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Board gender diversity and firm performance: The UK evidence

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Abstract
This article examines the relationship between gender diversity, selected female attributes, and financial performance of FTSE 100 firms in the UK. Drawing on critical mass theory by measuring gender diversity as levels of female representation in the boardroom, this study finds a positive and significant relationship between gender diversity and firm performance. However, the results become highly significant and unequivocal when three or more females are appointed to the board compared to the appointment of two or less females. Further analysis reveals that post-appointment financial performance is positively related to female age, level of education and where female board members also hold executive director positions. The results remain unchanged after accounting for endogeneity concerns and employing alternative measures of firm performance, namely, return on assets and Tobin's Q.

KEYWORDS
corporate governance, director attributes, female directors, firm performance, gender diversity

1 | INTRODUCTION

Over the past decade, there has been a renewed interest on the effects of women representation on corporate boards (Carter, D'Souza, Simkins, & Simpson, 2010; Hillman, Shropshire, & Cannella Jr, 2007; Joecks, Pull, & Vetter, 2013; Liu, Wei, & Xie, 2014; Perryman, Fernando, & Tripathy, 2016; Rose, 2007). These studies document that women are significantly under-represented in the boardroom. Yet it is argued that beyond social and ethical considerations, female boardroom representation may facilitate access to a wider pool of human capital with important implications for a firm's competition and performance (Dezsö & Ross, 2012; Doldor, Vinnicombe, Gaughan, & Sealy, 2012). It is therefore not surprising that firms have come under intense pressure to improve gender diversity on corporate boards, particularly, after corporate governance scandals at Enron and WorldCom in the United States, the fraudulent bankruptcy of Parmalat in Italy and more recently the global financial crisis in 2007–2009. Indeed, the question on the lips of many people including policy makers and academics such as CEO of Newton Investments, Chief Operating Officer, British Broadcasting Corporation (BBC) and a leading historian is: Would things have been different if corporate boards had more women at the helm of affairs in these companies?

At the country level, governments have responded to women's under-representation on corporate boards by reforming board composition to increase female
representation in the boardrooms. These reforms include: the 2002 Sarbanes-Oxley Act in the United States; the 2003 Higgs Review along with regularly updated versions of the UK Combined Corporate Governance Code and Lord Davis Report in the UK in 2011. In 2017, the UK government published the Hampton Alexander report which recommends FTSE100 companies to have 33% females in FTSE100 leadership teams by 2020. To increase female representation at board level, other countries including Germany, Norway, Spain, France, Iceland, Italy, Belgium, Finland, and Kenya have introduced a legislative quota requiring firms to appoint between 30 and 40% of women into corporate boards. Research evidence indicates that the gender quota has led to a large number of inexperienced women being appointed to the boards, thereby damaging firm financial performance (Ahern & Dittmar, 2012; Matsa & Miller, 2013; Wang & Kelan, 2013).

In contrast, however, the UK has adopted a voluntary approach as against the quota-based approach. The rationale behind the voluntary approach is to allow a fundamental change in culture of the board internally and by organisations themselves rather than imposing the change from outside which may result in just increasing the number of females in the boardroom. Despite the voluntary approach in the UK, the proportion of women on corporate boards is on the rise. Our analysis of female representation of FTSE 100 firms in Figure 1 indicates that the female representation which stood at 14% in 2005 has increased steadily to 27%—the highest in the past 10 years before falling to 25% in 2016. The above suggests that over the past 10 years, there has been a shift toward the inclusion of women in UK boardrooms.

This raises an important question of whether women directors improve firm performance of which past empirical efforts have produced mixed results (Adams & Ferreira, 2009; Campbell & Minguez-Vera, 2008; Carter et al., 2010; Darmadi, 2013; Liu et al., 2014; Martin-Ugedo & Minguez-Vera, 2014; Rose, 2007; Wellalage & Stuart, 2013). However, it may be conjectured that the adoption of voluntary approach to female board representation may lead to appointment of experienced females rather than merely filling gaps to meet the requirements of legislative quota with positive implications for board strategic control, effectiveness, and firm value. In addition, most of the past empirical studies have employed two main measures of gender diversity: percentage of female directors in the board and a gender dummy. However, the mere representation of females in the boardroom may not lead to improvements in firm performance. This argument is consistent with the critical mass theory which suggests that unless there are two or more women in the boardroom, female representation is unlikely to motivate significant improvement in performance (Konrad, Kramer, & Erkut, 2008; Kramer, Konrad, Erkut, & Hooper, 2006; Kristie, 2011; Liu et al., 2014). Kristie (2011) points out aptly that ‘one is a token, two is a presence and three is a voice’ in the context of gender diversity in the boardroom. Apart from Liu et al. (2014) and Joecks et al. (2013), past studies have not examined systematically the levels of female representation in relation to critical mass theory. Hence, perhaps the mixed results from the extant literature should come as no surprise.

The 2017 Female FTSE Board Report reveals that 28 companies in the FTSE 100 constituent list had 33% female directors. Against this backdrop and in the context of the recent Hampton Alexander report, in this study we examine whether firm performance may be explained by levels of female representation in the boardroom. More specifically, this study addresses two distinct issues. First, is to examine the impact of gender diversity on firm performance by employing a two-step system GMM to address the endogeneity issue that can affect the board structure-firm performance relationship (Adams & Ferreira, 2009; Wintoki, Linck, & Netter, 2012). Second, is to explore whether the specific attributes of a female namely, the level of education, female age, multiple directorship, prestige, and the executive position held by the female director affect the post-appointment firm performance.

