Does board gender diversity influence firm profitability? A control function approach

Rey Dang, L'Hocine Houanti, Krishna Reddy, Michel Simioni

Laboratoire
de Recherche
en Gestion
& Economie

Working Paper

2019-01

Does board gender diversity influence firm profitability?

A control function approach

Rey Danga, L'Hocine Houanti, Krishna Reddy, Michel Simioni

January 2019

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex
http://large.em-strasbourg.eu/

Institut de Finance de Strasbourg

Does board gender diversity influence firm profitability? A control function approach

Rey Dang[a], L'Hocine Houanti[b], Krishna Reddy[c,1] and Michel Simioni[d]

[a] EM Strasbourg Business School, LaRGE, University of Strasbourg, France
[b] La Rochelle Business School, La Rochelle, France
[c] Toi Ohomai Institute of Technology, Rotorua, New Zealand
[d] INRA, UMR 1110 MOISA, Montpellier, France

ABSTRACT

We investigate the relation between board gender diversity and firm profitability using the control function (CF) approach recently suggested by Wooldridge (2015). The CF method takes account of the problem of endogenous explanatory variables that have potential to bias the results. Using a sample of firms that made up the S&P 500 over the period 2004-2015, we find that the presence of women on corporate boards (measured either by the percentage of female directors on corporate boards or the Blau index of heterogeneity) has a positive and significant (at the 1% level) effect on firm profitability (measured by the return on assets). We compare our results to more traditional approaches (such as pooled OLS or the fixed-effects model). Through this study, we shed light on the effect of women on corporate boards on firm performance, as it is still a controversial issue (Post and Byron, 2015).

JEL Classification:
G30
G34
J1

Keywords:
Women
Board of directors
Econometrics
Control function
Firm performance

[1] Corresponding author.

E-mail addresses: krishna.reddy@toiohomai.ac.nz (K. Reddy), rey.dang@em-strasbourg.eu (R. Dang), houantil@esc-larochelle.fr (L. Houanti) and michel.simioni@inra.fr (M. Simioni).

1. Introduction

In recent years, board gender diversity (BGD) – or women on corporate boards (WOCB)[2] – has been at the center of policy and academic research (Terjesen, Sealy and Singh, 2009). Previously considered as an ethical issue (i.e. that it is wrong for individuals to be excluded from the highest echelons of organization purely on the grounds of gender), WOCB is increasingly perceived as a value-driver for organizations. Robinson and Dechant (1997) have suggested a "business case for board gender diversity", arguing that BGD may improve board decision-making, which, in turn, may influence firm performance. One may question, therefore, the veracity of this statement.

The academic literature puts forward several arguments in support of BGD. These arguments include enhanced quality of decision-making (Milliken and Martins, 1996) and a closer monitoring of boards' strategic decisions (Nielsen and Huse, 2010) and board behavior (Adams and Ferreira, 2009), which, in turn, induce better firm performance. However, these claims have not been confirmed empirically. Indeed, despite a relatively large body of literature examining the relationship between WOCB and firm performance, the empirical evidence is somewhat mixed (Post and Byron, 2015). Some studies have found that WOCB add value to the firm (e.g. Campbell and Mínguez-Vera, 2008, Liu, Wei and Xie, 2014), other studies have documented that WOCB decreases firm performance (e.g. Adams and Ferreira, 2009, Ahern and Dittmar, 2012), while some other studies have found that WOCB have no effect on firm performance (e.g. Carter, D'Souza, Simkins and Simpson, 2010, Rose, 2007).

Many reasons could explain such a mixed set of findings, with potential candidates including the use of different samples, time windows, empirical specifications and methodologies (Adams, Haan, Terjesen and Ees, 2015, Ferreira, 2015). We believe that such empirical inconsistency may be due to a failure to take endogeneity problems into account (Adams, 2016). Establishing a causal relationship between BGD and firm performance might be challenging, as board characteristics are not exogenous random variables. Board characteristics are endogenously chosen by firms to fulfill their operating and contracting environment (Adams, Hermalin and Weisbach, 2010, Sila, Gonzaleza and Hagendorff, 2016). Three sources of endogeneity may bias the effect of board structure and firm performance (Wintoki, Linck and Netter, 2012). First, omitted/unobserved firm characteristics (both fixed and time-varying) may simultaneously affect both the appointment of female directors and firm performance. A second problem is reverse causality: WOCB may affect firm performance but it is also possible that financially healthy firms are more likely to appoint female directors. Finally, dynamic endogeneity may arise when current firm value and board structure are attributable to past firm performance. Accordingly, not fully addressing the endogeneity issue may induce erroneous inferences about a causal relationship between BGD and firm performance. We argue that the inconsistency in results mentioned by Post and Byron (2015) is partly due to this phenomenon. Furthermore, the mixed results indicate that more evidence is needed to increase the level of knowledge regarding the relationship between BGD and firm performance.

The present study aims to fill this gap by using a control function (CF) approach to address the problem of endogeneity explicitly. The CF approach is an econometric method used to correct for biases that arise from endogeneity (Wooldridge, 2015). Specifically, a CF is a variable that, when added to an equation, renders an endogenous explanatory variable exogeneous (Wooldridge, 2010). The CF approach has three attractive features (Wooldridge, 2015). First, this method makes it possible to treat in a very simple way the case of one or more endogenous explanatory variables, as long as it is possible to have exogenous variables explain-

[2] We use both expressions in this study.

ing their variation; this method controls for the endogeneity of our variable of interest, BGD. Second, the approach provides a simple test to compare ordinary least squares (OLS) and two-stage least squares (2SLS), which are robust in terms of heteroscedasticity and cluster correlation. Third, the CF approach can parsimoniously handle models that are non-linear in endogenous explanatory variables. Consequently, we use the CF approach to address endogeneity associated with WOCB explicitly. In doing so, we make an empirical and econometric contribution by specifically taking into account the different facets of endogeneity through the CF approach (Wooldridge, 2015) that have not yet been used in the literature on WOCB.

This study makes a theoretical contribution to the corporate governance and WOCB literatures by examining the phenomenon in question within the framework of upper echelons theory (UET), rather than through agency and resource dependence theories (both commonly used). Following Post and Byron (2015), we surmise that the differentiated cognitive frames of female directors are likely to have a significant influence on firm outcome (Hambrick, 2007).

Finally, in this study, we only consider firm accounting returns, which are sometimes referred to as firm profitability (Post and Byron, 2015). According to Carter, D'Souza, Simkins and Simpson (2010), this refers to a company's ability to use its assets and investments efficiently to generate accounting income for the shareholders. Tobin's Q is frequently used in the literature as a proxy for firm performance but Bhagat and Bolton (2008) argue that this measure may be subject to investor anticipation. If investors anticipate any effect of corporate governance, long-term stock returns will not be correlated with governance, even if an actual correlation exists. Consequently, consistent with Amore, Garofalo and Minichilli (2014) and Wintoki, Linck and Netter (2012), we only consider return on assets as our measure of performance.

Under this framework, the purpose of this paper is to provide new evidence regarding the relationship between BGD and firm profitability, by taking into careful consideration the issue of endogeneity through the CF method. Based on UET, we examine if WOCB positively influence firm profitability.

The remainder of the article is structured as follows. Section 2 presents the theoretical framework and the hypothesis developed. Section 3 outlines the research design (focusing on the CF method). The results and concluding remarks are offered in Sections 4 and 5, respectively.

2. Theoretical framework and hypothesis development

As Post and Byron (2015) point out, a large number of theories, such as agency theory (Fama and Jensen, 1983, Jensen and Meckling, 1976), resource dependence theory (Pfeffer and Salancik, 1978), social identity theory (Ashforth and Mael, 1989) and social categorization theory (Tajfel, 1981), have served as a theoretical framework to examine the link between BGD and firm performance. Following Post and Byron (2015), we use UET (Hambrick, 2007, Hambrick and Mason, 1984) as our main theoretical framework in this study. Originally, UET focused on the top management team (TMT). However, the literature has applied this theory to boards of directors by considering the latter as "supra top management teams" (Finkelstein, Hambrick and Cannella Jr., 2009): 11). UET assumes that directors differ in terms of cognitive frames and that these cognitive differences significantly influence firm outcomes (Hambrick, 2007). However, as directors' cognitive frames are difficult to measure, the literature proxies cognitive frames through observable characteristics of directors, such as gender or age (see Dezsö and Ross, 2012, Krishnan and Park, 2005).

Hambrick (2007) defines directors' cognitive frames as their information-seeking and information-evaluation processes. He argues that directors' cognitive frames are linked to their own experiences, knowledge, and values and fundamentally shape how a director seeks and interprets the information he/she receives. This also significantly influences decision-making processes and *in fine* firm outcomes. Following Hillman, Cannella and Harris (2002) and Singh, Terjesen and Vinnicombe (2008), we argue that female and male directors significantly differ regarding their cognitive frames and that gender diversity in the boardroom is likely to influence firm performance (e.g. Carpenter, 2002).

