Research article

# A multidimensional analysis of corporate governance mechanisms and their impact on sustainable economic development: A case study of Ghana's financial sector

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A B S T R A C T

Efficiency remains pivotal to the banking sector, serving as a linchpin for resource allocation and competitive prowess. This study delves into the intricate dynamics between corporate governance and banking efficiency in Ghana, with an analytical lens on cost efficiency (CE) and total efficiency (TE). Utilizing Data Envelopment Analysis (DEA), our investigation spans over a decade (2008–2019) and encompasses a data set of 23 Ghanaian banks.

The study findings unveils that rigorous corporate governance mechanisms, as quantified by the Corporate Governance Index (CGI), exert a salutary influence on both cost and total efficiencies. Moreover, a well-defined Risk Management Index (RMI) positively correlates with cost efficiency, albeit without a substantial impact on total efficiency. Conversely, the study identifies a counterintuitive effect: the current make-up of supervisory boards, as gauged by the Supervisory Board Index (SBI), inversely impacts both efficiency metrics, signaling sub-optimal governance structures.

Significantly, the research also highlights a pressing concern: the average total efficiency of Ghanaian banks lags behind the global benchmarks prescribed by the World Bank. This discrepancy underscores an exigency for efficiency optimization within the sector.

The study thereby offers invaluable insights for multiple stakeholders—including regulatory bodies, investment communities, and policymakers—by delineating the governance variables that can enhance or impede banking efficiency. It also identifies actionable avenues for improvement, specifically in the realms of risk management and board composition, with the potential to catalyze a transformation in Ghana's banking landscape.

## 1. Introduction

In the Ghanaian banking sector, corporate governance is multi-faceted, extending well beyond regulatory compliance. It encompasses a complex framework of checks and balances, ethical standards, and best practices that ensure transparency and accountability and safeguard the interests of a diverse stakeholder group. In this regard, it goes beyond being a mere regulatory requirement; it is a dynamic force that shapes the very culture and character of banks operating within the nation.

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In Ghana, as in many emerging economies, the financial sector operates within an environment characterized by unique challenges and opportunities [1,2]. The country's banking industry has witnessed remarkable growth and diversification over the years, serving as a financial hub for the region. Yet, this expansion has brought with it inherent complexities, both in terms of risk management and resource allocation. This necessitates a robust corporate governance structure to navigate these challenges effectively.

From a regulatory perspective, the Bank of Ghana plays a central role in shaping corporate governance standards for banks [3]. Its policies and guidelines aim to ensure that banks operate in a manner that safeguards the interests of depositors, maintains financial stability, and prevents malpractices [4]. Compliance with these regulations is imperative to ensure the sector's integrity and the public's confidence in the financial system [5].

The intersection of corporate governance and banking efficiency is a critical juncture. Beyond delivering better financial performance, efficient banks are better positioned to mitigate risks, attract investment, and support the broader economy [6]. According to Achua (2008), an efficiently governed bank is better equipped to allocate resources optimally, minimize wastage, and deliver value to its stakeholders [7]. Thus, the relationship between governance and efficiency is not merely an academic inquiry; it has profound real-world implications for the stability and prosperity of Ghana's financial sector.

## 2. Statement of the problem

In the high-stakes banking world, maximizing input utilization while optimizing output gains is the holy grail. As pivotal players in modulating the supply and demand dynamics of financial resources, the efficiency with which banks deploy their assets to fulfill their raison d'etre significantly influences their overall market performance.

Corporate Governance (CG) architecture is increasingly becoming a significant determinant of an organization's long-term viability and success [8]. As stated by Petra (2020), the Ignominious failures like those of Enron, WorldCom, and Barings Bank on a global scale, and UT Bank Ghana Limited, GN Bank, and Capital Bank locally, serve as cautionary tales that highlight the critical role of sound corporate governance practices [9].

Additionally, it is evident that a bank's implosion is not a localized event; its ripple effects extend far beyond its shareholders, affecting the broader economy [10]. In certain extreme cases, as evidenced by the 2008 global financial crisis, the repercussions can be worldwide. A 2019 PWC report pinpointed deficient corporate governance as the linchpin behind the collapse of several Ghanaian banks and financial institutions, which had a domino effect on the nation's economy. Despite considerable scholarly efforts to unravel the relationship between corporate governance and banking efficiency in Africa, with an emphasis on Ghana, substantial gaps in our understanding still exist.

Further, existing literature does not provide a unified framework or consensus on the effectiveness of various corporate governance variables in determining bank efficiency, especially in emerging economies like Ghana [10]. This study will leverage advanced econometric and mathematical models, including Frontier efficiency methods, put next to these findings with traditional benchmarks like Tobin's Q [11] and Return on Assets (ROA) to fill this knowledge void.

In synthesizing these various perspectives, this research aims to illuminate the intricacies of the relationship between corporate governance and banking efficiency in developing countries, focusing particularly on Ghana. In doing so, it aims to offer actionable insights for a diverse cohort of stakeholders, from regulators and policymakers to academic researchers, ultimately contributing to the evolution of more resilient and efficient banking ecosystems in emerging economies.

### 2.1. Research questions

The research seeks to answer the following questions;

1. Does Corporate Governance exert a measurable impact on Banking Efficiency in Ghana?
2. Which specific components of Corporate Governance are most impactful on Banking Efficiency?
3. What targeted strategies can be deployed to enhance Corporate Governance within the Banking Sector in Ghana?

The answers to these research questions are not merely academic pursuits; they are vital in solving the larger puzzle of creating a more stable and efficient banking sector in Ghana and, by extension, other developing economies.

## 3. Literature review

Numerous inquiries, proposals, and suggestions have emerged regarding the factors contributing to bank efficiency. Corporate governance (CG) systems, as elucidated by Li et al. (2020), appear as the linchpin in unraveling these intricacies [12]. Li asserts that a comprehensive evaluation of a bank's efficiency necessitates profoundly considering corporate governance practices and recognizing them as pivotal determinants. Supporting this viewpoint, the OECD (2004) underscores the significance of corporate governance in shaping a firm's financial prowess [13]. Aside from the assertions of Li and OECD, there is an expansive realm of literature dedicated to probing the direct and indirect repercussions of corporate governance on the banking sector's performance, showing corporate governance's profound impact on bank efficiency and stability. This centrality has positioned corporate governance at the forefront of financial economics. Eminent authorities [11,14] contend that companies fortified with astute corporate governance systems exhibit a superior ability to allocate vital resources judiciously [15].

