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Board gender diversity, corporate governance and bank efficiency in Ghana: a two-stage data envelope analysis (DEA) approach

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Abstract

This study analyses the efficiency of banks under board gender diversity and examines the determinants of bank efficiency. Using a two-step framework, the first stage result shows that banks experience about 7.9 per cent improvement in their efficiency with board gender diversity on average. The second stage regression results reveal that gender diversity promotes bank efficiency up to a maximum of two female directors on a nine-member board, suggesting a threshold effect on bank efficiency. Board size improves bank efficiency. Board independence is negatively related to bank efficiency. Also, we find that powerful CEOs are detrimental for bank efficiency. Finally, we find that ownership structure, bank size, bank age and loan-to-deposit ratio are important factors affecting bank efficiency. The paper contributes to bank governance structure, namely gender composition of boards and provides an insight for regulators and shareholders to estimate the role of men and women on boards.

Keywords – Board gender diversity, corporate governance, bank efficiency, Ghana

Paper type – Research paper

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1 Introduction

The company's board is the single most significant internal control mechanism aimed at controlling management and serves as a deterrent to opportunistic behaviour of managers (Oba and Fodio, 2013). Board diversity has taken centre stage in corporate governance literature. Board diversity involves a set of gender diversity, ethnic or demographical diversity, and educational diversity (Zhang, 2012). Proponents of board gender diversity argue on two grounds: ethics and economics. On the ethical debate, Campbell and Mínguez-Vera (2008) argue that it is ethically wrong excluding women from boards' directorship just because they are women. On the economic front, prior studies suggest that the firm's performance and competitive advantage suffer a great deal if the female talent pool is ignored. This proposition makes it all important for firms to harness this great talent with that of their male counterpart in today's dynamic and complex business environment. In other studies, two or more female directors on a company's board contribute to revenue generation and profit maximization six years later (Brown *et al.*, 2002). Thus there are calls for firms to promote gender diversity to ensure economic empowerment and societal good.

Given that there has been massive campaign for affirmative action in Ghana which has led to the adoption of a non-mandatory political party quota of 40% women in governance (Tsikata, 2009), the question of whether Ghana should adopt a mandatory quota for female representation on corporate boards and top management positions still lingers. What is the optimal mix of male-female representation on corporate boards in Ghana?

Horak and Cui (2017), Rodríguez-Ruiz *et al.* (2016) and García-Meca *et al.* (2015) have shown empirically that board gender diversity (*BGD*) wields positive influence on performance (see also Pathan and Faff (2013), Kılıç and Kuzey (2013), Terjesen *et al.* (2016), and Carter *et al.* (2003)). Although these studies confirm the notion of value additive of gender diversity in the boardrooms, the models in these papers typically make predictions of the effect of *BGD* on performance but not efficiency. Meanwhile, empirical evidence shows that efficiency mediates *BGD* and bank performance relation (Miller and Triana, 2009). Consequently, there is the need to analyse the efficiency of banks under board gender diversity and examine the determinants of bank efficiency.

In prior studies, gender diversity has been defined to include zero female representation on boards (Ramly *et al.*, 2015; Titova, 2016; Chan and Heang, 2010). For example; Ramly *et al.* (2015) included in their study, gender diversity with a mean value of 0.111 which varies between 0.000 and 0.676. We argue that zero female representation on a board does not signify gender diversification and define '*gender diversified board*' as a board with at least one female director. How does this restriction impact on bank efficiency?

Available empirical evidence assumes that gender diversity on boards should increase in perpetuity (Low *et al.*, 2015); thus, we must as well have 100% female board of directors. However, Horak and Cui (2017) show that gender diversified boards do creditably well financially than gender homogenous boards. Likewise, Gordini and Rancati (2017) show that greater gender diversity promotes economic gains and sustain shareholder value; as such, they stress the need to find the right mix of men and women that optimizes firms' financial performance.

From the discussions above, three main gaps can be identified. The first is a conceptual gap, where it is evident from studies gathered that there is the need to exclude zero female representation in *BGD* debate since zero female representation on board of directors does not signify gender diversification on a board. Evidently, most of the studies reviewed have failed to consider this concept of gender diversified board completely. For the second gap, there is the need for empirical testing of the value relevance of a gender diversified board using DEA where board gender diversity is modeled as an input factor in the intermediation function of banks since previous studies had not considered it. Proponents of resource dependency theory posit that there are some resources that are provided by the board which include gender diversity that supports management in areas which are grey or lacking for the firm for use to command superior performance and competitive advantage. Finally, from the evidence gathered, there is the need to test possible nonlinearity between board gender diversity and bank efficiency since previous studies by Ramly *et al.* (2015), Chan and Heang (2010), among others ignored it. These have explored how board gender diversity related to bank efficiency using DEA technique. Ramly *et al.* (2015), for instance, show that *BGD* does not promote cost and profit efficiency, a result which seems to belie the previously mentioned studies. There is, therefore, the need to reconsider how board gender diversity influences bank efficiency since *diversity* was not well defined.

In this paper, we analyse efficiency of banks under board gender diversity and examine the determinants of bank efficiency using a two stage framework. First, we model *BGD* as an additional input variable in a data envelopment analysis (DEA) framework, following proponents of resource dependency theory. Second, we examine the determinants of bank efficiency by means of regression analysis. We argue that zero female representation on a board does not signify gender diversification and define ‘*gender diversified board*’ as a board of directors with at least one female director. After excluding banks with zero female representation on their board, we model board gender diversity as an additional input variable in a DEA framework, so as to examine the effect on bank efficiency. The value relevance of this conceptual and empirical approach is that, it helps us to isolate the effect of gender diversified board from a gender undiversified board and contribute to the search for appropriate input factors in the estimation of bank efficiency using DEA. To determine the optimal mix of male-female representation on boards, we model a nonlinear relationship involving *BGD* and bank efficiency by incorporating a quadratic term of *BGD* to capture the diminishing marginal effect. Consequently, the paper contributes to literature by providing evidence that deepens our understanding on *BGD* and bank performance nexus.

The rest of the study is organized as follows: Section 2 provides a review of literature and hypothesis development. Section 3 discusses data and estimation methods used for the empirical analysis. Section 4 presents results of our analysis; section 5 summarizes, concludes and discusses implications as well as provides direction for future research.

2 Literature review and hypothesis development

This section discusses the resource dependency theory which underpins the paper and testable hypotheses.

2.1 Resource dependency theory

The theory recognizes the need for women participation in top hierarchy role in corporate boardrooms as critical resource that firms can depend on because of the enhanced benefits on

firms' performance. The complex and dynamic business environment of banks requires advice from the boards put in place by shareholders. The resource dependence theorists say that "a firm is an open system, reliant on contingencies in the external environment" (Pfeffer and Salancik, 1978); as such, studies drawing on the theory suggest that, the board provides resources which includes gender diversity to support management in areas that are grey or lacking to control the uncertainties from the external dependencies (Hillman *et al.*, 2009). In this light, gender diversity is viewed as a relationship-oriented attribute that informs attitude, behavior and social process that exerts predictive power on performance. From a resource dependence theoretic standpoint, gender diversity is a resource that enhances the quality of decision making. Thus, the provision and use of resources to command superior performance and competitive advantage is what resource dependency theory concerns itself with. Also, resource dependence hypothesis concentrates on the role of intermediation and advisory of the board. This theory supports our hypothesize effect of *BGD* on bank efficiency.