First, the literature has found that female directors bring different cognitive frames to a board due to differences in their experiences and knowledge compared to their male counterparts. For instance, compared to male directors, females are more likely to possess a university degree and hold advanced degrees (e.g. Dang, Bender and Scotto, 2014, Hillman, Cannella and Harris, 2002, Singh, Terjesen and Vinnicombe, 2008). In terms of work experience, female directors are less likely to have been CEOs or COOs[3] and are more likely to have come from non-business backgrounds (e.g. Dang, Bender and Scotto, 2014, Hillman, Cannella and Harris, 2002, Singh, Terjesen and Vinnicombe, 2008).

In another vein, Daily, Certo and Dalton (1999) have suggested that WOCB are likely to bring to boards new insights and different understandings of market segmentation. A market segmentation strategy involves sound knowledge of the various market segments, as well as the different groups of consumers, in order to propose an attractive marketing mix (e.g. Dickson and Ginter, 1987, Smith, 1956). Accordingly, Daily, Certo and Dalton (1999) argue that WOCB expand perspectives to meet local and global needs, especially for firms operating in markets with a high concentration of female buyers (e.g. the luxury sector and the automotive industry).

Second, owing to these differences in cognitive frames, we argue that a greater representation of female directors is likely to influence the decision-making processes of a board (Post and Byron, 2015). Specifically, we contend that an increase in female representation on corporate boards significantly influences *how* decisions are made. Women’s leadership styles are said to be more participative, democratic and communal (Eagly, Johannesen-Schmidt and Van Engen, 2003) than those of men, who are more likely to be autocratic (Eagly and Johannesen-Schmidt, 2001). This is supported by Bart and McQueen (2013), who found that female directors make fair decisions when competing interests are at stake by virtue of their cooperative decision-making.

The literature has shown that diverse groups have the potential to provide critical and valuable information, as they bring a greater range of perspectives to a board because of their experiences and differentiated knowledge (Hillman, Shropshire and Cannella, 2007). It is assumed that female directors have the capacity to exploit fully a firm’s capability to generate profits from its assets and investments (Carter, D'Souza, Simkins and Simpson, 2010, Miller and del Carmen Triana, 2009). In this context, Galbreath (2016) also argues that WOCB enable firms to meet the expectations and demands of the various stakeholders, which, in turn, improves corporate social performance (Boulouta, 2013). Finally, by empowering a multitude of viewpoints and cultivating deliberativeness in decision-making, WOCB might improve a firm’s decision-making processes and *in fine* the quality of that decision-making (Loyd, Wang, Phillips and Lount Jr, 2013, van Ginkel and van Knippenberg, 2008). This, is turn, increases firm performance.

For all the above reasons, we hypothesize that BGD is likely to be positively related to firm performance. Accordingly, we assert the following:

Hypothesis: All else being equal, female representation on boards is positively related to firm performance.

[3] CEO: chief executive officer and COO: chief operating officer.

3. Research design

3.1. Sample

The initial sample of this study includes all the companies that made up the Standard & Poor's 500 (S&P 500) as of December 31, 2015. It covers the period from 2004 to 2015. This index represents a broad cross-section of the US equity market, including stock traded on the New York Stock Exchange (NYSE) and Nasdaq. The S&P 500 captures over 80% of the total domestic US equity float-adjusted market capitalization. This index has already been used in previous studies (e.g. Anderson and Reeb, 2003, Carter, D'Souza, Simkins and Simpson, 2010). This study focused exclusively on large-sized companies because they are more likely to be under scrutiny from various stakeholders in regard to BGD (Hillman, Shropshire and Cannella, 2007).

Following standard practice, financial (SIC codes 6000-6999) and utility (SIC codes 4900-4999) firms were excluded due to their particular features (in terms of specific disclosure requirements and accounting regulations). Finally, observations with insufficient data were also excluded from the analysis. The final sample consisted of 381 firms and 3,446 firm-year observations.

3.2. Variables definition

3.2.1. Dependent variable

Consistent with Wintoki, Linck and Netter (2012), our main measure of performance is return on assets (ROA), calculated as operating income before depreciation divided by total assets (Adams and Ferreira, 2009, Wintoki, Linck and Netter, 2012). ROA is an indication of the ability of a firm to generate accounting-based revenues in excess of actual expenses from a given portfolio measured on a historical basis. As such, ROA represents an indication of the accounting income produced for the shareholders (Carter, D'Souza, Simkins and Simpson, 2010).

Many studies that examine the relationship between BGD and firm performance use Tobin's Q as a measure of performance (e.g. Adams and Ferreira, 2009). However, two reasons motivated us to choose ROA as our measure of performance. First, Wintoki, Linck and Netter (2012) argue that the use of Tobin's Q as a measure of performance might be a proxy for growth opportunities. However, there are theoretical foundations suggesting that growth opportunities are a cause, rather than a consequence, of governance structures. Boone, Field, Karpoff and Raheja (2007) and Linck, Netter and Yang (2008), among others, provide empirical evidence to support this line of reasoning.

Second, in their meta-analysis of 100 studies examining the link between WOCB and firm performance, Post and Byron (2015) found that BGD is positively and significantly related to accounting returns (such as ROA). This suggests that firms with a greater proportion of WOCB have higher accounting returns. In contrast, these authors do not find any significant relationship between WOCB and market performance (such as Tobin's Q). Venkatraman and Grant (1986) question if Tobin's Q and ROA can be treated as equivalent, interchangeable measures of firm performance.

For both the above reasons, we followed Wintoki, Linck and Netter (2012) in choosing ROA as our measure of firm performance.

3.2.2. Independent variable

BGD was measured using two measures that have previously used in the literature. First, consistent with Adams and Ferreira (2009) and Carter, D'Souza, Simkins and Simpson

(2010), we employed the percentage of WOCB calculated as the number of female directors divided by the total number of directors.

Second, we used the Blau (1977) index of heterogeneity, measured as $(1-\sum p_i^2)$, where p_i is the percentage of board members in each category *i* (in this case, male and female directors). Blau's index can range from 0 (i.e. all board members are male) to 0.50 (which occurs when there is an equal number of female and male directors).

3.2.3. Control variables

Following prior studies, such as Bebchuk and Cohen (2005) and Bhagat and Bolton (2008), we controlled for firm and board characteristics that may affect our measure of performance.

Specifically, in Eq. [4, see section 3.3.5.], we first include *Firm size* (approximated using the natural logarithm of total assets; (Hillman, Shropshire and Cannella, 2007). Firm size is a key driver of firm value and firm performance. Large firms are associated with higher costs of monitoring, as they are more complex to lead. Consistent with the existing literature, we expected a negative relationship between firm size and firm financial performance (e.g. Adams and Ferreira, 2009, Isidro and Sobral, 2015). Second, we include *Leverage* (calculated as the ratio of total debt to total assets; (Campbell and Mínguez-Vera, 2008). According to Shleifer and Vishny (1997), leverage is an important governance mechanism that forces managers to generate enough cash flow in order to pay the interest and the principal. This will then mitigate agency conflicts resulting from cash flow. As a result, we expected a negative relationship between leverage and firm financial performance (e.g. Campbell and Mínguez-Vera, 2008, Isidro and Sobral, 2015). Third, we include *R&D Intensity* (measured as the R&D-to-sales ratio; (Honoré, Munari and de La Potterie, 2015). Higher research and development (R&D) investment is usually associated with superior performance (e.g. Chan, Martin and Kensinger, 1990, Eberhart, Maxwell and Siddique, 2004). Hence, we expected R&D intensity to be positively related to firm performance. Fourth, we control for *Growth opportunities* (defined as sales growth between *t* and *t*-1), as Green and Jame (2013) argue that a firm's operational growth is an important vector of firm performance. Consistent with Isidro and Sobral (2015), we expected a positive relationship between firm growth and firm performance. Finally, we include *Firm age* (measured as the natural logarithm of the number of years since the firm's inception; (Anderson and Reeb, 2003). Older firms are often associated with organizational rigidity and rent-seeking behaviour by managers, which can cause firm performance to deteriorate. Conversely, age may bring knowledge and skills. Green and Jame (2013) show that firm performance declines with firm age. Therefore, we expected a negative relationship between firm age and firm performance.

In our specification, we also include three sets of control variables related to board characteristics. First, we include *Board size* (measured as the logarithm of the number of directors on the board; (Wintoki, Linck and Netter, 2012). The arguments for a positive relationship between board size and firm performance stem from resource dependence theory, which posits that larger boards will have better information or greater knowledge due to the higher number of directors (e.g. Carter, D'Souza, Simkins and Simpson, 2010). However, proponents of agency theory posit a negative relationship (e.g. Yermack, 1996). Both theoretical and empirical evidence suggest that we should include board size in Eq. [4], even if the direction of the relationship is not certain. Second, in Eq. [4], we consider *Board independence* (measured as the proportion of outside – non-executive – directors on the board; (Wintoki, Linck and Netter, 2012). The effect of board independence on firm performance remains an open question in the literature (e.g. Adams and Ferreira, 2009, Bhagat and Bolton, 2008, Wintoki, Linck and Netter, 2012). Following Adams and Ferreira (2009) and Carter, D'Souza, Simkins and Simpson (2010), we include board independence as a control variable although the direction of the relationship is uncertain. Finally, we add *CEO duality* (measured as a dummy variable that is equal to 1 if the CEO is also the chair, and 0 otherwise; (Wintoki, Linck and Netter, 2012). Existing studies have found that CEO duality is likely to have an impact on firm performance. However, the effect is a double-edged sword (Finkelstein and D'aveni, 1994). As previously, we add CEO duality to Eq. [4], following Carter, D'Souza, Simkins and Simpson (2010).

