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Article

Regulation, institutional quality, and stability of the banking system in West African Economic and Monetary Union

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Regulation, institutional quality, and stability of the banking system in West African Economic and Monetary Union

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economics & finance

Koffi Sodokin¹*, Essowaba Egbeleo¹, Richard Kuessi¹, Mawuli Kodjovi Couchoro¹ and Akoété Ega Agbodji¹

Abstract: This study investigates the relationship between prudential regulation and banking risk in the West African Economic and Monetary Union contingent on institutional quality. The empirical analysis employed panel data from 63 banks spanning 2006–2019. The key findings reveal that stringent banking regulations and supervision enhance banks' stability. Capital regulations, activity restrictions, and supervisory authorities reduce the risk of bank insolvency. The results suggest that a favorable institutional climate promotes rigorous enforcement of regulatory standards and robust supervision, thereby amplifying their efficacy. Overall, this study concludes that prudential policies exhibit risk-mitigating effects in West African Economic and Monetary Union countries conditional on sound institutional frameworks.

Subjects: Economics and Development; Political Economy; Economics; Finance

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JEL codes: G38; G21; L51; O16

1. Introduction

Recent research has identified the stability and efficiency of the banking system as pivotal drivers of economic growth. Zeqiraj et al. (2020) find that banking efficiency is the main determinant of economic growth in Southeast European countries. Ijaz et al. (2020) highlight the importance of bank stability in contributing to growth in Europe. Elnahass et al. (2021) identified a recovery signal for bank stability during the COVID-19 outbreak, emphasizing its global significance. Together, these studies underscore the pivotal role of banking stability and efficiency in economic growth (Sodokin et al., 2022). However, information asymmetries such as adverse selection and moral hazard incentivize profit-seeking banks towards excessive risk-taking. The resultant banking crises can destabilize the financial system through deposit losses, payment disruptions, and economic contraction. Additionally, bank failures can escalate promptly into systemic crises, with economywide costs exceeding private costs. Consequently, experts, including Chen et al. (2021), who emphasize the independent effect of liquidity risk on bank performance during crises and Kenny et al. (2020), who associate banking crises with significant drops in economic growth, have shed light on the complex dynamics of banking failures and their broader implications. Dewatripont and Tirole (1994) and Karim et al. (2022) emphasized the need to regulate and supervise banks to safeguard depositors and contain systemic risks. In practice, a deficient banking system may struggle to attract the savings necessary for efficient economic financing (Sodokin et al., 2023).

Since the 2000s, regulators in the West African Economic and Monetary Union (WAEMU)¹ have instituted financial liberalization policies and Basel I, II, and III standards to enhance banking efficiency (Mkandawire, 1999; Kuessi et al., 2023). Banking authorities have adopted the Basel Committee's best supervisory practices (Basel I). Moreover, to bolster resilience, WAEMU monetary officials decided in 2007 to progressively increase the minimum capital levels of regional banks and financial firms, thereby expanding their financing capacity and solvency (Sy, 2007). Such phased capital increases tend to overhaul existing regulations based on Basel I, aligning them with Basel II and III. According to BCEAO (2016), this updated framework seeks to develop a resilient WAEMU banking system that serves regional economies while controlling for risk.

Despite being an underdeveloped stock market, banking remains integral to WAEMU's financial system, garnering most resources, albeit limited to direct financing (Ogbuabor et al., 2019). Thus, banking stability is paramount to unions' overall financial robustness. Although the global financial crisis had little impact on WAEMU nations, privatization, diversification, and the emergence of cross-border banking groups in the past 20 years have generated risks (Kanga et al., 2021). Consequently, regulations have been tightened since 2007 to reinforce banking stability based on Basel I and to avert the large-scale crises of the 1980s (Oduor et al., 2017). Systemic risk-prevention measures were implemented in 2011, with Basel II and III provisions incorporated in 2016 to match international standards while considering WAEMU's economic and banking characteristics.

Studies note that implementing prudential regulations in the WAEMU faces challenges as national authorities often delay and question rules for resolving troubled banks. Moreover, insufficient legal procedures for registering and recovering collateral and a lack of borrower credit information still hamper bank lending (BCEAO 2015). However, high institutional quality is key to lowering bank instability by enabling proper creditor protection through enforcing property rights (Fang et al., 2014; La Porta et al., 1997, 1998) and effective enforcement of regulations (Barth et al., 2004; Fernández & González, 2005; Klomp & de Haan, 2014).

This study examines two issues: (i) Do WAEMU's capital regulation, activity restrictions, and supervisory authority enhance banking stability? (ii) Despite regulations, can institutional quality contribute to fragility? Prior WAEMU research mostly focused on 1980s' crisis determinants, considering only bank-specific and macroeconomic factors. Recent studies have expanded this understanding. Adesina (2021) emphasizes the positive association between human capital efficiency and bank performance, while Kanga et al. (2021) explore the impact of Pan-African banks on banking stability and fragility in WAEMU, highlighting the complex dynamics of competition and stability in the region. Moreover, existing research has scarcely examined key issues such as the institutional framework for banks. However, sound institutions breed market disciplines and transparency, thereby enhancing efficiency. Recent insights by Godspower-Akpomiemie and Ojah (2021) shed light on the importance of market discipline and regulation in banking effectiveness. Thus, the macro-institutional context merits further analysis, as evidenced by Gbandi et al. (2021), Sodokin and Donou-Adonsou (2010) and Sodokin et al. (2023).

While this study examines insolvency risks, it focuses on three key regulation indices: within the WAEMU- capital (bank capitalization), activity restrictions, and supervisory authority. Additionally, the institutional environment geared toward stability, depositor protection, and growth was analyzed. By emphasizing prudential regulations and institutional quality, this study contributes to the literature on banking stability in WAEMU. The findings of this study underscore the necessity for effective regulations and high-quality institutions to support a stable and secure banking system.

This study offers three contributions: (i) examining the regulatory risk relationship contingent on institutional quality, (ii) assessing the three regulatory dimensions in WAEMU to gain a comprehensive understanding, and (iii) highlighting the pivotal role of institutional settings in ensuring regulatory success.

