Technical efficiency in the Ghanaian banking sector: does boardroom gender diversity matter?

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Abstract

Purpose – *The marginalization of women on boards is a heavily discussed topic across the world, especially in Ghana. Apart from estimating the link between boardroom gender diversity and technical efficiency of banks, this study aims to test the presence of upper echelons theory in the Ghanaian banking sector.*

Design/methodology/approach – *The study examines data from 2000 to 2019 annual reports of 23 banks in Ghana. The stochastic frontier analysis is used to estimate the impact of boardroom gender diversity on technical efficiency of banks in Ghana.*

Findings – *This study finds that greater boardroom gender diversity generates technical efficiencies for banks. The results remain unchanged after accounting for bank types (listed and non-listed). Thus, all banks benefit in terms of technical efficiency from more boardroom gender diversity. The upper echelons theory is validated in the Ghanaian banking context. Overall, the study supports pro-gender diversity on boards.*

Practical implications – *The results have implications at corporate, social and national levels. It supports the need for policies that improve greater boardroom gender diversity.*

Originality/value – *This study adds to a growing number of non-developed countries by investigating the link between the boardroom gender diversity and technical efficiency of banks in Ghana, a country which historically has had minimal female participation in the workforce. New insight is, therefore, offered into this relationship by using data which examines the technical efficiency of banks periods before and after the Women in Finance Charter in 2016.*

Keywords *Ghana, Efficiency, Banks, Stochastic frontier analysis, Boardroom gender diversity*

Paper type *Research paper*

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1. Introduction

Gender diversity, defined in this study as the presence of women on boards, has lately become a crucial international matter of contention (Adams and Ferreira, 2009; Gyapong *et al.*, 2016; Mahadeo *et al.*, 2012; Ullah *et al.*, 2018). Despite the recent increase in female presence on boards, figures from the BIS (2011) report shows that, in advanced economies, female representation on boards is usually below 10%. The Scandinavian countries (Finland, Norway and Sweden) only show figures above 20% women. Grant Thornton's (2011) report on corporate control in the UK reveals that women represent less than 10% of the board directors of Financial Times Stock Exchange (FTSE) 350 firms, and 40% of these boards have exclusively male representation. Only 2 of these 350 firms were chaired by women.

In March 2016, Women in Finance Charter was launched to encourage the financial industry to improve gender balance in senior management. In 2017, a year after the Women in Finance Charter, the UK Government published the Hampton Alexander Report, which

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recommends FTSE100 companies to have 33% women in FTSE100 leadership teams by 2020. Years after the introduction of Women in Finance Charter and Hampton Alexander Report, the growing popularity of the board gender diversity concept is not limited to Europe but other continents as well. For instance, in the USA, there is a wide campaign requesting firms to voluntarily pledge a 20% female representation on their boards by 2020 confirms the increasing popularity of the board gender diversity agenda across continents. Several empirical studies on diversity concept that have discussed its impact on firms and risk-taking (Khaw *et al.*, 2016; Lenard *et al.*, 2014), bankruptcy (Wilson and Altanlar, 2011) and internal weaknesses (Chen *et al.*, 2016). In terms of sectors, boardroom gender diversity has been tested on various industries and sectors such as green innovation (He and Jiang, 2019), organizational performance in social enterprises (Cho *et al.* (2017), Corporate Payout Policy (Byoun *et al.*, 2016), electronic manufacturing services industry (Chin and Tat, 2015), environmental, social and economic value creation (Nadeem *et al.*, 2020), activism in deinstitutionalizing old boys' networks (Perrault, 2015), justice, organizational benefits and policy (Fine *et al.*, 2020), hospitality industry (Menicucci *et al.*, 2019), corporate cash holdings (Atif *et al.*, 2019), corporate social responsibility disclosure (Khan *et al.*, 2019), Stock Portfolio Performance (Chapple and Humphrey, 2014) and voluntary disclosure of intellectual capital in initial public offering prospectuses (Nadeem, 2020). Also, empirical studies reveal that board gender diversity and its impact on performance have focused on profitability (Bennouri *et al.*, 2018; Nguyen *et al.*, 2015; Strøm *et al.*, 2014; Mahadeo *et al.*, 2012; Mori and Olomi, 2012) with little on technical efficiency.

The departure of this study from the above-mentioned studies is as follows: first, although relevant policies have been proffered from the above-mentioned studies; interestingly, none of these studies considered the banking industry space. Years after the passage of the Women in Finance Charter in 2016 and to the best of the author's awareness, this study is the first to examine the effect of female presence on board of directors on banks' technical efficiency in the Sub-Saharan countries, particularly Ghana for periods before and after Women in Finance Charter in 2016. Second, in the aftermath of the global financial crisis, policymakers and bank regulators have started raising questions about the effectiveness of boards of financial institutions. This became apparent in postcrisis analysis. Among the several shortcomings identified was the composition of the board of directors. Key decision-making body did not fulfill its major role to exert monitoring over senior management, and it failed to identify, understand and challenge risk-taking practices. A key recommendation was to increase the presence of women on the board. The motivation for this decision stemmed from the fact that personal attributes and women's ability allow the board to approach problems and formulate strategies, unlike boards composed predominantly by men. Hence, the need to estimate the influence of female presence on the board of directors on efficiency of banks.

Farrell (1957) defined technical efficiency as the ability of the producer to eliminate waste of resources by producing as much output as input usage allows or by using as little inputs as output production allows. Recent studies on whether board gender diversity significantly promotes technical efficiency by Ramly *et al.* (2015) and Andrieș *et al.* (2017) have yielded mixed results. The diverse institutional conditions and high percentage of female leaders' (Strøm *et al.*, 2014, p. 60) in the Ghanaian banking sector makes board gender diversity and technical efficiency interesting and unhurried to be investigated. This study attempts to answer the following question:

Q1. Does boardroom gender diversity affect the technical efficiency of banks?

The paper adopts a stochastic frontier analysis (SFA) approach to estimate the impact of boardroom gender diversity on technical efficiency of banks in Ghana. The study examines data from 2000 to 2019 annual reports of 23 banks in Ghana. SFA is chosen over other estimation techniques such as ordinary least squares (OLS) and corrected OLS (COLS) and data envelopment analysis (DEA) in computing measures of technical efficiency of

banks. This is because SFA allows other parameters of the production technology to be explored.

The results from the econometric enquiry in this paper are insightful. This study finds that greater boardroom gender diversity generates technical efficiencies for banks. The results remain unchanged after accounting for bank types (listed and non-listed). Thus, all banks benefit in terms of technical efficiency from more boardroom gender diversity. The upper echelons theory is validated in the Ghanaian banking context. Overall, the study supports pro-gender diversity on boards.

