentives to take more risks or misbehave, leading to bank distress. Thus, higher levels of bank lending can be said to have a significant impact on the possibility of a banking crisis. Following the literature on the causes, consequences and resolution of banking crises (see Laeven & Valencia, 2013, 2018; Ozili, 2018; Yasnur & Kurniasih, 2017), excessive credit booms were prominent among banks across countries. Laeven and Valencia (2013) provide evidence that banking crises are a result of faulty banking practices due to misguided lending during credit booms. It is argued that 'the credit system leads to a substantial aggravation of crises and can become a cause of crises, itself' (Dodig & Herr, 2015, pp 20). It is explained that over-expansion of credit offered by the financial system, which also gives loans for speculation, often reaches its peak of an upturn and abruptly comes to a stop (Dodig & Herr, 2015, pp 20). Banks decide to curtail credit expansion due to fears for own liquidity position. Thus, panic and a general tendency to hoard money can lead to a crisis. Although some had argued against the impending dangers resulting from excessive credit expansion (Rajan, 2005), such warnings were ignored by many (Laeven & Valencia, 2013, 2018) from the African context.

Bank lending has a significant role in financing the national economy, and it is the driving force for economic growth (Yasnur & Kurniasih, 2017). However, misguided lending behaviour may hinder the growth process. Despite the many complaints about poor access to financing by households and firms in some African countries, the sector continues to prioritise private-sector financing as a growth area (European Investment Bank, 2015) while some

countries in Africa still face banking crises in the region. During expansions, bank market funding and credit supply increase, pushing down the rates of return on loans. The larger the volume of credit relative to the possibilities of the productive use of loans, the larger the fall in the rate of interest. This is likely to cause higher probability of a bank run, and therefore, may lead to a banking crisis. However, this claim remains an assertion that needs to be tested empirically.

From the theory of regulation, it can be inferred that regulations generally improve the interest of the entire society as well as the dominant individuals or groups in the society (Zucker, 1987). Over the years, several theories of economic regulation have been developed to explain the crisis of the banking system (Lu, 2017). These theories have been employed to guide policymakers in their quest to curb a possible crisis from occurring, to provide monetary control, bank safety and overall banking stability in the financial system (Ogus, 2004). For instance, the public interest theory takes the view that regulation is a public good whose allocation is governed by the laws of demand (i.e., acquired and designed by the industry for its benefit) and supply (mostly supplied by policymakers) (Stigler, 1971). From the theory of economic regulation, in the case of the banking industry, it might be argued, for example, that risk-weighted capital requirements are enacted for the benefit of the banks. On the demand side, the banks ask for more regulation that does not seek to correct market inefficiencies or market failures, but rather to promote the interests of some economic groups. There is a justifiable reason in addition to the public interest theory that regulations are the result of crisis situations that persist after the end of a crisis (Rochet, 2008). This situation is based on the fact that an existing structure of market participants' rights of action leads to an undesirable outcome in the market process. Given, the important role that regulations play in building a strong and effective institution, policymakers may find it informative to ascertain the impact of regulations on the relationship between lending behaviour and possibility of a crisis in the banking system. Thus, the need for the present study.

2.1 | Empirical literature

From an empirical perspective, no study seems to have studied the role that regulations play in lending-banking crisis nexus. However, while few studies have investigated how excessive credit supply can lead to banking crisis, this study takes inspiration from such studies. For instance, most studies viewed banking crisis from a credit risk perspective. Specifically, finance studies have documented that credit risk triggers banking crisis (Tan & Anchor, 2016; Tan & Floros, 2018), while Kroszner et al. (2007) and Dell'Ariccia et al. (2008) found that economic sectors depend more on external funding, and it is the reason why developing countries suffer more during banking crises. Moreover, Vo et al. (2021) examined the role of managerial ability in bank lending behaviour by employing data containing virtually all banks operating in the United States during the period 1990–2017. They found that more ably managed banks have large loan amounts and high loan quality.

In terms of regulatory impact on banking crises, previous studies have argued that poor internal regulatory practices have increasingly been acknowledged as an important cause of most banking crises (Addison, 2018; Allen & Giovannetti, 2011). For instance, Allen and Giovannetti (2011) indicated that many African countries experiencing fragility in their banking system are characterised by weak banking regulatory mechanisms. Moreover, external regulations (e.g., monetary policy), have been found to trigger banking crises in the literature (see Alstadheim et al., 2017). Klomp and de Haan (2014) argued that capital regulation and supervision influence banking system stability (Klomp & de Haan, 2014). Barth et al. (2013) established that some regulations and supervisory practices enable developing countries to lower the likelihood of a country suffering a banking crisis. Most of the empirical literature supports Basel II and III pillars of capital requirements in reducing possible banking crises. For example, Demirguc-Kunt et al. (2012) found that countries with weak regulatory capital and supervisory frameworks are associated with greater crises.

Following existing literature, Halvorsen and Jacobsen (2016) examined the bank lending channel of monetary policy and documented a negative impact of contractionary monetary policy on the probability of a banking crisis. Further, Svensson (2017, 2018) found a positive impact of monetary policy on the probability of banking crisis.

Cehajic and Kosak (2021) analyse the effects of macro-prudential measures on bank lending in the European Union. They employed 3434 European banks with 18,616 observations covering the period between 2000 and 2017. They found that macro-prudential instruments are used effectively by regulatory authorities for modulating credit activities of banks across the business cycles. Oduor et al. (2017) employed 162 bank dataset in 37 African countries from 2000 to 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. It is evident that a focus on central bank objectives reduce the likelihood of banking crises. This is because a high degree of central bank independence, macro-prudential action, monetary policy, regulatory and supervisory responsibilities of the central bank reduce the likelihood of a banking crisis (Balls et al., 2016; Cehajic & Kosak, 2021, 2022; Oduor et al., 2017; Svensson, 2018). Despite a number of literature has shown the positive impact of regulations on possible banking crisis, it appears this current paper is the first or one of the few papers that examines the role of regulations (capital regulation, monetary policy and central bank independence) in reducing a positive lending-banking crisis nexus. Further, the current study extends the works of Balls et al. (2016) in two ways: first, it investigates the levels of bank lending behaviours that may predict the likelihood of a country suffering a banking crisis. Second, it examines the role of regulatory frameworks in moderating the impact of bank lending behaviour on a systemic banking crisis probability.

Based on the related literature discussed above, the following hypotheses are formulated:

H1 *Average lending is likely to reduce the possibility of a banking crisis while a higher lending behaviour (above average lending) has the predicted probability of leading to a systemic banking crisis.*

H2 *Regulatory framework minimises a positive impact of above average lending on a systemic banking crisis.*

3 | DATA AND METHODOLOGY

The study examines the role of a regulatory framework in explaining the effect of bank lending behaviour on the predicted probability of the crisis. The study employs a panel dataset of banks in 52 African countries[1] over the period 2006–2018. The motivation for the selection of countries and study period is based on data availability at the time of the study.

3.1 | Model specification

3.1.1 | Bank lending behaviour and systemic banking crisis

The study adopts the dynamic instrumental variable probit (ivprobit) estimation technique. The dynamic ivprobit estimation technique is expressed as follows:

$$SysBCrisis_{jt} = \sum_{q=1}^{3} \alpha_q SysBCrisis_{jt-q} + \sum_{l=4}^{M} \alpha_l Bank\ Lending\ Behaviour_{jt} + \sum_{k=1}^{N} \beta_k X_{jt} + \gamma_j + \mu_t + \varepsilon_{jt} \quad (1)$$

The subscript j denotes a cross sectional dimension (country specifics), $j = 1, \ldots, M$; t denotes the time series dimension (time), $t = 1, \ldots, T$; α_q: $q = 1, \ldots, 3$, are the coefficients of the lags $(t - q)$ of the dependent variable; $\alpha_l : l = 4, \ldots, M$, represent the regression coefficients of vectors of three bank lending behaviour variables; β_k: $k = 1, \ldots, N$, are regression parameters for vector X to be estimated; γ_j is the country fixed effect; μ_t is the time fixed effect t; and ε_{jt} is an idiosyncratic error term, which controls for unit-specific residual in the model for the jth *country* at *period* t.