The remainder of this paper is organized as follows: Section 2 reviews the theoretical and empirical literature. Section 3 presents the methodology and empirical analysis. The fourth section presents the results, and Section 5 concludes the paper.

2. Literature review

The literature notes that the impact of banking regulations on stability may depend on governance (Laeven & Levine, 2009), sector traits (Agoraki et al., 2011), and macroeconomics (Klomp & de Haan, 2015). In particular, institutional quality can shape the effect of regulations on stability by improving enforcement capacity, which is essential given the complexity of Basel I, II, and III norms over time (Haldane & Neumann, 2016). Recent insights by Godspower-Akpomiemie and Ojah (2021) further emphasize the importance of market discipline in banking effectiveness. Thus, institutional quality may complement regulation and promote stability.

Both theoretical and empirical scholars have examined various banking regulations and have found that they can enhance stability (Danisman & Demirel, 2019; Shaddady & Moore, 2019). A key area is to curb bank risk-taking to comply with such regulations. The theoretical perspectives on the effects of capital regulations on risk are mixed. It should be noted that implementing capital constraints lowers the overall portfolio risk (Kim & Santomero, 1988; Koehn & Santomero, 1980). However, depending on risk appetite, banks may opt for higher-return and riskier assets, thus increasing the odds of default (Tongurai & Vithessonthi, 2020). Conversely, higher capital requirements can reduce risk-taking, as intended by regulators (Furlong & Keeley, 1989; Keeley & Furlong, 1990; Louhichi et al., 2020; Santos, 2001). Some empirical studies agree that capital regulations boost bank capital and mitigate risk (Akter et al., 2018; Ediz et al., 1998; Rime, 2001; Shrieves & Dahl, 1992; Zheng et al., 2017).

Recent studies have provided nuanced insights into the context of capital regulation and its impact on bank risk-taking. Ashraf et al. (2020) conducted an international analysis to investigate

the relationship between capital regulation, deposit insurance, and bank risk during both the normal and crisis periods. Their findings reveal that stringent capital regulations effectively reduce bank default risk, a result that holds true regardless of the presence of explicit deposit insurance (Ashraf et al., 2020). This perspective is further complicated by Jiang et al. (2020), who explore the effects of capital buffers on bank risk taking in China. Contrary to the notion that increasing capital requirements uniformly reduces risk, they found that an excessive buildup of capital buffers might lead to greater risk-taking among high-risk banks. This suggests that a continuous increase in capital requirements does not necessarily translate into lower risk taking, highlighting the need for a more nuanced approach to capital regulation (Jiang et al., 2020). Together, these studies underscore the complexity of capital regulation and its multifaceted impact on bank risk-taking behavior, calling for a careful balance in regulatory policies. Thus, capital requirements curb risk-taking incentives (Chiaramonte et al., 2020).

However, under certain conditions, requirements can increase bank risk taking (Kim & Santomero, 1988; Koehn & Santomero, 1980). For instance, forced recapitalization to meet regulations may reduce share prices (Barth et al., 2004; Kopecky & VanHoose, 2012). This effect may be exacerbated by a continuous increase in capital requirements, leading to greater risk taking for high-risk banks (Jiang et al., 2020). This stems from the lower effort exerted by existing shareholders to fund risky loans, as their equity stakes decrease compared with those of new shareholders. Consequently, insiders reduce project selection and monitoring efforts, further dropping share prices and increasing default odds. The negative and significant impact of capital regulation stringency on liquidity risk also supports this view (Mohammad et al., 2020).

Additionally, some empirical studies find that activity restrictions are linked to a higher crisis probability and lower efficiency (Barth et al., 2001, 2004, 2013). A World Bank survey revealed that more restrictions are associated with major crises and declining sectoral efficiency (Barth et al., 2001). Barth et al. (2004) find that restrictions are negatively related to stability. Barth et al. (2013) determine that increased restrictions reduce bank efficiency. These findings are further supported by recent research showing that stringent capital regulation reduces bank default risk during normal growth periods (Ashraf et al., 2020), and that the quality of capital plays a pivotal role in reducing bank risk (Anginer et al., 2021), emphasizing the multifaceted relationship between capital regulations, risk-taking, and efficiency in the banking sector.

Economic and institutional settings shape financial soundness (Keefer, 1999). Strong institutions protect investors and promote prudent bank risk taking. Uddin et al. (2020) provide evidence that improving government effectiveness, controlling corruption, and adhering to the rule of law reduces banks' risk exposure and improves stability in emerging countries. Weak legal systems and governance can increase instability owing to corruption, poor enforcement, and inefficient governments (La Porta et al., 1998). High institutional quality provides better creditor protection against expropriation and supports financial market development (La Porta et al., 1997).

Empirically, weaker institutions increase the odds of financial fragility (Demirgüç-Kunt & Detragiache, 1998). Nasreen et al. (2020) found that economic growth and institutional quality are positively associated with financial development. Institutional development affects the effectiveness of regulations (Delis, 2012). For example, Klomp and de Haan (2014) found that liquidity rules and activity limits reduce bank risk only with high institutional quality, using 2002–2008 data across 60 countries. Other studies show that institutional reforms that strengthen legal systems, banking, and governance substantially improve stability by lowering portfolio risks (Fang et al., 2014).

Theoretically, the impact of robust regulation on stability differs. Public interest views argue that market failures necessitate formal regulators to address stability issues and improve efficiency (Bace et al., 2020; Stigler, 1984). Duru et al. (2020) find that the effects of bank accounting regulations are more pronounced in countries with stronger enforcement in the banking industry.

Several empirical studies agree that regulations enhance stability by reducing risk (Alley, 2022; Barth et al., 2007; Das, 2005; Fernández & González, 2005; Karim et al., 2021; Klomp & de Haan, 2012, 2014, 2015; Triki et al., 2017). Stricter rules improve bank risk management.