This study contributes to literature in a number ways. First, the paper provides results which demonstrate that in Ghana, technical efficient banks tend to have more women on their boards. This is likely to add to call for some policy and managerial interventions aimed at improving technical efficiency in the banking industry. Second, the result indicates that increasing the presence of women on the board is efficiency-enhancing for both listed and non-listed banks. This result mirrors the Australian context (Ali *et al.*, 2014). Third, the result of the study shows that after the passage of the Women in Finance Charter and Hampton Alexander Report, increasing the presence of women on the board of directors positively affects the technical efficiency of banks. This result supports recent endorsement by several key individuals, international commissions and organizations who have equally called for strong and legally binding action from member states to ensure diversity in boardrooms (Adams and Kirchmaier, 2016; Seierstad *et al.*, 2017; Valls Martínez *et al.*, 2019; Ali *et al.*, 2014; Rao and Tilt, 2016; Wittenberg-Cox, 2014; FRC, 2011; European Commission, 2010). Finally, this study provides compelling insights into upper echelons theory. This theory states that organizational outcomes are partially predicted by managerial background characteristics of the top-level management team. The study tests this theory in the Ghanaian banking context by incorporating the impact of women on boards on the efficiency of banks. In the Ghanaian situation, the impact of women occupying top organizational positions (chairs or chief executives) on organizational performance have been barely studied because women infrequently occupy these positions in large companies. This study extends and contributes not only to literature on the relationship between the presence of women on boardroom gender diversity and technical efficiency of banks but also it further attempts to validate or otherwise the upper echelons theory in the Ghanaian banking context.

The rest of the article is organized as follows: A stylized fact about the evolution of boardroom gender diversity is provided in Section 2. Section 3 discusses the related studies. Section 4 explores research design. While empirical findings and discussion are considered in Section 5 and in Section 6 summarize and conclude the study.

2. Stylized fact about the evolution of boardroom gender diversity

2.1 Global trends in gender diversity

The consideration for gender balance started in Norway in 2003. Year after its introduction in Norway, several European Union countries such as Sweden, Germany, Italy, France and Spain (Adams and Kirchmaier, 2016; Seierstad *et al.*, 2017; Valls Martínez *et al.*, 2019), Australia (Ali *et al.*, 2014), China (Liu *et al.*, 2014), India and Middle Eastern countries (Rao and Tilt, 2016) have all introduced quota regulations in an effort to increase the number of women on boards. Several key individuals, international commissions and organizations have equally called for strong and legally binding action from member states to ensure diversity in boardrooms. The chief executive officer of Unilever, Paul Polman, noted that the company will never achieve its growth and potential without gender balance right (Wittenberg-Cox, 2014). Polman further asserts that "Unless we recognize the critical role that women play and unless we involve women more directly in developing solutions, then we are destined never to fulfill our potential." The Financial Reporting Council concludes

that it is important to have a diversity of personal attributes, psychological types, backgrounds and gender to ensure that boards of directors are not composed of like-minded individuals and to ensure directors have the intellectual capacity to propose strategy (FRC, 2011). The European Commission (2010) noted "a lack of diversity and balance in terms of gender, social, cultural and educational background" and called for strong and legally binding action from member states and European Union (EU) institutions to ensure diversity in boardrooms.

2.2 Ghanaian context

Over the past two decades, the lives of women have improved unprecedentedly. Women's access to rights, education, services and labor markets have improved tremendously. Notwithstanding, many women all over the world still do not enjoy equal participation in economic, social and political life (International Finance Corporation, 2018). This inequality is considered as a tremendous economic and social loss.

Globally, women constitute a small percentage in senior management positions as compared with their male counterparts. The proportion of women in senior positions ranges from 3% to 12%, and the percentage of men in senior management positions is relatively stable across regions (Ganguli *et al.*, 2014; Jackson, 2009). According to World Development Indicators as contained in the World Bank (2016) report, in Africa, the presence of women in corporate and public leadership in Africa is scanty, even though the male-to-female ratio is 1:1. In Sub-Saharan Africa, one out of every 26 women makes it to a senior management position, whereas one out of every six to nine men in the workforce makes it to a senior management position (Jackson, 2009). While some African countries such as Kenya, Malawi, Nigeria and South Africa are spearheading the agenda on formally integrating gender diversity into principles of good governance, policy debate in Ghana is still ongoing. Despite the calls by these countries and international organizations, the influence of gender diversity and technical efficiency of banks in Ghana remains unknown.

The importance of gender diversity in the socioeconomic transformation of Ghana has received much attention by several governments over the past two decades with little results to show. Several attempts have been made to incorporate this into the laws of the country as well as to provide frameworks for addressing gender inequalities. For instance, Article 17 of the 1992 constitution prohibits discrimination on the basis of gender; Affirmative Action Policy of 1998 requires a 40% quota of women's representation on all government and public boards; creation of the Ministry of Gender, Children; Social Protection in 2013 and the development of National Gender Policy by the Ghanaian Government. These policies represent some attempts designed to promote gender equity in Ghana. However, the National Gender Policy does not specifically indicate the degree of gender diversity that corporate and public boards and management should attain. Besides, some corporate organizations have their own policy on gender representation regarding management and board composition.

International Finance Corporation report on Ghana Corporate Governance Program to raise awareness and inform the discourse about gender diversity concludes that 72.15% of the boards had female representation, even though the ratio of women to men remained low. Diversity typically ranged from 20.00% to 30.00%. Gender diversity (proportion of female to total board members) generally ranged from 7% to 25%. The number of women on boards ranged from one to six among the sampled firms, and the most common number of women on boards was one. The findings further revealed that 24.05% of the sampled boards are composed of only men. Thus, one out of every four boards has no female representation. Also, most women on boards (49.37%) were non-executive directors and only 6.49% of organizations have women as board chairs. This result provides very interesting insights into the involvement of women on boards of corporate and public organizations in Ghana.

3. Related studies

3.1 Theoretical framework

The study situates the gender diversity and efficiency nexus in four different theories in management research. These theories include agency theory, upper echelons theory, stewardship theory and social identity theory. These theories have established diverse effects of observable characteristics on efficiency (Pfeffer and Salancik, 1978; Hogg and Terry, 2000; Tajfel, 1978). The importance of these theories remains unsettled. Table 1 refers to a summary of the theoretical perspectives.

First, *agency theory* which inversely relates to agency conflicts between owners and managers is concerned with resolving problems that can exist in agency relationships due to unaligned goals or different aversion levels to risk. Agency theory is concerned with aligning the interests of owners and managers (Fama and Jensen, 1983; Jensen and Meckling, 1976). Agency theorists argue that the Board of Directors are a central governance mechanism that can align the interests of principals (shareholders) and agents (the managers). Jensen and Meckling (1976) suggest that with agency theory, there ought to be a positive impact on firm value for firms using such governance devices, and thus, better governance and an effective board can raise firm value. Second, *upper echelons theory* posits that a higher education level is associated with open-mindedness, capacity for information processing and tolerance to changes (Hambrick and Mason, 1984). Upper echelons theory further states that

