ERASMUS UNIVERSITY ROTTERAM

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# Why do firms comply faster with gender quotas than others?

## *Evidence from Colorado*

**Abstract**

This study exploits the natural experiment of the introduction of the Colorado female representation quota for the board of directors in 2017 to investigate which factors determine compliance speed with the quota. I constructed a yearly panel dataset of 6641 U.S. firms, 173 based in Colorado, and use a difference-in-difference estimation technique with two-way fixed effects, several logistic regression models and a Cox proportional hazards regression model to analyse compliance speed. I find that compliance speed impacts firm value for the entire sample, but that compliance itself is even more impactful. Also, firms with a higher proportion of male directors comply slower with the quota. The results contribute to the existing literature on gender quotas and compliance speed by providing additional case evidence and novel insights regarding compliance speed.

*Keywords*: Female representation, board of directors, gender quota, difference-in-difference

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# 1 Introduction

## 1.1 Research question

Imbalance is an inherent component of the modern-day corporate governance landscape. Neoclassical economic theory identifies individuals as a set of preferences conforming to axioms such as completeness, reflexivity, transitivity, and continuity (Simon, 1986). It treats a choice as rational if it is the one most likely to satisfy these preferences. A blatant departure from rationality has been occurring for decades in modern corporate America, namely the underrepresentation of females on the board of directors. Despite countless findings demonstrating the positive impact female representation has for the firm (Hill and Jones, 1992; Miller and Triana, 2009; Matsa and Miller, 2013; Chen, Leung & Evans, 2018), the gender ratio, denoting the percentage of male directors, is still far above 50%. As of December 2022, women held 32% of the director positions at firms listed on the S&P 500 (Green, 2022) and this number is even lower for firms in the Russel 3000 index, where only 28.9% company board seats are held by women as of March 2023, according to 50/50 Women on Boards (2023).

However, governments are intervening. Gender quotas have become a powerful tool to bolster female representation in the board room, the first example being the Norwegian quota in 2005, which required 40% of directors of listed companies to be female. Many examples have followed, such as the European Commission (2022), which also set the target at 40%, Spain, Iceland, France, Italy, Belgium, the Netherlands, Germany, Austria and Portugal and the states of California, Illinois, Massachusetts, New York, Pennsylvania and Washington. Even the White House and President Biden have declared in an executive order that it is the policy of the Biden Administration to "*cultivate a workforce that draws from the full diversity of the Nation*".

Empirical research has generated evidence that such gender quota effectively enhance the number of female board members (Grosvold and Brammer, 2011; Smith, 2018; Valls Martinez Cruz Rambaud and Parra Oller, 2019). Research has also focussed on the effects of quotas on the firm. Still, questions remain unanswered regarding which firms comply with such quotas faster than others and if complying faster leads to positive effects on firm performance indicators. This thesis attempts to answer these questions by exploiting a policy shift which occurred on March 14th 2017. On this day, the Colorado State Senate passed House Joint Resolution 17-1017. This gender quota required firms to meet representation requirements dependent on board size within the three year period from January 2018 to December 2020.

In light of the introduction above, this thesis researches the following question:

*Which firms comply quickly with the female representation standards in the board of directors set by the Colorado quota and does compliance speed impact firm value?*

I will investigate this using a panel dataset containing 6641 listed firms in the United States from January 2010 until March 2023, of which 173 firms are subject to the Colorado quota. A difference-in-difference estimation technique with firm and year fixed effects, exploiting the instalment of legislation in Colorado, will measure what would have happened in Colorado in absence of the gender quota to test whether the quota led to more female directors. In addition, logistic regressions and a Cox proportional hazards regression will provide insights regarding which type of firm complies faster compared to other firms with the Colorado quota. Lastly, a difference-in-difference model will once again be used to assess whether compliance speed impacts firm value.

This study is especially interesting in light of Kohler (2023), who describes in an article in the Denver Post how as of 2022, 24% of board seats in Colorado are held by women. This is the result of several years of growth, most likely due to the Colorado quota. Still, the average percentage of female board members lacks 2-3% behind the national average depending on the index on which the firm is listed as of the end of 2022. This could be due to a large portion of firms that did not comply with the Colorado quota.

This topic is highly relevant in economic literature. Notable papers that use a similar difference-in-difference approach to assess the effect of gender quota are Ahern and Dittmar (2012), Fracassi and Tate (2012) and Gerstberg, Mollerstrom and Pagel (2021). Additional case evidence will add to the stream of literature uncovering the effectivity of gender quota. Moreover, analysing speed of compliance has scarcely been performed before, meaning that the findings of this study will provide valuable insights into whether this is a fertile source of additional research. Lastly, the findings of this study will have policy implications for the state of Colorado, enabling them to assess the effectivity of their gender equality legislation, as well as for firm, providing them with insights whether fast compliance is beneficial for firm value.

**1.2 Preview of the results**

The research question is supported by six hypotheses. First, I test if the Colorado quota led to more females in Colorado board rooms. After that, hypotheses 2 through 5 test is pre-quota levels of female representation, board education, sector differences and ESG scores impact compliance speed with the Colorado quota. Lastly, hypothesis 6 analyses if compliance speed impacts firm value.

One of the main results is that the Colorado quota did not significantly lead to more female directors in the board of directors. Colorado based firms after 2018 do not have a significantly higher percentage of female board members compared to firms in other states. This suggests that the Colorado quota was ineffective in terms of boosting gender diversity in the board room. However, larger boards are more gender diverse and an additional director leads to a lower proportion of male directors. Therefore, if a firm hires an additional board member, it will more likely be a female rather than a male.

There also appears to be evidence that Colorado firms with a low proportion of male directors, with board members that are highly educated, that score well in ESG ratings and are active in certain sectors such as Business Services or Real Estate complied faster with the Colorado quota than firms with different characteristics.

Lastly, firms subject to the Colorado quota have a lower market value compared to the control group. Also, complying with a high standard of female representation, namely the Colorado quota, has a positive effect on market value for the sample with firms based in all U.S. states, but not specifically for Colorado firms. The results show that even slow compliance has a positive effect on market value, although this effect is smaller than having already complied with the quota or being a fast complier. While it is true that firms in states other than Colorado have no legal obligation to meet the female representation requirements set by the Colorado quota, firms that meet these relatively high standards of gender diversity in the board tend to be valued higher.

This study is structured as follows. First, a theoretical framework is constructed which discusses the most relevant economic findings regarding the role and impact of the board of directors, the impact of certain board and firm characteristics, such as gender diversity, on the firm and the role gender quotas play in boosting female representation. The six hypotheses of this study are incorporated in this section as well. After that, a description of the dataset and the sample will be discussed, followed by an overview of the methodology used to generate evidence in order to reject or accept the hypotheses. Next, the results of the econometric models used in this thesis will be interpretated and lastly the conclusions and a discussion of the limitations will be presented, along with a robustness check.

# 2 Theoretical framework

## 2.1 Introduction

The foundation on which corporate governance is based is the separation of control and ownership of the firm and the agency costs that arise due to this separation (John & Senbet, 1998). One of the main mechanisms to tackle agency costs is the board of directors, mainly tasked with monitoring the executives in charge of day-to-day operations of the firm. Discussions whether the board of directors is effective or not date back to research by Jensen (1993), who argues that internal control systems, such as the board of directors, have failed to keep up with changing technological, political, regulatory, and economic forces. Still, other researchers such as Baysinger and Butler (1985) and De Andres and Vallelado (2008) find that board composition matters, even though the relationship is complex. These findings therefore imply that the board of directors plays a fundamental role in corporate governance.

A broad theoretical foundation exists regarding the impact of diversity within executive boards of directors on firm performance. Board diversity relates to the range of backgrounds, demographics, skills, competencies and experiences that a board directors possess as a collective, according to the Harvard Business Review (2019). However, results regarding the effect of board diversity differ from study to study. On the one hand, Carter, Simkins and Simpson (2003) found a positive relationship between the fraction of women or minorities on the board and firm value. Other examples include Erhardt, Werbel and Shrader (2003), who find that board diversity is positively associated with return on assets and investment, and Hassan, Marimuthu and Kaur Johl (2015), who find that board diversity can have a positive impact on firm performance via the upper echelon theory. On the other hand, Carter et al. (2010) find that board diversity does not significantly impact Tobin's Q and Cucari, Esposito de Falco and Orlando (2018) find that the percentage of women in boards has a negative impact on ESG disclosure.

## 2.2 The role of the board of directors

The board of directors sits at the apex of the firm and is essentially a panel of executives who are hired to represent shareholder interests. Every public company is required to have a board of directors. Several key responsibilities are hiring and overseeing senior management, monitoring financial performance, ensuring compliance with regulations, supporting managers with their experience and mentoring capabilities and setting the company's strategies. Most importantly, the board of directors represents shareholder interests. Internally, the board of directors is regularly split between the executive board, headed by the CEO and tasked with overseeing daily operations, and the supervisory board, which deals with long-term issues such as strategy and shareholder interests (Talerico, 2023).

Their right to existence is based on agency theory, which suggests that the board of directors serves a key role as a monitor of managerial action and acts as an important control mechanism to curb managerial self-interest which should in turn increase firm performance (Fama & Jensen, 1983). The agency problem within firms arises due to the separation of control and ownership. Often, those executives tasked with the operating side of a business are not the owners of the firm. Agency costs can be reduced by performance-based pay, direct intervention by shareholders and threat of dismissal, to name a few (Zogning, 2017).

Despite being the solution to reducing agency costs, a stream of literature has started to question whether the board of directors lacks effectiveness. For many years, boards were viewed largely as groups packed with close friends of the CEO serving primarily as passive endorsers of management decisions (Lorsch & MacIver, 1989). However, the occurrence of corporate scandals over the last decade has reignited the focus on the board's significance in discussions surrounding corporate governance, leading to calls for a more proactive role for boards (Withers, Hillman, & Cannella, 2012). While Gillespie and Zweig (2010) state that "…the corporate board of directors is a largely useless, if mostly harmless, institution carried on out of inertia", Leblanc and Gillies (2005) state that "nothing is more important to the wellbeing of a corporation than its board of directors. These two quotes illustrate the continued controversy about the practical relevance of the board in the modern-day firm.

The core metric used to test whether boards serve their purpose is to assess whether boards can fulfil their main task: monitoring the executives that control the firm. In order to assess whether boards efficiently monitor, Hinsz, Tindale and Vollrath (1997) conceptualize the board as an information-processing group. Their ability to obtain, process and then share information theoretically corresponds with their effectivity as a board. There are three groups of barriers posed to process information: individual, group and firm factors. Hinsz, Tindale and Vollrath (1997) find that cognitive and group processes involved in information processing are dependent on a specific context. Therefore, analysing the context in which boards operate is essential to understand their ability to process information and thus effectively contribute to reducing agency costs (Boivie et al., 2016).

Firstly, individual barriers reduce the ability of board members to effectively process information through cognitive biases, bounded rationality, the complexity of the information processing demands and the busy board hypothesis, which suggests that board members with more outside appointments reduce their performance at the focal firm (Perry & Peyer, 2005; Oldroyd & Morris, 2012). These biases lead to individual barriers such as outside job demands and the similarity and complexity of those outside jobs.

Secondly, group factors. Boards function as a group, meaning that they face the inherent challenges of group decision-making that other groups face. The most prominent example is board size, which has extensively been researched. Examples are Dowell, Shackell and Stuart (2011), Mak and Kusnadi (2005) and Yermack (1996). Each example shows that a larger board has a negative impact on firm performance. The explanation for this relationship is that as boards become larger, the need to coordinate actions with more individuals may make it more difficult for the board to effectively fulfil its role of monitoring, thus providing valuable resources to firms. Other group factors that limit their capacity to monitor are meeting frequency, social norms within groups that stifle candid discussion, CEO power, which refers to the fact that powerful CEOs appoint directors with ties to the CEO, thus limiting their capacity to independently monitor the executive branch of the firm (Fracassi & Tate, 2012). Diversity in the board also plays a role limiting information processing capabilities through communication barriers. However, board diversity also has positive effects, which will be revisited in detail further on.

Lastly, firm factors also play a role limiting information collection. The most prominent examples are firm size and firm complexity. For example, Coles, Daniel and Naveen (2008) provide evidence that more complex firms require more monitoring. Therefore, boards of highly complex firms will have a more difficult time monitoring management because of the significant disparities in their knowledge of the firm compared to board members' knowledge, which in turn increases agency costs.

A large body of empirical research advocates that the board of directors is a critical governance control mechanism, in contrast to research discussed above. Prior literature in this area has generally focused on board effectiveness by either suggesting that boards need more properly motivated directors (Dalton, Hitt, Certo, & Dalton, 2007), or that boards should have directors with greater qualifications and ability (Hillman & Dalziel, 2003). The approach to determine whether the board of directors is an effective part of the firm lies on researching what board structures impact the firm.

To name a few board characteristics, Fama and Jensen (1983a) propose that boards add value by monitoring and advising the CEO. Existing research posits that board size may be important for monitoring and advising (Jensen 1993; Yermack 1996). Other papers emphasize the role of insiders on a board (Hermalin and Weisbach 1991; Harris and Raviv 2008). We argue that personal characteristics of board members such as age, education, and professional experience are also likely to directly affect a director's ability to monitor and advise

**2.3 Board characteristics and impact on the firm**

Even though there may always be doubts if the board of directors is an effective body within the firm to monitor management, there is still a large body of research on the optimal board structure. The first piece of research dates back to Baysinger and Butler (1985), in reaction to papers two years prior by Fama and Jensen (1983a) and Williamson (1983), who advocated that the board of directors is an essential part of the firm. Baysinger and Butler (1985) research the impact of board independence on firm performance. They find that firms with higher proportions of independent directors have higher performance up to a certain point and argue that a mix of insiders and outsiders constitutes the perfect board composition. Since then the literature has focused on several board characteristics. The fact that this series of board characteristics impacts the firm, either positively or negatively, is evidence that the board of directors matters.

Perhaps the most researched board characteristic is board size, referring to the number of directors on the board. Traditionally, a negative effect between board size and firm performance was found (Yermack, 1996; Mak and Kusnadi, 2005; Haniffa and Hudaib, 2006; Brick and Chidambaran, 2010; Doğan & Yildiz, 2013). The reasoning behind these findings is that a large board of directors is faced with an increase in asymmetric information, the problem of communication between its members and difficulty in achieving consensus to reach a decision. However, this is true up to a certain point. Pérez de Toledo (2010) observes an inverted U-shaped relationship between board size and firm performance, as do Adams and Mehran (2005) and De Andres and Vallelado (2008). The latter finds that the optimal number of board member is 19 in the banking industry. Therefore, finding the optimal board size is a trade-off between advantages, such as increased monitoring, and disadvantages, such as the coordination problems mentioned by Yermack (1996). Some researchers have found solely positive effects of board size on firm performance, such as Belhkir (2009) and Zubeltzu-Jaka, Álvarez-Etxeberria and Ortas (2020). This illustrates that board characteristics can have significant impact.

One of the characteristics that has also extensively been researched is board diversity. Research has linked diversity among directors to a number of important benefits including increased firm reputation, greater corporate social responsibility, enhanced firm performance and more disciplined CEO compensation, among others (Bear, Rahman, & Post, 2010; Erhardt, Werbel, & Shrader, 2003; Zhu, 2014). Research on the benefits of diversity also argues that diverse groups are able to generate better solutions during problem solving because of their ability to consider a greater range of possible solutions (McLeod & Lobel, 1992; Watson, Kumar, & Michaelsen, 1993). Increased diversity of directors can yield different perspectives (Farrell & Hersch, 2005) and allow the firm to access a wider array of resources (Arfken, Bellar, & Helms, 2004). These positive effects of diversity are conditional upon education level and previous experience (Aripin et al., 2016).

Gender diversity has received significant attention in the literature as well. Pletzer et al. (2015) assess 3097 U.S. firms and find that on average female participation on boards was low, with a mean of 14%.

In line with the findings regarding diversity in the board of directors, researchers have hypothesized that the marginal effect of adding females to the board on firm performance is positive. Findings differ significantly. Pletzer and his co-authors find that a small and nonsignificant correlation exists between females on the board and firm performance. Merely the fact that women are on the board does therefore not enhance firm performance. Alves et al. (2015) find firms with gender diversified boards and where the chairman is non-executive have a capital structure composed with more long term sources of financing, while Adams and Ferreira (2009) show that attendance problems occur less frequently in more gender-diverse boards, suggesting that gender-diverse boards allocate more effort into their monitoring responsibilities. They also find that CEO turnover is more sensitive to stock performance and directors receive more equity-based compensation in firms with more gender-diverse boards. Also, they find that gender diversity has a negative effect on firm performance, similar to Ahern and Dittmar (2012).

While several papers have not found a significant link between gender diversity and firm performance or have found a negative effect, including Rose (2007) and Marinova, Plantenga and Remery (2016), researchers have also found opposite results. More recent studies find evidence of a positive effect on firm value (Mohsni, Otchere & Shahriar, 2021; Liu, Wei & Xie, 2014; McKinsey & Company, USA, 2007; Lückerath-Rovers, 2013, Carter, Simkins, and Simpson, 2003). Female representation on boards also impacts a wide array of other firm characteristics. Pucheta-Martínez, Consuelo and Bel-Oms (2016) find that the percentage of female directors on the board and the percentage of independent female directors have a positive impact on dividend policy. Mohsni, Otchere and Shahriar (2021) find that gender diversity is negatively related to risk, similar to findings by Lee (2023) and Jane-Lenard et al. (2014). The latter measures risk via variability of stock market returns, which is relevant for investments decisions.

In addition, female board representation is negatively associated with mergers and acquisitions (Chen, Crossland and Huang, 2016) and show a smaller drop in performance during the financial crisis of 2007-2009 (Chen et al., 2019). Chen and co-authors also find that male CEOs at firms with female directors exhibit less overconfidence, measured via the option exercise behaviour of the CEO. Female representation in the board also leads to fewer employee layoffs (Matsa and Miller, 2013), higher investments in innovation (Miller and Triana, 2009), greater innovative success and performance in innovation-intensive industries (Chen, Leung & Evans, 2018), better firm reputation (Hill and Jones, 1992) and lower probability to initiate acquisition bids as well as lower bid premiums (Levi et al., 2014).

Zhang (2020) answers the question why findings regarding gender diversity diverge so widely. He states that gender diversity's relationship with performance depends on both its normative and regulatory acceptance in the broader institutional environment. The more that gender diversity has been accepted in a country or industry, the more that gender-diverse firms experience positive market valuation and increased revenue. However, evidence exists for multiple countries, developed and undeveloped, that gender diversity continuously positively impacts firm performance. Campbell and Mínguez-Vera (2008) find that in a panel of Spanish firms the percentage of female directors has a positive effect on firm value, Gordini and Rancati (2017) find the same for listed Italian firms between 2011-2014, Lee-Kuen, Sok-Gee and Zainudin (2017) find the same for Malaysian firms and Lückerath-Rovers (2013) finds the same for Dutch firms. This positive effect also is found in a sample of Nigerian firms (Chijoke-Mgbame, Boateng & Mgbame, 2020).

An area of ongoing debate in the literature is whether female and male directors differ systematically in terms of underlying personality characteristics, preferences, and cognitions. This could be the underlying driver of the impact female representation has on a wide array of firm characteristics. For example, Byrnes, Miller, and Schafer (1999) and Croson and Gneezy (2009) suggest that men are significantly more likely than women to engage in risk-taking behaviour. Barber and Odean (2001) find that men are more likely to engage in excessive trading and risk-taking than women. Also, there is evidence that male and female leaders may be associated with different behavioural patterns, as hypothesized by Huang and Kisgen (2013). They find that male directors undertake more acquisitions and issue debt more often than female directors. Further, acquisitions made by firms with male executives have announcement returns approximately 2% lower than those made by female executive firms and debt issues have lower announcement returns for firms with male executives. Also, female executives place wider bounds on earnings estimates and are more likely to exercise stock options earlier than their male counterparts. Therefore, there is some evidence in the literature that male and female directors differ significantly, which could explain the differences in their impact on the firm.

A conclusive remark on the effect of female representation in the board room lies with Joecks, Pull and Vetter (2013), who apply the critical mass theory to gender diversity. Critical mass theory refers to the critical number of personnel needed to afflict change. Joecks, Pull and Vetter (2013) find evidence that gender diversity first negatively affects firm performance and, only after the critical mass of 30% women has been reached, is to be associated with higher firm performance than completely male boards. This leads to the idea of a “magic number” of women in the board room, as the U-shaped relationship between firm performance and gender diversity seems to optimizable to achieve maximal benefits of gender diversity.

### 2.4 Enhancing board diversity via gender quota

An important ethical question focuses on whether a corporation's board should reflect the firm's stakeholders or be more in line with society in general (Rose, 2007). A way to boost female representation is via the use of a gender quota. Research on this topic is vast, similar to research discussed above regarding the impact of gender diversity on the firm. Governments have introduced gender quotas to enhance the number of female board members. Norway was the first country to introduce a quota in 2003, which mandated firms to have at least 40% female board members. The effect of the gender quota has been extensively researched, most notably by Ahern and Dittmar (2012). Using a robust research design exploiting the exogenous policy shift, they find that the quota led to a drop in the stock price upon the announcement of the law and a large decline in Tobin's Q over the following years, providing evidence that gender quota have a negative effect on firm value. Moreover, the quota led to younger and less experienced boards and increases in leverage and acquisitions. These negative effects are driven by the lack of experience of the new female board members, not the fact that they are female per se. The Norwegian quota has also been researched by Wang and Kelan (2013), who find that the likelihood of women being appointed to top leadership roles as board chairs or corporate CEO increases due to the quota. Dale-Olsen, Schøne and Verner (2013) find that the Norwegian quota did not impact the return on total assets nor changed operating revenues. However, the quota did lead to firms having accumulated more capital, either financed by debt or by a combination of debt and own capital. Also, Matsa and Miller (2013) show that operating performance declined and costs increased due to the installation of the quota.

