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# Women on board: evidence from a masculine industry

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## Abstract

**Purpose** – This paper aims to provide insights on the gender-performance relationship, this paper studies the impact of board gender diversity on firm performance, by taking into account the "critical mass" of women directors and their educational level.

**Design/methodology/approach** – The hypotheses are tested on a unique dataset of 211 European Union publicly listed companies in 2012 belonging to the construction industry from 28 different countries through a set of ordinary least squares regressions.

**Findings** – The evidence shows that the "critical mass" rather than the simple presence of women has an incremental benefit on firm performance. In addition, results show that the educational level of women directors negatively affects firm performance, as it might impact the dynamics within the boardroom.

**Research limitations/implications** – The quantitative nature of the study does not allow drawing strong inferences on behavioral processes and dynamics in and around the boardroom. Nevertheless, this study will open new research insights on exploring the educational level on board.

**Practical implications** – Regulators and policymakers that should be aware of the influence of women as a group on firm performance and that this role is differential across industries.

**Originality/value** – The novelty of this paper is that it investigates the role of women in a high masculine gender-specific industry and explores a still poorly understood demographic variable (i.e. the educational level) of women directors.

**Keywords** Performance, Board of directors, Education, Critical mass, Gender diversity, Masculine industry

**Paper type** Research paper

## Introduction

The role of women in board positions is gaining increasing attention (Terjesen *et al.*, 2009; Vinnicombe *et al.*, 2008). Most of these studies argue for more women on corporate boards. They point that boards where women are systematically excluded (not because of talent but gender) are sub-optimal choice (Carver, 2002).

However, research has failed to establish a convincing case for the presence of women on corporate boards of directors and empirical results on the relationship between women representation on board and firm performance are controversial (Joecks *et al.*, 2012). While some studies find the relation between women on boards and firm performance to be positive (Mahadeo *et al.*, 2012), others provide evidence of a negative link (Adams and Ferreira, 2009; Ahern and Dittmar, 2012), and still others do not find a link at all (Miller *et al.*, 2009; Rose, 2007).

As a result, the contribution that women make in the boardroom remains underexplored. Not surprisingly, there is an important call from literature that encourages scholars to address much of the uncertainty that still reigns on the effects of women directors on corporate board (Nielsen and Huse, 2010). Following this call, this paper develops an

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empirical test that considers the effect of women presence, a critical mass of women representation on board and the education of women directors on firm performance.

Our research draws upon previous studies that have addressed gender diversity and education in governance (Huse *et al.*, 2009) by considering gender diversity through their presence on corporate boards (Hillman *et al.*, 2007). We examine in depth this scenario by addressing also the question of whether a certain number of women directors build up a critical mass that substantially contributes to firm performance.

We draw upon the critical mass theory (Kanter, 1987) that suggests that the nature of group interactions depends upon size. When the size of the subgroup reaches a certain threshold, or critical mass, the subgroup's degree of power and influence increases. Kanter (1977b) suggests that women, as minorities in male-dominated environments, have little chance to exert influence on the organization until they become a consistent or significant minority. Above that point, they could begin to effect organizational changes (Torchia *et al.*, 2011).

To investigate this issue and to allow for a more sophisticated understanding of the presence of women directors, we also investigate the educational level of women directors. In fact, recent stream of literature in corporate governance has noted the relevance of knowledge and skills of the board members in fulfilling all their governing roles (Hillman and Dalziel, 2003). We build on the human capital theory, asserting that the educational background provides relevant human capital for the execution of board's roles and it enhances its ability to effectively execute both monitoring and resources provision roles, by improving the organizational performance. Indeed, we refer to the literature on "board process" that suggests that the educational level of women directors also has a specific effect on board dynamics (Petrovic, 2008). In fact, women need to establish more credibility and legitimacy than man (Biernat and Kobrynowicz, 1997). This is especially true in settings where they generally achieve low job positions (Byrne *et al.*, 2005; de Cabo *et al.*, 2011; Chan, 2013; Potter and Hill, 2009; Powell, 2002). However, empirical evidence is still lacking for what concerns the influence of the educational level of women directors within a specific masculine industry in terms of board dynamics and outcomes (Petrovic, 2008).

Our hypotheses are tested using information on European publicly listed firms in the construction industry. We collected information on performance and composition of the board of directors, in terms of gender diversity and education. According to the first digit US standard industrial classification (SIC) code of these firms, we selected 211 firms operating in the mining and construction industries.

We focused on listed companies because previous literature clearly identifies a relationship among the role of woman and the performances of these firms (Lückerath-Rovers, 2011; Virtanen, 2010). Differently from previous research that analyzes a single country (Kang *et al.*, 2010; Singh *et al.*, 2008), we operate a cross-country analysis all over the European Union (EU). The topic we examine is one of the priorities of the European Union's strategy for the next years. The EU attempts not only to generally improve the involvement of women in board in publicly traded companies but to establish such minimum quotas for female representation (Mateos de Cabo *et al.*, 2011). In fact, recent agenda of the EU has established that publicly listed companies on stock exchanges in Europe would have to bring in transparent recruitment procedures so that by 2020, at least 40 per cent of their non-executive directors are women. Currently, boards are dominated by one gender: 85 per cent of non-executive board members and 91.1 per cent of executive board members are men, while women make up 15 and 8.9 per cent, respectively (European Union, *Database on Women and men in decision-making*, 2003-2013).