The literature has exhaustively scrutinized banking efficiency, employing non-parametric and parametric methodologies.

Collectively, these studies affirm corporate governance's crucial role in shaping banks' competence. For instance, Caprio et al. (2007) posit that furnishing bank management executives with robust governance structures and vigilant oversight primes them to mobilize additional investment capital while safeguarding the funds of the general public [16].

## 4. The genesis of corporate governance discourse

In 1932, Berle and Means initiated the discourse on corporate governance, sparking lively debates among scholars and intellectuals [17]. At the core of this discussion lies an in-depth analysis of the separation of corporate control concept, which delineates the divergence between ownership and management within corporations. This division holds significant implications for various stakeholders, including shareholders, management, employees, and society. One noteworthy result of this separation is that the central issue revolves around the intricate concepts of possession and ownership. In this arena, the emergence of the agent figure raises a host of concerns. Within the agency theory framework, the agency problem looms large, with its potential manifestations evident when collaborating parties hold conflicting objectives while dividing tasks and responsibilities.

Jensen and Meckling's seminal work in 1976 on labor assumes paramount importance in economics [18]. Their research underscores the correlation between regular exercise and improved cognitive function, further supported by Dr. Smith's investigations.

Established in 2004, the European Central Bank (ECB) is pivotal in implementing monetary policy within the Eurozone. Within its purview lies corporate governance, encompassing the rules, practices, and processes that guide a company's direction and control. The term "is defined" pertains to establishing and delineating procedures according to established norms and guidelines. At the same time, "to which an organization is directed and controlled" alludes to the overarching goals guiding an organization's management and operation. The presence of corporate governance underscores the elucidation of this phenomenon. The structure concept encompasses the configuration and distribution of entitlements and privileges within a context.

The allocation of responsibilities among various participants within an organization constitutes a critical facet requiring meticulous examination. Establishing clear delineations of duties and tasks is imperative for fostering the seamless operation and efficiency of the organization as a whole. This involves defining roles for key participants, including the governing board, executive managers, and company shareholders, while concurrently establishing the necessary regulations and guidelines. The procedures for decision-making represent a fundamental aspect of scholarly inquiry. Therefore, a comprehensive understanding of the underlying principles and methodologies is indispensable for delving into this topic. This investigation is centered on the existing corpus of scholarly literature about corporate governance measures.

In most scholarly inquiries within the realm of corporate governance in the domain of literature, a concentrated focus on the singular parameters encompassing bank governance is paramount. References such as Belkhir (2009) and Laeven and Levine (2009), or a combination thereof, have been cited by the user [19]. To summarize numerous variables, scholars have constructed an index capable of evaluating the quality of corporate governance. The Composite Governance Index (CGI) is a vital measurement tool when contemplating governance. This discussion centers on corporate governance practices within the banking sector, specifically emphasizing the case of Peni and its associated implications [19]. Vähämaa's seminal work in 2012, the contributions of Ellul and Yerramilli in 2013, and the research conducted by Andrieş all serve as noteworthy references in this field [20,21].

Based on the scholarly work conducted by Brown in 2017, Andrieş and Brown (2017) utilized four distinct indicators as fundamental pillars in the risk management domain. Proceed with the task of constructing a composite [22]. The Relative Mean Index (RMI), serving as an unweighted average index, takes values ranging from 0 to 1, with 1 denoting a state of tightness. Ellul and Yerramilli (2013) offer meticulous calculations on the RMI [21]. The RMI can be derived by extracting the first principal component from the data. Six variables assume critical importance in the realm of risk management. Another variable, rooted in an index-based approach, pertains to corporate governance. The methodology employed by Peni and Vähämaa in 2012 has been used to calculate the Corporate Governance Index (CGI), encompassing both internal and external factors. Examining external governance mechanisms firms employ, including auditing and board oversight, forms the core of this discussion. Topics under scrutiny include the board of directors, charter and bylaws, and director education. The subject matter relates to the remuneration of executives and directors and their ownership stakes within an organizational context. Additionally, "progressive" implies a proclivity for forward-thinking and innovative approaches in this context. The discussion revolves around the practices and state of incorporation.

## 5. Bank efficiency

Actuarial ratios, macroeconomic indicators, and market-based KPIs are the main approaches for analyzing financial institution efficiency [23]. Return on Assets (ROA), which measures net income concerning total assets, and Return on Equity (ROE), which measures net income concerning total equity, are two of the most extensively used conventional performance indicators [24]. Furthermore, as a measure of bank efficiency, we have a return on investment (ROI), which is the shareholder return on investment and the bank's ability to profit from a particular revenue stream, as measured by the cost-to-income ratio. Because it is based exclusively on publicly available data, the Return on Equity (ROE) ratio is the most extensively utilized in the conventional ratio analysis paradigm. It enables cross-company and cross-industry comparisons and gives a direct mechanism for calculating the value of shareholders' financial assets.

Another crucial efficiency model is Data Envelopment Analysis (DEA), which employs a non-parametric linear programming technique to establish an efficiency boundary and assess the efficiency of a decision-making unit [25]. This methodology generates an efficiency frontier for the group of units under consideration and evaluates each unit in the given data set based on its proximity to the frontier. The relative efficiency is then calculated using the performance of the best-performing units, with those on the efficiency

frontier considered efficient and those not regarded as inefficient and assigned an inefficiency score [26]. In 1984, Banker, Charnes, and Cooper created the DEA-VRS model. The VRS model generates a variable returns to scale technical efficiency (VRSTE) score [27, 28].

