MASTER THESIS

The Impact of Gender-diverse Boards on the Financial Performance of U.K. Listed Firms

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Abstract

This paper examines the effect of board gender diversity on firm financial performance of U.K. listed firms in the period between 2015 and 2018. This study documents a positive and significant relationship between the percentage of women directors on boards and firm financial performance. This positive influence is mainly caused by the non-executive women directors, which suggests that the monitoring effect is more pronounced over the executive effect in this study. Moreover, boards with at least 30% women directors have a stronger impact on firm performance than boards with only one female director. These findings suggest that women directors enhance boards of director's effectiveness, which are more pronounced when the critical mass is reached. This paper contributes to the limited and inconsistent U.K. gender diversity literature.

Table of contents

1. Introduction

1.1. Background information

The corporate's board of directors is a corporate governance mechanism that is tasked with guiding and authorizing strategic decisions of the firm, including mergers, acquisitions, alliances, hiring/firing executives, and capital structure (Adams, Hermalin, & Weisbach, 2010; Forbes & Milliken, 1999; Terjesen, Couto, & Francisco, 2016). These strategic decisions in turn affect the financial performance of the firm (Terjesen et al., 2016). According to Gillan and Starks (1998), corporate governance can be defined as "the system of laws, rules, and factors that control operations at a company" (p. 4). Corporate governance is needed to avoid potential conflicts of interest among participants and/or stakeholders (Gillan & Starks, 1998).

However, the global desire for better corporate governance is a major factor, especially after recent corporate scandals and the financial crisis. According to Adams and Funk (2012), these scandals and the financial crisis were caused by male-dominated corporate boards in the United States, since there was a lack of monitoring in firms. They suggest that women directors have better attendance behavior at board meetings and tend to sit on more monitoring-related committees than male directors (Adams & Funk, 2012). Hillman, Shropshire, and Canella (2007) add to this that women directors bring different perspectives and experiences into the boardroom, which help improve the quality of board decisions and enhance the legitimacy of firm practices. This raised the question whether corporate scandals and the financial crisis could have been avoided if more women had served on director seats (Liu, Wei, & Xie, 2014).

With above-mentioned arguments, many European countries are considering or even mandating public firms to add more women directors to their boards. In 2008, Norway was the first country that have set a gender quota to stimulate gender equality at the top of firms: at least 40 percent of the board members must be women. Belgium, Denmark, France, Germany, Italy, and Spain have followed this Norwegian principle for public firms in Europe, who can receive a penalty for non-compliance (Smith, 2014). According to MSCI (2019)[1], other European countries, where a comply or explain systems is active now in for instance Finland, the Netherlands, Turkey and the United Kingdom (U.K.), are considering imposing such a mandatory gender quota. All with the goal to increase gender equality on corporate's boards. However, do more gender-diverse boards lead to improved financial performance?

1.2. Relevance and research objective

Many researchers around the world have examined the impact of gender-diverse boards on firm financial performance, for example in the following five articles: Adams & Ferreira, 2009; Bennouri, Chtioui, Nagati, & Nekhili, 2018; Liu et al., 2014; Low, Roberts, & Whiting, 2015; Terjesen, Couto, & Francisco, 2016. These articles will be used as key papers for conducting this research. From these papers, various insights can be obtained because they use different theories, samples and measurements, in order to make informed decisions during this research. The results of these studies show conflicting conclusions. This indicates that the effect of more gender-diverse boards on firm

[1] The Morgan Stanley Capital International (MSCI) manages 160,000 indexes, including an index for women on corporate boards.

financial performance is not clear up to the present day (these and more results will be discussed in chapter 2.6). This research will therefore contribute to the existing gender diversity literature with the goal to make the effect more obvious.

In addition, the aforementioned findings do not provide clear guidance in the case of firms in the U.K. There are both ethical and economic reasons for greater board gender diversity in these firms. U.K. boards are still predominantly male, despite a significant growth in gender diversity in recent years (Grosvold, Brammer, & Rayton, 2007). The percentage of women directors holding these seats have increased from 25.3% in 2016 to 31.7% in 2019, despite there is no mandatory gender quota in the U.K (MSCI, 2019). Nevertheless, when searching for U.K. board gender diversity literature and their impact on firm financial performance, only a small amount of studies has been found. For this reason, this study will contribute to the limited U.K. gender diversity literature by focusing on the effect of women directors among U.K. corporate boards.

Next to the inconsistent and limited results, empirical evidence shows that there is a discrimination against women when appointing directors because of stereotyping, even though women can bring positive influences on male-dominated boards (Schubert, Brown, Gysler, & Brachinger, 1999). If it is true that more gender-diverse boards lead to better firm performance, firms will adjust their board's compositions more and more in the future. An increase in firm performance leads to a better competitive advantage, what means that firms are more profitable and have more money to invest in new opportunities. The stereotyping regarding to women can therefore be invalidated and gender discrimination would decrease. The question is then in what proportion women directors must be on corporate boards to be able to exercise enough influence on group discussions. Research suggest that a critical mass must be achieved for the minority group where women are no longer seen as outsiders and are able to influence the content and process of board discussions more substantially (Liu et al., 2014). By investigating the effect of gender-diverse boards, this research will provide a relevant and valuable substantiation for firms in determining the board composition.

In summary, this study offers three contributions. First, it adds new empirical evidence to the inconsistent gender diversity literature. Second, this research will extend the current limited U.K. gender diversity literature. Third, this study adds new evidence regarding the critical mass theory. This is all with the goal to clarify the effect of gender-diverse boards for firms. Therefore, the following research question will be investigated:

To what extent does board gender diversity influence firm financial performance of U.K. listed firms?

To empirically answer this question, a panel of 331 U.K. listed firms in the FTSE All-Share and Fledging index in the period between 2015 and 2018 will be examined. This study separates itself from earlier research on board gender diversity, as it takes on a sample composition with current research data that has not been found in other studies yet.

1.3. Outline

The remainder of this paper is organized as follows. The literature review in the second chapter discusses relevant terms, theories, empirical evidences, and the hypotheses involving this study. The third chapter explains the research methodology and variables that will be used to test the hypotheses. The sample composition and data selection criteria are described in detail in the subsequent chapter.

The fifth chapter discusses the results of this study and shows whether the hypotheses are confirmed based on the regression results. In the sixth chapter, an answer on the research question will be given in the conclusion part. Lastly, the seventh chapter describes a couple of limitations of this study and recommendations for further research.

2. Literature review

The literature review starts with explaining the term "firm financial performance". Second, the concept "corporate governance" including the mechanism "board of directors" will be discussed. Third, underlying theories based on the board gender diversity literature will be examined. Next, various empirical evidences are compared with each other and described regarding to the influence of board gender diversity on firm financial performance. In the last section, the hypotheses will be formulated based on the earlier mentioned theories and empirical evidences.

2.1. Firm financial performance

More gender-diverse boards have an impact on the decision-making process of firms, and these decisions in turn have a negative or positive influence on the firm performance. According to Santos and Brito (2012), firm performance is "a subset of organizational effectiveness that covers operational and financial outcomes" (p. 98). Based on this citation, it can be argued that there are two different dimensions of firm performance: operational and financial performance. These dimensions of firm performance can be conceptualized into several facets: customer satisfaction, employee satisfaction, quality, innovation, social performance, environmental performance, growth, profitability, and market value. The difference between operational and financial performance is that operational performance can be indicated as non-financial competitive facets, where financial performance has financial competitive facets (Santos & Brito 2012). The dimensions and its facets can be divided under these kinds of performance and are illustrated in Figure 1.

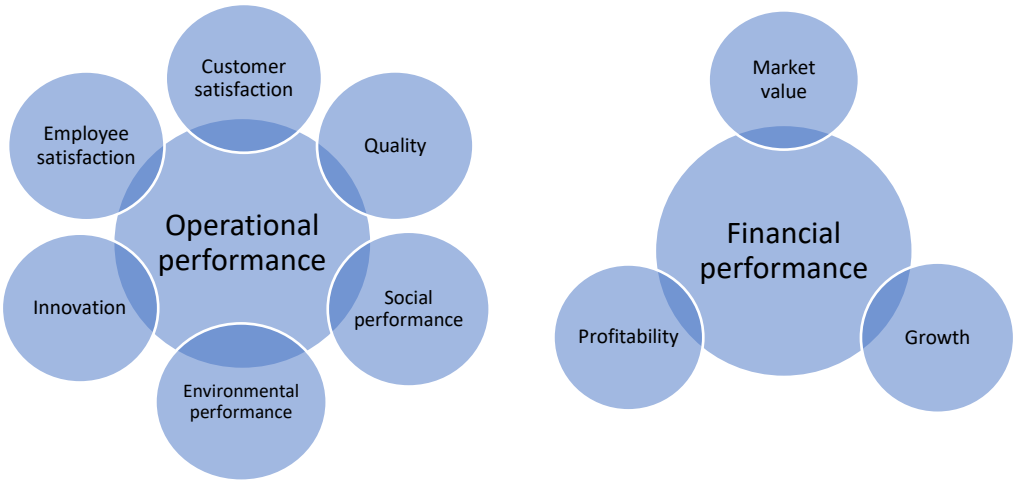

Figure 1: Conceptualization of firm performance

The focus of policy discussions, such as the influence of increasing women directors, is primarily on the extent it influences firm financial performance. Superior financial performance is a manner to satisfy investors. As shown in Figure 1, financial performance can be conceptualized by the facets profitability, growth and market value, which are complementary to each other. According to Cho and Pucik (2005), the facet profitability measures a firm's past generated returns, where growth measures a firm's past increase in size. Growing in size means an increase in profitability level at the same time, because of the increase in profit and cash generation. Larger size can also bring future competitive advantage, because an increase in economies of scale and market power enhances future

profitability. Market value represents the external assessment and expectations of firm's future performance (Cho & Pucik, 2005). Historical profitability and growth should be correlated with investor's confidence for the future, which leads to a rise in the firm's market value (Santos & Brito 2012).

In addition, Combs, Crook, and Shook (2005) have investigated which performance measurement have been used in 238 several empirical studies between 1980 and 2004. In these studies, firm performance is measured 450 times, where a total of 56 different performance indicators were used. Firm financial performance has been measured most frequently (82%), in contrast to operational performance (18%). In most cases, financial performance was measured by the facet profitability (52%) with the profitability ratio's return on assets (ROA), return on sales (ROS), return on equity (ROE), and return on investment (ROI) (Francoeur, Labelle, & Sinclair-Desgagné, 2008; Shrader, Blackburn, & Iles, 1997). Furthermore, the change in sales and profit are used to measure the facet growth, that have been used for 17%. Lastly, market value is used in 11% of the cases and is often measured by stock returns, market to book value or Tobin's Q (Combs et al., 2005).

2.2. Corporate governance

Since many global financial and accounting scandals in the past and the increasing need for stable and productive business conditions which assure the protection for the rights and interests of internal and external stakeholders in recent years, corporate governance has become an important and prevalent issue (Haidar, 2019). As mentioned in the introduction, corporate governance can be defined as "the system of laws, rules, and factors that control operations at a company." (Gillan & Starks, 1998, p. 4). Failures of corporate governance can cause enormous financial losses, not only to individual corporations and their stockholders, but also to the society (Craig, 2004). The purpose of corporate governance is to avoid potential conflicts of interest among managers and shareholders in corporations (agency problems). They can have different goals and preferences, or there is information asymmetry between the two that causes these conflicts. The traditional concerns of corporate governance have focused on mismanagement and self-dealing, but modern scandals have focused on financial statements, risk management, and executive compensation (Pinto, 2010).

Most countries worldwide have their own corporate governance codes. The objective of these codes is to improve the quality and transparency of corporate management of firms (Werder, Talaulicar, & Kolat, 2005). In the U.K., corporations are governed by the U.K. Corporate Governance Code, formerly known as the Combined Code. The code is published by the Financial Reporting Council (FRC)[2] and sets out standards of good practice for listed firms based on leadership, effectiveness, accountability, remuneration, and relations with shareholders.

Shareholders are the owners of publicly traded firms. They have control rights in the form of votes. However, these rights are too small and numerous to exercise this control daily. Because of this, the shareholders delegate the daily control to a board of directors, which in turn delegates it to management. The chief executive officer (CEO) (elected by the board of directors) is the senior executive officer in charge of managing the organization and has the role to report to the board of directors and is charged with maximizing the value of the entity (Lin, 2013). So, there is a separation

[2] The FRC is an independent regulator in the U.K. and Ireland, responsible for regulating auditors, accountant and actuaries, and setting the U.K.'s Corporate Governance Codes.

of ownership and control in the structure of firms. Next to that, dispersed shareholders have little or no incentive to monitor management. Hart (1995) argues that monitoring is a public good: "if one shareholder's monitoring leads to improved company performance, all shareholders benefit. Given that monitoring is costly, each shareholder will free-ride in the hope that other shareholders will do the monitoring." (Hart, 1995, p. 681). This will lead to the fact that all the shareholders will think the same and that (almost) no monitoring will take place.

Because of a lack of monitoring and the separation of ownership and control, managers of public firms will pursue their own goals and are able to do things what are in their own interest. Managers can overpay and give themselves excessive perks, they may carry out unprofitable but power-enhancing investments, they may seek to entrench themselves, or they have goals that are more benign but that are still inconsistent with value maximization of the firm. Because of this, it is important that there exist checks and balances on managerial behavior, which is a major part of the corporate governance (Pirson & Turnbull, 2011).

Furthermore, managers can be constrained using various corporate governance mechanisms. There are a lot of corporate governance mechanisms, but the most used are described in the next section. These mechanisms can be divided into internal and external corporate governance mechanisms. Internal mechanisms are structures involved within the firm that help oversee managers, such as ownership concentration, large shareholders, executive compensation, board of directors, and proxy fights. The second set of mechanisms are external mechanisms that are from outside of the firm in the industry and in government space where these are designed to make sure management stays in check from the external side. Examples of external mechanisms are hostile takeovers and actions from public institutions (Pinto, 2010).

2.2.1. Internal mechanisms

Ownership concentration

Ownership concentration is the percentage of outstanding shares owned by a single owner. A high concentration means that there is a high percentage of shares in hands of a few investors. Higher concentration leads to more power in the hands of fewer people. Large owners have incentives to monitor actively for two reasons. One, they have an ability through their large equity stake, since they have many votes to influence managerial activity. Two, because they own such large proportions of the equity, it often represents a significant proportion of their wealth. Thus, they are more concerned than smaller shareholders about the managers taking actions that pursue growth and stock prices and following shareholders interest. Higher ownership concentration leads to more active monitoring and more shareholder power to oversee management. In contrast, more diffuse concentration leads to free riding problem in monitoring (Pinto, 2010).

Large shareholders

As mentioned before, small shareholders (diffuse concentration) leads to a free riding problem in monitoring. Therefore, some commentators have suggested that a way to improve corporate governance is to ensure that the firm has one or more large shareholders. On the one hand, this argument is right because in a firm where the shareholder has 100% ownership, there is no longer a separation between ownership and control. However, this outcome is undesirable for some reasons. When a large shareholder owns less than 100% of the firm, agency problems may be reduced, but they

are not eliminated. Large shareholders will still underperform monitoring and intervention activities since he does not receive 100% of the gains. Furthermore, a larger shareholder may use his (voting) power to improve his own position at the expense of other shareholders. For example, the large shareholder might connive with the management to obtain some interest for both of them, like to persuade the management to transfer the profits to himself through selling goods to a firm the large shareholder owns or by buying goods from a firm the shareholder owns at a high price (Hart, 1995; Horsch, 2015).

Executive compensation

Executive compensation involves providing managers incentives to motivate them to take appropriate actions and decisions that follow shareholder's desires. The key components of executive compensation are salary, cash bonus, shares, stock options, or long-term incentive pay. Salary and cash bonus are used for risk aversion, because for managers there is no benefit for them to put salary and bonus at risk. Thus, higher salary and cash bonuses mean greater risk aversion. However, with bonuses, managers take some level of risk aversion once the target is achieved. Using bonusses in the form of stocks and shares can create a downside risk. If the stock price declines, managerial wealth declines. Thus, some small amount of stock pay encourages risk-taking. As the level of stock compensation increases, it increases the risk aversion because more of the managers wealth is tied up in stock, therefore managers will take decisions that will not harm the stock price. In contrast, stock options give the managers an option to buy stock at a certain price. This removes the downside risk associated with just simply shares of stock. By providing stock options the firm provides managers an opportunity to gain if the stock price goes up and then thinking in terms of increasing stock price without the associated risk. Long-term incentive pay means that managers by reaching long-term targets receive cash in multiple years (Pinto, 2010).

Board of directors

The board of directors is a corporate governance mechanism that have the responsibility to represent the best interest of the firm's shareholders. Since shareholders cannot effectively control managers, they install and elect the board of directors. The board carries out multiple functions, including: 1) voting on major proposals, 2) hiring and evaluating managers, 3) offering expert advice to top managers, and 4) monitoring managerial activities (Anderson, Reeb, Upadhyay, & Zhao, 2011). The last two points are the main tasks of the board in order to review the performance of top managers. Shareholders of firms elect the board to act on their behalf. In some cases, the board can replace the firm's CEO and other members of the top management team (Hart, 1995). The size of the board depends on the size of the firm. However, when the board size increases, coordination and communication problems will increase too, which leads to ineffective boards (Krivogorsky, 2006).

In addition, the board structure – the way the board of directors is formed by different persons – could be characterized by two types of boards: one-tier and two-tier boards. A one-tier board (which is prevailed in the U.K.) does not make the separation between supervisors and management, in contrast to a two-tier[3]. They both have their own advantages. Since the one-tier board makes no

[3] Corporate Governance Committee (2016, December 8). *The Dutch Corporate Governance Code 2016. Principles of Good Corporate Governance and Best Practice Provisions*. Retrieved June 12, 2019, from: http://www.mccg.nl/

separation between supervisors and the management, the relationships are closer and the information flow between the bodies is smoother. On the other hand, the two-tier board represents a clearer, formal separation between the function of supervision and the executive roles (Krivogorsky, 2006).

Furthermore, the board consists of internal/dependent/executive directors who are members of the management team, and external/independent/non-executive directors who are outsiders of the firm. Executives can influence the daily operations due their executive channel, where non-executives do this with their monitoring function. However, there are some doubt about the effectiveness of the board of directors. Namely, it is reasonable to say that the executive directors monitor themselves. On the other hand, the non-executive directors may not monitor well in contrast to effective directors for several reasons: 1) they may not have a significant financial interest in the firm, and they may therefore have little to gain personally from improvements in firm performance, 2) non-executives often are members of boards from different firms, so they have no fully focus on and time for one firm, and 3) non-executive directors may also owe their positions to management, who proposed them as directors in the first place. As well as feeling loyal to management, they may want to stay in management's good graces, so that they can be re-elected and continue to collect their fees (Hart, 1995).

Proxy fights

It is likely that the board of directors does not monitor the management well. If this is the case in combination with bad performances, shareholders can replace them through a proxy fight. A proxy fight happens when a group of shareholders are persuaded to join forces and gather enough shareholder proxies to win a corporate vote. This works as follows: "a dissident shareholder puts up a slate of candidates to stand against management's slate, and tries to persuade other shareholders to vote for his (or her) candidates" (Hart, 1995, p. 682). The disadvantage of this mechanism is that it may not be a very powerful tool, because there is a significant free-rider problem since the dissident will bear the cost of monitoring alone, especially when the shareholders are dispersed (Corum & Levit, 2019).

2.2.2. External mechanisms

Hostile takeovers

A hostile takeover is a very powerful control mechanism that allows someone to gain large reward from identifying an underperforming firm. A hostile takeover is the acquisition of one firm (target firm) by another (acquirer). However, the management of the target firm can use three different defense mechanisms against hostile takeovers.