In our analysis, we consider the construction industry because it is a high masculine gender-specific industry and it constitutes an ideal setting to investigate the role of women (Byrne *et al.*, 2005). Women's involvement in this industry is still low and they occupy low-status and low-salary roles (Byrne *et al.*, 2005; Potter and Hill, 2009). It depends on a number of factors such as the occupational segregation (Dolado *et al.*, 2004), the

under-estimation of women's skill (Phelps, 1972) the nature of this industry in terms of working hours and mobility of work place and the masculine image of construction industry (Gale, 1994; Ness, 2012).

All data of our analysis were obtained from the Osiris Database (Bureau Van Dijk). To improve the accuracy of this dataset, and given that information on education and composition of board of directors is not properly complete, we also manually collected the information reported in the curriculum vitae of directors of the selected firms to double-check the data, according to triangulation logic.

Our study makes several contributions. First, our evidence contributes to literature dealing with gender diversity on the board by focusing on a typical masculine industry (Byrne *et al.*, 2005). Second, following the call for a more specific understanding of demographic variables (Barroso *et al.*, 2011), we analyze the educational level of women directors, showing some counterintuitive results on their effect on firm performance. Third, to the best of our knowledge, this is the first attempt to perform a cross-country analysis among European publicly listed firms. Finally, in view of the increasing pressure to raise the number of women directors as well as the changing demographics of the workplace in general, the results of this study may have important implications for both corporate boards as well as for policymakers and regulators that should be aware of the influence of the women as a group on firm performance.

The remainder of the article is structured as follows. In the following section, the research gap is identified through a review of the literature on gender diversity, critical mass and education in board of directors. Hypotheses are developed in the section after that. Next, data collection and research methodologies are explained. In the penultimate section, we report empirical results and their discussion. We then offer conclusions in the final section.

## Theoretical background and hypotheses

Governance literature has extensively debated the roles played by the board of directors. It has generally acknowledged that its composition may influence both the way these tasks are performed and company outcomes (Carter *et al.*, 2010). Despite the influence of gender diversity on firm performance being a serious concern of board composition (Campbell and Mínguez-Vera, 2008; Mahadeo *et al.*, 2012), the extant research is far from providing univocal and conclusive results.

Board diversity relies on characteristics and expertise of its members, such as gender, age, ethnicity, professional background, education and industry experience (Walt and Ingleby, 2003; Singh *et al.*, 2008). To narrow the scope of inquiry, this paper primarily focuses on gender and education diversity.

The debate around board gender diversity has been strongly fueled by policymakers and governance research (Fields and Keys, 2003).

Prior studies suggest that companies can enjoy competitive benefits when women directors are appointed to the board (Ntim, 2015). This is supported by the anecdotal evidence, as well as by governance legislative initiatives that encourage the presence of female directors.

In this respect, the appointment of women on board positively affects company governance. One argument is that female representation provides new skills and abilities to the board, especially in terms of decision-making process (de Cabo *et al.*, 2011; Francoeur *et al.*, 2008). First, women directors bring forth fresh perspectives and new dynamics in the deliberations of the board to the benefit of a larger array of constituencies (Burke, 1994). In particular, board gender diversity fosters the development of a questioning culture within the board, thus enhancing the top executives' control and the shareholders' protection (Selby, 2000). Second, gender diversity provides the board with relevant information and viewpoints and increases the array of alternatives to examine for decision-making (Adams and Flynn, 2005;

Luckerath-Rovers, 2013; Rose, 2007). Third, women executives enhance company flexibility (Rosener, 1995) and limit excessive risk-taking in strategic decisions (Jianakoplos and Bernasek, 1998). Fourth, female directors have less attendance problems than their male peers and positively affect their attendance behavior (Adams and Flynn, 2005). Fifth, female directors could more closely respond to the concept of the independent director emphasized in theory (Adams and Ferreira, 2009). In addition their representation within the board enhances the compliance with standards of best practice (Nekhili and Gatfaoui, 2012). In this respect, board gender diversity enforces ethical behavior and supports good governance practices (Labelle *et al.*, 2009), as female directors pay more attention to ethical concerns (Rodriguez-Dominguez *et al.*, 2009). As a result, female appointment on board strongly affects corporate reputation (Bear *et al.*, 2010) and limits the expropriation of shareholders through accounting numbers (Gul *et al.*, 2011; Labelle *et al.*, 2009; Srinidhi *et al.*, 2011). An additional argument for the advantages of female representation relies on the notion that workforce diversity is a source of competitive advantage (Richard, 2010). In fact, board gender heterogeneity serves as a positive signal of workforce diversity and attracts talented qualified employees, thus enhancing board effectiveness (Rose, 2007). This is especially true with regard to educated female directors, as the empirical evidence suggests that the educational level positively affects organizational legitimacy and credibility (Certo, 2003), as well as the degree of company internationalization and innovation (Barroso *et al.*, 2011; Wincent *et al.*, 2010).