Since the Norwegian quota, several other countries such as the United States, Norway, Spain, Iceland, France, Italy, Belgium, the Netherlands, Germany, Austria and Portugal have introduced corporate board quotas (CBQ) as of the  beginning of 2018. Mensi-Klarbach and Seierstad (2020) determine two characteristics of CBQs that impact their effectiveness, which are *hardness*, regarding enforcement and precision, and *progressiveness,* regarding year of acceptance, implementation schedule, quota target, requested increase, duration and scope. Grosvold and Brammer (2011) state that "the radical intervention of gender quotas is often considered the 'ultimate' political option when voluntary attempts to increase female representation on boards fail". Other studies have also assessed the effectivity of gender quota, such as Smith (2018) and Valls Martinez Cruz Rambaud and Parra Oller (2019), who respectively find that quotas increase the number of women on boards of directors and increase voluntary disclosure of CSR reports and the inclusion in a sustainability index.

However, gender quotas also have disadvantages. Boards with members who differ from the company's senior management may experience communication problems internally and with management. Also, quotas imply that less experienced women will join boards because the supply of qualified women in senior executive positions is thin and there is evidence that quotas have little positive effect on increasing the pool of women with senior executive experience. (Smith, 2018). In addition, the attitude towards newly hired female directors could have a negative connotation because they obtained a board seat due to the quota, not because of their qualities. Lastly, Merchant (2011) states that firms will find a way around the quota if they wish, which highlights the importance of adequate repercussions if the quota is not met.

Lastly, Gerstberg, Mollerstrom and Pagel (2021) research the impact of the first gender quota in the United States, namely the California quota of 2018. They found that support for new female directors dropped significantly after the quota compared to new hired pre-quota. Also, share prices reacted negatively to the quota. California is not the only state to have adopted such a quota, Colorado as well.

### 2.5 The Colorado gender diversity quota

On March 14th 2017 the Colorado State Senate passed House Joint Resolution 17-1017, requiring firms to meet the following requirements within the three year period from January 2018 to December 2020:

1) Every publicly held corporation in Colorado with nine or more director seats have a minimum of three women on its board
2) Every publicly held corporation in Colorado with five to eight director seats have a minimum of two women on its board; and
3) Every publicly held corporation in Colorado with fewer than five director seats have a minimum of one woman on its board.

This piece of legislation was sworn into law in an attempt to follow the rest of the United States, where firms were rapidly altering the gender composition of their board of directors. As of 2007, only 7% of board positions in Colorado were held by women. By the end of 2020, when the compliance period of the quota ended, that number had jumped to 21% (Kohler, 2021). This thesis aims to expand this stream of literature by examining the impact of the relatively novel Colorado quota. It is not always evident if gender quotas are effective, as even mentioned by the Gender Quotas Database (2023). Therefore, the first hypothesis of this thesis tests the effectivity of the Colorado quota:

***Hypothesis 1:*** *Compared to the rest of the United States, the percentage of female members of the board of directors will increase due to the passing of the Colorado quota in 2017.*

### 2.6 Compliance speed

An area that has received relatively little attention in the field of gender quota is compliance speed. Greene, Intintoli and Kahle (2020) assess the announcement effects of the previously mentioned gender quota in California. Returns are more negative for firms that are required to add more female directors, while returns are less negative for firms that can more easily adjust board composition. In terms of compliance, they find that firms significantly increase female director appointments in response to the law, meaning that they do comply with the quota, just not at which speed. The researchers also find that the annual direct cost of compliance is 0.76% of market value and that female appointments to director positions significantly increased in response to the California gender quota. Nygaard (2011) arrives at a similar conclusion. He finds that announcement effects of the gender quota were higher for firms with above- median levels of female representation within boards, which indicates that firms that have to undertake less action to comply with regulation are better off compared to firms that have to undertake more action. Do firms tend to comply quicker with new regulation compared to other firms when both firms have to undertake equal action to comply with new regulation? This topic has received relatively little attention within corporate governance. While it may seem obvious that firms with a higher proportion of male directors take longer to comply with female representation standards, finding statistical evidence is valuable. To research if firms with above median levels of male representation comply slower with the Colorado quota, I hypothesize the following:

***Hypothesis 2:*** *Firms with above-median levels of male representation comply slower with the Colorado quota.*

According to Shaw, He and Cordeiro (2021), compliance speed depends on firm structure as well. The researchers found that family firms are slower to comply with board independence requirements than non-family firms in an Indian sample. Yang and Han (2020) find that compliance speed with institutional practices by multi-national firms was faster in countries with a higher level of institutional development. They also find that delayed compliance led to increased financial performance, which could explain why firms choose to comply slower with gender quota. De Cabo et al. (2019) assess noncompliance rates, which is in essence a very slow speed of compliance, for the soft gender quota instated in Spain in 2007. Soft refers to the fact that there were no severe consequences for firms upon noncompliance when the compliance period expired. They find that less than nine percent of firms fully comply with the quota, which indicates that consequences of noncompliance impact compliance speed. To further research which firm and board characteristics impact compliance speed, I hypothesize the following:

***Hypothesis 3:*** *Firms with higher educated board members comply quicker with the Colorado quota.*

***Hypothesis 4****: The sector in which a firm is active significant impacts the speed of compliance with the Colorado quota.*

The literature has extensively researched if female representation has a positive impact on firm performance in terms of Environmental, Social and Governance (ESG) scores. Velte (2016), Ginglinger and Raskopf (2019) and Shakil, Tasnia and Mostafiz (2021) each find a positive effect between female representation in the board and ESG performance. The findings suggest that female directors have unique qualities, experiences, and preferences that enable them to steer firms toward more ESG-oriented policies. Wasiuzzaman and Subramaniam (2023) focus more on ESG disclosure rather than performance and find that female directors positively influence the quality of ESG disclosure. They highlight the need to assess ESG components separately, which is what this thesis does, as will be touched upon in later chapters. In light of the positive relationship between gender diversity and ESG performance, I hypothesize the following:

***Hypothesis 5:*** *Firms with higher ESG-scores comply quicker with the Colorado quota.*

Lastly, there appears to be a gap in the literature on whether compliance speed impacts firm value. This could lead to valuable insights for firms whether it is beneficial to comply faster or not if shareholders value fast compliance. The final hypothesis forms the main objective of this thesis:

***Hypothesis 6:*** *The Colorado quota has a positive effect on firm value for quick-adapting firms and a negative effect on slow-adapting and non-adapting firms.*

**2.7 Hypotheses**

In conclusion, the theoretical framework deduced three hypotheses from the existing literature. The hypotheses are listed again below:

***Hypothesis 1:*** *Compared to the rest of the United States, the percentage of female members of the board of directors will increase due to the passing of the Colorado quota in 2017.*

***Hypothesis 2:*** *Firms with above-median levels of male representation comply slower with the Colorado quota.*

***Hypothesis 3:*** *Firms with higher educated board members comply quicker with the Colorado quota.*

***Hypothesis 4****: The sector in which a firm is active significant impacts the speed of compliance with the Colorado quota.*

***Hypothesis 5:*** *Firms with higher ESG-scores comply quicker with the Colorado quota.*

***Hypothesis 6:*** *The Colorado quota has a positive effect on firm value for quick-adapting firms and a negative effect on slow-adapting and non-adapting firms.*

# 3 Data

### 3.1 Data sources

In order to assess if the Colorado quota impacted female representation in the board of directors, which type of firms comply with the quota faster than others and if speed of compliance impacts firm valuation, I needed to obtain board information combined with firm information. Previous research by for example Rose (2007), Ahern and Dittmar (2012) and Fracassi and Tate (2012) each collect board and information from firm's financial statements and combine them. Instead of searching through financial statements, I used BoardEx, Compustat, Eikon and Execucomp.

BoardEx is a database containing board characteristics from a firm and individual perspective. Individual information ranges from educational background and prior employment, to connections of directors and independence measures, while firm information ranges from basic firm information such as state the firm is located in to the ratio of male to female directors in the board. Compustat is a widely used database, for example by Ahern and Dittmar (2012), containing information regarding financial, statistical and market information. The integration with CapitalIQ is useful to obtain advanced firm information such as market valuation from firms listed on the S&P 500. Lastly, Eikon was used to distil ESG score information per firm and Execucomp was used to obtain director compensation variables.

### 3.2 Samples

The starting point was to extract Organization Summary Analytics from BoardEx by submitting queries per month between 2010 and 2022. This enabled me to obtain data on the gender ratio, which is denoted by the number of male directors divided by the total number of directors. Ideally I would have used a gender ratio that denoted the number of female directors on the board, but the results with the male gender ratio are simply the inverse of a female gender ratio. After contacting the BoardEx team, I discovered that BoardEx does not map female representation per month per firm. Therefore, I had to manually extract data for each month of the analysis and combine them to arrive at a panel dataset usable for a female representation roadmap. At its most frequent, the gender ratio is documented on a quarterly basis, but mostly gender ratio is documented yearly. Therefore, a panel dataset of firms and their corresponding gender ratios listed per quarter from 2010-2023 was the maximally obtainable result.

After removing variables with an individual scope, such as director title, a dataset remained with firms per quarter with their corresponding board characteristics, which will be explained in section 3.3. Next, I merged the BoardEx dataset with Compustat information such as market value and net income on

GVKEY code, which is a connector between the CUSIP codes of Compustat and the BoardID codes of Boardex. Additionally, I merged the BoardEx-Compustat database with a query from the Eikon database. After dropping duplicate observations and outliers, I restructured the data into a quarterly panel dataset from a firm perspective from January 2010 until December 2022, which spans 52 quarters. Essentially, the dataset can list a specific firm maximally 52 times quarterly and 13 times yearly. This approach allows me to analyse the evolution of the percentage of female board members per firm and allows me to assess which variables impact this.

However, the data obtained from the three databases was not sufficient to analyse questions regarding the speed of compliance. Therefore, I constructed a series of variables, which will discussed in the following section in greater detail. First, I created a variable that indicated if a firm complied with the Colorado quota in that period, which is dependent on the number of total board members due to the fact that the quota aims to ensure that a minimum percentage of board members is female, instead of an absolute number. Secondly, I created a variable that indicated in which quarter compliance was achieved first, which in turn could be used to determine the speed of compliance, the ultimate goal of this research. The Colorado quota had a three year adaption period, between 2018 and 2020. Therefore, a fast complier reached compliance in 2018, a medium complier in 2019 and a slow complier in 2020. A firm that reached compliance before 2018 was categorized as already complied and non-complying firms served as the baseline.

This thesis uses four samples. Sample A is the main sample and contains 50,582 observations of 6,641 unique firms, which means that a firm appears in 7,6 year on average. The average of 7,6 is lower than the maximum of 13 years (2010-2022). This is due to the fact that firms enter and exit the dataset when they become delisted, go bankrupt or become listed in the timespan of 2010-2022. The results is an unbalanced panel. However, this is not a huge issue if the missing observations occur randomly This sample is used to analyse hypotheses 1 and 6. Sample B only contains firms with headquarters in Colorado and is used for hypotheses 2 through 5, analysing which factors determine the speed of compliance. Firms located in other states are not needed for these hypotheses, as the Colorado quota is not applicable to them. This sample contains 1,415 observations of 173 unique firms. Lastly, datasets C and D have an additional set of ESG indicators and will be used to analyse if ESG performance impacts compliance speed. ESG datasets are matched on ISIN, making them less complete as the coverage of ISIN in the BoardEx database is less than 100%. Therefore, sample C contains 14,954 observations of 1,706 unique firms and sample D contains 385 observations of 48 unique firms.

Despite a rigorous construction process, the dataset still has several limitations. First, several board indicators, which will be discussed in the following section, are measured annually rather than quarterly. In the process of transforming the dataset from quarterly to yearly, I used the year-end value as the value for the entire year. Fortunately, this is not a large issue (Cox, 2023). The revamping of the dataset from a quarterly to a yearly panel was done to expand the dataset to allow for more relevant control variables. Also, the results are more reliable now that all variables are transformed to be unique once a year, rather than some variables occurring once a year and thus repeating itself over the four quarter and other variables occurring quarterly. Secondly, the results regarding the impact of ESG performance may be biased due to the matching issue regarding uncomplete reporting of ISIN codes in BoardEx data. ISIN codes are only reported for listed firms, while the complete sample contains of mix of listed and non-listed firms. Therefore, the results regarding ESG performance will be biased towards listed firms as the dataset does not contain information regarding ESG performance of non-listed firms.

In conclusion, the final sample with all firms spans from January 2010 until December 2022 and contains at the most 6,641 unique firms, observed yearly rather than quarterly.

### 3.3 Variables

In order to build a suitable dataset for analysing the impact of the Colorado quota on female representation in the board room and whether the speed of compliance with this piece of legislation impacts market value, I started with a dataset of firm indicators. Examples of these indicators are board name, BoardID, CUSIP, GVKEY, ticker code, ISIN number, sector, index and several time indicators to structure the panel into a quarterly panel. This setup allowed for the continuous addition of a range of board and firm characteristics to serve as dependent and independent variables, which will be discussed in the following section.

#### 3.3.1 Board characteristics

***Gender ratio*** The proportion of male directors at the annual report date. Measured differently per firm, ranging from several times per year to yearly and obtained from BoardEx Organization Analytics. This variable is the main variable of interest, as it serves as a proxy for female representation. A lower gender ratio indicates a higher proportion of female directors.

***Succession rate*** Measurement of the clustering of directors around retirement age at the annual report date. Measured yearly and obtained from BoardEx Organization Analytics. A higher succession rate indicates that the average turnover in the board was higher in a given year (Ocasio, 1994) . Used as a control variable.

***Attrition rate*** Number of directors that have left a role as a proportion of average number of directors for the preceding reporting period at the annual report date. Measured yearly and obtained from BoardEx Organization Analytics. This variable is a proxy for the actual turnover rate. In comparison, the succession rate only measures board member turnover due to the reaching of the retirement age. The attrition rate encompasses all reasons why a director leaves his or her post. Used to control for the fundamental differences between boards with high turnover and boards with low turnover.

***Nationality mix*** Proportion of directors from different countries at the annual report date. Measured yearly and obtained from BoardEx Organization Analytics. Serves as a control variable to control for varying levels of diversity per board.

***Number of Directors*** The number of members of the board of directors. Measured quarterly and obtained from BoardEx Organization Analytics. Serves as a proxy for board size. This variable is essential for determining whether a firm complies with the Colorado quota or not, as the required number of female board members is dependent upon board size.

***Sum of number of qualifications (sumnoquals)*** This variable is the sum of the number of qualifications at undergraduate level and above for all the directors at the annual report date selected. This variable is used as a proxy for the level of education of a board. A higher value indicates a higher educated board. Measured yearly and obtained from BoardEx Organization Analytics. Serves as an explanatory variable to determine compliance speed.

***Sum of network size*** This variable is the sum the size of directors networks, meaning the number of overlaps through employment, other activities and education. Measured yearly and obtained from BoardEx Organization Analytics. Serves as a control variable for the connectedness of the firm's board.

***Standard deviation of age*** This variable denotes the standard deviation of age within a board. A higher value indicates that a board has a higher level of age diversity. Serves as a control variable and is measured yearly.

### 3.3.2 Firm characteristics

***Net income*** Net income in millions of dollars. Measured quarterly and obtained from Compustat. Used as a control variable.

***Stockholders equity*** This variable represents the common equity, preferred equity and nonredeemable noncontrolling interest of a company in millions. Measured quarterly and obtained from Compustat. Used to calculate the book value of equity.

***Deferred Taxes and Investment Tax Credit*** This variable represents the accumulated tax deferrals due to timing differences between the reporting of revenues and expenses for financial statements and tax forms and investment tax credit. Measured quarterly and obtained from Compustat. This variable is used to calculate the book value of equity.

***Research and development expense*** This variable represents all costs incurred during the year that relate to the development of new products or services in millions. Measured quarterly and obtained from Compustat. Used as a control variable.

***Market value*** This variable is calculated by multiplying common shares outstanding by the month-end price that corresponds to the quarter. Market value is the dependent variable for hypothesis 6, testing whether compliance speed impacts market valuation. Obtained from Compustat and calculated quarterly.

***Market value of assets*** Calculated by total assets plus the market value of equity minus the book value of equity.

***Book value of assets*** Denoted by total assets in millions. Measured quarterly and obtained from Compustat.

***Market value of equity*** Calculated by multiplying the stock price at the end of the quarter times common shares outstanding at the end of the quarter.

***Book value of equity*** Calculated by total stockholders' equity minus value of preferred stock plus deferred taxes and investment tax credit. Calculation based on Fracassi & Tate (2012).

***Tobin's Q*** Proxied by taking the ratio of the market value of assets to book value. Calculation based on Fracassi & Tate (2012). Serves as dependent variable for hypothesis 6.

***Tobin's Q equity*** Proxied by taking the ratio of the market value of equity to book value. Serves as dependent variable for hypothesis 6.

### 3.3.3 Control variables

An important component in the female representation literature is the selection of control variables. Previous studies in this field generally use similar control variables. Chen, Crossland and Huang (2016) control for firm size with log total assets, firm performance with return on assets and leverage ratio and governance conditions via board size, diversity and a dummy for female CEO. Rose (2007) adds incentive payment schemes and ownership division, along with other board characteristics such as age diversity and nationality diversity. Chen, Leung and Evans (2018) control for number of independent directors, return on assets, leverage and R&D expenditures. The use of control variables will compensate a lack of within-firm variation in the gender ratio, as this would work against finding a significant relation between the explanatory variables and compliance speed in firm and year fixed effects regressions (Zhou, 2001). For these reasons, I also estimate regressions without firm and year fixed effects, but this will be touched upon in the following chapter.

Control variables that have been previously described are succession rate, attrition rate, number of directors, nationality mix, number of qualifications, standard deviation of age and the sum of network size to control for differences between boards. Previously mentioned are also net income, market value and research and development expense to control for firm differences. Additionally, I have added the following control variables in line with previous research:

***Return on assets*** Denotes the return on assets in millions of dollars. Measured yearly and obtained from Compustat.

***Debt/equity ratio*** Total debt divided by equity in millions of dollars. Measured yearly and obtained from Compustat.

***Total compensation*** Sum of total compensation of all board members per year as recorded in SEC filings. Measured yearly and obtained from Execucomp.

***Total stock awards*** Sum of stock awards of all board members per year as recorded in SEC filings. Measured yearly and obtained from Execucomp.

***Total option awards*** Sum of option awards of all board members per year as recorded in SEC filings. Measured yearly and obtained from Execucomp.

***Listed board positions*** Sum of the number of boards of publicly listed companies that board members have served on at the Annual Report Date selected. Measured yearly and obtained from BoardEx. Used as a measure of board independence.

***Unlisted board positions*** Sum of the number of boards of non-listed companies that board members have served on at the Annual Report Date selected. Measured yearly and obtained from BoardEx. Used as a measure of board independence.

***Other board positions*** Sum of the number of boards of other companies that board members have served on at the Annual Report Date selected. Measured yearly and obtained from BoardEx. Used as a measure of board independence.

### 3.3.4 Constructed variables

***Colorado*** Dummy variable which takes value 1 when a firm is incorporated in Colorado. This variable is necessary to determine the impact of the Colorado quota on Colorado-based firms compared to the control group, which are firms in the other 49 states.

***Above_median*** Dummy variable which takes value 1 when a firm has an above median level of male directors in the board. Serves as an explanatory variable.

***Post_quota*** Dummy variable which takes value 1 when an observation occurs after January 2018. The Colorado female representation quota became effective from January 2018 onwards.

***ComplianceX*** This dummy indicates whether a firm has reached compliance with the Colorado quota yet or not. It is a series of dummies ranging from *Compliance2* to *Compliance14* and takes value 0 or 1 for every quarter. Compliance is dependent upon the number of board members. Therefore, a firm with 2 board members must have a gender ratio of 0.5 to comply with regulation, while a firms with 14 board members, which is the largest board in the sample, must have at least a gender ratio of 0.78 to comply. Manually inspection revealed that once firms reach compliance, they continuously meet the female representation requirements in later periods and do not fall short of the requirements.

***First_compliance*** This variable is a dummy variable that takes value 1 in the year when a firm passes the compliance threshold, determined by the series of *ComplianceX* dummies, for the first time. Therfore, *first_compliance* takes value 1 the first time the *CompolianceX* takes value 1. This variable can be used to create the variable *compliance_quarter*, which indicates in which quarter first compliance occurs.

***Compliance_speed*** Lastly, I created a series of 5 complier speed variables; already complier, fast complier, medium complier, slow complier and non-complier. A firm is denoted as a fast complier if the firm complies in 2018, medium in 2019 and slow in 2020, because firms had these three years to comply with the Colorado quota. Already compliers have reached compliance before 2018 and noncompliers do not reach compliance, even in 2021 or 2022. These five dummy variables are explanatory variables in the difference-in-difference regression for hypothesis 6 and the dependent variables for hypotheses 2 through 5.

***ESG scores*** Series of ESG scores denoting firm performance in terms of environmental, social and governance benchmarks. A series of scores have been added due to the notoriously uncorrelated nature of ESG scores, as one rater will give a high score to a firm, while a different rater gives a middle or low score (Dimson, Marsh, & Staunton, 2020).