First, if small shareholders hold their shares since they feel that their provisions are negligible and have no impact on the success of the bid, they do not respond to the raider tender that consists of corporate laws that prevent the expropriation of small shareholders. This can increase the added value for those shareholders and lead to a loss for the raider due to the high costs of bidding in addition to identifying the target besides the increase in the share price (Haidar, 2019; Hart, 1995).

Second, the competition from other bidders and minority shareholders. The acquirer's bid for the target firm may alert other to the fact that the firm is undervalued. Because of this, a bidding war arises, and the firm's price may be drive up to the level the acquirer wishes to obtain. This competition reduces the acquirer's intended profit or may result in loss if the ex-ante bidding costs are included (Haidar, 2019; Hart, 1995).

Third, another competition will take place where the acquirer may face bids from the current management of the target firm. In this case, there is slack in the firm because it is not running at maximum efficiency. The manager must act to reduce slack after the bid is announced by, for example, selling unprofitable assets or to raise debt capital to finance new investments. These actions will increase the stock value of the firm if the bid fails, and hence force the acquiring firm to pay more to get control. Although shareholders may gain from these actions, the acquirer's profit is reduced, and, anticipating this, the acquiring firm may be put off from bidding (Haidar, 2019; Hart, 1995).

Actions from public institutions

A second external mechanism is actions from public institutions. This only occurs when the firm has broken laws or has failed to comply with regulations. For example, the securities and exchange commission (SEC) plays a major role in protecting public shareholders through the enforcement of federal securities laws. It can bring administrative actions against those who are subject to their regulations, such as brokers. The government also oversee firms in, for example, following publicly traded firm guidelines, environmental guidelines, or tax guidelines. So, these institutions become involved when the firm violates any legal standards in poor management decisions (Pinto, 2010).

2.3. Board diversity

The most relevant mechanism in this study is the board of directors. The board of directors is composed of people with different origins and personal characters. This is called "board diversity". According to Campbell and Mínguez-Vera (2008), board diversity can be defined as "the variety inherent in the board's composition" (p. 3). There are various facets of board diversity, such as: gender, age, race, culture, ethnicity, nationality, educational background, expertise, etcetera (Figure 2). According to Carter, Simkins and Simpson (2003), gender, racial, and culture composition on the board of directors are the most significant governance issues. These issues have taken on a high public profile because of reports in the popular press, shareholder proposals from advocacy groups, and policy statements from major institutional investors. For example, the Interfaith Center on Corporate Responsibility (ICCR)[4] has sponsored numerous shareholder proposals that would require corporations to increase and report board diversity at major corporation in the U.S. (Carter et al., 2003).

Figure 2: Forms of board diversity

[4] The ICCR is an association advocating for corporate social responsibility.

Furthermore, the influence of board diversity on firm performance is a widely examined topic by social psychology, economic and organizational studies (Herring, 2009; Skerry, 2002). For instance, Herring (2009) shows positive results of diversity in firms on its performance, because diversity enriches the workplace by broadening employee perspectives, strengthening their teams, and offering greater resources for problem solution. In homogeneous groups, where preferences, views and incentives are the same, decisions aren't critically analyzed, resulting in more extreme and possibly more risky decisions (Appelman, 2019). On the other hand, researchers who see diversity as a loss argue that diversity incurs significant potential costs. For instance, emotional conflicts among co-workers because of differences in race and ethnic. It also diminishes group cohesiveness, what leads to an increase in employee absenteeism (Skerry, 2002). It may also be the cause of lower quality, since it can lead to positions being filled with unqualified workers (Herring, 2009).

2.4. Board gender diversity

Gender diversity is the most debated diversity issue in recent years, not only in terms of female participation in economic activity and in society in general, but also in terms of board gender diversity (Mínguez-Vera & Martin, 2011). Board gender diversity can simply be defined as the presence or proportion of women on the board (Perrault, 2015). Empirical evidence shows that women encounter a "glass ceiling" or barrier to advancement into the top ranks of organizations. Although many expected this barrier to be broken with the large influx of women into the labor force in last years, only a little change has occurred in the top of firms (Adams & Funk, 2012; Bass & Avolio, 1994). Women are, nevertheless, as capable in fulfilling director roles as men, according to Chen, Crossland, and Huang (2016). Because of this, the government of some countries has set a minimum required number of women, a so-called gender quota, to stimulate gender equality at the top of firms. Norway was the first country that have set a quota: at least 40 percent of the directors of firms should be women (Smith, 2014). If firms will not reach this quota, they could, for example, be denied registration as a business enterprise and be subject to forced dissolution by the courts (Terjesen et al., 2016).

Furthermore, existing psychological studies have examined the comparisons and differences between the personal characters of men and women in the corporate decision-making process. These studies show that female executives directors are more cautious than male executives directors in making important corporate decisions, so men are making more risky decisions while women are more risk-averse (Byrnes, Miller, & Schafer, 1999; Liu et al., 2014). Furthermore, economic studies show that women are less confident and more risk-averse in making group decisions, investment decisions, and are less willing to enter into a competition (Adams & Funk, 2012; Halko, Kaustia, & Alanko, 2012).

2.5. Theories on board gender diversity

The board of directors mainly advice and monitor managers. This section describes several theories from finance, economic, and psychology literature in order to gain enough theoretical information about the influence of board gender diversity on firm performance. This relationship is usually explained by several theories, like the agency theory (monitoring function), resource dependence theory (diversity brought to boards by women), and token status and critical mass theory (proportion of women on boards). These theories are described in this section.

2.5.1. Agency theory

The first and most dominant theme in the literature is the agency theory. This theory is the most often used one by researchers in finance and economics to understand the link between board characteristics and firm value and performance (Carter et al., 2003). The agency theory focuses on solving conflicts (or agency problems) between the principal (shareholders) and the agent (directors and managers), in order to increase firm value and financial performances (Low et al., 2015). These conflicts occur when managers do not have shareholders' best interest in mind when making corporate decisions. Conflicts are associated with a cost insofar as internal factors, such as corporate governance mechanisms. These mechanisms can reduce these costs and thus become important drivers of performance. Weak governance creates agency costs and negatively affect the firm's performance (Reguera-Alvarado, de Fuentes, & Laffarga, 2017). Efficient board guidance and monitoring are essential in mitigating these conflicts. The board of directors is such a governance mechanism that fulfills a crucial role in monitoring and controlling managers and in solving agency problems (Liu et al., 2014). Mainly the women non-executive directors do influence firm performance through the monitoring channel due to their independence status (Liu et al., 2014).

Board diversity increases board independence because people with a different gender, ethnicity, or cultural background might ask questions that would not come from directors with more traditional backgrounds (Carter et al., 2003). In other words, a more gender-diverse board might be more active in monitoring activities. These boards demand more audit efforts and managerial accountability that can partially remedy weak governance (Liu et al., 2014). Thus, increasing the number of women to boards means more gender-diverse boards that act as a better control mechanism, because a wider range of views increases board independence. This will increase the value of the firm and its financial performance in its turn (Reguera-Alvarado et al., 2017).

2.5.2. Stakeholder theory

The pressure on firms to appoint women as directors or senior managers comes from a broad set of people. This includes shareholder activists, large institutional investors (Fields & Keys, 2003, p. 12), politicians, consumer groups, or in short: stakeholders (Francoeur et al., 2008). A useful grid to explore this phenomenon and its consequences is the stakeholder theory, which is an extension of the agency theory (Low et al., 2015). This theory suggests that the board of directors represent not only the financial interest of shareholders, but also other expectations of those stakeholders that matter to the firm. Huse and Rindova (2001) suggest that the board composition should be adjusted accordingly to reflect all stakeholders' expectations. As women directors have been shown to display an increased sensitivity to social and environmental issues (Williams, 2003), appointment of women directors should boost performance of the firm in these areas, leading to a favorable reputation amongst its wider stakeholders (Bear, Rahman, & Post, 2010). Subsequently, these stakeholders may provide easier access to the resources that they control, with a subsequent beneficial effect on financial performance and value of the firm (Low et al., 2015, p. 383).

2.5.3. Resource dependence theory

The resource dependence theory is a theoretical perspective that takes a broad view on multiple roles that boards play and the interdependence between the organization and its external environment (Low et al., 2015). The theory sees a corporate board as a provider of resources or board

capital, which consist of both human capital and relational capital (Hillman & Dalziel, 2003). Organizations depend on the resources in their external environments to be able to survive (Pfeffer & Salancik, 1978). These dependencies pose risks and uncertainties to the businesses, because an organization is dependent on its external resources. To reduce the dependencies, businesses can cultivate linkages to the external entities that control those resources (Liu et al., 2014). In addition, with these linkages, directors may also reduce the transaction costs associated with interdependencies between the firm and various institutions in the environment. This is because directors with regulatory expertise or knowledge may reduce transaction costs associated with regulatory agency (Hillman, Cannella, & Paetzold, 2000). With the rise of women as consumers, as leaders in business and society, and as a growing majority of the talent pool, the importance of female representation on corporate board of directors and their role in providing and securing new resources is claimed to be evident (Burke & Mattis, 2000). According to Bennouri et al. (2018) and Pfeffer and Salancik (1978), women bring positive influence on male-dominated boards that attribute to corporate board linkages, based on the following characteristics: advice and counsel, legitimacy, and communication channels. These characteristics enhance the functioning of the board and ultimately firm performance.

First, based on the aspect advice and counsel, gender-diverse boards are linked to higher quality board deliberations of complex issues, some of which might be considered unpalatable in male-dominated boards, according to Huse and Solberg (2006). This is because women directors are more likely to have non-business backgrounds that include a portfolio of experience (Hillman, Cannella Jr, & Harris, 2002). This diversity of perspectives can enhance overall creativity and innovation with respect to problem solving (Terjesen et al., 2016). Second, in terms of legitimacy, firms' practices are legitimized by accepting societal norms and values by signaling that the firm promotes gender equality (Liu et al., 2014; Isidro & Sobral, 2015). Hillman et al. (2007) adds to this that companies are under pressure to conform to societal values and therefore must respond to demands from stakeholders such as institutional investors and labor markets for more gender-diverse boards. This increased legitimacy from electing women directors to corporate boards may send positive signals to various stakeholder groups, such as investors, customers and communities, thereby developing the firm's image and consequently enhance financial performance (Francoeur et al., 2008; Huse & Solberg, 2006). Third, "board member networks and contacts are crucial for their ability to perform the role of boundary spanners securing contacts for their organizations" (Ruigrok, Peck, & Tacheva, 2007, p. 547). Communication channels in gender-diverse boards are beneficial because of the different life experiences and perspectives of women directors. Women are better equipped to connect their firms to female customers, women in the labor force and society at large (Liu et al., 2014). Terjesen et al. (2016) adds to this that women directors generally have more diverse networks, compared to male directors. With these connections with external resources of dependency, board gender diversity has the potential to increase critical resourcing, thus enhancing firm performance (Reguera-Alvarado et al., 2017).

In summary, the resource dependence theory points out the beneficial effects that women bring to male-dominated boards, based on the following characteristics: advice and counsel, legitimacy, and communication channels. These characteristics enhance the functioning of the board and ultimately firm performance.

2.5.4. Token status and critical mass theory

The token status theory, or tokenism, is about making perfunctory gestures of inclusiveness towards minority groups. This theory is used to explain many of the difficulties that women face in traditionally male occupations (Low et al., 2015). A single woman director on corporate boards may have a positive impact on firm's reputation, but they may also face challenges. Groups with a single minority member (one female director in this case) may consider the minority member to be a "token", or in extreme cases "solos"; they may perceive the minority individual as less competent and of lower status. The rarity of females or minorities in top management is an example of tokens regarding to gender (Liu et al., 2014). Consequently, the group may fail to take the token's opinion or contributions seriously (Bear et al., 2010; Brewer & Kramer, 1985; Kanter, 1977). The contributions of gender minorities are then limited, because participation in decision-making process is denied and are only hired to comply with legislative requirements or to serve as "proof" to counter claims of discrimination (Low et al*.,* 2015, p. 385).

Furthermore, an extension of the token status theory is the critical mass theory. This theory states that the numerical proportion of women directors on boards must be "significant" enough to allow the female "voice" to be heard and truly valued (Low et al*.,* 2015). Liu et al. (2014) suggest that the minimum number of the minority on a group should be three women directors to create this voice. Liu et al. (2014) expressed this as "One is a token, two is a presence, and three is a voice." (p. 171). Torchia, Calabrò, and Huse (2011) agree with this and show in their study that a critical mass of three or more women is the minimum to cause a fundamental change in the boardroom. Minority voices are not easily expressed or heard in groups, because social pressures encourage conformity with the majority's opinion. However, when a group is faced with consistent opinions from multiple minority members, it is more likely to consider and learn from the minority voice (Bear et al., 2010, p. 211). Konrad, Kramer, and Erkut (2008) agree with the above-mentioned studies, that a critical mass in a group is achieved when the minority contains at least three people. Konrad et al. (2008) states that women on boards with a minimum of three are no longer seen as outsiders and can influence the content and process of board discussions more substantially and to have more impact on corporate decisions and firm performance. Women directors are more able to ask challenging questions and work together to demonstrate collaboration in decision-making (Konrad et al., 2008).

However, Dahlerup (2006) and Isidro and Sobral (2015) argue that only a percentage of the total board size counts, in contrast to a number of three women that Liu et al. (2014), Torchia et al. (2011) and Konrad et al. (2008) suggest. For instance, three women directors on a board with four members has another effect than three women directors on a board of twenty members. In the last case, the critical mass of three women directors is reached, but they are still far in the minority (Isidro & Sobral, 2015). Because of this, Dahlerup (2006) argues that a minimum of three women doesn't always create a critical mass, since the size of the group must be considered. She states that a qualitative shift will take place when women exceed a proportion of about 30% in groups, instead a number of three (Dahlerup, 2006).

Furthermore, the opposite can also be true. It may be possible that there are too many women on the board, which even can reduce the board's effectiveness (Bear et al., 2010). However, this is very rare on corporate boards nowadays. Although, it can be stated that a critical mass is reached when there is a certain balance of diversity in a group. For instance, the ratio in a group must be at least

30/70 so that the minority group can be heard and can participate seriously and influence group discussions.

2.6. Empirical research on board gender diversity

The empirical evidence of board gender diversity and its influence on firm financial performance is a widely examined topic. This subject has attracted the attention of many researchers and scholars around the world who conducted a study about this. Next to that, board gender diversity also impacts other variant issues, such as risk-taking behavior and firm riskiness. All of these empirical evidences are discussed in this chapter and are summarized in Appendix 1. Also, the theories used by researchers, but not discussed in this study, are briefly described in this appendix.

2.6.1. Firm financial performance

The presence of women directors

The impact of gender-diverse boards on firm financial performance has been examined in many different research compositions. The results of these studies indicate positive, negative, and no relationships between these variables. These studies have used various samples and theories. The dependent variable firm financial performance has been measured using a market-based performance measurement (Tobin's Q) and/or accounting-based performance measurements (ROA, ROE, ROI, and ROS) (Marinova, Plantenga, Remery, 2016).

First, positive effects of board gender diversity on firm financial performance have been found (Bennouri et al., 2018; Campbell & Mínguez-Vera, 2008; Carter et al., 2003; Erhardt, Werbel, & Shrader, 2003; Isidro & Sobral, 2015; Liu et al., 2014; Low et al., 2015; Perryman, Fernando, & Tripathy, 2016; Reguera-Alvarado et al., 2017; Terjesen et al., 2016). These studies suggest that women directors bring different skills, perspectives and experiences into the boardroom, which help improve the quality of board decisions and enhance the legitimacy of firm practices. Hence, gender-diverse boards could partially offset weak corporate governance (Liu et al., 2014; Reguera-Alvarado et al., 2017). Campbell and Mínguez-Vera (2008) adds to this that greater board gender diversity increases a firm's competitive advantage relative to firms with less diversity in two ways. Firstly, it is argued that greater diversity promotes a better understanding of the marketplace by matching the diversity of a firm's directors to the diversity of its potential customers and employees. Secondly, greater diversity stimulates the creativity and innovation within firms. Next to that, according to Bennouri et al. (2018) and Carter et al. (2003), women directors are more diligent to monitor managers and demand more audit efforts than male directors. They suggest that greater diversity increases the independence of the board as women are more inclined to ask questions that would not be asked by male directors. Lastly, women on the board improve the firm's observance of ethical and social policies, which in turn positively affects the financial performance of the firm (Isidro & Sobral, 2015; Reguera-Alvarado et al., 2017; Terjesen et al., 2016).

On the other hand, studies report a negative relationship between gender diversity and firm financial performance (Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Bennouri et al., 2018; Bøhren & Staubo, 2016; Richard, Barnett, Dwyer, and Chadwick, 2004; Shehata, Salhin, & El-Helaly, 2017; Ujunwa, Okoyeuzu, & Nwakoby, 2012). The main argument for this negative effect is that more gender-diverse boards can result in a too strong governance mechanism, because women are more diligent to monitoring. This could result in tough boards, what in turn leads to overmonitoring within firms and

poorer financial performance (Adams & Ferreira, 2009; Bennouri et al., 2018). Next to that, diverse board corrode group cohesion and lead to a board whose members are less cooperative and experience more emotional conflicts (Ujunwa et al., 2012). Richard et al. (2004) adds to this that more gender diversity on boards may encourage stronger identification by directors with the opinions expressed by other directors of the same gender, thus increasing the likelihood of conflicts. This can be especially problematic if a firm is operating in a highly competitive environment where the ability to react quickly to changes in the market is an important issue (Williams & O'Reilly, 1998). Ahern and Dittmar (2012) even mentioned in their study that women directors lead to a large decline in firm value measured by Tobin's Q, and because of this firms will not attempt women to boards to maximize value.

Lastly, research show no relationship between gender diversity and firm financial performance (Carter, D'Souza, Simkins, & Simpson, 2010; Gregory-Smith, Main, & O'Reilly, 2014; Kagzi & Guha, 2018; Marinova et al., 2016; Rose, 2007). Researchers argue that this result is due to the contingency effect of board diversity on performance, which means that the relationship between board gender diversity is dependent on the circumstances and the context in which the firm is operating (Carter et al., 2010; Kagzi & Guha, 2018; Marinova et al., 2016). Next to that, Rose (2007) states that board members with an unconventional background are socialized unconsciously adopting the behavior and norms of the majority of conventional board members. The reason is that it might be the only way to be qualified in the eyes of the top decision makers for high positions in society including access to firms' board rooms. This entails that the gains from having women directors are never realized or reflected in any chosen performance measure.

As shown in Appendix 1, a limited number of studies have examined the in fluence of board gender diversity on U.K. firms. Studies from Gregory-Smith et al. (2014) and Shehata et al. (2017) are the only reliable articles found and these indicate no signs and a negative relationship between women directors and firm financial performance, respectively. Shehata et al. (2017) have used small and medium U.K. enterprises from 2005 to 2013 in their study, and Gregory-Smith et al. (2014) firms from the FTSE 350 index in the period 1996 through 2011. With the increase of women directors in the last years in the U.K., it is interesting to see their impact on firm performance with current U.K. data.

In summary, the relationship between board gender diversity and firm performance remains inconclusive. The conflicting evidences could be a result of different factors that mediate the diversity-performance relationship, such as the influence of the monitoring effectiveness of boards. Next to that, gender diversity studies on U.K. firms are very limited, to which this study can contribute.

Critical mass for women directors

In addition to the empirical evidence of the presence of women directors, it is worthy to mention the results of studies that have examined the impact of reaching a critical mass within the board on firm financial performance. This is because the critical mass theory, that have been described in the literature review, will be tested in this study. A limited number of studies have been found that have tested this theory, however. These studies both have used a minimum number of three women directors, and a percentage of 30% to indicate the critical mass within boards.