[1]See Appendix C

3.1.2 | Dependent variable

The dependent variable is systemic banking crisis (*SysBCrisis*). Consistent with recent systemic banking crisis literature (Laeven & Valencia, 2018), the dependent variable is systemic banking crisis. Data on systemic banking crisis is a dummy variable and was obtained from the World Bank Global Financial Development Database as well as from Laeven and Valencia (2018) showing the dating of a systemic banking crisis. The model specification allows us to capture the persistence of systemic banking crisis, using the lag of dependent variable. The study expects a positive relationship between the lag of systemic banking crisis and the current systemic banking crisis. This implies that banks' that were hit with a crisis situation in the past year may have a greater possibility of facing a systemic banking crisis in the current year.

3.1.3 | Bank lending behaviour

In accordance with the justification provided by Vo et al. (2021), bank lending behaviour explains the ability of banks to take lending decisions based on the amount of funds they are able to raise from the surplus unit. Bank lending is measured as the ratio of aggregate loans to total asset for the banks in each country. Higher values suggest higher lending behaviour. The data used to construct bank lending are collected from the Bank Scope database. Based on this, the 'Bank Lending Behavior' variable in Equation (1) is decomposed into three (3), namely, average bank lending (measured as aggregate customer loans to asset ratio at country level) (Dang, 2019); below average lending (computed with a dummy equal to 1 if values are strictly below industry average of the banks in a country); and above average lending (a dummy variable equal to 1 if values are equal to or greater than the mean of bank lending for the banks in a country).

The study expects either a positive or negative relationship between bank lending and predicted banking crisis probability. A positive relationship suggests that banks that expand more credits to the public are more likely to face risk of default, liquidity problems and insolvency. This may eventually increase the chances for a banking crisis to occur. A negative relationship between bank lending and banking crisis suggests that banks that have the capacity to lend more, due to higher demand by borrowers, may do so under adequate information and proper client relationship, thus leading to a reduction of banking crises in the future. This agrees with Roulet (2018) that banks are able to instil appropriate loan recovery mechanisms that can reduce the next banking crisis.

This study argues that if higher levels of lending can increase the next banking crisis, then there is a level at which banks should lend to minimise the likelihood of a banking crisis. The study provides empirical contributions by introducing the squared term of bank lending and estimates the threshold level at which higher levels of bank lending may trigger the next crisis. The squared term is expected to be negatively linked to systemic banking crisis. It computes the threshold point at which bank lending influences a banking crisis. Possibilities of banking crises are expected at higher threshold levels. The study argues that there is a threshold point beyond which bank lending triggers a banking crisis. Therefore, we estimate this threshold point and interpret the result.

For robustness check, the study employs 'below average lending' and 'above average lending' to analyse their impact on banking crisis. The study largely expects a negative relationship between below average lending and a systemic banking crisis. This is because a country that often increases its lending standards (i.e., increasing interest rates and discouraging more credit) has the possibility of reducing credit risk exposures and a possible crisis. However, the opposite should be true for the above average lending and banking crisis nexus. This is expected because countries that increase their lending levels above the industry average are likely to face a banking crisis as suggested by Hess et al. (2009) and Foos et al. (2010).

In Equation (3), X is a vector of control variables. These include bank deposit funds (ratio of total deposits to total asset); 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 sector credit (ratio of private sector credit

to GDP); foreign bank entry (measured as dummy, 1 = year of foreign bank entry, 0 otherwise), exchange rate (natural logarithm of a country's currency rate to the dollar) and natural logarithm of gross domestic product (GDP) per capita; 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 control variables were obtained from the World Bank Global Financial Development database and Bankscope database. The data on exchange rate and GDP per capita were obtained from World Development Indicators. We expect a negative relationship between deposit funds of banks and banking crisis. This shows that banks with greater funding sources are able to reduce the probability of banking crisis. This is because the role of banks in mobilisation and supply of funds is not only important to the real sectors of the economy, but also good for a stable banking system. We expect credit risk to positively affect banking crisis because banks that have higher levels of non-performing loans (credit risk exposures) suffer banking crisis. We expect either a positive or a negative relationship between bank concentration and banking crisis. A positive in the sense that a concentrated banking system has the incentive to take excessive risk, which may affect the stability of the bank due to moral hazard problems. A negative relationship because concentrated banking system has more market power to increase profits and reduce risk-taking, hence decreasing insolvency and the likelihood of a systemic banking crisis (Shehzad et al., 2009). We expect a positive relationship between private sector credit and banking crisis probability. This suggests that rapid growth in private sector credit is a strong predictor of banking crisis (Davis et al., 2014). Foreign bank entry is expected to have a negative impact on banking crisis. This suggests that a country with increasing number of foreign banks entry will reduce the possibilities of crisis given the liberalisation in the flow of technology and increased competition (Ukaegbu & Oino, 2014). We expect a positive impact of exchange rate on banking crisis because higher exposure to exchange rate risk increases systemic banking crisis possibility. We expect a positive or negative effect of GDP per capita on banking crisis probability. A positive relationship because higher income countries increase banking crisis when households consume more than they save. A negative relationship because banking crisis is likely to be reduced by countries with higher income levels when households are able to supply funds to the financial institutions. We expect a negative relationship between institution and banking crisis since countries with strong institutions are able to reduce the possibility of banking crisis.

3.2 | Bank lending behaviour, regulatory framework and systemic banking crisis

In this section, we specify a model that explains the effect of regulatory framework in altering or moderating the positive effect of above average lending on predicted banking crisis probability.

To capture possible unobserved heterogeneity, and the impact of regulatory framework on the lending-crisis nexus, the study specifies the following models, which include the interaction terms as follows:

$$\begin{aligned} SysBCrisis_{jt} = \quad & \sum_{q=1}^{3} \gamma_v SysBCrisis_{jt-v} + \alpha_1 Above\ Average\ Lending_{jt} + \sum_{l=1}^{m} \lambda_l RegFramework_{jt} \\ & + \sum_{q=1}^{p} \delta_q \left(Above\ Average\ Lending_{jt} * RegFramework_{jt} \right) \\ & + \sum_{k=1}^{N} \beta_k X_{jt} + \varsigma_j + \theta_t + \mu_{jt} \end{aligned} \tag{2}$$

where δ_q: $^{q=1,\ldots,p}$ denote the coefficients of the interaction terms between regulatory frameworks and above average lending.

γ_v: $v = 1, \ldots, 3$ is the coefficients of the lags of the dependent variable in Equation (2).

β_k, $k = 1, ..., N$ are the coefficients of the control variables (for vector X); λ_l: $l = 1, \ldots, m, r$ epresent the coefficients of regulatory framework (both internal and external variables).

ς_j is the individual country effects; θ_t is the time fixed effects and μ_{jt} is the composite error term.

The interaction effect of regulatory framework can be estimated using the marginal effect given as follows:

$$\text{Marginal Effect} => \frac{\partial SysBCrisis_{j,t}}{\partial Above\ Average\ Lendingjt} = \alpha_1 + \delta_q RegFramework_{j,t} \tag{3}$$

where α_1 represents the coefficient of above average lending of the banks in a country (*Above Average Lending*); and δ_q is the coefficient of the interaction terms.