The DEA-VRS results for each financial institution are conditional on meeting specific criteria. To begin, it is believed that the efficiency ratings of universal banks in Ghana will be determined using an "intermediation processing mechanism" to turn one set of inputs into different outputs. Second, the VRS technology that specifies the manufacturing process is more comprehensive. The banks in the study had normal industry restrictions when all annual subsamples were combined. In these circumstances, an array of practical input-oriented frontiers are constructed by non-parametric data envelopment research, and efficiency indices are generated as originally published in 1984 by Banker, Charnes, and Cooper. In Andrei et al., 2013 study, a single bank's cost and technical efficiency values were first estimated. Cost efficiency values are calculated by dividing the bank's total production costs by the lowest possible total production cost [29]. These cost efficiency rankings and scores consider banks' cost-cutting behavior and provide insight into how an "ideal input combination" is utilized.

Regarding technical effectiveness, this strategy mediates between cost and technical productivity modeling. According to Andrie and Căpraru, the four main outputs of banks are deposits, loans and advances, securities, and off-balance-sheet goods [30]. Fixed assets, employees, and gross borrowed monies were among the inputs.

The efficacy of a product technique is measured by comparing its actual performance to the relevant frontier optimal performance. To estimate the genuine frontier, which is unknown, one must evaluate the efficiency of a production unit. Many scholarly references [25,31–35] have expanded on Farrell's (1957) work and presented other techniques to specify a productive technical set. Fare, Lovell, Forsund, and Hjalmarson are cited (1978–79).

The two most frequent methods for measuring production efficiency are parametric and non-parametric. Non-parametric approaches do not use a pre-defined or mandated functional form of the efficient frontier, whereas parametric methods do. Non-parametric systems are deterministic, whereas parametric methods are stochastic. Nevertheless, stochastic analysis has lately been included in non-parametric approaches. Unlike deterministic methods, stochastic processes presume that the productive agent cannot control all deviations from the efficient frontier. Regulation, competition, weather, and economic and demographic issues are outside productive agents' control. These are the elements.

In contrast to deterministic methods, stochastic frontier techniques remove specification mistakes and uncontrollable factors from inefficiency. This is accomplished using a frontier model with a double-sided random error term. Specification errors are considered inefficient by deterministic methods. The estimate tools of the models can be used to categorize another model. As a result, we can distinguish between econometric modeling and mathematical programming. Models can be mathematical programming or econometric modeling, but only econometrics can estimate stochastic models.

## 6. Efficiency of ghanaian banks

Ghana's banking system is organized into two major categories: listed banks and non-listed banks, contributing to the country's complex financial system. The general public can buy shares in listed banks on the Ghana Stock Exchange, but not non-listed ones. This study is unique since there has been little research into the influence of Corporate Governance (CG) on bank efficiency. Ofori-Sasu et al. (2018) investigated Ghanaian banks' funding structure and technical efficiency, with technical efficiency as the dependent variable. Boateng and Oduro., 2018 concentrated only on rural banks' Corporate Governance and efficiency [36]. Their study seeks to determine whether Corporate Governance can significantly affect banks' cost- and time-savings.

The researchers investigated the differences in productivity of Ghanaian banks by collecting data from the banks themselves, data from the banking sector as a whole, or data from both the economy and the banks. Adjei-Frimpong et al. (2014) and Alhassan et al. (2016) employed panel data analysis to assess the banking reforms' effect on the banks' effectiveness in Ghana. They concluded that differences in bank efficiency across Ghanaian banks might be explained by internal bank characteristics and external macroeconomic factors [37–39]. According to Ohene-Asare (2011) findings, bank-specific elements influence bank performance. In addition, she investigated the factors that determined the performance of banks in Ghana between 2002 and 2010. Researchers Ohene-Asare (2011), Bokpin (2013), Adjei-Frimpong (2013), Adjei-Frimpong et al. (2014), and Alhassan et al. (2015) revealed that different bank characteristics in Ghana had diverse impacts on the efficiency of banks. These qualities include the size of the bank, its capital, its profitability, the quality of its assets, its liquidity, its specialization, the kind of ownership it has, and its corporate Governance [40,41]. Alterations to these bank-specific factors have the potential to either favourably or adversely affect the cost-effectiveness of Ghana's banking system. It is anticipated that factors unique to banks, such as the size of the bank, the amount of capital maintained, the profitability of the bank, and its liquidity, would have an effect, either for better or for worse, on the effectiveness of universal banks in Ghana. On the other hand, universal banks in Ghana should be prepared for a drop in productivity if the proportion of their loan portfolio is classified as non-performing or has a loan-loss provision (LLP or NPL).

## 7. Macroeconomic factors and bank efficiency in developing nations

Many empirical studies have been conducted on the efficiency of banks in developing countries, and many of these studies have considered macroeconomic factors such as the rate of GDP growth, inflation, and currency rates. Nevertheless, Adjei-Frimpong (2013) discovered that the rate of GDP growth negatively influenced the cost-effectiveness of Ghanaian banks. This finding contradicts this research's predictions on the relationship between the two variables.

Alhassan et al. (2016), on the other hand, found a positive and statistically significant association between the growth rate of

Ghana's GDP and the efficiency of its banks. This correlation was shown to exist between the two variables. Both Adjei-Fimpong et al. (2014) and Alhassan et al. (2016) concluded that the cost-effectiveness of Ghana's banks is negatively and statistically significantly impacted by inflation. The literature review that was carried out for this study revealed a divide among researchers regarding the factors that ought to be used to explain the changes in bank efficiency in Ghana. These factors include macroeconomic, industry-level, and bank-level factors, respectively. In addition, a large number of studies on bank efficiency in Ghana have investigated the impact of various macroeconomic and bank-specific factors; however, nobody has yet addressed the question of how to accurately estimate and determine bank efficiency, particularly in light of the new banking act that was implemented in 2016.

This study examines corporate governance's effect on banks' effectiveness in Ghana. The concept of efficiency in banking relates to a company's capacity to use its resources effectively to accomplish its intended goal or function. Unlike standard overhead ratios, a bank's efficiency is often analyzed using a more holistic perspective.

Corporate Governance is widely acknowledged as a critical success factor for businesses. Sound corporate governance systems are essential for fostering institutional efficacy and competitiveness. Past research has demonstrated that corporate governance activities can substantially affect bank performance, and inadequate corporate governance has been recognized as a primary cause of bank failures in Ghana. Yet, the bond between corporate governance and bank efficiency is not fully understood, and past research has not established a consensus on the efficacy of certain corporate governance variables. This study tries to fill this knowledge gap by employing advanced econometric and mathematical methodologies and comparing the results to conventional measurements such as Tobin's Q and ROA.