From the viewpoint of private interest, one may doubt whether regulatory authorities can properly counter market failures to optimize bank functions. While market hindrances such as informational and enforcement costs could obstruct private oversight, government failures might lead to detrimental effects if regulators are authorized, causing more harm than good (Bace et al., 2020; Djankov et al., 2002; Shleifer & Vishny, 1998; Taylor & Quintyn, 2002). In real-world scenarios, official supervisors might ignore market flaws, guiding credit to affiliated companies, or falling prey to banking influences; this is known as the lobby theory. Empirical evidence shows that strict bank regulation may not effectively reduce risks and may even negatively affect banking stability (Barth et al., 2004; Beltratti & Stulz, 2012; Borio & Zhu, 2012; Danisman & Demirel, 2019; Danisman & Tarazi, 2020; Demirgüç-Kunt & Detragiache, 2011; Demirgüç-Kunt & Huizinga, 2010; Flannery, 1989; González, 2005; Sundararajan et al., 2001). In certain instances, stringent controls can foster corruption and impair banking efficiency. Existing research indicates that regulatory limits do not always guarantee stability, and may even instigate financial disruptions. The subprime crisis serves as a testament to the drawbacks and boundaries of banking regulation, highlighting regulatory loopholes that fail to restrain banks from a burdensome society (Stiglitz, 2010). This accentuates the necessity for empirical analysis of regulation, aiming to recognize practices that can foster banking stability and effectiveness across various contexts.

3. Methodological approach

3.1. The assumptions of the model

This study examines the relationship between prudential regulation and bank risk in WAEMU countries contingent on their institutional quality. Drawing from the relevant literature, two hypotheses were formulated to accomplish the research objective of analyzing how institutional quality moderates the linkage between prudential policies and bank risk-taking in the WAEMU region.

Hypothesis 1: Prudential regulation reduces the risk of banking institutions' insolvency, except for restrictions on activities.

Prudential regulations encompassing a set of rules and guidelines serve as protective measures to ensure the integrity of banking institutions and to fortify the financial system against potential hazards (Aiyar et al., 2015; Benhabib et al., 2016). These regulations primarily aim to curtail the risk of insolvency in the banking sector. To achieve this objective, regulatory authorities enforce a variety of standards, including, but not limited to, capital adequacy requirements (Mamatzakis & Bermpei, 2014; Tongurai & Vithessonthi, 2020), mechanisms for liquidity management (Corrado & Schuler, 2017; Klomp & de Haan, 2014; Mohammad et al., 2020), and protocols for comprehensive risk management (Hoque et al., 2015). Within this regulatory framework, restrictions on specific banking activities were integral. Such restrictions, which include limitations on high-risk endeavors such as proprietary trading or investments in hedge funds, constrain potential earnings and thereby diminish the likelihood of insolvency (Klomp & de Haan, 2014). This aspect of regulation is instrumental in preserving the stability of the banking system. Recent empirical evidence further elucidates this relationship. Specifically, a 2021 investigation by Chen et al. (2021) revealed that liquidity risk, far from being a mere manifestation of underlying insolvency issues, exerts an autonomous influence on bank performance during financial upheavals (Chen et al., 2021). This finding underscores the multifaceted nature of prudential regulation and its pivotal role in shaping the banking industry's resilience and stability.

Hypothesis 2: The institutional environment in the WAEMU contributes to banking fragility and does not promote a strong impact of prudential regulation on the probability of failure.

The institutional framework, encompassing legal, regulatory, and administrative dimensions, is pivotal in shaping banking operations in the WAEMU zone (Kanga et al., 2021; Tomgouani, 2017). Hypothesis 2 proposes that this complex framework may engender banking instability and render prudential regulations ineffective at averting bank failures (Saidane et al., 2021). Such instability could arise from deficient enforcement and oversight of prudential rules, enabling heightened risk-taking and potentially culminating in insolvency (Anarfo et al., 2020; Wang et al., 2019). Furthermore, feeble legal and judicial systems may impede contract enforcement and asset recovery, creating a moral hazard in which banks act recklessly without fear of the consequences (Fang et al., 2014). High political interference, exacerbated by the entry of Pan-African banks, can both stabilize and destabilize the banking system (Kanga et al., 2021). Ultimately, these multifaceted factors could undermine the efficacy of prudential regulations in preventing bank failures in WAEMU (Ozili, 2018). In an environment that lacks robustness, the intended impact of these regulations may be compromised, thereby perpetuating banking instability (Kanga et al., 2021).

3.2. Specification of the model

To econometrically analyze the effect of regulation and supervision on the probability of bank failure conditional on the institutional environment of countries within the WAEMU, our specification was inspired by those of Klomp and de Haan (2014, 2015) and is as follows:

$$Z - \text{score}_{ij,t} = \beta_0 Z - \text{score}_{ij,t-1} + \beta'_q \text{regul}_{qj,t} + \alpha \text{inst}_{ij,t} + \delta \text{regul}_{qj,t} * \text{inst}_{ij,t} + \rho_k X_{kij,t} + \eta_t + \mathcal{E}_{\gamma|,\sqcup}$$
(1)

where *i*, *j*, and *t* represent banks, countries, and periods, respectively; $Z - score_{ij,t}$ is the bank's *i* risk in the country *j* at *t* approximated by the logarithm of the Z-score; $Z - score_{ij,t-1}$ is the lagged variable of $Z - score_{ij,t}$; $regul_{qi,t}$ is the vector of q = 3 bank regulatory and supervisory cues (capital regulation, activity restriction, supervisory power); $X_{kij,t}$ is a vector of *k* explanatory variables; and *inst*_{ij,t} is the institutional variable. n_t denotes time effects and captures unobservable period characteristics, such as country and bank invariants, such as a global crisis or regulatory change. The inclusion of n_t eliminates the effects of time-related universal shocks in error terms, to avoid serial correlation. Finally, ε_{ijt} is the error term, β_0 , α and δ are parameters to be estimated, β'_q and ρ_k are vectors of the parameters to be estimated.