3.3. Methodology

3.3.1. Endogeneity issues in estimating the relationship between board gender diversity and firm performance

According to Adams, Hermalin and Weisbach (2010), there is no convincing reason to believe that board structure is exogenous. Indeed, there are both theoretical arguments and empirical evidence that suggest board structure is actually endogenous (e.g. Hermalin and Weisbach, 1988, 1998, 2003). For instance, Hermalin and Weisbach (1998) argue that board structure reflects an equilibrium resulting from a bargaining process between the CEO and the board. The CEO’s bargaining position stems from his or her ability (for which firm performance is a proxy). As such, board structure depends on past performance. Hermalin and Weisbach (2003) argue that board structure and firm performance are jointly endogenous. Furthermore, Coles, Daniel and Naveen (2008) and Fama and Jensen (1983), among others, argue that board structure is a function of the scope and complexity of the firm.

The prospect that BGD is a conscious choice made by a firm must be taken into account when estimating the relationship between BGD and firm performance (Adams and Ferreira, 2009). Consequently, in this study, we specifically consider this endogeneity problem, following Hambrick (2007), who highlighted that this issue is “essential for gaining a grasp of the causal mechanisms that lie behind empirical associations” (p. 2007).

However, in order to examine the relationship between BGD and firm performance accurately, two alternative explanations must be considered: omitted/unobserved factors and reverse causality (Adams and Ferreira, 2009, Sila, Gonzaleza and Hagendorff, 2016).

3.3.2. Omitted/unobserved factors

‘Omitted variable bias’ and ‘unobserved heterogeneity’ are variables, other than those specified in the model, that could provide an alternative or additional explanation to phenomena under study (Gippel, Smith and Zhu, 2015). According to Adams, Almeida and Ferreira (2009) and Adams (2016), this is a major problem, especially when estimating the relationship between BGD and firm performance, as a firm’s characteristics (both fixed and variable across time) may affect both the appointment of female directors and the governance choices made by an organization.

For instance, based on institutional theory (DiMaggio and Powell, 1983, Meyer and Rowan, 1977), the larger and more visible an organization, the greater the pressure put on it to comply socially. Hillman, Shropshire and Cannella (2007) emphasize the fact that large listed companies are subject to much attention and are particularly exposed to the scrutiny of a variety of stakeholders (e.g. employees, customers, investors and communities) to increase female representation at all levels of the organization, especially in the boardroom. We also know that large firms behave differently from small ones regarding gender diversity (Martín-Ugedo and Minguez-Vera, 2014). If we do not properly account for firm size, this factor could play a role in the observed correlation between BGD and corporate. Consequently, the eventual outcomes could suffer from omitted variable bias, making it difficult to determine the magnitude of the causal effect of gender diversity (Adams, 2016).

In the same vein, firms that are concerned about female representation on corporate boards may be more likely to appoint directors (the demand side) or may have a larger pool of women candidates on which to draw for board positions (the supply side; see Gabaldon, Anca, Mateos de Cabo and Gimeno, 2015). On the demand side, socially responsible organizations may be more likely to be progressive and appoint WOCB, because female director appointments are a means of displaying their legitimacy to stakeholders (Carleton, Nelson and Weisbach, 1998, Hillman, Shropshire and Cannella, 2007). Within this framework, BGD is a component of corporate social responsibility (CSR) and corporate social performance (CSP). Empirical studies have shown a positive association between BGD and CSR/CSP (e.g. Byron and Post, 2016). On the supply side, socially responsible organizations may appear to be very attractive in the eyes of female directors (Hillman, Shropshire and Cannella, 2007, Turban and Greening, 1997). Indeed, social identity theory suggests that individuals seek to surround themselves with people who share perspectives and values, particularly as a basis for group membership (Dutton and Duncan, 1987, Tajfel and Turner, 1986). Adams and Funk (2012) find in their sample that female directors are more likely to possess what Eagly, Johannesen-Schmidt and Van Engen (2003) labelled 'communal traits':[4] universalism and benevolence, among others.

Firm-specific unobserved variables, i.e. unobserved variables that represent time-invariant properties of firms, such as national institutional systems (Grosvold and Brammer, 2011) or cultural effects towards BGD (Carrasco, Francoeur, Labelle, Laffarga and Ruiz-Barbadillo, 2015), may significantly affect the relationship between BGD and firm performance. Indeed, Grosvold and Brammer (2011) and Carrasco, Francoeur, Labelle, Laffarga and Ruiz-Barbadillo (2015) argue that country-level institutions play a significant role in the female representation on corporate boards and cultural traits significantly affect a firm's performance. However, these antecedents may be difficult to observe and measure. Consequently, these antecedents are usually omitted from econometric specifications.

In this context, whatever the source of the omitted variable bias (which, moreover, can be cumulative), it is possible to observe a statistical relation between BGD and firm performance, even in the absence of a causal relationship between the two variables. In general, the literature deals with this issue by using panel data analysis and fixed-effects estimators, as these can take account of this bias under certain assumptions (Wooldridge, 2010). However, this treatment may not be sufficient because of a second explanation: reverse causality (Adams and Ferreira, 2009).

3.3.3. Reverse causality

Another problem associated with endogeneity is reverse causality (or simultaneity), which occurs when the dependent variable and the variable of interest are jointly determined (Gippel, Smith and Zhu, 2015). There might be a source of endogeneity in the relationship between BGD and firm performance, as the match between corporate boards and female directors is likely to be a function of both firm and individual characteristics (Adams, 2016). Specifically, any correlation between corporate outcomes and BGD may be the result of both the effect of WOCB on outcomes and the effect of outcomes on BGD. In performance specifications, WOCB may affect firm performance, but it is also possible that financially successful firms may be more likely to appoint female directors (Adams and Ferreira, 2009). Not taking into account reverse causality in the specification might produce biased results, as the direction of causality could go both ways (Gippel, Smith and Zhu, 2015). Beyond these two sources of endogeneity, Wintoki, Linck and Netter (2012) categorized a third source of endogeneity: dynamic endogeneity.

[4] In essence, 'communal traits' encompass caring, sensitivity, honesty, understanding, compassion and sympathy (Eagly, Johannesen-Schmidt and Van Engen, 2003).

3.3.4. Dynamic endogeneity

Generally, the term 'dynamic endogeneity' refers to the type of endogeneity that arises when a firm's current actions are correlated to its control environment and future performance (Wintoki, Linck and Netter, 2012). In a general framework of the relation between governance and performance, endogeneity could arise when the current corporate governance mechanisms, control characteristics and firm performance are determined by the firm's past performance. For instance, if a firm suffers from poor performance, it is likely that this situation will prompt shareholders to replace board members who will issue more stringent governance rules. This is likely to affect the firm's current board structures, some control characteristics and performance (Hermalin and Weisbach, 1998). Consequently, Wintoki, Linck and Netter (2012) argue that corporate financial decisions are likely to be dynamic in nature. Raheja (2005) and Harris and Raviv (2008) hypothesize that past performance has a direct influence on a firm's innovation environment or potential profits. All these factors (individually and collectively) might affect the optimal board structure, including female representation on corporate boards. Consequently, Wintoki, Linck and Netter (2012) refer to this relationship as dynamic endogeneity. They find that, in the US market, a dynamic relationship between current governance and past firm performance exists. Their results imply that, if the dynamic endogeneity problem is not carefully controlled, the relation between current board structure and past performance is likely to yield inconsistent results.

3.3.5. Identification strategy

Our main model is as follows:

$$(\text{Firm Performance})_{it} = \alpha + \beta\,(\text{WOCB or BLAU})_{it} + Z_{it}^{'}\,\gamma + \varepsilon_{it} \qquad \textbf{[1]}$$

where *i* denotes firms in the sample, *t* refers to period, (Firm Performance) is a measure of firm performance *i*'s at time *t*, (WOCB / BLAU) is a measure of BGD in the same firm at the same time, Z'_{it} is a vector of observable control variables influencing firm *i*'s performance at time *t*, and ε_{it} is an error term; α, β and γ are parameters to be estimated given a random panel sample of firm observations.

Studies such as Adams and Ferreira (2009) and Carter, D'Souza, Simkins and Simpson (2010) implement a fixed- effects (FE) panel model in order to overcome estimation issues associated with endogeneity. If the unobservable characteristics are constant over time for an individual firm, an FE panel model might produce consistent parameter estimates robust to these unobservable effects (Petersen, 2009). This hypothesis is reasonable if the panel dataset exhibits a small-time series and a large cross section due to unobserved time-invariant characteristics.

An FE panel model only produces consistent parameter estimates under the assumption of strict exogeneity: a firm's corporate governance and controls are orthogonal to past, present and future innovations in performance. As stressed earlier, the problem of endogeneity could violate the assumption of strict exogeneity. Several studies of the BGD-performance relation provide evidence consistent with reverse causality (e.g. Adams and Ferreira, 2009, Sila, Gonzaleza and Hagendorff, 2016). This is likely to violate the strict exogeneity of the FE panel model, as the regressors are correlated with the errors.