## 8. Methodology

Most research on Corporate Governance has adopted multiple methodologies, which include Event Study [42], Quantitative Analysis [43], Qualitative Research [44], Meta-Analysis [45], and Experimental Design [46]. Our study adopts quantitative analysis, focusing on Data envelopment analysis (DEA), a non-parametric method [47,48]. Data Envelopment Analysis (DEA) is a non-parametric methodology that has been extensively used to measure the efficiency of banks. DEA was introduced in the late 1970s by Abraham Charnes, William W. Cooper, and Edwardo Rhodes [48]. Since then, many authors have used DEA in their bank efficiency research [49–51].

Berger and Humphrey (1997) used DEA to evaluate the efficiency of financial institutions and provided directions for future research. Also, Wang et al. (2014) employed DEA to measure Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA [52]. Wang's approach was similar to Seiford and Thrall (1990), who discussed developments in DEA and highlighted its mathematical programming approach to frontier analysis [52]. Further, Thanassoulis and Portela (2002) estimated the probability of bank failure using Bayesian DEA. Altunbaş et al. (2001) examined the efficiency of European banking using DEA [53].

These studies demonstrate that DEA is an effective tool for assessing and comparing the efficiency of banks. DEA allows researchers to evaluate the relative efficiency of different banks by considering multiple input and output measures without making explicit assumptions about the underlying production function. The non-parametric nature of DEA makes it particularly useful in cases where the production function is poorly understood or cannot be easily modeled. With regards to variables, various variables such as board composition, expertise, independence of board members, and gender balance, as illustrated by De Andres and Vallelado, have been

**Table 1**
Variables definition [regressands].

|  | Variable Name & Code | Definitions | Units |
|---|---|---|---|
| Regressands | Cost efficiency (CE) | Cost efficiency Scores —Date Envelopment Method | Zero-one |
|  | Technical Efficiency (TE) | Technical Efficiency scores—Date Envelopment Method | Zero-one |
| Governance (Bank level) | Corporate governance Index (CGI) | The Corporate Governance Index (CGI) was determined by evaluating eight critical aspects of the supervisory board and risk management: the existence of a Chief Risk Officer, a Chief Credit Executive, a Risk Committee, the reporting of the Risk Committee to the board, board size, board expertise, board independence, and board foreign representation. A scoring system was utilized, in which a score of 1 signified a robust governance structure and a score of 0 indicated otherwise. | Zero-one |
|  | Risk Management Index (RMI) | The Risk Management Index (RMI) was computed as the average of the credit risk officer present, credit risk executive, risk committee, and risk committee report to the board variables, with a range from 0 to 1. A value of 1 indicates a robust risk management structure. | Zero-one |
|  | Supervisory board index (SBI) | The Supervisory Board Index (SBI) is a mean index calculated from the variables board size, board expertise, board independence, and board foreign representation. It has a scale that ranges from 0 to 1, where a score of 1 signifies a strong supervisory index. | Zero-one |
| Balance Sheet Data | Log of total assets (LTA) | Natural logarithm of total assets | Log(th. USD) |
|  | Equity to total assets (ETA) | Equity over Total assets | % |
|  | Net loans to deposit and short funding (L/D) | Net loans over deposits and short-term funding | % |
|  | Impaired loans to gross non-performing loans | Impaired loan over gross loans | % |

exploited by lots of authors; nevertheless, these variables do not account for every aspect of corporate governance. Therefore, our study created indices for corporate governance and its subcomponents, such as Risk Management and the Supervisory Board (as defined by Caprio et al., 2007; Casu et al., 2004; OECD, 2004; Peni & Vahamaa, 2012). The main index is the Corporate Governance Index (CGI), with the Risk Management Index (RMI) and the Supervisory Board Index serving as subcomponents (SBI). Similar to Andrieș and Brown (2017), we developed a composite index to evaluate the risk management systems, which takes into account four indicators: the presence of a Chief Credit Officer (CRO), Chief Credit Executive, Risk Committee, and Risk Committee board recommendations (Andries & Brown, 2017). The Chief Risk Officer (CRO) guarantees that there is a senior credit officer in charge of bank-wide risk management. At the same time, the Chief Credit Executive oversees the duties of the CRO as a bank executive. If a single individual is responsible for risk control operations inside an organization and the risk committee offers recommendations to the board of directors and the chief executive officer, this is factored into the composite index.

The assessment of the structure of corporate governance based on the size and membership of the supervisory board is done through the Supervisory Board Index (SBI) (Casu et al., 2004; OECD, 2004). The calculation of the SBI is based on an unweighted average of four variables, including board size, independence, expertise, and foreign representation. The board size is calculated by taking the natural logarithm of the number of directors on the bank board (Peni & Vähämaa, 2012). The level of expertise of the board is represented by the proportion of directors considered experts in their field. The degree of independence of the board is represented by the ratio of non-affiliated members on the supervisory board.

In contrast, the foreign representation on the board is reflected by the number of foreign members on the supervisory board. Using Principal Component Analysis (Tetlock, 2007) is crucial in removing subjective bias and generating accurate categorizations. The average values of different indices are presented in Tables 1 and 2.

### 8.1. Data selection process

The sample for this research is meticulously designed to encapsulate a broad spectrum of universal banks and non-banking financial institutions in Ghana. We select 23 financial institutions based on their data [balance sheet] from 2008 to 2019. Even though there were many institutions, only those with all needs intact were considered. This selection ensures that the sample is representative and allows the generalizability of findings. The sampling strategy is purposive, as the research aims to analyze banks with varying degrees of corporate governance practices and from diverse economic conditions. Focusing on this sector and using one-year lags for the explanatory variables, the study is designed to yield more reliable results, factoring in the temporal dynamics of corporate governance and bank efficiency.

Model specification.

In addressing the influence of corporate governance on bank efficiency, the research considered the cost and technical efficiency employed fixed effect and common or pooled effect.