### 3.4 Descriptive statistics

This thesis uses 4 subsamples. Below the most relevant summary statistics are displayed for samples A and B. The summary statistics for samples C and D are displayed in the appendix. Table 1 provides an overview of the number of observations and the number of unique firms in each of the four samples.

**Table 1**

*Tabulation of number of firms per sample*

| Number of firms | A | B | C | D |
|---|---|---|---|---|
| Observations | 50,582 | 1,415 | 14,954 | 385 |
| Unique firms | 6,641 | 173 | 1706 | 48 |

**Subsample A – All firms**

Tables 2.1 until 2.4 display the summary statistics for subsample A, containing all firms. The most standout features are that the mean number of directors is relatively high at 8.271. Furthermore, the gender ratio, the main variable of interest, has a mean of 0.867, which indicates that men are highly represented in American boardrooms. Also, the sample is made up of small and large firms, indicated by the high standard deviation of stockholders equity. The mean value for total compensation is twice the mean of stock awards, indicating that a large portion of director compensation is independent of stock awards. Lastly, the summary statistics show that most firms have already complied or have not complied with the Colorado gender quota. While it is true that not all these firms are subject to the quota, it does indicate whether firms would have complied with the quota or not.

**Table 2.1**

*Summary statistics of board characteristics for sample A*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| succession rate | 42,512 | .315 | .166 | 0 | 2 |
| attrition rate | 19,705 | .063 | .090 | 0 | 5.9 |
| gender ratio | 42,503 | .867 | .124 | .182 | 1 |
| nationality mix | 38,551 | .090 | .177 | 0 | .9 |
| NumberDirectors | 42,509 | 8.271 | 2.439 | 1 | 33 |
| sumnoquals | 35,954 | 47.198 | 35.557 | 0 | 846 |
| sumnetworksize | 35,954 | 32092.49 | 36370.31 | 0 | 1055824 |
| sumstage | 34,393 | 128.0437 | 51.73775 | 1 | 193 |
| listed board positions | 18,705 | 3.166 | 3.187 | 1 | 59 |
| Unlisted board positions | 12,503 | 6.647 | 7.993 | 1 | 181 |
| Other board positions | 7,332 | 1.344 | .827 | 1 | 19 |
| sum_stock_awards | 25,419 | 925.8426 | 12120.61 | 0 | 1,9mln |
| sum_option_awards | 25,419 | 130.9264 | 889.9124 | 0 | 60706.28 |
| total compensation | 25,419 | 1815.886 | 12181.36 | 0 | 1,9mn |

**Table 2.2**
*Summary statistics of firm characteristics for sample A*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| net income (million) | 44,938 | 0.619 | 5,630 | -253.9 | 325.5 |
| stockholders equity (million) | 44,811 | 23.609 | 106.5 | -86.659 | 48.06 |
| def tax inv tax cr~t (million) | 37,484 | 2.714 | 18.317 | -0.750 | 769.6 |
| Research (million) | 23,568 | 0.546 | 3.506 | 0 | 208.1 |
| market value (million) | 44,452 | 61.927 | 295.7 | 0 | 22030 |
| bookvaluee equity (million) | 37,401 | 24.634 | 105.7 | 0 | 5567 |
| marketvalue equity (million) | 42,028 | 83.111 | 124.0 | 0 | 22390 |
| marketvalue assets (million) | 10,537 | 48.224 | 838.4 | 0,489 | 82180 |
| tobinQ (million) | 13,519 | 0.728 | 2.231 | .019 | 228.7 |
| TobinQ equity (million) | 34,677 | 0.685 | 4.832 | 0 | 841.5 |
| log assets | 15,211 | 6.515 | 2.104 | -5.116 | 14.279 |
| roa | 38,985 | .011 | .331 | -13.803 | 2.041 |
| de ratio | 39,075 | 2.975 | 160.582 | -9212.8 | 29585 |

**Table 2.3**
*Summary statistics of constructed characteristics for sample A*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Colorado | 50561 | .028 | .165 | 0 | 1 |
| post quota | 50561 | .425 | .494 | 0 | 1 |
| above median | 50561 | .391 | .488 | 0 | 1 |
| first compliance | 50561 | .004 | .064 | 0 | 1 |
| compliance year | 22859 | 2016 | 3.866 | 2010 | 2021 |
| already complier | 50561 | .236 | .425 | 0 | 1 |
| fast complier | 50561 | .036 | .187 | 0 | 1 |
| medium complier | 50561 | .006 | .08 | 0 | 1 |
| slow complier | 50561 | .098 | .297 | 0 | 1 |
| non complier | 50561 | .624 | .484 | 0 | 1 |

**Table 2.4**
*Tabulation of compliance speed for sample A*

| | Already Complied | Fast Complier | Medium Complier | Slow Complier | Non complier |
|---|---|---|---|---|---|
| Observations | 11,938 | 1,827 | 324 | 4,937 | 31,535 |
| Firms | 1,252 | 186 | 32 | 588 | 5,329 |

**Subsample B – Only Colorado**

Tables 3.1 until 3.4 display the summary statistics for 173 Colorado-based firms. Interestingly, the gender ratio is slightly higher for Colorado firms than all firms, 0.884 compared to 0.864, indicating that Colorado boardrooms are have a higher share a men on average when compared to the nationwide average. Also, the summary statistics again show that most firms have already complied or have not complied with the Colorado gender quota, which is an interesting finding by itself, as it questions the effectivity on the quota in general.

**Table 3.1**
*Summary statistics of board characteristics for sample B*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| succession rate | 1237 | .338 | .18 | 0 | 1.5 |
| attrition rate | 1237 | .062 | .077 | 0 | .6 |
| gender ratio | 1237 | .886 | .129 | .333 | 1 |
| nationality mix | 1237 | .102 | .2 | 0 | .8 |
| NumberDirectors | 1237 | 7.674 | 2.122 | 2 | 14 |
| sumnoquals | 1237 | 42.64 | 31.606 | 6 | 336 |
| sumnetworksize | 1237 | 31277.374 | 35044.324 | 0 | 371760 |
| stage | 1237 | 127.662 | 53.834 | 7 | 193 |
| listed board positions | 1023 | 2.132 | 2.147 | 1 | 59 |
| Unlisted board positions | 874 | 5.425 | 4.986 | 1 | 181 |
| Other board positions | 599 | 1.342 | .734 | 1 | 19 |
| sum_stock_awards | 1145 | 843.434 | 10925.64 | 0 | 1.8mln |
| sum_option_awards | 1145 | 130.832 | 739.9644 | 0 | 59345.5 |
| total compensation | 1145 | 943.456 | 739.3428 | 0 | 1.9mln |

**Table 3.2**
*Summary statistics of firm characteristics for sample B*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Netincome (million) | 1237 | .241 | 2.089 | -43.83 | 80.59 |
| stockholders equiy (million) | 1145 | 14.903 | 29.452 | -2.912 | 247.51 |
| def tax inv tax credit (million) | 1123 | 1.689 | 4.727 | 0 | 49.301 |
| Research (million) | 540 | .078 | .199 | 0 | 3.139 |
| market value (million) | 1237 | 32.218 | 58.4 | 0 | 630.039 |
| bookvaluee equity (million) | 1121 | 16.476 | 34.28 | 0 | 270.97 |
| marketvalue equity (million) | 1237 | 38.576 | 71.959 | .002 | 897.709 |
| marketvalue assets (million) | 1561 | 14.713 | 28.959 | .002 | 219.581 |
| tobinQ (million) | 454 | .051 | .479 | 0 | 16.974 |
| TobinQ equity (million) | 345 | .058 | 2.208 | 0 | 124.088 |
| roa | 1237 | -.007 | .485 | -80.195 | 61.163 |
| de ratio | 1237 | 3.29 | 241.467 | -9243.9 | 68951 |
| log assets | 545 | 6.309 | 1.937 | -2.465 | 9.837 |

**Table 3.3**
*Summary statistics of constructed characteristics for sample B*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Colorado | 1414 | 1 | 0 | 1 | 1 |
| post quota | 1414 | .428 | .495 | 0 | 1 |
| above median | 1414 | .484 | .5 | 0 | 1 |
| first compliance | 1414 | .001 | .027 | 0 | 1 |
| complinace year | 547 | 2015 | 4.011 | 2010 | 2021 |
| already complier | 1414 | .216 | .412 | 0 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| fast complier | 1414 | .042 | .202 | 0 | 1 |
| medium complier | 1414 | 0 | 0 | 0 | 0 |
| slow complier | 1414 | .057 | .232 | 0 | 1 |
| non complier | 1414 | .684 | .465 | 0 | 1 |

**Table 3.4**

*Tabulation of compliance speed for sample B*

| | Already Complied | Fast Complier | Medium Complier | Slow Complier | Non complier |
|---|---|---|---|---|---|
| Observations | 306 | 60 | 0 | 81 | 967 |
| Firms | 28 | 6 | 0 | 10 | 129 |

**Pairwise correlations**

**Table 4**

*Pairwise correlation table containing the most important variables of interest in sample A*

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) succession_rate | 1.000 | | | | | | | | | |
| (2) attrition_rate | 0.139 | 1.000 | | | | | | | | |
| (3) gender_ratio | 0.063 | 0.056 | 1.000 | | | | | | | |
| (4) nationality_mix | 0.056 | 0.006 | -0.042 | 1.000 | | | | | | |
| (5) NumberDirectors | -0.074 | -0.277 | -0.264 | 0.067 | 1.000 | | | | | |
| (6) net_income | -0.065 | -0.023 | -0.079 | 0.035 | 0.145 | 1.000 | | | | |
| (7) market_value | -0.085 | -0.082 | -0.321 | 0.143 | 0.373 | 0.667 | 1.000 | | | |
| (8) above_median | 0.034 | 0.051 | 0.800 | -0.034 | -0.171 | -0.045 | -0.118 | 1.000 | | |
| (9) TobinQ_equity | 0.001 | 0.058 | 0.006 | 0.000 | -0.010 | -0.002 | -0.003 | 0.007 | 1.000 | |
| (10) tobinQ | 0.004 | 0.025 | -0.006 | 0.008 | -0.010 | -0.002 | 0.002 | -0.007 | 0.002 | 1.000 |

Table 4 displays the pairwise correlations of the key variables in this thesis. Correlations are low, except for the correlation between the gender ratio and above median. This was expected due to the fact that above median is constructed via the gender ratio. Interestingly, a higher gender ratio is associated with less board diversity in terms of nationality, smaller boards and lower net income. These correlations show premature evidence that gender diversity in boards has positive effects for U.S. firms.

# 4 Methodology

## 4.1 Econometric tools

### 4.1.1 Difference-in-difference

The first econometric approach I use to assess the impact of the Colorado quota on female representation is difference-in-difference (DiD). This approach is especially used in quasi-natural experimental settings, for example when estimating the effects of certain policy interventions and policy changes that do not affect all observations at the same time and in the same way. This research design disentangles the causal effect of a policy change by taking the difference between two groups. What DiD essentially does in this context is take the average change in inventor mobility in the control group in both periods and subtract that from the average change in inventor mobility in the treatment group in both time periods. The difference between the differences is the causal effect of the intervention or treatment. (Hombert & Matray, 2017; Lechner, 2011)

Notable examples of the use of difference-in-difference are the Michigan experiment by Marx, Strumsky and Fleming (2011), who use the sudden shift in tolerance towards noncompete agreements in Michigan in 1985 to assess the impact of noncompete agreements on inventor mobility, and Schreyögg and Grabko (2011), who assess the impact of the sudden introduction of ambulatory copayments in 2004 on the overall demand for physician visits.

From an econometric perspective difference-in-difference has several advantages. The most important advantage is solving endogeneity issues. Endogeneity occurs when an unobservable component of the error term, such as variables or distinctions between groups and individuals that cannot be directly observed, accounts for a portion of the causal relationship between X and Y. Endogeneity can result from reverse causality, omitted variable bias, measurement errors, and other factors. By calculating the mean differences between the treatment and control groups during two periods and subtracting them, the presence of unobserved heterogeneity between the groups is effectively mitigated. (Riumallo-Herl, 2022).

A second advantage is the quasi-experimental design of DiD. The treatment and control groups are created via a random policy design. This solves selection bias, where units of observation are placed into treatment and control groups based on pre-existing differences instead of randomly (Duflo, Glennerster & Kremer, 2007). Important to note is that the control group must be comparable to the treatment group. This is not an issue in this research setting, as the other 49 states serve as a control group. The goal is to find a control group for which a similar increase in gender ratios would have occurred as in Colorado in the absence of the quota, which is an acceptable premise as Colorado is not substantially different in terms of gender diversity than the rest of the United States as the descriptive statistics show.

Lastly, DiD is simple to implement and the interpretation is intuitive. The causal impact of the intervention is reflected in any divergence observed in the trend of the treatment group compared to that of the control group. To capture this impact, dummy variables are used to represent the treatment and time indicators. The DiD estimator is simply derived from the interaction effect between these variables. Subsequently, an Ordinary Least Squares panel linear regression is employed to estimate the coefficient for the DiD estimator. This coefficient can be interpreted as the causal effect of the treatment. (Yoon, 2019; Berger & Roman, 2020).

In this thesis the DiD estimator is the interaction effect between two dummy variables; *Colorado*, denoting whether a firm is based in Colorado, and *post_quota*, denoting whether an observation occurs after the quota has been instated. This can be summarized as follows:

$$\{E[Y_i|c = Colorado, t = post\_quota] - E[Y_i|c = Colorado, t = pre\_quota]\} -$$
$$\{E[Y_i|c = rest\ of\ U.S., t = post\_quota] - E[Y_i|c = rest\ of\ U.S., t = pre\_quota]\}$$

Therefore, a similar approach is used in this thesis as in Card (1990), with two dummy variables for location and time interacted creating the main explanatory variable, the DiD estimator. The DiD estimator splits the sample into a treatment group, for which the DiD estimator takes value 1, and a control group, for which the DiD estimator takes value 0. Therefore, if the differences between the groups are constant over time (in the absence of treatment), it can be differenced out by deducting group-specific means of the outcome of interest to arrive at an estimation of the causal effect of the Colorado quota.

Difference-in-difference is an effective tool to isolate the treatment effect from other covariates impacting the outcome variable which cannot be controlled for, but two assumptions must hold in order for the estimation to be accurate.

*Parallel Trends Assumption (PTA)*

First, the parallel trends assumption much hold. It requires that in the absence of treatment, the difference between the treatment and control group is constant over time. Although there is no statistical test for this assumption, visual inspection of trends can be used to draw conclusions about this assumption (Bertrand, Duflo & Mullainathan, 2004; Abadie, 2005). Essentially, visual inspection should indicate that pre-treatment trends of the variable of interest are parallel for the treatment and the control group. In this thesis, this would mean that the trend in the gender ratio must be similar for Colorado firms, which are marked as treated, as for firms in the remaining 49 states, marked as control, for hypothesis 1 and that the trend in market value is similar for the treatment and control group as well. In figure 1 the gender ratio trends are shown and in figure 2 the trends in market value.

**Figure 1**

*Mean value of the gender ratio per firm plotted against year for sample A.*

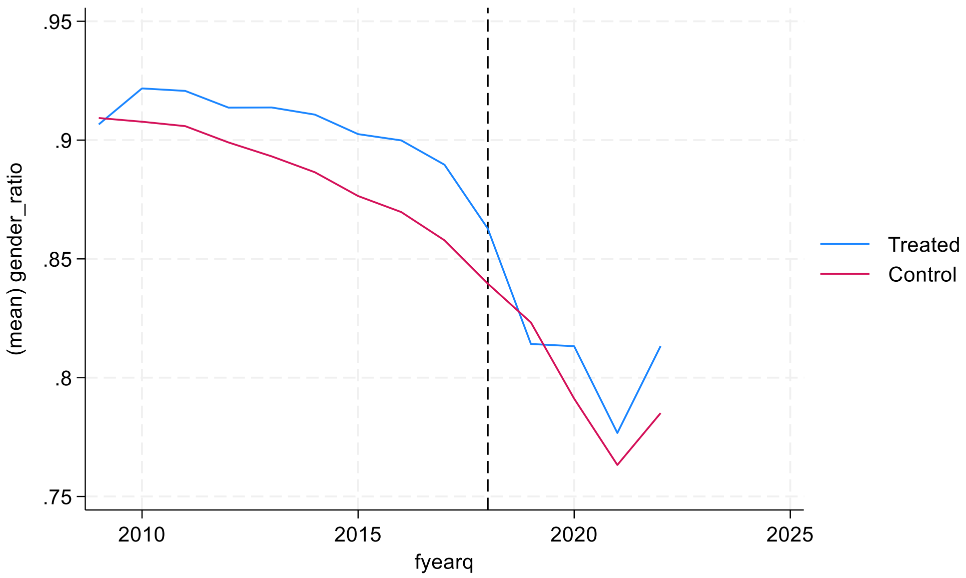



**Figure 2**

*Mean value of the market value per firm plotted against year for sample A.*

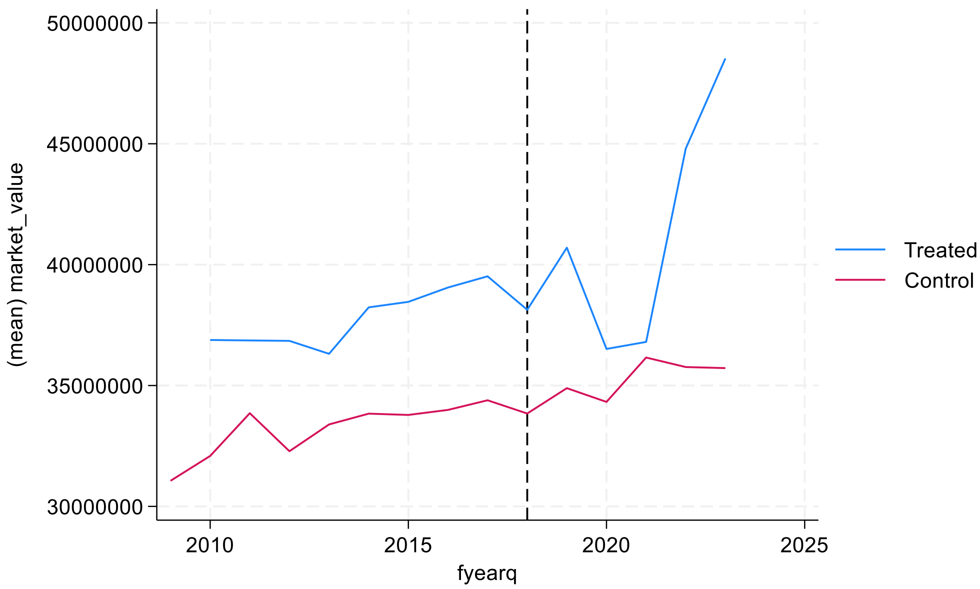
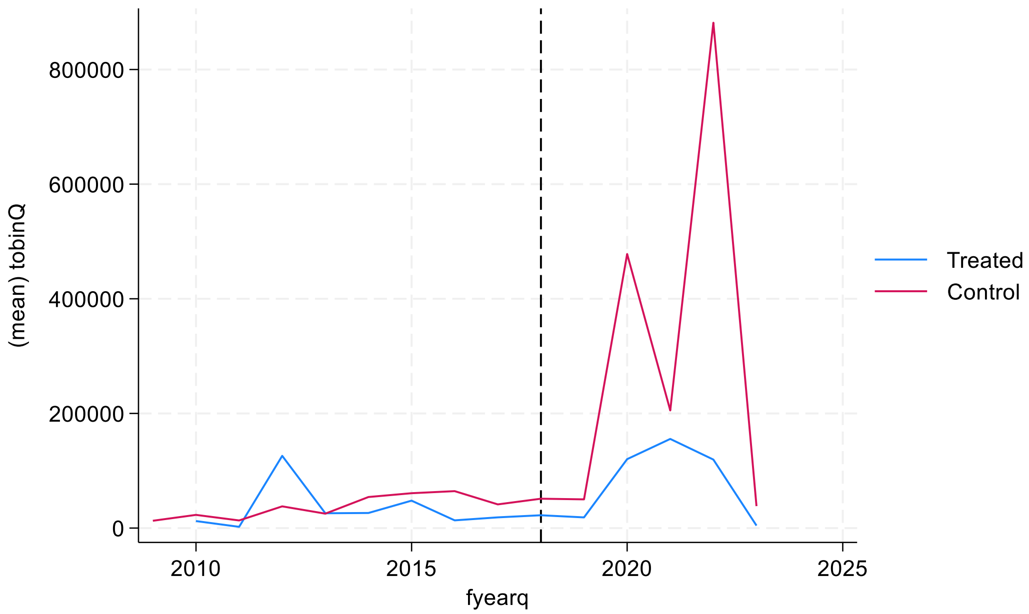


**Figure 3**

*Mean value of Tobin's Q per firm plotted against year for sample A.*




Visual inspection of the figures provides convincing evidence that PTA holds for gender ratio. Pre-treatment trends are parallel and downwards sloping, indicating that the proportion of male directors decreases over time. There does not appear to be a sharp decrease after the passing of the Colorado quota. This provides preliminary evidence that the Colorado quota did not result in a higher proportion of female directors. Interestingly, a slight increase in the gender ratio occurs in 2021 and 2022. Also, Colorado firms were consistently less gender diverse than the average firm in the remaining 49 states.