The FE approach might not be adequate to control for all sources of endogeneity because of the restrictions mentioned previously. Consequently, we employ the control function method suggested by Wooldridge (2015) as being robust enough to deal with dynamic endogeneity, reverse causality and omitted variable bias.

Wintoki, Linck and Netter (2012) suggest that the dynamic relationship between BGD and firm performance induces that $(\text{WOCB})_{it}$ is a function of past performance, as well as other firm characteristics. Accordingly, the dynamic relationship of BGD might be as follows:

$$(\text{WOCB})_{it} = f[(\text{Past Performance})_{i,t-k}, Z_{it}^{'} \gamma_{it}, \varepsilon_{it}] \quad \textbf{[2]}$$

The notations correspond to those presented in Eq. [1].

To account for dynamic endogeneity, following Arellano and Bond (1991) and Wintoki, Linck and Netter (2012), we extend Eq. [1] by including a lagged dependent variable. Eq. [3] is as follows:

$$(\text{Firm Performance})_{it} = \alpha + \rho\,(\text{Firm Performance})_{i,t-k} + \beta\,(\text{WOCB})_{it} + Z_{it}^{'}\,\gamma + \varepsilon_{it} \quad \textbf{[3]}$$

The number of lags of the dependent variable, i.e. (k), used in Eq. [3] is empirically determined. Existing studies in the corporate governance literature has either used $k=1$ (e.g. Adams and Ferreira, 2009, Dezsö and Ross, 2012) or $k=2$ (e.g. Wintoki, Linck and Netter, 2012) to control any potential effects of the autoregressive process on the stochastic term. Consistent with Nguyen, Locke and Reddy (2014), we use $k=1$, as there are no significant differences between $k=1$ and $k=2$. These authors argue that one-year lagged firm performance is sufficient to construct a complete and dynamic specification of Eq. [3]. Accordingly, when $k=1$, the baseline model is as follows:

$$\begin{aligned}(\text{Firm Performance})_{it} = {} & \alpha + \rho\,(\text{Firm Performance})_{i,t-1} + \beta_1(\text{WOCB or BLAU})_{it} \\ & + \beta_2(\text{fsize})_{it} + \beta_3(\text{lev})_{it} + \beta_4(\text{R \& D})_{it} + \beta_5(\text{growth})_{it} \\ & + \beta_6(\text{fage})_{it} + \beta_7(\text{bindep})_{it} + \beta_8(\text{bsize})_{it} + \beta_9(\text{dual})_{it} + \varepsilon_{it}\end{aligned} \quad \textbf{[4]}$$

Generally, a FE model or a correlated random effects (CRE) model can be used to address the endogeneity associated with unobserved time invariant characteristics. We choose the CRE approach to estimate Eq. [4], as it allows us to recover the coefficients of invariant unobserved variables (Wooldridge, 2015). To address the potential problem of unobserved time-varying factors, we use a control function approach, or CFA (see Wooldridge, 2015), for an introduction).[5] We adopt the CFA rather than the more typical instrumental variables (IV) or 2SLS approach. The CFA is inherently an IV method. Its implementation assumes the availability of variables that do not appear in the equation to be estimated, i.e. excluded instrumental variables, which explains the variation in the endogenous explanatory variable, here $(\text{WOCB or BLAU})_{it}$. The exogenous variation induced by excluded instrumental variables provides a separate variation in the residuals obtained from a reduced form, and these residuals serve as the controls. By adding appropriate control functions, which are usually estimated in a first-stage regression, the endogenous explanatory variable becomes appropriately exogenous in a second-stage regression. We go into the chosen methodology in more detail below.

The model we estimate can be written as:

$$y_{1it} = z_{1it}^{'}\beta_1 + \beta_2 y_{2it} + \rho y_{1i,t-1} + c_{1i} + \eta_t + u_{1it},\ i = 1, \ldots, N \text{ and } t = 1, \ldots, T \quad \textbf{[5]}$$

where y_{it} denotes the performance index of firm i at time t, η_t is a time t effect, y_{2it} is the indicator of BGD of firm i at time t, $\mathbf{z}_{1it}$ is a vector of the control variables, c_{1i} is the firm i fixed effect, and u_{1it} is the usual two-sided error term. In the application,

[5] Recent applications of CFA can be found in Giles and Murtazashvili (2013), Liverpool-Tasie (2017), and López-Feldman and Chávez (2017) and Woldeyohanes, Heckelei and Surry (2017).

- $y_{it} = ROA$
- $w_{it} = WOCB \; or \; Blau$, and
- $z'_{1it} = \begin{pmatrix} \text{firm size, leverage, R \& D, growth, firm age, board independence, board size} \\ \text{and duality} \end{pmatrix}$.

This model is often called the 'structural' model in the control function approach (Wooldridge, 2015).

Let $z_{it} = (z_{i1}, ..., z_{iT})$ denote the vector of the observed strictly exogenous variables (conditional on c_{i1}). Note that $\mathbf{z}'_1$ is part of $\mathbf{z}_i$, i.e. we can define $\mathbf{z}_{it}$ as $z_{it} = (z'_{1it} \; z'_{2it})$, where $\mathbf{z}'_{2it}$ denotes a vector of instrumental variables that are excluded from Eq. [5]. In the application,

- $z'_{2it} = F100$

where $F100$ is the instrumental variable used in this study. Following Reguera-Alvarado, Fuentes and Laffarga (2017), this variable relates to the visibility of the firm. Consistent with these authors, we use a dummy variable that equals 1 if a firm is included in the S&P 100 Index and 0 otherwise. As this index encompasses the largest companies in the US,[6] we hypothesize that those firms are expected to have a higher exposure to investors, customers, communities, media, etc., especially regarding BGD (Hillman, Shropshire and Cannella, 2007).

This model allows for two types of unobserved heterogeneity among firms: a time-constant unobserved heterogeneity, c_{1i}, and time-varying unobservable, u_{it}. Thus, there are two kinds of potential omitted variables. The time-constant heterogeneity, c_{1i}, may be correlated with y_{2it} and $\mathbf{z}_i$. Second, the time-varying omitted variables captured by the error term u_{it} are, by definition, uncorrelated with $\mathbf{z}_i$ – strict exogeneity – but may be correlated with y_{2it}. These two issues can be addressed using simultaneously the control function approach and the correlated random effect estimator.

In a control function approach, it is assumed that the reduced form of the endogenous explanatory variable y_{2it} is a linear projection in the population, or:

$$y_{2it} = z'_{1it}\delta_1 + z'_{2it}\delta_2 + c_{2i} + u_{2it} \quad \textbf{[6]}$$

The classical rank condition of identification in IV estimation can now be written as $\delta_2 \neq 0$, and tested using a classical F-test. This equation can also be written as:

$$y_{2it} = z'_{it}\delta_1 + c_{2i} + u_{2it} \quad \textbf{[7]}$$

Eq. [7] can be estimated using a classical FE estimator but this approach prevents the use of any time-invariant regressors in the equation. Another estimation strategy is then to use the correlated random estimator proposed by Mundlak (1978). This estimator is based on the assumption that:

$$c_{2i} = \bar{z}_i\lambda + a_{2i} \quad \textbf{[8]}$$

Where $\bar{z}_{ji}$ denotes the time average of the j^{th} variable for firm i, i.e. $\bar{z}_{ji} = T^{-1}\sum_{t=1}^{T} z_{jit}$. Then, plugging Eq. [8] into Eq. [7], the latter becomes:

[6] 63% of the market capitalization of the S&P 500 and approximately 51% of the market capitalization in the US (source: Standard & Poor's).

$$y_{2it} = z_{it}^{'}\delta + \bar{z}_i\lambda + v_{2it} \qquad \textbf{[9]}$$

where $v_{2it} = a_{2i} + u_{2it}$. This equation can be estimated by pooled OLS as $E(a_{2i} + u_{2it} | z_{it}) = 0$. It is important to note that (i) this approach can be shown to be equivalent to fixed-effect estimation, (ii) it can be used to estimate the effects of time-invariant variables, and (iii) a simple test of correlation between c_{2i} and $\bar{z}_i$ can be performed using H_0: $\lambda = 0$.