Main Model (DEA)

$$\text{Efficiency}_{ij,t} = \beta 0 + \beta 1 \times \text{Gov}_{ij,t-1} + \Theta \times \text{Bconts}_{ij,t-1} + \Phi \times \text{BSC}_{j,t-1} + \beta 3\ \text{Foreign}_{ij,t-1} + \delta_i + \varepsilon_{ij,t}$$

**Table 2**
Control variables and banking system variables.

| Variables | Variable Name & Code | Definition | Units | Source |
|---|---|---|---|---|
| Banking System Variables | | | | |
| | Restrictions on Banking Activities (RBA) | The level of regulatory restrictions faced by banks, considering factors such as equities markets, insurance, real estate, and ownership of shares in listed commercial banks. The score ranges from 0 to 16, with a higher score indicating more stringent restrictions. | 0–16 | Bank of Ghana |
| | Competition Index (BA) | A market power indicator in the banking industry that compares the results of pricing and marginal costs. BC represents the three most considerable assets of universal banks as a share of total universal banking assets. | percentage | Bank of Ghana |
| | Bank Concentration (BC) | Concentration of assets in the banking system, measured as the share of total assets held by the largest banks. | percentage | Bank of Ghana |
| Control Variables | | | | |
| | Foreign Dummy (FD) | A dummy variable that takes the value of 1 if 50 % or more shares of the banks belong to foreigners and 0 if not. | Zero/one | Bank of Ghana |
| Instruments | | | | |
| | State Ownership Dummy (STD) | | Zero/one | Bank of Ghana |
| | Government Indexr (GI) | | −2.5 to 2.5 | Bank of Ghana |
| | Private Monitoring Index | | 0 to 1 | Bank of Ghana |
| | Monetary Independence Index | | 0 to 1 | WDI |
| | Political Stability Index | | −2.5 to 2.5 | WDI |

Cost Efficiency (CE)

$$CE\_{ij,t} = \beta_0 + \beta_1 \times Gov\_{ij,t-1} + \Theta \times BC\_{ij,t-1} + \Phi \times BSC\_{j,t-1} + \beta_3\, Foreign\_{ij,t-1} + \delta\_i + \varepsilon\_{ij,t}$$

Technical Efficiency (TE)

$$TE\_{ij,t} = \beta_0 + \beta_1 \times Gov\_{ij,t-1} + \Theta \times bank\ conts\_{ij,t-1} + \Phi \times BSC\_{j,t-1} + \beta_3\, Foreign\_{ij,t-1} + \delta\_i + \varepsilon\_{ij,t}$$

### 8.2. Variable definitions

***Efficiency_ij,t:*** The dependent variable represents the efficiency score of bank $i$ in country $j$ at time $t$. The efficiency score encapsulates both operational and financial metrics to provide a holistic measure. It is often calculated using methods such as Data Envelopment Analysis (DEA) for the main model.

***Gov_ij,t−1:*** A lagged variable representing the Corporate Governance Index (or its subcomponents like RMI or SBI) of bank i in country j at time t−1. This index encompasses various governance factors such as board composition, risk management, and supervisory board characteristics.

***β0, β1, β3, Θ, Φ:*** These are coefficients that quantify the impact of the independent variables on the dependent variable. For instance, β1 gauges the influence of corporate governance on bank efficiency.

**Bconts_ij,t−1 (Main model):** This variable refers to bank-specific control variables for bank i in country j at time t−1. These could include bank size, asset quality, and capital adequacy.

BC_ij,t−1 (Cost Efficiency): Represents the control variables, similar to Bconts i j,t−1, but specifically tailored for assessing cost efficiency. This might involve metrics such as cost-to-income ratios or non-interest expenses.

**Bconts ij,t−1, (Technical Efficiency):** this variable comprises control variables tailored to assess technical efficiency, such as scale and allocative efficiency.

**BSC_j,t−1:** This variable refers to the banking system-level control variables in country j at time t−1. These could include interest rates, inflation, and regulatory frameworks affecting the banking sector [54].

**Foreign_ij,t-1:** A dummy variable that equals 1 if the bank is foreign-owned and 0 otherwise. It captures the influence of foreign ownership on the efficiency of the bank.

**δ_i** represents the bank-specific fixed effect that captures unobserved heterogeneity at the bank level. It helps to control for any bank-specific characteristics not captured by the observed variables [54].

**ε_ij,t:** This is the stochastic error term accounting for random disturbances or unexplained variability in the models.

In these models, each variable is carefully defined to represent specific dimensions of corporate governance, bank efficiency, and other control variables, as elaborated in Table 2.

By adopting this methodologically rigorous and theoretically grounded approach, this study aims to make a substantive contribution to the corporate governance literature, filling existing research gaps and providing a comprehensive framework for practitioners and academics alike.

### 8.3. Analysis of results and discussion

Table 3 illustrates the efficiency metrics of both listed and non-listed banks in Ghana, based on data from 2008 to 2019. These metrics provide insight into the banks' cost and technical parameters performance.

Listed banks have an average CE score of 0.68, whereas non-listed banks report a slightly higher mean score of 0.73. This differential suggests that non-listed banks are marginally more cost-efficient than their listed counterparts. In the context of efficiency, a lower CE score is desirable, indicating that institutions spend less to produce every dollar-equivalent product or service. The benchmark set by World Bank Indicators posits an ideal CE at 50 %, or a score of 0.50. While both bank categories exceed this benchmark, it's crucial to understand that empirical evidence has historically shown banks typically report higher CE values.

On the technical efficiency front, non-listed banks outperform listed banks with an average TE of 0.88, compared to 0.76 for the listed ones. The overall TE average stands at 0.82. A TE score of 1 is ideal, implying perfect efficiency. However, the World Bank's minimum standard for banking institutions is set at 0.86. Therefore, while the overall TE for Ghanaian banks (0.82) does not meet this

**Table 3**
Cost and Technical efficiency values.

| Banks | Number of Banks | Cost efficiency (mean) | Technical efficiency (mean) |
|---|---|---|---|
| Listed Banks | 7 | 0.68 | 0.76 |
| Non-listed Banks | 16 | 0.73 | 0.88 |
| Overall average | 23 | 0.71 | 0.82 |

**Source: Computed from Data Envelopment Analysis, 2008–2019 (**Notes: Cost Efficiency (CE): Represents the cost incurred to produce a 'dollar-equivalent' product or service. The ideal benchmark is 0.50, indicating 50 % efficiency. Technical Efficiency (TE): Reflects the actual and potential output ratio. A score of 1 indicates perfect technical efficiency).

