Do Board Gender Quotas affect Managerial Overconfidence? Evidence from California Senate Bill No. 826

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By

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Abstract

This study investigates the impact of California's gender quota, Senate Bill 826, on the overconfidence levels of male CEOs in California, compared to CEOs in states without a similar policy. Previous research suggested that the presence of female directors tends to temper male CEO's overconfidence. Based on this premise, the central research question probed whether SB 826, aimed at increasing female board representation, would similarly affect male CEO overconfidence. To explore this, the study employed a difference-in-differences methodology using data from ExecuComp, ISS, and Compustat, spanning from 2014 to 2021. CEOs of California-based firms were compared to a control group from states that have not historically supported Democratic presidential candidates, presuming these states are less likely to adopt similar gender quota policies. Contrary to expectations, the findings do not support the hypothesis that the enactment of SB 826 led to reduced levels of overconfidence among male CEOs in California compared to those in other states. The results were robust across various matched control samples and timeframes. The study further highlights the complexities involved in measuring CEO overconfidence, suggesting that interpretations can vary depending on the metrics used. This research contributes to the growing body of literature on corporate governance and behavioural finance by being the first to examine the potential effects of gender quotas on managerial overconfidence. It challenges pre-existing views and provides valuable insights for policymakers and stakeholders interested in understanding how structural changes in board composition influence CEO behaviour.

Keywords: CEO overconfidence, gender quotas, board diversity

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1. Introduction

In his signing statement, Governor Brown stated that "*it is high time corporate boards include the people who constitute more than half the 'persons' in America."* This statement was made on September 30, 2018, when Governor Brown signed California Senate Bill No. 826 (SB 826) into law. The main goal of this reform was to improve the representation of women in leadership roles within the corporate sector and address the gender pay gap in that field (Bertrand et al., 2019). California SB 826 required that all publicly traded companies headquartered in the state have at least one female board member by the end of 2019. Moreover, for boards consisting of five or more directors, a minimum of two female directors is mandated by the end of 2021, and this number increases to three for boards with six or more directors. Given the persistent underrepresentation of women on corporate boards, the issue of board composition and gender diversity remains not only relevant but central to discussions of corporate governance (Terjesen et al., 2009).

Empirical research offers mixed insights into the impact of gender-diverse boards on firm performance. While some studies, such as those by Campbell and Mínguez-Vera (2008) and Dezsö and Ross (2012), indicate a positive influence of board gender diversity on firm outcomes, others like Adams and Ferreira (2009) suggest an average negative effect. Chapple and Humphrey (2014) find no conclusive evidence linking board diversity to performance, and Matsa and Miller (2013) report both positive and negative effects. Thus, while the evidence on the impact of gender-diverse boards on firm performance remains inconclusive, literature suggests that female directors positively impact corporate governance by mitigating CEO dominance through a 'power-sharing' approach (Burgess and Tharenou, 2002). They offer unique values and risk profiles (Adams and Funk, 2012), and enhance the range of expertise available in boardrooms (Kim and Starks, 2016).

Given the impact of gender diversity on corporate boards and its influence on CEO decision-making, it becomes compelling to examine how such diversity specifically affects CEO behaviour. Prior research, like Chen et al. (2019), have already delved into the relationship between CEO behaviour and female board representation, focusing particularly on signs of overconfidence among male CEOs. According to their research, male CEOs in companies with female board members are less likely to hold onto deep-in-the-money options. This suggests that having women on the board may mitigate a male CEO's overconfidence regarding the company's future prospects. Building on these findings, I identify a gap in existing literature concerning whether gender quotas, designed to improve board diversity, could also have an effect on male CEO overconfidence. This leads me to formulate the following main research question. *How does the California gender quota impact male CEO overconfidence, and how does this compare to firms in states without a similar gender quota policy?*

Considering that female directors often exhibit greater caution in decision-making, I anticipate that the enactment of SB 826, mandating the addition of female directors to boards, could potentially temper the overconfidence of male CEOs. This leads to the formulation of the following main hypothesis. *After*

the implementation of SB 826, male CEOs of California companies exhibit reduced overconfidence in comparison to male CEOs of companies based outside California. Throughout this study, the term 'male CEO' will be simplified to 'CEO'.