Endogeneity of y_{2it} arises in Eu. [5] if and only if u_{1it} in Eu. [5] is correlated with u_{2it} in Eq. [6]. We can summarize this by writing the linear projection of u_{1it} on u_{2it} in error form as:

$$\begin{aligned} u_{1it} &= \theta\, u_{2it} + e_{1it} \\ u_{1it} &= \theta\,(v_{2it} - a_{2i}) + e_{1it} \end{aligned} \qquad \textbf{[10]}$$

where $\theta = E(u_{2it}\, u_{1it}) / E(u_{1it}^2)$ is the population regression coefficient. Note that, in this construction, $E(u_{2it}\, e_{1it}) = 0$ and $E(z_{it}\, e_{1it})$, because both u_{1it} and u_{2it} are uncorrelated with z_{it}. Thus, $E(y_{2it}\, e_{1it}) = 0$.

$$\begin{aligned} y_{1it} &= z_{1it}^{'}\beta_1 + \beta_2\, y_{2it} + \rho\, y_{1i,t-1} + c_{1i} + \phi(v_{2it} - a_{2i}) + e_{1it} \\ y_{1it} &= z_{1it}^{'}\beta_1 + \beta_2\, y_{2it} + \rho\, y_{1i,t-1} + c_{1i} + \phi\, v_{2it} + (c_{1i} - \theta\, a_{2i}) + e_{1it} \\ y_{1it} &= z_{1it}^{'}\beta_1 + \beta_2\, y_{2it} + \rho\, y_{1i,t-1} + \theta\, v_{2ii} + c_{0i} + e_{1it} \end{aligned} \qquad \textbf{[11]}$$

where $c_{0i} = c_{1i} - \theta\, a_{2i}$. We now view v_{2it} as an additional explanatory variable in Eq. [5]. The introduction of this additional variable now makes it possible to avoid the problem of the endogeneity of y_{2it} when estimating β_2 in Eq. [11]. However, we are still faced with the problem of a possible correlation between the fixed effect c_{0i} and this additional variable. We can proceed in the same way as we did for the fixed effect in Eq. [5], i.e. by assuming that:

$$c_{0i} = \alpha_0\, \bar{v}_{2i} + a_{1i} \qquad \textbf{[12]}$$

where $\bar{v}_{2i}$ denotes the time average of the v_{2ii} s for firm i, i.e $\bar{v}_{2i} = T^{-1}\sum_{t=1}^{T} v_{2it}$.

Finally, plugging Eq. [12] into Eq. [11], we have the following 'augmented' model:

$$y_{1it} = z_{1it}^{'}\beta_1 + \beta_2\, y_{2it} + \rho\, y_{1i,t-1} + \theta\, v_{2it} + \alpha_0 \bar{v}_{2i} + a_{1i} + e_{1it} \qquad \textbf{[13]}$$

where, now $E(a_{1i} + e_{1it} | y_{2it}) = 0$. This equation can be estimated using pooled OLS.

To sum up, estimation of the impact of BGD is performed in two steps:

1. Estimation of the reduced form, Eq. [9] for y_{2it}, using pooled OLS. Obtain residuals $\hat{v}_{2it}$ for all (i,t) pairs and computation of $\bar{\hat{v}}_{2it} = T^{-1}\sum_{t=1}^{T}\hat{v}_{2it}$.
2. Estimation of the augmented regression from Eq. [13], in which we replace v_{2it} and $\bar{v}_{2i}$ with their estimated values $\hat{v}_{2it}$ and $\hat{\bar{v}}_{2i}$, using pooled OLS. Testing the endogeneity of y_{2it} is now equivalent to testing H_0: $\theta = 0$ using robust t-statistics.

Finally, because of the two-step procedure, the standard errors in the second step are known to be incorrect. Murphy and Topel (2002) proposed a general method of calculating the correct asymptotic covariance matrix for the second step estimators. However, this method entails complicated calculations. Instead, we prefer to estimate the robust standard errors in the second step using a bootstrap technique; that is to say, by resampling the firms a large number of times. This number can be fixed, following Davidson and MacKinnon (2000).

For purposes of comparison, in our tables we report the results of pooled OLS and the panel FE of Eq. [4].

3.4. Descriptive statistics and correlation analysis

Table 1 presents descriptive statistics of all the variables. The mean ROA is 7.65%. However, there is a large variation in ROA within the sample firms, as the minimum is -61.82% and the maximum is 46.84%. Compared to Adams and Ferreira (2009) and Carter, D'Souza, Simkins and Simpson (2010),[7] the firms in our sample enjoyed a better economic performance, the aforementioned studies finding mean (ROA) values of 3.19% and 3.90%, respectively. This is probably due to our time window being more recent (2004-2015), compared to 1996-2003 and 1998-2002, respectively.

The mean (resp. median) percentage of WOCB is approximately 25% (resp. 28%), which is significantly higher than that reported by Adams and Ferreira (2009) of 8.50%. The more recent time period of our study may explain the difference. The Blau index of BGD ranges from 0.00 (i.e. no WOCB) to 0.50 (half of the board are female directors). Approximately 85% of the firms in our sample have at least one female director. This proportion is much larger than the 61% reported by Adams and Ferreira (2009). Finally, the average number of WOCB is 1.76, while Carter, D'Souza, Simkins and Simpson (2010) reported 1.30 for their sample. In a nutshell, women have been more prominent in the boardrooms in the last decade. Female directors seem to have made significant inroads on governance bodies.

Relative to Carter, D'Souza, Simkins and Simpson (2010), the firms in our sample are larger in terms of assets (9.39 vs. 8.35) and managed by slightly smaller boards (10.52[8] vs. 11.21[9]). Compared to Adams and Ferreira (2009), the firms in our sample are more independent (82% vs. 63%). Finally, relative to Carter, D'Souza, Simkins and Simpson (2010), 57% (vs. 71%) of the firms in our sample have CEOs acting as chairs.

Ultimately, given the above differences, the firms in our sample seem to have significant differences with existing studies. This observation has to be underlined.

[Place Table 1 here]

Table 2 reports the correlations among the variables. As a rule of thumb, a correlation of 0.70 or higher in absolute value may indicate a multicollinearity issue (Liu, Wei and Xie, 2014). The results show that the highest correlation coefficient of 0.98 (in bold) appears between the percentage of WOCB and the Blau index. However, since these two variables are used alternately in Eq. [4], their high correlation is not an issue. No other correlation coefficient has an absolute value higher than 0.7.

To make sure that multicollinearity is not a problem in Eq. [4], we calculated the variance inflation factors (VIF) for all the variables (Wooldridge, 2014). The VIFs ranged from 1.02 to 2.31, well below the cut-off of 10 recommended by Wooldridge (2014). Consequently, we concluded that multicollinearity had little impact on our analyses.

---

7 The two main studies examining the relationship between BGD and firm performance, using ROA as their measure of performance.

8 Non-logarithmic values.

9 Adams and Ferreira (2009) reported a board size value of 9.38.

Table 2 also reveals several significant correlations between the variables. First, there is a significant and positive relationship between ROA_t and ROA_{t-1}, confirming the hypothesis developed by Wintoki, Linck and Netter (2012) that past performance may affect current performance. Second, Table 2 shows a significant and positive relationship (at the 1% level) between our measures of BGD and firm size. This suggests that larger firms are more likely to appoint female directors (Hillman, Shropshire and Cannella, 2007).

[Place Table 2 here]

4. Results

Table 3 presents the estimates of Eq. [4] with the percentage of WOCB as our explanatory variable. The results obtained from pooled OLS and FE estimations are reported in columns 1 and 2 of Table 3, respectively. The results associated with the CF method are displayed in columns 3 to 5.

Regardless of the method used, we note that the coefficient related to past performance is found to be positive and significant (at the 1% level), supporting the claim of Wintoki, Linck and Netter (2012) that performance is path-dependent, i.e. past performance has a significant effect on current performance.

In column 1 of Table 3, the coefficient of the WOCB variable is found to be statistically positive at the 5% level of significance (β = 0.028; t = 0.05). Conversely, this variable is found not to be statistically significant at the 10% level in the FE model (column 2 of Table 3).

Let us turn now to the CF approach. Before going into the detail of Eq. [4], we need to establish whether our instrument is significantly related to the percentage of WOCB. The results of the first-stage instrumental variable are shown in column 3 of Table 3. We can see that the variable associated with WOCB is positively and significantly (at the 1% level) linked to belonging to the S&P 100 index (our instrumental variable), firm size, age of the firm and board independence. The instrument we chose thus has a significant effect on the percentage of WOCB after controlling for other characteristics of the firms. This is clearly confirmed by the p-values associated with the rank condition test. As the variable F100 has the sign we expected, our model therefore makes theoretical sense. Column 4 of Table 3 reports the results of the estimation of Eq. [13]. We begin by considering the percentage of WOCB as exogenous. As previously, we find that past performance has a positive and significant effect (at the 1% level) on current performance, thereby confirming the hypothesis of Wintoki, Linck and Netter (2012) regarding dynamic endogeneity.

The possibility that BGD is endogenous is then taken into account via the incorporation of the estimated residual of the first-stage regression as an additional variable in Eq. [13]. The results reported in Table 3 clearly show that WOCB must be considered as endogenous. The residual is indeed significantly different from zero. WOCB always has a significantly positive effect on the performance of a firm. Where WOCB is treated as endogenous, however, the effect is seven times higher than in the case where WOCB is considered as exogenous. Everything else being equal, a one standard deviation increases in the percentage of WOCB (an increase in the number of female directors by about 1.3) corresponds to an estimate increase in firm profitability (ROA) of approximately 3.49.[10]

[Place Table 3 here]

[10] Based on the figures in Table 1.

To confirm the previous results of Eq. [13], we also use the Blau index as our independent variable. The results are shown in Table 4. Overall, our results are consistent with those presented earlier, that WOCB has a positive and significant effect (at the 1% level) on firm profitability. This effect is six times higher when WOCB is considered as endogenous. A one standard deviation increase in WOCB yields an estimated increase in firm profitability of 2.44%. It should be noted that the effect of past performance is significant and positive, and has the same magnitude, whether the percentage of WOCB is considered as exogenous.