Table 1 Summary of theoretical perspectives

S/N	*Author*	*Name of theory*	*Theoretical explanation*	*Relationship*	*Full reference*
Positive linear relationship: board educational background and firm performance					
1	Jensen and Meckling (1976)	Agency theory	Agency theory stipulates that the main function for board of directors is to supervise management on behalf of shareholders. Agency cost can be reduced when monitoring is improved	Positive	Jensen, M.C. and Meckling, W.H. (1976), "Theory of the firm: managerial behavior, agency costs and ownership structure", Journal of Financial Economics, Vol. 3 No. 4, pp. 305-360
2	Hambrick and Mason (1984)	Upper echelons theory	Upper echelons theory states that organizational outcomes are partially predicted by managerial background characteristics of the top-level management team. The theory tries to explain a correlation between the organizational outcome and managerial background characteristics	Positive	Hambrick, D.C. and Mason, P.A. (1984), "Upper echelons: the organization as a reflection of its top managers", Academy of Management Review, Vol. 9 No. 2, pp. 193-206
3	Donaldson and Davis (1994)	Stewardship theory	The stewardship theory holds that managers inherently seek to do a good job, maximize company profits and bring good returns to stockholders. Stewardship theory claims that directors are essentially trustworthy individuals and therefore good stewards of the resources entrusted to them. This theory proposes that more number of insider directors can enhance firm performance	Positive	Donaldson, L. and Davis, J.H. (1994), "Boards and company performance – research challenges the conventional wisdom", Corporate Governance: An International Review, Vol. 2 No. 3, pp. 151–160
Negative linear relationship: board educational background and firm performance					
4	Taijfel (1978)	Social identity theory	Social identity theory introduced the concept of a social identity as a way in which to explain intergroup behavior. Social identity theory therefore suggests that board members categorization at the group level hampers the firm performance	Negative	Tajfel (1978), Differentiation between Social Groups: Studies in the Social Psychology of Intergroup Relations, Academic Press, Oxford

Source: Author's compilation (2021)

organizational outcomes are partially predicted by managerial background characteristics of the top-level management team. The theory tries to explain a correlation between the organizational outcome and managerial background characteristics Hambrick and Mason (1984). Research based on the upper echelons theory found that several attributes of top executives, such as international experience (Daily *et al.*, 2003), educational level (Herrmann and Datta, 2005; Tihanyi *et al.*, 2000), age (Herrmann and Datta, 2005; Tihanyi *et al.*, 2000), positional tenure (Herrmann and Datta, 2005) and duality (Sanders and Carpenter, 1998), can be proxies for their cognitive orientation, knowledge base and information processing abilities, and consequently, have an impact on the firm's behavior. Besides, s*tewardship theory* shifts the board role away from exerting control toward advice giving. This theory assumes a different model of man based on pro-organizational and collectivistic behavior. The stewardship theory holds that managers inherently seek to do a good job, maximize company profits and bring good returns to stockholders. Stewardship theory claims that directors are essentially trustworthy individuals and, therefore, good stewards of the resources entrusted to them (Donaldson and Davis, 1994). This theory proposes that more number of insider directors can enhance firm performance (Donaldson and Davis (1994). Finally, *social identity theory* suggests that board members' categorization at the group level hampers the firm performance (Taijfel, 1978). The theory introduced the concept of a social identity as a way in which to explain intergroup behavior. The theory analyses board groups, which has the potential to provide insight into the social dynamics influencing directors' behavior (Hogg and Terry, 2000). The theory further argues that people tend to classify themselves and others based on various social categories such as nationality, education and profession and concentrates on the norms and stereotypes of social group membership as influencing behavior (Hogg *et al.*, 1995).

3.2 Empirical evidence and hypothesis development

Table 2 illustrates the empirical perspective and the main findings of selected literature. From the empirical literature presented and reviewed in Table 2, the literature on US markets has provided solid observable evidence. Although the US market literature is substantial, it is just a fraction of the literature. Apart from the empirical evidence provided in Table 2, substantial studies have established a mixed relationship.

According to McKinsey (2014), European companies in which gender equality is achieved in the administrative and control bodies achieve a 41% higher return on equity than other counterparts with lower gender equality. An empirical study investigated by Credit Suisse Research Institute (2012) concludes that in the six years from 2006 to 2012, listed companies where at least one woman resides on the boards recorded an average share performance of 26% higher than the companies led by entirely a male leadership. A growing academic literature devoted to the influence of female presence in boards and firms' efficiency includes the empirical studies of Campbell and Minguez-Vera (2008), Francoeur *et al.* (2008), Adeabah *et al.* (2019), Alazzani *et al.* (2017), Benkraiem *et al.* (2017), Booth-Bell (2018), Groening (2019), Kyaw *et al.* (2017), Ullah *et al.* (2019), Zhang (2012), Ali *et al.* (2020), Menicucci and Paolucci (2021), Harjoto *et al.* (2019), Adams and Ferreira (2009) and Carter *et al.* (2010). Carter *et al.* (2003) find a significant positive link between the ratio of women on the board and firm value. Krishnan and Parsons (2008) conclude that firms are more efficient and have higher stock returns when more women are in senior management positions. Francoeur *et al.* (2008) state that the presence of women in these firms seems to explain higher returns than those expected variables that usually explain firm returns. Farrell and Hersch (2005) show that better performing firms tend to have more women on the board. Hafsi and Turgut (2013) conclude that greater female presence on boards positively influences better performance.

However, there are some studies that do not find a positive relationship between female presence on boards and firms' efficiency. Jurkus *et al.* (2011) find the same results about

Table 2 Articles examined

No.	Authors	Objective	Country	Relationship
1	Al-Qahtani and Elgharbawy (2020)	Investigates the association between board diversity characteristics and the level of disclosure of greenhouse gas (GHG) information	UK	Positive
2	Atif *et al.* (2020)	Examine the impact of female directors on firm sustainable investment	USA	Positive
3	Beji *et al.* (2020)	Analyzes how the board's characteristics could be associated with CSR		Positive
4	Orazalin and Baydauletov (2020)	Examine the effects of CSR strategy and board gender diversity on environmental and social performance	Europe	Positive
5	Ramon-Llorens *et al.* (2020)	Analyze the role of the social and human capital of female directors on CSR disclosure	Spain	Positive
6	Tingbani *et al.* (2020)	Explore the impact of gender diversity and environmental committees on GHG voluntary disclosures		Positive
7	Uyar *et al.* (2020)	Explore whether board characteristics (sustainability committee, board independence, board diversity and board diligence) lead to greater CSR	International	Positive
8	Kılıç and Kuzey (2019)	Investigate whether corporate governance characteristics impact the voluntary disclosure of carbon emissions	Turkey	Non-significant
9	Pucheta-Martínez *et al.* (2019)	How disclosure of CSR information is affected by independent and institutional women directors	Spain	Positive/negative
10	Yang *et al.* (2019)	Based on Critical mass theory, study the relationship between the number and background characteristics of female directors and CSR	China	Non-significant
11	Birindelli *et al.* (2018)	Impact of a critical mass of female directors on ESG performance	Europe and USA	Positive/negative
12	Zhuang *et al.* (2018)	Investigate the relationship between board composition (i.e. political experience, academic affiliations, overseas background and gender diversity) and CSR performance of Chinese firms	China	Non-significant
13	Azmat and Rentschler (2017)	Relationships between corporate responsibility and ethnicity and gender diversity on arts boards	Australia	Positive/negative
14	Haque (2017)	Examines the effects of board characteristics and sustainable compensation policy on carbon reduction initiatives and greenhouse gas (GHG) emissions of a firm	UK	Positive/non-significant Positive

Notes: CSR = Corporate social responsibility; ESG = Environmental, social, and governance
Source: Author's compilation (2021);

the beneficial effects of gender diversity. Their findings, therefore, indicate that companies with weak corporate governance mechanisms, increasing diversity in management can be positive for firms. The performance of firms with weak governance systems is affected positively by gender diversity (Adams and Ferreira, 2009). Konrad *et al.* (2008) find that firms tend to be more beneficial when they have three or more women on their board. Several other studies have shown that gender quota has led to a large number of inexperienced women being appointed to the boards, thereby damaging firm financial performance (Ahern and Dittmar, 2012; Matsa and Miller, 2013; Arena *et al.*, 2015; Ujunwa, 2012), Ayadi *et al.*, 2015; Wang and Kelan, 2013). Fernandez-Temprano and Tejerina-Gaite (2020) investigate the effect of board diversity on firm performance and find no evidence about a possible influence of gender diversity on performance.