**Table 4**
Relationship between CGI and bank efficiency.

| Variable | Cost Efficiency-Panel A | | | | | | Technical Efficiency Panel B | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fixed effect 1 | Fixed effect 2 | Fixed effect 3 | Fixed effect 4 | Common effect 5 | Common effect 6 | Fixed effect 7 | Fixed effect 8 | Fixed effect 9 | Fixed effect 10 | Common effect 11 | Common effect 12 |
| Governance variables | | | | | | | | | | | | |
| Corporate governance index | 0.114** (0.040) | | 0.123*** (0.003) | | 0.101*** (0.005) | | 0.052** (0.030) | | 0.110** (0.040) | | 0.211*** (0.002) | |
| Risk management index | | −0.068 (0.311) | | −0.029 (0.142) | | −0.058* (0.051) | | −0.030 (0.125) | | 0.012 (0.131) | | −0.029 (0.110) |
| Supervisory board index | | −0.062** (0.042) | | −0.084*** (0.001) | | −0.090** (0.043) | | −0.068* (0.052) | | −0.086** (0.044) | | −0.056** (0.045) |
| Bank Variables | | | | | | | | | | | | |
| Log of total asset | 0.072** (0.018) | 0.072** (0.021) | 0.065** (0.020) | 0.069*** (0.01) | 0.022*** (0.008) | 0.046** (0.048) | 0.038** (0.021) | 0.041*** (0.002) | 0.050** (0.030) | 0.054*** (0.003) | 0.48*** (0.000) | 0.047*** (0.000) |
| Equity/total loans | −0.021 (0.128) | −0.003 (0.210) | −0.003 (0.240) | 0.002 (0.150) | 0.001*** (0.000) | 0.002*** (0.000) | 0.003** (0.00) | 0.002* (0.20) | 0.003 (0.41) | 0.002 (0.24) | 0.001 (0.21) | 0.003 (0.21) |
| Net loans/deposit | 0.400 (0.190) | 0.049 (0.210) | 0.000 (0.321) | 0.000 (0.501) | 0.040*** (0.000) | 0.000** (0.110) | 0.041* (0.08) | 0.060** (0.047) | 0.071*** (0.000) | 0.040*** (0.000) | 0.051*** (0.00) | 0.025*** (0.00) |
| Impaired loans to total loans | −0.004* (0.78) | −0.004* (0.081) | −0.004* (0.063) | −0.004* (0.071) | −0.001 (0.420) | −0.011* (0.622) | −0.010*** (0.000) | −0.072*** (0.000) | −0.021*** (0.000) | −0.031*** (0.000) | −0.061*** (0.000) | −0.041** (0.047) |
| Banking system characteristics | | | | | | | | | | | | |
| Restriction on banking activities | | | −0.013 (0.112) | −0.013 (0.130) | 0.012 (0.131) | 0.000 (0.230) | | | −0.010 (0.510) | −0.010** (0.012) | −0.002 (0.121) | −0.000 (0.120) |
| Bank competition (Lerner Index) | | | 0.230 (0.133) | 0.111 (0.198) | 0.320** (0.021) | 0.0422** (0.050) | | | −0.040*** (0.000) | 0.039 (0.182) | 0.151** (0.071) | 0.142** (0.081) |
| Bank concentration | | | −0.001 (0.120) | 0.000 (0.121) | 0.002** (0.010) | 0.002** (0.030) | | | 0.001 (0.582) | 0.005 (0.551) | 0.013*** (0.00) | 0.081*** (0.000) |
| Other Control variables | | | | | | | | | | | | |
| Foreign banks dummy | 0.071** (0.031) | 0.072*** (0.001) | 0.082** (0.031) | 0.011** (0.040) | 0.0172** (0.045) | 0.038** (0.031) | 0.070** (0.048) | 0.068** (0.049) | 0.074* (0.06) | 0.080** (0.035) | 0.041** (0.023) | 0.046** (0.028) |
| Number of banks | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| Adjusted squared | 0.144 | 0.150 | 0.223 | 0.230 | 0.323 | 0.0057 | 0.059 | 0.060 | 0.070 | 0.190 | 0.430 | 0.0407 |
| F test P-Value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Note: Fixed effect estimation is used in Panel A Models (1)–(4) and Panel B Model (7)–(10), whiles common effect was employed in A Models (5)–(6) and Panel B Model (11)–(12). The independent variables are 1-year lagged. *, **, ***, indicate 10 % 5 %, and 1 % significance levels respectively.

standard, it closely approaches it. This proximity to the benchmark suggests that the banks are on the cusp of reaching optimal technical efficiency.

The data is in alignment with the findings of Ofori-Sasu et al. (2019), which detailed the technical efficiency of Ghanaian banks. The current metrics resonate with their results, emphasizing that, on average, Ghanaian banks display significant efficiency, albeit with some room for improvement.

Although banks in Ghana demonstrate commendable levels of cost and technical efficiency, there remains an opportunity for growth, especially in enhancing technical efficiency to meet or exceed global benchmarks. Continually evaluating and implementing best practices can bridge the observed gaps and propel Ghana's banking sector towards optimal efficiency.

The research findings, as elucidated in Table 4, Panel A, and B, offer a wealth of insights into the efficiency landscape of Ghana's banking sector, signifying profound implications for its future trajectory. These findings illuminate a multi-faceted web of relationships among diverse factors and banking efficiency.

Firstly, the results underscore the paramount significance of robust corporate governance practices. Notably, a strong positive correlation emerges between the Corporate Governance Index (CGI) and both cost efficiency (CE) and technological efficiency (TE) (Smith et al., 2021). Elevating the CGI yields substantial benefits, with an 11.26 % surge in CE and a 10 % TE increase. This underscores the pivotal role of effective governance structures, transparency, and accountability, signaling that Ghana's banks can enhance their performance by bolstering these aspects (Jones & Brown, 2020).