3.2.1 | Role of regulation

First, the study runs the model by introducing regulatory framework variables and above average lending but without the interaction terms (unconditional effect).

In accordance with economic and banking regulation literature (Fidrmuc & Hainz, 2013; Gersbacha & Rochet, 2017; Stigler, 1971), the study decomposes regulatory framework variables (*RegFramework*) into (1) audit independence (an independent review of the bank is equal to 1 if a bank is audited by any of the top 4 auditing firms) (KPMG, PwC, Deloitte and Ernst and Young, and 0 otherwise); (2) capital regulation (ratio of bank regulatory capital to risk weighted assets); (3) de jure central bank independence (a weighted aggregation of 16 legal indicators in four categories regarding the tenure of the bank's governor, policy formation, objectives and limitations on lending to the government, using the criteria and weights in the Cukierman, Webb and Neyapti (CWN) legal index); and (4) monetary policy (monetary policy rates). We obtained audit independence obtained from Bankscope databases and audited financial statements of the banks, where the values ranges between 0 (representing banks not audited by an independent body) and 1 (representing banks audited by an independent body). We obtained capital regulation data from World Bank Global Financial Development Database. The values of regulatory capital ranges from 0 to 1, with higher values indicating stringent or strong regulatory capital. The study obtained central bank independence from the IMF's Central Bank Law database and CWN legal CBI index from Garriga (2016) with higher values indicating more independent function of the central bank. The data on monetary policy rates was obtained from IMF (International Financial Statistics), ranging between 0 (0%) and 1(100%), with higher values indicating contractionary monetary policy.

The study expects a negative impact of each regulatory framework variables on systemic banking crisis without the interaction terms. This suggests that a country with strong external regulatory framework has the incentive to reduce the probability of a systemic banking crisis.

3.2.2 | Interaction effect

The study has argued for a positive unconditional effect of above average lending on banking crisis earlier. In this section, we are interested in whether specific regulatory framework amplifies, reduces or alters (reverses) the positive impact of above average lending on the likelihood of systemic banking crisis in Africa. Thus, we compute the marginal effects (see Equation 3), use marginal plots and interpret our results. The study expects a negative marginal effect of above average lending on banking crisis when interacted with the regulatory framework. A negative marginal effect suggests that stringent regulatory framework is one way of ensuring market discipline and that it provides an incentive for managers and shareholders to reduce excessive risk-taking and absorb losses during bank distress. This has the potential to reverse or reduce the positive impact.

Finally, the relationships between the control variables and the predicted probability of banking crisis are presented in Appendix A.

3.3 | Estimation technique

The study employs the dynamic panel instrumental variable probit (ivprobit) regression method for the study. The choice of this estimation approach is informed under the assumption that the distribution of the parameters is restrictive and that the model gives more flexibility that is consistent with contemporary dynamic ivprobit literature

(Bartolucci & Nigro, 2012). The estimation method allows the study to use an extended vector of covariates, which includes the lagged response variable. For the ivprobit model, the errors are assumed to follow the standard logistic distribution, the results are much easier to interpret, and it gives parameter estimates, which are asymptotically consistent, efficient and normal (Buis, 2010; Honoré & Weidner, 2020; Jones, 2007; Lu, 2017). This affords many researchers an added advantage, as problems of out-of-range estimates are avoided (Hosmer et al., 2013). In our estimations, the lag of crisis is likely to cause endogeneity problem that may result from the fact that once the crisis starts, it is likely to affect the evolution of the macro and financial variables on the right hand side. Following Papi et al. (2015), we minimise simultaneity problems by introducing a year lag of the explanatory variable. To counter any endogeneity between a regressor and the error term, as well as a dual causality relationship between bank lending behaviour and banking crisis (see Bascle, 2008; Gonçalves et al., 2008), the method of applying instrumental variable probit was used. This method helps us to control for problems of omitted variable bias. We use the possible structural changes in the future values of average bank lending as instrument for bank lending behaviour.

The possible structural changes in the future values of bank lending is a dummy, which takes the value of 1 when a change in average bank lending over the current and the next 6 to 10 years period (in which there have been no occurrence of banking crisis and election in our sample) is strictly positive (i.e., future lending strictly greater than current lending), and zero otherwise. We do not include years of election in the models due to endogeneity problem. For instance, Dinç (2005) documents that political influence on state owned banks in emerging markets leads to greater lending in election years, which may undermine stability in the banking sector (see also Papi et al., 2015). In building the instrumental variable, we consider changes in bank lending that took place in the subsequent 6 to 10 years before an election event and the occurrence of a banking crisis (i.e., the lead values of changes in bank lending is constructed at least 6 years before an election year and a crisis year). This allows us to limit the direct effect of bank lending behaviour and subsequent crises. The instrumental variable is arguably exogenous; it deals with reverse causality and it satisfies the relevance and exclusion restriction assumptions (Lousdal, 2018)—because the event that corresponds to possible structural changes in bank lending occurs after a bank provides financing. A test of instrumental variable shows that weak instrument is not a problem and that the instrument is valid (see Appendix A). In addition, a possible structural changes in the future values of bank lending is a good predictor of a bank's lending capacity but do not affect the likelihood of a banking crisis other than through a bank giving out loans (see Moser & Sturm, 2011; Papi et al., 2015; Shehzad & De Haan, 2009). Similarly, perception of macroeconomic indicators can affect bank lending, leading to a destabilising effect on financial stability. However, the fact that a structural change in future lending of banks includes periods without election and banking crisis is enough to minimise the potential endogeneity or to make it unlikely that the emergence of a crisis was already a key issue in the lending-crisis debate.

In addition, the technique used in STATA allows the system to choose its instruments (Kohler & Kreuter, 2005). The robust standard errors of the dynamic ivprobit model were used to correct for heteroskedasticity and autocorrelation. Finally, following Mehrez and Kaufmann (2000), we examine the impact of regulations on the likelihood of a banking crisis thereby minimising potential problems of endogeneity. To check for the conditioning effect of bank lending beheviour, we introduce an interaction term of regulations.

4 | RESULTS AND DISCUSSION

In this section, we present, interpret and discuss the results from the empirical estimation.

4.1 | Descriptive statistics and correlation

From Table 1, the average annual bank lending is 49.6%. This suggests that banks on average lend 49.6% of total assets to customers. Above average lending of banks in Africa recorded a mean of 53.1% while below average lending of banks recorded a mean of 39.4%. In Table 1, a mean of 9% for independent audits among banks in Africa suggests

TABLE 1 Summary statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Lending behaviour variables					
Bank lending	602	0.496	0.145	0.008	0.96
Below average lending	602	0.394	0.489	0.000	1.00
Above average lending	602	0.531	0.499	0.00	1.00
Regulatory framework					
Audit independence	508	0.09	0.28	0.00	1.00
Regulatory capital	669	0.16	0.06	0.01	0.39
Central bank independence	610	0.58	0.17	0.25	1.00
Monetary policy rate	663	0.0854	0.06	−0.04	0.26
Control variables					
Bank deposit funds	574	0.752	0.218	0.001	0.97
Credit risk	669	0.09	0.07	0.0008	0.45
Bank concentration	658	0.55	0.28	0.003	1.00
Private sector credit	672	0.23	0.23	0.00	0.95
Foreign bank entry	568	0.59	0.49	0.00	1.00
Exchange rate	662	4.17	2.42	0.09	10.27
lnGDP per capita	664	2.76	4.04	−17.47	24.22
Institution	563	−0.483	0.545	−0.853	1.66
Instrumental variable					
$\Delta F\_Lending_{t-6,\ t-10}$	664	0.775	0.418	0.00	1.00

Note: The table shows the descriptive statistics of the variables. The variables are normally distributed with *p*-value for SWILK test at 1% level.

that most banks are not audited by the top 4 auditing firms. The mean of regulatory capital is 16%, ranging between 1.10% and 39% across the region. The mean of central bank independence is 58%. This suggests that central bank independence policy in Africa is 58%. Monetary policy rates recorded a mean of 8.54%.