First, Bennouri et al. (2018), Liu et al. (2014), Low et al. (2015), and Wiley and Monllor-Tormos (2018) found positive effects on firm financial performance (ROA, ROE, ROS, and Tobin's Q) when a critical mass on the board has been reached for women directors. This confirms that boards with at least 30% (or three) women directors will have positive influence on firm financial performance, since

this minority group have gained a voice and will be heard in groups, so that they can exercise their influence on the decision-making substantially (Liu et al., 2014). These studies have both used a minimum number of three women directors and percentage of 30%.

Furthermore, no negative relationships have been found, but the study of Isidro and Sobral (2015) indicate no sign between a critical mass for women on the board on firm financial performance because of a lack of evidence (Isidro & Sobral, 2015). This study has used a minimum percentage of 30%.

In conclusion, limited research has been executed to find the impact of having a critical mass for women directors on corporate boards. The studies found suggest positive or no relationships of a critical mass for women directors on firm performance. No negative sings have been found. This research can contribute to the limited empirical evidence that have examined the critical mass theory.

2.6.2. Decision-making behavior

Another, but less investigated, relationship is the impact of gender diversity on the amount of risk-taking in the corporate decision-making process. The board of directors has to take various strategic, financial decisions in, for example, making investments. Every investment has some level of risk. Men and women deal differently with their risk-taking behavior in making these corporate decisions. Several studies show that female executives directors are more cautious than male executives directors in making important corporate decisions. Thus, in general, men are taking more risky decisions while women are more risk-averse (Byrnes et al., 1999; Liu et al., 2014). The amount of risk the board of directors takes will be determined in the decision-making process. For example, the board has to decide the amount of leverage that a firm enters in or will spend on R&D expenditures (Cosentino, Montalto, Donato, & Via, 2012; Faccio, Marchica, & Mura, 2016).

Empirical evidence indicates that gender diversity negatively impacts the amount of leverage, acquisitions, cash holdings, R&D, and investments firms have and take (Chen et al., 2016; Elsaid & Ursel, 2011; Faccio et al., 2016; Loukil & Yousfi, 2016; Perryman et al., 2016). This suggest that women directors are more risk-averse in corporate decision-making than men.

However, Ahern and Dittmar (2012) have found mixed results: a negative relationship with cash holdings, but positive relationships with the amount of leverage and acquisitions (Ahern & Dittmar, 2012). They have used Norwegian firms in their sample, where the gender quota has been introduced a couple of years ago. The researchers suggest that, because of the gender quota, firms must hire more staff. This causes larger firm size what in turn leads to a bigger amount of leverage and more acquisitions (Ahern & Dittmar, 2012).

2.6.3. Firm riskiness

The impact of gender-diverse boards on firm riskiness is another widely examined effect. Firm riskiness reflects the influence of gender-diverse boards on firm's stock fluctuations. A variable that quantifies firm riskiness is the volatility of stock returns and ROA.

Studies show very consistent results. They indicate that adding women directors on boards will lead to less risky firms based on the decrease in variability of stock returns (Ahern & Dittmar, 2012; Byrnes et al., 1999; Chapple & Humphrey, 2014; Halko et al., 2012; Lenard, Yu, York, & Wu, 2014; Perryman et al., 2016). In addition, Faccio et al. (2016) found a negative relationship with ROA. Only one study shows no significant relationship between gender diversity and firm riskiness (Sila, Gonzalez,

& Hagendorff, 2016). Thus, it can be concluded that adding women directors to corporate boards decreases the volatility of stock returns and ROA what declines firm riskiness.

2.7. Hypotheses

Based on the earlier mentioned theories and empirical evidences, various hypotheses are formulated. The first hypothesis is about the impact of the presence of women directors, and the second about having a critical mass for women directors on boards.

2.7.1. The presence of women directors

The board of directors is a corporate governance mechanism that advices and monitors the management. Three key theories suggest that the presence of women directors may contribute to better board effectiveness and performance, namely the agency theory, stakeholder theory, and resource dependence theory.

Based on the agency theory, weak governance does create agency costs and negatively affect firms' financial performance. Efficient board guidance and monitoring are essential in mitigating these agency costs. Board diversity increases board independence, because board members from outside the firm will not collude with inside directors to subvert shareholder interests. Thus, a more diverse board acts as a better control mechanism because a wider range of views increases board independence. This will improve firms' financial performance (Reguera-Alvarado et al., 2017).

Furthermore, the stakeholder theory adds to this that the pressure on firms to appoint women directors comes from different stakeholders (Francoeur et al., 2008). The board composition must be adjusted to reflect all stakeholders' expectations. The appointment of women directors should boost performance of the firm, because women directors are sensitive to social and environmental issues that increases the reputation amongst the firm's stakeholders. Because of this, the stakeholders may provide easier access to the resources that they control, with a beneficial effect on firm financial performance (Low et al., 2015).

Another perspective which confirms that women directors positively affects firm performance is the resource dependence theory. This theory states that gender-diverse boards can reduce risks and uncertainties in firms through women can add valuable resources to the board, because women have other personal characteristics than men in business based on human and relational capital. With these resources, gender-diverse boards do have three benefits over male dominated boards based on the following characteristics: advice and counsel, legitimacy, and communication channels. These linkages from gender-diverse boards enhance the functioning of the board and ultimately firm performance (Bennouri et al., 2018; Liu et al., 2014; Huse & Solberg, 2006).

Empirically, researchers report positive relationships between the presence of women on corporate boards and firm financial performance in general (Bennouri et al., 2018; Campbell & Mínguez-Vera, 2008; Carter et al., 2003; Erhardt et al., 2003; Isidro & Sobral, 2015; Liu et al., 2014; Low et al., 2015; Perryman et al., 2016; Reguera-Alvarado et al., 2017; Terjesen et al., 2016). Women bring skills, perspectives and experiences into the board that improve the quality of board decisions. Due to this, creativity and innovation increases. In addition, women are more diligent to monitor managers, in contrast to male. Lastly, women directors improve the firm's observance of ethical and social policies. All these aspects positively affect the financial performance of firms.

Thus, the theories and the above-mentioned studies describe positive influences of more gender-diverse boards on firm financial performance. Because of this, a positive effect of women directors on firm performance is expected. Based on this, the following hypothesis can be formulated:

Hypothesis 1a: *The presence of women directors on corporate boards affects firm financial performance positively.*

Controversy, several studies report a negative effect of women directors on firm financial performance (Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Bennouri et al., 2018; Bøhren & Staubo, 2016; Richard et al., 2004; Shehata et al., 2017; Ujunwa et al., 2012). They argue that more gender-diverse boards can result in a too strong governance mechanism, because women are more diligent to monitoring. This could result in tough boards, what in turn leads to overmonitoring and poorer financial performance (Adams & Ferreira, 2009; Bennouri et al., 2018). Next to that, diverse boards create group cohesion and leads boards whose members are less cooperative and experience more emotional conflicts (Ujunwa et al., 2012). These aspects negatively influence firm financial performance. Because of these contrary results, the following alternative hypothesis is formulated:

Hypothesis 1b: *The presence of women directors on corporate boards affects firm financial performance negatively.*

2.7.2. Critical mass for women directors

The token status theory and the critical mass theory argue about the minimum proportion of women directors on boards in order to be heard and gain a voice. The token status theory states that the group may fail to take the token's opinions or contributions seriously. This means that the minority in a group does probably have no (significant) influence on specific corporate decisions (Bear et al., 2010; Brewer & Kramer, 1985; Kanter, 1977). The critical mass theory adds to this that the minority in a group (in this case women directors) will get a "voice" when three or more women on a board can create a critical mass. "One is a token, two is a presence, and three is a voice." (Liu et al., 2014, p. 171). This means that three or more women can influence the content and process of board discussions more substantially. If women directors have impact on corporate decisions and finally on firm financial performance, those impacts should be more pronounced when the critical mass is reached (Konrad et al., 2008). It is, however, more appropriate to use a percentage of 30% instead of a number of 3 women directors, to take the size of the board into account (Dahlerup, 2006). Thus, according to the critical mass theory, a minimum proportion of 30% women directors on the board positively affects firm financial performance.

Furthermore, a limited number of studies have tested the above-mentioned theories, but none have been found that suggest a negative relationship of have a critical mass for women directors on corporate boards (Bennouri et al., 2018; Liu et al., 2014; Low et al., 2015; Wiley and Monllor-Tormos, 2018). Liu et al. (2014), Low et al. (2015), and Wiley and Monllor-Tormos (2018) argue that boards with a critical mass for women directors positively influences firm financial performance, because the minority have gained a voice and will be heard in the group so they can exercise their influence on the decision-making.

In conclusion, it is expected that having a critical mass for women on boards will positively influence firm performance, based on the critical mass theory and empirical evidence that have tested this. With this in mind, the second hypothesis can be formulated as follows:

Hypothesis 2: *A critical mass for women directors on corporate boards affects firm financial performance positively.*

3. Research methodology

This chapter describes the research methodology of this study. First, several methods that have been used in other comparable studies will be discussed. Based on this, the most appropriate research method for this study will be explained in the second section. In the subsequent section, the measurements of firm financial performance, board gender diversity and control variables will be described.

3.1. Methods used in comparable studies

Pooled OLS regression

The most commonly used estimation method in the board and performance literature is the pooled ordinary least squares (OLS) regression (Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Bennouri et al., 2018; Isidro & Sobral, 2015; Liu et al., 2014; Low et al., 2015, Perryman et al., 2016). This statistical dependence technique estimates the relationship between one (or more) independent variable(s) and a dependent variable. More specifically, this technique estimates the relationship by minimizing the sum of the squares in the difference between the observed and predicted values of the dependent variable configured as a straight line (Tofallis, 2009). Pooled OLS can be applied to the analysis of causes, forecasting of impact of something, and time series analysis (trends) (Wooldridge, 2001).

However, the pooled OLS regression has its disadvantage that it doesn't account for endogeneity (Brooks, 2014). Endogeneity arises when the dependent variable is correlated with one or more independent variables. With other words, the dependent variable's value is explained by a variable in the model. This may be the case in this study, because multiple studies argue that women are likely to accept a directorship when the financial performance of that firm is well (Liu et al., 2014; Sila et al., 2016). Low et al. (2015) even mentioned in their study that insignificant results from the OLS regression may be due to the fact that gender diversity could be endogenous in their regression model. However, not all gender diversity studies suffer from this problem, but it will be taken into account if this method will be used in this research.

Furthermore, most gender diversity studies include industry and year fixed effects in the OLS regressions to control for industrial influence and yearly fluctuations of firm performance (Adams & Ferreira, 2009; Bennouri et al., 2018; Liu et al., 2014; Terjesen et al., 2016). Namely, outcomes of firm performance can be a result of the variability in industry or year and not because of gender-diverse boards.

Random effects regression

The random effects regression model is a statistical model where the parameters are random variables: different intercepts for different entities, and the intercepts being constant over time (Brooks, 2014; Rose, 2007). This regression method is often used in panel data analysis where an estimation "between" entities is most appropriate (park, 2011). The random effects model is more appropriate when there is no correlation between the fixed effects and the model variables and allows us to obtain more efficient coefficients. Next to that, it assumes that the variables are non-random and not correlated with the explanatory variables (Rodríguez-Domínguez, García-Sánchez, & Gallego-Álvarez, 2012).

In the equation of a random effects regression, μ_i is included for a random effect specific to individual or time period that is not included in the regressions, and errors are independent identically distributed (Brooks, 2014). A random effects model assumes that individual effect (heterogeneity) is not correlated with any regressor and then estimates error variance specific to groups (or times). Hence, μ_i is and individual specific random heterogeneity or a component of the composite error term. The intercept and slopes of regressors are the same across entities. The difference among entities (or time periods) lies in their individual specific errors, not in their intercepts (Park, 2011).

When there are reasons to believe that differences across entities have some influence on the dependent variable, then the random effects model is very useful. An advantage of this model is that it is possible to include time-invariant variables (i.e. gender). In the fixed effects model these variables are absorbed by the intercept (Baltagi, 2005). On the other hand, this method is not appropriate when the variables in the model are endogenous to each other which may create biased results.

Fixed effects regression

Another possible and commonly used estimation method is the fixed effects regression, often used in panel data analysis (Adams & Ferreira, 2009; Bennouri et al., 2018; Liu et al., 2014; Rose, 2007). A fixed effects regression, or "within groups" estimation, examines group differences in intercepts. This method can be useful when variables are endogenous to each other, in contrast to the random effects model (Liu et al., 2014; Park, 2011). The core differences between random and fixed effects regression lies in the role of using dummy variables. A parameter estimate of a dummy variable is a part of the intercept in a fixed effect model and an error component in a random effect model (Park, 2011). Fixed effects regression explores the relationship between predictor and outcome variables within an entity (country, individual, firm, etc.). Each entity has its own individual characteristics that may or may not influence the predictor variables (Baltagi, 2005). When using fixed effects, something within the entity may impact or bias the predictor or outcome variables that has to be controlled. This is the rationale behind the assumption of the correlation between entity's error term and predictor variables. Fixed effects remove the effect of those time-invariant characteristics, and because of this the net effect of the predictors on the outcome variable can be assessed (Adams & Ferreira, 2009; Liu et al., 2014; Low et al., 2015; Terjesen et al., 2016).

In the equation of a fixed effects model, μ_i will be included that indicates the fixed effect that is specific to an entity or time period that is not included in the regressions, and errors are independent identically distributed (Brooks, 2014). This indicates individual differences in intercepts, assuming the same slopes and constant variance across entities. Since an individual specific effect is time invariant and considered a part of the intercept, μ_i is allowed to be correlated with other regressors (Park, 2011).

One side effect of the features of fixed effects models is that they cannot be used to examine time-invariant causes of the dependent variable. Technically, time-invariant characteristics of the individuals are perfectly collinear with the entity dummies. Substantively, fixed effects models are designed to study the causes of changes within an entity. A time-invariant characteristic cannot cause such a change, because it is constant for each entity (Kohler & Kreuter, 2005). The problem is that gender is a time-invariant predictor of firm performance in this case. This means that the fixed effects regression method is not suitable to use this study.

2SLS regression

The two-stage least squares (2SLS) regression is a statistical estimation method that is used in the analysis of structural equations (Campbell & Mínguez-Vera, 2008; Low et al., 2015; Reguera-Alvarado et al., 2017). This technique is an extension of the OLS method and is mainly used when the relationship between the dependent variable and independent variable is endogenous (Low et al., 2015). This problem can be solved by adding instrumental variables (IVs). IVs are variables that are uncorrelated with the error term and the dependent variable but correlated with the independent variable. IVs are used to identify the true correlation between the independent variable and the dependent variable.

The 2SLS regression with IVs works in two stages (Wooldridge, 2001). In the first stage, a new IV for board gender diversity is needed, which is an unbiased estimate of board gender diversity and uncorrelated with the error term. The regression with the IV is based on OLS regression. In the second stage, a GMM regression will be applied (explained next). The goal of dividing this the analysis into two stages is to concern potential endogeneity and causality associated with the relations between the number of women directors and financial performance.

This raised the question which IVs have been chosen in the key papers. According to Terjesen et al. (2016), the IVs should be correlated with the endogenous variable being instrumented, but not with the error term (except throughout the endogenous variable). For example, Liu et al. (2014) used the percentage of women directors in the firm's 2-digit standard industrial classification (SIC) coded industry and the percentage of female employment in the firm's 2-digit SIC coded industry as IVs for the proportion of women on the board (in percentages). Furthermore, Adams and Ferreira (2009) used the fraction of male directors with board connections to female directors as an instrument on the basis that access to informal social networks amongst male directors helps women to secure a position on corporate boards. Terjesen et al. (2016) used in their study the lag percentages of independent and female directors on the board (as of 2009 fiscal year end), the lag of the board size, the number of employees (log), and the country's working women index as the initial set of instruments. The model in this study then have chosen the best linear combination of these instruments for each instrumented independent variable. Lastly, Low et al. (2014) used the proportion of female managers as an instrument for the endogenous variable: percentage of female directors. This IV was selected on theoretical grounds and properly tested for both validity and relevance, in contrast to prior studies.

However, the 2SLS regression method bring some disadvantages. First, in the context of governance regressions, it is usually difficult to come up with valid IVs, because the factors that are arguably most correlated with the endogenous variable are other governance characteristics that are already (or should be) included in performance regressions, such as board size, independence, etcetera (Adams & Ferreira, 2009). Second, it is possible that fewer IVs are chosen than needed. In this case, there are more unknowns than equations. This is called "under identify": there are not enough instrumental variables, which means that instrumental variables are used, but still endogeneity exist. Also, the opposite could happen, this is called "over identify": there are too many IVs, so the amount must be reduced (Wooldridge, 2001). Third, technically 2SLS is applied when there is endogeneity in, for example, time series, panel or primary. This method is most ideal for cross-sectional data only. If 2SLS is used in time series it will not be able to ensure co-integration, so results may become spurious. Lastly, if 2SLS is applied in panel data models it might not incorporate the cross-sectional

heterogeneity. So, researchers use GMM regression as advanced version of 2SLS in panel data models (Wooldridge, 2001).

GMM regression

Many used estimators in econometrics, including OLS and 2SLS with IVs, are derived from the generalized method of moments (GMM) regression (Bennouri et al., 2018; Reguera-Alvarado et al., 2017; Terjesen et al., 2016). It is an addition to the OLS regression method, but it mitigates the different endogeneity concerns. With this estimation method, the relation between women directors on the board and firm financial performance can be estimated in weighted levels. The method requires that a certain number of moment conditions were specified for the model. Moment conditions with larger variances receive relatively less weight in the estimation. In contrast, moment conditions with smaller variances receive relatively more weight (Wooldridge, 2001). In the more realistic case where the moment conditions are correlated, the weighting matrix efficiently combines the moment conditions by accounting for different variances and nonzero correlations. This estimation method controls for endogeneity and the dynamic structure of the relationship between firm financial performance and board gender diversity (Wooldridge, 2001). However, according to Wooldridge (2001), when endogeneity exists, it often has only a minor impact on estimates of coefficients and statistical significance. In addition, this method is very complicated and can easily generate invalid estimates (Roodman, 2009; Wooldridge, 2001).

Difference-in-differences (DID)

The difference-in-differences (DID) method is widely used research design by examiners to estimate the effect in issues subject to a policy intervention. The outcomes are measured both before and after policy interventions. This method allows researchers to account for changes of time that are unrelated to the policy intervention (Ahmed, Monem, Delaney, & Ng, 2017). Sila et al. (2016) adds to this that the DID exploits the 'parallel trends' assumptions, which means that two similar firms are likely to follow the same change without any treatment. Adding a treatment has any impact on the outcome, and the impact should be reflected in the difference between the change of the two firms (Sila et al., 2016). With other words, the DID method compares the outcomes of two (matched) groups, with (or before) and without (after) a treatment.

As mentioned before, this method is often used by examining the effect of adding a policy intervention. In gender diversity studies, it could be useful when investigating the effect of firms that used to have no, but later have women directors on corporate boards. In this case, the treatment group contains firms that in the first years have no women directors but added in a later phase of the sample period. In contrast, the control group contains firms without women directors in the whole sample period. Afterwards, the differences before and after the transitions, and the difference between the two groups are measured. For example, Ahmed et al. (2017) used the DID design by investigating whether gender-diverse boards contribute to capital market efficiency though their role in corporate disclosure in Australia. Next to that, Sila et al. (2016) investigated the relationship between boardroom gender diversity and firm risk with this method. Both studies measured the outcomes before and after a transition from male to female and matches them with firms with only male directors the whole time.