2.2 *Board gender diversity and bank efficiency*

Recent studies about the gender – performance relationship can be categorized into three broad areas: (1) firm-level analysis (e.g. Gordini and Rancati, 2017); (2) group level analysis (e.g. Apesteguia *et al.*, 2012) and (3) entire workforce analysis (e.g. Rodríguez-Ruiz *et al.*, 2016). We review those firm-level analyses which are in line with our research objective.

From this perspective, Francoeur *et al.* (2008) document evidence on whether and how female participation in both governance and senior management position affect corporate performance. They show that firms that have high participation of women in top hierarchy position experience positive and significant corporate performance, if the firms operate in complex environment. This result suggests that homogenous boards do not fit well in complex industry. A result which sharply contrasts evidence put forward by Adams and Ferreira (2004) about homogenous boards and their fit for riskier business environments.

In view of the inclusive results above, Horak and Cui (2017) perform a comparative analysis of gender diversified board and gender homogenous board to answer the question 'which one performs better financially?'. The results show that gender diversified boards perform better financially. Although, banks have peculiar characteristics that need consideration regarding their boards' composition, the above non-bank findings should provide a good premise to the value relevance of *BGD* to banks.

In the banking literature, several studies have documented extensively the positive outlook of *BGD* on bank performance. For example, García-Meca *et al.* (2015) observed that *BGD* promotes performance of banks. Likewise, Pathan and Faff (2013) examined whether gender diversity, among other things, affect the performance of banks. They report that *BGD* was effective in promoting bank performance; however, following the introduction of Sarbanes-Oxley Act (SOX), the positive effect shrinks. This result reveals very relevant feature of gender diversity on the boards of banks, i.e. gender diversity substitutes for SOX reforms. More recently, Owen and Temesvary (2018) show a threshold effect of gender diversity on bank performance, suggesting significant non-linearity in *BGD* and bank performance.

Literature is limited in the space of banks' boards – efficiency nexus (Chan and Heang, 2010; Ramly *et al.*, 2015; Titova, 2016). Particularly, gender composition on board and its relation with efficiency levels of banks have seen very little work. Chan and Heang (2010) as well as Ramly *et*

al. (2015) document the causal link between *BGD* and cost as well as profit efficiencies of banks in Malaysia and ASEAN-5 (i.e. Indonesia, Malaysia, the Philippines, Thailand and Singapore) nations respectively. These studies advance that board gender diversity decreases both cost and profit efficiencies of banks. They however, add a caveat that, the number of female directors on the boards of banks in their sample was small, a caveat we seek to address.

Based on the discussion above, the first hypothesis (H_1) related to board gender diversity is as follows:

Hypothesis 1 (H_1): Bank efficiency has an inverted U shaped relation with board gender diversity.

2.3 *Board size and bank efficiency*

Board size framework of corporate governance has received greater attention in the literature by far. Prior studies examine either the link between bank performance and board size or board size effect on bank performance and report mixed findings. These results range from positive, negative, and concave (e.g. Salim *et al.* (2016), Pathan and Faff (2013), Grove *et al.* (2011)). Several reasons have been cited for these findings: the measure of bank performance (i.e. Tobin Q, ROA, ROE) (Owen and Temesvary, 2018), the structure of board (i.e. larger boards or smaller boards), the economic environment (Coles *et al.*, 2008) and endogeneity problem (Wintoki *et al.*, 2012).

Banks have need for greater advisory because they are heavily debt financed, have greater complexity in operations and highly regulated; consequentially, large boards are beneficial to banks (Coles *et al.*, 2008). Thus, the performance effect of board size on bank efficiency is contextual. As pointed out by Bokpin (2013), banks with larger board size have improved efficiency. However, the effect of larger board size in banks is dependent on the complexity of operations (Titova, 2016). This suggests that banks have highly complex operations (Andres and Vallelado, 2008); and as such, enjoy efficiency-enhancing effect of board size. Moreover, Salim *et al.* (2016) recognize that resource dependency theory predictions of the performance effect of board size on banks is positive, as larger board means more experts yielding high quality decisions that exert improvement in performance. On the other hand, Pathan and Faff (2013) show that board size is negatively related to bank performance after controlling for potential endogeneity issues. Likewise, Liang *et al.* (2013) document that board size is negatively related to bank performance. A potential explanation for these findings is the variation of measures of bank performance.

Based on the resource dependency theory predictions, and the contextual dependency of the performance effect of board size; we expect that board size in banks improves their efficiency. As such, the second hypothesis (H_2) related to board size is as follows:

Hypothesis 2 (H_2): Board size has positive effect on bank efficiency.

2.4 *Board independence and bank efficiency*

The presence of independent non-executive directors measures board independence in prior studies. From earlier studies board independence enhances its monitoring role and adds value to firms in their fiduciary responsibilities (Jensen and Meckling, 1976). Similarly, some empirical

evidence shows that the existence of independent directors lessen management intake of freebees which in turn advances bank performance (Andres and Vallelado, 2008).

On the other hand, other studies have found no significant relation between board independence and bank performance (Yermack 1996). With regards to efficiency, the results in available literature are no different. The analysis by Tanna *et al.* (2008) show board independence has no value relevance with bank efficiency. Likewise, Andres *et al.* (2005) show that greater independence on the board of directors does not really affect bank efficiency; suggesting that the cost and benefits of maintaining a highly independent board zero out.

In spite of the above discussions, our resource dependency theory standpoint is that independence of the board of directors is critical for greater transparency and improved disclosures; as such, limits the premium paid for information opacity. Specifically, we posit that in a relatively opaque banking setting such as Ghana; the savings that would be made from greater board independence outweighs the associated costs. Thus, we expect efficiency-enhancing effect of board independence. Therefore, the third hypothesis (H_3) related to board independence is as follows:

Hypothesis 3 (H_3): Board independence has positive effect on bank efficiency.

3 Methodology

In this section, we discuss the source of data for the analysis and formulate models used for the analysis of data collected.

3.1 Data source and sample selection

Data for analysis were obtained from annual reports of 21 commercial banks for the period 2009 to 2017. The data comprises year-end financial characteristics such as total assets, total loans and advances, customer deposits, interest income and non-interest income. Also, we manually extracted data on the total number of female directors on the board, the total number of directors constituting the board, the total number of independent directors on the board of each bank as well as the age of the bank and the number of branches from the corporate information section of the annual reports. The period captures the effect of universal banking law where all banks had a level playing field because they had all acquired the universal banking license. As at year-end December 31, 2017, there were 33 commercial banks operating with universal banking license in Ghana; however, the final sample of 21 commercial banks, which represent 63.63%, were used because those banks with no female representation on their board were excluded. Also, there were some bank-year observations for which there was zero female representation resulting in 148 bank-year observations in total.