The pre-treatment trends for the treatment and control group for market value in figure 2 are relatively parallel. Both trends are slightly increasing between 2010 and 2022. The treatment group displays a spike in mean market value in 2021, while the control group remains stable. This discrepancy occurs after the Colorado quota. Therefore, the parallel trends assumption holds for market value. The same holds for Tobin's Q in figure 3. Pre-treatment trends are parallel and stable, while the control group displays a spike in Tobin's Q after the Colorado quota passed.

*Stable Unit Treatment Value Assumption (SUTVA)*

The second assumption for accurate DiD estimation is that the treatment effect is only due to the treatment and not due to interactions between members of the population. It is therefore essential that firms cannot transfer between the treatment and control groups. This assumption cannot be visually tested, but it can be reasoned why this would hold or not. If SUTVA were violated, that would mean that between 2010 and 2023 firms incorporated in Colorado relocated to a different state. Inspecting the dataset uncovered that such a switch did not occur.

#### 4.1.2 Logit regression model

In order to assess which factors impact the speed of compliance with the Colorado quota I use two approaches, the first being a logistic or logit regression model. Logistic regression analysis is used to investigate the relationship between a binary outcome and explanatory variables. An example of the use of a logit regression is attempting to predict the impact of explanatory variables on the probability of bankruptcy, the binary outcome variable being the default probability (Trueck & Rachev, 2009). The method usually fits linear logistic regression models for binary outcomes by maximum likelihood estimation. (Hosmer & Lemeshow, 1989).

A logistic regression model has several advantages compared to alternative models such as linear regression. First, it is easy to implement. If the dependent variable is structured as a binary variable, a logistic regression can be easily used. Secondly, logistic regression does not rely on assumptions of normality for the predictor variables or the errors. Therefore, a normal distribution of the explanatory variables is not required (Glen, 2023). Lastly, a logistic regression allows for the selection effect to vary between units of observation nonlinearly. It is likely that this is the case given that the outcome variable is either a 0 or a 1 (Janzen & Stern, 1998).

For this research a series of five logistic regressions will be used, each modelling the probability of a firm having a certain speed of compliance. As explained in the previous chapter, I have broken down compliance speed into five binary variables ranging from *already_complier* to *non_complier*. Logistic regression analysis will allow me to quantify the effect of the explanatory variables such as *above_median* and the sum of qualifications of board members (*sumnoquals)* on the probability of a firm being one of the five compliance speed types.

An important footnote regards the interpretation of a logistic regression. While logistic regression is an efficient and powerful way to analyse the effect of a group of independent variables on a binary outcome by quantifying each explanatory variable's contribution, the coefficients generated by the model display the effect of explanatory variables on the log-odds of the dependent variable, not on the probability. The probability of a firm having a certain compliance speed is the essence of this thesis. Parameters estimated in the log-odds scale do not have a useful interpretation other than sign, indicating that no conclusions can be made regarding the magnitude of a causal effect. If variables were kept in the log-odds scale, an example of an interpretation would be increasing the succession rate by 1 unit will result in a 0.13 increase in log(p/1-p), p being the probability of the outcome variable, for example *fast_complier*, taking value 1. If log(p/1–p) increases by 0.13, that means that p/(1 — p) will increase by exp(0.13) = 1.14, meaning that a 1 unit increase of the succession rate would lead to a 14% increase in the log-odds ratio (Kisselev, 2023). Such an interpretation is insufficient for the critical scope of this thesis. Therefore, I will use average marginal effects, which will allow me to draw conclusions about the magnitude of the effect of the explanatory variables on the binary outcome variable (Taberner, 2023).

### 4.1.3 Cox proportional hazards regression

Lastly, a Cox proportional hazards regression will be used to analyse which factors determine the speed of compliance with gender quota. The variable *first_compliance* is relevant in this section of the analysis. This variable denotes in which quarter a firm complies to the Colorado quota. This can be seen as an event of which the probability is dependent upon a set of independent variables. This approach is more formally known as survival analysis.

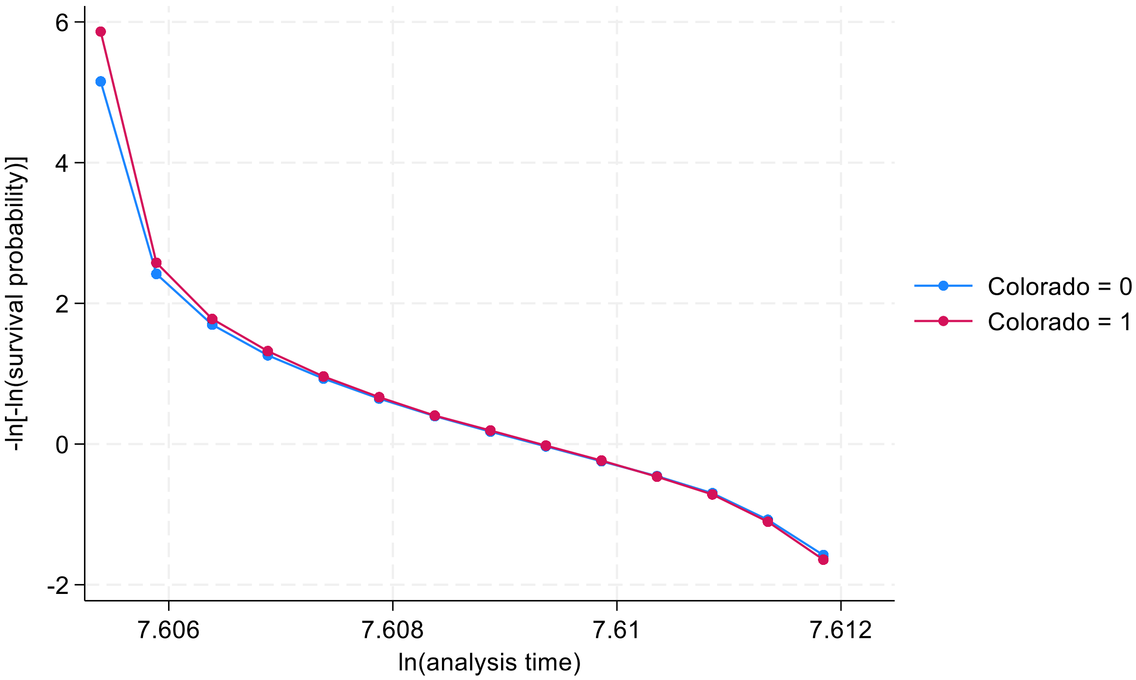
According to Jenkins (2005), survival analysis models time-to-event data. In the context of this thesis, the event would be reaching compliance with the Colorado quota for the first time. Typical examples of events modelled by survival analysis the impact of certain dosages of a medicine on time to death or the impact of personal characteristics on time to marriage. A survival analysis approach complements the logit regression in two ways. First, survival analysis techniques takes the differences in time in which each person or firm is at risk of experiencing the event into account. Secondly, time-varying explanatory variables can be handled more easily by survival analysis techniques.

The output of survival analysis is the hazard rate, which is defined as the probability of an event in a short interval of time given it has survived up till that moment per unit interval of time. Therefore, a higher hazard rate means that more events of interest are occurring at a specific time (Kumar, 2021).

The most common used model in survival analysis is the Cox proportional hazards regression model, introduced by Cox (1972). Examples of the use of this econometric technique are Lane, Looney and Wansley (1986), who famously first applied this regression technique to a finance context when attempting to predict bank failures, and Huang and Liang (2019), who more recently used this approach to predict cases of cancer. The distinguishing feature of the Cox proportional hazards regression model is that it made it possible to estimate the relationship between the hazard rate and explanatory variables, without having to make any assumptions about the shape of the baseline hazard function. The key assumption of the model is the proportional hazards assumption. It states that the hazard ratio between any two individuals is constant over time. In other words, the relative hazard of an event occurring for one group compared to another remains constant over time. The hazard ratio is used to empirically quantify the between-group difference and boils down to the ratio of the hazard rates corresponding to the conditions characterised by two distinct levels of a treatment variable of interest. (Uno et al., 2014). In the context of speed of compliance with gender quota, it could mean that a firm with above median female representation in a given quarter is more likely to comply with the Colorado quota faster, compared to a firm with below median female representation (Fox & Weisberg, 2002).

As mentioned above, the main assumption behind the Cox regression is the proportional hazards assumption, which implies that the hazard curves for different groups or levels of an explanatory variable are parallel and do not cross each other. In other words, the model assumes that the hazard ratios for both groups are constant over time. This assumption is important because it allows for the estimation of a single hazard ratio that represents the effect of a covariate throughout the entire follow-up period. Without satisfying the assumption, baseline comparison to firms without a specific set of explanatory variables is prone to bias, as the hazard ratio is then not a fixed value but changes over time. Therefore, if the plotted lines of the survival probability over time for both groups are reasonably parallel, then the proportional-hazards assumption has not been violated. According to STATA manuals (2023), this graphical approach is preferred over a statistical test, as the graphical approach allows for better comparison between the treated and non-treated groups and is more intuitive.

**Figure 4**
*Graphical test of proportional-hazards assumption*




The parallel lines in figure 4 imply that the proportional-hazards assumption for the treatment indicator has not been violated. In this graph the failure is set as the inverse of the first compliance dummy. This way the graph plots the probability of reaching compliance. This also explains why the line has a downward slope. The later on in time, the lower the probability that a firm will still reach compliance.

### 4.2 Models

#### 4.2.1 Hypothesis 1

First, I hypothesize that the Colorado quota resulted in more female members of executive boards in Colorado after 2018 compared to before 2018. To analyse the effect of this sharp policy change I use a difference-in-difference approach in which firms in Colorado after 2018 serve as a treatment group and firms in the rest of the United States serve as a control group. This model will be run for sample A containing firms incorporated in all 50 states. Model 1 displays the model for hypothesis 1:

$$Gender\ ratio = \beta_0 + \gamma_c * Colorado + \beta_t * post_{quota} + \delta * Colorado * post_{quota} + \beta_1 * succession\ rate + \beta_2 * attrition\ rate + \beta_3 * nationality\ mix + \beta_4 * number\ of\ directors + \beta_5 * sum\ of\ qualifications + \beta_6 * board\ network\ size + \beta_7 * standard\ deviation\ directors\ age + \beta_8 * net\ income + \beta_9 * R\&D\ expenditures + \beta_{10} * market\ value + \beta_{11} * log\ of\ assets + \beta_{12} * return\ on\ assets + \beta_{13} * debt\ equity\ ratio + \beta_{14} * sum\ total\ compensation + \beta_{15} * sum\ stock\ compensation + \beta_{16} * sum\ option\ compensation + \beta_{17} * listed\ board\ positions + \beta_{18} * unlisted\ board\ positions + \beta_{19} * other\ board\ positions + \mu_n * D_{firm} + \theta_n * D_{year} + \alpha_i + u_{it} \quad (1)$$

Equation 1 represents the difference-in-difference estimation with $\beta_t$ as a time indicator, $\gamma_c$ as a location indicator, $\delta$ as the interaction term between the time and location indicator, $\mu_n$ as firm fixed effects denoted as a dummy per state and $\theta_n$ as year fixed effects denoted as a dummy per year. Furthermore, $\alpha_i$ denotes the fixed part of the error term, the unobserved unit heterogeneity and $u_{it}$ denotes the time-varying part of the error term.

#### 4.2.2 Hypotheses 2, 3, 4 and 5

Two models will be used for these four hypotheses, the five logistical regressions are denoted in equations 2 until 6 and a Cox proportional hazards regression model denoted in equation 7. These four hypotheses assess the effect of above median female representation, education of board members, ESG score performance and sector heterogeneity on compliance speed. Sector fixed effects instead of firm fixed effects are added to assess the beforementioned sector heterogeneity. One model will be used in order to collectively test the impact of the explanatory variables. These models will be applied to sample B with only Colorado-based firms and sample D, to test the impact of ESG scores.

$$logit(P(already_{complier} = 1 \mid x_1, \dots, x_k)) = \beta_0 + \beta_1 * above\ median + \beta_2 * sum\ qualifications + \beta_3 * ESG\ scores + + \beta_4 * succession\ rate + \beta_5 * attrition\ rate + \beta_6 * nationality\ mix + \beta_7 * number\ of\ directors + \beta_8 * board\ network\ size + \beta_9 * standard\ deviation\ directors\ age + \beta_{10} * net\ income + \beta_{11} * R\&D\ expenditures + \beta_{12} *$$

$$market\ value + \beta_{13} * log\ of\ assets + \beta_{14} * return\ on\ assets\ + \beta_{15} *\ debt\ equity\ ratio\ + \beta_{16} * sum\ total\ compensation\ + \beta_{17} * sum\ stock\ compensation + \beta_{18} * sum\ option\ compensation\ + \beta_{19} * listed\ board\ positions\ + \beta_{20} * unlisted\ board\ positions + \beta_{21} * other\ board\ positions + \mu_n * D_{sector} + \theta_n\ * D_{year} + \varepsilon_i \quad (2)$$

$$logit(P\big(fast_{complier} = 1\,\big|\,x_1, \ldots, x_k)) = \ \beta_0\ +\ \beta_1 * above\ median +\ \beta_2 * sum\ qualifications +\ \beta_3 * ESG\ scores + + \beta_4 * succession\ rate + \beta_5 * attrition\ rate +\ \beta_6 * nationality\ mix +\ \beta_7 * number\ of\ directors +\ \beta_8 * board\ network\ size +\ \beta_9 * standard\ deviation\ directors\ age + \beta_{10} *\ net\ income + \beta_{11} * R\&D\ expenditures + \beta_{12} * market\ value + \beta_{13} * log\ of\ assets + \beta_{14} * return\ on\ assets\ + \beta_{15} * debt\ equity\ ratio\ + \beta_{16} * sum\ total\ compensation\ + \beta_{17} * sum\ stock\ compensation + \beta_{18} * sum\ option\ compensation\ + \beta_{19} * listed\ board\ positions\ + \beta_{20} * unlisted\ board\ positions + \beta_{21} * other\ board\ positions + \mu_n * D_{sector} + \theta_n\ * D_{year} + \varepsilon_i \quad (3)$$

$$logit(P\big(medium_{complier} = 1\,\big|\,x_1, \ldots, x_k)) = \ \beta_0\ +\ \beta_1 * above\ median +\ \beta_2 * sum\ qualifications +\ \beta_3 * ESG\ scores + + \beta_4 * succession\ rate + \beta_5 * attrition\ rate +\ \beta_6 * nationality\ mix +\ \beta_7 * number\ of\ directors +\ \beta_8 * board\ network\ size +\ \beta_9 * standard\ deviation\ directors\ age + \beta_{10} *\ net\ income + \beta_{11} * R\&D\ expenditures + \beta_{12} * market\ value + \beta_{13} * log\ of\ assets + \beta_{14} * return\ on\ assets\ + \beta_{15} *\ debt\ equity\ ratio\ + \beta_{16} * sum\ total\ compensation\ + \beta_{17} * sum\ stock\ compensation + \beta_{18} * sum\ option\ compensation\ + \beta_{19} * listed\ board\ positions\ + \beta_{20} * unlisted\ board\ positions + \beta_{21} * other\ board\ positions + \mu_n * D_{sector} + \theta_n\ * D_{year} + \varepsilon_i \quad (4)$$

$$logit(P\big(slow_{complier} = 1\,\big|\,x_1, \ldots, x_k)) = \ \beta_0\ +\ \beta_1 * above\ median +\ \beta_2 * sum\ qualifications +\ \beta_3 * ESG\ scores + + \beta_4 * succession\ rate + \beta_5 * attrition\ rate +\ \beta_6 * nationality\ mix +\ \beta_7 * number\ of\ directors +\ \beta_8 * board\ network\ size +\ \beta_9 * standard\ deviation\ directors\ age + \beta_{10} *\ net\ income + \beta_{11} * R\&D\ expenditures + \beta_{12} * market\ value + \beta_{13} * log\ of\ assets + \beta_{14} * return\ on\ assets\ + \beta_{15} *\ debt\ equity\ ratio\ + \beta_{16} * sum\ total\ compensation\ + \beta_{17} * sum\ stock\ compensation + \beta_{18} * sum\ option\ compensation\ + \beta_{19} * listed\ board\ positions\ + \beta_{20} * unlisted\ board\ positions + \beta_{21} * other\ board\ positions + \mu_n * D_{sector} + \theta_n\ * D_{year} + \varepsilon_i \quad (5)$$

$$logit(P\big(non_{complier} = 1\,\big|\,x_1, \ldots, x_k)) = \ \beta_0\ +\ \beta_1 * above\ median +\ \beta_2 * sum\ qualifications + \beta_3 * ESG\ scores + + \beta_4 * succession\ rate + \beta_5 * attrition\ rate +\ \beta_6 * nationality\ mix +\ \beta_7 * number\ of\ directors +\ \beta_8 * board\ network\ size +\ \beta_9 * standard\ deviation\ directors\ age + \beta_{10} *\ net\ income + \beta_{11} * R\&D\ expenditures + \beta_{12} * market\ value + \beta_{13} * log\ of\ assets + \beta_{14} * return\ on\ assets\ + \beta_{15} *\ debt\ equity\ ratio\ + \beta_{16} * sum\ total\ compensation\ + \beta_{17} * sum\ stock\ compensation + \beta_{18} * sum\ option\ compensation\ + \beta_{19} * listed\ board\ positions\ +$$

$$\beta_{20} * unlisted\ board\ positions + \beta_{21} * other\ board\ positions + \mu_n * D_{sector} + \theta_n * D_{year} + \varepsilon_i \quad (6)$$

$$h(t) = h_0(t) * \exp(\beta_1 * gender_{ratio} + \beta_2 * succession\ rate + \beta_3 * ESG\ scores + \beta_4 * sum\ qualifications + \beta_5 * attrition\ rate + \beta_6 * nationality\ mix + \beta_7 * number\ of\ directors + \beta_8 * log\ net\ income + \beta_9 * log\ market\ value + \beta_{10} * sum\ total\ compensation + \beta_{11} * sum\ stock\ compensation + \beta_{12} * sum\ option\ compensation + \beta_{13} * listed\ board\ positions + \beta_{14} * unlisted\ board\ positions + \beta_{15} * other\ board\ positions + \beta_{16} * debt\ equity\ ratio + \varepsilon_i) \quad (7)$$

Equation 7 represents the Cox proportional hazards regression model, where $h(t)$ denotes the hazard ratio. The event is set at *first_compliance*, meaning that the regression model calculates the causal effect of the predictor variables on the time to the first quarter in which a firm reaches compliance.

**4.2.3 Hypothesis 6**

The final hypothesis states that the Colorado quota has a positive effect on firm value for quick-adapting firms and a negative effect on slow-adapting and non-adapting firms. Firm value is proxied by market value, Tobin's Q and Tobin's Q equity. A similar difference-in-difference approach as for hypothesis 1 will be used in equation 8 and a triple interaction term difference-in-difference will be used in equation 10. The model will be used for sample A and is displayed in equations 8, 9 and 10:

$$Firm\ value = \beta_0 + \gamma_c * Colorado + \beta_t * post_{quota} + \delta * Colorado * post_{quota} + \beta_1 * gender\ ratio + \beta_2 * succession\ rate + \beta_3 * attrition\ rate + \beta_4 * nationality\ mix + \beta_5 * number\ of\ directors + \beta_6 * sum\ of\ qualifications + \beta_7 * board\ network\ size + \beta_8 * standard\ deviation\ directors\ age + \beta_9 * net\ income + \beta_{10} * R\&D\ expenditures + \beta_{11} * log\ of\ assets + \beta_{12} * return\ on\ assets + \beta_{13} * debt\ equity\ ratio + \beta_{14} * sum\ total\ compensation + \beta_{15} * sum\ stock\ compensation + \beta_{16} * sum\ option\ compensation + \beta_{17} * listed\ board\ positions + \beta_{18} * unlisted\ board\ positions + \beta_{19} * other\ board\ positions + \mu_n * D_{firm} + \theta_n * D_{year} + \alpha_i + u_{it} \quad (8)$$

$$Firm\ value = \beta_0 + \gamma_c * Colorado + \beta_t * post_{quota} + \delta * Colorado * post_{quota} + \beta_1 * already\ complier + \beta_2 * fast\ complier + \beta_3 * medium\ complier + \beta_4 * slow\ complier + \beta_5 * gender\ ratio + \beta_6 * succession\ rate + \beta_7 * attrition\ rate + \beta_8 * nationality\ mix + \beta_9 * number\ of\ directors + \beta_{10} * sum\ of\ qualifications + \beta_{11} * board\ network\ size + \beta_{12} * standard\ deviation\ directors\ age + \beta_{13} * net\ income + \beta_{14} * R\&D\ expenditures + \beta_{15} * log\ of\ assets + \beta_{16} * return\ on\ assets + \beta_{17} * debt\ equity\ ratio + \beta_{18} * sum\ total\ compensation + \beta_{19} * sum\ stock\ compensation + \beta_{20} *$$

$$sum\ option\ compensation\ + \beta_{21} * listed\ board\ positions\ + \beta_{22} * unlisted\ board\ positions + \beta_{23} * other\ board\ positions + \mu_n * D_{firm} + \theta_n * D_{year} + \alpha_i + u_{it} \quad (9)$$

$$Firm\ value = \beta_0 + \gamma_c * Colorado + \beta_t * post_{quota} + \delta * Colorado * post_{quota} + \delta * Colorado * post_{quota_{alreadycomplier}} + \delta * Colorado * post_{quota_{fastcomplier}} + \delta * Colorado * post_{quota_{mediumcomplier}} + \delta * Colorado * post_{quota_{slowcomplier}} + \beta_1 * gender\ ratio + \beta_2 * succession\ rate + \beta_3 * attrition\ rate + \beta_4 * nationality\ mix + \beta_5 * number\ of\ directors + \beta_6 * sum\ of\ qualifications + \beta_7 * board\ network\ size + \beta_8 * standard\ deviation\ directors\ age + \beta_9 * net\ income + \beta_{10} * R\&D\ expenditures + \beta_{11} * log\ of\ assets + \beta_{12} * return\ on\ assets + \beta_{13} * debt\ equity\ ratio + \beta_{14} * sum\ total\ compensation + \beta_{15} * sum\ stock\ compensation + \beta_{16} * sum\ option\ compensation + \beta_{17} * listed\ board\ positions + \beta_{18} * unlisted\ board\ positions + \beta_{19} * other\ board\ positions + \mu_n * D_{firm} + \theta_n * D_{year} + \alpha_i + u_{it} \quad (10)$$

In the models $\beta_t$ serves as a time indicator, $\gamma_c$ as a location indicator, $\delta$ as the interaction term between the time and location indicator. Five triple interaction terms have been added as well, to test if firms in Colorado after the Colorado quota who are one of the five complier types have different market values than the control group. Once again $\mu_n$ represents firm fixed effects denoted as a dummy per firm and $\theta_n$ represents year fixed effects denoted as a dummy per year. Furthermore, $\alpha_i$ denotes the fixed part of the error term, the unobserved unit heterogeneity and $u_{it}$ denotes the time-varying part of the error term.