The advantages of having women on boards can be explained in the light of the theories that have fueled the debate around the influence of board gender diversity on company performance. Agency theory suggests that board diversity is beneficial in terms of board independence and executive monitoring, and therefore may have a positive effect on firm outcomes (Abdullah, 2014; Ntim, 2015). In turn, resource dependence theory highlights that board diversity provides critical resources to the company (Arnegger *et al.*, 2014). Additional arguments are based on the notion that gender diversity can add value to the firm by providing different perspectives to the decision-making and bringing new ideas (Adams and Ferreira, 2009; Campbell and Mínguez-Vera, 2008). Board diversity may increase competition within a company's internal labour market, leading to better performance (Rose, 2007). Therefore, gender diversity is expected to foster returns and overall company outcomes (Stephenson, 2004). This would be especially true in settings with limited appointment of female directors as women may choose to serve boards of better performing firms (Farrell and Hersch, 2005).

Consistent with these arguments, some empirical studies find that women on board have a positive impact on firm value and financial performance. Campbell and Mínguez-Vera (2008) examine a sample of Spanish companies and find that board gender diversity has a positive effect on firm value as measured by Tobin's Q. Erhardt *et al.* (2003) report similar results for a sample of US companies, showing that board diversity is positively related to financial performance. This is consistent with the findings of Mahadeo *et al.* (2011) who demonstrate that women on boards positively affect firm outcomes. Francoeur *et al.* (2008), Adler (2010), and, more recently, Ntim (2015) report that the benefits also involve the market performance, as their studies find that board gender diversity is positively associated to market valuations.

The opponents of board gender diversity suggest different conclusions. These scholars contend that diversities can improve disagreement and conflicts among directors. In this perspective, women on board may limit boardroom cohesion, inhibit decision-making process and undermine firm performance (Adams and Ferreira, 2009). In addition, gender-based diversity is often the sign of tokenism. Thereby, the potential benefits of women may be fairly limited (Abdullah, 2014) as empirical evidence suggests. In the USA, some studies report that the average effect of gender diversity on firm performance is negative (Adams and Ferreira, 2009; Shrader *et al.*, 1997). Outside the USA, other studies show a negative relationship between the proportion of women on boards and Tobin's Q,



gross profits to sales and market performance (Bøhren and Strøm, 2006; Dale-Olsen *et al.*, 2013; Smith *et al.*, 2006; Ujunwa *et al.*, 2012).

These results are in contrast with those provided by the studies that find no effects of board gender diversity on company performance (Carter *et al.*, 2010; Rose, 2007). The same conclusions are provided by Randøy *et al.* (2006) and Farrell and Hersch (2005) who show that gender diversity does not affect return on assets and market performance.

The absence of mixed evidence on this relationship suggests to empirically assess the impact of gender diversity on company outcomes. We try to fill this gap by examining the influence of women directors, critical mass and educational level on corporate performance within a masculine industry.

### *Women directors in masculine industry*

Previous studies recognize industrial sector as a major distinguish factor of women representation in board of directors (Brammer *et al.*, 2007; Fryxell and Lerner, 1989). The effect of gender diversity depends on different industries: Ali *et al.* (2011) find that the service industry can better capitalize the effect of board diversity. In addition, Gneezy *et al.* (2003) show that in a competitive environment women are less effective than men.

Looking at the construction industry, scholars (Chan, 2013) highlight that women's involvement in this industry is still limited, and women occupy low-status and low-salary roles (Byrne *et al.*, 2005; Potter and Hill, 2009). Advocates of gender equality suggest the formation of a critical mass of women within this masculine industry (Greed, 2000). In addition, de Cabo *et al.* (2011) empirically demonstrate that the low proportion of women employees in technical-specific industries (e.g. oil and energy; commodities, industry and construction) decreases the expected number of women on the board. From a social standpoint, there are several explanations for this lack of women's representation in construction industry. First, we can look at occupational segregation (Dolado *et al.*, 2004) which reduces women's involvement in finance-related or more technical positions. Second, gender under-representation may not directly depend on discrimination, but it could be a consequence of an under-estimation of women's skill. According to the "statistical discrimination" theory, the firm will discriminate against women if the cost of obtaining information about candidates is excessive (Phelps, 1972). Thus, the companies will judge on the basis of costless information/characteristics such as gender. However, Bertrand *et al.* (2005) highlight that the presence of women on board can reduce the bias. Another explanation of the lack of women's representation in the construction industry is related to the nature of this industry in terms of working hours and mobility of work place. Typically, men are more oriented to a long-term commitment, while women are more devoted to family ties, which could interrupt the development of career (Bertrand and Hallock, 2001).

One of the main reasons that inhibit women's participation is the masculine nature of construction industry (Gale, 1994; Ness, 2012). Iacuone (2005) argues that the "macho" image of this industry is still perpetuated through misogyny, horseplay, alcohol consumption and excessive risk-taking. As a result, women's commitment in this industry is always questioned, sometimes facing humiliation (Poggio, 2000; Watts, 2009).

At the balance, we predict a negative impact of the presence of women directors on firm performance in a masculine industry. Therefore, we hypothesize that:

- H1.* Within masculine industries, there exists a negative relationship between gender diversity on board and firm performance.