3.3. Methods of estimation

The estimation of our models faces several problems that may lead to a bias in our results. First, it is impossible to consider all determinants of bank risk. Some factors such as managers' risk aversion were not observed. Second, the lagged explained variable $(Z - score_{ij,t-1})$ in the regression model makes it inappropriate to use either the fixed effects or random effects method, because the fixed effects are correlated with at least this variable. Endogenous explanatory variables require sophisticated techniques, such as the generalized method of moments (GMM), to rectify (Holtz-Eakin et al., 1988). We employed the first-difference GMM estimator of Arellano and Bond (1991) to rewrite the equation, erase certain effects, and use lagged values as instruments (Bond et al., 2001). However, this method has limitations, including loss of long-term data and inadequacy with persistent variables. A refined GMM estimator addresses these shortcomings by providing additional moment conditions (Arellano & Bover, 1995) and by combining various conditions for both differences and levels (Blundell & Bond, 1998). Although more effective, it may show bias in limited samples (Roodman, 2009; Windmeijer, 2005). Tests such as Sargan/Hansen overidentification and Arellano and Bond autocorrelations were used to verify the reliability of these estimators.

3.4. Description of variables

While several indicators can be used as proxies for bank risk, including default distance, the ratio of impaired loans to total gross loans, and earnings volatility, we follow Laeven and Levine (2009), Houston et al. (2010), Klomp and de Haan (2015), Lepetit and Strobel (2015), and Mare et al. (2017) and measure bank risk using the Z-score. The measure of bank risk using each bank's Z-score equals the return on assets plus the capital-asset ratio divided by the standard deviation of asset returns. Denoting profit by π , A is the total assets of the bank and the return on assets is given by

$$roa = \frac{\pi}{A}$$
(2)

Let σ_{roa} be the standard deviation of *roa* and *car* the capital-asset ratio. Bank insolvency is a state in which inequality is $(car + roa) \leq 0$.

If asset returns are random and normally distributed, such that $roa \approx N(\mu_{roa}, \sigma_{roa}^2)$, Boyd and Graham (1986) note that the probability of default can be given by:

$$p(roa \le -car) = p\left(\frac{roa - \mu_{roa}}{\sigma_{roa}} \le -(Z - score)\right) = \Phi(-(Z - score))$$
(3)

where $\Phi(\cdot)$ is the cumulative distribution function (CDF) of the standard normal distribution N(0; 1) and is defined as

$$\mathbf{Z} - \mathbf{score} = \frac{\mathbf{car} + \mathbf{roa}}{\sigma_{\mathbf{roa}}} \tag{4}$$

Z-score is the inverse of the probability of insolvency. Thus, this variable indicates the standard deviations below the mean at which returns would have to fall for capital to be exhausted and the bank to be insolvent (Lepetit & Strobel, 2015). This ratio combines performance information (return on assets indicator, ROA), leverage (return on equity indicator, ROE), and risk (the standard deviation of ROA). A bank can then be considered less stable or close to insolvency if it has poor performance, is poorly capitalized, or has high revenue variation. A higher Z-score indicated a more stable bank. Because the Z-score is highly skewed, following Laeven and Levine (2009), Houston et al. (2010), Ahamed and Mallick (2017), and Albaity et al. (2021), we used the natural logarithm of the Z-score to minimize skewness. Hereafter, we use the Z-score to refer to the natural logarithm.

To measure bank regulation and supervision, we used data from Barth et al (2001, 2006, 2008). Čihák et al. (2012), and Anginer et al. (2021), who collected detailed and comprehensive information on bank regulation and supervision for more than 160 jurisdictions under the auspices of the World Bank between 1999 and 2019. We retain three indices: the capital regulation index (*acs*), which measures the stringency of regulatory capital; the banking regulation index (*actrest*), which determines the extent to which national regulators allow banks to engage in fee-based activities rather than more traditional activities; and the supervisory power index (*supv*) related to the power of supervisors in terms of prompt corrective action, declaration of insolvency, and restructuring (Klomp & de Haan, 2014). Through the Principal Component Analysis (PCA) statistical technique, we captured a linear combination of all these regulatory variables and a linear transformation of the data. It is not assumed that the data satisfy a specific statistical model, although interval-level data are required. Otherwise, the linear combinations are meaningless. Thus, the linear combination of all these regulatory variables and analysis (PCA) statistical technique provides an overall regulatory index (*global*). World Bank governance indicators capture the institutional situation within a country. The institutional variable (*instut*) used in this study is not a weighted average of these indicators but is obtained from the factor analysis (FA) of the six institutional indicators. PCA and FA are dimension-reduction techniques that use the idea that a small number of derived or underlying variables can replace originally measured variables with little loss of information (Joliffe & Morgan, 1992). Factor analysis in the context of institutional variables is explicitly motivated by the existence of latent factors (unobservable variables) underlying observed data (Huang & Wang, 2018).

Finally, the control variables are inflation (*infl*), real GDP per capita growth rate (rgdpg), concentration (*concent*), total bank assets (*size*), loan to total assets (*loan*), deposit to total assets (*dep*), and personnel expenses to total assets (*cost*) (Samad, 2015).

In addition to banking regulations and institutional frameworks, several other elements can also affect the activity and stability of the banking system (Fazio et al., 2015). Thus, we consider internal or bank-specific factors, and external or macroeconomic factors related to the environment in which banks operate (Batten & Vo, 2019). We retained GDP per capita growth, inflation, and concentration of the banking market for variables linked to the environment or country-specific variables. Bank-specific variables include the size of banks measured by the logarithm of total assets, the ratio of bank loans to total assets, the ratio of bank deposits to total assets, and the ratio of personal costs divided by total assets (IJtsma et al., 2017). According to the literature, macroeconomic and bank-specific variables can influence the stability of banking systems in various ways (Pham et al., 2021).

The analysis covers 63 banks in the West African Economic and Monetary Union countries from 2006 to 2019. The banking data come from the balance sheets and income statements of the BCEAO banks and financial institutions. We used data from Barth et al. (2007), Cihak et al. (2012), and Anginer et al. (2021) to measure banking regulation and supervision. These authors collected detailed and comprehensive information on banking regulations and supervision for more than 160 jurisdictions between 1999 and 2019 under the auspices of the World Bank. Macroeconomic and institutional data are drawn from the World Bank databases, including the World Development Indicators (WDI), Global Financial Development Database (GFDD), and Worldwide Governance Indicators (WGI) (Table 1).