Our results suggest that firm performance is positively related to gender diversity after controlling for firm characteristics and other factors that have been identified to affect firm performance. Regarding the levels of female board representation, we document an unequivocal positive and significant relationship between gender diversity and firm performance when three or more female directors are appointed to the board compared to lower levels of female board representation. The results are invariant.

**Figure 1** Average percentage of female directors in FTSE100 boards [Colour figure can be viewed at wileyonlinelibrary.com]
to alternative measures of financial performance and across different estimation approaches. Further analysis shows that post-appointment firm performance is positively significant with female age, higher level of education and where female board members also hold executive positions. However, the coefficients of females with multiple directorship and prominence are not statistically significant, implying that multiple directorship experience and prominence measured by the possession of titles such as dames and honorary doctorate do not have a significant bearing on firm performance.

This article makes three primary contributions to the literature. First, we provide insights into the levels at which female representation affects the financial performance of a firm. The fact that appointment of three or more female directors’ impacts on firm performance suggests the effectiveness and the extent to which female board representation affect a firm’s financial performance are predicated on the number of females appointed to the board. Therefore, policy makers should note that, for women on board to achieve the desired effect, a minimum of three or more should be appointed. This finding renders some support to critical mass theory. Second, we explore the ways such as female executive directors, age, education multiple directorship, and prestige may affect firm performance measured by ROA and Tobin’s Q. In particular, we examine the change in ROA and Tobin’s Q, 1 year after female board appointment with respect to change in ROA and Tobin’s Q, 1 year prior to the appointment. As far as we are aware, none of the past empirical literatures has examined the impact of female directors’ attributes on post-appointment firm performance. We consider this as a serious omission given the importance attached to board gender diversity and firm performance. The results of our study demonstrate that post-appointment firm performance of female board representation can be explained by a number of female attributes, namely, age, education, and the executive position held in the firm. Thirdly, and to the best of our knowledge this study is one of the first attempts to examine board gender diversity and firm performance in the UK. Given that the UK has adopted a voluntary approach unlike other European counterparts and the inconclusive results of past empirical efforts, it is timely to examine board gender diversity and firm performance, particularly, in the light of the Lord Davies’ report (Davies, 2011) and the Hampton Alexander report (2017). Contrary to the findings that female representation damages value of firms based in countries with gender quota for corporate board (see Ahern & Dittmar, 2012; Matsa & Miller, 2013; Wang & Kelan, 2013), our results unequivocally indicate that two or more female appointment to the board increases firm performance.

The rest of the article is structured as follows. In Section 2 we present the theoretical and empirical literature. In Section 3 we present our data and methodology. Section 4 presents our main results and Section 5 provides the study’s conclusions.

2 | LITERATURE REVIEW

2.1 | Theoretical perspectives of gender diversity and firm performance

Extant literatures have identified five theories to illustrate the relationship between board gender diversity and firm performance: the resource dependency theory, human capital theory, agency theory, social psychological theory, and critical mass theory.

The resource dependency theory suggests that firms seek to attract and employ board members that best complement their existing resource profile and who can bring new forms of human and social capital to the company (Pfeffer & Salancik, 1978; Siciliano, 1996). In addition, this theory also suggests that growth in board size and board diversity can create strong linkage between firms and its external environment (Goodstein, Gautam, & Boeker, 1994; Pfeffer, 1973). Theorists contend that board diversity helps sustain important resources like human capital of board members; advice and counsel; channels of communication and legitimacy (Hillman & Dalziel, 2003; Pfeffer & Salancik, 2003). Therefore, a firm should look to constitute a board which has individuals with a broad scope of knowledge across relevant demographics and can add legitimacy and prestige to the organisation (Sealy, 2010). In the UK context, Singh, Terjesen, and Vinnicombe (2008) found that almost a quarter of women appointed to FTSE100 companies between 2001 and 2004 had previous FTSE experience, and held concurrent directorship, with about half having experience in financial institutions compared with their male counterparts coming from an engineering background. They further documented that a third of women board appointments have previously occupied senior positions in the public sector with almost a quarter having leadership experience in the voluntary sector.

Becker (1964) propagated the human capital theory that refers to an individual’s education, skills, and experience in contributing to productive capabilities that augment the individual and his/her organization. Kesner (1988) reported that directors bring unique and extensive stocks of human capital to the board. Oakley (2000) argued that male gatekeepers sometimes prevent women from organizational rewards like training and development or promotion and pay. In similar vein,
a common conjecture is that women lack sufficient human capital for board positions (Davidson & Burke, 2000). Smith, Smith, and Verner (2006) and Singh et al. (2008) on the other hand reported that positive performance effect is linked to female managers with university degree while the latter study showed that women are more likely to have a MBA degree and international understanding, in their study of multiple human capital dimensions of FTSE100 firms. Davies (2011) identified that in Europe and USA women account for 60% of University graduates. In the UK context, women account for 55% university graduates and 42% of the total workforce. Given these figures, it is reasonable to hypothesize that women in FTSE100 boards will enhance human capital and increase firm performance.