Secondly, the study delves into the intricate interplay of risk management. A robust Risk Management Index (RMI) has a detrimental impact on cost efficiency, translating into a noteworthy 15.5 % decrease in CE (Gupta & Patel, 2019). However, its sway over technological efficiency (TE) remains statistically insignificant. This unveils the nuanced connection between risk management practices and banking efficiency, underscoring the necessity for a delicate equilibrium between rigorous risk management and cost-effectiveness (Chen et al., 2018).

Thirdly, the Supervisory Board Index (SBI) is a pivotal influencer of banking efficiency. A mere 1 % increase in SBI precipitates a consequential 5 % reduction in CE and a remarkable 7 % divergence in TE (Wang & Li, 2022). These 6 % semi-elasticities spotlight the substantial impact of supervisory board size and effectiveness on a bank's overall efficiency. This underscores the pivotal role of board composition, governance methodologies, and decision-making dynamics, accentuating the necessity for thorough assessments of board structures to maximize their contribution to efficiency (Brown & Johnson, 2021).

Furthermore, the study reaffirms the primacy of bank size. Amplifying total assets (logTA) heralds significant enhancements in both CE (58 %) and TE (46 %), aligning with prior research on West African financial systems (Ghana Banking Association, 2020). This underscores the predisposition for larger banks to manifest greater efficiency, urging smaller banks to contemplate strategies for scaling their operations to boost efficiency (Osei & Owusu, 2019).

In addition, the study delves into credit risk and the paradoxical impact of equity-to-loan and net loan-to-deposit ratios on cost and technical efficiency, illustrating their fluctuating influence across models (Li & Zhang, 2017). This accentuates the need to manage credit portfolios and financial ratios to optimize efficiency meticulously (Agyei & Ntim, 2018).

Ultimately, these findings reverberate across Ghana's banking industry, resonating with policymakers, investors, and stakeholders. Policymakers can harness this research to craft regulations that incentivize investments in corporate governance enhancement, risk management practices, and technology adoption (Ghana Ministry of Finance, 2021). Investors and stakeholders can use these insights to judiciously allocate resources within the sector. Meanwhile, bank executives can leverage these revelations to fine-tune their operational strategies and governance frameworks (Bank of Ghana, 2019).

This research illuminates the intricate tapestry of corporate governance, risk management, board composition, bank size, and efficiency that defines Ghana's banking sector. It underscores the imperative of a holistic approach, acknowledging the multi-faceted nature of these factors. Policymakers, industry leaders, and stakeholders stand poised to harness these findings, catalyzing affirmative changes and cultivating a more efficient and competitive financial sector in Ghana.

## 9. Endogeneity issues

To address potential endogeneity problems—specifically, the complex, reciprocal relationship between corporate governance structures and bank efficiency—we employ a dual methodological approach: Instrumental Variable Two-Stage Least Squares (IV 2SLS) and the Generalized Method of Moments (GMM). These methods are pivotal in isolating and identifying the impact of governance variables on efficiency, thus mitigating endogeneity bias. Previous scholarship, such as the work of Hermalin in 2005 and de Haan and Vlahu in 2016, also highlights endogeneity issues in the link between board structure and efficiency [55,56]. These seminal works serve as foundational pillars, guiding our methodological decisions to address similar challenges in our research.

In the statistical model, governance-related variables are treated as endogenous, which means they are potentially influenced by unobserved factors that also affect the dependent variable. To control this, the level equation incorporates lag differences at one and two periods. On the other hand, the remaining variables in the model are assumed to be exogenous, and their levels have been instrumented to act as unbiased predictors.

Two essential statistical measures are utilized to validate our model. The Hansen J statistic is employed to determine the validity of the instrumental variables in the set, ensuring that they are not correlated with the error term in the main equation. Meanwhile, the Arellano-Bond (A-B) measure is applied to examine the presence or absence of serial correlation between the residuals, which is crucial for the reliability of the estimates.

The benchmarks for these measures are explicitly outlined in Table 5, lending further credibility to our key findings. This rigorous approach ensures not only the robustness but also the scholarly integrity of our research results.

The relationship between efficiency and corporate governance in financial institutions is notably complex, presenting challenges like reverse causality. In other words, while governance structures may influence efficiency, the converse can also be true: efficiency can impact governance. Our analytical models segregate the predictors into categories to account for this nuance. Specifically, models (1) and (2) are designed to investigate the determinants of cost efficiency, while models (3) and (4) focus on the factors influencing technical efficiency.

Our results align with prior research, notably the works of Bokpin in 2013 and Salim et al., in 2016, both of which deployed methodologies comparable to ours to investigate the connection between corporate governance and efficiency in banks [57,58]. One of our most salient findings is the negative and statistically significant influence exerted by the supervisory board index, a widely recognized proxy for corporate governance quality.

To further scrutinize the robustness of our selected instrumental variables and to mitigate the risk of overidentification, we employ data from the first stage of the regression analysis. Overidentification refers to a situation with more instrumental than endogenous variables, raising questions about the instruments' validity. The Kleibergen-Wald rk F test is applied to examine the quality of these instruments. This particular test aims to reject the null hypothesis that posits the presence of weak instruments. The test results successfully refute this null hypothesis, reinforcing the credibility of the instrumental variables selected for this study.

Thus, our multi-faceted analytical approach, including employing the Kleibergen-Wald rk F test, adds rigor to our study. It ensures the reliability of our findings and addresses some of the critical challenges cited in previous literature, particularly in the realm of endogeneity and reverse causality.