For the remaining variables, our results suggest that their inclusion in the same model does not pose any multicollinearity problems. The Variance Inflation Factor (VIF) test on each model's variables confirms this result. Finally, the Sargan test was used to ensure instrument validity. Descriptive statistics are presented (Tables 2 and 3).

4. Results and discussion and robustness check

4.1. Results and discussion

This study investigates the multifaceted impact of prudential regulation on bank risk within the West African Economic and Monetary Union (WAEMU), with an emphasis on the role of institutional quality. A series of robustness tests were conducted, including the analysis of pairwise correlation coefficients between variables, which revealed a strong correlation among the regulatory factors. Consequently, one stringency indicator is included in each model. The application of a dynamic panel model buttressed by the generalized method of moments underscores that capital regulation significantly reduces bank risk (see Table 4). Specifically, a 1% increase in the strictness of capital regulations leads to a 3.9% decrease in bank risk, at the 1% significance level. This finding aligns with that of Ashraf et al. (2020), who demonstrate that more stringent capital regulations lower bank default risk across 111 countries. Danisman and Demirel (2019) find capital requirements to be the most potent regulatory tool for decreasing bank risk, especially for banks with greater market power.

Table 1. Variables and data sources							
Variables	Symbol	Definition	Sources				
Dependent							
Bank risk	Z-score	ROA+(equity/assets))/ stdv(ROA); stdv(ROA) is the standard deviation of ROA.	BCEAO				
Independent							
Global regulation	global	Combination of all these regulatory variables through the statistical technique of principal component analysis (PCA)	The Bank Regulation and Supervision Survey				
Capital regulation	ocs	The stringency of regulatory capital	The Bank Regulation and Supervision Survey				
Activities restriction	actrest	The extent to which national regulatory authorities allow banks to engage in fee-based activities rather than more traditional activities.	The Bank Regulation and Supervision Survey				
Supervisory power	supv	The power of supervisors to take prompt corrective action, declare insolvency, and restructure.	The Bank Regulation and Supervision Survey				
Institution	inst	Result of the factor analysis on the six institutional indicators.	Worldwide Governance Indicators				
Control							
Inflation	infl	the consumer price index	World Development Indicators				
GDP per capita growth	rgdpgrth	GDP per capita growth rate	World Development Indicators				
Concentration	concent	Assets of the three largest commercial banks as a share of total commercial banking assets.	Global Financial Development Database				
Size	size	the natural logarithm of real total assets	BCEAO				
Deposits to Assets	dep	the ratio of deposits to total assets	BCEAO				
Loans to Assets	loan	the ratio of loans to total assets	BCEAO				
Personal costs to assets	cost	the ratio of personnel expenses to total assets	BCEAO				

Source: Authors.

The conclusions of this study resonate with those of Dannon and Lobez (2014) in the WAEMU context and broader literature, including Agoraki et al. (2011), Cerutti et al. (2007), and Barth and Caprio (2018), who report a negative effect of capital regulation on non-performing loans and banking crises. Laeven and Levine (2009) and Klomp and de Haan (2012, 2014, 2015) also advocate that stricter requirements curb bank risk.

Table 2. Descr	Table 2. Descriptive statistics								
Variable	Observations	Mean	Std. Dev.	Minimum	Maximum				
Z-score	910	10.14688	14.14794	-18.95663	149.4678				
Global regulation	910	-1.70e-08	1.240335	-1.652652	1.112232				
Capital regulation	910	8.302857	0.4791227	8	9.06				
Activities restriction	910	7.071429	0.7990349	6	8				
supervisory power	910	9.642857	0.4794209	9	10				
institution	910	-1.17e-09	1	-2.490638	1.866984				
Inflation	910	1.759937	2.566255	-3.233389	11.30511				
GDP per capita growth	910	4.969947	2.499171	-5.370447	10.76021				
Concentration	882	0.6712508	0.1723975	0	1				
size	904	5.166522	0.5297086	3.584331	6.332973				
Deposits to Assets	910	0.6868086	0.2081856	0	2.227974				
Loans to Assets	910	0.5432125	0.1477675	0	0.8638012				
Personal costs to assets	559	0.0249044	0.0478348	0.0013289	0.654273				

Source: Authors.

However, it is vital to acknowledge the heterogeneity in the impact of capital regulation on bank risk, as shown by Delis et al. (2012), who trace this diversity to bank and industry traits as well as macroeconomic conditions. Moreover, Triki et al. (2017) observed that the effect of bank regulation on risk may depend on the size and risk level of banks in the African context.

Conversely, some studies, such as Beck et al. (2006) and Delis and Staikouras (2011), find no evidence that stricter requirements reduce bank risk. Lindquist (2004) also found a negative or non-significant risk effect, suggesting that introducing more risk-sensitive capital regulations could affect certain banks. While most studies affirm that capital regulation is pivotal in mitigating bank risk, its effect is nuanced and varies across contexts and conditions. This study enriches the understanding of the role of prudential regulation in shaping the WAEMU banking landscape by providing empirical evidence.

Banking regulations that restrict activities have been shown to reduce risk, with a 1% increase in restrictions decreasing the insolvency risk by 2.8%. This observation aligns with Delis and Staikouras (2011), who posited that such regulations reduce the default distance. However, this contradicts Beck et al. (2006), who argue that activity restrictions increase the likelihood of a crisis by hindering risk diversification. Recent studies also emphasize the heterogeneous impact of capital regulation on bank risk across contexts (Delis et al., 2012). Supervisory power has been found to decrease bank risk by 1.3% per 1% increase in supervision, which is consistent with the findings of Klomp and de Haan (2014, 2015) and Fernández and González (2005). This trend towards stability is further evidenced by Hoque and Liu (2021), who indicate that combined measures compel banks to adopt safer behaviors. Notably, the beneficial effects of capital restrictions and official supervisory power on bank efficiency are more pronounced in countries with superior institutional quality (Chortareas et al., 2012).