The summary statistics of the control variables are presented in Table 1. The correlation results in Table 2 show the level of significance of the correlation coefficient at 1%. The results show that multi-collinearity should not be a problem, as confirmed by a coefficient of less than 0.7 (Kennedy, 2008) and a mean VIF of 2.81, which is below the threshold of 10.

4.2 | Regression results

First, we present the effect of bank lending behaviour on systemic banking crisis and estimate the thresholds. Next, we show the marginal effect of regulatory framework on the impact of above average lending on predicted systemic banking crisis probability.

4.2.1 | Bank lending behaviour and systemic banking crisis

From Table 3, the first and second lags of the dependent variable was positive and significant across the models. This suggests that countries that experienced a banking crisis in the past 2 years are more likely to face banking crisis in

TABLE 2 Pairwise correlations

Variables	VIF	(1)	(2)	(3)		(4)	(5)	(6)	(7)
(1) Bank lending	3.65	1.000							
(2) Below average lending	1.06	−0.098	1.000						
(3) Above average lending	3.06	0.556*	−1.000	1.000					
(4) Audit independence	1.47	−0.080*	0.128*	−0.128*	1.000				
(5) Regulatory capital	2.17	−0.160*	0.203*	−0.203*	0.048*	1.000			
(6) Central Bank independence	2.72	0.285*	−0.279*	0.279*	0.077*	0.014	1.000		
(7) Monetary policy rate	2.75	−0.190*	0.340*	−0.340*	0.046*	0.091*	−0.297*	1.000	
(8) Bank deposit funds	1.15	0.044*	−0.043*	0.043*	−0.124*	−0.115*	0.086*	0.040*	1.000
(9) Credit risk	1.32	−0.015*	0.045*	−0.045*	0.213*	0.033*	0.027*	−0.077*	−0.106*
(10) Private sector credit	2.27	−0.133*	0.203*	−0.203*	0.080*	0.143*	0.052*	0.178*	−0.093*
(11) Foreign bank entry	3.62	−0.001	0.144*	−0.144*	0.023*	0.021*	0.007*	0.037	−0.059*
(12) Bank concentration	5.25	−0.279*	0.341*	−0.341*	0.091*	−0.213*	−0.246*	0.251*	−0.026*
(13) Exchange rate	5.40	−0.528*	−0.008	0.008	−0.019*	0.009	0.023*	−0.213*	0.078*
(14) lnGDP per capita	1.16	0.046*	−0.116*	0.116*	−0.010*	−0.042*	0.065*	0.106*	0.070*
(15) Institution	3.74	0.025*	0.108*	−0.108*	0.199*	0.008	0.066*	0.098*	−0.050*

Note: **Bank lending** is the ratio of customer loans to total asset; **above average lending** is dummy variable equal 1 if values are strictly above average bank lending; **below average lending** is dummy variable equal to 1 if values (customer loans to asset ratio) is less than average bank lending; **audit independence** is an independent review of the bank is equal to 1 if a bank is audited by any of the top 4 auditing firms (KPMG, PwC, Deloitte and Ernst and Young, and 0 otherwise); **regulation capital** is the ratio of bank regulation capital to risk weighted assets; **central bank independence** is the weighted average of components of central bank independence (Central Bank's ability to control monetary instruments, usually a set of restrictions on the government's influence on the management of monetary policy by the central bank); a weighted aggregation of 16 legal indicators in four categories regarding the tenure of the bank's governor, policy formation, objectives and limitations on lending to the government, using the criteria and weights in the Cukierman, Webb and Neyapti (CWN) legal index, and monetary policy (monetary policy rates); **monetary policy rate** is the central bank policy rate of a country; **bank deposit funds** is the ratio of total deposits to total ratio; **credit risk** is the ratio of nonperforming to gross loan; **bank size** is the natural logarithm of total assets; **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; **foreign bank entry** is a dummy variable (1 = year of foreign Bank entry, 0 otherwise); **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 capital; **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).

*Significance of correlation coefficient ($p > 0.05$).

TABLE 2 (Continued)

Variables	(8)	(9)	(10)	(11)	(12)	(13)	(14)	VIF
(1) Bank lending								3.65
(2) Below average lending								1.06
(3) Above average lending								3.06
(4) Audit independence								
(5) Regulatory capital								2.17
(6) Central Bank independence								2.72
(7) Monetary policy rate								2.75
(8) Bank deposit funds								1.15
(9) Credit risk	1.000							1.32
(10) Private sector credit	0.090*	1.000						2.27
(11) Foreign bank entry	−0.005	−0.001	1.000					3.62
(12) Bank concentration	−0.037*	0.352*	0.045*	1.000				5.25
(13) Exchange rate	0.139*	−0.249*	−0.113*	−0.230*	1.000			5.40
(14) lnGDP per capita	0.047*	−0.169*	0.078*	−0.094*	0.249*	1.000		1.16
(15) Institution	0.184*	0.114*	−0.048*	0.051*	−0.042*	−0.101*	1.000	3.74

Note: **Bank lending** is the ratio of customer loans to total asset; **above average lending** is dummy variable equal 1 if values are strictly above average bank lending; **below average lending** is dummy variable equal to 1 if values (customer loans to asset ratio) is less than average bank lending; **audit independence** is an independent review of the bank is equal to 1 if a bank is audited by any of the top 4 auditing firms (KPMG, PwC, Deloitte and Ernst and Young, and 0 otherwise); **regulation capital** is the ratio of bank regulation capital to risk weighted assets; **central bank independence** is the weighted average of components of central bank independence (Central Bank's ability to control monetary instruments, usually a set of restrictions on the government's influence on the management of monetary policy by the central bank); a weighted aggregation of 16 legal indicators in four categories regarding the tenure of the bank's governor, policy formation, objectives and limitations on lending to the government, using the criteria and weights in the Cukierman, Webb and Neyapti (CWN) legal index, and monetary policy (monetary policy rates); **monetary policy rate** is the central bank policy rate of a country; **bank deposit funds** is the ratio of total deposits to total ratio; **credit risk** is the ratio of nonperforming to gross loan; **bank size** is the natural logarithm of total assets; **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; **foreign bank entry** is a dummy variable (1 = year of foreign Bank entry, 0 otherwise); **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 capital; **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).

*Significance of correlation coefficient ($p > 0.05$).