### 4.3 Two-way fixed effects

The difference-in-differences (DiD) method is employed to address the presence of unobservable variables that could introduce bias into estimates of causal effects. However, pre-existing differences between the treatment and control groups can still pose a challenge. To mitigate this issue, as well as account for dissimilar pre-treatment trends between the groups, I have incorporated firm and year fixed effects into the regression analysis. According to Jakiela (2021), it is common practice in DiD estimations that evaluate program impacts to include two-way fixed effects. The primary advantage of incorporating unit fixed effects and time fixed effects in a regression is the ability to control for time-invariant differences between units and time periods, especially when control data is not readily available (Woolridge, 2021).

When estimating the average treatment effect across various locations and time periods, it is important to consider the issue of negative weights assigned to observations with below-mean treatment intensity. These observations may be considered part of the control group, even though they technically belong to the treatment group. However, in the case of two-way fixed effects estimation, it is the outcomes with below-mean levels of residualized treatment intensity, after accounting for firm and year fixed effects, that receive negative weights (Blaauw, 2022).

Negative weights can be addressed by having a sufficiently large never-treated group and an ample amount of pre-treatment data. This ensures that negative weights do not arise in the treatment group. However, in datasets with a limited number of pre-treatment periods or in periods where all or most units receive treatment, two-way fixed effects estimation can result in negative weights assigned to treatment effects in later periods for early-adopter units. Consequently, this can lead to incorrect estimates.

Fortunately, in this thesis, the issue of negative weights does not pose a significant concern, allowing the utilization of two-way fixed effects as a control mechanism. When the treatment effects are homogeneous and do not vary significantly (which is the case here), the two-way fixed effects model is correctly specified. In such cases, an OLS regression adequately adjusts for the fact that the estimated fixed effects related to high treatment units and high-treatment periods capture some portion of the true treatment effect. However, when treatment effects are heterogeneous, more substantial problems can arise (Goodman-Bacon, 2018). Additionally, Imai and Kim (2020) suggest that the ability of a two-way fixed effects model to simultaneously account for unobserved variables associated with location and time crucially relies on the assumption of linear additive effects.

# 5 Results

This chapter provides an overview of the results of the main models used to study the impact of the Colorado quota on female representation in board rooms and the relationship between board and firm characteristics on the speed of compliance with the quota. The results will be discussed per model, meaning that the results for hypothesis 1, 5 and 6 will be discussed separately and hypotheses 2, 3 and 4 together in one subparagraph. The most standout feature of the analysis is the fact that multiple models show evidence of a negative relationship between the gender ratio and compliance speed, which indicates that firms with a higher percentage of men in the board of directors comply slower with gender quota.

## 5.1 Hypothesis 1

The results for the difference-in-difference regression model to analyse the impact of the Colorado quota on the number of female members of executive boards in Colorado before and after 2018 are displayed below in table 6. A meticulous selection process based on the existing literature determined which control variables to involve and which to omit. Firm and year fixed effects have been omitted for the sake of brevity. The coefficients for the difference-in-difference estimator are highlighted.

**Table 6**
*Difference-in-difference regressions with gender ratio as dependent variable*

| | (1)<br>**GenderRatio** | (2)<br>**GenderRatio** | (3)<br>**GenderRatio** | (4)<br>**GenderRatio** |
|---|---|---|---|---|
| Colorado | 0.0359<br>(0.0429) | -0.0100<br>(0.0351) | 0.0110<br>(0.0246) | 0.0127<br>(0.0251) |
| post_quota | 0.000552<br>(0.00374) | -0.0409*** <br>(0.00651) | 0.000786<br>(0.00352) | -0.0420*** <br>(0.00604) |
| Colorado*post_quota | **-0.00954**<br>**(0.0630)** | **-0.0111**<br>**(0.0618)** | **-0.0105**<br>**(0.0592)** | **-0.0110**<br>**(0.0582)** |
| Succession | 0.0721<br>(0.0375) | 0.0968** <br>(0.0345) | 0.0653* <br>(0.0321) | 0.0875** <br>(0.0296) |
| Attrition | -0.0276<br>(0.0445) | -0.0432<br>(0.0448) | -0.0312<br>(0.0408) | -0.0461<br>(0.0410) |
| NationalityMix | -0.00688<br>(0.0302) | -0.0183<br>(0.0313) | -0.00960<br>(0.0255) | -0.0199<br>(0.0263) |
| NumberDirectors | -0.00673* <br>(0.00333) | -0.00924** <br>(0.00318) | -0.00725** <br>(0.00273) | -0.00924*** <br>(0.00264) |
| sumnoquals | 0.0000586<br>(0.000281) | 0.000623* <br>(0.000245) | 0.000207<br>(0.000219) | 0.000679*** <br>(0.000201) |
| sumnetworksize | -0.000000597* <br>(0.000000233) | -0.000000785** <br>(0.000000245) | -0.000000676*** <br>(0.000000190) | -0.000000830*** <br>(0.000000202) |
| STDEVAge | 0.0000183<br>(0.0000539) | 0.0000107<br>(0.0000538) | 0.00000856<br>(0.0000483) | -4.75e-09<br>(0.0000482) |

| | | | | |
|---|---|---|---|---|
| net income | -1.09e-10 | 8.78e-10 | 1.09e-10 | 1.12e-09 |
| | (1.53e-09) | (1.58e-09) | (1.38e-09) | (1.43e-09) |
| R&D | 6.11e-09 | 7.47e-10 | 8.66e-09 | 4.16e-09 |
| | (9.17e-09) | (8.54e-09) | (8.24e-09) | (7.72e-09) |
| market value | 7.68e-11 | -4.80e-11 | 4.97e-11 | -5.63e-11 |
| | (8.94e-11) | (8.98e-11) | (7.24e-11) | (7.44e-11) |
| log_assets | -0.00110 | -0.000828 | -0.00137 | -0.000609 |
| | (0.00144) | (0.00149) | (0.00123) | (0.00126) |
| roa | -0.00822 | -0.00493 | -0.0104$^{*}$ | -0.00634 |
| | (0.00471) | (0.00498) | (0.00430) | (0.00437) |
| de_ratio | -0.0000177 | -0.0000219 | -0.0000159 | -0.0000207 |
| | (0.0000299) | (0.0000306) | (0.0000281) | (0.0000289) |
| sum_total_comp | -0.187 | -0.179 | -0.0225 | -0.0312 |
| | (0.0186) | (0.0175) | (0.00855) | (0.0130) |
| stock_comp | -0.143 | -0.16 | -0.00775 | -0.00713 |
| | (0.0289) | (0.0253) | (0.0174) | (0.0140) |
| option_comp | -0.117 | -0.126 | -0.157 | -0.188 |
| | (0.0205) | (0.0169) | (0.0143) | (0.0189) |
| listed_board_positions | 0.0167 | 0.0128 | 0.0789 | 0.0182 |
| | (0.0180) | (0.0130) | (0.0190) | (0.0153) |
| unlisted_board_positions | 0.0272 | 0.0159 | 0.0673 | 0.0362 |
| | (0.00935) | (0.00596) | (0.00936) | (0.00129) |
| other_board_positions | 0.00775 | 0.0312 | 0.0386 | 0.0492 |
| | (0.0174) | (0.0130) | (0.0197) | (0.0153) |
| Firm fixed effects | YES | YES | NO | NO |
| Year fixed effects | YES | NO | YES | NO |
| Constant | 1.041$^{***}$ | 1.037$^{***}$ | 0.969$^{***}$ | 0.940$^{***}$ |
| | (0.0223) | (0.0219) | (0.0254) | (0.0216) |
| Observations | 6215 | 6215 | 6215 | 6215 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

The results show that the Colorado quota did not have a significant effect on female representation measured via the gender ratio. This can be seen via the nonsignificant coefficients for the interaction effect between *Colorado* and *post_quota*, denoting the difference-in-difference estimator. Therefore, the Colorado quota did not significantly lead to more women in the board in Colorado-based firms. Difference-in-difference is known as a robust estimation technique when researching the impact of policy changes. Therefore, this finding questions the effectivity of the Colorado quota and raises questions regarding quota enforcement.

Interestingly, the number of directors systematically has a negative effect on the gender ratio, when including and excluding firm and year fixed effects. This effect is significant at the 0.1% level. The gender ratio is the proportion of male directors, which means that a higher gender ratio corresponds to a board with more men. When including firm and year fixed effects, adding an extra director to a board leads to a 0.00673 reduction in the gender ratio, which ranges between 0 and 1. Therefore, when boards expand, the new hires are often women across the sample of the entire United States. Other additional findings are that a higher succession rate is associated with a higher gender ratio, except when controlling for firm and year fixed effects, and a board with a larger network is associated with a lower gender ratio, although this effect is small.

### 5.2 Hypotheses 2, 3 and 4

#### 5.2.1 Logistic Regression

Hypotheses 2, 3 and 4 investigate the impact of firm and board characteristics on speed of compliance. The results of the logistic regression for sample 2 are displayed below in table 7. Control variables have been omitted for brevity and due to nonsignificant coefficients. The same control variables were used in the logit regressions as in table 6.

**Table 7**
*Logit results with sample B containing Colorado firms with compliance speed as dependent variables*

| | (5)<br>**already_complier** | (6)<br>**fast_complier** | (7)<br>**medium complier** | (8)<br>**slow_complier** | (9)<br>**non_complier** |
|---|---|---|---|---|---|
| | | | No observations | | |
| above_median | -2.926*** | -18.39*** | | 1.103*** | 2.507*** |
| | (0.155) | (0.733) | | (0.277) | (0.121) |
| sumnoquals | 0.0311*** | 0.0666*** | | -0.0199*** | -0.0238*** |
| | (0.00684) | (0.0125) | | (0.00371) | (0.00338) |
| NumberDirectors | 0.215*** | -0.516*** | | 0.0639 | -0.0738 |
| | (0.0506) | (0.140) | | (0.0700) | (0.0400) |
| Business Services | 0.839 | 0 | | 0.446 | -2.025*** |
| | (0.420) | (.) | | (0.361) | (0.433) |
| Construction & Building Materials | 0 | 3.043*** | | 0 | 1.695*** |
| | (.) | (0.662) | | (.) | (0.371) |
| Electronic & Electrical Equipment | -1.368*** | 3.157*** | | -0.203 | -1.652*** |
| | (0.377) | (0.674) | | (0.369) | (0.278) |
| Engineering & Machinery | 0 | 2.127* | | 0 | 2.746*** |
| | (.) | (0.831) | | (.) | (0.681) |
| Food Producers & Processors | -0.426 | 0 | | 0 | 0.768* |
| | (0.350) | (.) | | (.) | (0.319) |
| Health | 1.686*** | 0 | | 0 | -1.167*** |
| | (0.289) | (.) | | (.) | (0.253) |
| Household products | 0 | 23.06*** | | 0 | -3.061*** |
| | (.) | (1.346) | | (.) | (0.493) |
| Leisure & Hotels | -0.0412 | 0 | | -3.431*** | 0.213 |
| | (0.287) | (.) | | (0.793) | (0.267) |
| Mining | -1.352*** | 0 | | -1.173** | 0.446 |
| | (0.275) | (.) | | (0.373) | (0.260) |
| Oil and Gas | -2.069*** | 0 | | -1.673*** | 1.190*** |

| | | | | |
|---|---|---|---|---|
| | (0.267) | (.) | (0.390) | (0.252) |
| Pharmaceuticals & Biotechnology | 0.772$^{*}$ | 0 | 0 | -0.312 |
| | (0.300) | (.) | (.) | (0.269) |
| Real Estate | 0.196 | 0 | 0 | -1.050$^{***}$ |
| | (0.292) | (.) | (.) | (0.228) |
| Renewable Energy | 0.973 | 0 | 0 | -0.570 |
| | (0.702) | (.) | (.) | (0.626) |
| Software & Computer Services | -1.138$^{**}$ | 0 | -3.715$^{***}$ | 1.185$^{**}$ |
| | (0.406) | (.) | (1.074) | (0.370) |
| Specialty & Other Finance | 1.452$^{*}$ | 0 | 0 | -1.103 |
| | (0.681) | (.) | (.) | (0.579) |
| Telecommunication Services | 0 | 0 | 0 | 1.763$^{***}$ |
| | (.) | (.) | (.) | (0.470) |
| Constant | -2.284$^{***}$ | -2.425$^{*}$ | -1.773$^{*}$ | 0.902$^{*}$ |
| | (0.470) | (0.998) | (0.735) | (0.423) |
| Observations | 1457 | 1457 | 1457 | 1457 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Important to note is that there were no observations for medium compliers in the Colorado sample. There were simply no firms in the dataset who reached compliance for the first time in 2019. This means that this thesis is unable to generate results regarding causal inference for firms that comply at a medium speed. Due to the absence of medium speed complier and the small amount of fast and slow compliers, respectively 6 and 10, several sector dummy variables were unable to generate coefficients. This is not due to misappropriation of the model, but due to lack of observations. However, conclusions still can be drawn for already-compliers and noncompliers.

Hypothesis 2 hypothesizes that firms with above-median levels of male representation comply slower with the Colorado quota. The results in table 7 show a negative and significant effect of gender ratio on already complier at the 0.1% level. A similar and even strong relation exists between gender ratio and fast complier. On the other hand, the results reveal a positive and significant effect at the 0.1% level of gender ratio on slow complier and noncomplier. This result indicates that having above median levels of male representation show that a firm complies slower to the Colorado quota.

Hypothesis 3 tests if higher educated boards comply quicker with the Colorado quota. In table 7 the coefficients for the variable denoting the sum of the number of qualifications per board, the proxy for education level of a board, are positive and highly significant at the 0.1% level for already compliers and fast compliers, while the coefficients are negative and highly significant at the 0.1% level for slow compliers and noncompliers.

Lastly, hypothesis four tests if sector heterogeneity has a significant impact on compliance speed. As the results in table 7 show, due to lack of data it was not possible to generate results for all sectors. However, several sectors do generate significant results. Coefficients for Business Services, Electronic and Electrical Equipment, Health, Household products and Real Estate in the model with noncomplier as dependent variable are all negative and significant at the 0.1% level, indicating that Colorado firms active in these sectors have a lower probability of being a noncomplier to the Colorado quota. On the other hand, coefficients for Construction and Building Materials, Engineering & Machinery, Food Producers and Processors, Oil and Gas, Software & Computer Services and Telecommunication Services in the model with noncomplier as dependent variable are all positive and significant at minimally the 5% level, indicating that Colorado firms active in these sectors have a higher probability of being a noncomplier to the Colorado quota. These results show evidence that sector heterogeneity has a significant impact of the speed of compliance with the Colorado quota.

As mentioned in the previous chapter, the results of a logistic regression only allows me to draw conclusions regarding sign and significance. To analyze the magnitude of the causal effect, the marginal effects at the mean of the variables of interest are displayed below for the five compliance types.

**Table 8**
*Average marginal effects*

| | **Already complier** | **Fast complier** | **Medium complier** | **Slow complier** | **Non complier** |
|---|---|---|---|---|---|
| Above median | -0.332 *** | -0.041*** | No observations | 0.0170* | 0.627*** |
| Sumnoquals | 0.0007*** | 0.0003*** | | -0.0010*** | -0.001*** |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8 displays marginal effects and shows evidence that having above median levels of male representation in boards leads to a 0.332 lower probability of having already complied, a 0.041 lower probability of being a fast complier, a 0.0170 higher probability of being a slow complier and a 0.627 higher probability of being a noncomplier, each on a scale from 0 to 1 and keeping all else constant. Also, Having an extra qualification of a board member, even when controlling for board size, leads to a 0.0007 higher probability of having already complied, a 0.0003 higher probability of being a fast complier, a 0.0010 lower probability of being a slow complier and a 0.001 lower probability of being a noncomplier, each on a scale from 0 to 1 and keeping all else constant.

### 5.2.2 Cox proportional hazards regression

The second approach to answering what drives compliance speed with the Colorado quota is a Cox proportional hazards regression, which models the factors that impact the probability of obtaining first compliance. The results are displayed in table 9. Important to note is that this model is an addition to the findings in table 8 and serves as a test of the robustness of earlier found results.

**Table 9**

*Results of the Cox proportional hazards regression analysis for sample B with time per quarter*

| | (1)<br>**Time until first compliance (quarters)** |
|---|---|
| GenderRatio | -7.562*** |
| | (1.932) |
| Succession | -1.107 |
| | (2.186) |
| ESG Education score | -0.00488*** |
| | (0.00148) |
| Resources Used score | 0.00988*** |
| | (0.00317) |
| ESG Management score | 0.0105*** |
| | (0.00221) |
| sumnoquals | 0.0165 |
| | (0.0100) |
| Attrition | 1.971 |
| | (4.276) |
| NationalityMix | 0.450 |
| | (1.624) |
| NumberDirectors | -0.230 |
| | (0.243) |
| Log net income | -0.282** |
| | (0.107) |
| Log market value | 0.344 |
| | (0.388) |
| sum_total_comp | -0.972 |
| | (0.0186) |
| stock_comp | -0.369 |
| | (0.0289) |
| option_comp | -0.117 |
| | (0.0205) |
| listed_board_positions | 0.0247 |
| | (0.0017) |
| unlisted_board_positions | 0.0924 |
| | (0.00194) |
| other_board_positions | 0.00883 |
| | (0.00732) |
| de_ratio | -0.000313 |
| | (0.00146) |
| Observations | 1234 |

Standard errors in parentheses

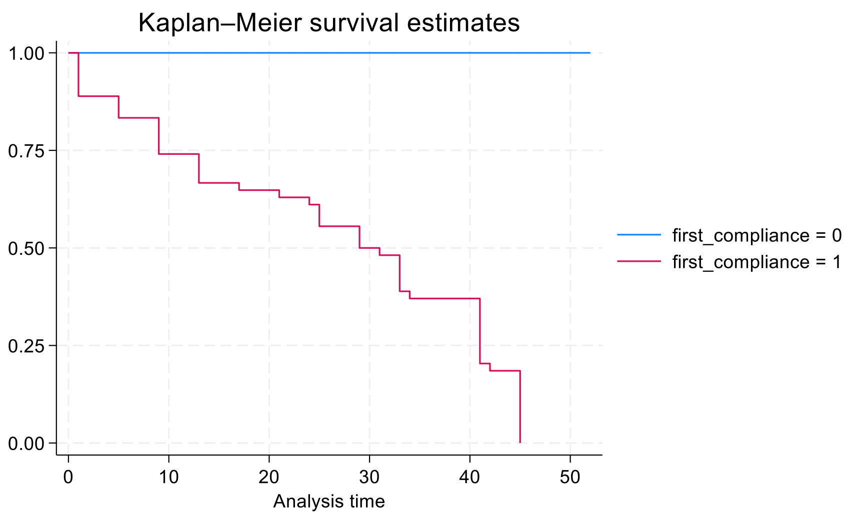
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results of the survival analysis are not displayed in hazard ratios but in coefficients to allow for easier interpretation. Also, the results are displayed in terms of quarters instead of years to more accurately approach the time until first compliance. The results show that only gender ratio has a significant impact on the time to first compliance. If the gender ratio increases by 1, the first time a firm reaches compliance will be 7.562 quarters later, *ceteris paribus*. Therefore, a firm with a board that is entirely made up of men will comply almost 2 years later with the Colorado quota than a firm with an entirely female board. This effect is highly significant at the 0.1% level. In addition, the logarithmic transformation of net income also displays a negative and significant coefficient at the 1% level. This shows that firms with higher net income reach compliance in a later quarter. Also, I included the ESG components with significant coefficients in the table. Increased performance in terms of the management score and resources used score leads to slower compliance, while increased performance in the education score leads to faster compliance.

These results can also be displayed in a graph, as has been done in figure 5. The horizontal axis represents time in quarters and the vertical axis shows the probability of obtaining first compliance. Therefore, the Kaplan-Meier survival estimates graph plots the probability of having reached first compliance in a given quarter. In quarter 0, meaning the first quarter of 2010, no firms meet the compliance standards of the Colorado quota. The Kaplan-Meier survival plot shows that over time an increasing number of firms reaches compliance levels of female representation. As time continues, the probability that a firm which has not yet reached compliance reduces, displayed by the sharp drops in the graph. Eventually the probability of survival, which is complying with the quota, drops to 0 as the compliance period ends at the end of 2020.