Furthermore, institutional quality directly impacts WAEMU banks' insolvency risk, with the "institutional" variable having significantly negative coefficients. This higher default risk echoes

	rsonal sts to ssets													1.000	
	ns Pei ets a												0	61	
	Loa b to s Asse												1.00	0.0	
	Deposits to Asset											1.000	.392*	.123*	
	Size										1.000	-0.148*	-0.091*	-0.263*	
	Concentration									1.000	-0.383*	0.031	0.015	0.018	
	GDP per capita growth								1.000	156*	.170*	039	.008	.020	
	Inflation							1.000	-0.168*	0.263*	-0.234*	0.012	-0.009	-0.041	
	Institution						1.000	-0.080*	0.171*	-0.233*	0.144*	0.040	0.086*	-0.042	
	Supervisory power					1.000	.104*	344*	.229*	277*	.414*	088*	050	.062	
	Activities restriction				1.000	-0.867*	-0.142*	0.396*	-0.269*	0.413*	-0.467*	0.115*	0.062	-0.062	
ariables	Capital regulation			1.000	849*	.471*	.142*	335*	.233*	436*	.386*	110*	057		
k between v	Global regulation		1.000	0.567*	-0.917*	0.994*	0.115*	-0.363*	0.244*	-0.314*	0.436*	-0.096*	-0.054	0.062	
ion matrix	Z-score	1.000	0.108*	0.219*	-0.175*	0.086*	-0.039	-0.070*	0.019	-0.202*	0.187*	-0.264*	-0.021	0.013	t p<.05.
Table 3. Correlat	Variables	(1) Z-score	(2) Global regulation	(3) Capital regulation	(4) Activities restriction	(5) Supervisory power	(6) Institution	(7) Inflation	(8) GDP per capita growth	(9) Concentration	(10) Size	(11) Deposits to Assets	(12) Loans to Assets	(13) Personal costs to assets	*shows significance a

	Persor costs asset												
	Loans to Assets												1.000
	Deposits to Assets											1.000	.392*
	Size										1.000	-0.148*	-0.091*
	Concentration									1.000	-0.383*	0.031	0.015
	GDP per capita growth								1.000	156*	.170*	039	.008
	Inflation							1.000	-0.168*	0.263*	-0.234*	0.012	-0.009
	Institution						1.000	-0.080*	0.171*	-0.233*	0.144*	0.040	0.086*
	Supervisory power					1.000	.104*	344*	.229*	277*	.414*	088*	050
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<u> </u>									o				

Table 4. Results o	f the estimation of	the impact of reg	julation on bank risk	
Dependent variable: Z-score				
	(1)	(2)	(3)	(4)
Z-score_t-1	0.888***	0.891***	0.828***	0.870***
	(0.0157)	(0.0175)	(0.0291)	(0.0162)
Global	3.572***			
	(0.164)			
capital regulation		3.992***		
		(0.178)		
Activities restriction			2.842***	
			(0.240)	
supervisory power				1.341***
				(0.110)
Institution	-0.453***	-0.415**	-0.727**	-0.246*
	(0.121)	(0.126)	(0.256)	(0.134)
Inflation	0.175***	0.169***	0.0508**	0.218***
	(0.0217)	(0.0225)	(0.0205)	(0.0279)
GDP per capita growth	0.165***	0.167***	0.0916***	0.182***
	(0.0180)	(0.0179)	(0.0191)	(0.0159)
Concentration	-3.192***	-3.182***	-1.681***	-1.384***
	(0.200)	(0.203)	(0.216)	(0.153)
Size	-3.268***	-3.506***	-2.799***	-2.546***
	(0.247)	(0.265)	(0.201)	(0.215)
Deposits to Assets	-10.97***	-11.65***	-5.282***	-1.789**
	(0.386)	(0.407)	(0.618)	(0.872)
Loans to Assets	-8.601***	-9.494***	-1.357	1.113
	(1.091)	(1.025)	(1.467)	(1.170)
Personal costs to assets	34.01***	33.95***	23.37***	30.35***
	(1.483)	(1.549)	(1.738)	(0.944)
Time fixed effects	Yes	Yes	Yes	Yes
Estimation method	System GMM	System GMM	System GMM	System GMM
Number of observations	476	476	476	476
Number of individuals	63	63	63	63
Arellano-Bond test for AR (1)	0.055	0.054	0.079	0.066
Arellano-Bond test for AR (2)	0.254	0.954	0.517	0.613
Sargan test	0.207	0.193	0.165	0.152

Robust standard errors in parentheses: * p < 0.10 ** p < 0.05 *** p < 0.01.

the findings of La Porta et al. (1997), Fang et al. (2014), and Demirgüç-Kunt and Detragiache (1998), who suggest that weak institutions increase the likelihood of banking crises due to deficiencies in law enforcement and governance. Recent research also highlights that improving government effectiveness, controlling corruption, and adhering to the rule of law reduce bank risk

exposure and enhance stability in emerging countries (Uddin et al., 2020). Our findings for the control variables indicate that the Z-score is positively influenced by the GDP per capita increase, signifying that economic expansion contributes to greater wealth and lower insolvency rates. This growth typically bolsters business activities and minimizes defaults, thereby increasing bank profits and reducing risk. However, the literature presents mixed findings on this variable. Abedifar et al. (2013) argue that higher GDP per capita correlates with decreased bank stability, while Čihák and Hesse (2010) assert that GDP growth does not influence stability.

This study reveals that larger banks in WAEMU carry a greater risk of failure, consistent with agency theory assumptions and prior evidence linking bank size to systemic risk (Table 5) (Mensah & Premaratne, 2017). However, this contrasts with studies attributing lower failure risk in large banks to diversification (Claessens & Klingebiel, 2001; Klomp & de Haan, 2015) and evidence that increasing bank size may increase risk while reducing failure odds (Haubrich, 1998). All concentration variable coefficients are significantly negative, implying that concentration heightens failure risk in WAEMU, aligning with De Nicolo et al. (2006) but conflicting with studies showing no concentration-stability link (Căpraru & Andrieş, 2015; IJtsma et al., 2017; Blankson et al., 2022). Recent research also suggests that concentration enables lending relationships in which institutions impede market development (Fernández et al., 2010) and that less concentrated systems exhibit greater efficiency (Al-Gasaymeh, 2016). Deposits are negatively linked to the Z-score, increasing default risk, possibly due to deposit insurance moral hazard, which requires further exploration. This may be shaped by governance, ownership, and economic conditions (Lin & Yang, 2016; Mohammad et al., 2020).