This study, therefore, hypothesizes the following relationships:

H1. Women and the position held exert positive and significant influence on technical efficiency of banks.

H2. After the passage of the Women in Finance Charter, increasing the presence of women on the board of directors positively affects technical efficiency of banks.

H3. Increasing the presence of women on the board is efficiency-enhancing for both listed and non-listed banks.

H4. Organizational outcomes are partially predicted by managerial background characteristics of the top-level management team positions in large companies.

4. Research design

4.1 Sample, data sources and justification

The study examines data from 2000 to 2019 annual reports of all 23 banks in Ghana. The time frame selected represents periods of major structural changes in the annals of the banking sector. SFA is used to estimate the impact of boardroom gender diversity on technical efficiency of banks in Ghana. Bank-specific, control variables and macroeconomic data were collected from the financial statements of the sampled universal banks operating in Ghana compiled by Ghana Association of Bankers and Ghana Statistical Service and Bank of Ghana (BOG), respectively. The original data set of 35 banks was reduced to a usable sample of 23 universal banks when various restrictions were applied. These restrictions included the following:

- acquired, merged and collapsed banks are duly considered and excluded;
- banks without the required data are eliminated; and
- the data set is decomposed into listed, non-listed and the period before and after the introduction of the Women in Finance Charter.

The justification for the restrictions and selection of these variables are not far-fetched. First, the banking industry in Ghana, therefore, provides interesting ground for further investigation. In the past decade, the banking sector in Ghana has witnessed a lot of mergers and acquisitions. This was mainly motivated by the minimum capital requirement. A deliberate and comprehensive reform agenda by the BOG to help protect depositor's funds. After the introduction of the reforms, a lot of banks who could not meet the deadline resorted to mergers and acquisitions, hence the need to restrict the data set of these banks. Second, differences in accounting practices, reporting periods and types of financial ratios often used by these banks compelled this study to decompose the data set into listed and non-listed banks. Finally, the decomposition of the data set into various regimes would allow the data set to be assessed critically.

Further justification is provided for using Ghana as a unique laboratory to conduct this study. Acheampong and Dana (2015) established that Ghana represents a fast-expanding market. The financial history of Ghana was enriched in the later part of 2017 when the central bank finally cracked the whip on non-performing banks resulting in the collapse of banks, which later led to further mergers and acquisitions. The year 2018 was characterized as a remarkable year for Ghana's banking industry. Several reforms such as new capital requirement directives, mergers and acquisitions, license revocations have been carried out. Despite the impact of all these reforms and several other reforms yet to be introduced, the Ghanaian banking sector has become buoyant and colorful to the admiration of many. These developments in the banking space provide a base for further investigations to be conducted.

4.2 Construction and rationale of the variables

Two competing approaches, i.e. production and intermediation, are dominant in the banking literature in selecting variables. These approaches are uniformed in their application of the traditional microeconomic theory of firms to banks but differ only in the specific banking activities (Das and Kumbhakar, 2012). While the production approach treats banks as the provider of services to customers (Benston, 1965), the intermediation approach views banks as the mediator of funds between savers and investors (Sealey and Lindley, 1977). The present study adopts the intermediation approach.

4.2.1 Stochastic frontier analysis. Two unique approaches are relevant when examining technical efficiency of firms in an industry. These two approaches are non-parametric or parametric approaches. DEA is a non-parametric approach that makes no assumptions

concerning the form of the production function. Instead, the best practice function is obtained empirically from observed inputs and outputs. DEA precludes the possibility of evaluating the marginal products and elasticity of substitution of the production technology (Admassie and Matambalya, 2002; Arunsawadiwong, 2007; Coelli *et al.*, 2005; Zahid and Mokhtar, 2007). On the contrary, SFA is a parametric approach where the form of the production function is assumed to be known or is estimated statistically. SFA is preferred over other estimation techniques in computing measures of technical efficiency such as OLS, COLS and DEA. The study provides the following justifications: first, SFA allows other parameters of the production technology to be explored. Any deviation from the frontier is mainly due to random shocks and managerial inefficiency. The advantage of this approach is that hypotheses can be tested with statistical rigor given that the relationships between inputs and outputs follow known functional forms. Second, the SFA approach is superior in that it estimates the best practice technology upon which the production function concept is based (Admassie and Matambalya, 2002; Arunsawadiwong, 2007; Coelli *et al.*, 2005; Zahid and Mokhtar, 2007). Therefore, a conventional econometric model may produce results that are fundamentally inconsistent with the definition of the production function (Arunsawadiwong, 2007; Coelli *et al.*, 2005). Finally, the SFA uses the maximum likelihood method to predict technical efficiency and estimate the technical inefficiency effects of universal banks in Ghana. The maximum likelihood method has desirable large-sample (or asymptotic) properties (Amornkitvikai and Harvie, 2011; Coelli *et al.*, 2005), and it is preferred to other estimation techniques in computing measures of technical efficiency such as OLS and COLS (Amornkitvikai and Harvie, 2011; Coelli *et al.*, 2005, p. 245). OLS estimates cannot be used to examine the technical efficiency of firms since the estimated intercept coefficient obtained from the OLS is biased downwards even though the estimated slope coefficients are consistent.

4.2.2 Description of output, input variables and inefficiency determinants. From the intermediation approach, banks act as financial intermediaries in receiving deposits and give the same as loans for deficit spending units. While the study uses loans as output, deposits, fixed assets and personnel expenses are the three inputs used in generating the output variables. A time trend variable is included in the cost function to account for technological change over time (Coelli *et al.*, 2005). The time trend captures technical change with passage of time (Kumbhakar and Lovell, 2000). Determinants of banks' inefficiencies used in the study and the justifications for their inclusions are as follows.

4.2.2.1 Board diversity (boadiv). Board diversity is defined as the presence of women on boards, and it is included in the study to consider the impact diversity in boardrooms on the efficiency of banks. Carter *et al.* (2003) estimate the link between board diversity and firm efficiency for Fortune 1,000 firms in the USA and find a significantly positive relationship between the proportion of women on the board and firm value. With regard to developed countries in Europe, Smith *et al.* (2006) find that the proportion of women in top management teams has a positive effect on various measures of firm performance for the Danish firms, even after controlling for firm characteristics and direction of causality.

4.2.2.2 Total assets (basize). Total assets used as a proxy for bank size (basize) is measured as the natural logarithm of total assets. Studies by Ataullah *et al.* (2004), Hauner (2005), Chen *et al.* (2005), Isik and Hassan (2003), Girardone *et al.* (2004) and Weill (2004), among several others, have found mixed and inconclusive evidence on the size-efficiency relationship.

4.2.2.3 Financial intermediary (fint). The financial intermediation ratio reflects the extent of intermediation to which banks convert deposits into loans. The higher the intermediation ratio, the higher the efficiency of banks (Fries and Taci, 2005).