3.2 Bank efficiency estimation

The DEA methodology is suited for our efficiency analysis since it has the ability and consistency to estimate efficiency incorporating multiple inputs and outputs that characterize banks. Further, the utilization of DEA helps with unraveling independent and identically distributed issues in the regression stage in light of the fact that efficiency scores derived are not founded on residuals got from econometric techniques. The advantage of DEA approach is that, we do not have to think about the appropriate functional form of the model *a priori* compared to stochastic frontier analysis. Though, there is lack of diagnostic checks to detect model

misspecification in DEA resulting from inappropriate inputs and outputs variables (Galagedera and Silvapulle, 2003), Raab and Lichty (2002) suggest a rule of thumb: three times the sum of production (inputs and outputs) variables. In the spirit of this rule, we needed 18 bank-year observations as minimum data set. However, there are 148 bank-year observations for this study.

We model banks' input and output variables based on intermediation approach in line with prior studies and the following input and output variables are derived for use in our paper; input variables – customers' deposit, number of branches and *BGD*; output variables –loans and advances, interest income and non-interest income.

We apply an output oriented Variable Return to Scale (VRS) model proposed by Banker *et al.* (1984). The primal version of Banker *et al.* (1984) (BCC) model that estimate technical efficiency score for each Decision Making Unit (DMU_o) is:

$$\begin{aligned} & \text{Maximise} \left(TE_0 = \theta_0 + \varepsilon \sum_{j=1}^m e_j + \varepsilon \sum_{i=1}^h s_i \right) \\ & \text{s. t.} \\ & \sum_{k=1}^n \delta_k y_{ik} = \theta y_{io} + s_i \quad \forall i = 1, 2, \dots, h \\ & \sum_{k=1}^n \delta_k x_{jk} = x_{jo} - e_j \quad \forall j = 1, 2, \dots, m \\ & \sum_{k=1}^n \delta_k = 1 \quad \forall k = 1, 2, \dots, n \\ & s_i, e_j, \delta_k \geq 0 \end{aligned}$$

where TE_0 = the technical efficiency score of the DMU_0 under analysis; θ_0 = amount of possible argumentation to output level y_0 while maintaining the same level of inputs; ε = non-Archimedean infinitesimal to impede DMUs from giving zero weights to factors that manage poorly; n = number of DMUs under analysis; h = number of outputs; m = number of inputs y_{ik} = the value of output i for DMU_k x_{jk} = the value of input j for DMU_k ; s_i = shortage in output production for the specific output i ; e_j = excessive use of input j .

3.2 Econometric model for determining bank efficiency

To determine the influence of BGD on bank efficiency we formulate our model in the form

$$Y = X\beta + \varepsilon$$

where Y is an $n \times 1$ vector, X is an $n \times (k+1)$ design matrix of the BGD characteristics and control variables, β is a $(k+1) \times 1$ vector of parameters and ε is an $n \times 1$ vector of residuals for $n, k \in \mathbb{Z}^+$. Specifically, we examine the determinants of bank efficiency by specifying the model:

$$\begin{aligned} \ln TE_{it} = & \alpha_0 + \beta_1 BGD_{it} + \beta_2 BGDSQD_{it} + \beta_3 BOARDSIZE_{it} + \beta_4 BOARDIND_{it} + \beta_5 POWERFULCEO_{it} \\ & + \beta_6 OWN_{it} + \beta_7 \ln SIZE_{it} + \beta_8 \ln LDR_{it} + \beta_9 \ln BANKAGE_{it} + \varepsilon_{it} \end{aligned}$$

for bank i at time t . \ln is the natural logarithm. The dependent variable TE is the technical efficiency score estimated by the DEA. The independent variables are defined as follows:

- BGD: board gender diversity treated as the absolute number of female directors excluding zero. We expect the coefficient of β_1 to be positive. The quadratic term, *BGDSQD*, is to determine the optimal number *BGD* to yield the greatest efficiency.
- BOARDSIZE: total directors constituting the board. Banks have need for greater advisory because they are heavily debt financed; consequentially, large board are beneficial to banks (Coles *et al.*, 2008). Empirically, there are findings suggesting that board size exert positive influence on bank performance (Adams and Mehran, 2012). Board size is used to test board impact over management actions on bank efficiency and it is expected that the coefficient β_3 will be positive.
- BOARDIND: total number of non-executive directors. We expect the coefficient of β_4 to be positive. Nyamongo and Temesgen (2013) report findings which suggest that greater independence on a board leads to a high performing bank.
- POWERFUL CEO: this is a dummy variable representing one if the CEO/MD is not the only executive director on the board and zero if otherwise. We expect the coefficient of β_5 to be negative. We posit that other executive directors on bank's board make the CEO powerful because they are likely to do the bidding of the CEO. This could lead to higher discretionary power and an incentive for opportunistic behavior, which is detrimental for bank efficiency.
- OWN: this is a dummy variable representing one if the majority ownership of a bank is foreign at the financial year end and zero otherwise. We expect the coefficient of β_6 to be positive. Following prior studies, foreign owned banks are generally relatively more efficient (Bokpin, 2013; Andrieş *et al.*, 2018) than domestic owned banks.
- SIZE: the total assets at fiscal year. We expect the coefficient of β_7 to be positive because large banks have scale and scope advantage which leads to efficiency gains. Bokpin (2013) postulates that bank size is a significant predictor of bank efficiency.
- LDR: the loan-to-deposit ratio. This variable is used to test for the impact of banks' intermediation role on their efficiency amidst the rising levels of non-interest income and to serve as early-warning performance signals to help regulators implement remediation programme to curb the risk of bank failure (Ayadi *et al.*, 1998). We expect the coefficient of β_8 to be negative because high level of LDR increases exposure to credit risk which breeds inefficiency in the intermediation function of banks.
- BANKAGE: the number of years since incorporation. The older a bank is, the more experience it has gained over the years and such experience should have a positive impact on efficiency. Therefore, we expect the coefficient of β_9 to be positive. According to Ayadi *et al.* (1998), banks are relatively efficient when they are old.

3.4 *Econometric estimation method*

We make use of Prais-Winsten (PW) regression technique to estimate the parameter β and specify a first-order autocorrelation because of its presence. This estimation method is suited for our analysis because it allows for the correction of serially correlated residuals and heteroskedasticity (Prais and Winsten, 1954). We are also able to ensure that the sampling variability in the estimates of the β is measured correctly (Beck and Katz, 1995). Further, this method is justified because the asymptotic results show the suitability of the PW estimates as the best. Further, we estimate pooled OLS and random effect models to ensure consistency in the estimates.

4 Empirical results and discussions

4.1 Descriptive statistics and correlation matrix

Table I reports summary of the descriptive statistics for variables used in the second stage of the regression analysis. For *BGD*, the sample mean value of approximately 2 shows boards of banks in the sample do not have the critical mass of female directors suggested by Liu *et al.* (2014) for an optimal effect on efficiency. Equally, the average percentage of female (POF) on bank's board is 21.09 per cent which represents 0.415 Blau Index of diversity. The results also reveal that female directors represent a minority on the board of banks in Ghana. On average, board size of banks included in the sample consists of approximately nine directors. This is consistent with best practice of corporate governance for International Financial Institutions (IFIs) that suggests that the 'ideal board size should not be less than seven' (Bukair and Rahman, 2015).