[Place Table 4 here]

As far as the control variables are concerned, we notice that, consistent with previous studies (e.g. Adams and Ferreira, 2009, Isidro and Sobral, 2015) firm size has a negative and significant effect (at the 1% level) on firm profitability in models 5 and 10. This result suggests that larger firms have more complex activities and are more difficult for investors to monitor. As expected, leverage is, in all models, negatively and significantly (at the 1% level) correlated to firm profitability, suggesting that leverage is not an efficient mechanism, in our sample firms, for reducing agency conflict in a firm. Our results are consistent with Isidro and Sobral (2015).

Regarding board characteristics, we find that board size and board independence are negatively and significantly related to firm profitability only when BGD is endogenous (see models 5 and 10). We notice that the size and independence of a board are not statistically significant at the 10% level when the endogeneity of board structure is not properly taken into account (see models 1, 2, 6 and 7), confirming the claim by Adams, Hermalin and Weisbach (2010) on this matter. The fact that board size is negatively correlated with firm profitability is consistent with previous studies, such as Adams, Almeida and Ferreira (2005) and Cheng (2008), among others. This is in line with the view that larger boards need to comprise to reach consensus and, consequently, induce destruction in firm performance. Finally, the significant negative relationship between board independence and firm profitability is consistent with Agrawal and Knoeber (1996) and Bebchuk and Cohen (2005), among others. According to Faleye (2007), this is due to the fact that "the costs of weak advising outweigh the board's monitoring" (p. 177).

5. Concluding remarks

5.1. Conclusions

Claims that BGD improves firm performance are abundant in the business press and in academic literature (Terjesen, Sealy and Singh, 2009). There is no consensus in the literature regarding the effect of WOCB on firm performance, as the results are mixed (Post and Byron, 2015). This study seeks to shed light on the topic. Consistent with Adams, Almeida and Ferreira (2009) and Wintoki, Linck and Netter (2012), we argue that not properly taking into account the problem of endogeneity that arises because of differences in unobservable characteristics across firms, reverse causality and dynamic endogeneity may induce erroneous inferences regarding the relationship between BGD and firm performance. The contrasting results mentioned by Post and Byron (2015) are probably explained by this observation. Accordingly, we pay careful attention to endogeneity issues that could mitigate the finding by using the CF method developed by Wooldridge (2015), instead of the generalized method of moments (GMM) classically used in the literature In essence, Wooldridge (2010) defines the CF as a proxy variable that renders an endogenous explanatory variable exogenous (when conditioned on) in a regression.. Overall, we find that BGD is positively and significantly (at the 1% level) correlated to firm profitability. The economic effect is higher when BGD is considered as exogenous. In line with Wintoki, Linck and Netter (2012), we also find that past performance has a significant effect on the relationship between BGD and firm performance, confirming the claim of these authors regarding dynamic endogeneity. Our findings confirm the results of Farrell and Hersch (2005), who find a positive relationship between ROA and the likelihood of appointing a higher proportion of female directors to boards. Our study confirms some previous studies on the positive link between BGD and firm performance (e.g. Liu, Wei and Xie, 2014, Reguera-Alvarado, Fuentes and Laffarga, 2017).

Our study, like those cited above, temper the assertion of Adams and Ferreira (2009) and Ferreira (2015) that when the endogenous characteristics of women's representation on corporate boards is taken into, the relationship is necessarily negative. Our findings do not support this assumption. We argue that idiosyncratic characteristics of firms are likely to have a significant influence on the relationship between BGD and firm performance. Indeed, our results may be influenced by the 'critical mass' of WOCB (Joecks, Pull and Vetter, 2013, Konrad, Kramer and Erkut, 2008). Critical mass theory (Kanter, 1977) suggests that the interactions within a group depend fundamentally upon the size of the group. When a sub-group size reaches a certain threshold, or critical mass, the influence of this sub-group increases significantly. As shown in Table 2, the mean percentage of WOCB is about 25% (vs. 8.50% for Adams and Ferreira, 2009), with 21% of firms in the sample having at least three women on their corporate board. Joecks, Pull and Vetter (2013) argued that critical mass is a key component in assessing the relationship between BGD and firm performance. Consequently, different firms' idiosyncrasies may alter the link.

Consequently, this article offers new insights regarding the relationship between BGD and economic results (measured by the ROA) resulting from new US data and a new econometric approach (via the CF method).

5.2. Implications

Our results offer some managerial insights and policy implications. First, we support, to some extent, the business case for BGD, since we find a positive and significant relationship between BGD and firm profitability. Second, our findings suggest that firms should have a more efficient view regarding having WOCB, as we show that a greater proportion of WOCB creates value of, more or less, 3% on ROA. This increase in firm economic performance is often accompanied by greater visibility and commitments to CSR, which in turn affects CSP (Boulouta, 2013). Third, this research has strong implications for both governments and lawmakers (market regulators), as well as shareholders and fund managers, in terms of enhancing public decision-making towards BGD and portfolio management.

5.3. Limitations

Our study is not without limitations. First, we analyze the impact of BGD on firm profitability in the US context (English-origin countries; see La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1998). Grosvold and Brammer (2011) argue that institutional, cultural and political systems are important when analyzing the relationship between BGD and firm performance. Hence, further cross-country studies are necessary to confirm (or dispute) our findings, as they might be driven by national specificities. Second, our study focuses on the largest US listed companies in the S&P 500 index. Further studies are needed on small- and medium-sized firms, entrepreneurial and private equity firms, and public sector firms and nonprofit organizations, since they are significantly different (e.g. in terms of capital structure or ownership). The differences may significantly affect the relationship between BGD and firm performance.

References

Adams R, Almeida H, Ferreira D, Understanding the relationship between founder-CEOs and firm performance. Journal of Empirical Finance 2009;16; 136-150

Adams RB, Women on boards: The superheroes of tomorrow? The Leadership Quarterly 2016;27; 371-386

Adams RB, Almeida H, Ferreira D, Powerful CEOs and their impact on corporate performance. Review of Financial Studies 2005;18; 1403-1432

Adams RB, Ferreira D, Women in the boardroom and their impact on governance and performance. Journal of Financial Economics 2009;94; 291-309

Adams RB, Funk P, Beyond the glass ceiling: Does gender matter? Management Science 2012;58; 219-235

Adams RB, Haan J, Terjesen S, Ees H, Board diversity: Moving the field forward. Corporate Governance: An International Review 2015;23; 77-82

Adams RB, Hermalin BE, Weisbach MS, The role of boards of directors in corporate governance: A conceptual framework and survey. Journal of Economic Literature 2010;48; 58-107

Agrawal A, Knoeber CR, Firm performance and mechanisms to control agency problems between managers and shareholders. Journal of Financial and Quantitative Analysis 1996;31; 377-397

Ahern KR, Dittmar AK, The changing of the boards: The impact on firm valuation of mandated female board representation. Quarterly Journal of Economics 2012;127; 137-197

Amore MD, Garofalo O, Minichilli A, Gender interactions within the family firm. Management Science 2014;60; 1083-1097

Anderson JC, Reeb DM, Founding-family ownership and firm performance: evidence from the S&P 500. Journal of Finance 2003;58; 1301-1328

Arellano M, Bond S, Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 1991;58; 277

Ashforth BE, Mael F, Social identity theory and the organization. Academy of management review 1989;14; 20-39

Bart C, McQueen G, Why women make better directors. International Journal of Business Governance and Ethics 2013;8; 93-99

Bebchuk LA, Cohen A, The costs of entrenched boards. Journal of Financial Economics 2005;78; 409-433

Bhagat S, Bolton B, Corporate governance and firm performance. Journal of Corporate Finance 2008;14; 257-273

Blau PM. Inequality and heterogeneity: a primitive theory of social structure. Collier Macmillan: New York; 1977.

Boone AL, Field LC, Karpoff JM, Raheja CG, The determinants of corporate board size and composition: An empirical analysis. Journal of Financial Economics 2007;85; 66-101

Boulouta I, Hidden connections: The link between board gender diversity and corporate social performance. Journal of Business Ethics 2013;113; 185-197

Byron K, Post C, Women on goards of directors and corporate social performance: A meta-analysis. Corporate Governance: An International Review 2016;24; 428-442

Campbell K, Mínguez-Vera A, Gender diversity in the boardroom and firm financial performance. Journal of Business Ethics 2008;83; 435-451

Carleton WT, Nelson JM, Weisbach MS, The influence of institutions on corporate governance through private negotiations: Evidence from TIAA-CREF. Journal of Finance 1998;53; 1335-1362