I seek to explore this hypothesis by examining whether the CEO's exercise of stock options, indicative of their level of overconfidence, is influenced by the California gender quota. The CEO's decisions regarding option exercise provide an ideal setting for addressing both the hypothesis and research question. Firstly, stock options form a significant part of executive compensation (Hall and Murphy, 2002), making the exercise and timing of options an important aspect of CEO's individual wealth management and more likely to reflect their personal beliefs. Secondly, CEO's personal choices in their portfolios offer insights into their perceptions of future firm performance. Existing literature suggests that manager who willingly embrace exposure to the firm's specific risks typically hold confidence in the firm's future prospects (Malmendier and Tate, 2005).

A growing body of evidence suggests that a substantial portion of corporate executives exhibit indications of overconfidence in their decision-making (Malmendier and Tate, 2015). Considering the pivotal role of CEOs as primary decision-makers within companies, it is likely that overconfidence is even more prevalent among this group (Graham et al., 2013).

To assess the potential impact of SB 826 on male CEO overconfidence, I employ a methodology similar to that of Campbell et al. (2011), Hirshleifer et al. (2012), and Chen et al. (2019). This involves calculating the moneyness of CEO's option portfolios, which represents the extent to which the stock price exceeds the exercise price. This measure serves as a proxy for their levels of (over)confidence. In this context, CEOs who choose to retain stock options beyond the vesting period, when exercise becomes possible, are considered overconfident (Hirshleifer et al., 2012). This perception arises from the tendency of risk-averse individuals, who favour diversification, to exercise their executive options early (Malmendier and Tate, 2005).

To identify the companies affected by California's SB 826, I utilize the ExecuComp database to gather data on male CEOs leading California-based firms listed on major stock exchanges from 2014 to 2021. This data includes details on their stock and option holdings as well as patterns of option exercise. Additionally, I use ExecuComp to collect various CEO characteristics. For board characteristics, I rely on data from ISS, while accounting data is sourced from Compustat. Stock return data is obtained from CRSP. I specifically exclude CEOs from financial firms and those categorized as 'durable' under the Fama and French 12-industry classification.

I utilize a control sample approach similar to Greene et al. (2020). In this approach, I generate a sample of companies that were not directly affected by SB 826. Specifically, I exclude firms headquartered in states that have consistently supported the Democratic presidential candidate from 2000 to 2016. This exclusion is based on the probability that such states would be more likely to enact similar legislation in line with their political stance.

To enhance the validity of the findings in this study, I implement a variety of control samples. These are constructed using different matching procedures to produce non-California firm-year observations that closely align with California firm-years in terms of observable characteristics. In addition, I investigate alternative timelines, different metrics for assessing overconfidence, and additional measures designed to evaluate the impact of the SB 826 requirements.

To assess the data, I employ a difference-in-differences methodology. This approach helps to isolate the effects of the enactment of SB 826 from other confounding variables. This strategy is particularly effective for isolating the effects of SB 826's enactment by controlling for time variations and pre-existing differences between firms in California and those in other states. Utilizing this methodology will strengthen the robustness of the conclusions regarding the impact of SB 826 on CEO overconfidence within California-based firms.

To the best of my knowledge, this paper is the first to investigate the impact of gender quotas on managerial overconfidence, offering a new angle to the established body of research in corporate governance and behavioural finance. This study enhances existing literature by offering fresh insights into the impact of gender quotas, with a specific emphasis on CEO overconfidence. Additionally, the research fills a gap in the limited body of work on the effects of SB 826, which has not been extensively covered due to its recent enactment. Notable studies examining the effects of California's SB 826 include studies by Hwang et al. (2021), Greene et al. (2020), and von Meyerinck et al. (2019). Greene et al. (2020) identified a significant negative stock market return for publicly traded companies headquartered in California in response to the enactment of SB 826. Similarly, von Meyerinck et al. (2019) reported significant negative returns upon the announcement of SB 826, not just for California-based companies but also revealing a spill-over effect affecting firms outside California. Hwang et al. (2021) discovered that SB 826 led to a decrease in shareholder value for California-based firms. This decline became more pronounced as the mandated number of female directors to meet the quota increased.