### *Critical mass of women directors and firm performance*

Despite predicting the effect of women on board on organizational performance within a masculine industry, we also believe that different numbers of women directors can mitigate or strengthen this relationship (Joecks *et al.*, 2012).

Some studies enlighten that the main reason of different effects of women directors on firm performance depends on the number of women on boards that they use (Torchia *et al.*, 2011). For example, some scholars (Campbell and Mínguez-Vera, 2008; Hillman *et al.*, 2007; Huse *et al.*, 2009) measure gender diversity only considering the ratio of women directors or their presence on boards. However, they do not consider the impact of different numbers of women directors on firm performance. In this sense, drawing from sociological studies, the critical mass theory provides a relevant contribution (Kanter, 1977b). The author finds that the presence of women as the “minority” group, rather than a single member, has an incremental benefit on overall outcome. Therefore, the influence of a minority in a group depends upon the strength, and number of its members (Latane and Zipf, 1981). Therefore, according to the critical mass theory, when a certain threshold or “critical mass” of women in a group is reached, the nature of group interactions change as women are able to bring their different abilities and skills.

This assumption has implications for board of directors’ research. On one side, a number of studies have tried to identify what the “magic number” to which critical mass corresponds could be. More specifically, Erkut *et al.* (2008) and Konrad *et al.* (2008) report that the critical mass of women directors is reached when boards have “at least three women”, by supporting the experiments of Asch (1951, 1955). The idea is that, when at least three women directors are appointed to the board, it is more likely that their voices and ideas are heard. This affects the board working style as well as board processes and dynamics (Erkut *et al.*, 2008; Konrad *et al.*, 2008). On the other side, previous studies have provided empirical evidence on the effect of women critical mass on firm performance. In detail, Torchia *et al.* (2011) and Joecks *et al.* (2012) show that the attaining of the women critical mass positively influences the level of firm innovation, as well as of firm performance. At the balance, we predict the effect of women critical mass on performance and we hypothesize that:

H2. Within masculine industries, there exists a relationship between critical mass of women directors and firm performance.

### *Educated women directors and firm performance*

Notwithstanding the predicted effect of women directors on the organizational performance, we believe that the educational level of women may further affect the results.

A commonly held assumption of board selectors is that, compared to men, women lack adequate human capital for board positions as they have traditionally made fewer investments in education (Tharenou *et al.*, 1994). Differently, Hillman *et al.* (2002) suggest that according to the status characteristics theory, women should be more likely to hold a higher education to demonstrate their ability than men. Also empirical studies do not report unanimous findings. Some authors suggest that women directors are generally better educated than men directors within the USA, Norway and the UK settings (Hillman *et al.*, 2002; Singh *et al.*, 2008; Storvik and Teigen, 2010). However, in different contexts, other scholars report that women on board are not better educated than male directors (Singh *et al.*, 2008; Virtanen, 2010). In light of this contrasting evidence, we focus on female directors educational background drawing our hypothesis from different research streams (Hillman and Dalziel, 2003; Smith *et al.*, 2006).

The literature on “Board capital” claims that having a high educational level is likely to provide additional human capital and be regarded as a relevant asset by business firms (Barroso *et al.*, 2011; Certo, 2003; Hillman and Dalziel, 2003; Lester *et al.*, 2008). In fact, directors’ academic achievements would be able to affect their skills, cognitive abilities and knowledge level (Wiersema and Bantel, 1992). Thereby, it has implications on the execution of governing role and on organizational performance. In this sense, Barroso *et al.* (2011) and Wincent *et al.* (2010) find that the level of academic education of board members positively affect the degree of firm internationalization as well as firm innovation. Moreover, Certo (2003) enlightens that the educational level of board members also

influences board prestige, thus improving the organizational legitimacy and credibility. Finally, Dalziel *et al.* (2011) support the idea that educated board members better performed the monitoring role.

However, other studies do not report significant findings about the relationship between directors' educational levels and firm performance (Kim and Lim, 2010; Rose, 2007).

While one could find many reasons to assert that the educational background provides relevant human capital for the execution of board's roles, literature on "Board process" could suggest that the educational level of women directors also has a specific effect on board dynamics (Petrovic, 2008). Literature enlightens that the educational level of women directors depends on their need to achieve substantially more than males to be considered as peer (Hillman *et al.*, 2002; Biernat and Kobrynowicz, 1997) with consequences on the board processes (Forbes and Milliken, 1999; Li and Hambrick, 2005; Petrovic, 2008). In this sense, we could expect that more educated women directors would be more likely to show their ability by imposing their ideas leading to a relationship conflict (Petrovic, 2008). This can be especially true in settings where women generally achieve lower job positions than men, such as the construction industry (Byrne *et al.*, 2005; de Cabo *et al.*, 2011; Chan, 2013; Potter and Hill, 2009; Powell, 2002). Literature enlightens that relationship conflict determine tension, annoyance and animosity among group members and can negatively affect the firm performance (Simons and Peterson, 2000). At the balance, we can hypothesize that, on one side, the educational level of women on board positively influences firm performance for human capital explanation. However, on the other side, it could negatively affect the same outcomes due to the conflict group argumentation. Thus, we investigate broadly this relationship:

H3. Within masculine industries, there exists a relationship between the educational level of women on board and firm performance.