All the assumptions of the OLS regression apply equally to the DID method, for example, endogeneity may not take place. In addition, the DID requires two groups which have parallel trends in outcome and composition. The advantage of this method lies in the fact that it can be used for intuitive interpretation. This means that based on common sense, relationships can be thought of and tested via a DID design. Further, in contrast to the fixed effects regression, this method can be used to examine time-invariant causes of the dependent variable. The disadvantage of this method is that another treatment can cause an effect that is not taken into account (Ahmed et al., 2017). This method is difficult to apply in this study. It is hardly to analyze the effect of adding a female to male-dominated boards in this study, because the largest sample consist of 45 firms without women directors on board in one year, and not all firms have even added a woman to their boards in a later stadium. This means only a small number of firms can be analyzed, which can create biased results. Thus, this is not an appropriate method to use in this study, but it would have been if the sample had been larger.

3.2. Method for testing the hypotheses

The sample in this study represents U.K. listed firms in a period of four years (2015-2018). In this case, different variables for several entities over a certain time period will be structured. This is called panel data (Brooks, 2014). Hassan, Marimuthu and Johl (2017), Low et al. (2005), Liu et al. (2014) and Reguera-Alvarado et al. (2017) all used panel data in their studies with firms from several countries. With panel data, more reliable analysis than simple cross-sectional data can be provided, and it is more powerful in controlling for unobservable heterogeneity and omitted variable biases (Low et al., 2015). Baltagi (2005) adds to this that panel data bring the following advantages with: it includes heterogeneity, is more variability, less collinearity (among variables), more degrees of freedom, more efficiency, dynamics of change, larger sample size, more informative data, and thus, bias is minimized. Hassan et al. (2017) suggest that panel data also helps to give robust results, especially for modeling purposes. On the other hand, panel data could create design and data collection problems, short time-series dimensions of micro panels, and cross-section dependency in the case of macro panels in, for example, correlation between countries (Baltagi, 2005).

Furthermore, every panel has its own characteristics. A panel may be long or short, balanced or unbalanced, and fixed or rotating. A short panel has many entities but few time periods, while a long panel has many time periods but few entities (Park, 2011). Next to that, with balanced panel data, the numbers of observations in the time series is the same for each cross-sectional unit. If the numbers differ, it is unbalanced panel data (Brooks, 2014). Lastly, panels can be fixed or rotating. If the same entities are observed for each period, the panel data set is called a fixed panel. If a set of individuals changes from one period to the next, the data set is a rotating panel (Park, 2011). The panel in this study can be characterized as a short (331 firms in 4 years), balanced, and fixed panel.

Panel data can be analyzed by various methods which are described in the previous section. However, as described before, some methods are not suitable to use in this study (random effects, fixed effects, and difference-in-differences) or are too complex and sensitive to estimation errors (2SLS and GMM). Because of this, the most used regression method in the board and performance literature, the pooled OLS regressions, will be executed in order to examine the relationship between gender diversity and firm performance. This method is appropriate to test both the influence presence and proportion (critical mass) of women directors on firm performance. Year and industry dummies will be included in the OLS regressions to control for time-varying economic and industry influence on firm

performance (Bennouri et al., 2018; Liu et al., 2014). The main OLS regression equation model with industry and year fixed effects can be written as follows:

$$PERFORMANCE_{it} = \beta_0 + \beta_1(GENDER\ DIVERSITY)_{it} + \beta_2(CONTROL\ VARIABLES)_{it} + \lambda_t + \alpha_i + \varepsilon_{it}$$

Where:

$PERFORMANCE_{it}$ = measures of firm performance.

β_0 = the regression intercept or constant. It represents the expected value for firm financial performance when all the independent variables are zero.

$GENDER\ DIVERSITY_{it}$ = measures of board gender diversity.

$CONTROL\ VARIABLES_{it}$ = variables that are deemed to affect financial performance.

λ_t = year fixed effects to control for yearly economy-wide fluctuations on firm performance.

α_i = industry fixed effects to control for industrial-specific influence on firm performance.

ε_{it} = the error term. It is the total amount of change that cannot be explained by the variables in the model.

3.3. Variables

Multiple variables will be used in this study to test the hypotheses. The measurements of firm financial performance, board gender diversity and control variables will be described in this section. These variables with their codes and descriptions are summarized in Table 1 at the end of this section.

Firm performance measures

The dependent variable in this study is firm financial performance of firm *i* in year *t*. In this study, firm performance will be measured using the ratio's return on assets (ROA), return on equity (ROE), return on sales (ROS), and Tobin's Q (TQ) (Adams & Ferreira, 2009; Carter et al., 2010; Francoeur et al., 2008; Shrader et al., 1997). ROA can be measured by dividing EBIT by total assets, ROE by dividing net income by common equity, and ROS dividing EBIT by net sales. These financial performance measurements are the most commonly used to indicate the firm's earnings to shareholders and firm's profitability (Adams & Ferreira, 2009; Carter et al., 2010). Furthermore, Tobin's Q can be determined as the sum of market value of stock and book value of debt divided by the book value of total assets (Bennouri et al., 2018; Isidro & Sobral, 2015). According to Terjesen et al. (2016), this performance measure provides an indication of the firm's expected performance. A Tobin's Q greater than one means that the shareholders believe the firm is worth more than its book value, what in turns leads to a higher market value (Cho & Pucik, 2005). In contrast, a Tobin's Q smaller than one indicates that the market is expecting the firm to destroy shareholders' value in the future (Francoeur et al., 2008).

In addition, ROA, ROE, and ROS are accounting-based measurements, where Tobin's Q is a market-based measurement of financial performance. Compared to the accounting bases measurements, Tobin's Q is less affected by accounting conventions and by the documented strategic manipulation of earnings (Bennouri et al., 2018). Next to that, the results of accounting-based measurements and market-based measurements show mixed results, as mentioned in the empirical evidence of board gender diversity on firm financial performance (Appendix 1). For these reasons, both kinds of performance measurements are used in this study to see if the results differ (Shrader et al., 1997).

Board gender diversity measures

The measure of interest in this study is board gender diversity. Gender diversity will be measured as the percentage or the number of women directors on boards (TWD) for testing hypothesis 1 (Adams & Ferreira, 2009; Liu et al., 2014; Low et al., 2015; Terjesen et al., 2016). This is the manner almost all gender diversity studies do. This percentage will be divided into women executive (WED) and non-executive (WNED) directors to examine their influence on firm financial performance in this study. It is interesting to see their different impact on firm performance, since male-dominated boards have a lack of monitoring that women non-executives bring to boards. The executive directors have more opportunities to observe and influence firm decisions beyond the board room with their proximity to operating activities, where the non-executives influence due their monitoring effect (Adams & Ferreira, 2009; Adams & Funk, 2012; Liu et al., 2014; Low et al., 2015; Terjesen et al., 2016).

Next to that, testing the critical mass theory for women directors on boards (hypothesis 2) can be measured in two ways: (1) a dummy variable coded 1 if there are at least three women directors on the boards, and (2) a dummy variable coded 1 if there are at least 30% women directors on the board (Dahlerup, 2006; Isidro & Sobral, 2015; Konrad et al., 2008; Liu et al., 2014). In this study the 'three or more women directors' indicator proposed by Konrad et al. (2008) and Liu et al. (2014) will not be used, because board size in the sample varies considerably, and thus the influence of three women or more on a board of four members can be very different from their influence on a board of 20 members. Instead, the related rule of thumb of 'at least 30% of women directors' on the board will be used as Dalherup (2006), Isidro and Sobral (2015), and Low et al. (2015) show in their studies. For this, a dummy variable (D_CM) will be used that turns 1 when the critical mass of 30% women directors is reached and 0 otherwise. This percentage can be calculated by dividing the number of women directors by the total number of directors on the board. Next to that, a dummy variable of one female director (D_1W) will be included that will turn 1 if one only female director is on the board and 0 otherwise (Liu et al., 2014). This dummy is included to show the difference of having one female director or a critical mass for women directors. This dummy must be small enough to indicate that there is no critical mass on the board, because the smallest board contains of five members (1 woman divided by a minimum of 5 board members means 20% women). Hereby, no separation between women executive and non-executive directors will be made, because a limited amount of board compositions has at least 30% women executive directors what makes this theory impossible to examine.

Measures of control variables

Based on the key papers, several control variables of firm *i* in year *t* will be included in this study. These control variables will be divided into three different groups: board characteristics, firm characteristics and fixed effects. Logarithms are used for some control variables to reduce their standard deviations, make the values more normal distributed, and to make it easier to read due to the large values they contain. These variables are indicated with and 'L' in front of their codes.

First, the board characteristics include the log of board size (L_BSIZE), calculated as the sum of all executive and non-executive directors on the board. Previous research shows that board size influences performance, and therefore it should be included as a control variable. Several researchers argue that corporate performance declines as a firm's board size becomes larger (Low et al., 2015; Terjesen et al., 2016). Large boards may create coordination costs (Terjesen et al., 2016), and simply

have more directors and therefore have more capability to contain a more diverse mix of directors (Low et al., 2015). It must be taken into account that board size may be correlated with the number of women in the boardroom since larger boards have more seats available, potentially allowing for greater representation by women. Second, the percentage of non-executive directors (NED) is included. This is measured by the number of independent directors over the total number of directors on the board. The fraction of non-executive directors could influence the financial performance of a firm. The most appropriate board composition includes both inside and outside directors. Shareholders value rise when there is separation between ownership and control (Liu et al., 2014; Low et al., 2015).

In addition, the group of firm characteristics contains several control variables that describe firm *i*. First, the log of employees (L_EMP) is included that explains the size of a firm (Liu et al., 2014; Low et al., 2015). This control variable seems a better proxy than the book value of total assets, since the board size (L_BSIZE) is highly correlated with total assets in a lot of studies (Bennouri et al., 2018; Terjesen et al., 2016). Another included control variable that may affect financial performance is the log of firm's years since incorporation (L_FAGE), although its impact remains largely ambiguous. On the one hand, older firms may have more (production) experience which may enhance firm performance, but on the other hand firm performance may decline with age, as older firms are more prone to organizational rigidities and bureaucratism (Low et al., 2015). Next to that, the level of tangibility (TAN), leverage (LEV), and R&D expenses (RD) are included because they influence firm performance as well (Adams & Funk, 2012; Bennouri et al., 2018; Halko et al., 2012; Liu et al., 2014). For instance, firms with more tangible assets have lower firm performance, since higher tangibility leads to a lower proportion of intangible assets (e.g., human capital) to generate cash flows (Bennouri et al., 2018; Margaritis & Psillaki, 2010; Yuan et al., 2008). For leverage, it can create agency costs exist from conflicts between debt and equity investors. These conflicts arise when there is a risk of default, referred as an underinvestment of debt overhang problem. In this case, debt will have a negative impact on firm performance (Liu et al., 2014; Margaritis & Psillaki, 2010). According to Torchia et al. (2011), R&D expenses indicate the extent a firm innovates, what in turn is one of the most important predictors of firm performance, because it expands market share and increase firm performance.

Lastly, a common practice in other comparable studies is controlling for year and industry effects (Adams & Ferreira, 2009; Bennouri et al., 2018; Liu et al., 2014; Low et al., 2015). First, year fixed effects must be included because of time-varying economic influence on firm performance, using a dummy variable for every year in the sample period. Second, the largest industries can influence firm performance too. To control for this, a dummy variable that equals 1 (0) if the firm (does not) operates in one of the three largest industries: manufacturing (IND_1), wholesale & retail trade (IND_2), or information & communication industry (IND_3). According to Hillman et al. (2007), the proportion of women directors is linked to the sector in which it operates. They underline the importance of links to attract women directors. In this light, having a gender diverse workforce could influence the proportion of women directors.

Table 1: Variables defined

Variable	Code	Description
Firm performance		
Return on assets	ROA	EBIT / total assets.
Return on equity	ROE	Net income / common equity.
Return on sales	ROS	EBIT / net sales.
Tobin's Q	TQ	Market value of equity + book value of debt / total assets.
Gender diversity		
Total women directors	TWD	Total number of women directors / total number of directors on the board.
Women executive directors	WED	Total number of executive women directors / total number of directors on the board.
Women non-executive directors	WNED	Total number of non-executive women directors / total number of directors on the board.
Critical mass	D_CM	Dummy code equals 1 when at least 30% of the directors on the board are women.
One female director	D_1W	Dummy code equals 1 when only one female director is on the board.
Control variables		
Board characteristics		
Board size	L_BSIZE	Log of total number of directors on the board.
Board independence	NED	Number of non-executive directors on the board / total number of directors.
Firm characteristics		
Employees	L_EMP	Log of the number of employees.
Firm age	L_FAGE	Log of the number of years since incorporation.
Tangibility	TAN	Fixed assets / total assets.
Leverage	LEV	Long-term debt / total assets.
R&D expenses	RD	Research & development expenditures / total assets.
Fixed effects		
Year	YEAR	Dummy variables for every year in the sample period to control for time-varying effects.
Manufacturing	IND_1	Dummy variable equals 1 to control for firms in the manufacturing industry.
Wholesale & retail trade	IND_2	Dummy variable equals 1 to control for firms in the wholesale & retail trade industry.
Information & communication	IND_3	Dummy variable equals 1 to control for firms in the information & communication industry.

4. Data collection

This chapter starts with describing the sample composition. The subsequent section discusses the data selection criteria and an overview in which industries the firms in the final sample participate.

4.1. Sample composition

In this study, the data will be gathered from the U.K. Financial Times Stock Exchange (FTSE) All-Share and Fledging index for the period between 2015 and 2018. The FTSE All-Share index is a market capitalization weighted stock market index incorporating the largest 619 firms by capitalization which have their primary listing on the London Stock Exchange. The FTSE Fledging index contains approximately 200 listed companies that are smaller than those on the All-Share index. U.K. firms have been chosen as sample because the gender diversity literature is limited for the U.K., while in general the board and financial data of U.K. firms are widely available and therefore is suitable to examine. This is the same story for listed firms, where data from non-listed firms are more difficult to obtain.

Furthermore, a sample period from 2015 until 2018 will be used because it is desirable to generate current results in this study over more than one year. Measuring performance over a time-period rather than one year is recommended, according to Low et al. (2015). There are three reasons for this. First, measuring performance at different points in time better controls for market fluctuations and produces more consistent results. Second, controlling for prior performance means that the regression model captures changes in firm performance from a prior year. Third, the effect of board gender diversity on financial performance occurs over time, and the impacts of strategic decision making on organizational performance requires several years to materialize (Low et al., 2015).

4.2. Data selection

In this study, two different databases will be used to collect the necessary data. First, the BoardEx database is being consulted to obtain information about the board composition of the sample, such as the number of women directors on the board of a specific firm. BoardEx is a business intelligence service used as a business development tool and as a source for academic research concerning corporate governance and boardroom processes. Second, the ORBIS database will be used to gather all the needed financial and other firm specific data from firms in the sample. ORBIS is compiled by Bureau van Dijk Electronic Publishing (BvD) and provides firm-level data for many countries worldwide.

Several criteria will be selected in these databases to gather the most appropriate data for this study. An overview of the sample selection criteria is given in Table 2. First, firms from the FTSE All-Share and Fledging index are selected, where ORBIS only recognizes 719 firms. Second, following the convention in the literature, some industries have to be excluded in the sample. For instance, financial firms use financial ratios that are not comparable to those of non-financial firms, therefore these firms have to be omitted in this study. Utility firms will also be excluded because these firms tend to be regulated and largely state-owned in Europe. Industries other than from the production or service sector that have a minimum contribution to the sample, such as water supply and forestry and fishing industry, are also excluded, since these firms could negatively impact the analysis (Klapper, Laeven, & Rajan, 2006; Liu et al., 2014; Perryman et al., 2016; Sila et al., 2016). Third, too small firms are excluded from the sample, because these companies have certain minimum values of firm characteristics (such

as holdings with 1 or 2 employees) which can give the analysis a distorted picture. Lastly, when there is missing information (such as missing financial data or board information), it is searched for in the annual reports and websites of that specific firm. When this information cannot be found in all years, they will also be excluded from the sample. Finally, this selection results in a full sample of 331 firms that will be analyzed for hypothesis 1. These firms are specified per industry in Table 3, based on NACE codes[5]. This table indicates that the manufacturing industry is by far the largest one (36%).

In addition, nothing is mentioned about a minimum board size for testing the critical mass theory in the literature. Nevertheless, it is decided that boards with less than five members will be excluded from the sample, because a board that is large enough is needed to test this theory. This leads to an exclusion of an additionally 31 firms, resulting in a sample of 300 firms for hypothesis 2.

Finally, the full sample contains 1201 observations. When putting all these observations into Stata (the analyzation software used in this study), it indicates that the panel data is strongly balanced. According to Park (2011), balanced panels are preferred, because unbalanced panels could cause some bias since some firms could be represented more in the sample, which is not favorable in the analysis.

Table 2: Sample selection

	Excluded	**Total**
Firms from the FTSE ALL-Share and Fledging index	0	819
Firms not recognized by ORBIS	100	719
Excluding firms from financial, utility and other irrelevant industries	317	402
Excluding too small firms	22	380
Excluding firms with unavailable information	49	331
Final sample H1		**331**
Excluding firms with too small boards	31	300
Final sample H2		**300**

Table 3: Full sample quantified by industry

Industry	**NACE code**	**Frequency**	**Percentage**
Mining and quarrying	5-9	25	7.6%
Manufacturing	10-33	119	36.0%
Construction	41-43	15	4.5%
Wholesale and retail trade	45-47	42	12.7%
Transportation and storage	49-53	17	5.1%
Accommodation and food service activities	55-56	10	3.0%
Information and communication	58-63	30	9.1%
Real estate activities	68	24	7.3%
Professional, scientific and technical activities	69	18	5.4%
Administrative and support service activities	77-82	24	7.3%
Other services activities	94	7	2.1%
		331	**100%**

[5] Statistical classification of economic activities in the European Community.

5. Results

This chapter starts with describing the data and the manner to deal with outliers in this study. In the subsequent section, two ways to test for multicollinearity in this study will be discussed: the Pearson's correlation matrix and the Variance Inflation Factor. Next, the results about the influence of the presence of women directors (hypothesis 1) and the critical mass for women directors (hypothesis 2) on firm financial performance will be given in the following two sections. This chapter ends with robustness checks on both hypotheses.

5.1. Descriptive statistics

The collected data contains 331 non-financial U.K. listed firms from the FTSE All-Share and Fledging index in the period between 2015 and 2018. The descriptive statistics (with outliers) are displayed Appendix 2. This table shows the variables used in this study with their number of observations, means, standard deviations, medians, minimum values, and maximum values.

However, there are a couple of extreme high values for certain variables in this table, called outliers. For example, the performance measurement (ROE) shows a minimum value of -1,654% and a maximum of 1,960%, while the average is 12.5% with a standard deviation of 86.2%. Another extreme value is the number of employees (EMP) with a minimum of 10 and a maximum 611,366 employees, while the average firm performs its duties with 21,091 employees with a standard deviation of 4,123. These outliers indicate that the data is very dispersed, which creates a distorted picture of the real situation. Because of this, it is important to adjust the data for outliers. To make the data more normal distributed, the winsorization technique has been applied in this study. This technique is named after biostatistician Charles Winsor (1895-1951) who has introduced the term. The winsorization technique transforms extreme values in statistical data to reduce the effect of possibly outliers by replacing the lowest and the highest values of a series of numbers by the respectively adjacent lowest and highest values. Because outliers will not be deleted in this case, the analysis doesn't lose power (Dixon, 1980). In this study, the variables with outliers are assessed and winsorized at the 1% tails, which is the most appropriate percentage in this study and very common when working with financial data (Bennouri et al., 2018; Matsa & Miller, 2013). This means that on both tails of the normal distribution the lowest 1% and highest 1% of the data will be winsorized (Dixon, 1980). When applying this technique, a significant change has occurred.