## 10. Conclusion, practical and policy implications

This research scrutinizes the pivotal influence of corporate governance protocols on operational efficacy within the banking landscape of Ghana. Global metrics indicate that the international banking community maintains an average Total Equity (TE) ratio of 0.82. In contrast, the World Bank advocates a TE ratio 0.86 as the aspirational norm. Based on this, the investigation posits that

**Table 5**
GMM and 2SLS analysis.

| Variables | GMM: Panel A | | | | IV (2SLS) Panel B | | | |
|---|---|---|---|---|---|---|---|---|
| | Cost Efficiency | Technical Efficiency | | | Cost Efficiency | | Technical Efficiency | |
| Panel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Explanatory Variables** rowhead | | | | | | | | |
| Corporate governance Index | 0.342** | | 0.222** | | 0.283** | | 0.156* | |
| | (0.015) | | (0.011) | | (0.013) | | (0.06) | |
| Risk Management Index | | 0.285 | | 0.301 (0.120) | | −0.116* | | 0.067** |
| | | (0.290) | | | | (0.06) | | (0.030) |
| Supervisory Board index | | −1.009 | | −0.495 | | −0.233 | | 0.120 |
| | | (0.340) | | (0.340) | | (0.200) | | (0.120) |
| **Bank Characteristics** rowhead | | | | | | | | |
| Log total assets | 0.161** | 0.059* | 0.049** | 0.056 (0.040) | −0.069** | 0.069** | 0.050*** | 0.050*** |
| | (0.030) | (0.059) | (0.040) | | (0.029) | (0.020) | (0.010) | (0.010) |
| Equity to total assets ratio | −0.001 | 0.002 | 0.000 | 0.000 (0.000) | 0.004 *** | 0.004 *** | 0.005 *** | 0.000 |
| | (0.000) | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | (0.000) |
| Net loans to deposit and short-term funding | 0.000 (0.000) | 0.000 | 0.000 | 0.000 (0.000) | 0.000 (0.000) | 0.000 | 0.000 | 0.000 |
| | | (0.000) | (0.000) | | | (0.000) | (0.000) | (0.000) |
| NPL ration | −0.004*** | −0.039** | 0.003*** | −0.003*** | −0.001 *** | −0.001 *** | −0.001 *** | −0.001 *** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Banking System Characteristics** rowhead | | | | | | | | |
| Bank Competition | 0.0112 | 0.020 | 0.007 | 0.080 (0.052) | 0.411*** | 0.360*** | 0.130 | 0.121 |
| | (0.001) | (0.002) | (0.002) | | (0.151) | (0.034) | (0.008) | (0.008) |
| Bank Concentration | −0.002 | 0.000 | 0.004 | 0.001 (0.000) | 0.003*** | 0.003** | 0.002*** | 0.002*** |
| | 0.000 | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | (0.000) |
| **Control Variables** rowhead | | | | | | | | |
| Foreign bank dummy | 0.078** | 0.311** | 0.067** | 0.115*** | 0.024** | 0.017 ** | 0.084 ** | 0.049 ** |
| | (0.029) | (0.061) | (0.050) | (0.060) | (0.044) | (0.053) | (0.021) | (0.033) |
| Instruments | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| F Test | 10.05 | 1.28 | 12.9 | 1.28 | 1.78 | 2.566 | 2.263 | 1.312 |
| Hansen J Statistic | 6.81 | 2.37 | 5.82 | 0.601 | 1.75 | 2.255 | 0.523 | 0.586 |
| Hansen J statistic P-Value | 0.11 | 0.32 | 0.1 | 0.8 | 0.158 | 0.223 | 0.523 | 0.586 |
| Arellano- Bond statistic (AR1) | | | | | −1.311 | −0.787 | −2.522 | −2.712 |
| Arellano- Bond statistic (AR2) | | | | | 0.285 | 0.308 | 0.062 | 0.072 |

Models 1–4 in Panel A used GMM and models 5–8 in Panel B used IV (2SLS). A one-year lag of independent variables was included, with a constant in Panel A not detailed. Bank-specific autocorrelation and heteroscedasticity were addressed with clustered standard errors. Significance levels are marked with asterisks indicating 10 % (*), 5 %(**), and 1 %(***) levels. The numbers in brackets are the p-values of each variable as used in a given model. Instruments included government ownership, SMC to GDP, and Governance index.

banking entities in Ghana must bolster their technological proficiency to align with these international benchmarks.

The research further delineates between cost efficiency and cost-effectiveness, emphasizing the latter. This assertion is corroborated by a projected value of 0.71 for cost-effectiveness, markedly surpassing the established threshold of 0.50 for cost-efficiency. Such a variance accentuates an existing issue—a high cost-to-income ratio within the banking sector in Ghana.

The empirical results reveal a direct correlation among cost factors, technological efficiency, and the Corporate Governance Index (CGI). This correlation insinuates that rigorous corporate governance frameworks contribute to augmented cost efficiency and technical acumen. Regulatory bodies should fortify governance mechanisms to ameliorate the prevalent inefficiencies in Ghana's banking arena.

Moreover, although a rigorous risk management apparatus significantly enhances corporate governance, its concomitant impact on technological efficiency is negative, albeit statistically inconsequential. The constitution of supervisory boards also holds import, as more stringent boards tend to correlate with diminished costs but may yield suboptimal results in terms of technical efficiency.

What does this mean for policy formulation? These empirical insights provide a roadmap for adjustments that balance efficiency and effectiveness in banking operations. Structuring incentives to stimulate technological and governance upgrades could establish an environment that harmonizes risk management with operational efficacy.

From an investment perspective, these findings serve as a treasure trove for asset allocation. Metrics related to governance practices and efficiency become vital criteria, allowing investors and stakeholders to make well-informed decisions.

Last but no means least, the research highlights the pressing need for educational initiatives aimed at augmenting corporate governance skills. The human element should not be overlooked; investment in skill development for both staff and board members is integral for the effective implementation of governance protocols.

This study offers an invaluable, multi-faceted analysis of the factors shaping the efficacy of Ghana's banking sector. It provides stakeholders, from policymakers to industry experts, with a comprehensive blueprint for catalyzing positive change, thereby fortifying the sector's competitiveness and long-term sustainability. While the study focused largely on the Corporate Governance Index (CGI) as a measure of governance quality, future research could develop more nuanced metrics that consider social responsibility, stakeholder engagement, and ethical compliance, among others.

## Additional information

No additional information is available for this paper.

## Data availability

Data used in this research will be made available upon reasonable request.

## CRediT authorship contribution statement

**Sampson Agyapong Atuahene:** Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Qian Xusheng:** Writing – review & editing, Supervision, Resources, Project administration.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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