## Methodology

We empirically test our hypotheses by relying on a sample of European publicly listed firms in 2012 belonging to the construction industry from 28 different countries. We focus on listed companies because previous studies clearly identify a relationship among the role of woman and performances of these firms (Campbell and Miguez Vera, 2009; Huse *et al.*, 2009; Lückcrath-Rovers, 2011). Differently to prior research that analyzes a single country (Kang *et al.*, 2007; Singh *et al.*, 2008), we operate a cross-country analysis. Moreover, we choose to consider the construction sector because it is a high masculine industry. Hence, it constitutes an ideal setting to investigate the role of women (Byrne *et al.*, 2005).

Our initial sample considers all listed companies in 2012 belonging to EU 28. Then, we retain companies belonging to the construction industry according to the two-digit US SIC code (SIC 15-16-17). Next, we exclude companies for which we were unable to collect data for our financial and governance variables (101). The final sample comprises 211 firms from 19 different countries (Table I, Panel A). The majority of firms in our sample firms belong to Romania, UK, Spain, Bulgaria and Greece (Table I, Panel B). The distribution of our sample proportionally reflects the number of firms belonging to the construction sectors in those countries (Deloitte, 2013). Despite the massive presence of companies listed in the UK, one of the largest EU market by capitalization and numbers of listed firms, we can observe an even larger number of Romanian firms. This can be explained in the light of the recent development of the construction industry in Eastern countries (Eurostat, 2011). Also, the construction industry is characterized by a fragmented production process which is generally dominated by small- and medium-sized companies, ultimately affecting the sample size (Fellini *et al.*, 2007).

For these companies, we collected information on performance and composition of the board of directors, in terms of gender diversity and education. All data were obtained from the Osiris Database (Bureau Van Dijk). To improve the accuracy of our dataset, and given



Table I Sample	
<i>Panel A: Sample selection</i>	
<i>Steps</i>	<i>Frequency</i>
Listed companies in 28 EU countries in 2012	12,960
	– 12,648
Construction firms (missing financial data)	312
	– 55
(missing governance data)	257
	– 46
Final sample	211
<i>Panel B: Breakdown of sample by countries</i>	
<i>Country</i>	<i>Frequency</i>
Austria	2
Belgium	4
Bulgaria	13
Croatia	6
Denmark	2
Finland	2
France	6
Germany	9
Greece	10
Ireland	1
Italy	8
The Netherlands	1
Poland	6
Portugal	1
Romania	62
Slovakia	3
Spain	18
Sweden	7
UK	50
Total	211

that information on education and composition of board of directors has not been properly complete, we also manually collected the information reported in the curriculum vitae of directors of the selected firms to double-check the data, according to a triangulation logic.

As a measure of firm performance we use the return on assets (ROA) for the fiscal year 2012 (FPERF). The gender diversity in the boardroom and firm financial performance measurements in other studies vary considerably, but these studies can generally be divided into two groups: those that use mainly accounting measures and those that use Tobin's Q. We use accounting-based measure of performance rather than market-based measures because ROA is one of the most relevant figures from the stakeholders' perspective, and it is widely used as an overall profitability measure for corporations capturing its operating results (Brick and Chidambaran, 2010; Shen and Lin, 2009). Moreover, we choose not to rely on market-based measures of performance because they are susceptible of the investors' anticipation and the risk of suffering a downward bias due to the observation period (Bhagat and Bolton, 2008).

As proxies for the gender diversity of the board of directors, we use the percentage of women on the board (PWOMEN). According to recent studies claiming that the presence of at least three women on board can be a good proxy of the "critical mass" (Asch, 1951, 1955; Joecks *et al.*, 2012; Torchia *et al.*, 2011), we also calculate the presence of the critical mass of women, measured as a dummy variable assuming the value of "1" if boards has at least three women, "0" otherwise (DMASS). We proxy for the education of women on board as the percentage of women without Master's, MBA and/or PhD (EDUC) (Kim and Lim, 2010). Following the well-established literature on gender diversity–performance relationship, we also include a number of control variables (Campbell and Mínguez-Vera, 2008; Mahadeo *et al.*, 2011; Nekhili and Gatfaoui, 2012; Rose, 2007). Specifically, we control for the total number of directors

(BSIZE), the leverage (LEV), the firm's prior performance (FPERF\_L) and the size of the firm (SIZE). Table II reports details on variable measurements.