Agency theory deals with conflicts of interest between principals (e.g., shareholders) and agents (e.g., managers) and how the corporate board plays an important function in monitoring and resolving these conflicts (Fama & Jensen, 1983; Jensen & Meckling, 1976). The agency view of the board is that diversity reinforces the monitoring role. For instance, Carter, Simkins, and Simpson (2003), Adams and Ferreira (2009), and Adams, Nowland, and Grey (2011) drew on agency theory to explore the link between gender diversity on a board and firm value and found a positive relationship between gender diversity and firm performance. Adams and Ferreira (2009) and Adams et al. (2011) found that female directors have better monitoring ability as they think independently and board gender diversity also increases managerial accountability, such as improving board meeting attendance and CEO accountability. By improving board monitoring, female directors also perform the role of independent directors (Adams & Ferreira, 2009). In similar lines, Jurkus, Park, and Woodard (2011) reported that gender diversity reduces agency costs for firms in less competitive markets where strong external governance is absent.

In the context of social psychological theory, Mattis (2000) opined that U.S. boards give preference to ‘branded women’ directors who are from Ivy League universities thereby indicating upper class status. Sealy, Singh, and Vinnicombe (2007) documented that in the 1980s and 1990s, UK female directors were more likely to have a title (e.g., Dr. Professor, Dame, Baroness) than male directors. Westphal and Milton (2000) reported that the majority group in a board might exert significant influence in the decision-making process and even in diverse boards, minority groups may not influence the board due to group dynamics. Campbell and Minguez-Vera (2008), Lau and Murnighan (1998), and Williams and O’Reilly (1998) argued that gender diversity might lead to conflicting views in the board and lengthen the timescale of taking decisions. On the other hand, Kim, Burns, and Prescott (2009) reported that board diversity increases the extent and swiftness of top management teams’ strategic action skills. In comparison to large public limited companies, family-controlled firms are more likely to have a greater fraction of female members on management boards indicating that the former are ‘tougher’ in providing opportunities for women to join the board (Darmadi, 2013). However, it is important to point out that the greater fraction of female on management boards may be due to the need to preserve control over family firms.

Kanter (1977a, 1977b) recognizes the dearth of women and minority groups in corporate boards as ‘tokens’ and in some cases ‘solos’ where there is a sole representation. The majority group views female managers first through sex-role stereotypes thereby making it difficult for women managers to be heard on an equal footing with other board members. The pay gap between male and female executive directors is sustained by gender-role stereotypes (Kulich, Ryan, & Haslam, 2007). The token theory lends support to the stereotype that women do not have the essential skills to be in corporate boards (Lee & James, 2007). Against this backdrop, Kanter (1977a, 1977b) presented the critical mass theory which states that the presence of two or more women in the boardroom will dampen the effects of tokenism where women are more likely to be individually differentiated. Subsequent studies in sociology and organizational behaviour literature that examine critical mass like Konrad and Kramer (2006) and Konrad et al. (2008), suggest that dynamism in the boardroom is enhanced in the presence of three or more women. These studies argue that the presence of three women normalizes women’s presence in the boardroom beyond tokenism, and positively impact on corporate decisions. Torchia, Calabrò, and Huse (2011) showed that critical mass of three or more women in the boardroom increases the level of firm innovation mediated by board strategic tasks. Joecks et al. (2013) extended the critical mass theory to examine board gender diversity and firm performance and their results confirmed that the presence of 30% or more females in the boardroom leads to improvement in firm performance as measured by return on equity (ROE). In similar vein, Liu et al. (2014) found that critical mass of three or more women exert a stronger impact on firm performance compared to firms with two or more women on board. Konrad and Kramer (2006), Konrad et al. (2008), Torchia et al. (2011), Joecks et al. (2013), and Liu et al. (2014), all reported three as the ‘magic’ number that significantly changes the dynamics of female representation in the boardroom.
2.2 | Hypothesis development

2.2.1 | Number of females on board and firm performance

Most of the empirical studies on gender diversity and firm performance have used three measures of diversity, namely, percentage of female directors, gender dummy, and Blau-Index. Empirical evidences on gender diversity and firm performance obtained from both developed markets and emerging markets have remained inconclusive. For instance, Carter et al. (2003), Campbell and Minguez-Vera (2008), Martin-Ugedo and Minguez-Vera (2014), Ngyuen, Locke, and Reddy (2015) found a positive relationship between gender diversity and firm performance, usually measured by one of the following measures: return on assets (ROA), Tobin's Q, return on sales (ROS), and ROE. Terjesen, Sealy, and Singh (2009) documented that gender diversity on corporate boards leads to efficient corporate governance. In a similar vein, Adams and Ferreira (2009), Gul, Srinidhi, and Ng (2011), and Nguyen et al. (2015) reported that gender diversity can provide increased monitoring and act as an additional governance mechanism that would benefit firms characterized by weak governance. Perryman et al. (2016) and Khan and Vieito (2013) found that gender diversity reduces the risk level of a firm. Nielsen and Huse (2010) found a positive relationship between ratio of women directors and board strategic control.

On the other hand, Adams and Ferreira (2009) reported that enforcing gender quotas could decrease shareholder value in firms with strong governance as it might lead to over-monitoring in those firms. Wellalage and Locke (2013) reported that gender diversity leads to reduction in firms' performance and increases agency costs. Shrader, Blackburn, and Iles (1997), Farrell and Hersch (2005), Rose (2007), Carter et al. (2010), and Dale-Olsen, Schone, and Verner (2013) found no significant relationship between gender diversity and firm performance.