The analysis also reveals that banks have approximately 7 non-executive directors; suggesting a good balance of internal business process expertise and external expertise that could be brought to bear to ensure overall efficiency. However, the minimum value of three gives a cause to worry as it would hinder the monitoring and advisory role of the board. The $\ln(\text{SIZE})$ and $\ln(\text{BANKAGE})$ of banks in the sample is about 14.13 and 2.92 respectively. $\ln(\text{LDR})$ among banks averages -0.54 but varies between -1.85 and 0.39. This means that a greater proportion of deposits taken from surplus units are actually transformed into loans for deficit units.

(Insert Table I here)

Table II reports correlation coefficients. Obviously, we have significant correlation coefficients ($p\text{-value} < 0.05$) among board gender diversity, corporate governance measures and bank characteristics included in our model. The mean variance inflation factor (VIF) is 8.7. There is perfect multicollinearity between *BLAUINDEX* and *BOARDSIZE*. As such, we did not use both measures in the same model. *BGDSQD* is a deterministic non-linear function of *BGD*.

(Insert Table II here)

4.2 First stage results: technical efficiency

The efficiency score for each bank obtained by implementing the output orientation of the primal version of BCC model is given in Table III. The results are interpreted based on Panel A, where technical efficiency score is without board gender diversity as an input variable. The results reveal that the estimated efficiency scores average 0.709 (i.e. 70.9%). The explicit implication is that banks averagely have potential to augment output levels (i.e. customers' loan, interest income and non-interest income) by about 0.291 (29.1%) while maintaining the same level of inputs (i.e. customers' deposit and number of branches) in order to be technically efficient. It can also be observed that out of the 21 banks only 11 are efficient at least once in the observation period (2009 – 2017). From the estimated efficiency scores, it could be said that only one bank has its resource utilization process functioning properly with no piping issue whereas the same cannot be said of the remaining 20 banks over the sample period; suggesting that Ghanaian banks underperformed their intermediation role and are inefficient in the transformation of inputs (i.e. deposits) into output (i.e. loans).

4.3 Effect of board gender diversity on bank efficiency

Apart from analyzing the efficiency scores of each bank included in this study based on input variables such as customers' deposit and number of branches and output variables as interest income, non-interest income and customers' loan, we also model *BGD* as an input variable following arguments of resource dependency theorists. Panel B of Table III has this result. The results show that banks experience about 7.9% (78.8% - 70.9%) improvement in their efficiency with *BGD* on average. Thus based on the resource dependency theory, we argue that gender diversity is a critical resource that board of directors of banks provides to ensure improved efficiency. We recognize that efficiency scores variation are minimal for banks with *BGD* compared to banks without *BGD*. This signifies greater predictability of banks with *BGD* on banks efficiency compared to banks without *BGD*. Potentially, this result will translate into greater predictability of bank efficiency for those banks with gender representation compared to those without.

(Insert Table III here)

Again, in order to identify whether bank efficiency without *BGD* differs significantly from bank efficiency with *BGD*, we employ the Mann-Whitney U-Test. The null hypothesis tests that there is no difference between bank efficiency without *BGD* and efficiency with *BGD*. The result is shown in Table IV. From the table, it can be observed that efficiency score with *BGD* differs significantly from efficiency score without *BGD*. Thus, the null hypothesis under consideration is to be rejected. By implication, banks derive increased efficiency from the presence of female directors on their boards. Therefore, banks should harness this great talent with that of their male counterpart for improved efficiency and bottomline.

(Insert Table IV here)

4.4 *Optimal level of female representation*

From Figure I the optimal number of female directors on boards to achieve the highest level of efficiency for banks in the sample is 2 on average. From Figure I, banks derive maximum benefit from a board with at most 2 female directors. This result contrasts findings of Liu *et al.* (2014). Given the parabolic shape, the first female director promotes bank efficiency by 0.133, and the second female appointed contributes 0.088 $[(0.178 + 2(-0.045)(1))]$. This result is not only statistically significant but also economically significant. For instance, an increase in *BGD* by one (sample) standard deviation would increase bank efficiency by approximately 9.4 per cent $[(0.878) \times 0.133/(1.24)]$.

(Insert Figure I here)

4.5 *Second stage regression results: determinants of bank efficiency*

Table V reports the estimation results where technical efficiency is the dependent variable. The diagnostic tests are reported in Table V show a statistically significant test statistics for heteroskedasticity; as such, we report heteroskedasticity-robust standard errors. The test results also show a statistically significant test statistics for Wooldridge test for autocorrelation which signifies the presence of first order autocorrelation. Therefore, we interpret our findings based on PW-PCSEs, because of criticisms of OLS as being inefficient in the face of panel data because the errors are likely to show 'panel heteroskedasticity and contemporaneous correlation' (Beck, 2001, p.278).

With regard to board gender diversity, the coefficients on *BGD* are statistically significantly positive at 5 per cent from model (1) to (3) in Table V. Overall, the results strongly support hypothesis 1 (H_1) as shown by a positively and statistically significant relation between *BGD* and *lnTE* (0.178), and a negative and significant relation between *BGDSQD* and *lnTE* (-0.045). The significant positive coefficient on *BGD* in the pooled OLS is consistent with Pathan and Faff (2013). The statistically significant positive coefficient on *BGD* in the RE model is consistent with prior studies (e.g. Joecks *et al.*, (2013)). The positive relationship indicates that the higher the number of female directors on the board, the better the efficiency of the bank up to a maximum value of 2 female directors as captured by *BGDSQD*, depicting a parabolic shaped relation between *BGD* and bank efficiency. This result show that banks included in the sample exhibit an increasing return to scale up to a maximum number of 2 female directors; however, banks exhibit a decreasing return to scale when there are more women, i.e. in excess of 2 women on a 9-member board. This is interesting given that women are generally risk averse and men are generally risk takers, the appropriate mix of safe investment from the perspective of female directors, and risky investment from the perspective of male directors, which return maximal value to shareholders, is paramount. This result confirms our argument that *BGD* is a critical resource that promotes high quality decision; an expansion in imagination and development, and superior critical thinking. These attributes of a gender diversified board induce improved efficiency in banks' operation. With 2 female directors as optimum, additional female director would actually lower bank efficiency. An R-squared of 0.302 indicates that about 30.2% variance in efficiency of banks is interpreted by board gender diversity and the seven control variables.

(Insert Table V here)

Regarding other corporate governance variables, the coefficients on *BOARDSIZE* are positive and statistically significant at 5 per cent in all estimation models. Overall, the results strongly support hypothesis 2 (H_2) that, board size is positive and significantly related to bank efficiency. The significant positive coefficient on *BOARDSIZE* in the pooled OLS model is consistent with the findings of Kyereboah-Coleman and Biekpe (2006). The statistically significant positive coefficient on *BOARDSIZE* in RE model is consistent with the findings of Adams and Mehran (2012). The result suggests that board size of banks has a significant positive spillover effect on management actions which leads to improved efficiency.

In respect of *BOARDIND*, the coefficients are negative and statistically significant at 5 per cent in all estimation models. The significant negative coefficient on *BOARDIND* in the pooled OLS model is consistent with prior studies (e.g. Pathan and Faff (2013), Belkhir (2009)). Likewise, the negative significant coefficient on *BOARDIND* in the RE estimation is consistent with Andres and Vallelado (2008). Overall, the result strongly contradicts hypothesis 3 (H_3) that board independence is positively and significantly related to bank efficiency.