To assess the relationship between women board membership and firm performance (*H1*) we estimate model (1)[1]:

$$\begin{aligned} \text{FPERF}_i = & \beta_0 + \beta_1 * \text{PWOMEN}_i + \beta_2 * \text{BSIZE}_i + \beta_3 * \text{SIZE}_i + \beta_4 * \text{LEV}_i \\ & + \beta_5 * \text{FPERF\_L}_i + \varepsilon_i \end{aligned} \quad (1)$$

Next, to test *H2* on the relationship between the critical mass of women on board and performance, we run model (2):

$$\begin{aligned} \text{FPERF}_i = & \beta_0 + \beta_1 * \text{PWOMEN}_i + \beta_2 * \text{BSIZE}_i + \beta_3 * \text{DMASS}_i + \beta_4 * \text{SIZE}_i \\ & + \beta_5 * \text{LEV}_i + \beta_6 * \text{FPERF\_L}_i + \varepsilon_i \end{aligned} \quad (2)$$

Finally, to test *H3* on the relationship between the woman's education and firm performance, we estimate model (3):

$$\begin{aligned} \text{FPERF}_i = & \beta_0 + \beta_1 * \text{PWOMEN}_i + \beta_2 * \text{BSIZE}_i + \beta_3 * \text{EDUC}_i + \beta_4 * \text{SIZE}_i \\ & + \beta_5 * \text{LEV}_i + \beta_6 * \text{FPERF\_L}_i + \varepsilon_i \end{aligned} \quad (3)$$

### Empirical results and discussion

In Table III, we report the descriptive statistics for our variables. The firm's average performance is  $-0.301$ , while the mean percentage of women on board (PWOMEN) is  $0.152$ . This is lower than how prior studies show (Campbell and Minguez Vera, 2009; Carter *et al.*, 2003; Farrell and Hersch, 2005; Huse *et al.*, 2009; Torchia *et al.*, 2011). However, this difference is not surprising given the characteristics of our industry. Literature has in fact extensively enlightened a low involvement of women in technical specific industries (de Cabo *et al.*, 2011) such as the construction one (Chan, 2013). This exclusion of women is

**Table II** Description of variables

Variable	Definition	Source
FPERF	Operating income for the fiscal year 2012 divided by the total asset for the fiscal year 2012 in euro	Osiris Database
PWOMEN	Number of women directors divided by the total number of directors on the board	Hand-collected
BSIZE	Total number of directors on the board	Hand-collected
DMASS	Dummy variable assuming value "1" if boards has at least three women, "0" otherwise	Hand-collected
EDUC	Number of women directors not having a Master Degree and/or a PhD divided by the total number of directors on the board	Hand-collected
SIZE	Natural logarithm of total assets in euro	Osiris Database
LEV	Total debt divided by total assets for the fiscal year 2012 in euro	Osiris Database
FPERF_L	Operating income for the fiscal year 2011 divided by the total asset for the fiscal year 2011 in euro	Osiris Database

**Table III** Descriptives

Variable	n	Minimum	Mean	Median	Maximum	SD
FPERF	211	-2.329077	-0.301295	0.0161688	0.9028972	0.225192
PWOMEN	211	0	0.1525566	0	1	0.2429769
BSIZE	211	1	4.834123	4	26	4.127258
DMASS	211	0	0.0805687	0	1	0.2728189
EDUC	211	0	0.0869707	0	1	0.1899341
SIZE	211	4.598105	10.88774	10.8624	17.54273	3.040348
LEV	211	0.0004374	0.6173476	0.624284	5.201613	0.462976
FPERF_L	211	-0.6411278	0.0054533	0.0277467	0.6164333	0.1206701

Note: See Table II for variable definition

also suggested by the recent EU's attempts to overcome labour market segregation by improving the role of gender and minorities within construction industry (Byrne *et al.*, 2005).

Table IV reports the Pearson bivariate correlations of the used variables, which allows checking for possible multicollinearity between independent and control variables. The analysis shows that we do not have serious problems of correlation among variables.

Table V reports the OLS models (1), (2) and (3) respectively testing *H1*, *H2* and *H3*. More specifically in Column 1, we can observe that the percentage of women on board (PWOMEN) is negatively and significantly related to our proxy of firm performance (*H1*) ( $\beta = -0.179$ ;  $p < 0.01$ ). Therefore, it seems that the negative aspects outweigh any positive aspects of greater female board representation, supporting, in that way, our first hypothesis. This result differs from previous studies (Adler, 2010; Campbell and Mínguez-Vera, 2008; Erhardt *et al.*, 2003; Francoeur *et al.*, 2008; Mahadeo *et al.*, 2012; Ntim, 2015), as we explore the gender performance relationship in a masculine industry. Here, the contribution of the women to the value creation is prevented from the humiliation they may face (Poggio, 2000; Watts, 2009). In addition, women on the board may limit boardroom cohesion, inhibit the decision-making process by improving relationship conflicts and undermining firm performance (Adams and Ferreira, 2009; Simons and Peterson, 2000).

As far as the control variables are concerned, board size (BSIZE) itself does not have a significant effect on performance. Conversely, leverage is negatively and significantly related with performance. Finally, as expected, the firm's size is positively and significantly related with performance.