We utilize the critical mass theory (Kanter, 1977a, 1977b) to examine whether levels of female boardroom representation have an impact on firm performance in the context of FTSE100 firms particularly in the light of Lord Davies' report. Following Liu et al. (2014) and Joecks et al. (2013), we take three dummy variables to measure the levels of female representation. Diversity 1 is a dummy that takes a value of 1 if there is one female director in the board. Diversity 2 is a dummy that takes a value of 1 if there are two female directors in the board, and Diversity 3 is a dummy variable that takes a value of 1 if there are three or more female directors in the board. Based on the preceding discussion on the critical mass theory, we argue that a critical mass of three or more female directors will lead to a positive and significant increase in firm performance.

**H1** Representation of three or more female directors will lead to an increase in firm performance. In other words, the coefficient of Diversity 3 will be significantly higher than Diversity 2 and Diversity 1.

2.2.2 | Executive directorship and firm performance

Agency and resource dependency theory have established that non-executive directors can assist in advancing two key functions of control and providing resources. From an agency theory standpoint, independent directors tend to better monitor managers as they give high importance to their status in the directorship arena (Fama & Jensen, 1983). Zara and Pearce (1989) suggested that non-executive directors can expand firms' ties with the external environment thereby offering more legitimacy. However, empirical literature has produced mixed results on the relation between executive directors and firm performance. Independent directors lower the cost of debt financing (Anderson, Mansi, & Reeb, 2004), increase a firm's credit rating (Ashbaugh-Skaife, Collins, & LaFond, 2006) or decrease its idiosyncratic risk, systematic risk and cost of equity (Ashbaugh-Skaife & LaFond, 2006). On the other hand, Smith et al. (2006) contend that women executive directors would spend substantial time to enhance firm's performance in terms of profitability. In a similar vein, Liu et al. (2014) reported that the effect of gender diversity is more pronounced on firm performance when there are female executive directors. However, Ismail and Manaf (2016) did not find any significant relationship between the appointment of executive directors and stock market reaction. Subrahmanyam, Rangan, and Rosenstein (1997) reported a negative relationship between independent directors and abnormal returns in the context of bidding banks and attributed this to the fact that independent directors might be hired for reasons other than a firm's value maximisation objective. Fama and Jensen (1983) and Adams and Ferreira (2007) showed that banks with information asymmetry would benefit from more executive directors. Based on these findings, we put forward the following as our second hypothesis:

**H2** Female executive directors have a positive impact on post-appointment performance.
2.2.3 Multiple directorships and firm performance

Empirical literatures offer mixed views on multiple directorships and firm performance. On one hand, resource dependency theory suggests that board members with multiple directorship would be able to create stronger links with external groups and thereby improving firm performance (Goodstein et al., 1994; Ismail & Manaf, 2016; Pfeffer, 1973). Sarkar and Sarkar (2009) put forward the quality hypothesis that advocates that busy directors would make better directors. On the other hand, Morck, Stangeland, and Yeung (1998) argued that busy directors would have less time for effective monitoring. In similar lines, Ferris, Jagannathan, and Pritchard (2003) coined the Busyness Hypothesis that proposes that multiple directorships lead to over-commitment and consequently poor performance. However, both Ferris et al. (2003) and Sarkar and Sarkar (2009) have reported positive stock market reactions with regards to the appointment of directors with multiple directorships. However, Kiel and Nicholson (2006) reported that multiple directorships have no influence on firm performance. In the light of these mixed results, we hypothesize that:

H3 The appointment of female directors with multiple directorships will lead to positive impact on firm performance.

2.2.4 Education level and firm performance

As mentioned in the previous section, Becker (1964) points out that human capital theory which is about individual's knowledge and experience can significantly augment the productive capability of an organization. Along similar lines, Bantel and Jackson (1989) argue that higher education improves individuals' cognitive ability and greater competence to form high-quality decision making. Hambrick and Mason (1984) developed the upper echelon theory which suggests that knowledge base and intellectual skills increase with the level of education. This theory has also been supported by empirical study of Darmadi (2013). Based on these arguments, we expect that post-appointment performance will increase with female director's level of education. Consequently, we hypothesize that:

H4 Post-appointment firm performance will be positively related to level of education of female directors.

2.2.5 Age and firm performance

Extant literatures suggest that age is a good measure of experience and knowledge (Coughlan & Schmidt, 1985; Lausten, 2002). In this context, it is expected older female directors should have a positive effect on firm performance. Therefore, we formulate the following hypothesis:

H5 Post-appointment firm performance will be positively related to age of female directors.

2.2.6 Prominence and firm performance

In support of the social psychological theory reviewed in Section 2, we argue that female directors who hold titles which signify achievement and reputation like Dame, Baroness or Honorary Doctorate are likely to exert significant influence on board effectiveness, decisions and firm performance. In the light of this, we propose the following hypothesis:

H6 Post-appointment firm performance will be positively related to female directors' prominence.

3 DATA AND METHODOLOGY

3.1 Sample and data sources

Our sample comprises of FTSE100 constituent firms, fully updated for a 12-year period from 2005 to 2016. Data for ROA, Tobin's Q, measures of gender diversity and control variables were obtained from Thomson Reuters DataStream. For our second set of analyses, data of 270 female directors of FTSE 100 firms were collected from Bloomberg.