The coefficients on *POWERFULCEO* are negative and statistically significant at 1 per cent in PW-PCSE (-0.179) and pooled OLS (-0.212) estimations. In the RE (-0.189) estimation, the negative coefficient is statistically significant at 5 per cent. The significant negative coefficient on *POWERFULCEO* supports the arguments that powerful CEO compromises the independence of the board, which dampens the monitoring power, and thus detrimental for bank efficiency. Another possible explanation is that CEO/MD of banks in the sample are mainly rewarded in fixed salaries and other contract package, as such they have very little motivation to fix any

piping issues with efficiency because it does not necessarily affect their pocket (i.e. fixed salaries) (Pathan, 2009).

On ownership structure, the coefficient on *OWN* is negative and statistically significant in all estimation models. The results suggest that, for the banks in the sample technical efficiency is ownership structure specific. Foreign owned banks are less efficient than local owned ones. This result contradicts our expectation and the findings of prior studies (e. g. Bokpin (2013), Andries *et al.* (2018)). A possible explanation is the relative lack of knowledge of local market dynamics. Thus, the blind implementation of headquarter processes and policies by foreign banks without recourse to local market dynamics may be counterproductive. As such, it is detrimental to efficiency.

lnSIZE has a positive significant relationship with efficiency of banks. This result indicates that, large sized banks are able to take advantage of economies of scale. Similarly, due to the large size of the banks, some of the benefits accruing to the bank are channeled out to customers in the form of relatively lower prices in order to expand output. This finding is consistent with Bokpin (2013).

With respect to *lnBANKAGE*, Mester (1996) posits that age matters in efficiency analysis of banks because of learning by doing. The results reveal that age of a bank (*lnBANKAGE*) negatively and significantly affects their efficiency in PW-PCSEs, RE and the OLS models. This contends the ‘learning by doing effect’ on bank performance.

lnLDR is the final control variable in the proposed model. Contrary to our expectation, the results show that the ratio of loan-to-deposit is positively significant with bank efficiency. The implication of this result is that, high level of intermediation services improve access to and use of financial services. Although, high level of *lnLDR* promotes bank efficiency, care must be taken to ensure that it does not increase exposure to credit risk since they are interdependent. It is also an indication that although banks look to diversify their income stream, this should not be done at the expense of interest income which is the traditional source of banks’ income.

4.6 *Robustness tests: other measures of board gender diversity*

As a test of robustness, the estimation process was repeated using measures of board gender diversity used in prior studies such as percentage of female to board size – *POF* and *BLAUINDEX* – and the results are presented in Table VI. Very consistent results in terms of direction and significance of the variable of interest, and the overall predictive power of the models were found. We find statistically significant coefficients on *POF* and *POFSQD* in pooled OLS and RE estimations. When we proxy gender diversity with *BLAUINDEX*, the result is not consistent with the hypothesis of an inverted U shaped relation between *BGD* and bank efficiency.

(Insert Table VI here)

4.7 *Alternative estimation technique*

The two-stage least squares (TSLS) approach is employed in this study to account for the potential endogeneity of board gender diversity, board size and board independence (Wintoki *et al.*, 2012). For instance, our preliminary analysis found board size to promote board independence as well as gender diversity. This illustration depicts potential endogeneity

problem. A key issue in this estimation method is the difficulty in getting ‘good’ instruments. In this regard, we follow Wintoki *et al.* (2012) and use lag one of *BGD*, *BOARDSIZE* and *BOARDIND* (board characteristics) as instruments for Model (1) in Table VII. For Model (2) in Table VII, we use lag one of *POF*, *BOARDSIZE* and *BOARDIND*. Finally, in Model (3), we use lag one of *BLAUINDEX* and *BOARDIND*. We conduct specification test to ensure validity of instruments and endogeneity of board characteristics. The Wooldridge’s over-identifying restriction test (Wooldridge’s OIR) is employed to assess the validity of the instruments. The null hypothesis is that instruments are valid (see diagnostic results in table VII). For the potential endogeneity of board characteristics, we conduct Wooldridge robust score test for exogeneity and robust regression exogeneity test. The null hypothesis in both tests is that board characteristics are exogenous.

(Insert Table VII here)

Table VII presents TSLS estimates for our sample. The results generally confirm the findings from the PW-PCSEs, RE and OLS models in terms of sign, except in Model (3) where the sign flips on *BLAUINDEX*. A potential explanation is the efficiency-enhancing effect of gender diversity in the banking industry appears to be more complex (Owen and Temesvary, 2018). We find statistically significant coefficients on *BGD* and *BGDSQD* after accounting for the endogeneity of *BOARDSIZE*, *BGD* and *BOARDIND*. This is true with alternative measures of gender diversity (i.e. *POF* and *POFSQD*). The Wooldridge’s robust score test for exogeneity and the robust regression exogeneity test fails to reject the null hypothesis that board characteristics are exogenous. This confirms that our result in Table VI is not susceptible to endogeneity bias. The Wooldridge’s OIR is not available as the model is identified.

5 Summary, conclusion, implications and future research

This paper aims to evaluate bank efficiency under board gender diversity among Ghanaian banks. We follow a two stage approach as proposed by Banker and Natarajan (2008). The novel feature of the efficiency model used is that it incorporates board gender diversity as an additional input variable in line with the proposition of proponent of resource dependency theory.

Our empirical results sharply contrast Ramly *et al.* (2015) and Chan and Heang (2010) findings that board gender diversity impacts bank efficiency negatively. However, it is consistent with the findings by Owen and Temesvary (2018). Consistent with H_1 , we find that gender diversity promotes bank efficiency up to a maximum of 2 female directors on a 9-member board of directors, suggesting a threshold effect on bank efficiency. Our result supports a parabolic relationship between board gender diversity and bank efficiency; and contributes to explain the threshold of mandatory quota regime for female directors on a bank’s board. We demonstrate that for banks included in the sample, the optimal mix of men and women on the board follows approximately 80:20 rule. Consistent with H_2 , board size improves bank efficiency; however, contrary to H_3 , we find support for negative influence of board independence for bank efficiency. Overall, we find that powerful CEO, ownership structure, bank size, bank age and loan-to-deposit ratio are important factors affecting bank efficiency.

Theoretical implications

Theoretically, we extend prior studies especially regarding the inverted U shaped relation between board gender diversity and bank efficiency as well as give support for our resource

dependency theory predictions in the banking industry. As such, we provide an understanding of the implications of gender diversity on banks' boards. We recognize that there is an upper limit to gender composition on banks' board of directors; suggesting a potential trade-off existing between gender diversity on bank board and efficiency.

Further, our results lend support for favourable valuation effect of board size on bank efficiency. This result specifically contests agency theorists' stance on the implication of larger board on bank performance. Our findings emphasize the role of larger boards in the banking industry in view of the high level of complexity associated with banks' operations (Coles *et al.*, 2008). Therefore, the role of board size within the banking industry needs to be examined with the resource dependency theory.

Finally, the inclusion of gender diversity as an input variable in our bank efficiency model presents alternative theoretical paradigm. Thus, banking efficiency models could benefit from the inclusion of non-financial measures; specifically, corporate governance measures and this is grounded in our resource dependency theory predictions.