Turning our attention to the second model, here we consider the possibility that the relationship between the gender diversity and performance may also be affected by the presence of a critical mass (*H2*). From the Column 2 of Table V, we can observe that

Table IV		Correlation						
Variables	FPERF	PWOMEN	BSIZE	DMASS	EDUC	SIZE	LEV	FPERF_L
FPERF								
PWOMEN	-0.2448*							
BSIZE	0.0346	-0.0513						
DMASS	0.0387	0.2904*	0.3471*					
EDUC	-0.0345	0.7341*	-0.0524	0.2330*				
SIZE	0.1881*	-0.0950	0.3786*	0.0831	-0.0950			
LEV	-0.3468*	0.0827	0.0388	-0.0130	-0.0305	0.0348		
FPERF_L	0.2324*	-0.0058	0.0629	0.0488	-0.0198	0.1954*	-0.0053	

Notes: \* $p < 0.1$ ; see Table II for variable definition

Table V		Results		
Variables	(1) FPERF	(2) FPERF	(3) FPERF	
PWOMEN	-0.179*** (0.0576)	-0.211*** (0.0605)	-0.303*** (0.0761)	
BSIZE	-0.00131 (0.00360)	-0.00420 (0.00398)	-0.00199 (0.00357)	
DMASS		0.0981* (0.0586)		
SIZE	0.0121** (0.00506)	0.0128** (0.00505)	0.0132*** (0.00502)	
LEV	-0.158*** (0.0302)	-0.156*** (0.0301)	-0.150*** (0.0300)	
FPERF_lag	0.367*** (0.118)	0.358*** (0.117)	0.369*** (0.116)	
EDUC			0.259** (0.105)	
Constant	YES	YES	YES	
Dual system	YES	YES	YES	
Observations	211	211	211	
R <sup>2</sup>	0.237	0.247	0.259	

Notes: \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ ; standard errors in parentheses

the presence of a critical mass of women on board (DMASS) is positively and significantly related to a firm's performance by confirming  $H2$  ( $\beta = 0.0981^*$ ;  $p < 0.1$ ). In line with recent research (Torchia *et al.*, 2011), this suggests that when there are at least three women on board this increases the effectiveness of the "women group" pressure, and it is more likely that their voices and ideas are heard (Kanter, 1977a; Latane and Zipf, 1981). The presence of a women group increases the women working style as well as the relationship and interactions between the two groups (women and men). This generally influences the board dynamics and the processes with positive implications for firm performance (Erkut *et al.*, 2008; Konrad *et al.*, 2008). In this sense, when the critical mass occurs, a positive effect of the women on the board is achieved. This corroborates the previous research that supports the idea about the positive effect of women on the board functions. According to previous research, in fact, women provide several advantages to the decision-making process within the board: fresh perspectives and new dynamics in the deliberations (Burke and Mattis, 2000), alternative and relevant information and viewpoints (Lückerath-Rovers, 2011; Rose, 2007), a certain degree of flexibility (Rosener, 1995), less excessive risk-taking view in strategic decisions (Jianakoplos and Bernasek, 1998), less attendance problems than their male peers (Adams and Ferreira, 2009) and higher reputation (Bear *et al.*, 2010). Finally, it is noteworthy to enlighten that the positive effect that occurs in case of critical mass is also consistent with the EU's widespread attempts to establish such minimum quotas for board female representation (Mateos de Cabo *et al.*, 2011).

Finally, in Column 3, we test the effect of the educational background of women directors on the firm performance ( $H3$ ). Here we find that the percentage of non-educated women on board (EDUC) is significantly and positively related to performance ( $\beta = 0.259$ ;  $p < 0.05$ ). Women who have achieved higher academic results do not suffer of sense of inferiority embedded in a masculine-specific industry (Poggio, 2000; Watts, 2009). Differently, they feel strong of their education and, to show to be at least equal to male directors (Hillman *et al.*, 2002), they try to impose their ideas. This can determine emotional conflicts that negatively affect the quality of board decision and the firm performance (Petrovic, 2008; Simons and Peterson, 2000; Smith *et al.*, 2006).

#### *Additional analysis*

To measure the firm performance, we rely on a widely used accounting-based proxy for the overall profitability (i.e. ROA), as it is one of the most relevant figures from the stakeholders' perspective (Brick and Chidambaran, 2010; Shen and Lin, 2009). To check the robustness of our results, we perform additional analysis by using other proxies of accounting-based performance.

Following Loughran and Ritter (1997), we use EBITDA ratio (earnings before interest, taxes, depreciation, and amortization over total asset) to construct firm operating profit margin. Compared to many other accounting-based measures, EBITDA ratio is less subject to managers' discretionary policy choices, so it is a better reflection of a company's actual performance (Elliott *et al.*, 2003; Jiraporn *et al.*, 2011). We re-run Models 1, 2 and 3 by using EBITDA ratio as alternative dependent variable and we find results consistent with Table V (Table VI, Panel A).

Second, to assess the robustness of our analysis, we rely on a different specification of our models. Particularly, we conduct further analysis using the interaction between the proportion of women on board (PWOMEN) and the educational level (EDU). Tables VI Panel B presents the regressions. We observe that the educational level does not significantly affect the performance. Nevertheless, when we focus on the educational level of women directors, we find that it negatively affect the performance, as both proxied by the ROA and the EBITDA ratio. Thus, our results hold either when we consider FPERF or EBITDA ratio as measure of firm performance. Thus, we have evidence that our results are consistent with our previous findings.