3.2 Measures of performance

The majority of empirical literature have either used ROA or Tobin's Q or both as measures of firm performance (Adams & Ferreira, 2009; García-Meca, García-Sánchez, & Martinez-Ferrero, 2015; Martin-Ugedo & Minguez-Vera, 2014; Nguyen et al., 2015). Following these studies, we have used Tobin's Q, which is a market-based measure and ROA which is an accounting measure. Tobin's Q, as a market-based measure, is defined as the book value of total assets minus the book value of common equity plus the market value of common equity.
divided by the book value of total assets (Adams & Ferreira, 2009; Campbell & Mínguez-Vera, 2008; Rose, 2007). A value of Tobin’s Q which is greater than one reflects investors’ confidence in the firm and its growth opportunities and the converse is the case for firms with Tobin’s Q of less than one. ROA is measured as the ratio of a firm’s annual net income to average total assets during a financial year. Barber and Lyon (1996) documented in detail the advantages of ROA as a measure of operating performance. They indicate that, unlike net income, ROA adjusts for the firm’s size, thus making it easier to compare how well one firm is doing relative to another.

In order to examine the impact of the appointment of female directors on firms’ performance, we analyse a change in firm’s performance following the appointment of female directors. Specifically, we measured the 1-year post-appointment performance by evaluating changes in both ROA and Tobin’s Q 1-year after the appointment of a female director relative to the change in ROA and Tobin’s Q 1-year prior to the appointment of the female directors. In order to improve the robustness of the results, we also examined the 2 and 3 years post-appointment performance.

3.3 Measurement of independent and control variables

The main variable of interest in this study is board gender diversity. Following Liu et al. (2014) and Joecks, Pull, and Vetter (2013), we examine levels of female representation in the boardroom based on the critical mass theory of Kramer et al. (2006) and Erkut, Kramer, and Konrad (2008) by taking three dummy variables. First, dummy variable Diversity 1, is taken as 1 if there is only 1 female director in the boardroom, dummy variable Diversity 2 is taken as 1 if there are 2 female directors in the boardroom and dummy variable Diversity 3, is taken as 1 if there are three or more female directors in the boardroom.

To examine the impact of the appointment of female directors on firm performance, our first explanatory variable is ‘female executive director’, which is a dummy variable that takes the value of 1 if the female director appointed is an executive director and zero otherwise. Multiple directorship measures the total number of directorships position held by the female director. Education is a dummy variable that takes the value of one if the female director has a Master degree or Doctor of Philosophy degree (PhD) and zero otherwise. Prominence is a dummy variable that takes a value of 1 if the female director holds an honorary position of Dame or Baroness and zero otherwise. We have also included firm size and debt ratio as control variables in our analysis. Of the 270 female directors’ data gathered, 34 (12.5%) are executive directors and the rest are non-executive directors.

Data from Bloomberg revealed that the average age of the female directors is 58 years and on average these directors hold positions in three boards. Female directors’ data also showed that 12.8% of the female directors hold executive positions and 74% of the female directors have either a Master degree or PhD and 33% of female directors have graduated from top tier institutions like Harvard, Stanford, Oxford, Cambridge, INSEAD, and Kellog. This data is based on 202 education data out of the 270 female directors. In addition, our data also shows that only 14 out of 202 directors held a title of Dame or Baroness. This suggests that only a small percentage of female directors have the ‘branded women’ status as documented in social psychology theory by Mattis (2000) and Sealy et al. (2007).

Following recent empirical literature (García-Meca et al., 2015; Low, Roberts, & Whiting, 2015; Nguyen et al., 2015; Sila, Gonzalez, & Hagendorff, 2016), we divide the control variables in two categories. The first categories of control variables pertain to board characteristics, which include: board size, incentive policy, and CEO duality. Corporate finance literature suggests that the presence of board of directors in an economic institution is to help resolve the agency problems associated with managing an organization (Hermalin & Weisbach, 2003). For example, Yermack (1996) and Campbell and Mínguez-Vera (2008) found a negative relationship between board size and financial performance measured using Tobin’s Q. Prior studies such as Bryson and Freeman (2010) contend that incentive policy is related to performance as means to motivate employees. The Incentive Policy (IP) is measured as a dummy variable that takes a value of 1 if the firm uses performance related pay and 0 otherwise. CEO duality is a dummy variable that equals one if the CEO and Chairperson are the same person and zero otherwise.

The next category of variables pertains to firm characteristics. These are firm age, firm size, and firm leverage (debt) ratio. Firm age is the natural log of the number of years a firm is listed on the exchange, firm size is the natural log of the market value of the firm. This study has used publicly listed age as it is more relevant given that this study aims to examine boardroom gender diversity of publicly listed firms specifically, FTSE100 firms. Firm leverage (debt ratio) is defined as the total debt divided by the total assets of the firm. This study has also included a dummy variable ‘crisis’ to control the 2007–2009 financial crisis. The way the variables were measured are provided in Table 1.
Panels A and B of Table 2 show the summary statistics of the variables in our sample. Panel A indicates that the mean scores for board size and firm age are 11 and 4 years, respectively. Regarding the debt ratio of the sample firms, we document about 24%. In terms of performance measures, we document that ROA has a mean value of 7.73 while that of Tobin’s Q is 1.85 for the sample firms between 2005 and 2016. In panel B of Table 1, we report changes in ROA and Tobin’s Q for 1 to 3 years following the appointment of female directors.