Practical implications

The findings presented in this paper show how the characteristics of a bank's board significantly influence its efficiency. Our paper contributes to bank governance structure, namely gender composition of boards and provides an insight for regulators and shareholders to estimate the role of men and women. Regulators and shareholders can find motivation on our findings of a positive 'valuation effect' of gender diversity. Thus, gender diversified board should not only be seen as desirable but an economically significant resource that must be attained if the optimal efficiency enhancing effect of gender diversity is to be achieved. Further, our findings regarding the effect of powerful CEOs on efficiency provides an understanding into the performance effect of CEO/MD surrounded by executive directors on bank's board. Overall, the results should guide shareholders in their decision making process about the composition of their corporate boards.

Our results concerning the effect of bank size on efficiency is consistent with prior studies and contributes to a debate on bank regulation, namely mergers and acquisitions. Indeed, our results show that, large sized banks over perform small sized banks on technical efficiency. Regulators can be motivated by our finding to implement reforms that encourage larger banks. One of such reforms should look at mergers and acquisitions.

Further, our findings regarding the effect of bank age on efficiency is not consistent with Mester (1998) and contends 'learning by doing effect' on bank performance. Although, we agree that experience comes with age, shareholders should keep bank manager on their toes to avert any dysfunctional behavior. Finally, our findings on the effect of loan-to-deposit ratio on bank efficiency reveal that depth of bank intermediation function improves efficiency; however, care must be taken to curb its negative repercussions should it get out of control.

Limitations and future research

Our methodology of including board gender diversity in our efficiency model means that we exclude all those bank-year observations with no female representation on their board. As such, our paper is limited to 21 banks; and despite the justification given earlier, the results of the study have to be applied cautiously. Although, our robustness test using TSLS show that endogeneity (reverse causality and simultaneity) is less of a concern in our paper, we recognize

that dynamic endogeneity is generally a concern in corporate governance literature thus, may limit our conclusions. Future research should look at a larger dataset and adopt econometric methodologies that account for dynamic endogeneity.

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Figure I: Optimal level of female board representation

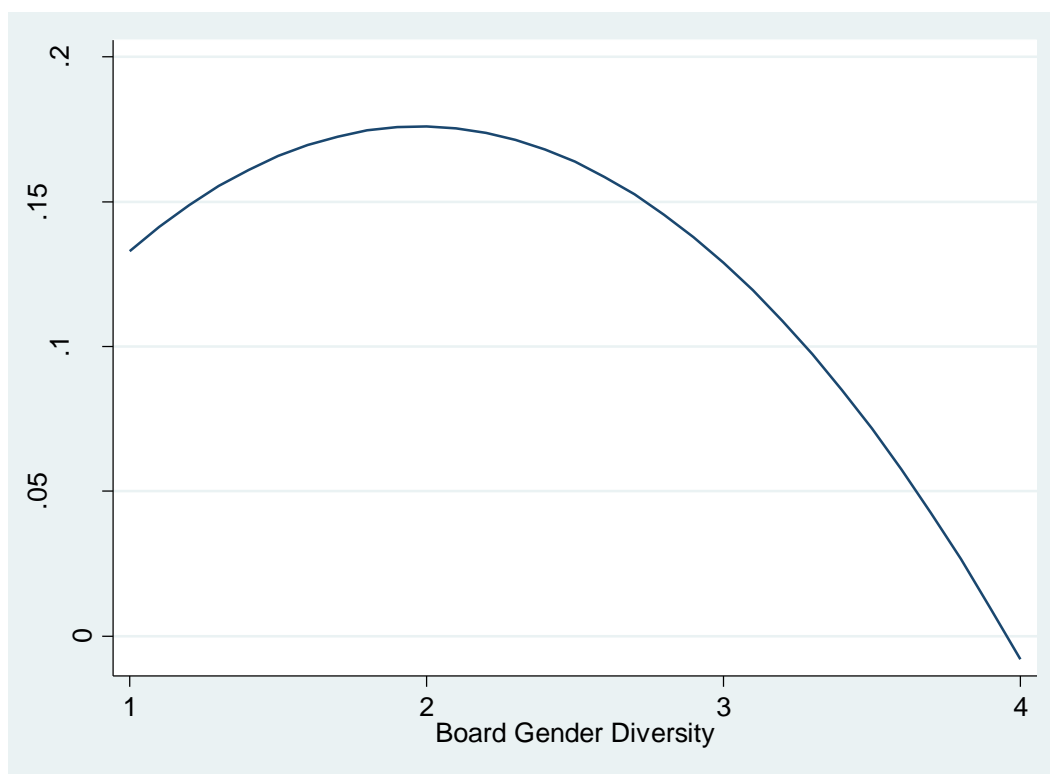


Table I: Descriptive statistics for efficiency determinants

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
<i>lnTE</i>	148	-0.377	0.261	-1.115	0.000
BGD	148	1.845	0.878	1.000	4.000
POF	148	21.09	11.15	9.091	66.67
BLAUINDEX	148	0.415	0.224	-0.090	0.870
BOARDSIZE	148	9.014	1.534	5.000	13.00
BOARDIND	148	6.453	1.643	3.000	10.00
POWERFULCEO	148	0.784	0.413	0.000	1.000
OWN	148	0.574	0.496	0.000	1.000
<i>lnSIZE</i>	148	14.13	0.869	12.18	16.07
<i>lnBANKAGE</i>	148	2.919	0.990	0.000	4.796
<i>lnLDR</i>	148	-0.542	0.428	-1.850	0.387

	<i>lnTE</i>	BGD	POF	BLAUIINDEX	BOARDSIZE	BOARDIND	POWERFULCEO	OWN	<i>lnSIZE</i>	<i>lnBANKAGE</i>	<i>lnLDR</i>
<i>lnTE</i>	1.0000										
BGD	-0.0451 (0.5866)	1.0000									
POF	-0.0432 (0.6019)	0.9041 (0.0000)	1.0000								
BLAUIINDEX	0.0211 (0.7988)	0.3049 (0.0002)	0.6021 (0.0000)	1.0000							
BOARDSIZE	-0.0293 (0.7234)	0.0520 (0.5298)	-0.3334 (0.0000)	-0.9183 (0.0000)	1.0000						
BOARDIND	0.0481 (0.5617)	0.0114 (0.8909)	-0.2607 (0.0014)	-0.6368 (0.0000)	0.6832 (0.0000)	1.0000					
POWERFULCEO	-0.1937 (0.0183)	0.0380 (0.6465)	-0.0187 (0.8211)	-0.2222 (0.0066)	0.2301 (0.0049)	-0.2758 (0.0007)	1.0000				
OWN	-0.1623 (0.0487)	-0.0279 (0.7360)	-0.0270 (0.7447)	-0.0369 (0.6561)	0.0255 (0.7585)	-0.1876 (0.0224)	-0.0538 (0.5158)	1.0000			
<i>lnTA</i>	0.2979 (0.0002)	0.0516 (0.5336)	0.0138 (0.8675)	-0.1161 (0.1601)	0.1349 (0.1020)	0.0520 (0.5299)	0.1459 (0.0768)	-0.0472 (0.5689)	1.0000		
<i>lnBANKAGE</i>	0.0996 (0.2284)	0.1140 (0.1676)	0.0504 (0.5429)	0.0556 (0.5019)	0.0313 (0.7058)	0.0828 (0.3170)	0.0029 (0.9717)	-0.0267 (0.7470)	-0.4685 (0.0000)	1.0000	
<i>lnLDR</i>	0.2689 (0.0010)	0.0709 (0.3915)	0.0936 (0.2578)	0.2108 (0.0101)	-0.1722 (0.0364)	-0.0146 (0.8606)	-0.1125 (0.1734)	-0.1785 (0.0300)	-0.2442 (0.0028)	0.0989 (0.2315)	1.0000