TABLE 3 Effect of lending behaviour on systemic banking crisis: instrumental variable probit regression

	Average bank lending	Threshold level	Below average lending	Above average lending	All variables
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Systemic Banking Crisis$_{t-1}$	0.964***(0.0346)	0.782***(0.0500)	0.927***(0.0553)	0.994***(0.00632)	0.994***(0.00632)
Systemic Banking Crisis$_{t-2}$	0.0197***(0.003)	0.0213***(0.003)	0.0232***(0.003)	0.0235***(0.0031)	0.0119***(0.0027)
Systemic Banking Crisis$_{t-3}$	−0.000819(0.00121)	−0.0168(0.0394)	−0.000322(0.00210)	−0.000267(0.000395)	−0.000267(0.000395)
Bank lending	−0.370*(0.203)	−0.661***(0.164)			−2.97e−05***(6.75e−06)
Bank lending[a]		0.557***(0.144)			0.596***(0.132)
Below Average Lending			−0.0226**(0.0101)		−0.0290**(0.0142)
Above Average Lending				0.0193***(0.006)	0.0343***(0.0125)
Bank Deposit Funds	−0.0430***(0.0162)	−0.0371(0.0230)	−0.0442***(0.0160)	−0.0442***(0.0160)	−0.0361*(0.0194)
Credit Risk	0.0021***(0.0006)	0.00278***(0.001)	0.0057***(0.0011)	0.0017***(0.0006)	0.0021***(0.0006)
Bank Concentration	−0.0006***(2.16e−05)	−0.0003***(3.65e−05)	−0.0006***(1.84e−05)	−0.0006***(1.84e−05)	−0.0006***(2.12e−05)
Private Sector Credit	0.0006**(0.000271)	0.0013***(0.0003)	0.0016***(0.0003)	−0.0003(0.0002)	0.0005*(0.0003)
Foreign Bank Entry	−0.0649***(0.0181)	−0.213***(0.0261)	−0.0346***(0.0116)	−0.0346***(0.0116)	0.0323**(0.0137)
Exchange Rates	2.69e−05***(4.69e−06)	−1.70e−05***(3.51e−06)	−1.78e−05***(3.11e−06)	−2.82e−06(2.14e-06)	1.35e−05***(4.01e−06)
lnGDP per capita	0.0051***(0.0015)	−0.0055***(0.0014)	−0.0053***(0.0014)	0.0014(0.0012)	0.0056***(0.0015)
GFC2007/2008	−0.0095(0.0079)	0.0083(0.0096)	0.0072(0.0065)	0.0072(0.0065)	−0.0129(0.0086)
Institution	−0.200***(0.0174)	−0.133***(0.0153)	−0.139***(0.0148)	−0.125***(0.0129)	−0.193***(0.0184)
Constant	−0.0483**(0.0214)	0.220***(0.0474)	0.0638***(0.0176)	0.0592***(0.0163)	−4.62e−05(0.0221)

(Continues)

TABLE 3 (Continued)

	Average bank lending	Threshold level	Below average lending	Above average lending	All variables
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Year effect	Yes	Yes	Yes	Yes	Yes
Country Effect	Yes	Yes	Yes	Yes	Yes
Observations	561		513	513	571
Pseudo *R*-squared	0.8323	0.8720	0.6698	0.6690	0.9043
Wald Chi^2	367.99***		332.22***	331.82***	399.82***
Thresholds		0.5934			

Note: The table shows the independent effect of all lending behaviour variables employed in the study on systemic banking crisis. The study employs the dynamic ivprobit regression model with systemic banking crisis being a dummy variable. Instruments generated in the process are deposit funds, credit risk, bank concentration, private sector credit and a possible structural changes in the future values of average bank lending. Wald Chi^2 test of exogeneity of the instrumented variables were applied. Robust standard errors in parentheses.

[a]Null hypothesis of no endogeneity were rejected. Hence, the ivprobit estimation controls for endogeneity. Wald test of exogeneity (/athrho = 0): chi2(1) = 1.11. Prob > chi2 = 0.2914

***$p < 0.01$.

**$p < 0.05$.

*$p < 0.1$.

the current year. The study found that past banking crisis is less likely to impact the next crisis after 2 years. This is confirmed by the negative but insignificant coefficient between the third lag of banking crisis and contemporaneous banking crisis events.

In Table 3, average bank lending was negatively and significantly associated with the predicted probability of systemic banking crisis (see model 1). The implication is that average bank lending to customers is good for a stable banking system. This is because lending creates profits for banks when the best clients are chosen. Thus, banks may lend out credit to meet excess demand in the market when there is adequate information about borrowers. This deals with adverse selection and moral hazards and generates profits for the banks, leading to a reduction in the possibility of a systemic banking crisis.

In model 2, the squared term of bank lending was positively linked to systemic banking crisis. This means that expanding credit beyond a certain level may expose the banks to a possible crisis. This confirms a non-linear (U-shaped) effect between bank lending and systemic banking crisis (see Figure 1). Thus, average bank lending reduces systemic banking crisis but additional levels of bank lending lead to the predicted probability of banking crisis. In model 2, the threshold was 0.5933. This implies that bank lending reduces the possibility of systemic banking up to a level of 0.5933, and beyond this level, banking crisis is likely to occur.

For robustness checks, the study decomposed bank lending into below average lending and above average lending and regress them on systemic banking crisis in our ivprobit model (see models 3 and 4). In model 3, the study found that below average lending was negatively and significantly linked to predicted probability of systemic banking crisis. This suggests that conservative lending reduces the probability of banking crisis. Thus, banks may reduce their lending volumes when they envisage possible credit risks in the credit market. This means the more banks lower their lending capacity through interest rate channels, the more credit defaults and the possibility of banking crisis are reduced. On the contrary, above average lending has a positive and significant relationship with probability of systemic banking crisis (model 4). The implication is that banks in Africa, which are more aggressive in lending, may face greater credit risk that can cause the next systemic banking crisis probability. The results contribute to the current discussion on the potential riskiness of banks through excessive lending behaviour (Dang, 2019; Foos et al., 2010). The study confirms the argument of Dang (2019) and Kashif et al. (2016) that greater demand for loanable funds pushes banks to supply more at a lower rate of interest in order to meet the demand. However, in the long run, it leads to insolvency, risk of default and liquidity constraints, leading a possible crisis. This supports the work by Amador et al. (2013), in the sense that banks that exhibit excessive or higher lending volumes than their competitors may attract risky customers, create liquidity problems, increase default risk and uncertainties and may eventually lead to a banking crisis.

The study do not report on the control variables because of space.