4.2.2.4 Loans loss to total loans (lolostl). Loans loss to total loans (lolostl) used as a surrogate for bank asset quality is estimated as the ratio of loan loss provisions to total

loans. These provisions measure managerial competence. Poor asset quality is one of the major causes of bank failures (Athanasoglou *et al.*, 2008).

4.2.2.5 Management size (mgtsz). The efficiency of banks may change with the size of top management (Titova, 2016; Bhat *et al.*, 2020). Theoretical interest in top management teams can be traced to March and Simon's (1993) Behavioral Theory of the firm. According to this theory, decision-makers are often unable to make economically rational decisions because they are boundedly rational and must act in a social context of multiple and conflicting goals. Thus, the expected sign for *MGTSZ* is negative.

4.2.2.6 The growth rate of gross domestic product (grgdp). Literature suggests that the economic and environmental conditions within which banks operate can influence them. The growth rate of gross domestic product (GDP) is used as a proxy to measure the degree of economic activities, and it reflects the state of the economic cycle. GDP growth is expected to affect supply and demand for loans and deposits. This, therefore, suggests that bank efficiency may vary with the growth rate of GDP. The present study supports the empirical work of Staikouras and Wood (2003), which suggests that the growth rate of GDP hurt the efficiency of banks on assets among a sample of banks in 13 EU banking markets. Thus, the expected sign for *grgdp* is negative. Table 2 shows the outputs and inputs variables, determinants of inefficiencies, control variables with their labels and expected signs (Table 3).

4.3 Model for empirical estimation and framework of the study

The present study uses a Cobb-Douglas (CD) production function to predict technical efficiency and to estimate inefficiency effects models using panel data of the 23 universal banks. A preliminary analysis considered the other functional forms of production functions such as Generalized Production Function, Transcendental and Translog. Notwithstanding, the choice for CD production function was because the other functional forms of production produced unsatisfactory results. In estimating the technical efficiency frontier, this paper follows Maudos *et al.* (2002), Kasman and Yildirim (2006), among several others. It further expands the traditional production function approach and applies the SFA technique of Aigner *et al.* (1977). Under the SFA approach, two important assumptions need to be

Table 3 Variable definitions

Variable	*Proxies*	*Symbols*	*Variable estimations*	*Expected hypothesis*
Output variable				
loans		*Loans*	Total net loans	?
Input variables				
Deposits		*deps*	Total deposits	+
Fixed assets		*fixast*	Fixed assets	+
Personnel expenses		*perexp*	staff cost	+
Time trend		*timtr*	Time (Years)	+
Potential correlates of determinants of inefficiency				
Board diversity	Presence of women on boards	*boadiv*	Ratio of women to the total board size	+
Total assets	Bank size	*basize*	Total assets	−
Listing status	Listing status	*lisstu*	Dummy of 1 if listed and 0 if otherwise	−/+
Financial intermediary	Intermediation	*fint*	Ratio of deposits to loans	−/+
Loans loss to total loans	Assets Quality	*lolostl*	Impairment charge/gross loans and advances	+
Management size	Management control	*mgtsz*	Total size of management	−
Growth rate of gross domestic product	External factor	*grgdp*	Gross domestic product	+

Source: Author's compilation (2020)

stated. First, all the producers in the sample are fully efficient. Thus, they operate along the production possibility frontier. Second, any deviation from the frontier is mainly due to random shocks and managerial inefficiency. The CD production function is estimated simultaneously with the inefficiency effects model as indicated in equation (2):

$$\ln Y_{it} = \beta_0 + \beta_1 \ln(K_{it}) + \beta_2 \ln(L_{it}) + T + (\nu_{it} - \mu_{it})\ i = 1, \ldots, N;\ t = 1, \ldots, T \tag{1}$$

where Y_{it} denotes value-added, K_{it} represents net fixed assets, L_{it} represents the total number of employees, T is the time trend variable included to account for technological change over time (Coelli *et al.*, 2005). N_{it} are random error terms that are considered to be separately and uniformly distributed normal random variables with zero means and variances, ($\nu_{it} \sim iidN(0,\sigma^2\nu)$)and are considered to be independently distributed of the μ_{it}. The μ_{it} is non-negative random variables accounting for technical inefficiency in the production function that are considered to be separately distributed such that μ_{it} is defined by the truncation of the normal distribution with mean μ_{it} and variance σ^2. In addition, ν_{it} and μ_{it} are assumed to be independently distributed for all firms (i = 1, 2, …, N) (Battese and Coelli, 1995; Coelli *et al.*, 2005). If μ_{it} is equal to zero, it can be defined that the firm is totally technically efficient at its maximum output level given the inputs used. If μ_{it} is greater than zero, it can be defined that the firm is technically inefficient (Kumbhakar and Lovell, 2000). The subscript *I* refers to firms, β_0 represents the intercept term, β_1 represents the coefficient estimates of capital input and β_2 represents the coefficient estimates of labor input. The potential firm specific-factors that could influence technical efficiency are modeled in an inefficiency functional form as follows:

$$\mu_{it} = \delta_0 + \delta_1 boadiv_{it} + \delta_2 basize_{it} + \delta_3 lisstu_{it} + \delta_4 fint_{it} + \delta_5 lolostl_{it} + \delta_1 mgtsize_{it} + \delta_2 grgdp_{it} \tag{2}$$

where $\mu_{it} = 1 - TE$, δ, s are the unknown parameters to be estimated, and *boadiv, basize lisstu*, *fint, lolostl, mgtsz*, *grgdp* are the bank-specific and control variables expected to explain the technical inefficiency levels of inputs used in the bank intermediation approach in the study area and are fitted into a multiple regression equation. The study considers time-varying technical inefficiency models such as fixed- or random-effects type. The consideration is because technical inefficiency is time-variant. Thus, the inefficiency levels may be different for different individuals and they do change over time. In other words, these models suggest that an inefficient unit (e.g. a bank) learns over time. This might be the case in some situations where inefficiency is, for example, associated with managerial ability and there is change in management for any of the banks during the period of the study.

Two important diagnostic tests to see if the stochastic frontier model is a relevant model to be considered. First, the coefficients of the frontier and inefficiency effects model can be measured using the maximum likelihood method. The maximum likelihood function is defined in terms of the variance parameters as follows (Coelli *et al.*, 2005):

$$\sigma^2 = \sigma_v{}^2 + \sigma_u^2 \text{ and } \gamma = \frac{\sigma_u^2}{\sigma^2} \tag{3}$$

where σ^2 is the total variance of the error term. σ_v^2 is the variance coming from the random component and σ_μ^2 is the variance from the inefficiency component. This γ is the statistics that account for proportion or the variations in output accounted for by technical inefficiency. This statistic ranges between 0 and 1. If it is closed to 1, then it means that many variations are accounted for by technical inefficiencies. Indicating that the stochastic frontier is an appropriate model. If it is closed to 0, then little variations are accounted for by technical inefficiency. Thus, it is reasonable to use stochastic frontier model because more variables would be coming from random variations (Coelli *et al.*, 2005). Second, according to Kumbhakar and Wang (2005), the

likelihood ratio should be used in choosing a model that adequately represents the data for estimation of technical efficiency. The generalized likelihood-ratio statistic uses the restrictive model (CD) and unrestrictive model (stochastic frontier) and then compares it with the critical values reported by Kodde and Palm (1986), as shown in Table 4. The generalized likelihood ratio test (LR test), which can be defined as (Coelli *et al.*, 2005):

$$\lambda = -2\{\log[L(H_0)] - \log[L(H_1)]\} \quad (4)$$

where log [L (*H0*)] and log [L (*H1*)] are the values of a log-likelihood function for the frontier model under the null hypothesis (H_0) and the alternative hypothesis (H_1). The LR test statistic follows an asymptotic chi-square distribution with parameters equal to the number of restricted parameters imposed under the null hypothesis (H_0) (Coelli, 1996).