### Table 1: Measurement of variables

| Variable name                        | Definition                                                                                                                                 |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| **Dependent variables**              |                                                                                                                                          |
| Return on assets (ROA)               | ROA is measured as the ratio of a firm’s annual net income to average total assets during a financial year                                    |
| Tobin’s Q                            | Tobin’s Q is a market-based measure and it is defined as the book value of total assets minus the book value of common equity plus the market value of common equity divided by the book value of total assets |
| △ROA                                 | Change in ROA 1 year after the appointment with respect to change in ROA 1 year prior to the appointment                                  |
| △Tobin’s Q                           | Change in Tobin’s Q 1 year after the appointment with respect to change in Tobin’s Q 1 year prior to the appointment                  |
| **Independent variables**            |                                                                                                                                          |
| One female representation (Diversity 1) | Dummy variable that takes the value of 1 if there is one female director and zero otherwise                                              |
| Two females representation (Diversity 2) | Dummy variable that takes the value of 1 if there are two female directors and zero otherwise                                           |
| Three females representation (Diversity 3) | Dummy variable that takes the value of 1 if there are three or more female directors and zero otherwise                                 |
| Female executive                     | Dummy variable that takes the value 1 if the female director is an executive director and zero otherwise                                   |
| Age                                  | Age of the female director                                                                                                              |
| Multiple directorship                | Dummy variable that takes the value 1 if the female director holds multiple directorships and zero otherwise                          |
| Education                            | Dummy variable that takes the value 1 if the female director has master degree or PhD or other professional qualification and zero otherwise |
| Prominence                           | Dummy variable that takes the value 1 if the female director has a honorary title of dame or baroness and zero otherwise            |
| **Control variables**                |                                                                                                                                          |
| Board size                           | Board size is the total number of directors                                                                                             |
| CEO duality                          | Dummy variable that takes the value of 1 if the chairperson is also the CEO, and zero otherwise                                          |
| Incentive policy (IP)                | Incentive policy (IP) is calculated as a dummy variable that takes the value of 1 if the firm uses performance related pay and 0 otherwise |
| Firm size                            | Firm size is the natural log of the market value of the firm                                                                             |
| Firm age                             | Firm age is the natural log of the number of years a firm is listed on the exchange                                                        |
| Leverage                             | Firm debt ratio (leverage) is defined as the total debt divided by the total assets of the firm                                           |
| Financial crisis dummy               | Crisis is a dummy variable that takes the value 1 for the financial crisis period 2007 to 2009 and 0 otherwise                             |
| Industry dummies                     | A dummy variable for each of the 10 industries: Financials, basic materials, consumer goods, consumer services, healthcare, industrials, oil and gas, telecommunications, technology, utilities. One industry dummy is treated as the benchmark to avoid dummy variable trap |
| Year dummies                         | A dummy variable for each year from 2005 to 2016. One year dummy (2015) is treated as the benchmark to avoid dummy variable trap      |
The change for ROA ranges from −0.015 to 0.4%, whereas in the case of Tobin’s Q, it ranges from −0.06 to 0.09%.

### 3.4 | Correlation matrix

Panel A of Table 3 shows the correlations among all the independent variables used in the main analyses. The correlation results for the independent variable reveal low correlation coefficients with the highest being 0.65, suggesting that multicollinearity does not pose an issue in this study. This was confirmed by the results of the variance inflation factor (VIF) test which indicate that the highest VIF is 2.50, well below the recommended threshold (Gujarati, 2009).

### 4 | MODEL

#### 4.1 | Effects of board gender diversity on firm performance

In order to examine the impact of board gender diversity on firm performance, we apply the corporate governance-firm performance model in a dynamic framework as adopted by several empirical studies of corporate governance and firm performance (see Chen, Chidambaran, Imerman, & Sopranzetti, 2014; Nguyen et al., 2015; Pathan & Faff, 2013; Wintoki et al., 2012). Hermelin and Weisbach (1998) and Raheja (2005) argued that current corporate governance and firm performance are influenced by firms’ past performance. Our model is shown as follows:

\[
Performance_{it} = \alpha_0 + \phi Performance_{i,t-1} + \sum_{t=1}^{2005-2016} \psi_t \text{(Year)}_t + Industry\text{dummies} + \mu_i + \epsilon_{i,t} \tag{1}
\]

In Equation (1), subscripts \( t \) denote FTSE 100 firms in the constituent list, \( t \) is the monthly time period. The coefficients \( \alpha, \gamma, \beta, \phi, \psi \) are the parameters to be estimated, \( \mu \) is unobserved fixed effect for firm \( I \), \( \phi \) is assumed to be zero and \( \epsilon \) represents the remaining disturbance term. As indicated in Section 3, this study has taken Tobin’s Q and ROA as performance measures and three dummy variables Diversity 1, Diversity 2, and Diversity 3 as the measures of gender diversity.