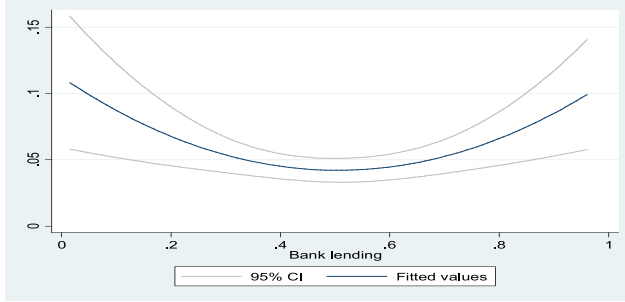


FIGURE 1 Impact of bank lending levels on predicted outcome of banking crisis

TABLE 4 Above average lending, regulations and systemic banking crisis

Variables	Model 6	Model 7	Model 8	Model 9	Model 10
Systemic banking crisis$_{t-1}$	0.993***(0.00740)	0.996***(0.00374)	0.990***(0.0102)	0.991***(0.00874)	0.995***(0.00492)
Systemic banking crisis$_{t-2}$	0.0138***(0.0027)	0.0142***(0.0026)	0.0157***(0.0033)	0.0102***(0.0032)	0.0072**(0.0031)
Systemic banking crisis$_{t-3}$	−0.000433(0.000491)	−0.0292(0.0186)	−0.000420(0.000526)	−0.000616(0.000679)	−0.000506(0.000563)
Above average lending	0.117***(0.0116)	0.0222***(0.0082)	0.166***(0.0172)	0.0246***(0.0087)	0.0730***(0.0100)
Audit independence	−0.178***(0.0340)	0.0810***(0.0095)			
Regulatory capital	−0.0005***(0.0001)		−0.0046***(0.0003)		
Central bank independence	−0.0096***(0.0018)			−0.0209***(0.002)	
Monetary policy rate	−0.0027***(0.0002)				−0.002***(0.0002)
Above average lending * audit independence		−0.0640**(0.0257)			
Above average lending * regulatory capital			−0.0110***(0.0021)		
Above average lending * central bank independence				−0.133***(0.0221)	
Above average lending * monetary policy rate					−0.00564***(0.0211)
Bank deposit funds	−0.0403**(0.0199)	−0.0293(0.0199)	−0.0919***(0.0230)	−0.0617***(0.0231)	−0.0863***(0.0229)
Credit risk	0.0008(0.0006)	0.0023***(0.0008)	0.002***(0.0006)	0.002***(0.0007)	0.0019***(0.0006)
Bank concentration	−0.0005***(3.11e−05)	−0.0006***(2.35e−05)	−0.0004***(3.56e−05)	−0.0005***(3.59e−05)	−0.0005***(3.30e−05)
Private Sector credit	−0.0002(0.0002)	−0.0003(0.0002)	0.0005*(0.0003)	0.0011***(0.0002)	0.0011***(0.0003)
Exchange rate	−3.29e−06(4.90e−06)	2.82e−06(2.45e−06)	2.27e−05***(4.48e−06)	3.21e−05***(4.66e−06)	1.36e−05***(4.57e−06)
lnGDP per capita	−0.007***(0.0013)	0.0002(0.0013)	−0.0047***(0.0013)	−0.0056***(0.0014)	−0.0037***(0.0014)
GFC2007/2008	0.00571(0.01)	0.0026(0.0100)	0.0039(0.0096)	−0.001(0.0096)	3.81e−05(0.0095)
Institution	−0.138***(0.0152)	−0.144***(0.0157)	−0.151***(0.0149)	−0.125***(0.0150)	−0.137***(0.0165)
Constant	0.0025(0.0226)	−0.0177(0.0213)	−0.144***(0.0243)		

TABLE 4 (Continued)

Variables	Model 6	Model 7	Model 8	Model 9	Model 10
Year effect	Yes	Yes	Yes	Yes	Yes
Country effect	Yes	Yes	Yes	Yes	Yes
Observations	613	613	614	621	613
Wald Chi^2	256.93***	254.70***	320.67***	278.71***	408.78***
Pseudo R-squared	0.8379	0.7515	0.6532	0.9605	
Average marginal effect (net effect)	-	0.0418*** [a]	−0.0118*** [b]	−0.1762*** [c]	0.0248*** [d]
$(dy/dx) = \alpha_1 + \delta_q RegFramework_{j,t}$ standard errors		0.000181	0.00036	0.00013	0.00015

Note: These results show the independent and interactive role of external regulatory framework on the relationship between above average lending and systemic banking crisis. Description of variables is found below Table 2. Robust standard errors in parentheses.

[a]Marginal Effect at levels of Audit Independence = −0.0418 [0.0222 + 0.064(1)]***.

[b]Marginal Effect at levels Regulatory Capital = −0.0118 [0.166–0.0110(16.16)]***.

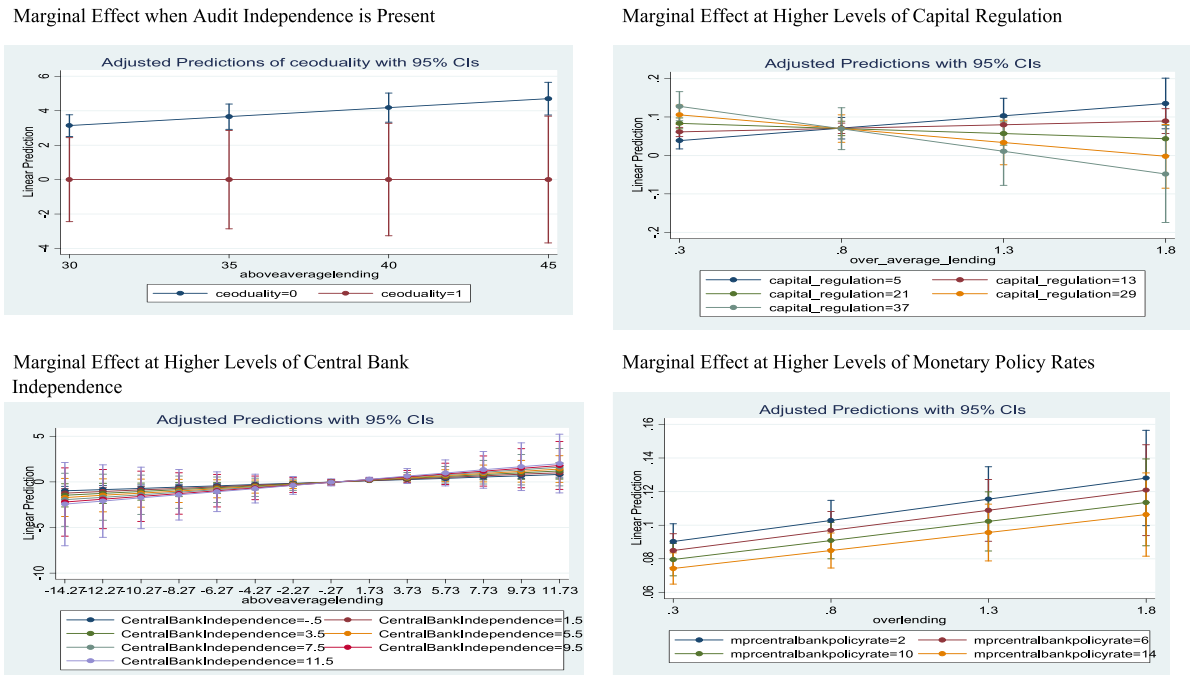
[c]Marginal Effect at levels of Central Bank Independence = 0.1762 [0.0246–0.133(1.5092)]***.

[d]Marginal Effect at levels of Monetary Policy Rate = 0.0248 [0.073–0.05643(8.535)]***.

***$p < 0.01$.

**$p < 0.05$.

*$p < 0.1$.



NB: Banking crisis is on the y-axis, above average lending is on the x-axis while the line graph shows the marginal effect at levels of regulation

FIGURE 2 Net effect margin plots: marginal effect of above average lending on banking crisis when regulatory framework is interacted. 2.1: Marginal effect when audit independence is present; 2.2: marginal effect at higher levels of capital regulation; 2.3: marginal effect at higher levels of central bank independence; 2.4: marginal effect at higher levels of monetary policy rates

4.2.2 | Role of regulatory framework

The study has established the positive impact of above average lending on the predicted probability of systemic banking crisis.

From Table 4 (model 6), audit independence has a negative impact on systemic banking crisis probability. This suggests that banks audited by independent auditors are more likely to reduce possible crisis. Similarly, regulatory capital has a negative effect on systemic banking crisis probability. This indicates that banks that are able to increase their resilience, may have the ability to reduce a systemic banking crisis. This is because they can cope with unexpected losses in their asset portfolio through higher regulatory capital (Global Financial Development report, 2019/2020). Central bank independence has a negative impact on banking crisis (see model 6). Monetary policy rates have a negative impact on banking crisis. Contractionary monetary policy reflects an increase in monetary policy rates (model 6). Thus, higher monetary policy rates provides banks the incentive to simultaneously increase interest rates at lower lending capacity, leading to greater profits and a reduction in the possibility of banking crisis.

From models 7–10, when above average lending is interacted with each regulatory framework (audit independence, capital regulation, central bank independence and monetary policy), a significant negative impact (coefficients of the interaction terms) on banking crisis was observed (models 6–8).

Following Brambor et al. (2006), we cannot establish policy implications for practice and theory exclusively on above average lending impacts or impacts of excessive lending. Specifically, interpretation of this result may not be informative to policymakers. Therefore, there is the need to compute marginal effects and to allow a proper interpretation of the results (see beneath Table 4).