5. Empirical findings and discussion

5.1 Descriptive statistics

In choosing a model that adequately represents the data for estimation of technical efficiency, Table 5 shows the findings for hypothesis tests for aggregate banks. From Table 5, it shows that the value of the generalized likelihood-ratio statistic for testing the null hypotheses stands at −493.3198, 818.4772, 153.7566, 131.6720, −453.3596 for Models 1, 2, 3, 4 and 5, respectively. These values exceed the critical Chi-square value of 5.4120 at 1% level of significance, with 1 degree of freedom. This suggests that inefficiency effects are not stochastic, and is firmly rejected. Thus, the stochastic frontier model is an adequate and statistically more favorable representation of the data.

Table 6 displays the definitions, summary statistics of output, inputs and time variables used in equation (1). From Table 6, the average loans within the banking industry from 2000 to 2019 is 16.7701 and a standard deviation of about 2.9515 with a minimum and maximum value of 7.2189% and 21.6953%, respectively. Deposits, fixed assets, personnel expenses and time variables did not show a wide variation across the sample. This implies that most of the variables have their observations clustered around the means.

Table 7 exhibits descriptive statistics and potential correlation of efficiency and expected signs of the variables. From Table 7, all the various variables failed to show a wide variation across the sample. When the correlation between any two independent variables is too high (±0.90 and above), it may result in multicollinearity. As shown in Table 7, none of the coefficients exceeded 0.7, showing that all the explanatory variables can be used in the estimations.

Table 4 Critical values of the mixed chi-square distribution significance level

dof	0.25	0.1	0.05	0.025	0.01	0.005	0.001
1	0.455	1.642	2.705	3.841	5.412	6.635	9.5

Source: Obtained from Table 1 of Kodde and Palm (1986)

Table 5 Statistics for hypothesis tests of the stochastic frontier model and inefficiency effects model by aggregate banks

Coefficients	*Null hypothesis*	*Loglikelihood value*	*Test statistic (λ)*	*Critical value*	*Decision*
Full sample (Model 1)	H_0: $\beta_{jk} = 0$	−512.3727	−493.3198***	5.4120	Reject H_0
Period before Women in Finance Charter (Model 2)	H_0: $\beta_{jk} = 0$	196.9961	818.4772***	5.4120	Reject H_0
Period after Women in Finance Charter (Model 3)	H_0: $\beta_{jk} = 0$	−26.6057	153.7566***	5.4120	Reject H_0
Listed banks (Model 4)	H_0: $\beta_{jk} = 0$	27.9725	131.6720***	5.4120	Reject H_0
Non-listed banks model (5)	H_0: $\beta_{jk} = 0$	−412.3288	−453.3596***	5.4120	Reject H_0

Note: ***$p < 0.01$
Source: Author's computation (2020)

Table 6 Summary of output, inputs and time

Variable	*Obs*	*Mean*	*SD*	*Min*	*Max*
Loans	333	16.77012	2.951467	7.21891	21.6953
deps	333	17.46568	2.926529	7.288928	21.9978
fixast	333	14.21035	2.944449	8.549854	19.4884
perexp	333	18.48822	0.358916	13.54454	18.6392
timtr	333	2,010.255	5.703334	2,000	2,019

Source: Author's computation (2020)

Table 7 Description statistics and potential correlates of efficiency

Description statistics	*Variable symbols*	boadiv	basize	lisstu	fint	lolostl	mgtsz	grgdp
Mean		0.1894	17.8087	0.3964	−0.6492	1.3681	2.5554	1.7986
Standard dev.		0.0487	2.8743	0.4899	0.5577	0.1644	0.1708	0.3658
Min		0.0770	11.9021	0.0000	−7.3489	−1.6140	1.6094	1.2809
Max		0.4447	22.4411	1.0000	0.5356	1.5318	3.3322	2.7087
Observation		333	333	333	333	333	333	333
Expected sign		+	−	−/+	−/+	+	−	+
Potential correlates of efficiency								
Board diversity	*boadiv*	1.0000						
Total assets	*basize*	−0.1169*	1.0000					
Listing status	*lisstu*	−0.0173	−0.1764*	1.0000				
Financial intermediary	*fint*	−0.0681	−0.1389*	0.1973*	1.0000			
Loans loss to total loans	*lolostl*	−0.1380*	−0.1605*	−0.0222	0.0991	1.0000		
Management size	*mgtsz*	0.0869	−0.0524	0.1155*	0.0286	−0.1494*	1.0000	
Growth rate of gross domestic product	*grgdp*	−0.0176	−0.0702	−0.0197	−0.0264	0.2441*	−0.0795	1.0000

Notes: *boadiv* ,log of ratio of women to the total board size, *basize* ,log of total assets, *lisstu*, listing status *fint* ,financial intermediary, *lolostl* ,loans loss to total loans *mgtsz* ,log of total size of management, *grgdp*, log gross domestic product, *$p < 0.01$
Source: Author's computation (2020)

5.2 Estimation results

Maximum likelihood estimates of the parameters of the stochastic frontier model and inefficiency effects model, as specified by equations (1) and (2), are estimated simultaneously using bank-level data for the period between 2000 and 2019. The estimated results for equations (1) and (2) are provided in Table 8.

5.2.1 Results for boardroom gender diversity and banks' technical efficiency: hypothesis 1. Table 8 shows the results for the maximum likelihood estimates and the partial elasticity values obtained. The maximum likelihood estimates of the stochastic frontier production function given in Table 8 reveal that all the inputs considered in the study are statistically significant and that they had positive effects on output, i.e. loans. The output elasticity is higher for deposits (1.4758), followed by fixed assets (0.4555), personnel expenses (0.4478) and time trend (−0.0164). The partial elasticity values obtained as shown in Table 8 indicate the relative importance of every factor used in loan production. Thus, 1% increase in any one of the variables (which are deposit, fixed assets, personnel expenses and time trend) holding constant the other variables, elicited 1.48%, 0.46%, 0.45% and −0.02% increase in output, respectively. Output of loans in the study area can be further improved by increasing the quantities of these inputs. The negative relationship between output and time trend shows that during the sample period, there has been a negative technical progress indicating an inward shift of production possibility frontier. The return to scale, as shown in Table 8, stands at 2.3791. The return to scale, defined as the percentage change in output from 1% change of all input factors, is equal to 2.3791. The estimate of the

Table 8 Maximum likelihood estimates for parameters of the stochastic frontier model and inefficiency effects model