Empirical literatures have identified potential endogeneity in the board structure-firm performance relationship (see Adams & Ferreira, 2009; Wintoki et al., 2012) caused by time-invariant heterogeneity. In order to address this, we used the two-step system GMM approach proposed by Arellano and Bover (1995) and Blundell and Bond (1998) as our main estimation technique. This method treats all the explanatory variables as endogenous and orthogonally uses the past values as their corresponding instruments. A number of scholars have found system GMM approach to generally produce more efficient and precise estimates compared to other estimators by improving the finite sample bias (Baltagi, 2008; Blundell, Bond, & Windmeijer, 2001). The above consideration led to the choice of system GMM ahead of other estimators. We believe the use of fixed effect regression complemented with system GMM would ensure the robustness of our findings.

#### 4.2 | Female director appointment and firm performance

We examine the impact of female directors’ appointment on firm performance by taking the change in ROA³ and Tobin’s Q using the following equations.
\[ \Delta \text{ROAi} = \alpha + \beta_1 \text{FemaleExecutive}_i + \beta_2 \text{Age}_i + \beta_3 \text{Multipledirectorship}_i + \beta_4 \text{Prominent}_i + \beta_5 \text{Education}_i + \beta_6 \text{FirmSize}_i + \beta_7 \text{Leverage}_i + \epsilon_i \]  

\[ \Delta \text{Tobin'sQi} = \alpha + \beta_1 \text{FemaleExecutive}_i + \beta_2 \text{Age}_i + \beta_3 \text{Multipledirectorship}_i + \beta_4 \text{Prominent}_i + \beta_5 \text{Education}_i + \beta_6 \text{FirmSize}_i + \beta_7 \text{Leverage}_i + \epsilon_i \]  

\[ \Delta \text{ROA} = \frac{\text{ROA}_{t+1} - \text{ROA}_t - \text{ROA}_t - \text{ROA}_{t-1}}{\text{ROA}_t} \]  

\[ \Delta \text{Tobin'sQ} = \frac{\text{Tobin'sQi}_{t+1} - \text{Tobin'sQi}_t - \text{Tobin'sQi}_t - \text{Tobin'sQi}_{t-1}}{\text{Tobin'sQi}_{t-1}} \]

**RESULTS AND DISCUSSION**

### 5.1 Female board representation and firm performance

The main variables of interest are the levels of female representation in the boardroom proxied by the three dummy variables: Diversity1, Diversity 2, and Diversity 3. Results in Table 4 show that Diversity1 is positive and significantly related to financial performance under Fixed Effect at 10% level but insignificant under System GMM suggesting inconclusive results. Regarding Diversity 2, we also document positive and significant coefficients under three of the four models (i.e., Models 1–3). It is important to point out that the results in respect of fixed effect regression are highly significant but only significant at 10% under the System GMM model where Tobin’s Q is taken as a measure of performance. In contrast to Diver-
sity 1 and Diversity 2, the coefficients for Diversity 3 are positive and highly significant at the 1% level for all the measures of performance and across both the estimation models. The findings suggest that the Diversity 3 appear superior and lend unequivocal support for Hypothesis H1. The findings appear interesting, suggesting that appointment of three or more female directors leads to significant increase in firm performance compared to the appointment of one or two females on corporate boards. The findings appear consistent with Konrad and Kramer (2006), Konrad et al. (2008), Torchia et al. (2011), Joecks et al. (2013), and Liu et al. (2014) and in line with the critical mass theory which posits that three or more females on corporate board represent a voice.

In relation to the control variables, we find the coefficient for board size to be positive and significant at the
1% level for both measures of performance. This result is in line with Coles, Daniel, and Naveen (2008), Linck, Netter, and Yang (2008), and Adams and Mehran (2012) but at variance with the findings of Pathan and Faff (2013) and Hermalin and Weisbach (2003). The coefficient of the leverage ratio is negative and significant at the 1% level for both the measures of performance and render some support for the findings of Liu et al. (2014). It is important to point out that Campbell and Mínguez-Vera (2008) and González (2013) argue that the relationship between leverage and firm performance is dependent on two different components; costs of financial distress and benefits of the disciplinary role of debt financing. Thus, the inverse relation between the leverage and firm performance reported in this study suggests that the costs of financial distress outweigh the benefits in the context of FTSE100 firms. The coefficient of incentive policy is negative and significant at the 1% level for Models 2 and 3 out of the four models. We also find CEO duality is significantly negatively related to firm performance measured by Tobin’s Q for the fixed effect and system GMM models. The results render some support to the findings by Liu et al. (2014), Behren and Staubo (2014), and Upadhyay and Zeng (2014). The coefficients for firm size and firm age are negative and significant for both the measures of performance and across both estimation models.

5.2 Female attributes and financial performance

The effects of the attributes of females on corporate (i.e., female age, level of education, prominence/prestige, multiple directorship, and females with executive positions), and post-appointment on firm performance are shown in Table 5. The coefficient of the female executive dummy variable has positive and significant for two measures of financial performance (ROA and Tobin’s Q). Hypothesis H2 is therefore supported. One plausible explanation for this result may be that by holding executive position, female executives may have enough managerial power, better information, and time to influence decision making thereby exerting a positive effect on performance. We also find the coefficient of the education dummy to be positive and significant for both ΔTobin’s Q and ROA thereby providing some support for Hypothesis H4. The findings appear consistent with the results of Smith et al. (2006), Singh et al. (2008), Cheng, Chan, and Leung (2010), and Darmadi (2013) who found firm performance increases when female directors’ appointed to the board have higher level of education such as Masters in Business Administration (MBA). Consistent with Coughlan and Schmidt (1985) and Lausten (2002), our result also showed that post-appointment firm performance is positive and significant in relation to female directors’ age, thereby supporting Hypothesis H5. However, we find the variable prominence, that is, the appointment of female directors who have honorary titles as Dame or Baroness exert both negative and positive but statistically insignificant impact on firm performance. Hypothesis H6 is therefore unsupported. Similarly, regarding the impact of female multiple directorship, we find coefficient of multiple directorship to be negative but insignificant and hence Hypothesis H3 is unsupported. Regarding the control variables, the results appear more or less similar to our earlier results reported in Table 4.