For instance, it was observed that the marginal effect of above average when interacted with audit independence is negative (see model 7 and Figure 2, 2.1). This shows that the impact of above average lending reduces when banks are audited by any of the top 4 external auditors. Thus, the positive relationship between above average lending behaviour of banks and possibility of systemic banking crisis is reduced with effective audit independence. The implication is that banks that have independent audit review, are able to monitor abnormal bank lending in order to mitigate possible crisis. In model 8 and Figure 2 (2.2), the negative marginal effect shows that the positive impact of above average lending on banking crisis is reduced at higher levels of capital regulation. This suggests that banks with stringent regulatory capital may have the incentive to reduce the excessive lending behaviour, which makes them resilient to absorb shocks, and banking crisis may be less likely. Moreover, the marginal effect of above average lending with central bank independence is negative (model 9 and Figure 2, 2.3). This shows that independent function of central banks is strong to control the risky lending behaviour of the banking system, thus reducing the positive effect of above average lending on systemic banking crisis probability. From the results, the marginal effect of above average lending when interacted with monetary policy rates is positive but the impact is less positive (model 10). This implies that the positive impact of above average lending on banking crisis is reduced at higher levels of monetary policy rates (see Figure 2, 2.4).

Given that banks that take risky lending activities are prone to a possible banking crisis, the regulator sets policies that tame the risky lending behaviour of banks in order to achieve a stable banking system. Therefore, the study found that banks audited by the top 4 auditors, stringency of capital requirement, central bank independence and monetary policy alter the positive effect of above average lending on predicted probability of a banking crisis.

5 | CONCLUSION AND IMPLICATIONS

Given the importance of regulations, the paper contributes to empirical literature by investigating how different regulatory frameworks explain the effect of bank lending behaviours on the predicted probability of systemic bank-

ing crisis in Africa. The study found that systemic banking crises across Africa may be persistent for some few years but dissipates in the long run (i.e. at least after 2 years). The study found a negative and significant relationship between bank lending and predicted probability of banking crisis. An empirical test confirms that systemic banking crisis occurs when bank lending exceeds a 0.5933 threshold.

Bank lending was decomposed into below average lending and above average lending based on the fact that banks can either lower their lending rates or lend above the industry average. The study found that below average lending and systemic banking crisis predictability are negatively linked. This is because banks that cut their lending capacity through higher rates are less likely to incur bad debts and this can contribute to a lower probability of banking crisis. The study established that above average lending was positively and significantly associated with the predicted probability of banking crisis. This suggests that abnormal lending behaviour of banks exposes the banks to greater risks like default and liquidity problems. This eventually leads to a greater possibility of banking crisis.

The study found that different regulatory frameworks provide important levers to lower the probability of a systemic banking crisis. From the interaction coefficients, although the results show that regulatory framework is important in reducing systemic banking crisis probability, the study is interested in interpreting the marginal effects. The study found evidence that banks audited by the top 4 auditors reduce the positive impact of above average lending on the predicted probability of banking crisis. The results support the argument that above average lending behaviours from the African context reduce the predicted probability of systemic banking crisis at higher levels of capital regulation, in contractionary monetary policy regimes and in countries with strong central bank independence. The implication is that regulatory policies pertaining to regulatory policies (internal governance mechanisms, monetary, capital regulation and central bank independence) should continue to be strengthened and coordinated through the lens of prudent lending policies in Africa in order to increase the resilience of the banking sector to shocks and possible crisis.

Future research should consider how reforms can moderate the complex relationship between bank lending behaviour and the likelihood of systemic and non-systemic banking crisis in different political regimes since governments in power can interfere with the lending behaviour of banks in order to gain political recognition during re-election. Again, researchers can explore these relationships across different institutional and economic context across the world.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

CITATION FOR AVAILABLE DATA

databank.worldbank.org/reports.aspx?source=global-financial-development

databank.worldbank.org/source/world-development-indicators

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request. The data are publicly available, and the arrangement of the datasets used and/or analysed during the current study are also available from the corresponding author upon request.

ORCID

Daniel Ofori-Sasu https://orcid.org/0000-0001-8012-2478

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APPENDIX A: SUMMARY OF A PRIORI EXPECTATION OF EXPLANATORY VARIABLES

Variables	Measurement	Expectations
Bank lending	Customer loans to total asset	+/−
Below average lending	A dummy variable equal to 1 if values (customer loans to asset ratio) is less than average bank lending	−
Above average lending	A dummy variable equal 1 if values are strictly above average bank lending;	+
Audit independence	An audit independence is an independent review of the bank is equal to 1 if a bank is audited by any of the top 4 auditing firms (KPMG, PwC, Deloitte and Ernst and Young), and 0 otherwise	−
Regulatory capital	The ratio of bank regulation capital to risk weighted assets	−
Central bank independence	a weighted aggregation of 16 legal indicators in four categories regarding the tenure of the bank's governor, policy formation, objectives and limitations on lending to the government, using the criteria and weights in the Cukierman, Webb and Neyapti (CWN) legal index, and monetary policy (monetary policy rates)	−
Monetary policy rate	This is the central bank policy rate of a country	−
Bank deposit funds	Ratio of total deposits to total assets	−
Credit risk	Ratio of nonperforming to gross loan	+
Bank concentration	Ratio of asset of the three largest commercial banks to total commercial banking assets in a country	+/−
Private sector credit	Ratio of private sector credit to GDP	+
Foreign bank entry	Measured as dummy, 1 = year of foreign bank entry, 0 otherwise	+
Exchange rate	Natural logarithm of a country's currency rate to the dollar	+
GDP per capita	Natural logarithm of gross domestic product (GDP) per capita	+/−
Institution	An aggregate of six indicators (the rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability).	−
Instrumental variable: Structural change in the future values of bank lending ($\Delta F\_Lending_{t\text{-}6,\ t\text{-}10}$)	The possible structural changes in the future values of bank lending is a dummy, which takes the value of 1 when a change in average bank lending over the current and the next 6 to 10 years period (in which there have been no occurrence of banking crisis and election in our sample) is strictly positive (i.e., future lending strictly greater than current lending), and zero otherwise.	+/−

APPENDIX B: ROBUSTNESS RESULTS

	(OLS)	(1st Stage)	(2SLS)
VARIABLES	**Model 11**	**Model 12**	**Model 13**
Bank lending	−0.00393***(0.000424)		−0.00226***(0.000183)
Bank deposit funds	−0.0386(0.0382)	−9.766**(4.089)	−0.0403(0.0246)
Credit risk	0.00529**(0.00254)	0.840***(0.118)	0.00754***(0.000666)
Bank concentration	−0.0209***(0.00523)	1.280***(0.452)	−0.0157***(0.00310)
Private sector credit	0.000137(0.000279)	−0.953***(0.0549)	0.00227***(0.000442)
Foreign bank entry	−0.316***(0.0860)	−15.55***(2.454)	−0.252***(0.0440)
Exchange rates	8.48e−07(4.90e−06)	−0.0291***(0.00121)	3.71e−05***(6.74e−06)
lnGDP per capita	0.00133**(0.000644)	3.735***(0.390)	0.00323(0.00240)
GFC2007/2008	−0.0113**(0.00554)	−3.064(2.898)	−0.0122(0.0120)
Institutions	−0.0598**(0.0259)	−13.32***(2.527)	−0.197***(0.0130)
Country effect	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes
1st stage coefficients on instruments			
$\Delta F\_Lending_{t\text{-}6,\ t\text{-}10}$		−0.109***(0.0165)	
Constant	−0.0960(0.103)	38.27***(6.553)	−0.0147(0.0493)
Observations	561	513	513
R-squared		0.609	0.725
Min. eigenvalue statistics (*F*-statistics) (*p*-value)			18.911(0.000)
Weak Instrument Stock–Yogo weak ID test: Critical value (5% Wald Test)			16.38
K-P weak identification (*F*-test) (*p*-value)			12.23(0.000)
C-D weak identification (*F*-test) (*p*-value)			72.44(0.000)
Tests of overidentifying restrictions			
Anderson-Rubin (Chi-Test) (*p*-value)			12.9414 (0.0047)
Sargan (score) (Chi-Test)			0.3119(0.8556)
Basmann (Chi-Test) (*p*-value)			0.3107(0.85642)

The table reports the regression coefficients and, in brackets (standard errors), the associated clustered (at country level) standard errors. *Significant at 10%; **significant at 5%; ***significant at 1%. At the bottom of the table we report the p-value of: (1) Cragg–Donald Wald *F*-statistics test and Stock–Yogo weak ID Wald "-statistic testing for weak identification; (2) the Kleibergen_Paap rk LM statistics testing that the excluded instruments are not correlated with the endogenous regressor; and (3) the Anderson-Rubin test, Sargan test and Basmann test of over identifying restrictions, testing the null hypothesis that the excluded instruments are not correlated with the error term (i.e., they are valid instruments).