Variables	*Parameters*	*Full sample (Model 1)*	*Period before women in finance charter (Model 2)*	*Period after women in finance charter (Model 3)*	*Listed banks (Model 4)*	*Non-listed banks (Model 5)*
Stochastic frontier model						
Constant		−1.7855 (3.9273)	0.7722054 (1.3224)	2.1234 (2.6764)	−1.5615 (2.4333)	−1.815302 (8.5875)
deps		1.4758*** (0.1726)	1.1502*** (0.0254)	0.4146 0.2579	1.1811*** (0.1446)	1.5304** (0.5509)
fixast		0.4555*** (0.1074)	0.1778*** (0.0153)	0.4258*** 0.0543	0.2369*** (0.0430)	0.5819** (0.2198)
perexp		0.4478** (0.2047)	−0.1587** (0.0562)	0.0775 0.0735	0.1381** (0.0429)	(0.0828) (1.1366)
timtr		−0.0164*** (0.0023)	0.0039*** (0.0007)	0.0012 0.0008	−0.0055*** (0.0010)	(0.0134) (0.0127)
Inefficiency effects model						
boadiv		−5.6215*** (1.3367)	0.6137** (0.1960)	−1.0501* (0.6033)	−2.1330*** (0.3879)	−8.1334** (3.6343)
basize		0.5277** (0.1797)	0.3487*** (0.0320)	−0.1593 (0.2749)	0.3781** (0.1518)	0.444628 (0.5666)
lisstu		−0.7221*** (0.1414)	0.0003 (0.0156)	−0.0037 (0.1037)	–	–
fint		−0.5940*** (0.1706)	−1.0118*** (0.0287)	−1.0135*** (0.0683)	−1.0273*** (0.0854)	−0.5267 (0.3123)
lolostl		−1.1587** (0.5318)	0.7068085 (0.6372)	0.1438 (0.1848)	−0.9936 (1.6084)	−1.16275 (0.9128)
mgtsz		−0.372819 (0.3781)	0.3164*** (0.0490)	0.3876 (0.1858)	−0.2366** (0.1015)	−0.4028 (0.9627)
grgdp		−0.507636 (0.7388)	0.6179*** (0.0295)	0.8536 (0.0200)	−0.4901 (1.1569)	0.0674 (6.9330)
Variance parameters						
Sigma-squared		0.0686	0.0126	0.1339	0.0527	3.7254
Gamma		0.6703	0.5176	0.1241	0.2160	0.1785
Log-likelihood function		−512.3727	196.9961	−26.6057	27.9725	−412.3288
Simple average technical efficiency[a]		0.1462	0.0534	0.0364	0.2057	0.1524
Returns to scale		2.3791	1.1693	0.9179	1.5561	2.0295
Not best practice		0.0000	0.0042	0.0000	0.0159	0.0000
Best practice		0.9988	0.3212	0.1345	0.9998	0.9996
Banks		23	23	23	8	15
Observation		333	256	77	132	201
Prob > chi2		0.0000	0.0000	0.0000	0.0000	0.0000
Wald chi2		128.38	2,204.12	66.47	114	29.86

Notes: Standard errors are in parentheses. *a*. The simple average technical efficiency is calculated as the sum of technical efficiency scores with respect to total number of firms. *The coefficients are statistically significant at 10%. ** The coefficients are statistically significant at 5%. *** The coefficients are statistically significant at 1%

Source: Author's computation (2020)

gamma parameter (λ) is 0.6703 (see Table 8), implying that deviations from the stochastic production frontier are due to considerable technical inefficiency (Coelli *et al.*, 2005). The coefficient of gamma of 0.6171 implies that about 62% of the difference between the observed and the frontier value productivity was mainly as a result of inefficient use of resources under the control of sampled banks, and little is due to random shocks (climate changes, intermediation risks, etc.).

In estimating the level of technical efficiency as presented in Table 8, the technical efficiency indexes of banks varied from 0.0000 (0.0%) to 0.9988(99.88%), with a mean of 0.1462 (14.62%). This indicates that, on average, a typical bank during the sample period operated at about 14.62% technical efficiency. This implies that, on average, during the sample period, banks operated about 85% below the maximum potential output or during the sample period there was a possibility that the average bank could increase its output by 85% without having to use more capital and labor. While the least performing bank operated at 0.0%, which is about 99.8% below the maximum potential output, the best practice bank operated less than 1% below the maximum potential output. The estimated results for equations (2) are shown under full sample (Model 1) in Table 8. The negative coefficient signs of the inefficiency effects model represent technical efficiency, so must be converted to positive for technical efficiency. Specifically, boardroom gender diversity (*boadiv)* negatively affects technical inefficiency at 1% significant level. Thus, increasing the presence of women on the board of directors positively affects the technical efficiency of banks.

5.2.2 Results for periods before and after the passage of the charter and banks' technical efficiency: hypothesis 2. Models 2 and 3, as presented in Table 8, discuss the results for periods before and after the passage of the Charter and banks' technical efficiency, respectively. Model 2, as presented in Table 8, the technical efficiency indexes of banks varied from 0.0042 (0.0%) to 0.3212 (32%), with a mean of 0.0534 (5%). This suggests that on average a typical bank before the passage of the Women in Finance Charter operated at 95% below the maximum potential output. Stated differently, during the sample period, there was the possibility that the average bank could increase its output by 95% without having to use more capital and labor. While the least performing bank operated at 0.0%, which is about 99.8% below the maximum potential output, the best practice bank operated less than 1% below the maximum potential output. In Model 2, boardroom gender diversity positively affects technical inefficiency at 1% significance level. Thus, increasing the presence of women on the board of directors negatively affects banks' technical efficiency. Model 3, as shown in Table 8, the technical efficiency indexes of banks varied from 0.000 (0.0%) to 0.1345 (13%), with a mean of 0.0364 (4%). This means that after the passage of the Women in Finance Charter, a typical bank, on average, operated at 96% below the maximum potential output. Boardroom gender diversity affects technical inefficiency negatively at 10% significantly level in Model 3. Thus, increasing the presence of women on the board of directors positively affects the technical efficiency of banks.

5.2.3 Results for presence of women occupying board positions of both listed and non-listed banks and banks' technical efficiency: hypothesis 3. Models 4 and 5, as captured in Table 8, are produced after decomposing the data set into listed and non-listed banks. Specifically, in Model 4, the technical efficiency indexes of banks varied from 0.0159 (1.59%) to 0.9998 (99.98%), with a mean of 0.2057 (20.57%). This result suggests that, in terms of listed banks, on average listed banks operated at 79.43% below the maximum potential output. *Boadiv* affects technical inefficiency negatively at 1% significance level. Thus, increasing the presence of women on the board of listed banks is efficiency-enhancing. A similar result is produced but at a 5% significant level for non-listed banks.

5.2.4 Validation of upper echelons theory: hypothesis 4. This study provides significant insights into upper echelons theory. The result shows that organizational outcomes are partially predicted by managerial background characteristics of the top-level management

team. Thus, in the Ghanaian context, the influence of women occupying top organizational positions specifically on the board of directors enhances technical efficiency of banks. The result, therefore, validates the upper echelons theory in the Ghanaian context.