Institutional quality significantly reduces negative insolvency risk impacts, highlighting the role of institutional settings in augmenting regulatory efficacy (Barth et al., 2004; Fernández & González, 2005; Klomp & de Haan, 2014). Recent studies emphasize that regulation effects depend on institutional development and quality (Klomp & de Haan, 2014), and that stronger institutions curb risk and promote stability (Uddin et al., 2020). In summary, this study's findings highlight the nuanced relationships between bank-specific factors, market structure, institutional environments, and risk profiles in WAEMU's banking system. The results align with and expand prior theoretical and empirical research in this domain.

4.2. Robustness check

To validate our findings, we evaluated bank risk using the logarithm of non-performing loans as an alternative stability indicator. This aligns with the understanding that reduced bank risk promotes system stability, and non-performing loans signify impaired credit quality, as they indicate delayed repayment or unmet return expectations (Godlewski, 2005). Non-performance is also highly correlated with bank failure likelihood (Campbell, 2007). Recent studies confirm that non-performing loans are significantly affected by bank-specific, industry-specific, and macroeconomic factors (Amuakwa-Mensah et al., 2017; Zheng et al., 2019). The results in Table 6 confirm that the examined regulations curtailed risk-taking and strengthened WAEMU's banking stability. The alobal index shows a negative correlation between regulations and non-performing loans, revealing that regulations aid in lowering risk. This validates the efficacy of prudential policies in fortifying the sector (Ghazouani & Basty, 2023) and demonstrates the robustness of our findings using the Z-score metric. Our conclusion aligns with evidence that stricter regulation and supervision reduce banking risk (Klomp & de Haan, 2014) and that regulatory restrictions are negatively related to system stability (González, 2005). Furthermore, the impact of market power on the regulatory-risk relationship has been deemed valuable for regulators (Louhichi et al., 2020), and emphasizing reforms' institutional embeddedness has been underscored (Brehm, 2008).

The results in Table 7 reveal that the intercept variables, quantifying regulation and supervision's indirect influence, approach zero and thus reduce the institution's negative impact on bank risk. This underscores the link between prudential policies' efficacy in lowering risk and the institutional quality in the countries investigated. Specifically, the findings highlight that while institutional

Table 5. Results of the effect	t of institutional	status on bank	risk	
Dependent variable: Z-score				
	(1)	(2)	(3)	(4)
Z-score t-1	0.846***	0.851***	0.875***	0.887***
	(0.0482)	(0.0286)	(0.0269)	(0.0319)
Global	4.067***			
	(0.204)			
Capital regulation		2.028***		
		(0.197)		
Activities restriction			0.349**	
			(0.113)	
Supervisory power				0.867***
				(0.120)
Institution	-2.415***	-1.953***	-1.793***	-1.982***
	(0.276)	(0.230)	(0.341)	(0.373)
Global * Institution	0.0326*			
	(0.0166)			
Capital regulation * Institution		0.0624**		
		(0.0186)		
Activities restriction * Institution			0.0656***	
			(0.0101)	
Supervisory power * Institution				0.0215*
				(0.0110)
Inflation	0.109**	0.167***	0.212***	0.198***
	(0.0341)	(0.0314)	(0.0319)	(0.0349)
GDP per capita growth	0.109***	0.108***	0.105***	0.0962***
	(0.0181)	(0.0199)	(0.0173)	(0.0173)
Concentration	-3.767***	-3.879***	-2.420***	-2.864***
	(0.324)	(0.406)	(0.234)	(0.317)
Size	-4.103***	-1.727***	-0.267**	-1.600***
	(0.295)	(0.224)	(0.107)	(0.215)
Deposits to Assets	-9.418***	-3.641***	-0.408	0.514
	(0.959)	(0.606)	(0.846)	(1.032)
Loans to Assets	-7.533***	-5.283***	-0.635	0.821
	(0.932)	(1.337)	(0.684)	(1.049)
Personal costs to assets	23.42***	31.48***	28.05***	22.53***
	(4.109)	(2.459)	(2.089)	(2.292)
Time fixed effectsEstimation methodNumber of observationsNumber of individuals Estimation method Number of observations Number of individuals	Yes System GMM 476 63	Yes System GMM 476 63	Yes System GMM 476 63	Yes System GMM 476 63
Arellano-Bond test for AR (1)	0.072	0.059	0.068	0.073
Arellano-Bond test for AR (2)	0.671	0.951	0.922	0.885
Hansen test	0.114	0.094	0.079	0.109

Robust standard errors are in parentheses: * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 6. Results o	Table 6. Results of the estimation of the impact of regulation on bank risk								
Dependent variable: Risk									
	(1)	(2)	(3)	(4)					
Risk_t-1	0.836***	0.816***	0.793***	0.827***					
	(0.0173)	(0.0146)	(0.0135)	(0.0173)					
Global	-0.112***								
	(0.0228)								
Capital regulation		-0.0208							
		(0.0274)							
Activities restriction			-0.165**						
			(0.0613)						
Supervisory power				-0.157***					
				(0.0256)					
Institution	0.0378	0.0612**	0.0761**	-0.00390					
	(0.0292)	(0.0225)	(0.0247)	(0.0365)					
Inflation	-0.0125**	0.00315	0.0200***	0.0113**					
	(0.00571)	(0.00399)	(0.00486)	(0.00542)					
GDP per capita growth	0.00170	0.00319	0.00537*	-0.00633**					
	(0.00466)	(0.00203)	(0.00305)	(0.00221)					
Concentration	-0.241***	-0.175***	-0.178***	-0.0722					
	(0.0461)	(0.0358)	(0.0431)	(0.0667)					
Size	0.446***	0.414***	0.557***	0.508***					
	(0.0278)	(0.0388)	(0.0501)	(0.0631)					
Deposits to Assets	-0.642**	0.00611	-0.0922	-0.108					
	(0.214)	(0.196)	(0.255)	(0.138)					
Loan to Assets	-1.062***	-1.189***	-0.499	0.239					
	(0.128)	(0.192)	(0.404)	(0.402)					
Personal costs to assets	0.614***	0.0384	1.343***	0.656**					
	(0.168)	(0.242)	(0.175)	(0.293)					
Time fixed effects	Yes	Yes	Yes	Yes					
Estimation method	System GMM	System GMM	System GMM	System GMM					
Number of observations	182	182	182	182					
Number of individuals	31	31	31	31					
Arellano-Bond test for AR (1)	0.017	0.013	0.015	0.023					
Arellano-Bond test for AR (2)	0.132	0.137	0.173	0.119					
Sargan test	0.041	0.013	0.013	0.014					

Standard errors in parentheses.