**Figure 5**

*Kaplan-Meier survival estimates plot with first compliance set as the event of failure*



Therefore, the results of the Cox proportional hazards regression provides evidence that for a sample of 173 Colorado-based firms, having above median levels of male representation in the board of directors reduces the speed of compliance with the Colorado gender quota.

### 5.3 Hypothesis 5

In hypothesis 5 I research whether ESG performance impacts compliance speed with the Colorado quota. I added a wide range of ESG measures to ensure robustness. The results of the logistic regression for sample D are displayed below in table 10. Control variables have been omitted for brevity and due to nonsignificant coefficients. The same control variables were used in the logit regressions as in table 6.

**Table 10**

*Logit results with sample D containing Colorado firms with compliance speed as dependent variables with ESG scores*

| | (11) | (12) | (13) | (14) | (15) |
|---|---|---|---|---|---|
| | **already_complier** | **fast_complier** | **medium_complier** | **slow_complier** | **non_complier** |
| ESG score | 0.0380** | -0.180*** | No observations | -0.0279 | 0.0160 |
| | (0.0134) | (0.0235) | | (0.0257) | (0.0117) |
| ESG Controversies score | -0.0128*** | 0.0473** | | 0 | -0.00320 |
| | (0.00331) | (0.0162) | | (.) | (0.00349) |
| Resources Used score | 0.0280*** | 0.0269*** | | 0.0517*** | -0.0393*** |
| | (0.00505) | (0.00797) | | (0.0131) | (0.00512) |
| ESG Management score | 0.00358 | 0.0420*** | | -0.00372 | -0.0132*** |
| | (0.00415) | (0.00746) | | (0.00849) | (0.00385) |
| CSR Strategy score | -0.0315*** | 0.00271 | | -0.0141 | 0.0235*** |
| | (0.00451) | (0.00437) | | (0.00836) | (0.00380) |
| ESG Workforce score | -0.0133* | 0.0699*** | | -0.136*** | 0.0115* |
| | (0.00589) | (0.00873) | | (0.0236) | (0.00486) |
| ESG Community score | -0.0165*** | 0.0497*** | | 0.0337** | -0.0100** |
| | (0.00444) | (0.00612) | | (0.0115) | (0.00324) |
| ESG Product Responsibility score | 0.0442*** | 0.0242** | | 0.0391* | -0.0365*** |
| | (0.00617) | (0.00743) | | (0.0171) | (0.00488) |
| Constant | -5.536*** | -10.72*** | | 1.084 | 4.295*** |
| | (0.534) | (1.760) | | (0.645) | (0.504) |
| Observations | 1440 | 1440 | | 1248 | 1440 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The coefficients for general ESG score are significant for already compliers and fast compliers. For already compliers the effect is positive and significant, while the effect is negative and significant for fast compliers, which seems contradictory. There is also contradictory evidence for ESG Controversies score, ESG Workforce score and ESG Community score. However, Resource Used score, ESG Management score and Product Responsibility score have a positive effect on compliance speed. Lastly, CSR Strategy score have a negative and significant effect on compliance speed.

To draw conclusions about the magnitude of the effect of ESG performance on compliance speed, the average marginal effects per ESG score are displayed below in table 11.

**Table 11**
*Average marginal effects*

| | Already complier | Fast complier | Medium complier | Slow complier | Non complier |
|---|---|---|---|---|---|
| ESG score | 0.007 *** | -0.003*** | No observations | -0.000* | 0.002 |
| Controversies | -0.009*** | 0.001*** | | -0.000 | -0.001 |
| Resources Used | 0.003*** | 0.001*** | | 0.000 | -0.008*** |
| Management | 0.001 | 0.001*** | | -0.000 | -0.003*** |
| CSR Strategy | -0.007*** | 0.000 | | -0.000 | 0.005*** |
| Workforce | -0.001 | 0.002*** | | -0.001*** | 0.004*** |
| Community | -0.003*** | 0.001*** | | 0.000*** | -0.002*** |
| Product Resp. | 0.008*** | 0.001*** | | 0.000*** | -0.007*** |

The marginal effects for ESG scores show the effects of ESG performance are generally significant, although very small. For example, scoring 1 point higher for general ESG leads to a 0.007 higher probability of being an already complier, on a scale from 0 to 1 and keeping all else constant. The remainder of the coefficients can be interpreted in a similar manner.

### 5.4 Hypothesis 6

The results for the difference-in-difference regression model to analyse the impact of compliance speed with the Colorado quota on market value of firms in Colorado before and after 2018 are displayed below in table 12. Firm and year fixed effects have been omitted for the sake of brevity. The entire collection of control variables has been added here, as there are several variables of interest with significant coefficients. The three models contain different sets of explanatory variables. Sample A was used. The coefficients for the difference-in-difference estimator are highlighted.

**Table 12**
*Difference-in-difference regressions with market value as dependent variable for sample A*

| | (16)<br>**Market value** | (17)<br>**Market value** | (18)<br>**Market value** |
|---|---|---|---|
| Colorado | -12730789.3*** | -12730789.3*** | -13630525.1*** |
| | (3851823.7) | (3851823.7) | (4119513.9) |
| post_quota | 3357948.2** | 3357948.2** | 3347863.2** |

| | | | |
|---|---|---|---|
| | (1115335.3) | (1115335.3) | (1111936.1) |
| Colorado*post_quota | **-7033832.9**** <br> **(2371113.7)** | **-7033832.9**** <br> **(2371113.7)** | **-5270136.7*** <br> **(2224772.4)** |
| Gender_ratio | 5740466 <br> (6643652) | 5740466 <br> (6643652) | 5773405 <br> (6657134) |
| Succession | 346080.0 <br> (4671125.8) | 346080.0 <br> (4671125.8) | 380613.2 <br> (4729665.9) |
| Attrition | 2415923.4 <br> (8582397.3) | 2415923.4 <br> (8582397.3) | 2401675.5 <br> (8589331.3) |
| NationalityMix | 1010326.7 <br> (4469402.0) | 1010326.7 <br> (4469402.0) | 1003550.7 <br> (4479629.1) |
| NumberDirectors | 944067.5 <br> (954824.4) | 944067.5 <br> (954824.4) | 941658.3 <br> (956557.9) |
| sumnoquals | 26575.4 <br> (98172.7) | 26575.4 <br> (98172.7) | 26611.2 <br> (98216.8) |
| sumnetworksize | 56.99 <br> (97.53) | 56.99 <br> (97.53) | 56.98 <br> (97.59) |
| STDEVAge | 11621.0 <br> (6511.0) | 11621.0 <br> (6511.0) | 11623.0 <br> (6519.9) |
| Net income | 8.770* <br> (3.409) | 8.770* <br> (3.409) | 8.769* <br> (3.410) |
| R&D | 28.54** <br> (9.811) | 28.54** <br> (9.811) | 28.54** <br> (9.813) |
| log_assets | -226372.9 <br> (278807.2) | -226372.9 <br> (278807.2) | -227813.3 <br> (279107.0) |
| roa | 692113.0 <br> (686645.4) | 692113.0 <br> (686645.4) | 689707.8 <br> (686834.9) |
| de_ratio | -5510.7 <br> (7306.6) | -5510.7 <br> (7306.6) | -5507.8 <br> (7308.2) |
| sum_total_comp | 145302.8 <br> (248345.7) | 239674.4 <br> (196385.8) | 759385.3 <br> (483038.2) |
| stock_comp | 185939.3 <br> (175926.2) | 847592.6 <br> (549259.2) | 7639582.2 <br> (548296.3) |
| option_comp | 1749374.6 <br> (185945.3) | 375372.3 <br> (285795.3) | 793827.4 <br> (653953.2) |
| listed_board_positions | -7033832.9 <br> (4827407.3) | -7033332.7 <br> (3759376.2) | -7033739.3 <br> (3857395.5) |
| unlisted_board_positions | -6847397.3 <br> (5838691.1) | -6937683.2 <br> (3867477.2) | -6837632.4 <br> (498236.2) |
| other_board_positions | -3058674.3 <br> (145874.3) | -3857730.9 <br> (1832496.5) | -3624628.3 <br> (1749384.3) |
| already_complier | | 24055401.7*** <br> (2864260.6) | |
| fast_complier | | 18973446.9*** <br> (4407346.9) | |
| medium_complier | | 9763831.6** <br> (2990783.0) | |

| | | | |
|---|---|---|---|
| slow_complier | | 11473138.1** | |
| | | (3492301.6) | |
| DiDalready_complier | | | -2162418.9 |
| | | | (2835331.6) |
| DiDfast_complier | | | 0 |
| | | | (.) |
| DiDmedium_complier | | | 0 |
| | | | (.) |
| DiDslow_complier | | | -1514424.8 |
| | | | (2450101.9) |
| Constant | -7776014.0 | -7776014.0 | -7760559.5 |
| | (4133390.2) | (4133390.2) | (4139906.9) |
| Observations | 44452 | 44452 | 44452 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

For model 16, results show that firms after 2018 have a significantly higher market value than firms before 2018, namely 3.35 million dollars higher, keeping all else constant. This effect is significant at the 0.1% level. The difference-in-difference estimator is also significant in models 16, 17 and 18, showing that firms subject to the Colorado quota have a lower market value compared to the control group. This provides evidence that investors view the need to apply to a gender quota as a negative external factor for the value of the firm.

Model 17 adds compliance speeds. The four compliance speeds each have a positive and significant effect on market value compared to noncompliers, which is omitted as noncompliance serves as a baseline. Model 17 provides evidence for the entire sample that complying with a high standard of female representation, namely the Colorado quota, has a positive effect on market value. However, this relationship only holds for the entire sample, not for the subsample with only Colorado firms. The positive effect of compliance is the largest for already compliers with 24 million dollars, then fast compliers with 18 million, then slow compliers with 11 million and lastly medium compliers with 9 million. This shows that compliance speed does indeed matter in terms of market valuation.

Lastly, model 18 adds triple interaction effects to analyse the effect of compliance speed for firms subject to the Colorado quota. The difference-in-difference estimator is still significant and negative, indicating that the Colorado quota has a negative effect on market value for firms. Interestingly, the triple interaction terms are each insignificant. The interaction terms with fast complier and medium complier are omitted due to lack of observations and noncompliance serves as a baseline again. These results provide evidence that speed of compliance for firms subject to the Colorado quota does not impact market value.

Table 13 displays the same model table 12, except with two versions of Tobin's Q as dependent variable. Models 19, 20 and 21 with the first approximation of Tobin's Q display negative and significant coefficients for Colorado, indicating that firms located in Colorado have a lower Tobin's Q than firms located in other states. Furthermore, *market value* has a positive effect on Tobin's Q and *log_assets* and *R&D expenses* have a negative effect. In respect to compliance speed, the results show evidence for the sample with the entire U.S. that having already complied with the standards set by the Colorado quota or being a medium complier leads to a higher Tobin's Q, while being a fast and a slow complier leads to a lower Tobin's Q. The triple interaction effects are all insignificant, such as in table 12. Lastly, all coefficients models 22, 23 and 24 with a proxy of Tobin's Q based on equity are all insignificant. This is most likely due to issues with the dataset, which will be discussed in a later chapter.

**Table 13**

*Difference-in-difference regressions with two proxies for Tobin's Q as dependent variables for sample A*

| | (19)<br>**tobinQ** | (20)<br>**tobinQ** | (21)<br>**tobinQ** | (22)<br>**TobinQ_equity** | (23)<br>**TobinQ_equity** | (24)<br>**TobinQ_equity** |
|---|---|---|---|---|---|---|
| Colorado | -128945.1* | -128945.1* | -169191.4** | 33877.6 | 33877.6 | -3702.884 |
| | (53823.6) | (53823.6) | (61714.3) | (36090.4) | (36090.4) | (31050.46) |
| post_quota | -19765.4 | -19765.4 | -20491.6 | 45577.5 | 45577.5 | 45606.7 |
| | (30061.6) | (30061.6) | (30309.1) | (49752.2) | (49752.2) | (49715.1) |
| Colorado*post_quota | **-61297.7** | **-61297.7** | **15716.3** | **-28789.4** | **-28789.4** | **-42437.7** |
| | **(51798.3)** | **(51798.3)** | **(45698.5)** | **(32021.8)** | **(32021.8)** | **(48369.7)** |
| GenderRatio | 2156.6 | 2156.6 | 4224.3 | 37510.2 | 37510.2 | 37338.3 |
| | (50901.1) | (50901.1) | (51062.2) | (62052.6) | (62052.6) | (62499.8) |
| Succession | 12164.1 | 12164.1 | 15753.3 | -23514.6 | -23514.6 | -23636.3 |
| | (30344.3) | (30344.3) | (28676.6) | (40630.8) | (40630.8) | (41149.9) |
| Attrition | -39369.2 | -39369.2 | -39922.8 | 17962.5 | 17962.5 | 18054.7 |
| | (43971.5) | (43971.5) | (43965.9) | (25790.6) | (25790.6) | (25789.7) |
| NationalityMix | 12958.0 | 12958.0 | 11860.8 | 28667.8 | 28667.8 | 28602.8 |
| | (41042.5) | (41042.5) | (40795.7) | (20343.8) | (20343.8) | (20438.4) |
| NumberDirectors | -68.71 | -68.71 | -219.9 | -8093.9 | -8093.9 | -8082.5 |
| | (3631.3) | (3631.3) | (3649.8) | (6563.0) | (6563.0) | (6537.1) |
| sumnoquals | 478.6 | 478.6 | 477.5 | 770.4 | 770.4 | 769.8 |
| | (353.7) | (353.7) | (353.6) | (551.9) | (551.9) | (551.4) |
| sumnetworksize | -0.181 | -0.181 | -0.176 | -0.547 | -0.547 | -0.546 |
| | (0.204) | (0.204) | (0.203) | (0.651) | (0.651) | (0.653) |
| STDEVAge | -18.39 | -18.39 | -17.55 | -1.915 | -1.915 | -1.907 |
| | (68.19) | (68.19) | (68.16) | (156.0) | (156.0) | (156.1) |
| Net income | 0.000738 | 0.000738 | 0.000708 | -0.000619 | -0.000619 | -0.000617 |
| | (0.00314) | (0.00314) | (0.00315) | (0.00242) | (0.00242) | (0.00242) |

| | | | | | | |
|---|---|---|---|---|---|---|
| R&D | 0.0151<br>(0.00888) | 0.0151<br>(0.00888) | 0.0152<br>(0.00892) | -0.00614<br>(0.00674) | -0.00614<br>(0.00674) | -0.00614<br>(0.00673) |
| log_assets | -176713.4** <br>(55790.7) | -176713.4** <br>(55790.7) | -176839.7** <br>(55836.6) | 5809.8<br>(14258.7) | 5809.8<br>(14258.7) | 5820.3<br>(14274.4) |
| roa | 33974.9<br>(27956.8) | 33974.9<br>(27956.8) | 33724.6<br>(27953.4) | 10980.1<br>(30355.3) | 10980.1<br>(30355.3) | 10980.5<br>(30391.5) |
| de_ratio | -52.96* <br>(21.15) | -52.96* <br>(21.15) | -52.68* <br>(21.13) | -8.783<br>(52.89) | -8.783<br>(52.89) | -8.802<br>(52.91) |
| Market value | 0.000365* <br>(0.000146) | 0.000365* <br>(0.000146) | 0.000364* <br>(0.000146) | -0.0000944<br>(0.000104) | -0.0000944<br>(0.000104) | -0.00614<br>(0.00673) |
| already_complier | | 2111841.*** <br>(425680.5) | | | 89387.16<br>(180045.1) | |
| fast_complier | | -436688.3** <br>(166003.1) | | | 241525.3<br>(350321.4) | |
| mediumcomplier | | 305771.9** <br>(109413.3) | | | 48618.76<br>(102819.2) | |
| slow_complier | | -43561.8** <br>(15090.8) | | | 82302.29<br>(114020) | |
| DiDalready_complier | | | -114319.3<br>(96469.6) | | | 14065.24<br>(68323.59) |
| DiDfast_complier | | | No observations | | | No observations |
| DiDmedium_complier | | | No observations | | | No observations |
| DiDslow_complier | | | -23178.1<br>(45161.5) | | | -45219.61<br>(73716.03) |
| Firm fixed effects | YES | YES | YES | YES | YES | YES |
| Year fixed effects | YES | YES | YES | YES | YES | YES |
| Constant | 912249.7** <br>(290489.8) | 912249.7** <br>(290489.8) | 910951.9** <br>(290153.0) | -33082.3<br>(143481.7) | -33082.3<br>(143481.7) | -33009.9<br>(143845.4) |
| Observations | 4275 | 4275 | 4275 | 10634 | 10634 | 10634 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

## 5.5 Robustness check

Among other topics, this thesis has tested the effectivity of the Colorado gender quota. Examples from the literature presented in previous chapters, such as Ahern and Dittmar (2012) and Wang and Kelan

(2013), show that gender quota lead to a higher percentage of females in the board of directors. Using a difference-in-difference estimation, I find that the Colorado quota did not significantly lead to more female representation. This finding is contrary to previous findings, which automatically places doubts on the validity of this finding. To test the robustness of the dataset, I assess the effectivity of the California gender quota.

The California gender quota was the first of its kind in the United States. This piece of legislation required all public firms whose principal executive offices are located in California to have at least one female director on their boards by December 31, 2019, either by filling an open seat or by adding a seat. By December 31, 2021, such publicly held corporations were required to have minimum numbers of female directors based on the total size of the corporation's board of directors (California Secretary of State, 2018). Gerstberg, Mollerstrom and Pagel (2021) and Rijsewijk (2022) find that the quota led to a significant increase in the percentage of female board members. Lu and White (2014) emphasize the importance of robustness checks to provide evidence of the structural validity of the core regressors. By extrapolating the method used to analyse the Colorado quota to the California quota, the validity of the results is tested. The results of model 9, which is the same regression model used for hypothesis 1 except with a dummy denoting California instead of Colorado, are displayed below in table 14.

$$Gender\ ratio = \beta_0 + \gamma_c * Colorado + \beta_t * post_{quota} + \delta * Colorado * post_{quota} + \beta_1 * succession\ rate + \beta_2 * attrition\ rate + \beta_3 * nationality\ mix + \beta_4 * number\ of\ directorsn + \beta_5 * sum\ of\ qualifications + \beta_6 * board\ network\ size + \beta_7 * standard\ deviation\ directors\ age + \beta_8 * net\ income + \beta_9 * R\&D\ expenditures + \beta_{10} * market\ value + \beta_{11} * log\ of\ assets + \beta_{12} * return\ on\ assets + \beta_{13} * debt\ equity\ ratio + \mu_n * D_{firm} + \theta_n * D_{year} + \alpha_i + u_{it} \tag{11}$$

**Table 14**

*Difference-in-difference regressions with gender ratio as dependent variable for the California quota*

| | (25)<br>**GenderRatio** |
|---|---|
| California | -0.0840* <br>(0.0361) |
| Post_2018 | -0.0354<br>(0.0423) |
| California*Post_2018 | -0.0204**<br>(0.0200) |
| Succession | 0.0577<br>(0.0375) |
| Attrition | -0.00509<br>(0.0529) |
| NationalityMix | -0.0199 |

| | |
|---|---|
| | (0.0337) |
| NumberDirectors | -0.00621 |
| | (0.00393) |
| Sumnoquals | 0.000225 |
| | (0.000321) |
| Sumnetworksize | -0.000000643* |
| | (0.000000280) |
| STDEVAge | 0.0000214 |
| | (0.0000649) |
| Net income | 3.32e-10 |
| | (3.15e-09) |
| R&D | 5.24e-09 |
| | (1.72e-08) |
| Market value | 1.67e-10 |
| | (9.41e-11) |
| Log_assets | -0.00143 |
| | (0.00384) |
| Roa | -0.0126 |
| | (0.0167) |
| De_ratio | -0.0000675 |
| | (0.000142) |
| Firm fixed effects | YES |
| Year fixed effects | YES |
| Constant | 1.119*** |
| | (0.0490) |
| Observations | 6385 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The coefficient for the difference-in-difference estimator is negative and significant at the 1% level. This finding indicates that firms located in California after the instalment of the California quota on average had a gender ratio 0.0204 percentage points lower than firms that were not exposed to the quota. This finding provides evidence that the California quota led to a reduction of the gender quota, denoting the percentage of male directors in the board, and thus an increase in female representation. This is in line with the findings by Gerstberg, Mollerstrom and Pagel (2021) and Rijsewijk (2022). The finding also provides evidence of the validity of the main results presented in this thesis.

# 6 Conclusion and Discussion

## 6.1 Conclusions

This study has assessed the impact of House Joint Resolution 17-1017, referred to as the Colorado quota, which was instated in 2017 and set female representation requirements for the board of directors for Colorado based firms. These firms had three years to comply with the newly instated piece of diversity-enhancing legislation, from January 2018 to December 2020, which essentially meant either hiring female directors and enlarging the board or replacing male with female directors. The literature on board diversity suggests that a gender quota can have positive effects on the firm, ranging from firm valuation to employee satisfaction in the workplace.

The analysis in this thesis is threefold. First, this study assess whether the Colorado quota has generated the impact it was meant to by the state legislator, being a higher percentage of women on the board of directors in corporate Colorado. A difference-in-difference technique is used to account for trends across the United States that could have led to a higher percentage of female board members. Secondly, this thesis investigates the impact of firm and board characteristics on speed of compliance and tries to answer the question what type of firms comply faster with gender regulation, using historical evidence from the Colorado quota. Lastly, the relationship between speed of compliance and firm valuation is analysed to test whether speed of compliance is viewed as a value-enhancing firm characteristic.