5.2.5 Results for other determinants of banks' efficiency. Relationship between bank size *(basize)* and technical inefficiency is further examined in Models 1, 2 and 4 as shown in Table 8. Contrary to our earlier position, while the study finds a positive relationship between bank size and technical inefficiency for Models 1, 2 and 4 at 5%, 1% and 5% significant levels, respectively, insignificant relationships are established for Models 3 and 5. This does not reflect the economies of scale and scope advantages that characterize large-scale banking operations. The listing status of banks *(lisstu)* negatively affects technical inefficiency of banks in Ghana. Thus, as more banks are listed on the stock exchange, technical efficiency of banks is enhanced. Financial intermediary *(fint)* negatively affects technical inefficiency of banks across all Models at 1% significant levels except Model 5. This suggests that a higher financial intermediation ratio translates into a higher banks' efficiency. In Model 1, loans loss to total loans *(lolostl)* which measures managerial competencies negatively affect technical inefficiency at 5% significance level. This indicates that a higher assets quality reduces technical inefficiency banks. While Management size *(mgtz)* positively affects technical efficiency of banks during the period before the passage of the Women in Finance Charter at 1% significance level, a negative relationship is established for listed banks at 5% significance level. As shown in Table 8, while Models 1, 3, 4 and 5 show an insignificant relationship between growth rate of GDP *(grgdp)* and technical inefficiency, the study finds a positive and significant relationship between *grgdp* and technical inefficiency before the passage of the Women in Finance Charter at 1% significance level.

6. Summary, conclusion and implications

The study uses a SFA to examine the impact of boardroom gender diversity and banks' technical efficiency using 23 universal banks in Ghana from 2000 to 2019. The results from the econometric enquiry in this paper are insightful. First, contrary to our earlier position, the study reveals that increasing the presence of women on the board of directors negatively affects technical inefficiency of banks in Ghana. Inversely, increasing the presence of women on the board of directors positively affects technical efficiency of banks. The inclusion of more women on the board provides opportunity for diversity in decision-making to enhance loan output, given the state of the art. This suggests that in Ghana, technical efficient banks tend to have more women on the board. Thus, the recommendations contained in the Hampton Alexander report (2017), which calls for an increase of female representation on board of FTSE100 companies to 33% and increase in female executive directors are steps in the right direction. This article corroborates that the appointment of more women into the board enhances the technical efficiency of banks in Ghana. This result runs parallel with the empirical studies such as Carter *et al.* (2003), Smith *et al.* (2006), Campbell and Minguez-Vera (2008) and Francoeur *et al.* (2008), the results of the study fail to support earlier studies by Jurkus *et al.* (2011), Adams and Ferreira (2009), Konrad *et al.* (2008) and Hafsi and Turgut (2013).

Second, the study decomposed the data set into two segments, i.e. periods before and after the passage of the Women in Finance Charter. For the periods before the passage of the Women in Finance Charter, a positive relationship is found between boardroom gender diversity and technical inefficiency. Thus, boardroom gender diversity negatively affects technical efficiency of banks. An inverse link is confirmed for boardroom gender diversity and technical inefficiency after the passage of the Women in Finance Charter. This suggests that increasing the presence of women on the board of directors positively affects the technical efficiency of banks. This result supports recent endorsement by several key individuals, international commissions and organizations have equally called for strong and

legally binding action from member states to ensure diversity in boardrooms (Adams and Kirchmaier, 2016; Seierstad *et al.*, 2017; Valls Martínez *et al.*, 2019; Ali, Ng and Kulik, 2014; Rao and Tilt, 2016; Wittenberg-Cox, 2014; FRC, 2011; European Commission, 2010).

Third, the study result indicates that increasing the presence of women on the board is efficiency-enhancing for both listed and non-listed banks. This result mirrors the Australian context. Ali *et al.* (2014) concur that in Australia as a rule listed companies found on Australian Securities Exchange must adopt and disclose their gender diversity initiatives and gender proportions at all levels, including boards (Ali *et al.*, 2014). Finally, this study provides significant insights into upper echelons theory. The result shows that organizational outcomes are partially predicted by managerial background characteristics of the top-level management team. Thus, in the Ghanaian context, the influence of women occupying top organizational positions specifically on the board of directors enhances technical efficiency of banks. The result, therefore, validates the upper echelons theory in the Ghanaian context.

In terms of the technical inefficiency determinants, varied results are produced. Although studies such as Chen *et al.* (2005), Isik and Hassan (2003), Girardone *et al.* (2004), Weill (2004), and among several others, have found inconclusive evidence on the bank size-efficiency nexus, the present study shows that bank size does not influence technical efficiency. The study further reveals that banks' technical efficiency is enhanced as more banks are listed on the stock exchange. Financial intermediary *(fint)* negatively affects technical inefficiency of banks across all models. Thus, in Ghana, a higher financial intermediation ratio translates into a higher banks' efficiency.

This result does not support the empirical study of Fries and Taci (2005). The negative relationship between loans loss to total loans and technical inefficiency shows that a higher asset quality reduces banks' technical inefficiency (Athanasoglou *et al.*, 2008). While Management size *(mgtz)* positively affects technical efficiency of banks during the period before the passage of the Women in Finance Charter, a negative relationship is established for listed banks. Thus, before the passage of the Women in Finance Charter listed banks, huge sizes of top management were not efficient banks. This result invalidates March and Simon's (1963) behavioral theory of the firm which recognizes that organizational vitality may depend more on the quantity, quality and speed of a firm. Finally, the study finds a positive relationship between growth rate of GDP (*grgdp*) and banks' inefficiency. The growth rate of GDP which reflects economic and environmental conditions within which banks operate does not make banks efficient. *Grgdp* is expected to affect supply and demand for loans and deposits. The present study supports the empirical work of Staikouras and Wood (2003), which suggests that the *grgdp* hurt banks' efficiency on assets among a sample of banks in 13 EU banking markets.

In general, this result, therefore, serves as a good basis for intensifying advocacy for the inclusion and participation of more women on Ghanaian boards. This study will serve as a useful resource for government, regulatory authorities, corporate and public institutions, researchers and students (International Finance Corporation, 2018). Specifically, the study recommends the following corporate, social and national implications:

6.1 Implication at corporate levels

First, boardroom gender diversity enhances better governance by fostering more responsible thinking and creating a dynamic environment and by extension technical efficiency. Second, the economic case for gender-balanced boards is as much as it is about improving technical efficiency of banks as it is about promoting equal opportunities for women. Therefore, increasing female representation in the boardrooms will help achieve long-term sustainable change in the workplace. Finally, with the right people on the board,

diversity can lead to more creativity and greater innovation-important characteristics for the banking industry.

6.2 Implication at social levels

The positive relationship between increasing presence of women on the board of directors and technical efficiency of banks in Ghana suggests that deep seated prejudices on the status and role of women in society and businesses should be challenged. Factors such as education, media, legislation and politics that seek to enhance efficiency of women in our society should be encouraged.

6.3 Implications at national levels

First, from the regulatory point of view, the result should matter to policymakers concerned about underrepresentation of women on boards. The underrepresentation of women in the banking space has long-term consequences for corporate leadership, hence, technical efficiency of banks. Second, policies that ignore supply constraints, such as the quota set in Norway and other countries should be encouraged. Finally, at the national level, achieving a certain percentage of female representation would bring Ghana in the front line of countries with gender diversity which improves the country's image globally.

6.4 Limitations and future research

The link between boardroom gender diversity and technical efficiency is studied within one special national context, the Ghanaian system. As Grosvold *et al.* (2007) stressed, the institutional and cultural context might be of importance when analyzing board diversity and its effects. Hence, further studies should incorporate cross-country analyses.

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