Note: Figures in parentheses represent *p*-values

Table III: Technical efficiency score of banks in Ghana

Banks	Obs.	Mean	Std. Dev	Min	Max
<i>Panel A: Technical efficiency score without board gender diversity</i>					
ADB Bank	9	0.743	0.066	0.610	0.835
Access Bank	8	0.692	0.138	0.566	1.000
Bank of Africa	8	0.634	0.203	0.392	1.000
Bank of Baroda	4	0.989	0.023	0.954	1.000
Cal Bank	9	0.863	0.154	0.596	1.000
Ecobank Ghana	9	0.751	0.241	0.402	1.000
First Atlantic Bank	4	0.528	0.069	0.460	0.619
Fidelity Bank	9	0.619	0.204	0.328	0.884
GCB Bank	9	0.817	0.183	0.474	1.000
Guaranty Trust Bank	9	0.564	0.061	0.438	0.615
HFC Bank	9	0.784	0.128	0.572	1.000
National Investment Bank	5	0.642	0.134	0.519	0.855
Premium Bank	2	1.000	0.000	1.000	1.000
Prudential Bank	9	0.618	0.089	0.487	0.779
Royal Bank	4	0.930	0.098	0.793	1.000
Standard Chartered Bank	9	0.762	0.209	0.452	1.000
Soceite Generale	9	0.616	0.081	0.490	0.700
United Bank of Africa	4	0.701	0.203	0.517	0.981
Universal Merchant Bank	3	0.677	0.114	0.579	0.802
UniBank	7	0.703	0.151	0.564	1.000
Zenith Bank	9	0.598	0.158	0.422	0.820
<i>Total</i>	<i>148</i>	<i>0.709</i>	<i>0.180</i>	<i>0.328</i>	<i>1.00</i>
<i>Panel B: Technical efficiency score with Board Gender Diversity</i>					
ADB Bank	9	0.831	0.121	0.684	1.000
Access Bank	8	0.720	0.141	0.566	1.000
Bank of Africa	8	0.636	0.201	0.393	1.000
Bank of Baroda	4	1.000	0.000	1.000	1.000
Cal Bank	9	0.918	0.122	0.684	1.000
Ecobank Ghana	9	0.901	0.159	0.536	1.000
First Atlantic Bank	4	0.663	0.144	0.497	0.842
Fidelity Bank	9	0.703	0.213	0.447	1.000
GCB Bank	9	0.845	0.183	0.501	1.000
Guaranty Trust Bank	9	0.698	0.211	0.438	1.000
HFC Bank	9	0.909	0.134	0.675	1.000
National Investment Bank	5	0.655	0.130	0.531	0.856

Premium Bank	2	1.000	0.000	1.000	1.000
Prudential Bank	9	0.688	0.116	0.579	0.964
Royal Bank	4	0.968	0.038	0.928	1.000
Standard Chartered Bank	9	0.781	0.200	0.490	1.000
Soceite Generale	9	0.805	0.180	0.535	1.000
United Bank of Africa	4	0.770	0.176	0.561	0.986
Universal Merchant Bank	3	0.691	0.098	0.619	0.802
UniBank	7	0.802	0.202	0.564	1.000
Zenith Bank	9	0.731	0.255	0.422	1.000
<i>Total</i>	<i>148</i>	<i>0.788</i>	<i>0.188</i>	<i>0.393</i>	<i>1.00</i>

Table IV: Results of Mann-Whitney U-Test

<i>z</i> :	9.159	<i>p</i> -value:	0.0000	Inference: <i>reject H₀</i>
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Table V: Gender diversified board, corporate governance and bank efficiency – PW-PCSEs, Pooled OLS, and Random Effects (RE)

Dependent variable: <i>ln</i> (TE)		Pred. Sign	Model (1) PW-PCSE	Model (2) OLS	Model (3) RE
<i>Board Gender Diversity</i>					
β_1	BGD	+	0.178** (0.093)	0.281** (0.108)	0.224** (0.108)
β_2	BGDSQD	-	-0.045** (0.021)	-0.073*** (0.025)	-0.054** (0.024)
<i>Corporate Governance Measures</i>					
β_3	BOARDSIZE	+	0.027** (0.022)	0.031** (0.025)	0.045** (0.029)
β_4	BOARDIND	+	-0.027** (0.021)	-0.032** (0.024)	-0.044** (0.025)
β_5	POWERFUL CEO	-	-0.179*** (0.051)	-0.212*** (0.069)	-0.189** (0.090)
β_6	OWN (FOREIGN =1)	+	-0.084** (0.042)	-0.087** (0.045)	-0.092** (0.079)
<i>Bank Characteristics</i>					
β_7	<i>ln</i> SIZE	+	0.144*** (0.032)	0.152*** (0.027)	0.172*** (0.045)
β_8	<i>ln</i> LDR	-	0.212*** (0.044)	0.240*** (0.057)	0.214*** (0.078)
β_9	<i>ln</i> BANKAGE	+	-0.064** (0.026)	-0.051** (0.022)	-0.093*** (0.033)
	Constant		-2.114*** (0.428)	-2.327*** (0.405)	-2.514*** (0.662)
<i>Diagnostic tests</i>					
	Observations		148	148	148
	Wald Chi2(8)/(9)		54.02***	n/a	43.04***
	F statistics(9,138)		n/a	11.63***	n/a
	R-squared		0.302	0.342	0.365
	Adj. R-squared		n/a	0.299	n/a
	R-squared (between)		n/a	n/a	0.210
	R-squared (overall)		n/a	n/a	0.300
	Number of banks		21	-	21
<i>Wooldridge test for autocorrelation in panel data</i>					
	F statistics (1, 19)/p-value		10.186 (0.0048)		
<i>Breusch-Pagan / Cook-Weisberg test for heteroscedasticity</i>					
	Chi2(1)/p-value		7.30 (0.0069)		

Notes: Values in parenthesis under PW-PCSEs are panel corrected standard errors; under OLS and RE are robust standard errors. Dependent variable: natural log of technical efficiency score $\ln\text{TE}$ computed using DEA. BGD = number of female directors on board; BOARDSIZE= total number of members on board; BOARDIND = number of non-executive directors on board; POWERFUL CEO= dummy variable representing 1 if the CEO/MD is not the only executive director on the board and 0 otherwise; OWN= dummy variable representing 1 if the majority ownership of a bank is foreign at the financial year end and 0 otherwise. $\ln\text{SIZE}$ = natural log of total assets; $\ln\text{BANKAGE}$ = natural log of number of years since incorporation; $\ln\text{LDR}$ = loan-to-deposit ratio. ***, **, and * indicate significance at 1%, 5% and 10% respectively