In line with existing literature, I hypothesize that the Colorado quota led to a higher percentage of female board members, that characteristics such as education and an above median level of female representation have a positive effect on the percentage of female board members and that speed of compliance is positively associated with firm value. To generate results regarding these hypotheses I use a difference-in-difference estimation technique with two-way fixed effects, a logistic regression model and a Cox proportional hazards regression model.

### 6.1.1 Conclusion to hypothesis 1

*Compared to the rest of the United States, the percentage of female members of the board of directors will increase due to the passing of the Colorado quota in 2017.*

This study uses a difference-in-difference model to answer hypothesis 1. The results reveal that while a firm after 2018 has a significantly lower gender ratio, which emulates a lower percentage of men on the board and thus a higher percentage of women on the board, a firm after 2018 in Colorado does not lead to a significantly lower gender ratio. Moreover, the effect of *post_quota* disappears when accounting for year fixed effects. Unfortunately for the state of Colorado, the data suggests that the

Colorado quota was not as effective as intended, due to the finding that Colorado based firms after 2018, the year in which the quota was instated, do not have a significantly higher percentage of female board members compared to firms in other states, meaning that hypothesis 1 is rejected.

However, the analysis generated an additional finding. The number of directors appears to systematically have a negative effect on the gender ratio, when including and excluding firm and year fixed effects. This finding generates two insights regarding firm behaviour. First, when board size increases, the percentage of women also increases. This means that larger boards are more gender diverse. Secondly, the findings indicate that an additional director leads to a lower gender ratio. Therefore, if a firm hires an additional board member, it will more likely be a female rather than a male.

#### 6.1.2 Conclusion to hypothesis 2

*Firms with above-median levels of male representation comply slower with the Colorado quota.*

First, a logistic regression was used to answer hypothesis 2. The regression included all firm and board characteristics, along with a series of control variables. Therefore, the conclusions regarding the impact of firm and board characteristics on compliance speed with the Colorado quota can be made simultaneously for each variable of interest. The results provide convincing and highly significant evidence that firms with above median levels of male representation comply slower with the Colorado gender quota. These firms with a high proportion of male directors have to execute more changes to the composition of their board, whether that is simply hiring more females or replacing male with female directors. Therefore, if firms have to execute more actions to comply with a gender quota, it will take longer to comply with gender regulation.

Secondly, a Cox proportional hazards regression was used. The results reveal that the gender ratio has a significant effect on the quarter in which a firm reaches compliance with the Colorado quota for the first time. Therefore, firms with a higher gender ratio comply slower with the Colorado quota. Also, three ESG indicators and the log of net income also significantly impact the time to compliance. Both the analyses generate convincing evidence that firms with a high proportion of male directors comply slower with gender quota. Therefore, I find evidence to support hypothesis 2.

#### 6.1.3 Conclusion to hypothesis 3

*Firms with higher educated board members comply quicker with the Colorado quota.*

The same logistic regression model was used as for hypothesis 2 to assess whether firms with higher educated board members reach compliance earlier. The evidence suggests that, while controlling for board size, if a board collectively has more educational qualifications, the firm will have a higher probability of complying faster with the quota. While the sum of the number of qualifications is a proxy for education and does not take into account the quality of those qualifications or actual intelligence or experience, I still find sufficient evidence supporting hypothesis 3.

#### 6.1.4 Conclusion to hypothesis 4

*The sector in which a firm is active significant impacts the speed of compliance with the Colorado quota..*

Hypothesis 4, unlike hypotheses 2 and 3, does not analyse the impact of one board or firm characteristic on compliance speed, but attempts to answer the broader question whether firms in a certain sector have a higher probability of complying faster with a gender quota. Adding sector fixed effects indeed reveals that sector heterogeneity impacts compliance speed. However, the relationship is not the same for each sector. Firms active in Business Services, Electronic and Electrical Equipment, Health, Household products and Real Estate have a higher probability of complying faster, while firms active in Construction and Building Materials, Engineering & Machinery, Food Producers and Processors, Oil and Gas, Software & Computer Services and Telecommunication Services have a higher probability of being a noncompliant firm. Firms active in Mining have a lower probability of being a fast and slow complier and firms active in Electronic and Electrical Equipment generate contradictory results, with a lower probability of being an already complier or noncomplier and a positive effect on the probability of being a fast complier.

As the results show, there is significant sector heterogeneity regarding the impact of sector on compliance speed. Therefore, I find sufficient evidence supporting hypothesis 4.

#### 6.1.5 Conclusion to hypothesis 5

*Firms with higher ESG-scores comply quicker with the Colorado quota.*

To answer hypothesis five, a logistic regression was used with a sample containing 8 different ESG scores. The results are mixed. The Resource Used, ESG Management and Product Responsibility scores each have a positive effect on compliance speed, as is hypothesized. However, CSR Strategy score has a negative and significant effect on compliance speed and the general ESG score, ESG Controversies score, ESG Workforce score and ESG Community score have contradictory effects on compliance speed. Therefore, I find partial evidence supporting hypothesis 5.

#### 6.1.6 Conclusion to hypothesis 6

*The Colorado quota has a positive effect on firm value for quick-adapting firms and a negative effect on slow-adapting and non-adapting firms.*

The final hypothesis of this thesis combines the results generated in previous models to draw the main conclusion and help answer the research question whether speed of compliance impacts firm value, measured via Tobin's Q and market value. Three specifications were used, the first the same difference-in-difference analysis as for hypothesis 1 with Tobin's Q and market value as dependent variables, the second adding compliance speed and the third adding triple interaction terms denoting Colorado firms subject to the quota after 2018 and their assigned compliance speed to test whether that impacts firm valuation.

The three models with market value as dependent variable show that firms subject to the Colorado quota have a lower market value compared to the control group. Therefore, the Colorado quota is viewed by investors as a value-reducing external effect. The second specification, which adds compliance speed indicators as explanatory variables, provides evidence for the entire sample that complying with a high standard of female representation, namely the Colorado quota, has a positive effect on market value. The results show that even slow compliance has a positive effect on market value. Therefore, complying is more important than compliance speed. Still, the magnitude of the positive effect of compliance speed on market value is the largest for already compliers and fast compliers. Therefore, even though complying itself is the most valuable, compliance speed does have a marginal effect on market value.

Combing this with earlier findings such as having above median levels of male representation leads to slower compliance, it can be concluded that having a high proportion of male directors leads to a relatively lower market value, while good ESG performance, highly educated board members and being active in certain sectors leads to a higher market valuation. Moreover, the third specification, incorporating triple interaction terms, furnishes evidence suggesting that the rate of compliance for companies subject to the Colorado quota does not impact their market value. Consequently, it can be concluded that the Colorado quota failed to generate increased market valuations for firms. Nevertheless, evidence from the entire sample of U.S. companies suggests that prompt compliance with a high standard of gender diversity within the board is associated with a relatively higher market valuation. This relationship is likely influenced by a myriad of factors, which will be further explored in the subsequent section.

The results also show that firms located in Colorado have a lower Tobin's Q than firms located in other states. Furthermore, *market value* has a positive effect on Tobin's Q and *log_assets* and *R&D expenses* have a negative effect. In respect to compliance speed, the results show evidence for the sample with the entire U.S. that having already complied with the standards set by the Colorado quota or being a medium complier leads to a higher Tobin's Q, while being a fast and a slow complier leads to a lower

Tobin's Q. This result appears contradictory, which questions the robustness of the finding. The triple interaction effects are all insignificant, such as in table 12. However, this relationship may also be subject to biases.

In conclusion, I do not find support for hypothesis 6. Still a wide range of findings emerged from the analysis, such as the negative impact of the Colorado quota on market value. However, that fast compliance has a positive effect and slow compliance has a negative effect on market value and Tobin's Q did not emerge from the analysis.

### 6.1.7 Conclusion to the research question

*Which firms comply quickly with the female representation standards in the board of directors set by the Colorado quota and does compliance speed impact firm value?*

The research question is twofold. The first part is researched by hypotheses 2,3,4 and 5. In these hypotheses, a series of variables predetermined by existing research was chosen. It is likely that a wide range of other firm and board characteristics also determines which firms comply faster with gender quota than others. Keeping that in mind, in this thesis I find evidence that firms with a low proportion of male directors, board members that are highly educated, that score well in ESG ratings and are active in specific sectors such as Business Services or Real Estate complied faster with the Colorado quota than firms with different characteristics. Firms with these characteristics comply faster with female representation standards in the board of directors.

Secondly, there is no evidence that compliance speed impacts firm value for firms based in Colorado. In fact, the Colorado quota has a negative impact on firm value. Interestingly, there is evidence for the sample of firms based in all U.S. states that compliance speed and the sheer act of compliance with a high standard of female representation impacts firm value positively. While it is true that firms in states other than Colorado have no legal obligation to meet the female representation requirements set by the Colorado quota, firms that meet these relatively high standards of gender diversity in the board tend to have a higher market valuation. In conclusion, gender diversity in the board of directors does pay off to shareholders, only not when analysing Colorado firms.

### 6.2 Discussion

#### 6.2.1 Limitations

As is the case with all academic studies, the conclusions in this thesis must be interpreted with caution due to several limitations. First, the concept of causality must be used with caution. The most important findings of this thesis are that compliance speed with the Colorado quota impacts firm value for U.S. firms and that a higher proportion of male board members leads to a lower probability of complying with the Colorado quota quickly for Colorado-based firms. In an ideal setting, I could state that having a high proportion of male directors automatically leads to slower compliance with the Colorado quota. However, it may be that other firm characteristics that I do not control for due to lack of data or unobservable differences between firms are the actual driver of this association. For example, if having high overhead costs causally leads to a firm having a higher proportion of male directors and causally leads to slower compliance with diversity regulation, it is not the proportion of male directors that drives slower compliance, but rather having high overhead costs. This concept is referred to as omitted variable bias (OVB). The role of OVB is considerably reduced by adding a wide range of control variables supported by the literature, using two-way fixed effects to control for unobserved time-invariant unit heterogeneity and the robustness of the econometric techniques used such as difference-in-difference. Still, OVB might play a role via time-variant characteristics or other unobserved variables for which it is impossible to collect data. Also, reverse causality could have led to biased estimates. It is therefore safer to interpret the results as a correlation or an association, instead of pure causality.

The second limitation refers to difference-in-difference. While on the one had the technique is robust in such quasi-natural experimental settings, an important condition is the presence of a suitable control group. In an ideal setting, I would have compared gender ratios of Colorado firms in a world with the quota and a world without the quota. Unfortunately, the latter counterfactual setting is non-existent. Therefore, a control group must be chosen with care to mimic the counterfactual outcomes in Colorado without the quota. This study uses the entire United States as a control group. Checking for parallel trends showed in the chapter containing methodology that the entire United States is an adequate control group, but is can never be the perfect control group. Therefore, results must be interpreted with caution. The DID design is not a perfect substitute for randomized experiments, but it often represents a feasible way to learn about casual relationships.

A third limitation is the relatively small treatment group for the difference-in-difference models for hypotheses 1 and 6. There are only 173 firms subject to the quota, while 6,641 firms are not subject to it. Research has shown that causal inference fares poorly when the number of treated panel clusters is relatively small. However, collapsing the data down to group-level cells, clustering robust standard errors, and using clustered bootstraps work relatively well (Wing, Simon & Bello-Gomez, 2018). I have clustered the robust standard errors in order to solve this inference issue. Conley and Taber (2011) designed an alternative approach for inference with difference-in-difference with a small number of policy changes regarding, but this exceeds the scope of this thesis and could be an area for future research.

Fourthly, the results of the Cox proportional hazards regression must be interpretated with caution. In most situations, the estimation technique is used to compare groups. In this thesis the model is used to estimate the expected number of events, being a firm reaching first compliance per one unit of time, being a quarter year. Even though the proportional hazards assumption holds, comparing the hazard, being the probability of first compliance occurring in a given quarter, between firms can be subject to known biases such as OVB and reverse causality. Also, this regression assumes a multiplicative relationship between the predictors and the hazard rather than a linear relationship. In this thesis a linear relationship is more likely, as it is assumed in the logistic regressions, which is also a reason to proceed with caution when interpreting the results of the proportional hazards regression.

Also, selection bias may have occurred when testing hypothesis 5 regarding ESG scores. Selection bias refers to the distorted representation of a true population due to sampling methods (Heckman, 1990). As explained in the data chapter, the sample of firms with documented ESG scores was significantly smaller than the complete sample, with 1,706 firms compared to 6,641 firms in the whole sample and 48 firms compared to 173 firms in the Colorado sample. Firms for which the ESG scores are documented may significantly differ from firms without ESG scores on a wide range of characteristics. This could lead to the sample misrepresenting the true population, which would lead to biased estimates regarding the impact of ESG performance on compliance speed with the Colorado quota. Therefore, these results must be interpreted with caution.

Lastly, a data collection issue emerged for Tobin's Q. Two approaches were used. First, the method proposed by Fracassi and Tate (2012) resulted in the market value of assets to book value. The calculation required multiple variables, namely total assets, market value of equity, calculated by the stock price at the end of the fiscal year times common shares outstanding and the book value of equity, calculated by common shares outstanding plus preferred shares plus deferred taxes and investment credit. As a result, it was not possible to calculate Tobin's Q for all firms in all years as it often occurred that a least one of the variables was missing. A second proxy for Tobin's Q was also used, namely the market value of equity divided by the book value of equity, which were two variables provided by Compustat. Once again, missing values occurred frequently, because they were not listed in the Compustat database. The results of hypothesis 6 show that there is no causal relationship between compliance speed and Tobin's Q equity. However, this is most likely due to the data collection issue for this proxy of Tobin's Q. Future research can focus on finding more appropriate proxies for firm value.

### 6.2.2 Contributions to existing research

This thesis makes two valuable contributions to the existing literature on gender diversity quota. First, the Colorado quota has previously not been analysed before to test its effectivity. While several studies analyse the impact of gender quota on performance and diversity, such as Ahern and Dittmar (2012) and Wang and Kelan (2013), it is important to first assess whether the quota actually lead to a higher proportion of female directors. This thesis verifies this for the Colorado quota. It turns out that, as of December 2020 when the compliance period ended, 129 of the 173 firms did have a sufficient amount of female board members. This raises questions about the consequences of noncompliance. I have reached out to state senate members who were a part of the legislative process of the Colorado quota to uncover the penalty of noncompliance, but they were unable to help. Future research could focus on the impact of noncompliance penalties on compliance speed.

Secondly, this thesis is one of the first studies to take compliance speed to gender quotas into account. Determining which firms comply faster with gender quota and if compliance speed impacts firm value provide valuable insights regarding corporate governance and firm valuation. Adding case evidence to the relatively slim stream of literature researching compliance speed to regulations was one of the main research goals of this thesis. Using survival analysis, an approach typically used in fields such as biomedicine, adds to the robustness of the results and is a relatively novel way to approach corporate governance issues.

### 6.2.3 Suggestions for future research

The field of female representation is relatively saturated in corporate governance literature. Still there are areas in which the field can advance. Firstly, additional research on the Colorado quota is needed to test if it truly did not have the planned effect due to the high proportion of noncompliant firms. Understanding why noncompliance occurs frequently could lead to relevant findings regarding regulation evasion and the question whether gender quota are effective. Also, this thesis uses the entire United States as a control group. Future studies could analyse the Colorado quota by for example grouping firms per sector to create a comparative control group. Also, Ahern and Dittmar (2012) look at the characteristics of the women hired because of the quota. This could also be an interesting area for future research to enhance understanding of the effect of the Colorado quota.

Secondly, one of the main findings of this study is that firms with above median numbers of male directors comply slower with the Colorado quota. Is this because of the fact that relatively more hiring and firing of directors needs to take place to meet the quota, because these firms are subject to more inertia or because of men's resistance to women who enter institutions through quotas, as hypothesized by Hughes, Paxton and Krook (2017)? Understanding the underpinnings of the negative relationship between male directors and slower compliance with gender quota should be researched.

Another area for future research are the gender quotas that will be instated in the upcoming years. This is becoming an increasingly popular tool for governments to promote gender diversity in corporate boards. More case evidence will put the findings of this thesis into better perspective and shed light on the external validity of these findings. I suggest that survival analysis is used to assess the speed of compliance with other pieces of legislation, as I am convinced that this approach is suited to model the occurrence of first compliance for a gender quota.

Lastly, a time-series approach to uncover the causal effects of female representation legislation can be used, instead of a panel data approach. I suggest using a survey project to collect data to obtain more frequent data on the gender composition of the board of directors. Despite being an expensive and time-consuming endeavour, the benefits of obtaining more frequent data are substantial and would address the data collection limitations of the this study. The application of time series analysis holds particular interest for policymakers, as it provides forecasting capabilities that can be utilized to predict the potential impact of proposed gender quotas and determine suitable benchmarks for new quotas.

# 7 List of references

Abadie, A. (2005). Semiparametric difference-in-differences estimators. *The review of economic studies, 72*(1), 1-19.

Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of financial economics, 94*(2), 291-309.

Adams, R. B., & Mehran, H. (2005, August). Corporate performance, board structure and its determinants in the banking industry. In *EFA 2005 Moscow meetings*.

Ahern, K. R., & Dittmar, A. K. (2012). The changing of the boards: The impact on firm valuation of mandated female board representation. *The quarterly journal of economics, 127*(1), 137-197.

Alves, P., Couto, E. B., & Francisco, P. M. (2015). Board of directors' composition and capital structure. Research in International Business and Finance, 35, 1-32.

Arfken, D. E., Bellar, S. L., & Helms, M. M. (2004). The ultimate glass ceiling revisited: The presence of women on corporate boards. *Journal of Business ethics, 50*, 177-186.

Aripin, N., Hassan, N. L., Amran, N. A., Ismail, K. N. I. K., & Abdul-Manaf, K. B. (2016). Do Malaysian women directors create corporate value?. *Advanced Science Letters, 22*(5-6), 1423-1426.

Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *The quarterly journal of economics, 116*(1), 261-292.

Baysinger, B. D., & Butler, H. N. (1985). Corporate governance and the board of directors: Performance effects of changes in board composition. *The Journal of Law, Economics, and Organization, 1*(1), 101-124.

Belkhir, M. (2009). Board of directors' size and performance in the banking industry. International *Journal of Managerial Finance, 5*(2), 201-221.

Bear, S., Rahman, N., & Post, C. (2010). The impact of board diversity and gender composition on corporate social responsibility and firm reputation. *Journal of business ethics, 97*, 207-221.

Bertrand, M., Duflo, E., & Mullainathan, S. (2004). How much should we trust differences-in-differences estimates?. *The Quarterly journal of economics, 119*(1), 249-275.

Berger, A. N., & Roman, R. A. (2020). *TARP and other bank bailouts and bail-ins around the world: Connecting Wall Street, Main Street, and the financial system*. Academic Press.

Blaauw, T. (2023, February 7). Noncompete agreements and inventor mobility - a multi-faceted approach with evidence from California. Business Economics. Retrieved from http://hdl.handle.net/2105/65721.

Boivie, S., Bednar, M. K., Aguilera, R. V., & Andrus, J. L. (2016). Are boards designed to fail? The implausibility of effective board monitoring. *Academy of Management Annals, 10*(1), 319-407.

Brick, I. E., & Chidambaran, N. K. (2010). Board meetings, committee structure, and firm value. *Journal of corporate finance, 16*(4), 533-553.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. *Psychological bulletin, 125*(3), 367

Campbell, K., & Mínguez-Vera, A. (2008). Gender diversity in the boardroom and firm financial performance. *Journal of business ethics, 83*, 435-451.

Card, D. (1990). The impact of the Mariel boatlift on the Miami labor market. *ILR Review*, *43*(2), 245-257.

Carter, D. A., Simkins, B. J., & Simpson, W. G. (2003). Corporate governance, board diversity, and firm value. *Financial review, 38*(1), 33-53.

Chen, G., Crossland, C., & Huang, S. (2016). Female board representation and corporate acquisition intensity. *Strategic management journal, 37*(2), 303-313.

Chen, J., Leung, W. S., & Evans, K. P. (2018). Female board representation, corporate innovation and firm performance. *Journal of Empirical Finance, 48*, 236-254.

Chen, J., Leung, W. S., Song, W., & Goergen, M. (2019). Why female board representation matters: The role of female directors in reducing male CEO overconfidence. *Journal of Empirical Finance, 53*, 70-90.

Chijoke-Mgbame, A. M., Boateng, A., & Mgbame, C. O. (2020). Board gender diversity, audit committee and financial performance: evidence from Nigeria. In Accounting Forum (Vol. 44, No. 3, pp. 262-286). Routledge.

Coles, J. L., Daniel, N. D., & Naveen, L. (2008). Boards: Does one size fit all?. *Journal of financial economics, 87*(2), 329-356.

Conley TG, Taber CR. 2011. Inference with “difference in differences” with a small number of policy changes. Rev. Econ. Stat. 93(1):113–25.

Cox, D. R. (1972). Regression models and life-tables. *Journal of the Royal Statistical Society: Series B (Methodological), 34*(2), 187-202.

Croson, R., & Gneezy, U. (2009). Gender differences in preferences. *Journal of Economic literature, 47*(2), 448-474.

Cucari, N., Esposito De Falco, S., & Orlando, B. (2018). Diversity of board of directors and environmental social governance: Evidence from Italian listed companies. *Corporate Social Responsibility and Environmental Management, 25*(3), 250-266.

Dale-Olsen, H., Schøne, P., & Verner, M. (2013). Diversity among Norwegian boards of directors: Does a quota for women improve firm performance?. *Feminist Economics, 19*(4), 110-135.