**Table VI** Additional analysis

<i>Panel A: Alternative measure for firm performance</i>			
<i>Variables</i>	<i>(1)</i> <i>EBITDA ratio</i>	<i>(2)</i> <i>EBITDA ratio</i>	<i>(3)</i> <i>EBITDA ratio</i>
PWOMEN	−0.176*** (0.0548)	−0.205*** (0.0578)	−0.290*** (0.0725)
BSIZE	−0.00111 (0.00343)	−0.00366 (0.00380)	−0.00172 (0.00341)
DMASS		0.0859 (0.0559)	
SIZE	0.0102** (0.00477)	0.0108** (0.00477)	0.0111** (0.00473)
LEV	−0.146*** (0.0287)	−0.144*** (0.0287)	−0.139*** (0.0286)
EBITDA_lag	0.438*** (0.122)	0.424*** (0.122)	0.450*** (0.121)
EDUC			0.237** (0.100)
Constant	YES	YES	YES
Dual system	YES	YES	YES
Observations	211	211	211
<i>R</i> <sup>2</sup>	0.241	0.250	0.262
<i>Panel B: Interaction between women directors and educational level</i>			
<i>Variables</i>	<i>(1)</i> <i>FPERF</i>	<i>(2)</i> <i>EBITDA ratio</i>	
PWOMEN	−0.335*** (0.0800)	−0.318*** (0.0762)	
BSIZE	−0.00191 (0.00394)	−0.00108 (0.00376)	
SIZE	0.0129** (0.00501)	0.0108** (0.00472)	
LEV	−0.147*** (0.0302)	−0.137*** (0.0288)	
PERF_lag	0.383*** (0.117)		
EDU	−0.0303 (0.0571)	−0.0458 (0.0543)	
EDU_WOMEN	0.324** (0.144)	0.325** (0.138)	
EBITDA_lag		0.470*** (0.121)	
Constant	YES	YES	
Dual system	YES	YES	
Observations	211	211	
<i>R</i> <sup>2</sup>	0.265	0.268	

Notes: \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ ; standard errors in parentheses

### Concluding remarks

This paper contributes to the literature on board diversity and firm performance by disentangling the influence of women directors and the impact of “critical mass” on corporate performance. To better understand the gender-performance relationship, we also investigate the educational level of women directors.

Drawing upon studies on sociological and critical mass perspective (Kanter, 1977b), as well as research on board demography (Johnson *et al.*, 2012) and dynamics (Petrovic, 2008), we hypothesize that board gender diversity influences performance, and that the critical mass and the level of education of women directors also counts for performance.

To examine the relationship between women directors, education and firm performance, we rely on a sample of 211 publicly listed companies belonging to a masculine industry (Byrne *et al.*, 2005).

We find that the presence of women directors does not positively affect performance. This suggests that the sense of inferiority and skill underestimation that women face in masculine industry (Poggio, 2000; Watts, 2009) may create relationship conflicts and prevent their contribution to the value creation (Simons and Peterson, 2000). In addition, we find that women “critical mass” rather than the single presence has a positive effect on firm performance. Furthermore, when we take into account the educational level of women directors, our results suggest that women who have achieved higher academic level determine emotional conflicts in the board that negatively affect firm performance (Petrovic, 2008; Simons and Peterson, 2000; Smith *et al.*, 2006).

The results of our study may have important implications for practitioners, policymakers and regulators. First, they show the importance of a greater number of women on board to



obtain benefits deriving from the board diversity, in terms of shared values, backgrounds and skills. In fact, the study underlines the relevance of having a critical mass of women on a board to minimize the conflict with male directors and to persuade them to accept their opinions. In this regard, firms that do not have women on their board, especially in masculine industry, should consider the competitive advantage that may result from their presence. Second, our study reveals that, in a masculine industry, higher educated women directors are more likely to show their ability to contrast the male directors' opinions and ideas with negative consequences for firm performance. This suggests that in these types of industries firms should appoint women and men on the board with at least similar social characteristics to avoid relationship conflict.

Nevertheless, the approach we suggest has some limitations that can be addressed in future studies. One important limitation that simultaneously opens avenues for future research is the quantitative nature of the study. Differently, recent research has emphasized the need to focus on behavioral processes and dynamics in and around the boardroom (Forbes and Milliken, 1999; Huse, 1998; McNulty and Pettigrew, 1999). Thus, our study will open up new insights on the educational level of board directors. In fact, combining primary survey data on board dynamics and involvement with in-depth interviews about women directors' characteristics may open up intriguing future inquiries. For instance, it would be possible to assess to what extent the influence of women directors on board effectiveness is based on educational differences from male directors. Furthermore, future research may investigate how the addition of women directors may create faultiness in corporate boards.

Moreover, our research design does not allow making strong inferences regarding the causal effect of women directors on performance although we have controlled for prior year's performance. A longitudinal research design could provide stronger evidence in the future (Menard, 1991) and our hypotheses could be tested in a feminine industry exploring the gender diversity on board on the male side. However, exploring gender diversity in boardroom is only one aspect of examining the presence of women at the top of corporate hierarchy. Future research should explore if and to what extent women representation in top management team may have important implications for firm's competitiveness. Finally, the educational level could be combined with other proxies to explore the influence of women directors on board, such as the background.

## Note

1. We recognize that our sample can be biased by difference in the board structure among EU jurisdictions (one- vs two-tier board) board system. To address this potential bias we include in all models a dummy variable equal to 1 if firms belong to countries with two-tier board.

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