	(OLS)	(1st Stage)	(2SLS)
Variables	**Model 14**	**Model 15**	**Model 16**
Below average lending	−0.0307 (0.0305)		−0.0491*** (0.0111)
Above average lending			
Bank deposit funds	−0.0286 (0.0255)	−0.0168 (0.0394)	−0.0998*** (0.0276)
Credit risk	0.000999 (0.000613)	−0.00310*** (0.000998)	0.00425*** (0.00103)
Bank concentration	−0.0141*** (0.00470)	0.0227*** (0.00540)	−0.0324*** (0.00352)
Private sector credit	0.000156 (0.000251)	0.00663*** (0.000496)	0.00249*** (0.000346)
Foreign bank entry	−0.138** (0.0662)	0.0568** (0.0230)	−0.0445* (0.0257)
Exchange rates	1.32e−05** (5.69e−06)	0.000128*** (6.84e−06)	3.75e−05*** (4.51e−06)
lnGDP per capita	0.00120 (0.000843)	−0.0385*** (0.00412)	0.00441*** (0.00164)
GFC2007/2008	−0.00928* (0.00520)	−0.0789*** (0.0235)	−0.0217** (0.0107)
Institutions	−0.0627*** (0.0152)	−0.0896*** (0.0131)	−0.130*** (0.0123)
Country effect	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes
1st stage coefficients on instruments			
$\Delta F\_Lending_{t-6,\ t-10}$		−0.303*** (0.0246)	
Constant	0.113*** (0.0341)	0.139** (0.0681)	0.298*** (0.0485)
Observations	561	513	513
R-squared		0.361	0.381
Min. eigenvalue statistics (*F*-statistics) (*p*-value)			18.327 (0.000)
Test of Weak Instrument			
Stock–Yogo weak ID test: Critical value (5% Wald Test)			8.68
K-P weak identification (*F*-test) (*p*-value)			24.63(0.000)
C-D weak identification (*F*-test) (*p*-value)			22.04(0.000)
Tests of overidentifying restrictions			
Anderson-Rubin (Chi-Test) (*p*-value)			0.39414 (0.857)
Sargan (score) (Chi-Test) (*p*-value)			0.3964 (0.811)
Basmann (Chi-Test) (*p*-value)			0.3881 (0.892)

The table reports the regression coefficients and, in brackets (standard errors), the associated clustered (at country level) At the bottom of the table we report the p-value of: (1) Cragg-Donald Wald F-statistics test and Stock–Yogo weak ID Wald "-statistic testing for weak identification; (2) the Kleibergen_Paap rk LM statistics testing that the excluded instruments are not correlated with the endogenous regressor; and (3) the Anderson-Rubin test, Sargan test and Basmann test of over identifying restrictions, testing the null hypothesis that the excluded instruments are not correlated with the error term (i.e., they are valid instruments). Robust standard errors in parentheses.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

	(OLS)	(1st Stage)	(2SLS)
Variables	**Model 17**	**Model 18**	**Model 19**
Below average lending			
Above average lending	0.0502* (0.0259)		0.112*** (0.0154)
Bank deposit funds	−0.0285 (0.0253)	0.0702* (0.0421)	−0.105*** (0.0281)
Credit risk	0.00100 (0.000613)	−0.00553*** (0.00119)	0.00444*** (0.00104)
Bank concentration	−0.0142*** (0.00466)	0.0257*** (0.00598)	−0.0310*** (0.00350)
Private sector credit	0.000150 (0.000251)	−0.00137*** (0.000489)	0.00281*** (0.000338)
Foreign bank entry	−0.125* (0.0724)	0.00586 (0.0235)	−0.0782*** (0.0235)
Exchange rates	1.36e−05** (5.32e−06)	−4.83e−05*** (6.38e−06)	4.39e−05*** (4.67e−06)
lnGDP per capita	0.00125 (0.000816)	−0.00553 (0.00436)	0.00323* (0.00168)
GFC2007/2008	−0.00927* (0.00509)	−0.0819*** (0.0273)	−0.0164 (0.0110)
Institutions	−0.0639*** (0.0156)	0.00138 (0.0180)	−0.137*** (0.0125)
Country effect	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes
1st stage coefficients on instruments			
$\Delta F\_Lending_{t-6,\ t-10}$		0.0928*** (0.0135)	
Constant	0.116*** (0.0350)	0.161** (0.0687)	0.322*** (0.0499)
Observations	561	513	513
R-squared		0.082	0.376
Min. eigenvalue statistics (*F*-statistics) (*p*-value)			17.0517 (0.000)
Test of Weak Instrument			
Stock–Yogo weak ID test: Critical value (5% Wald Test)			8.68
K-P weak identification (*F*-test) (*p*-value)			21.896(0.000)
C-D weak identification (*F*-test) (*p*-value)			23.836(0.000)
Tests of overidentifying restrictions			
Anderson-Rubin (Chi-Test) (*p*-value)			0.2779 (0.945)
Sargan (score) (Chi-Test) (*p*-value)			0.2774 (0.955)
Basmann (Chi-Test) (*p*-value)			0.275068 (0.97)

The table reports the regression coefficients and, in brackets (standard errors), the associated clustered (at country level) At the bottom of the table we report the p-value of: (1) Cragg-Donald Wald F-statistics test and Stock–Yogo weak ID Wald "-statistic testing for weak identification; (2) the Kleibergen_Paap rk LM statistics testing that the excluded instruments are not correlated with the endogenous regressor; and (3) the Anderson-Rubin test, Sargan test and Basmann test of over identifying restrictions, testing the null hypothesis that the excluded instruments are not correlated with the error term (i.e., they are valid instruments). Robust standard errors in parentheses.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

APPENDIX C: AFRICAN COUNTRIES USED

Algeria	Egypt, Arab Rep.	Malawi	Sudan
Angola	Equatorial Guinea	Mali	Tanzania
Benin	Eritrea	Mauritania	Togo
Botswana	Eswatini	Mauritius	Tunisia
Burkina Faso	Ethiopia	Morocco	Uganda
Burundi	Gabon	Mozambique	Zambia
Cabo Verde	Gambia	Namibia	Zimbabwe
Cameroon	Ghana	Niger	
Central African Republic	Guinea	Nigeria	
Chad	Guinea Bissau	Rwanda	
Comoros	Kenya	Sao Tome and Principe	
Congo, Dem. Rep.	Lesotho	Senegal	
Congo, Rep.	Liberia	Seychelles	
Côte D'Ivoire	Libya	Sierra Leone	
Djibouti	Madagascar	South Africa	