Table 4 presents the descriptive statistics which have been adjusted for outliers. This table indicates that ROA has a value of 7.8%, which is higher than in studies the from Adams and Ferreira (2009) with a ROA of 3.19%, and Liu et al. (2014) with a ROA of 3.2%. This is probably because these studies have used net income instead of earnings before interest and taxes (EBIT) to calculate ROA, what results in relatively lower values. The second performance ratio, ROE, denotes in this study a value of 12.6%, which is higher than Bennouri et al. (2018) report (5.05%). The third performance ratio, ROS, indicates a ratio of 14.5% in this study. This is way higher than Liu et al. (2014) reports (4.8%). Again, probably because they calculate ROS with net income instead of EBIT. Lastly, Tobin's Q (TQ) has a mean value of 1.241. This is slightly higher than the reported average of Bennouri et al. (2018), but way lower than Adams and Ferreira (2009) mentioned, with values of 1.04 and 2.09, respectively.

In addition, the table provides information about the independent variables that measure board gender diversity. The female board presentation (TWD) is 21% for the whole sample, where Liu et al. (2014), Bennouri et al. (2018), and Terjesen et al. (2016) indicate a mean of 10%, 11%, and 9%,

respectively. This shows that the female board presentation is way higher in this study. This is probably because these studies have used countries in their sample where women incorporation in business is less developed, and/or these studies have used sample periods from 2011 or older, when women were less incorporated on corporate boards. For instance, Christiansen, Lin, Pereira, Topalova, and Turk (2016) and Appelman (2019) report in their U.K. study a female board presentation of 24% and 21%, which indicates that this current information from European firms about the board presentation shows higher female participation. From the total board presentation of 21%, 2.3% of all directors are women executives (WED) and 18.5% non-executives (WNED). This indicates that the percentage of women directors in executive roles is very low, in contrast to non-executives. Liu et al. (2014), the only research found that reported these variables, mentioned in their sample an average of 6.6% women executives and 3.6% women non-executives. This difference is also probably because the sample from Liu et al. (2014) dates from 1999 to 2011 when less women were on corporate boards (only 10% as mentioned before). Further, the critical mass variable (D_CM) reports that 20.5% of the firms in this study have at least 30% women on their boards. Isidro and Sobral (2015) and Liu et al. (2014) indicate that around 7.5% of the firms have a critical mass, which is way lower. 32.5% of the firms in this study only have one female director (D_1W). This is somewhat lower in other studies: Adams and Ferreira (2009) and Liu et al. (2014) report that 40% and 36.5% of the firms have one female director, respectively.

Table 4 further presents the descriptive statistics for the control variables. The normal values of the log variables are displayed, because logarithms don't provide good descriptive information. first, an average board has about 8 members (BSIZE), where 58% of all directors are non-executives (NED). The board size is in line with other studies that report a mean of 8 (Bennouri et al., 2018) and 9 members (Adams and Ferreira, 2009; Terjesen et al., 2016). Board independence is about the same as Adams and Ferreira (2009) and Terjesen et al. (2016) indicate, but double in studies by Bennouri et al. (2018) and Liu et al. (2014). Next, the average firm has about 20,255 employees (EMP) and a firm age (FAGE) of 45 years. Appelman (2019) reports an average firm age of 48.6 years. The firms' assets are on average for 61% tangible (TAN), which is in line with the study of Appelman (2019) that reports a mean of 63%. The mean leverage (LEV) is 26.5% of their assets, which is in line with Appelman (2019), Bennouri et al. (2018) and Terjesen et al. (2016) that report 22.5%, 23% and 25%, respectively. Next, the mean R&D expenses (RD) are 1.02% of the firm's assets, with more than half of the firms having no R&D expenses. This is because some firms don't have any R&D expenses, for example in the industry classification real estate and administrative services. This R&D percentage is in line with the study of Appelman (2019) and Bennouri et al. (2018) that both report a value of 1.2%. Lastly, 36% of the firms participate in the manufacturing industry, 12.7% in the wholesale and retail trade industry, and 9.1% in the information and communication industry. These numbers cannot be compared to other studies, because they don't mention the descriptive statistics of the fixed effects variables.

In addition, Figure 3 illustrates the trend of board gender diversity in the sample from 2015 to 2018. This figure shows that women directors (TWD) are considerably in minority: in 2015 and 2016, about one-fifth of all directors in the sample are women. In particular, the executive roles for women (WED) are very low. The positive point is that the total number of women directors is emerged from 524 in 2015 to 692 in 2018, while the total number of directors (BSIZE) keeps approximately the same during the years. This is an increase of 32% and is mainly due to the rise of 159 women non-executive directors (WNED), where the executive roles (WED) has emerged with only 9 women from 2015, however.

Table 4: Descriptive statistics

Variable	Observ.	Mean	Std. Dev.	Median	Min.	Max.
Firm performance						
ROA	1201	.078	.092	.071	-.246	.387
ROE	1201	.126	.281	.119	-1.195	1.241
ROS	1201	.145	.242	.099	-.543	1.329
TQ	1201	1.241	1.091	.897	.112	6.628
Gender diversity						
TWD	1201	.208	.11	.222	0	.6
WED	1201	.023	.057	0	0	.4
WNED	1201	.185	.102	.182	0	.5
D_CM	1201	.205	.404	0	0	1
D_1W	1201	.325	.469	0	0	1
Control variables						
BSIZE	1201	8.391	1.988	8	4	14
NED	1201	.583	.136	.57	.17	.85
EMP	1201	20,225	52,274	4,123	45	448,988
FAGE	1201	45.127	37.339	31	2	162
TAN	1201	.611	.232	.64	.03	.98
LEV	1201	.265	.166	.259	.001	.687
RD	1201	.01	.029	0	0	.21
IND_1	1201	.36	.472	0	0	1
IND_2	1201	.127	.329	0	0	1
IND_3	1201	.091	.291	0	0	1

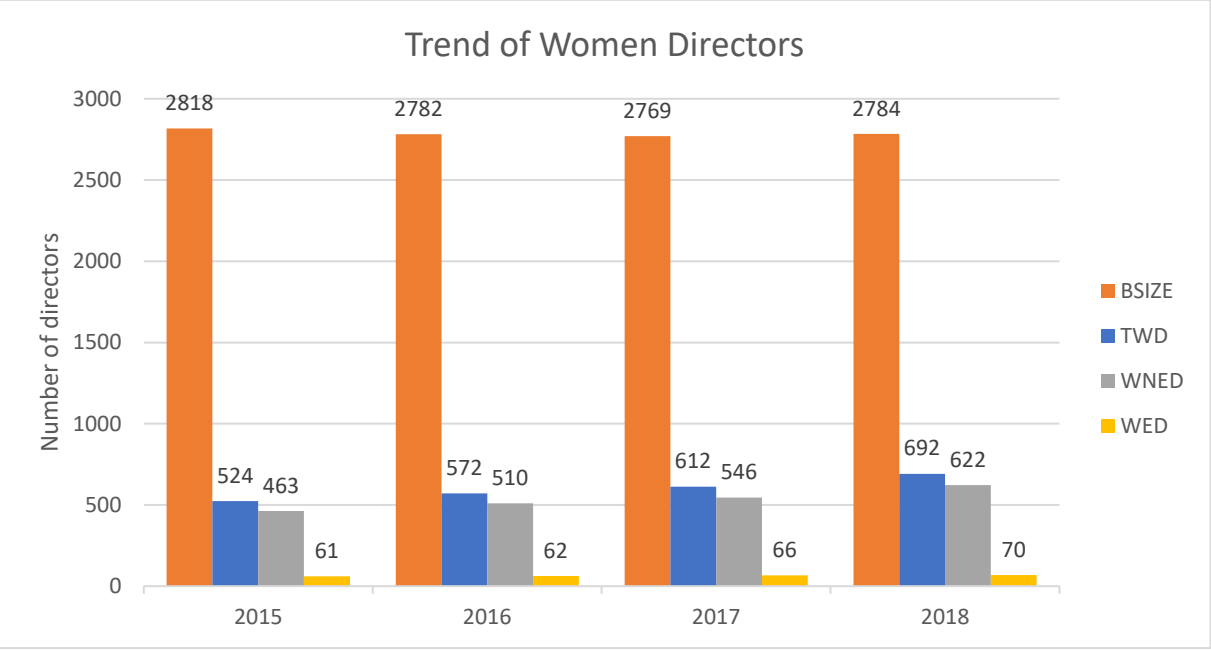

Figure 3: Trend of women directors in the sample

5.2. Multicollinearity

A problem that in statistics could arise is that of multicollinearity. Multicollinearity exists when two or more predictor variables are highly correlated with each other, meaning that variables in a multiple regression model are very linear related. This phenomenon is a problem because it undermines the statistical significance of an explanatory variable. Two ways to check for multicollinearity used in this study are the Pearson's correlation matrix and the Variance Inflation Factor (VIF).

5.2.1. Pearson's correlation matrix

Table 5 reports the Pearson's correlation matrix that shows the correlation coefficients among all dependent, independent and control variables used in this study. Correlations below .3 will not create issues, but correlations with values higher than .3 could cause multicollinearity problems (Vithessonthi & Racela, 2016). In the table is shown that the performance and gender diversity measurements are highly correlated with each other (values > .03). Since these variables are used alternatively instead of simultaneously in the regression models, these high correlations are no issues. However, some of the gender diversity measurements and board characteristics control variables are also highly correlated among each other, for instance (NED) with (WNED), and (L_BSIZE) with (L_EMP). These highly correlated variables have to be taken into accountant in the analysis and will be checked separately before adding them to the regression model. Otherwise, they will be excluded from the regression models.

Further, this matrix tells something about the strength of the correlations among other variables which are worth to discuss. First, when looking at the dependent performance measurements, (ROA) and (ROE) are positively and significant correlated with the independent variables (TWD), (WNED), and (D_CM). This indicates that more gender-diverse boards (TWD), boards with more non-executive women directors (WNED), and boards that have a reached a critical mass for women directors (D_CM) have higher firm performance based on (ROA) and (ROE). In contrast, no performance measurement is significantly correlated with (WED) and (D_1W). These correlations are in line with the theories described in the literature review, that more women directors and critical masses positively affects firm financial performance. Performance measurements (ROS) and Tobin's Q (TQ), however, are not significant correlated with any gender diversity predictor. Next, all performance measurements show inconsistent correlations among the control variables. For instance, (ROA) and (ROE) show contrasting results with (ROS) and (TQ) on (L_EMP), indicating that more employees result in higher firm performance based on (ROA) and (ROE), but lower on (ROS) and (TQ).

Second, the independent variables present significantly correlations among each other. For instance, firms with a higher proportion of women directors (TWD) participate in organizations with larger boards (L_BSIZE), more non-executive directors (NED), more employees (L_EMP), and longer years of incorporation (L_FAGE). The significant correlation between the gender diversity variables and (L_EMP) and (L_BSIZE) is very logically. Namely, it shows that larger firms with more employees (L_EMP) need bigger boards (L_BSIZE) with more seats where women can take place, and the possibility of reaching a critical mass is more obvious (D_CM), what in turn leads that these firms have fewer single women directors (D_1W). These correlations show that the size of firms have an impact on the number of women directors on corporate boards. Further, the gender diversity variables show that (TWD) and (D_CM) have similar correlations among other variables but contradicting with

Table 5: Pearson's correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) ROA	1.000															
(2) ROE	0.572**	1.000														
(3) ROS	0.334**	0.212**	1.000													
(4) TQ	0.580**	0.315**	0.008	1.000												
(5) TWD	0.081**	0.113**	-0.014	0.022	1.000											
(6) WNED	0.068*	0.109**	0.007	0.011	0.858**	1.000										
(7) WED	0.033	0.023	-0.040	0.023	0.397**	-0.131**	1.000									
(8) D_CM	0.074*	0.079**	-0.036	0.015	0.701**	0.568**	0.338**	1.000								
(9) D_1W	-0.046	-0.040	0.024	-0.011	-0.433**	-0.384**	-0.148**	-0.352**	1.000							
(10) L_BSIZE	-0.025	0.020	0.150**	-0.111**	0.248**	0.303**	-0.063*	-0.330**	0.149**	1.000						
(11) NED	-0.054	0.011	-0.105**	-0.083**	0.340**	0.430**	-0.113**	-0.188**	0.219**	0.206**	1.000					
(12) L_EMP	0.083**	0.121**	-0.320**	-0.064*	0.351**	0.377**	0.003	-0.261**	0.237**	0.398**	0.411**	1.000				
(13) L_FAGE	0.024	0.042	0.016	-0.059*	0.121**	0.109**	0.037	-0.054	0.098**	0.058*	0.027	0.086**	1.000			
(14) TAN	-0.241**	-0.128**	0.281**	-0.219**	0.014	0.037	-0.040	-0.012	-0.029	0.225**	0.038	0.013	-0.093**	1.000		
(15) LEV	-0.133**	-0.041	0.094**	-0.277**	0.031	0.080**	-0.085**	-0.073*	0.007	0.284**	0.105**	0.236**	-0.032	0.242**	1.000	
(16) RD	-0.059*	-0.104**	-0.100**	0.130**	0.021	0.013	0.018	-0.027	-0.043	-0.039	0.040	-0.053	0.032	-0.115**	-0.051	1.000

Table 5 presents the Pearson's correlation matrix in order to measure the correlations among variables. ** and * denote significance at the 1% and 5% levels, respectively.

(D_1W). The correlations among the critical mass measurements (D_1W) and (D_CM) are significantly negative correlated with each other. This logically indicates that boards with only one female director have no critical mass, and vice versa.

5.2.2. Variance Inflation Factor (VIF)

Another way that have been used to test for multicollinearity in this study is the Variance Inflation Factor (VIF). The results of this test tell the researcher to what extent the variance of the estimated coefficient is increased. A VIF of 1 indicates that no correlation between the independent variables is found. Scores higher than 10 expresses that multicollinearity issue exists what causes a problem for the analysis (Bennouri et al., 2018). After executing the VIF results for all variables in this study, it indicates that the values range between 1.01 and 1.27. This is way below the critical value of 10. Thus, it can be concluded that, based on the VIF, no multicollinearity issues will take place in the analysis of this study.

5.3. Presence of women directors

First will be examined if the percentage of women directors on boards (TWD) has a significant impact on firm performance. Hypothesis 1 states that women directors significantly and positive affects firm financial performance. Table 6 presents the regression results where gender diversity is measured by (TWD) and firm performance by (ROA). The variables which are highly correlated with (TWD) or (ROA) are excluded from this test. These are tested separately in Appendix 7. With the other independent variables, all possible combinations are regressed and the most relevant are shown in Table 6 in six different models. Year and industry dummies are included in all models to control for time-varying economic and industry-specific influence on firm performance.

The first model in Table 6 presents the 'benchmark', which shows the influence of the control variables on (ROA). First, firm age (L_FAGE) is added to the models to show its impact. The expectations of firm age on firm performance is a little bit ambiguous, because on the one hand, older firms may have more experience which may enhance firm performance, but on the other hand, firm performance may decline with age, as older firms are more prone to organizational rigidities and bureaucratism (Low et al., 2015; Liu et al., 2014). In model 1 is shown that (L_FAGE) has insignificant influence on firm performance, which is in line with the comparable study of Low et al. (2015), but Liu et al. (2014) indicate significant negative effect. Second, firm's tangibility (TAN) is added as control variable since it is expected that firms with more tangible assets have lower firm performance, because higher tangibility leads to a lower proportion of intangible assets (e.g., human capital) that generate cash flows (Bennouri et al., 2018; Margaritis & Psillaki, 2010; Yuan et al., 2008). The sign of (TAN) in model 1 are consistent with these studies: significant negative related on firm performance. Third, leverage (LEV) is also significant negative related to firm performance in model 1. Firm's leverage may create agency costs exist from conflicts between debt and equity investors. These conflicts arise when there is a risk of default, referred as an underinvestment of debt overhang problem. In this case, the amount of debt will have a negative impact on firm performance (Liu et al., 2014; Margaritis & Psillaki, 2010). This is in line with prior research, that also shows significant negative impact of leverage on firm performance (Bennouri et al., 2018; Liu et al., 2014; Margaritis & Psillaki, 2010). Moreover, research and development expenses (RD) is included because it is one of the most important predictors of firm performance since it expands market share and firm performance in turn (Torchia et al., 2011). In

model 1, however, is shown that (RD) significant negatively impacts firm performance. This in contrast to the literature but is in line with the regression results of Bennouri et al. (2018). Lastly, the industry dummies in all models indicate that only the manufacturing industry (IND_1) makes a difference because of its significant and positive results in all models. In summary, these control variables indicate that the age of firms have no impact on firm performance, where firms with higher tangibility, more leverage and R&D expenses have lower firm performance in general, and firms from the manufacturing industry on average have higher firm performance.

From model 2 , the independent variable of interest, (TWD), is included in each model besides different combinations of control variables to test hypothesis 1. The control variables leverage (LEV) and R&D expenses (RD) are included in model 2. The gender diversity variable (TWD) indicates a positive and significant relationship with (ROA) at the 1% level. This means that when the proportion of women on board is higher, firm performance increases. With the inclusion of (L_FAGE) in model 3 and (TAN) in model 4, (TWD) remains positive and significant on firm performance. (L_FAGE) is included to show that the firm's age doesn't influence firm performance. In the fifth model, the regression results with all variables are included except (L_FAGE) because of its weakness. These models indicate the same results as mentioned before, where the T-statistic for (TWD) and the adjusted R-squared of the models have grown. Lastly the full model is displayed in model 6, which indicates that with the inclusion of all variables, (TWD) remains significant and positive at the 1% level

Table 6: Presence of women directors on ROA

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.066***	.061**	.067***	.07***	.072***
		(2.78)	(2.50)	(2.86)	(3.00)	(3.09)
L_FAGE	-.002		0			-.003
	(-0.59)		(-0.16)			(-0.95)
TAN	-.09***			-.094***	-.09***	-.091***
	(-7.18)			(-8.37)	(-7.25)	(-7.29)
LEV	-.03*	-.084***			-.031*	-.031*
	(-1.75)	(-5.28)			(-1.82)	(-1.83)
RD	-.353***	-.29***			-.358***	-.359***
	(-3.90)	(-3.16)			(-3.96)	(-3.97)
Constant	.141***	.079***	.058***	.116***	.123***	.132***
	(11.00)	(10.91)	(5.37)	(12.57)	(13.19)	(9.99)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.025***	.027***	.022***	.017***	.023***	.024***
IND_2	.003	.009	.013	.002	-.001	0
IND_3	.001	-.003	-.003	-.004	0	0
Adjusted R^2	.076	.043	.015	.07	.082	.082
F-statistic	15.04***	9.93***	4.62***	18.91***	16.38***	14.44***
Observations	1201	1201	1201	1201	1201	1201

Table 6 presents the OLS regression results where gender diversity is measured by the percentage of women directors on boards (TWD). The dependent variable is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

with a coefficient of .072. This coefficient tells that with a 1% rise in the percentage of women directors, (ROA) increases by .072%. In comparison with the benchmark model, there are no significant differences in values when including (TWD). The adjusted R-squared has increased from .076 to .082. So, it can be stated that enough evidence has been found that support hypothesis 1a, which means that the presence of women directors positively affects firm financial performance based on (ROA). This automatically leads to hypothesis 1b (negative influence on firm performance) being rejected.
The results of the other performance measurements (ROE), (ROS), and (TQ) are given in Appendix 3. The OLS regression on (ROE) show results which are consistent with (ROA) except for (TAN): significant positive relationships with (TWD), significant negative with (LEV) and (RD), and no sign with (L_FAGE). The regression results on (ROS) and (TQ), however, show positive relationships with (TWD), but insignificance in all models. This indicates that (ROS) and (TQ) are somewhat weaker performance measurements in this study. Overall, these results are also in line with hypothesis 1a.