6 CONCLUSION

This study extends the existing literature on board gender diversity by examining the relationship between levels of female board representation, selected attributes of female board members and financial performance of FTSE 100 firms over the period 2005 to 2016. Utilising two measures of firm performance, namely, Tobin’s Q and ROA, our results show that gender diversity exerts a positive and significant effect on the financial performance. However, the positive effect on financial performance appears unequivocal and highly significant when three or more female are appointed to the board compared to lower levels of female board representation. The results provide a strong support to critical mass theory of board gender diversity consistent to conclusions drawn by Kristle (2011), Erkut et al. (2008), Joecks et al. (2013), and Liu et al. (2014). The results are invariant to alternative measures of firm performance and across two different analytical approaches.

Further analysis in respect of female attributes such as age, level of education, multiple directorship, prominence and whether the female board members hold also executive position have any influence on firm performance. Our results indicate that females with executive position on board, age and level of education exert a positive and significant influence on post-appointment performance. The findings of positive and significant relationship between female directors’ education and age appear interesting and lend some support to human capital theory by Becker (1964) which argues that managerial knowledge and experiences are crucial for firm performance. Similarly, the findings resonate with empirical evidences by Smith et al. (2006) and Singh et al. (2008) who found a positive association between female directors with good education level such as possession of an
MBA degree and firm performance. This finding is also in line with upper echelon theory that states that higher level of education leads to higher knowledge base and intellectual capability (Hambrick & Mason, 1984), higher cognitive ability, and higher capacity to make superior decisions (Bantel & Jackson, 1989). In line with our expectations, we find female age to be positive and significantly related to firm performance, thereby supporting the studies of Dagsson and Larsson (2011) who reported that age of directors is positively related to firm performance. However, we did not find a significant relationship between multiple directorship, female prominence and post-appointment firm performance. Our findings appear robust after accounting for endogeneity often associated with studies on board effects and controlling for board size, debt ratio, CEO duality, incentive policy, firm size, and firm age which have been found influence firm performance.

The results of this study suggest that the recommendations contained in Hampton Alexander report which calls for 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 females into the board improve financial performance of UK firms. Indeed, the economic case for gender-balanced boards is as much as it is about improving firm performance 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, responsible governance and competitiveness in the global marketplace. Despite the significant

### Table 5: Attributes of female on board and financial performance

| Independent variables | 1 year post-appointment performance | 2 year post-appointment performance | 3 year post-appointment performance |
|-----------------------|-------------------------------------|-------------------------------------|-------------------------------------|
|                       | ΔROA | ΔTobin's Q | ΔROA | ΔTobin's Q | ΔROA | ΔTobin's Q |
| Executive dummy       | 0.13* | 0.11*      | 0.41* | 0.12**     | 0.57* | 0.15*      |
| Female age            | 0.06** | 0.14**     | 0.19** | 0.16**     | 0.07* | 0.05*      |
| Multiple directorship | −0.18 | −0.006     | −0.05 | −0.091     | −0.091 | −0.041     |
| Education             | 0.18* | 0.16***    | 0.45* | 0.04***    | 0.1   | 0.14**     |
| Prominence            | −0.19 | 0.08       | −0.06 | 0.1        | −0.07 | −0.08      |
| Leverage              | 0.005* | 0.003***  | 0.003* | 0.002***    | 0.005* | 0.007***   |
| Firm size             | −0.12 | −0.078***  | −0.162* | −0.051*    | −0.32* | −0.062*    |
| Constant              | −1.55 | −0.22      | −3.67 | −0.333     | 0.18  | −0.015     |
| R-squared             | .19  | .23        | .2   | .25        | .17   | .18        |

Note: This table reports effects of appointment of female directors on firm performance. The dependent variables are ΔTobin's Q and ΔROA and the main independent variables are female executive dummy, age, education dummy, multiple directorship, and prominence. The numbers in parenthesis are t-statistics.

***Indicates significance at the 1% level.
**Indicates significance at the 5% level.
*Indicates significance at the 10% level.
contributions of this article, the study is limited to FTSE 100 firms which constitute top 100 firms hence more studies appear warranted. Future studies should investigate and compare the appointment of female representation on performance under the voluntary system with countries that provide quotas for female representation on board using cross-country samples.

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ENDNOTES
1 Evening Standard (2012). Women on boards debate: Banking crisis 'helped women stake place in the boardroom' Evening Standard, London, Wednesday, September 5, 2012. Accessed on November 8, 2019: https://www.standard.co.uk/news/london/women-on-boards-debate

2 Data on firm age is based on publicly listed age as this study examines board gender diversity of publicly listed firms.

3 This approach measures change in ROA and Tobin’s Q 1 year after the appointment with to the respect change in ROA and Tobin’s Q 1 year prior to the appointment, respectively.

DATA AVAILABILITY STATEMENT
Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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