Carpenter MA, The implications of strategy and social context for the relationship between top management team heterogeneity and firm performance. Strategic Management Journal 2002;23; 275-284
Carrasco A, Francoeur C, Labelle R, Laffarga J, Ruiz-Barbadillo E, Appointing women to boards: is there a cultural bias? Journal of Business Ethics 2015;129; 429-444
Carter DA, D'Souza F, Simkins BJ, Simpson WG, The gender and ethnic diversity of US boards and board committees and firm financial performance. Corporate Governance: An International Review 2010;18; 396-414
Chan SH, Martin JD, Kensinger JW, Corporate research and development expenditures and share value. Journal of Financial Economics 1990;26; 255-276
Cheng S, Board size and the variability of corporate performance. Journal of Financial Economics 2008;87; 157-176
Coles JL, Daniel ND, Naveen L, Boards: Does one size fit all? Journal of Financial Economics 2008;87; 329-356
Daily CM, Certo ST, Dalton DR, A decade of corporate women: Some progress in the boardroom, none in the executive suite. Strategic Management Journal 1999;20; 93
Dang R, Bender A-F, Scotto M-J, Women on French corporate board of directors: How do they differ from their male counterparts? Journal of Applied Business Research 2014;30; 489-507
Davidson R, MacKinnon JG, Bootstrap tests: How many bootstraps? Econometric Reviews 2000;19; 55-68
Dezsö CL, Ross DR, Does female representation in top management improve firm performance? A panel data investigation. Strategic Management Journal 2012;33; 1072-1089
Dickson PR, Ginter JL, Market segmentation, product differentiation, and marketing strategy. Journal of Marketing 1987;51; 1-10
DiMaggio PJ, Powell WW, The iron cage revisited: Collective rationality and institutional isomorphism in organizational fields. American Sociological Review 1983;48; 147-160
Dutton JE, Duncan RB, The creation of momentum for change through the process of strategic issue diagnosis. Strategic Management Journal 1987;8; 279-295
Eagly AH, Johannesen-Schmidt MC, The leadership styles of women and men. Journal of Social Issues 2001;57; 781-797
Eagly AH, Johannesen-Schmidt MC, Van Engen ML, Transformational, transactional, and laissez-faire leadership styles: a meta-analysis comparing women and men. Psychological Bulletin 2003;129; 569
Eberhart AC, Maxwell WF, Siddique AR, An examination of long-term abnormal stock returns and operating performance following R&D increases. The Journal of Finance 2004;59; 623-650
Faleye O, Does one hat fit all? The case of corporate leadership structure. Journal of Management & Governance 2007;11; 239-259
Fama EF, Jensen MC, Separation of ownership and control. Journal of Law and Economics 1983;26; 301-326
Farrell KA, Hersch PL, Additions to corporate boards: the effect of gender. Journal of Corporate Finance 2005;11; 85-106
Ferreira D, Board diversity: Should we trust research to inform policy? Corporate Governance: An International Review 2015;23; 108-111
Finkelstein S, D'aveni RA, CEO duality as a double-edged sword: How boards of directors balance entrenchment avoidance and unity of command. Academy of Management journal 1994;37; 1079-1108
Finkelstein S, Hambrick DC, Cannella Jr. AA. Strategic leadership: Theory and research on executives, top management, teams, and boards. Oxford University Press: Ney York; 2009.

Gabaldon P, Anca C, Mateos de Cabo R, Gimeno R, Searching for women on boards: An analysis from the supply and demand perspective. Corporate Governance: An International Review 2015;
Galbreath J, Is board gender diversity linked to financial performance? The mediating mechanism of CSR. Business & Society 2016; 1-27
Giles J, Murtazashvili I, A control function approach to estimating dynamic Probit model with endogenous regressors. Journal of Econometric Methods 2013;2; 69-87
Gippel J, Smith T, Zhu Y, Endogeneity in accounting and finance research: Natural experiments as a state-of-the-art solution. Abacus 2015;51; 143-168
Green TC, Jame R, Company name fluency, investor recognition, and firm value. Journal of Financial Economics 2013;109; 813-834
Grosvold J, Brammer S, National institutional systems as antecedents of female board representation: An empirical study. Corporate Governance: An International Review 2011;19; 116-135
Hambrick DC, Upper echelons theory: An update. Academy of Management Review 2007;32; 334-343
Hambrick DC, Mason PA, Upper echelons: The organization as a reflection of its top managers. Academy of Management Review 1984;9; 193-206
Harris M, Raviv A, A theory of board control and size. Review of Financial Studies 2008;21; 1797-1832
Hermalin BE, Weisbach MS, The determinants of board composition. RAND Journal of Economics 1988;19; 589-606
Hermalin BE, Weisbach MS, Endogenously chosen boards of directors and their monitoring of the CEO. American Economic Review 1998;88; 96-118
Hermalin BE, Weisbach MS, Boards of directors as an endogenously determined institution: A survey of the economic literature. Economic Policy Review 2003;9; 7-20
Hillman AJ, Cannella AA, Jr., Harris IC, Women and racial minorities in the boardroom: How do directors differ? Journal of Management 2002;28; 747-763
Hillman AJ, Shropshire C, Cannella AA, Jr., Organizational predictors of women on corporate boards. Academy of Management Journal 2007;50; 941-952
Honoré F, Munari F, de La Potterie BvP, Corporate governance practices and companies' R&D intensity: Evidence from European countries. Research policy 2015;44; 533-543
Isidro H, Sobral M, The effects of women on corporate boards on firm value, financial performance, and ethical and social compliance. Journal of Business Ethics 2015;132; 1-19
Jensen MC, Meckling WH, Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics 1976;3; 305-360
Joecks J, Pull K, Vetter K, Gender diversity in the boardroom and firm performance: What exactly constitutes a 'critical mass?'. Journal of Business Ethics 2013;118; 61-72
Kanter RM. Men and women of the Corporation. Basic Books: New York; 1977.
Konrad AM, Kramer V, Erkut S, Critical mass: The impact of three or more women on corporate boards. Organizational Dynamics 2008;37; 145-164
Krishnan HA, Park D, A few good women-on top management teams. Journal of Business Research 2005;58; 1712-1720
La Porta R, Lopez-de-Silanes F, Shleifer A, Vishny RW, Law and finance. Journal of Political Economy 1998;106; 1113-1155
Linck JS, Netter JM, Yang T, The determinants of board structure. Journal of Financial Economics 2008;87; 308-328
Liu Y, Wei Z, Xie F, Do women directors improve firm performance in China? . Journal of Corporate Finance 2014;28; 169-184

Liverpool-Tasie LSO, Is fertiliser use inconsistent with expected profit maximization in sub-Saharan Africa? “Evidence from Nigeria”. Journal of Agricultural Economics 2017;68; 22-44
López-Feldman A, Chávez E, Remittances and Natural Resource Extraction: Evidence from Mexico. Ecological Economics 2017;132; 69-79
Loyd DL, Wang CS, Phillips KW, Lount Jr RB, Social category diversity promotes premeeting elaboration: The role of relationship focus. Organization Science 2013;24; 757-772
Martín-Ugedo JF, Minguez-Vera A, Firm performance and women on the board: Evidence from Spanish small and medium-sized enterprises. Feminist Economics 2014;20; 136-162
Meyer JW, Rowan B, Institutionalized Organizations: Formal Structure as Myth and Ceremony. Institutionalized Organizations: Formal Structure as Myth and Ceremony 1977;83; 340-363
Miller T, del Carmen Triana M, Demographic diversity in the boardroom: Mediators of the board diversity-firm performance relationship. Journal of Management Studies 2009;46; 755-786
Milliken FJ, Martins LL, Searching for common threads: Understanding the multiple effects of diversity in organizational groups. Academy of Management Review 1996;21; 402-433
Mundlak Y, On the pooling of time series and cross section data. Econometrica 1978;46; 69-85
Murphy KM, Topel RH, Estimation and inference in two-step econometric models. Journal of Business & Economic Statistics 2002;20; 88-97
Nguyen T, Locke S, Reddy K, A dynamic estimation of governance structures and financial performance for Singaporean companies. Economic Modelling 2014;40; 1-11
Nielsen S, Huse M, The contribution of women on boards of directors: Going beyond the surface. Corporate Governance: An International Review 2010;18; 136-148
Petersen MA, Estimating standard errors in finance panel data sets: Comparing approaches. Review of Financial Studies 2009;22; 435-480
Pfeffer J, Salancik GR. The external control of organizations: A resource dependence perspective. Harper & Row: New York; 1978.
Post C, Byron K, Women on boards and firm financial performance: A meta-analysis. Academy of Management Journal 2015;58; 1546-1571
Raheja CG, Determinants of board size and composition: A theory of corporate boards. Journal of Financial and Quantitative Analysis 2005;40; 283-306
Reguera-Alvarado N, Fuentes P, Laffarga J, Does board gender diversity influence financial performance? Evidence from Spain. Journal of Business Ethics 2017;141; 1-14
Robinson G, Dechant K, Building a business case for diversity. Academy of Management Executive 1997;11; 21-31
Rose C, Does female board representation influence firm performance? The Danish evidence. Corporate Governance: An International Review 2007;15; 404-413
Shleifer A, Vishny RW, A survey of corporate governance. Journal of Finance 1997;52; 737-783
Sila V, Gonzaleza A, Hagendorff J, Women on board: Does boardroom gender diversity affect firm risk. Journal of Corporate Finance 2016;36; 26-53
Singh V, Terjesen S, Vinnicombe S, Newly appointed directors in the boardroom: How do women and men differ? European Management Journal 2008;26; 48-58
Smith WR, Product differentiation and market segmentation as alternative marketing strategies. Journal of Marketing 1956;21; 3-8
Tajfel H. Human groups and social categories. Cambridge University Press: Cambridge; 1981.