In conclusion, the overall results suggest that the presence of women directors positively affects firm performance. It can be stated that women directors enhance board of director's effectiveness which influences firm performance positively. This is consistent with prior studies that mention the same positive and significant result (Bennouri et al., 2018; Campbell & Mínguez-Vera, 2008; Carter et al., 2003; Erhardt et al., 2003; Isidro & Sobral, 2015; Liu et al., 2014; Low et al., 2015; Perryman et al., 2016; Reguera-Alvarado et al., 2017; Terjesen et al., 2016). Possible reasons mentioned by these studies are that women bring skills, perspectives and experiences into the board that improve the quality of board decisions, and are more diligent to monitor managers, that enhance firm performance.

5.3.1. Non-executive versus executive women directors

Enough evidence has been found that with the rise in the percentage of women directors on boards, firm performance increases. Now, it is interesting to examine whether non-executive or executive directors are more responsible for this effect. No hypotheses have been formulated for this extra test, but in the introduction and literature review is discussed the effects these director types bring. Non-executive directors are likely to influence firm performance through the monitoring channel due to their independence status, while the executives mainly through the executive channel due to their executive power and management skills (Liu et al., 2014). The agency theory describes that because of a lack of monitoring in male-dominated boards, non-executive women directors can fulfill a crucial role in audit efforts and managerial accountability (Adams & Funk 2012; Liu et al., 2014). On the other hand, according to the resource dependency theory, the executive women directors bring positive human and relation capital with, which is an addition to male-dominated boards (Bennouri et al., 2018; Liu et al., 2014; Huse & Solberg, 2006). Thus, because of these added, it is expected that both female non-executives and executives affect firm performance positively.

To examine this, non-executive and executive directors are divided into two groups. The board gender diversity measure (TWD) is replaced by the percentage of women non-executive directors (WNED) and the percentage of women executive directors (WED). Again, the strongest regressions are chosen in which (L_FAGE), (TAN), (LEV), and (RD) are included in the models in different combinations. The most relevant regression results are shown in Table 7 for the non-executives and Table 8 for the executive in six different models on firm performance measurement (ROA). Year and industry dummies are included in all models to control for undesired effect on firm performance.

Table 7: Women non-executive directors on ROA

Model	(1)	(2)	(3)	(4)	(5)	(6)
WNED		.065**	.053**	.065**	.069***	.071***
		(2.52)	(2.04)	(2.56)	(2.74)	(2.82)
L_FAGE	-.002		0			-.002
	(-0.59)		(-.08)			(-0.89)
TAN	-.09***			-.094***	-.09***	-.091***
	(-7.18)			(-8.40)	(-7.24)	(-7.28)
LEV	-.03*	-.085***			-.033**	-.033*
	(-1.75)	(-5.37)			(-1.92)	(-1.93)
RD	-.353***	-.288***			-.356***	-.357***
	(-3.90)	(-3.14)			(-3.94)	(-3.95)
Constant	.141***	.081***	.06***	.118***	.125***	.133***
	(11.00)	(11.43)	(5.52)	(12.95)	(13.58)	(10.12)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.025***	.027***	.022***	.017***	.023***	.024***
IND_2	.003	.010	.014*	.003	0	.001
IND_3	.001	-.002	-.002	-.002	.001	.001
Adjusted R^2	.076	.042	.013	.072	.081	.081
F-statistic	15.04***	9.7***	4.2***	18.56***	16.15***	14.23***
Observations	1201	1201	1201	1201	1201	1201

Table 7 presents the OLS regression results where gender diversity is measured by the percentage of women non-executive directors on boards (WNED). The dependent variable in this table is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7 presents the regression results with gender diversity measure non-executive directors (WNED). This table displays that the control variables in general show the same sings as in the previous section: significant negative relationship for (TAN), (LEV) and (RD), and insignificant for (L_FAGE). With the inclusion of (L_FAGE) in model 3, it shows the weakest regression where the T-statistics, adjusted R^2 and F-statistic is decreased drastically. The variable of interest (WNED) shows a significant and positive relationship with (ROA) in model 2 to 6. Thus, it can be concluded that women non-executives positively affect firm performance through the monitoring channel.

The influence of the women executives (WED) is given in Table 8 with the same control variables as in the previous table for comparison purposes between these two director types. Because the executives can directly influence the daily operations of firms, it was expected that their impact was larger than the non-executives on firm performance. The results show that the opposite is true in this study. Table 8 displays that in model 2 to 6 the gender diversity measure (WED) is positive, but insignificant related to (ROA). This indicates that the effect is not strong enough to conclude that the executives in this study definitely increases firm performance that much.

Appendix 4 presents the results for the other performance measurements. These results are consistent, but the one stronger than the other. Again, (ROE)'s regression results are the same as (ROA) shows, but (ROS) and (TQ) show insignificant results for both (WNED) and (WED). This again indicates that these two performance measurements are not as strong as (ROA) and (ROE) are.

Table 8: Women executive directors on ROA

Model	(1)	(2)	(3)	(4)	(5)	(6)
WED		.039	.054	.042	.039	.04
		(0.85)	(1.16)	(0.93)	(0.87)	(0.89)
L_FAGE	-.002		0			-.002
	(-0.59)		(.07)			(-0.63)
TAN	-.09***			-.093***	-.089***	-.09***
	(-7.18)			(-8.22)	(-7.16)	(-7.18)
LEV	-.03*	-.081***			-.354***	-.354***
	(-1.75)	(-5.09)			(-3.90)	(-3.91)
RD	-.353***	-.286***			-.029*	-.029*
	(-3.90)	(-3.11)			(-1.68)	(-1.68)
Constant	.141***	.091***	.067***	.127***	.134***	.141***
	(11.00)	(15.40)	(6.52)	(15.43)	(16.02)	(10.92)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.025***	.028***	.023***	.018***	.024***	.025***
IND_2	.003	.011	.015	.004	.002	.002
IND_3	.001	-.002	-.003	-.003	.001	.001
Adjusted R^2	.076	.037	.011	.064	.076	.076
F-statistic	15.04***	8.72***	3.63**	17.34***	15.1***	13.26***
Observations	1201	1201	1201	1201	1201	1201

Table 8 presents the OLS regression results where gender diversity is measured by the percentage of women executive directors on boards (WED). The dependent variable in this table is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The results of this test are in contrast to the studies of Bennouri et al. (2018) and Liu et al. (2014), that show a significant and negative effect between the non-executives and firm performance, and a significant positive effect on firm performance for the executive women directors. No other studies are found that have investigated this effect, in specific for U.K. (listed) firms. It is suggested that further research is needed to make definite conclusions about this influence of the non-executive and executive directors, because no preliminary research has been executed for this relationship. Next to that, a larger sample size is recommended, because the sample of (WED) in this study only contains 2,3% of the total number of directors. This makes it difficult to interpret significant relationships.

In summary, the results suggest that the beneficial effect of women directors on firm performance primarily comes through the women non-executive directors' monitoring effect rather than the women executive directors' executive effect. Further research is needed that investigate these initial results for U.K. listed firms.

5.4. Critical mass for women directors

As mentioned in the introduction and literature review, having a critical mass for women directors matters for firm performance. Hypothesis 2 states that a board consisting of a minimum of 30% women may exert stronger influence than a board where only one woman participates. This hypothesis is tested by using a dummy variable (D_CM) that turns 1 when at least 30% of the board

members are women. These results are given in Table 9. After that, another test is executed in Table 10 where dummy variable (D_1W) is included that turns 1 when only one female director is presented on the board to show their different influences on firm performance. Again, the variables which are highly correlated with the gender diversity or performance measures are excluded from this test and are tested separately in Appendix 7. This leads to the fact that the same variables will be used as with testing hypothesis 1. With these remaining predictor variables, all possible combinations are regressed, and the most relevant combinations are given in the six different models. Year and industry dummies are included in all models to control for time-varying economic and industry influence on firm performance. The control variables are not discussed in this section because of their consistent results with hypothesis 1.

First, in Table 9, the focus is on the influence of having a critical mass (D_CM) for women directors on return on assets (ROA). As shown in this table, a board with a critical mass for women directors is significant and positive related to (ROA) at the 5% level in models 2 to 6. Adding other combinations of control variables to each model does not change the coefficient and T-statistic of (D_CM) much. The full model (model 6) indicates that a board with a critical mass for women directors is associated with an average 0,014% higher return on assets (ROA). This is in line with the studies of Bennouri et al. (2018), Liu et al. (2014), Low et al. (2015), and Wiley and Monllor-Tormos (2018), who suggest that boards with a critical mass for women directors positively influences firm financial

Table 9: Critical mass for women directors on ROA

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.015**	.016**	.015**	.014**	.014**
		(2.32)	(2.36)	(2.32)	(2.19)	(2.25)
L_FAGE	-.001		0			-.002
	(-0.26)		(-0.10)			(-0.80)
TAN	-.085***			-.093***	-.088***	-.089***
	(-6.47)			(-8.24)	(-7.11)	(-7.15)
LEV	-.034*	-.082***			-.031*	-.031*
	(-1.88)	(-5.20)			(-1.78)	(-1.80)
RD	-.311***	-.276***			-.344***	-344***
	(-3.29)	(-3.00)			(-3.79)	(-3.80)
Constant	.136***	.089***	.067***	.126***	.133***	.141***
	(9.84)	(15.22)	(6.53)	(15.22)	(15.83)	(10.96)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.025***	.028***	.022***	.018***	.024***	.024***
IND_2	.002	0.010	.014	.003	.001	.001
IND_3	.001	-.002	-.003	-.003	.001	.001
Adjusted R^2	.078	.041	.014	.067	.079	.079
F-statistic	12.82***	9.53***	4.48***	18.31***	15.73***	13.84***
Observations	1136	1136	1136	1136	1136	1136

Table 9 presents the OLS regression results for testing the critical mass theory. Gender diversity is measured with a dummy variable that turns 1 for having a critical mass for women directors (D_CM). The dependent variable in this table is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

performance, because the women are no longer seen as outsiders and are able to influence the content and process of board discussions more substantially. Thus, it can be stated that these results support hypothesis 2.

In comparison, the dummy variable for only one female director (D_1W) and its effect on (ROA) is displayed in Table 10. As shown in this table, (D_1W) significantly and negative influences (ROA) in models 2, 4, 5, and 6. With the inclusion of (L_FAGE) in model 3, (D_1W) turns insignificant with firm performance. The explanatory power is also way lower of this regression. The other models indicate that a board with only one female director is associated with a 0.011% lower return on assets (full model 6). This is in line with prior studies that show the same result (Bennouri et al., 2018; Liu et al., 2014; Low et al., 2015; Wiley & Monllor-Tormos, 2018). Reason for this effect is that minority voices are not easily expressed or heard in groups, because social pressures encourage conformity with the majority's opinion (Bear et al., 2010).

Table 10: One female director on ROA

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_1W		-.011**	-.009	-.009*	-.011*	-.011**
		(-2.00)	(-1.51)	(-1.69)	(-1.92)	(-1.97)
L_FAGE	-.001		0			-.002
	(-0.26)		(0.04)			(-0.70)
TAN	-.085***			-.093***	-.089***	-.089***
	(-6.47)			(-8.29)	(-7.13)	(-7.16)
LEV	-.034*	-.084***			-.032*	-.033*
	(-1.88)	(-5.31)			(-1.89)	(-1.90)
RD	-.311***	-.289***			-.356***	-.357***
	(-3.29)	(-3.15)			(-3.93)	(-3.94)
Constant	.136***	.096***	.071***	.132***	.14***	.147***
	(9.84)	(15.49)	(6.75)	(15.63)	(16.25)	(11.17)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.025***	.028***	.022***	.018***	.024***	.025***
IND_2	.002	.011	.015*	.004	.002	.002
IND_3	.001	-.003	-.003	.009	0	0
Adjusted R^2	.078	.04	.012	.065	.078	.078
F-statistic	12.82***	9.28***	3.82***	17.77***	15.56***	13.67***
Observations	1136	1136	1136	1136	1136	1136

Table 10 presents the OLS regression results for testing the critical mass theory. Gender diversity is measured with a dummy variable that turns 1 if only one female director is on the board (D_1W). The dependent variable in this table is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The results of the other performance measurements (ROE), (ROS), and (TQ) are given in Appendix 5. The OLS regression on (ROE) show results which are consistent with (ROA). The regression results on (ROS) and (TQ), however, show slightly negative and positive relationships with (D_CM), respectively, and negative with (D_1W), but insignificant in all models. This again indicates that (ROS) and (TQ) are weak performance measurements in this study.

In conclusion, the dummy variable (D_CM) is significant and positive related to the firm performance measurements. In comparison, the dummy variable for one female director (D_1W) shows no signs or even a significant negative relationship with these measures. This is in line with hypothesis 2, that boards with at least 30% women creates a critical mass where women are no longer seen as outsiders and are able to influence the content and process of board discussions more substantially. Since women directors positively impacts firm performance, those effects are stronger when critical mass is reached.

5.5. Robustness checks

As a robustness check of the results from hypotheses 1 and 2, the sample is modified into a subsample with firms that have R&D expenses in a certain year. As mentioned before, the regression results indicate that R&D expenses (RD) negatively affects firm performance in almost all regression models. The opposite was expected, however, because innovation expands market share what in turn leads to an increase in firm performance (Torchia et al., 2011). The subsample contains 282 observations. The same regression combinations are used as with testing the hypotheses in this chapter for comparison purposes. Industry fixed effects are omitted in this test, because R&D is industry-specific what causes that the industry dummies are highly correlated with (RD) in this subsample.

Table 11 displays the robustness check of hypothesis 1 with (TWD) regressed on (ROA), with only firms included that have R&D expenses. In comparison with Table 6, it seems that the signs are stronger with the inclusion of firms that have R&D expenses. Model 1 of Table 11 shows that the T-

Table 11: Presence of women directors on ROA (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.145***	.131**	.139***	.154***	.164***
		(2.91)	(2.52)	(2.72)	(3.14)	(3.31)
L_FAGE	-.006		-.004			-008
	(-1.00)		(-0.63)			(-1.44)
TAN	-.093***			-.079**	-.1***	-.099***
	(-2.89)			(-2.61)	(-3.17)	(-3.13)
LEV	-.041	-.084***			-.052*	-.051
	(-1.30)	(-2.80)			(-1.67)	(-1.64)
RD	-.524***	-.433***			-.512***	-.544***
	(-4.86)	(-4.23)			(-4.93)	(-5.14)
Constant	.191***	.093***	.068***	.099***	.144***	.172***
	(6.62)	(6.50)	(2.95)	(4.86)	(6.72)	(5.94)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.088	.087	.016	.038	.116	.12
F-statistic	7.77***	9.97***	3.22**	6.5***	10.23***	8.63***
Observations	282	282	282	282	282	282

Table 11 presents the robustness check results where gender diversity is measured by the percentage of women directors on boards (TWD). The dependent variable in this table is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

statistic of (RD) is lower than its value given in the Table 6, which indicates that the coefficient is even more significant. This is in line with the results of Bennouri et al. (2018) that R&D expenses negatively affects firm performance, but in contrast with the literature of Torchia et al. (2011). The variable of interest, (TWD), still shows the same results with the inclusion of different combinations of control variables: significant and positive in all models. The results of the other performance measurements in Appendix 6 indicate the same signs. Based on these results, it can be concluded that the robustness check results are in line with those given in section 5.4 and again supports hypothesis 1a, but (RD) remains significant negative related to firm performance.

Table 12 shows the robustness check of hypothesis 2 with independent variable (D_CM) and dependent variable (ROA) with only firms that have R&D expenses in the subsample. Only the results on (D_CM) is given to show if the critical mass hypothesis is supported and to show (RD)'s sign. In comparison with the results in Table 9 from the previous section, the T-statistics have increased significantly in all models, but (RD) remains significant negative related to firm performance. For (D_CM) the effect has become stronger in model 2 to 6 and shows that (D_CM) is now significant and positive related with (ROA) at the 1% level (except for model 3), where it was 5% significance in the previous section. Next to that, the robustness check results in Appendix 6 are consistent with these results. This indicates that the results of this robustness check are in line with hypothesis 2, where (RD) remains negatively related to firm performance.

Table 12: Critical mass for women directors on ROA (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.035***	.033**	.035***	.035***	.035***
		(2.71)	(2.48)	(2.65)	(2.79)	(2.81)
L_FAGE	-.006		-.002			-.006
	(-1.00)		(-0.38)			(-1.06)
TAN	-.093***			-.076**	-.095***	-.094***
	(-2.89)			(-2.52)	(-3.00)	(-2.96)
LEV	-.041	-.083***			-.052*	-.051
	(-1.30)	(-2.76)			(-1.66)	(-1.62)
RD	-.524***	-.419***			-.493***	-.517***
	(-4.86)	(-4.08)			(-4.74)	(-4.86)
Constant	.191***	.117***	.086***	.121***	.167***	.189***
	(6.62)	(10.98)	(3.93)	(6.66)	(8.45)	(6.63)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.088	.084	.015	.036	.11	.11
F-statistic	7.77***	9.58***	3.12**	6.29***	9.65***	7.95***
Observations	282	282	282	282	282	282

Table 12 presents the robustness check results for testing the critical mass theory. Gender diversity is measured with a dummy variable that turns 1 for having a critical mass for women directors (D_CM). The dependent variable in this table is return on assets (ROA). Year and industry dummies are included to control for time-varying and industry effects that influence firm performance. Full explanation of the variables is given in Table 1. The T-statistics are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

6. Conclusion

In this study is examined the effect of the presence and proportion of women directors on firm financial performance. Prior studies describe that women encounter a "glass ceiling" or barrier to advancement into top ranks of organization (Adams & Funk, 2012), despite women are as capable in fulfilling director roles as men (Chen et al., 2016). Women directors are more diligent to monitor managers and demand more audit efforts than male directors. Researchers suggest that greater diversity increases the independence of the board as women are more inclined to ask questions that would not be asked by male directors (Bennouri et al., 2018; Carter et al., 2003). On the other hand, more gender diversity can also result in tough boards, what in turn leads to overmonitoring within firms and poorer firm performance (Adams & Ferreira, 2009; Bennouri et al., 2018). The aim of this research is to shed a light on the question to what extent board gender diversity influences firm financial performance of U.K. listed firms. This study contributes to the existing limited and inconsistent U.K. gender diversity literature. The sample utilized in this study consists of 331 U.K. non-financial listed firms from the FTSE All-Share and Fledging index in the period between 2015 and 2018.

First, in this thesis is investigated a direct relationship between the percentage of women directors on boards and firm financial performance. The literature review identified three different theories that substantiate the hypothesis about the presence of women directors. Because of the inconsistent literature and empirical evidence, the first hypothesis, about the impact of the presence of women directors on firm performance, is hypothesized both as positive (1a) and negative (1b). An OLS regression with year and industry fixed effects is used to test this, which is the most commonly used estimation method in the board and performance literature (Liu et al., 2014). The results of this test suggest that the percentage of women directors significantly and positively influences firm performance, based on the performance measurements ROA, ROE, ROS, and Tobin's Q. These findings suggest that enough evidence has been found that women directors enhance board of director's effectiveness, which support hypothesis 1a.

From this conclusion, it is examined whether non-executive or executive women directors are more responsible for this increase in firm performance. These results show that the effect of female non-executive directors is stronger than that of female executive directors. This suggests that the monitoring effect is more pronounced over the executive effect of these director types. Further research is advised for this.

Second, the critical mass theory is examined in this study. It is hypothesized that a minimum of 30% women on boards should positively affect firm performance. Next to that, the influence of boards with only one female director was tested to see their different influence on firm performance. The results indicate that having a critical mass for women directors on the board positively affects firm performance based on ROA, ROE, ROS, and Tobin's Q. In contrast, the dummy variable for one female director shows no signs or even a significant negative relationship with these performance measurements. Because of this, it can be concluded that boards with a critical mass of women directors generally have a stronger positive impact on firm performance, which is in line with hypothesis 2.

In conclusion, women directors enhance boards of director's effectiveness, which are more pronounced when the critical mass is reached. From a theoretical perspective, the findings suggest that a multi-theoretical lens explanation can be quite powerful. The results from this study find fully support for the agency, stakeholder, resource dependency, token status, and critical mass theory.