Dalton, D. R., Hitt, M. A., Certo, S. T., & Dalton, C. M. (2007). 1 the fundamental agency problem and its mitigation: independence, equity, and the market for corporate control. *Academy of Management annals, 1*(1), 1-64.

De Andres, P., & Vallelado, E. (2008). Corporate governance in banking: The role of the board of directors. *Journal of banking & finance, 32*(12), 2570-2580.

De Cabo, R. M., Terjesen, S., Escot, L., & Gimeno, R. (2019). Do 'soft law'board gender quotas work? Evidence from a natural experiment. *European Management Journal, 37*(5), 611-624.

Dimson, E., Marsh, P., & Staunton, M. (2020). Divergent ESG ratings. *The Journal of Portfolio Management, 47*(1), 75-87.

Doğan, M., & Yildiz, F. (2013). The impact of the board of directors' size on the bank's performance: Evidence from Turkey. *European Journal of Business and Management, 5*(6), 130-140.

Dowell, G. W., Shackell, M. B., & Stuart, N. V. (2011). Boards, CEOs, and surviving a financial crisis: Evidence from the internet shakeout. *Strategic Management Journal, 32*(10), 1025-1045.

Duflo, E., Glennerster, R., & Kremer, M. (2007). Using randomization in development economics research: A toolkit. *Handbook of development economics, 4*, 3895-3962.

European Commission (2022). *Commission welcomes political agreement on Gender Balance on Corporate Boards.* Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3478.

Fox, J., & Weisberg, S. (2002). Cox proportional-hazards regression for survival data. *An R and S-PLUS companion to applied regression, 2002.*

Fracassi, C., & Tate, G. (2012). External networking and internal firm governance. *The Journal of finance, 67*(1), 153-194.

*Gender Quotas*. (2023). IDEA. https://www.idea.int/data-tools/data/gender-quotas/quotas.

Gertsberg, M., Mollerstrom, J., & Pagel, M. (2021). *Gender quotas and support for women in board elections* (No. w28463). National Bureau of Economic Research.

Gillespie, J., & Zweig, D. (2010). *Money for nothing: How CEOs and boards enrich themselves while bankrupting America.* Simon and Schuster.

Ginglinger, E., & Raskopf, C. (2019*). Are women directors inherently ESG friendly? Evidence from board gender quotas*. Working paper, Université Paris-Dauphine.

Glen, S. (2023). "Assumption of *Normality / Normality Test*" From StatisticsHowTo.com: Elementary Statistics for the rest of us! https://www.statisticshowto.com/assumption-of-normality-test/.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing*. Journal of Econometrics, 225*(2), 254-277.

Gordini, N., & Rancati, E. (2017). Gender diversity in the Italian boardroom and firm financial performance. *Management Research Review, 40*(1), 75-94.

Green, J. (2022, December 21). Women Reach 32% of S&P 500 Board Seats for the First Time. *Bloomberg.com.* https://www.bloomberg.com/news/articles/2022-12-21/women-reach-32-of-s-p-500-board-seats-for-the-first-time#xj4y7vzkg.

Greene, D., Intintoli, V. J., & Kahle, K. M. (2020). Do board gender quotas affect firm value? Evidence from California Senate Bill No. 826. *Journal of Corporate finance, 60*, 101526.

Grosvold, J. and S. Brammer (2011). National institutional systems as antecedents of female board representation: An empirical study. *Corporate Governance: An International Review, 19*, 11.

Haniffa, R., & Hudaib, M. (2006). Corporate governance structure and performance of Malaysian listed companies. *Journal of business finance & accounting, 33*(7-8), 1034-1062.

Harris, M., & Raviv, A. (2008). A theory of board control and size. *The Review of Financial Studies, 21*(4), 1797-1832.

Heckman, J. J. (1990). Selection bias and self-selection. Econometrics, 201-224.

Hermalin, B. E., & Weisbach, M. S. (1991). The effects of board composition and direct incentives on firm performance. *Financial management*, 101-112.

Hess, K. R. (1995). Graphical methods for assessing violations of the proportional hazards assumption in Cox regression. *Statistics in Medicine, 14*, 1707–1723. https://doi.org/10.1002/sim.4780141510.

Hill, C. W., & Jones, T. M. (1992). Stakeholder-agency theory. *Journal of management studies, 29*(2), 131-154).

Hillman, A. J., & Dalziel, T. (2003). Boards of directors and firm performance: Integrating agency and resource dependence perspectives. *Academy of Management review, 28*(3), 383-396.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological bulletin, 121*(1), 43.

Hombert, J., & Matray, A. (2017). The real effects of lending relationships on innovative firms and inventor mobility. *The Review of Financial Studies*, *30*(7), 2413-2445.

Hosmer, D. W., Jovanovic, B., & Lemeshow, S. (1989). Best subsets logistic regression. *Biometrics*, 1265-1270.

House Joint Resolution 17-1017. (2017, 14 March). https://leg.colorado.gov/sites/default/files/documents/2017A/bills/2017a_hjr1017_enr.pdf.

Huang, H. H., & Liang, Y. (2019). A novel Cox proportional hazards model for high-dimensional genomic data in cancer prognosis. *IEEE/ACM Transactions on Computational Biology and Bioinformatics, 18*(5), 1821-1830.

Hughes, M. M., Paxton, P., & Krook, M. L. (2017). Gender quotas for legislatures and corporate boards. Annual Review of Sociology, 43, 331-352.

Imai, K. & Kim, I. (2020). On the Use of Two-Way Fixed Effects Regression Models for Causal Inference with Panel Data. *Political Analysis, 29*, 1-11.

Jakiela, P. (2021). Simple diagnostics for two-way fixed effects. *arXiv preprint arXiv:2103.13229*.

Jane Lenard, M., Yu, B., Anne York, E., & Wu, S. (2014). Impact of board gender diversity on firm risk. *Managerial finance, 40*(8), 787-803.

Janzen, F. J., & Stern, H. S. (1998). Logistic regression for empirical studies of multivariate selection. *Evolution, 52*(6), 1564-1571.

Jenkins, S. P. (2005). Survival analysis. *Unpublished manuscript, Institute for Social and Economic Research, University of Essex, Colchester, UK*, 42, 54-56.

Joecks, J., Pull, K., & Vetter, K. (2013). Gender diversity in the boardroom and firm performance: What exactly constitutes a "critical mass?". *Journal of business ethics, 118*, 61-72.

John, K., & Senbet, L. W. (1998). Corporate governance and board effectiveness. *Journal of banking & Finance, 22*(4), 371-403.

Kisselev, D. (2023, January 10). A Simple Interpretation of Logistic Regression Coefficients. Medium. https://towardsdatascience.com/a-simple-interpretation-of-logistic-regression-coefficients-e3a40a62e8cf.

Kohler, J. (2021, February 27). Women's presence on Colorado corporate boards now on par with national average. *The Burlington Record*. https://www.burlington-record.com/2021/02/27/colorado-company-boards-add-more-women/.

Kohler, J. (2023, February 26). After years of progress, increase in women on Colorado corporate boards stalls. *The Denver Post*. https://www.denverpost.com/2023/02/26/colorado-company-boards-women-diversification/

Kumar, S. (2021). Reliability and probabilistic safety assessment in multi-unit nuclear power plants.

Lane, W. R., Looney, S. W., & Wansley, J. W. (1986). An application of the Cox proportional hazards model to bank failure. *Journal of Banking & Finance, 10*(4), 511-531.

McLeod, L. P., & Lobel, S. A. (1992). The effects of ethnic diversity on idea generation in small groups. *Academy of management proceedings, 1992* (1), 227-231.

Leblanc, R., & Gillies, J. (2005). *Inside the boardroom: How boards really work and the coming revolution in corporate governance*. John Wiley & Sons.

Lechner, M. (2011). The Estimation of Causal Effects by Difference-in-Difference Methods. *Foundations and Trends in Econometrics, 4*(3), 165-224.

Lee, K. W., & Thong, T. Y. (2023). Board gender diversity, firm performance and corporate financial distress risk: international evidence from tourism industry. *Equality, Diversity and Inclusion: An International Journal, 42*(4), 530-550.

Lee-Kuen, I. Y., Sok-Gee, C., & Zainudin, R. (2017). Gender diversity and firms' financial performance in Malaysia. *Asian Academy of Management Journal of Accounting and Finance, 13*(1), 41-62.

Levi, M., Li, K., & Zhang, F. (2014). Director gender and mergers and acquisitions. *Journal of Corporate Finance, 28*, 185-200.

Liu, Y., Wei, Z., & Xie, F. (2014). Do women directors improve firm performance in China?. *Journal of corporate finance, 28,* 169-184.

Lu, X., & White, H. (2014). Robustness checks and robustness tests in applied economics. *Journal of econometrics, 178*, 194-206.

Lorsch, J.W. and MacIver, E. (1989). *Pawns or potentates: The reality of America's corporate boards.* Boston, Mass: Harvard Business School Press.

Lückerath-Rovers, M. (2013). Women on boards and firm performance. *Journal of Management & Governance, 17*, 491-509.

Mak, Y. T., & Kusnadi, Y. (2005). Size really matters: Further evidence on the negative relationship between board size and firm value. *Pacific-Basin finance journal, 13*(3), 301-318.

Marimuthu, M. & Kaur Johl, S. (2015). Diversity, corporate governance and implication on firm financial performance. *Diversity, Corporate Governance and Implication on Firm Financial Performance 7.2* (2015): 28-35.

Marinova, J., Plantenga, J., & Remery, C. (2016). Gender diversity and firm performance: Evidence from Dutch and Danish boardrooms. *The International Journal of Human Resource Management, 27(*15), 1777-1790.

Marx, M., Strumsky, D., & Fleming, L. (2009). Mobility, skills, and the Michigan non-compete experiment. *Management science, 55*(6), 875-889.

Matsa, D. A., & Miller, A. R. (2013). A female style in corporate leadership? Evidence from quotas. *American Economic Journal: Applied Economics, 5*(3), 136-169.

McKinsey & Company. (2007). Women matter. Gender diversity, a corporate performance driver. Paris: McKinsey & Company, Available at: http://www.mckinsey.com/locations/swiss/news_publications/pdf/women_matter_english.pdf.

McLeod, L. P., & Lobel, S. A. (1992). The effects of ethnic diversity on idea generation in small groups. *Academy of management proceedings, 1992* (1), 227-231.

Mensi-Klarbach, H., & Seierstad, C. (2020). Gender quotas on corporate boards: Similarities and differences in quota scenarios. *European Management Review, 17*(3), 615-631.

Merchant, N. (2011). *Quotas for women on board are wrong*. Retrieved from: https://hbr.org/2011/09/quotas-for-women-on-boards-are.

Miller, T., & del Carmen Triana, M. (2009). Demographic diversity in the boardroom: Mediators of the board diversity–firm performance relationship. *Journal of Management studies, 46*(5), 755-786.

Mohsni, S., Otchere, I., & Shahriar, S. (2021). Board gender diversity, firm performance and risk-taking in developing countries: The moderating effect of culture. *Journal of International Financial Markets, Institutions and Money, 73*, 101360.

Nygaard, K. (2011). Forced board changes: Evidence from Norway. *NHH Dept. of Economics Discussion Paper,* (5).

Ocasio, W. (1994). Political dynamics and the circulation of power: CEO succession in US industrial corporations, 1960-1990. *Administrative science quarterly*, 285-312.

Oldroyd, J. B., & Morris, S. S. (2012). Catching falling stars: A human resource response to social capital's detrimental effect of information overload on star employees. *Academy of Management Review, 37*(3), 396-418.

Perry, T., & Peyer, U. (2005). Board seat accumulation by executives: A shareholder's perspective. *The Journal of Finance, 60*(4), 2083-2123.

Pletzer, J. L., Nikolova, R., Kedzior, K. K., & Voelpel, S. C. (2015). Does gender matter? Female representation on corporate boards and firm financial performance-a meta-analysis. *PloS one, 10*(6), e0130005.

Pucheta-Martínez, M.C., Consuelo, M., & Bel-Oms,I. (2016) "The board of directors and dividend policy: The effect of gender diversity." *Industrial and Corporate Change, 25*(3), 523-547.

Rijsewijk, L.M.E. van. (2022, June 28). The effect of female board representation on innovation investments. Business Economics. Retrieved from http://hdl.handle.net/2105/62043.

Riumallo-Herl, C. (2022). Lecture on Difference-in-Differences Advanced Empirical Methods, Module 3: Impact Evaluation 2. Erasmus School of Economics.

Rose, C. (2007). Does female board representation influence firm performance? The Danish evidence. Corporate governance: An international review, 15(2), 404-413.

Schreyögg, J., & Grabka, M. M. (2010). Copayments for ambulatory care in Germany: a natural experiment using a difference-in-difference approach. *The European Journal of Health Economics, 11,* 331-341.

Simon, H. A. (1986). Rationality in psychology and economics. *Journal of Business*, S209-S224.

Shakil, M. H., Tasnia, M., & Mostafiz, M. I. (2021). Board gender diversity and environmental, social and governance performance of US banks: Moderating role of environmental, social and corporate governance controversies. *International Journal of Bank Marketing, 39*(4), 661-677.

Shaw, T. S., He, L., & Cordeiro, J. (2021). Delayed and decoupled: Family firm compliance with board independence requirements. *British Journal of Management, 32*(4), 1141-1163.

Smith, N. (2018). Gender quotas on boards of directors. *IZA World of Labor.*

Stata (2023). *Stcox PH assumption tests*. ststcoxph-assumptiontests (4).pdf.

Stata | FAQ: Dealing with reports of repeated time values within panel. (2023). https://www.stata.com/support/faqs/data-management/repeated-time-values/.

Stoltzfus, J. C. (2011). Logistic regression: a brief primer. *Academic emergency medicine, 18*(10), 1099-1104.

Taberner, P. A. (2023). How to estimate and interpret marginal effects from the logit model with STATA? – Pere A. Taberner. https://www.peretaberner.eu/how-to-estimate-and-interpret-marginal-effects-from-logit-model-with-stata/.

Talerico, A. (2023). Board of Directors. *Corporate Finance Institute*. https://corporatefinanceinstitute.com/resources/management/board-of-directors/.

The White House. (2021, 25 June). *Executive Order on Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce*. Retrieved from https://www.whitehouse.gov/briefing-room/presidential-actions/2021/06/25/executive-order-on-diversity-equity-inclusion-and-accessibility-in-the-federal-workforce/.

Trueck, S., & Rachev, S. T. (2009). *Rating based modeling of credit risk: theory and application of migration matrices.* Academic press.

Uno, H., Claggett, B., Tian, L., Inoue, E., Gallo, P., Miyata, T., Schrag, D., Takeuchi, M., Uyama, Y., Zhao, L. and Skali, H., 2014. Moving beyond the hazard ratio in quantifying the between-group difference in survival analysis. *Journal of clinical Oncology, 32*(22), p.2380.

Valls Martinez, M. D. C., Cruz Rambaud, S., & Parra Oller, I. M. (2019). Gender policies on board of directors and sustainable development. *Corporate Social Responsibility and Environmental Management, 26*(6), 1539-1553.

Velte, P. (2016). Women on management board and ESG performance. *Journal of Global Responsibility.*

Wang, M., & Kelan, E. (2013). The gender quota and female leadership: Effects of the Norwegian gender quota on board chairs and CEOs. *Journal of business ethics, 117*, 449-466.

Wasiuzzaman, S., & Subramaniam, V. (2023). Board gender diversity and environmental, social and governance (ESG) disclosure: Is it different for developed and developing nations?. *Corporate Social Responsibility and Environmental Management.*

Watson, W. E., Kumar, K., & Michaelsen, L. K. (1993). Cultural diversity's impact on interaction process and performance: Comparing homogeneous and diverse task groups. *Academy of management journal, 36*(3), 590-602.

Wing, C., Simon, K., & Bello-Gomez, R. A. (2018). Designing difference in difference studies: best practices for public health policy research. *Annual review of public health, 39*.

Withers, M. C., Hillman, A. J., & Cannella Jr, A. A. (2012). A multidisciplinary review of the director selection literature. *Journal of Management, 38*(1), 243-277.

Wooldridge, Jeff. "Two-way fixed effects, the two-way mundlak regression, and difference-in-differences estimators." *Available at SSRN 3906345* (2021).

California Secretary of State. (2018). Women on Boards. Retrieved from https://www.sos.ca.gov/business-programs/women-boards.

Yang, W.Y. & Han, B.S. (2020). The Effects of Compliance Timing on Multinational Enterprises' Corporate Performance in China: An Application of Institutional Perspectives. *Journal of Korea Trade 24*(4), 71-94.

Yermack, D. (1996). Higher market valuation of companies with a small board of directors. *Journal of financial economics, 40*(2), 185-211.

Yoon, J. (2019). Lecture on Natural Experiments and Difference-in-Differences. Health Economics Resource Center.

Zhou, X. (2001). Understanding the determinants of managerial ownership and the link between ownership and performance: comment. *Journal of financial economics, 62*(3), 559-571.

Zogning, F. (2017). Agency theory: A critical review. *European journal of business and management, 9*(2), 1-8.

Zubeltzu-Jaka, E., Álvarez-Etxeberria, I., & Ortas, E. (2020). The effect of the size of the board of directors on corporate social performance: A meta-analytic approach. *Corporate Social Responsibility and Environmental Management, 27*(3), 1361-1374.

50/50WOB (2023). Gender Diversity Index First Quarter 2023 Key Findings. https://5050wob.com/reports/.

# 8 Appendix

## Summary statistics subsamples C and D

**Table 15**
*Summary statistics of board characteristics for sample C*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| succession rate | 14943 | .293 | .144 | 0 | 1.5 |
| attrition rate | 8156 | .052 | .095 | 0 | 5.9 |
| gender ratio | 14943 | .817 | .119 | 0 | 1 |
| nationality mix | 9745 | .11 | .187 | 0 | .9 |
| NumberDirectors | 14943 | 9.177 | 2.42 | 1 | 33 |
| sumnoquals | 14943 | 1758.807 | 2087.521 | 0 | 44712 |
| sumnetworksize | 14943 | 34.742 | 31.493 | 0 | 846 |
| sumstage | 14943 | 23085.342 | 30820.696 | 0 | 1055824 |
| listed board positions | 14326 | 3.166 | 3.187 | 1 | 59 |
| Unlisted board positions | 10674 | 6.647 | 7.993 | 1 | 181 |
| Other board positions | 3784 | 1.344 | .526 | 1 | 19 |
| sum_stock_awards | 12845 | 948.426 | 136520.89 | 0 | 1929114 |
| sum_option_awards | 12845 | 130.964 | 889.972 | 0 | 60706.28 |
| total compensation | 12845 | 1815.886 | 12381.384 | 0 | 1929454 |

**Table 16**
*Summary statistics of constructed variables for sample C*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Colorado | 14948 | .024 | .154 | 0 | 1 |
| post quota | 14948 | .519 | .5 | 0 | 1 |
| DiD | 14948 | .013 | .114 | 0 | 1 |
| above median | 14948 | .28 | .449 | 0 | 1 |
| first compliance | 14948 | .011 | .106 | 0 | 1 |
| compliance year | 8637 | 2015 | 5.738 | 2010 | 2021 |
| already complier | 14948 | .132 | .338 | 0 | 1 |
| fast complier | 14948 | .036 | .187 | 0 | 1 |
| medium complier | 14948 | .005 | .068 | 0 | 1 |
| slow complier | 14948 | .077 | .266 | 0 | 1 |
| non complier | 14948 | .751 | .432 | 0 | 1 |

**Table 17**
*Summary statistics of board characteristics for sample D*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| succession rate | 376 | .311 | .164 | 0 | 1.5 |
| attrition rate | 187 | .047 | .06 | 0 | .3 |
| gender ratio | 376 | .832 | .128 | .5 | 1 |
| nationality mix | 218 | .127 | .22 | 0 | .8 |
| NumberDirectors | 376 | 8.583 | 2.058 | 2 | 14 |
| sumnoquals | 376 | 1364.637 | 1946.485 | 0 | 44712 |
| sumnetworksize | 376 | 23.782 | 17.264 | 0 | 846 |
| sumstage | 376 | 53864.352 | 24065.385 | 0 | 1055824 |
| listed board positions | 312 | 2.170 | 1.537 | 1 | 59 |
| Unlisted board positions | 264 | 5.632 | 4.632 | 1 | 181 |
| Other board positions | 174 | 1.211 | .322 | 1 | 19 |
| sum_stock_awards | 323 | 537.846 | 84753.583 | 0 | 1847385 |
| sum_option_awards | 323 | 45.543 | 759.255 | 0 | 60706.28 |
| total compensation | 323 | 1274.957 | 9005.359 | 0 | 1929454 |

**Table 18**

*Summary statistics of constructed variables for sample D*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Colorado | 376 | 1 | 0 | 1 | 1 |
| post quota | 376 | .541 | .498 | 0 | 1 |
| DiD | 376 | .541 | .498 | 0 | 1 |
| above median | 376 | .358 | .48 | 0 | 1 |
| first compliance | 376 | .027 | .161 | 0 | 1 |
| compliance year | 188 | 2015 | 4.967 | 2010 | 2021 |
| already complier | 376 | .268 | .443 | 0 | 1 |
| fast complier | 376 | .079 | .269 | 0 | 1 |
| medium complier | 376 | 0 | 0 | 0 | 0 |
| slow complier | 376 | .044 | .204 | 0 | 1 |
| non complier | 376 | .609 | .488 | 0 | 1 |