Table VI: Robustness test using other measures of board gender diversity – Percentage of female directors (POF) and Blau Index

	Pred. Sign	Model (1) PW-PCSE	Model (2) OLS	Model (3) RE	Model (4) PW-PCSE	Model (5) OLS	Model (6) RE
<i><u>Board Gender Diversity</u></i>							
POF	+	0.0031 (0.0067)	0.0112** (0.0053)	0.0073** (0.0044)	.	.	.
POFSQD	-	-0.0001 (0.0001)	-0.0002*** (0.0001)	-0.0001** (0.0001)	.	.	.
BLAUINDEX	+	.	.	.	-0.134 (0.252)	-0.393** (0.300)	-0.200 (0.324)
BLAUINDEXSQD	-	.	.	.	-0.035 (0.279)	0.190 (0.395)	-0.009 (0.432)
<i><u>Corporate Governance Measures</u></i>							
BOARDSIZE	+	0.0218** (0.0232)	0.0202** (0.0251)	0.0405** (0.0285)	.	.	.
BOARDIND	+	-0.0283** (0.0209)	-0.0312** (0.0245)	-0.0450** (0.0248)	-0.024** (0.017)	-0.033** (0.021)	-0.031** (0.023)
POWERFUL CEO	-	-0.1669*** (0.0563)	-0.1954*** (0.0690)	-0.1745** (0.0879)	-0.160*** (0.052)	-0.211*** (0.063)	-0.130** (0.077)
OWN (FOREIGN =1)	+	-0.0773** (0.0436)	-0.0810** (0.0456)	-0.0872** (0.0801)	-0.073** (0.047)	-0.076** (0.044)	-0.075** (0.078)
<i><u>Bank Characteristics</u></i>							
<i>ln</i> SIZE	+	0.1435*** (0.0319)	0.1579*** (0.0270)	0.1732*** (0.0458)	0.139*** (0.033)	0.144*** (0.028)	0.179*** (0.048)
<i>ln</i> LDR	-	0.2076*** (0.0432)	0.2277*** (0.0576)	0.2121*** (0.0771)	0.205*** (0.043)	0.232*** (0.062)	0.212*** (0.080)
<i>ln</i> BANKAGE	+	-0.0611** (0.0263)	-0.0562** (0.0229)	-0.0923*** (0.0348)	-0.056** (0.028)	-0.035** (0.024)	-0.099** (0.040)
Constant		-1.9601*** (0.4275)	-2.1956*** (0.4129)	-2.3829*** (0.6658)	-1.662*** (0.479)	-1.636*** (0.507)	-2.063*** (0.753)
Observations		148	148	148	148	148	148
Wald Chi2(9)/(6)/(12)		70.74***	n/a	33.49***	52.54***	n/a	46.71***
F statistics(9,138)/(8,139)		n/a	7.53***	n/a	n/a	7.70***	n/a
R-squared		0.2882	0.3292	0.3534	0.283	0.307	0.344
Adj. R-squared		n/a	0.2855	n/a	n/a	0.267	n/a
R-squared (between)		n/a	n/a	0.1983	n/a	n/a	0.161
R-squared (overall)		n/a	n/a	0.2887	n/a	n/a	0.247
Number of banks		21	-	21	21	-	21

Notes: Values in parenthesis under PW-PCSEs are panel corrected standard errors; under OLS and RE are robust standard errors. Dependent variable: natural log of technical efficiency score *ln*TE computed using DEA. BGD = number of female directors on board; BOARDSIZE= total number of members on board; BOARDIND = number of non-executive directors on board; POWERFUL CEO= dummy variable representing 1 if the CEO/MD is not the only executive director on the board and 0 otherwise; OWN= dummy variable representing 1 if the majority ownership of a bank is foreign at the financial year end and 0 otherwise. *ln*SIZE= natural log of total assets; *ln*BANKAGE = natural log of number of years since incorporation; *ln*LDR = loan-to-deposit ratio. ***, **, and * indicate significance at 1%, 5% and 10% respectively

Table VII: Robustness test of TSLS regression of board gender diversity and bank efficiency

	Pred. Sign	Model (1)	Model (2)	Model(3)
<u>Board Gender Diversity</u>				
BGD	+	0.2896*** (0.1051)	.	.
BGDSQD	-	-0.0743*** (0.0242)	.	.
POF	+	.	0.0122** (0.0061)	.
POFSQD	-	.	-0.0003** (0.0001)	.
BLAUIINDEX	+	.	.	-0.5518** (0.3470)
BLAUIINDEXSQD	-	.	.	0.6156** (0.3744)
<u>Corporate Governance Measures</u>				
BOARDSIZE	+	-0.0421** (0.0512)	-0.0547** (0.0552)	.
BOARDIND	+	0.0334** (0.0447)	0.0381** (0.0463)	-0.0047 (0.0469)
POWERFUL CEO	-	-0.0137 (0.1034)	0.0088 (0.1074)	-0.0569 (0.0922)
OWN (FOREIGN =1)	+	-0.0033 (0.0586)	0.0006 (0.0595)	-0.0361 (0.0553)
<u>Bank Characteristics</u>				
lnSIZE	+	0.1988*** (0.0245)	0.2096*** (0.0249)	0.1053*** (0.0374)
lnLDR	-	0.3169*** (0.0591)	0.3029*** (0.0591)	0.3240*** (0.0654)
lnBANKAGE	+	-0.0228** (0.0267)	-0.0327** (0.0285)	0.0248** (0.0282)
Constant		-3.0159*** (0.4042)	-2.9631*** (0.4190)	-1.4231** (0.7778)
<u>Diagnostic tests</u>				
Observations		127	127	127
R-squared		0.4537	0.4383	0.5354
Adj. R-squared		0.4117	0.3951	0.4727
F-statistics (9/117)		22.16***	15.94***	12.71***
Robust score Chi ² p-value		0.5851	0.6389	0.961
Robust regression F stats p-value		0.5818	0.6298	0.964
Wooldridge OIR Chi ² p-value		n/a	n/a	n/a

Note: Robust standard errors in parentheses. Dependent variable: natural log of technical efficiency score *lnTE* computed using DEA. BGD = number of female directors on board; BOARDSIZE= total number of members on board; BOARDIND = number of non-executive directors on board; POWERFUL CEO= dummy variable representing 1 if the CEO/MD is not the only executive director on the board and 0 otherwise; OWN= dummy variable representing 1 if the majority ownership of a bank is foreign at the financial year end and 0 otherwise. *lnSIZE*= natural log of total assets; *lnBANKAGE* = natural log of number of years since incorporation; *lnLDR* = loan-to-deposit ratio. The diagnostic test reported include: (1) number of observations, (2) R squared test of model explanatory power, (3) Adjusted R-squared, (4) F-statistics for joint significance of coefficients, (5) Wooldridge's robust score test for exogeneity of which the null hypothesis is that Board Characteristics are exogenous, (6) Robust regression exogeneity test of which the null hypothesis is that Board Characteristics are exogenous, (7) Wooldridge's overidentifying restrictions test of which the null hypothesis is that the instruments are valid. . ***, **, and * indicate significance at 1%, 5% and 10% respectively.