7. Discussion

Given this study's findings that more gender-diverse boards are likely to enhance firm performance, it is suggested that corporate governance codes worldwide should try to give the same importance to gender diversity as certain European countries do with their gender quotas. In fact, acknowledging the role of women on corporate governance best practices can potentially increase the effectiveness of boards as it decreases the negative signal of an unbalanced gender board. Thus, this paper supports the notion that gender diversity is an important corporate governance issue. In fact, if firms wish to provide correct signals regarding board effectiveness, they should consider gender diversity. On top of that, a critical mass on corporate boards also matters. Enough evidence has been found that not one, but a minimum proportion of 30% women directors increases board effectiveness. Economically seen, this outcome is an extra incentive for countries to introduce mandatory gender quotas of minimum 30% women directors, because then firm performance increases significantly in general. An important note is that a board full of women is also not recommended, because then the positive influence that men bring disappears. A good balance must be found between men and women directors, for instance a minimum ratio of 30/70. This is more difficult in countries where the supply of women directors is low, but the good point is that the percentage of women on top ranks emerges worldwide. From my point of view, these governments should start introducing a relatively low gender quota which could rise in parallel with the availability of female directors over the years, or starting with a comply or complain regulation to stimulate hiring women on top positions.

Furthermore, this study acknowledges four limitations that point to future research directions. First, further research is advised to examine the influence of women executive and non-executive directors. In this study, initial tests with the current data is executed, but no extensive preliminary research has been done on this. It is recommended to examine this important topic to be able to conclude what the occupancy rate must be in boards in order to achieve the ultimate firm performance. Executives have more influence on the daily operations of firms, but the monitoring effect is as important as the executive effect. Further research must consider larger sample sizes, because in this study only 2.3% of the directors were female executives what makes it difficult to interpret significant relationships. Second, the sample is limited to U.K. listed firms. Cultural differences may imply that the findings do not generalize to other regions. On top of that, the reliance on the ORBIS database means that sample firms are all stock exchange-listed and therefore are more likely to be larger firms. The findings may not generalize to small or privately held firms. It is recommended for further research to take a more diverse sample composition, from small to large firms in several countries. Third, the findings would benefit from considering different types of governance mechanisms. In this study, data for board size (L_BSIZE) and the percentage of independent directors (IND) is collected, but it was not suitable to use these because of too high correlations between variables. It is recommended to use corporate governance mechanisms such as executive compensation, ownership concentration or board duality. Investigating this knowledge void could advance the understanding of comparative corporate governance systems. Fourth, endogeneity may arise between the number of women directors and firm performance, since women choose directorships earlier when the firm performance is better. OLS regression doesn't account for this endogeneity. For instance, future research should consider 2SLS regression with instrumental variables to control for endogeneity (Liu et al., 2014).

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Appendices

Appendix 1: Empirical research on board gender diversity summarized

	Sample	Theory	Relationship
Presence of women directors			
Bennouri et al., 2018	French firms	AT; HCT; RDT	+ ROA; + ROE; - TQ
Campbell & Mínguez-Vera, 2008	Spanish firms	AT; HCT; RDT	+ TQ
Carter et al., 2003	U.S. Fortune 1000 firms	AT	+ TQ
Erhardt et al., 2003	U.S. firms	AT; HCT	+ ROA
Isidro & Sobral, 2015	500 largest EU firms	AT; HCT; RDT	+ ROA; ROS
Liu et al., 2014	Chinese listed firms	AT; RDT	+ ROA; ROS
Low et al., 2015	Asian firms	AT; RDT; SHT	+ ROE
Perryman et al., 2016	U.S. Fortune 500 firms	HCT; RDT	+ TQ
Reguera-Alvarado et al., 2017	Spanish firms	AT; RDT; SHT	+ TQ; - SR
Terjesen et al., 2016	Public firms in 47 different countries	AT; RDT; GRT	+ ROA; TQ
Adams & Ferreira, 2009	U.S. firms	HCT; SIT	- TQ
Ahern & Dittmar, 2012	Norwegian listed firms	None	- TQ; SR
Bøhren & Staubo, 2016	Norwegian firms	AT; RDT	- ROA
Richard et al., 2004	Random U.S. banks	BTH	- ROE
Shehata et al., 2017	U.K. SMEs	AT; RDT; SHT; CT	- ROA
Ujunwa et al., 2012	Nigerian quoted firms	AT; RDT	- ROA
Carter et al., 2010	U.S. S&P 500 firms	AT; HCT; RDT	No ROA; TQ
Gregory-Smith et al., 2014	U.K. FTSE 350 firms	HCT	No ROA; ROE; TQ
Kagzi & Guha, 2018	Indian firms	AT; RDT	No TQ
Marinova et al., 2010	Dutch and Danish firms	None	No TQ
Rose, 2007	Danish firms	AT; HCT; RDT	No TQ
Critical mass			
Bennouri et al., 2018	French firms	CMT; TST	+ ROA; ROE
Liu et al., 2014	Chinese listed firms	CMT; TST	+ ROA; ROS
Low et al., 2015	Asian firms	CMT; TST	+ TQ
Wiley & Monllor-Tormos, 2018	Fortune 500 firms	CMT	+ TQ
Isidro & Sobral, 2015	500 largest E.U. firms	CMT; TST; SPT	No ROA

This table presents an overview of the positive (+), negative (-), and no signs (No) of the empirical evidence from different studies. Firm financial performance is measured by the return on assets (ROA), return on equity (ROE), return on investment (ROS), return on sales (ROS), stock return (SR), and Tobin's Q (TQ). The following underlying theories have been used: Agency theory (AT), Blau's (1977) theory of Heterogeneity (BTH), Contingency theory (CT), Critical mass theory (CMT), Human Capital theory (HCT), Resource Dependence theory (RDT), Social Psychology theory (SPT), Stakeholder theory (SHT), and Token status theory (TST).

Blau's theory of Heterogeneity (BTH)

While moderate levels of cultural heterogeneity can create barriers to effective social interaction, this theory suggests that a high degree of heterogeneity could actually weaken these barriers, as group members will be more evenly distributed across the cultural diversity categories, and in-group/out-group identities will be lowered. In groups with a high degree of cultural heterogeneity, informal social contacts and communication are more likely to involve members of different racial or gender groups. Furthermore, the pressure within the group that hinders social interaction with members outside the group must be mitigated. In management groups with a high heterogeneity, it is therefore less likely that out-group discrimination occurs (Richard et al., 2004).

Contingency theory (CT)

As shown before in this study and in the table on the previous page, the empirical evidence on board gender diversity provide very inconsistent results. These mixed results might be attributed to the explanation provided by contingency theory, which suggests that the relationship between board structure (including age and gender diversity) may vary under different circumstances at different times. Thus, the relationship between board diversity and firm performance might be dependent on the circumstances and the context in which a firm is operating (Shehata et al., 2017).

Human Capital theory (HCT)

Human capital theory deals with the role of a person's level of education, experience and skills that can be used for the benefit of an organization. In addition, gender differences lead to drivers having unique human capital. One question that arises from the fact that women and ethnic minorities have unique human capital is "the claim that women lack the 'right' human capital for directorships.". The data on women's human capital suggest that women are as well qualified as men in several key qualities, including educational attainment, but that women are less likely to have experience as business experts. The net result that human capital theory predicts is that board performance will be affected by board diversity due to diverse and unique human capital, but the effect can be positive or negative from a financial performance perspective (Adams & Ferreira, 2009; Bennouri et al., 2018; Campbell & Mínguez-Vera, 2008; Carter et al., 2010; Erhardt et al., 2003; Isidro & Sobral, 2015; Rose, 2007).

Social Psychology theory

Social psychology recognizes that the status and impact of minority groups depend on the social context and group dynamics. That is, diversity on the board can have positive or negative effects depending on the dynamics of the board. There are indications that minority board members, such as female board members, encourage dissent and motivate other board members to consider a wider range of possible solutions. But the perspective of social psychology also predicts that members of the majority group can exert excessive influence on decision-making and often resist the influence of minority members. Generally, social psychology theory suggests that women on the board can positively or negatively impact business value, depending on board dynamics (Isidro & Sobral, 2015).

Appendix 2: Descriptive statistics with outliers

Variable	Observ.	Mean	Std. Dev.	Median	Min.	Max.
Firm performance						
ROA	1201	.078	.102	.071	-.506	.856
ROE	1201	.125	.862	.119	-16.543	19.6
ROS	1201	.148	.424	.099	-7.294	5.172
TQ	1201	1.257	1.182	.897	.06	10.651
Gender diversity						
TWD	1201	.208	.11	.222	0	.6
WED	1201	.023	.057	0	0	.4
WNED	1201	.185	.102	.182	0	.5
D_CM	1201	.205	.404	0	0	1
D_1W	1201	.325	.469	0	0	1
Control variables						
BSIZE	1201	8.423	2.212	8	3	26
NED	1201	.582	.139	.57	0	.92
EMP	1201	21,091	59,848	4,123	10	611,366
FAGE	1201	45.547	39.198	31	1	276
TAN	1201	.611	.232	.64	.01	.99
LEV	1201	.266	.167	.259	0	.785
RD	1201	.011	.036	0	0	.43
IND_1	1201	.36	.472	0	0	1
IND_2	1201	.127	.329	0	0	1
IND_3	1201	.091	.291	0	0	1

This table presents an overview of the descriptive statistics of the variables used in this study with their number of observations, means, standard deviations, medians, minimum values, and maximum values, which are not adjusted for outliers.

Appendix 3: Presence of women directors results

Presence of women directors (TWD) on ROE

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.27***	.254***	.272***	.277***	.272***
		(3.69)	(3.43)	(3.73)	(3.82)	(3.72)
L_FAGE	.009		.009			.005
	(1.04)		(0.98)			(0.61)
TAN	-.162***			-1.44***	-.168***	-.166***
	(-4.16)			(-4.12)	(-4.35)	(-4.29)
LEV	.026	-.078			.020	.02
	(0.48)	(-1.61)			(0.37)	(0.38)
RD	-1.148***	-1.044***			-1.17***	-1.17***
	(-4.06)	(-3.70)			(-4.16)	(-4.15)
Constant	.18***	.081***	.03	.147***	.162***	.144***
	(4.50)	(3.62)	(0.91)	(5.13)	(5.59)	(3.52)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.021	.027	.008	.004	.019	.017
IND_2	.067**	.073***	.08***	.063**	.055**	.055**
IND_3	.033	.022	.011	.010	.027	.027
Adjusted R^2	.032	.029	.018	.031	.043	.042
F-statistic	6.67***	6.87***	5.26***	8.53***	8.68***	7.63***
Observations	1201	1201	1201	1201	1201	1201

Presence of women directors (TWD) on ROS

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.040	.034	.025	.028	.012
		(0.64)	(0.54)	(0.42)	(0.47)	(0.21)
L_FAGE	.016**		.011			.016**
	(2.32)		(1.49)			(2.28)
TAN	.273***			.262***	.268***	.273***
	(8.61)			(9.17)	(8.44)	(8.59)
LEV	-.036***	.118***			-.038	-.036
	(-0.83)	(2.90)			(-0.87)	(-0.83)
RD	-.371	-.581**			-.378	-.372
	(-1.61)	(-2.46)			(-1.64)	(-1.61)
Constant	-.006	.176***	.17***	.039*	.047**	-.008
	(-0.18)	(9.36)	(6.10)	(1.67)	(1.96)	(-0.23)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	-.092***	-.1***	-.11***	-093***	-.087***	-.093***
IND_2	-.135***	-.163***	-.165***	-.123***	-.135***	-.136***
IND_3	-.121***	-.114***	-.127***	-126***	-.122***	-121***
Adjusted R^2	.131	.076	.066	.126	.127	.130
F-statistic	26.75***	17.32***	17.95***	35.54***	25.9***	23.39***
Observations	1201	1201	1201	1201	1201	1201

Presence of women directors (TWD) on Tobin's Q

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.071	.085	.048	.085	.2
		(0.26)	(0.30)	(0.17)	(.31)	(0.74)
L_FAGE	-.129		-.106***			-.131***
	(-4.01)		(-3.12)			(-4.06)
TAN	-.499			-.975***	-.459***	-.501***
	(-3.47)			(-7.31)	(-3.18)	(-3.49)
LEV	-1.566	-1.82***			-1.555***	-1.569***
	(-7.96)	(-10.09)			(-7.85)	(-7.97)
RD	2.334	2.748***			2.393**	2.325**
	(2.25)	(2.64)			(2.29)	(2.24)
Constant	2.147	1.45***	1.328***	1.61***	1.676***	2.119***
	(14.46)	(17.41)	(10.36)	(14.68)	(15.43)	(13.82)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.489***	1.464***	.508***	.425***	.442***	.486***
IND_2	.260***	.293***	.347***	.221**	.245**	.251***
IND_3	.428***	.406***	.504***	.514***	.424***	.422***
Adjusted R^2	.141	.122	.047	.081	.129	.14
F-statistic	28.79***	28.61***	12.77	21.91***	26.15***	25.25***
Observations	1201	1201	1201	1201	1201	1201

Appendix 4: Non-executive versus executive women directors results

Women non-executive directors (WNED) on ROE

Model	(1)	(2)	(3)	(4)	(5)	(6)
WNED		.294***	.272***	.298***	.302***	.296***
		(3.72)	(3.43)	(3.79)	(3.85)	(3.76)
L_FAGE	.009		.009			.006
	(1.04)		(1.03)			(0.65)
TAN	-.162***			-.147***	-.168***	-.167***
	(-4.16)			(-4.20)	(-4.35)	(-4.30)
LEV	.026	-.086*			.012	.012
	(0.48)	(-1.77)			(0.22)	(0.23)
RD	-1.148***	-1.039***			-1.167***	-1.165***
	(-4.06)	(-3.69)			(-4.15)	(-4.14)
Constant	.18***	.084***	.03	.15***	.165***	.146***
	(4.50)	(3.85)	(0.91)	(5.28)	(5.78)	(3.57)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.0211	.028	.008	.004	.02	.018
IND_2	.067**	.076***	.083***	.066**	.058**	.058**
IND_3	.033	.027	.016	.015	.032	.032
Adjusted R^2	.032	.029	.017	.031	.043	.043
F-statistic	6.67***	6.90***	5.25**	8.64***	8.71***	7.67***
Observations	1201	1201	1201	1201	1201	1201

Women executive directors (WED) on ROE

Model	(1)	(2)	(3)	(4)	(5)	(6)
WED		.067	.066	.056	.068	.062
		(0.47)	(0.46)	(0.40)	(0.48)	(0.44)
L_FAGE	.009		.012			.009
	(1.04)		(1.35)			(1.03)
TAN	-.162***			-.139***	-.165***	-.162***
	(-4.16)			(-3.96)	(-4.24)	(-4.16)
LEV	.026	-.07			.027	.027
	(0.48)	(-1.42)			(0.50)	(0.51)
RD	-1.148***	-1.028***			-1.152***	-1.15***
	(-4.06)	(-3.62)			(-4.07)	(-4.06)
Constant	.18***	.13***	.067**	.196***	.211***	.179***
	(4.50)	(7.15)	(2.15)	(7.61)	(8.03)	(4.46)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.0211	.032*	.012	.01	.024	.021
IND_2	.067**	.084***	.089***	.074***	.067**	.066**
IND_3	.033	.027	.016	.015	.032	.032
Adjusted R^2	.032	.018	.008	.019	.031	.031
F-statistic	6.67***	4.58***	2.92**	5.72***	6.55***	5.86***
Observations	1201	1201	1201	1201	1201	1201

Women non-executive directors (WNED) on ROS

Model	(1)	(2)	(3)	(4)	(5)	(6)
WNED		.078	.062	.04	.045	.03
		(0.88)	(0.94)	(0.62)	(0.70)	(0.46)
L_FAGE	.019**		.011			.016**
	(2.52)		(1.46)			(2.26)
TAN	.278***			.262***	.268***	.273***
	(8.31)			(9.15)	(8.44)	(8.59)
LEV	-.046	.117***			-.04	-.037
	(-0.24)	(2.85)			(-0.90)	(-0.86)
RD	-.254	-.581			-.279	-.373
	(-1.15)	(-2.46)			(-1.64)	(-1.62)
Constant	-.028	.174***	.166***	.037	.045*	-.009
	(-0.79)	(9.48)	(5.97)	(1.62)	(1.91)	(-0.28)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	-.098***	-.1***	-.11***	-.094***	-.087***	-.093***
IND_2	-.133***	-.163***	-.165***	-.132***	-.135***	-.136***
IND_3	-.121***	-.114***	-.126***	-.125***	-.122***	-.121***
Adjusted R^2	.131	.076	.067	.126	.127	.13
F-statistic	24.98***	17.38***	18.08***	35.59***	25.94***	23.42***
Observations	1201	1201	1201	1201	1201	1201

Women executive directors (WED) on ROS

Model	(1)	(2)	(3)	(4)	(5)	(6)
WED		-.038	-.076	-.035	-.039	-.049
		(-0.32)	(-0.64)	(-0.30)	(-0.34)	(-0.43)
L_FAGE	.019**		.012			.017**
	(2.52)		(1.58)			(2.34)
TAN	.278***			.262***	.268***	.273***
	(8.31)			(9.18)	(8.45)	(8.61)
LEV	-.046	.119***			-.039	-.037
	(-0.24)	(2.90)			(-0.88)	(-0.85)
RD	-.254	-.578**			-.375	-.37
	(-1.15)	(-2.44)			(-1.62)	(-1.6)
Constant	-.028	.184***	.175***	.045**	.053**	-.005
	(-0.79)	(12.14)	(6.69)	(2.14)	(2.47)	(-0.16)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	-.098***	-.099***	-.109***	-.093***	-.086***	-.092***
IND_2	-.133***	-.161***	-.163***	-.131***	-.133***	-.134***
IND_3	-.121***	-.113***	-.124***	-.125***	-.121***	-.12***
Adjusted R^2	.131	.075	.066	.126	.127	0.13
F-statistic	24.98***	17.26***	17.97***	35.52***	25.88***	23.41***
Observations	1201	1201	1201	1201	1201	1201

Women non-executive directors (WNED) on Tobin's Q

Model	(1)	(2)	(3)	(4)	(5)	(6)
WNED		.163	.024	.045	.18	.293
		(0.56)	(0.08)	(0.15)	(0.62)	(1.01)
L_FAGE	-.122***		-.105			-.132***
	(-3.51)		(-3.10)			(-4.09)
TAN	-.508***			-.975***	-.46***	-.502***
	(-3.33)			(-7.31)	(-3.19)	(-3.50)
LEV	-1.544***	-1.826***			-1.561***	-1.578***
	(-7.32)	(-10.10)			(-7.87)	(-8.00)
RD	2.429**	2.747***			2.392**	2.325**
	(2.23)	(2.64)			(2.29)	(2.24)
Constant	2.143***	1.441***	1.337***	1.612***	1.663***	2.111***
	(13.33)	(17.71)	(10.44)	(14.91)	(15.55)	(13.83)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.487***	.462***	.509***	.425***	.441***	.485***
IND_2	.179***	.292***	.35***	.222**	.243**	.251***
IND_3	.442***	.407***	.506***	.515***	.425***	.425***
Adjusted R^2	.131	.123	.047	.081	.129	.141
F-statistic	23.98***	28.65***	12.75***	21.91***	26.2***	25.32***
Observations	1201	1201	1201	1201	1201	1201