Tajfel H, Turner JC 1986. The social identity of intergroup relations. In: S Worchel, WG Austin (Eds), Psychology of intergroup relations, Psychology of intergroup relations. Nelson-Hall: Chicago; 1986. p. 7–24.
Terjesen S, Sealy R, Singh V, Women directors on corporate boards: A review and research agenda. Corporate Governance: An International Review 2009;17; 320-337
Turban DB, Greening DW, Corporate social performance and organizational attractiveness to prospective employees. Academy of Management Journal 1997;40; 658-672
van Ginkel WP, van Knippenberg D, Group information elaboration and group decision making: The role of shared task representations. Organizational behavior and human decision processes 2008;105; 82-97
Venkatraman N, Grant JH, Construct measurement in organizational strategy research: A critique and proposal. Academy of Management Review 1986;11; 71-87
Wintoki MB, Linck JS, Netter JM, Endogeneity and the dynamics of internal corporate governance. Journal of Financial Economics 2012;105; 581-606
Woldeyohanes T, Heckelei T, Surry Y, Effect of off-farm income on smallholder commercialization: panel evidence from rural households in Ethiopia. Agricultural Economics 2017;48; 207-218
Wooldridge JM. Econometric analysis of cross section and panel data. MIT Press: Cambridge; 2010.
Wooldridge JM. Introduction to econometrics. Cengage Learning: Andover; 2014.
Wooldridge JM, Control Function Methods in Applied Econometrics. Journal of Human Resources 2015;50; 420-445
Yermack D, Higher market valuation of companies with a small board of directors. Journal of Financial Economics 1996;40; 185-211

Table 1

Descriptive statistics (N = 3,446)

Variables	Mean	SD	Median	Min.	Max.
ROA	7.650	7.939	7.335	-61.821	46.841
WOCB	16.000	9.493	16.667	0.000	54.545
Blau index	0.251	0.125	0.278	0.000	0.5000
Firm size	9.389	1.212	9.276	5.968	13.590
Leverage (%)	24.625	16.797	22.874	0.000	146.908
R&D (%)	4.674	15.920	0.468	0.000	540.072
Firm growth	8.944	39.124	6.232	-100.000	1,549.391
Firm age	3.790	0.950	3.912	0.000	5.361
Board independence (%)	82.503	10.353	77.778	16.667	100.000
Board size	2.353	0.202	2.398	1.386	2.996
Duality	0.574	0.495	1.000	0.000	1.000
S&P 100	0.205	0.403	0.000	0.000	1.000

Variables are defined in sub-section 3.2.

Table 2

Correlation matrix

		1	**2**	**3**	**4**	**5**	**6**
1	ROA	1.000					
2	Lagged ROA	0.575***	1.000				
3	WOCB	0.007	0.011	1.000			
4	Blau index	0.005	0.009	**0.978*** **	1.000		
5	Firm size	-0.155**	-0.136	0.216***	0.233***	1.000	
6	Leverage (%)	-0.220***	-0.187***	0.032	0.025	0.062***	1.000
7	R&D (%)	-0.190***	-0.193***	-0.020	-0.015	-0.101***	-0.103***
8	Firm growth	0.112***	-0.026	-0.060***	-0.071***	-0.044	-0.081***
9	Firm age	0.034	0.040	0.216***	0.231***	0.127***	0.121***
10	Board indep.	-0.057***	-0.036	0.208***	0.223***	0.163***	0.043
11	Board size	-0.096***	-0.089***	0.230***	0.271***	**0.497*** **	0.089***
12	Duality	0.008	0.014	0.088	0.083***	0.115***	0.048***
13	S&P 100	0.072***	0.099***	0.185***	0.199***	0.629***	-0.039***
		7	**8**	**9**	**10**	**11**	**12**
7	R&D (%)	1.000					
8	Firm growth	0.032	1.000				
9	Firm age	-0.077***	-0.106***	1.000			
10	Board indep.	0.010	-0.076***	0.134***	1.000		
11	Board size	-0.066***	-0.057***	0.187***	0.115***	1.000	
12	Duality	-0.065***	0.002	0.185***	0.196***	0.052***	1.000
13	S&P 100	0.011	-0.049***	0.142***	0.133***	0.279***	0.167***
		12					
13	S&P 100	1.000					

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
VIF	1.22	1.20	1.13	1.17	2.31	1.09	1.10	1.02	1.14	1.10	1.40	1.10	1.92

Variables are defined in sub-section 3.2. *** indicates significance at the 1% level.

Table 3

Results: ROA and WOCB

	Pooled OLS	Fixed effects	Control function		
			First stage	Second stage	
				Exogenous	Endogenous
	(1)	(2)	(3)	(4)	(5)
F100			1.765***		
			(0.498)		
Lagged ROA	0.532***	0.143**		0.686***	0.678***
	(0.037)	(0.034)		(0.013)	(0.030)
WOCB	0.028**	-0.021		0.035***	0.279***
	(0.014)	(0.025)		(0.010)	(0.102)
Firm size	-0.587***	-0.282	2.942***	-0.420***	-0.591***
	(0.143)	(0.778)	(0.516)	(0.082)	(0.130)
Leverage	-0.065***	-0.178***	0.035*	-0.041***	-0.037***
	(0.011)	(0.031)	(0.021)	(0.006)	(0.007)
R&D	-0.048***	-0.071***	-0.024	-0.029***	-0.032*
	(0.010)	(0.025)	(0.017)	(0.006)	(0.021)
Firm growth	0.023*	0.027*	-0.002	0.022***	0.023*
	(0.013)	(0.015)	(0.004)	(0.003)	(0.016)
Firm age	0.323**	3.550***	2.640***	0.210**	-0.126
	(0.139)	(0.895)	(1.003)	(0.096)	(0.191)
Board indep.	-0.011	0.025	0.119***	-0.013	-0.046***
	(0.013)	(0.023)	(0.028)	(0.009)	(0.017)
Board size	0.124	-0.885	-0.338	0.450	-1.453**
	(0.732)	(1.196)	(1.588)	(0.533)	(0.839)
Duality	0.017	0.113	0.296	0.054	-0.045
	(0.258)	(0.523)	(0.320)	(0.188)	(0.170)
Constant	9.660***	0.184	-21.834***	5.765***	11.905***
	(2.020)	(6.827)	(2.538)	(1.286)	(2.916)
Firm fixed effects	No	Yes			
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	3,061	3,061	3,440	3,058	3,058
R^2	0.378	0.147	0.141	0.549	0.552
Rank condition (*p*-value)			< 0.001		
First-stage residual					-0.291***
					(0.103)

Note: This table reports empirical results from estimating Eq. [13]. Specifically, column 1 reports the results obtained from the OLS method with clustering at the firm level. Column 2 presents the results obtained from the fixed-effects (within-groups estimator) method. Finally, columns 3 to 5 present the results from the CF approach.

Variables are defined in sub-section 3.2.

Regressions in column 3 include time averages of the explanatory variables. Columns 4 and 5 include bootstrapped robust standard errors with 399 replications. Furthermore, regressions include time averages of the first-stage residuals.

Robust standard errors are shown in parenthesis.

The asterisks ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 4

Results: ROA and Blau index

	Pooled OLS	Fixed effects	Control function		
			First stage	Second stage	
				Exogenous	Endogenous
	(6)	(7)	(8)	(9)	(10)
F100			2.412*** (0.646)		
Lagged ROA	0.531*** (0.037)	0.143** (0.034)		0.686*** (0.013)	0.678*** (0.030)
Blau index	2.334** (0.014)	-2.567 (2.090)		0.030*** (0.008)	0.195*** (0.070)
Firm size	-0.594*** (0.142)	-0.239 (0.781)	4.101*** (0.668)	-0.420*** (0.082)	-0.564*** (0.123)
Leverage	-0.065*** (0.011)	-0.178*** (0.031)	0.044 (0.027)	-0.040*** (0.005)	-0.036*** (0.008)
R&D	-0.065*** (0.011)	-0.071*** (0.025)	-0.032 (0.022)	-0.029*** (0.006)	-0.034* (0.022)
Firm growth	0.048*** (0.013)	0.027* (0.015)	-0.004 (0.006)	0.022*** (0.002)	0.024* (0.016)
Firm age	0.024* (0.013)	3.608*** (0.898)	3.759*** (1.300)	0.199** (0.096)	-0.116 (0.184)
Board indep.	-0.013 (0.013)	0.027 (0.023)	0.152*** (0.036)	-0.014 (0.009)	-0.046** (0.017)
Board size	0.038 (0.732)	-0.832 (1.205)	1.690 (2.059)	0.331 (0.536)	-1.810** (0.933)
Duality	0.024 (0.258)	0.106 (0.523)	0.177 (0.415)	0.060 (0.188)	0.005 (0.195)
Constant	9.781*** (2.017)	0.410 (6.867)	-31.509*** (3.289)	5.963*** (1.290)	11.982*** (2.984)
Firm fixed effects	No	Yes			
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	3,061	3,061	3,440	3,058	3,058
R^2	0.376	0.144	0.171	0.552	0.554
Rank condition (*p*-value)			< 0.001		
First-stage residual					-0.206*** (0.071)

Note: see Table 3 for explanation.

Working Papers

Laboratoire de Recherche en Gestion & Economie

http://ideas.repec.org/s/lar/wpaper.html

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex

http://large.em-strasbourg.eu/