*p < 0.10, ** p < 0.05, *** p < 0.01.

deficiencies can impede regulation effectiveness, enhancements to regulatory and supervisory frameworks can counteract this negative effect (Stewart & Chowdhury, 2021). Stricter regulation and supervision reduce banking risk, but their impact also depends on institutional development and quality (Klomp & de Haan, 2014). Moreover, improved government effectiveness, controlled

Table 7. Results of the effect	t of institutional	status on bank	risk	
Dependent variable: Risk				
	(1)	(2)	(3)	(4)
Risk t-1	0.825***	0.826***	0.740***	0.678***
	(0.0478)	(0.0351)	(0.0410)	(0.0476)
Global	-0.126***			
	(0.0307)			
Capital regulation		-0.0177		
		(0.115)		
Activities restriction			0.101	
			(0.0681)	
Supervisory power				-0.119**
				(0.0560)
Institution	0.976***	0.870***	0.486***	0.644***
	(0.143)	(0.118)	(0.120)	(0.117)
Global * Institution	0.0440			
	(0.0361)			
Capital regulation * Institution		0.0107**		
		(0.00515)		
Activities restriction * Institution			0.0116*	
			(0.00602)	
Supervisory power * Institution				0.0130**
				(0.00593)
Inflation	0.0147**	0.00948*	0.0114	0.0215**
	(0.00575)	(0.00546)	(0.00921)	(0.00675)
GDP per capita growth	0.00607	0.0120	0.0147**	0.0140*
	(0.00408)	(0.00863)	(0.00603)	(0.00793)
Concentration	0.149*	0.120	-0.110	0.0448
	(0.0856)	(0.0778)	(0.0883)	(0.0577)
Size	0.337***	0.296**	0.251**	0.628***
	(0.0415)	(0.128)	(0.0934)	(0.0809)
Deposits to Assets	-0.449**	0.371	0.340	0.642***
	(0.182)	(0.374)	(0.331)	(0.176)
Loan to Assets	-1.068**	-1.238***	-1.287**	-1.398**
	(0.311)	(0.323)	(0.418)	(0.421)
Personal costs to assets	1.642***	0.600	1.076**	1.373***
	(0.210)	(0.463)	(0.469)	(0.308)
Time fixed effects	Yes	Yes	Yes	Yes
Estimation method	System GMM	System GMM	System GMM	System GMM
Number of observations	182	182	182	182
Number of individuals	31	31	31	31
Arellano-Bond test for AR (1)	0.012	0.005	0.022	0.022
Arellano-Bond test for AR (2)	0.109	0.106	0.189	0.119
Sargan test	0.045	0.023	0.119	0.062

Standard errors in parentheses.

*p < 0.10, ** p < 0.05, *** p < 0.01.

corruption, and rule of law adherence curb bank risk exposure and promote stability (Uddin et al., 2020). The near-zero intercept coefficients imply that their indirect risk impact is trivial, emphasizing the role of institutional quality in developing a resilient and effective bank regulatory climate (Avgeri et al., 2021). This accords with evidence that risk governance effectiveness and bank risk are negatively related and that this relationship strengthens with higher institutional quality (Nguyen & Dang, 2022). Furthermore, capital restrictions and supervisory powers have greater beneficial impacts on bank efficiency with superior institutional quality (Chortareas et al., 2012).

In summary, the results highlight the interdependence between institutional environments, regulatory frameworks, and prudential policies in shaping bank risk profiles in the WAEMU countries. These findings expand our empirical understanding of how bank regulation efficacy is contingent on institutional conditions.

5. Concluding remarks

This study investigates the influence of prudential regulation on banking risk in the West African Economic and Monetary Union (WAEMU), focusing on institutional quality. Employing the methods of Blundell and Bond (1998) and Roodman (2009), the analysis finds that robust regulations and supervision decrease insolvency risk.

Three key aspects were identified as critical for reducing bank risk: (i) capital regulation, (ii) activity restrictions, and (iii) supervisory power. Capital regulations ensure adequate reserves and reduce insolvency risk, with a 1% increase in stringency causing a 3.9% risk decrease. A 1% increase in activity restrictions leads to a 2.8% reduction in risk. Supervisory power increased by 1% and lowered risk by 1.3%.

The implications for WAEMU policymakers include the following: (i) maintaining robust regulation and emphasizing capital requirements, activity limits, and supervisory authority. (ii) Improving institutional quality for stronger enforcement and oversight. (iii) Enhancing monitoring and enforcement of standards. (iv) Fostering coordination among regulatory bodies. In summary, the analysis demonstrates that stringent prudential regulation and supervision, buttressed by quality institutions, is imperative for mitigating bank risk and promoting financial stability in WAEMU. These findings offer insights to guide policies aimed at fortifying the banking system through regulatory and institutional enhancement.

This study has some limitations, such as the limited data period and the unexplored interactions between regulations. Future research could explore the long-term impacts, interactions between different regulations, the effect of recent crises, such as COVID-19, and the influence on banks' overall financial performance. In summary, this study offers valuable insights into the effects of banking regulations at WAEMU, with potential extensions for understanding stability and performance, particularly during international crises. This analysis provides policy implications to guide regulatory and institutional enhancements aimed at fortifying banking systems.

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Note

 The countries of the WAEMU are composed of: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo. These countries share a common currency, the CFA franc of the Central Bank of West African States (BCEAO) and work together to promote economic development and regional integration.

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