Women executive directors (WED) on Tobin's Q

Model	(1)	(2)	(3)	(4)	(5)	(6)
WED		-.258	.232	.035	-.26	-.192
		(-0.49)	(0.43)	(0.07)	(-0.50)	(-0.37)
L_FAGE	-.122***		-.105***			-.128***
	(-3.51)		(-3.12)			(-3.99)
TAN	-.508***			-.974***	-.458***	-.499***
	(-3.33)			(-7.30)	(-3.18)	(-3.47)
LEV	-1.544***	-1.83***			-1.56***	-1.571***
	(-7.32)	(-10.09)			(-7.86)	(-7.96)
RD	2.429**	2.756***			2.402**	2.34**
	(2.23)	(2.64)			(2.30)	(2.26)
Constant	2.143***	1.474***	1.338***	1.619***	1.698***	2.15***
	(13.33)	(21.95)	(11.10)	(16.60)	(17.46)	(14.45)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.487***	.466***	.509***	.426***	.444***	.489***
IND_2	.179***	.3***	.347***	.223**	.252***	.262***
IND_3	.442***	.414***	.501***	.515***	.432***	.432***
Adjusted R^2	.131	.122	.047	.081	.129	.14
F-statistic	23.98***	28.64***	12.79***	21.91***	26.18***	25.19***
Observations	1201	1201	1201	1201	1201	1201

Appendix 5: Critical mass results

Critical mass for women directors (D_CM) on ROE

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.045**	.046**	.047**	.043**	.042**
		(2.26)	(2.27)	(2.35)	(2.17)	(0.85)
L_FAGE	.01		.01			.007
	(1.07)		(1.15)			(0.85)
TAN	-.168***			-.139***	-.163***	-.161***
	(-4.26)			(-3.95)	(-4.19)	(-4.13)
LEV	.026	-.072			.023	.023
	(0.48)	(-1.49)			(0.42)	(0.44)
RD	-1.118***	-.998***			-1.122***	-1.121***
	(-3.98)	(-3.52)			(-3.97)	(-3.96)
Constant	.18***	.124***	.067**	.189***	.204***	.178***
	(4.25)	(6.87)	(2.13)	(7.33)	(7.79)	(4.46)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.015	.03	.011	.008	.022	.020
IND_2	.067**	.079***	.084***	.069***	.062**	.061**
IND_3	.038	.026	.015	.014	.031	.031
Adjusted R^2	.03	.022	.012	.024	.035	.035
F-statistic	5.74***	5.41***	3.92***	6.82***	7.21***	6.4***
Observations	1136	1136	1136	1136	1136	1136

One female director (D_1W) on ROE

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_1W		-.025	-.021	-.023	-.024	-.023
		(-1.47)	(-1.22)	(-1.36)	(-1.41)	(-1.35)
L_FAGE	.01		0.11			.008
	(1.07)		(1.30)			(0.97)
TAN	-.168***			-.14***	-.164***	-.161***
	(-4.26)			(-4.00)	(-4.22)	(-4.15)
LEV	.026	-.077			.019	.02
	(0.48)	(-1.57)			(0.35)	(0.37)
RD	-1.118***	-1.035***			-1.158***	-1.156***
	(-3.98)	(-3.65)			(-4.09)	(-4.08)
Constant	.18***	.142***	.077	.206***	.222***	.192***
	(4.25)	(7.41)	(2.40)	(7.83)	(8.27)	(4.68)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.015	.031*	.011	.009	.024	.021
IND_2	.067**	.083***	.089***	.074***	.066**	.066**
IND_3	.038	.025	.015	.014	.03	.031
Adjusted R^2	.03	.019	.009	.021	.033	.033
F-statistic	5.74***	4.91***	3.18***	6.07***	6.81***	6.07***
Observations	1136	1136	1136	1136	1136	1136

Critical mass for women directors (D_CM) on ROS

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		-.009	-.009	-.005	-.006	-009
		(-0.54)	(-0.54)	(-0.29)	(-0.35)	(-0.57)
L_FAGE	.016**		.012			.017**
	(2.32)		(1.60)			(2.37)
TAN	.273***			.262***	.268***	.273***
	(8.61)			(9.19)	(8.44)	(8.59)
LEV	-.036	.120***			-.037	-.036
	(-0.83)	(2.94)			(-0.85)	(-0.81)
RD	-.371	-.584**			-.38	-.377
	(-1.61)	(-2.47)			(-1.64)	(-1.63)
Constant	-.006	.185***	.175***	.045**	.053**	-.006
	(-0.18)	(12.21)	(6.68)	(2.13)	(2.47)	(-0.17)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	-.092***	-.099***	-.109***	-.093***	-.086***	-.092***
IND_2	-.135***	-.16***	-.163***	-.131***	-.133***	-.134***
IND_3	-.121***	-.113***	-.125***	-.125***	-.121***	-.121***
Adjusted R^2	.131	.075	.066	.126	.127	.13
F-statistic	26.75***	17.3***	17.95***	35.52***	25.88***	23.43***
Observations	1136	1136	1136	1136	1136	1136

One female director (D_1W) on ROS

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_1W		.007	.006	.007	.005	.007
		(0.51)	(0.40)	(0.47)	(0.38)	(0.51)
L_FAGE	.016**		.012			.017**
	(2.32)		(1.58)			(2.35)
TAN	.273***			.263***	.268***	.273***
	(8.61)			(9.20)	(8.45)	(8.60)
LEV	-.036	.121***			-.036	-.034
	(-0.83)	(2.96)			(-0.83)	(-0.78)
RD	-.371	-.576**			-.375	-.369
	(-1.61)	(-2.43)			(-1.62)	(-1.60)
Constant	-.006	.18***	.172***	.041**	.05**	-.01
	(-0.18)	(11.23)	(6.39)	(1.93)	(2.27)	(-0.29)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	-.092***	-.099***	-.109***	-.092***	-.086***	-.092***
IND_2	-.135***	-.161***	-.163***	-.131***	-.133***	-.135***
IND_3	-.121***	-.112***	-.125***	-.125***	-.12***	-.12***
Adjusted R^2	.131	.075	.066	.126	.127	.13
F-statistic	26.75***	17.29***	17.92***	35.55***	25.88***	23.42***
Observations	1136	1136	1136	1136	1136	1136

Critical mass for women directors (D_CM) on Tobin's Q

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.021	.025	-.004	.015	.041
		(0.28)	(0.33)	(-0.05)	(0.20)	(0.55)
L_FAGE	-.129***		-.106***			-.13***
	(-4.01)		(-3.12)			(-4.04)
TAN	-.499***			-.975***	-.457***	-.497***
	(-3.47)			(-7.31)	(-3.17)	(-3.46)
LEV	-1.566***	-1.819***			-1.554***	-1.568***
	(-7.96)	(-10.08)			(-7.84)	(-7.96)
RD	2.337**	2.765***			2.408**	2.364**
	(2.25)	(2.65)			(2.30)	(2.28)
Constant	2.147***	1.464***	1.34***	1.62***	1.689***	2.144***
	(14.46)	(21.87)	(11.12)	(16.59)	(17.34)	(14.44)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.489***	.438***	.509***	.426***	.443***	.487***
IND_2	.26***	.294***	.347***	.224**	.247**	.255***
IND_3	.428***	.407***	.505***	.516***	.426***	.426***
Adjusted R^2	.141	.122	.047	.081	.129	.14
F-statistic	28.79***	28.61***	12.77***	21.91***	26.15***	25.22***
Observations	1136	1136	1136	1136	1136	1136

One female director (D_1W) on Tobin's Q

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_1W		-.046	-.009	-.006	-.043	-.057
		(-0.73)	(-0.14)	(-0.09)	(-0.68)	(-0.91)
L_FAGE	-.129***		-.105***			-.13***
	(-4.01)		(-3.11)			(-4.05)
TAN	-.499***			-.975***	-.456***	-.497***
	(-3.47)			(-7.31)	(-3.16)	(-3.46)
LEV	-1.566***	-1.829***			-1.564***	-1.58***
	(-7.96)	(-10.11)			(-7.87)	(-8.00)
RD	2.337**	2.734***			2.383**	2.316***
	(2.25)	(2.62)			(2.28)	(2.23)
Constant	2.147***	1.487***	1.345***	1.622***	1.709***	2.175***
	(14.46)	(20.96)	(10.85)	(16.27)	(17.16)	(14.33)
YEAR	Y	Y	Y	Y	Y	Y
IND_1	.489***	.463***	.509***	.426***	.442***	.488***
IND_2	.26***	.294***	.35***	.223**	.247**	.257***
IND_3	.428***	.403***	.506***	.515***	.422***	.422***
Adjusted R^2	.141	.123	.047	.081	.129	.141
F-statistic	28.79***	28.7***	12.76***	21.91***	26.21***	25.29***
Observations	1136	1136	1136	1136	1136	1136

Appendix 6: Robustness checks results

Presence of women directors (TWD) on ROE (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.882***	.797***	.83***	.885***	.871***
		(5.38)	(4.69)	(4.88)	(5.38)	(5.24)
L_FAGE	.025		.028			.012
	(1.30)		(1.51)			(0.66)
TAN	-.01			.01	-.039	-.041
	(-0.09)			(0.10)	(-0.37)	(-0.39)
LEV	-.159	-.223			-.211**	-.212**
	(-1.46)	(-2.25)			(-2.01)	(-2.02)
RD	-1.409***	-1.538			-1.57**	-1.519***
	(-3.79)	(-4.57)			(-4.52)	(-4.27)
Constant	.13	.052	-.16**	-.068	.072	.029
	(1.31)	(1.11)	(-2.10)	(-1.00)	(1.01)	(0.29)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.057	.144	.081	.073	.141	0.139
F-statistic	5.24*	16.7***	13.31***	12.09***	12.52***	10.09***
Observations	282	282	282	282	282	282

Presence of women directors (TWD) on ROS (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.309***	.29**	.275**	.298***	.304***
		(2.80)	(2.58)	(2.47)	(2.70)	(2.73)
L_FAGE	0		.005			-.005
	(-0.03)		(0.39)			(-0.38)
TAN	.12*			.131**	.108	.109
	(1.67)			(1.99)	(1.52)	(1.53)
LEV	-.069	-.053			-.088	-.087
	(-0.97)	(-0.80)			(-1.25)	(-1.24)
RD	-.658***	-.762***			-.677***	-.696***
	(-2.73)	(-3.36)			(-2.90)	(-2.91)
Constant	.092	.095***	.034	-.021	.04	.057
	(1.42)	(3.00)	(0.67)	(-0.47)	(0.82)	(0.87)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.033	.053	.018	.031	.058	.055
F-statistic	3.39***	6.27***	3.6**	5.54***	5.3***	4.26***
Observations	282	282	282	282	282	282

Presence of women directors (TWD) on Tobin's Q (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
TWD		.239	.206	-.046	.194	.447
		(0.40)	(0.34)	(-0.07)	(0.32)	(0.75)
L_FAGE	-.209***		-.232***			-.216***
	(-3.15)		(-3.46)			(-3.22)
TAN	.52			-.187	.469	.504
	(1.37)			(-0.51)	(1.21)	(1.32)
LEV	-1.6***	-1.507***			-1.656***	-1.625***
	(-4.25)	(-4.14)			(-4.31)	(-4.30)
RD	.602	1.053			1.425	.545
	(0.47)	(0.85)			(1.12)	(0.43)
Constant	2.433***	1.859***	2.385***	1.683***	1.619***	2.38***
	(7.09)	(10.78)	(8.74)	(6.82)	(6.16)	(6.79)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.087	.053	.034	0.006	.055	.086
F-statistic	7.72***	6.29***	5.98***	.14	5.09***	6.28***
Observations	282	282	282	282	282	282

Critical mass for women directors (D_CM) on ROE (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.19***	.183***	.186***	.19***	.189***
		(4.44)	(4.21)	(4.23)	(4.43)	(4.41)
L_FAGE	.025		.037**			.024
	(1.30)		(1.99)			(1.26)
TAN	-.01			.03	-.01	-.015
	(-0.09)			(0.30)	(-0.10)	(-0.14)
LEV	-.159	-.21**			-.207*	-.212**
	(-1.46)	(-2.09)			(-1.94)	(-1.99)
RD	-1.409***	-1.458***			-1.467***	-1.373***
	(-3.79)	(-4.26)			(-4.16)	(-3.81)
Constant	.13	.201***	-.055	.066	.207***	.119
	(1.31)	(5.67)	(-0.76)	(1.09)	(3.09)	(1.23)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.057	.117	.067	.055	.114	.116
F-statistic	5.24*	13.43	11.15*	9.09*	10.04	8.37
Observations	282	282	282	282	282	282

Critical mass for women directors (D_CM) on ROS (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.044	.045	.042	.043	.043
		(1.52)	(1.55)	(1.45)	(1.51)	(1.51)
L_FAGE	0		.008			-.001
	(-0.03)		(0.69)			(-0.06)
TAN	.12*			.14**	.119*	.119
	(1.67)			(2.12)	(1.66)	(1.66)
LEV	-.069	-.042			-.081	-.081
	(-0.97)	(-0.63)			(-1.14)	(-1.13)
RD	-.658***	-.74***			-.647***	-.649***
	(-2.73)	(-3.23)			(-2.75)	(-2.70)
Constant	.092	.15***	.075	.026	.089*	.089
	(1.42)	(6.30)	(1.57)	(0.64)	(1.94)	(1.38)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.033	.035	.003	.018	.041	.037
F-statistic	3.39***	4.36***	1.48	3.51**	3.98***	3.18***
Observations	282	282	282	282	282	282

Critical mass for women directors (D_CM) on Tobin's Q (robustness check)

Model	(1)	(2)	(3)	(4)	(5)	(6)
D_CM		.218	.147	.133	.216	.225
		(1.42)	(0.95)	(0.84)	(1.40)	(1.49)
L_FAGE	-.209***		-.231***			-.211***
	(-3.15)		(-3.48)			(-3.18)
TAN	.52			-.208	.469	.513
	(1.37)			(-0.57)	(1.22)	(1.35)
LEV	-1.6***	-1.552***			-1.704***	-1.66***
	(-4.25)	(-4.28)			(-4.44)	(-4.40)
RD	.602	1.117			1.487	.645
	(0.47)	(0.91)			(1.17)	(0.51)
Constant	2.433***	1.882***	2.4***	1.662***	1.633***	2.419***
	(7.09)	(14.70)	(9.41)	(7.56)	(6.77)	(7.06)
YEAR	Y	Y	Y	Y	Y	Y
Adjusted R^2	.087	.06	.037	.004	.061	.091
F-statistic	7.72***	6.94***	6.39***	.49	5.59***	6.64***
Observations	282	282	282	282	282	282

Appendix 7: Separately tested control variables

TWD on ROA				TWD on ROE		
Model	(1)	(2)	(3)	(1)	(2)	(3)
TWD	.07***	.088***	.0468*	.262***	.228***	.188**
	(2.79)	(3.46)	(1.82)	(3.44)	(3.70)	(2.41)
L_BSIZE	-.017			0		
	(-1.43)			(0.01)		
NED		-.067***			-.064	
		(-3.26)			(-1.03)	
L_EMP			.002			.012***
			(1.60)			(2.61)
Constant	.09***	.09***	.04***	.056	.089**	-.024
	(3.73)	(7.62)	(3.30)	(0.76)	(2.46)	(-0.66)
YEAR	Y	Y	Y	Y	Y	Y
IND	Y	Y	Y	Y	Y	Y
Adjusted R^2	.017	.024	.017	.017	.018	.022
F-statistic	5.03***	6.79***	5.13***	5.06***	5.28***	6.29***
Observations	1201	1201	1201	1201	1201	1201

TWD on ROS				TWD on TQ		
Model	(1)	(2)	(3)	(1)	(2)	(3)
TWD	-.036	.117*	.296***	.272	.391	.312
	(-0.57)	(1.79)	(4.76)	(0.93)	(1.30)	(1.04)
L_BSIZE	.145***			-.526***		
	(4.89)			(-3.83)		
NED		-.177***			-.942***	
		(-3.35)			(-3.86)	
L_EMP			-.043***			-.06***
			(-11.57)			(-3.39)
Constant	-.087	.29***	.494***	2.052***	1.454***	1.42***
	(-1.41)	(9.63)	(16.79)	(7.21)	(10.48)	(9.96)
YEAR	Y	Y	Y	Y	Y	Y
IND	Y	Y	Y	Y	Y	Y
Adjusted R^2	.083	.073	.158	.051	.051	.048
F-statistic	22.61***	19.88***	45.86***	13.81***	13.84***	12.98***
Observations	1201	1201	1201	1201	1201	1201

The above-mentioned control variables are not included in the regression models of chapter 5, because of high correlations with the gender diversity measures as given in Table 5. Because of this, these variables are regressed separately to see their relationship with the performance measurements. These regression results are compared with prior research. Year and industry fixed effects are included in each model.

From the literature, several researchers argue that corporate performance declines as a firm's board size (L_BSIZE) becomes larger (Low et al., 2015; Terjesen et al., 2016). Large boards may create coordination costs (Terjesen et al., 2016), and simply have more directors and therefore have more capability to contain a more diverse mix of directors (Low et al., 2015). Second, the percentage of non-executive directors (NED) is included. The most appropriate board composition includes both inside and outside directors. Shareholders value rise when there is separation between ownership and

control (Liu et al., 2014; Low et al., 2015). Third, the log of employees (L_EMP) is included that explains the size of a firm, but this effect remains ambiguous (Liu et al., 2014; Low et al., 2015).

The variable of interest (TWD) in the tables shows positive and often a significant relationship with the performance measures. (ROS) and (TQ) are weak measurements, since with the inclusion of the control variables, (TWD) turn insignificant. For the control variables, only a conclusion can be given about (NED), because of its consistent T-statistic. (NED) is significant and negatively in (almost) all models. This indicates that when the number of non-executive directors increases, firm performance declines. In comparison, prior studies mention for these control variables very mixed results. For instance, Liu et al. (2014) mention a significant positive relationship, Low et al. (2015) a significant negative relationship, and Bennouri et al. (2018) an insignificant relationship between (NED) and firm performance. This is the same story for (L_BSIZE) and (L_EMP). This may be the cause of multicollinearity issues in those studies.

D_CM on ROA				D_CM on ROE		
Model	(1)	(2)	(3)	(1)	(2)	(3)
D_CM	.017**	.02***	.013**	.046**	.049**	.033
	(2.50)	(2.91)	(1.88)	(2.27)	(2.39)	(161)
L_BSIZE	-.013			.02		
	(-1.11)			(0.56)		
NED		-.056***			-.018	
		(-2.81)			(-0.30)	
L_EMP			.003**			.014***
			(1.87)			(3.18)
Constant	.093***	.097***	.044***	.059	.11***	-.01
	(3.81)	(8.22)	(3.64)	(0.79)	(3.03)	(-0.28)
YEAR	Y	Y	Y	Y	Y	Y
IND	Y	Y	Y	Y	Y	Y
Adjusted R^2	.015	.021	.017	.011	.011	.019
F-statistic	4.73***	6.08***	5.18***	3.71***	3.67***	5.63***
Observations	1201	1201	1201	1201	1201	1201

D_CM on ROA				D_CM on ROE		
Model	(1)	(2)	(3)	(1)	(2)	(3)
D_CM	-.02	.004	.033**	.049	.067	.06
	(-1.18)	(0.24)	(2.01)	(0.64)	(0.86)	(0.77)
L_BSIZE	.146***			-.507***		
	(5.04)			(-3.77)		
NED		-.148***			-.877***	
		(-2.90)			(-3.73)	
L_EMP			-.038***			-.057***
			(-10.69)			(-3.32)
Constant	-.093	.296***	.512***	2.058***	1.482***	1.445***
	(-1.50)	(9.78)	(17.18)	(7.20)	(10.64)	(10.10)
Adjusted R^2	.084	.071	.145	.055	.051	.048
YEAR	Y	Y	Y	Y	Y	Y
IND	Y	Y	Y	Y	Y	Y
F-statistic	22.85***	19.20***	41.51***	13.71***	13.64***	12.88***
Observations	1201	1201	1201	1201	1201	1201