This study aims to expand existing limited research on SB 826, providing timely insights into its broader managerial implications beyond board composition and firm performance.

The paper will be structured as follows. The next section will provide an explanation of the background, timeline, and the implications of SB 826 for California firms. In Section 3, a thorough literature review will be conducted, focusing on prior research related to overconfidence, gender diversity and quotas, and their impact on firms. This section will also include the development of hypotheses. Section 4 outlines the methodology, the sources of data, and research design employed in this study. Moving forward, Section 5 will be dedicated to presenting the obtained results. In Section 6, the implications of this paper will be discussed, limitations will be acknowledged, and avenues for future research will be suggested. Finally, Section 7 will answer the main research question and summarize the key conclusions.

2. California Senate Bill No. 826

During the mid to late 2000s, there was an increased focus on diversifying corporate boards, driven by investors and regulators. Although some European countries implemented gender quotas for public stock exchange participation, such quotas were not widespread, and until 2018, there were no mandatory requirements for gender diversity in US firms. However, stakeholders and governance advisory firms exerted pressure on firms to review their board composition and enhance the representation of female directors. Several states in the US, including Illinois, Massachusetts, Colorado, Pennsylvania, and California, passed non-binding resolutions encouraging firms to increase female board representation. (Hwang et al., 2021).

In 2013, California introduced SCR-62, a measure encouraging firms to increase the representation of female directors to at least 25% of the board within a three-year timeframe. However, despite the voluntary nature of the measure, most firms failed to meet the recommended target during the subsequent three years. To address this, California enacted SB 826, which mandates that all publicly listed companies headquartered in California must have at least one female director by the end of 2019. Furthermore, boards with five or more directors must have at least two female directors (or three for boards with six or more directors) by the end of 2021. Failure to comply with the law results in penalties, with a $100,000 fine for the first violation and a $300,000 fine for subsequent offenses. Each instance of a deficiency in female directors is considered a violation, which means that firms with all-male boards of six or more directors could face an annual penalty of up to $900,000 if they do not adhere to the law.

The bill's major legislative events, obtained from the California Assembly and Senate Daily Journal archive, occurred as follows: SB 826 was initially introduced on January 3, 2018. It passed the Senate on May 31, 2018, with 22 votes in favour and 11 votes against. On August 29, 2018, it passed in the Assembly, with 41 votes in favour and 26 votes against. The bill was confirmed as amended in the Senate on August 30, 2018. Finally, on September 30, 2018, SB 826 was signed into law by Governor Brown.

Senate bills are typically assigned to specific subcommittees, in order to evaluate the practicality of the proposed bill. These subcommittees, composed of a subset of Senate or Assembly members, convene to discuss and deliberate on the bill, listen to testimonies, and ultimately determine whether the bill should advance to the Senate or Assembly floor. Notably, SB-826 underwent multiple rounds of review by both the Appropriations and Judicial Committee. This reflects concerns related to the constitutionality of gender quotas and anticipated legal challenges, aligning with the Governor's expressed doubts about the bill's ability to withstand such challenges.

In conclusion, it was determined that SB 826 violates the Commerce Clause of the United States Constitution. It claims to apply to corporations based in California but chartered outside of California. According to the United States Supreme Court, a corporation's internal affairs, including rules regarding its board of directors and shareholder elections, are governed by the state where it is incorporated, not

the state where it is headquartered (Grundfest, 2018). As expected, legal challenges followed, leading to a California Judge declaring SB-826 unconstitutional on May 13, 2022.

3. Literature review

This section begins with a broad review of existing literature on overconfidence, followed by a breakdown of the available literature concerning CEO overconfidence and its implications. Subsequently, the literature related to gender diversity on corporate boards and gender quotas is presented. The final subsection concludes by outlining the research hypothesis.

3.1 Overconfidence

Overconfidence is the tendency of individuals to think that they are better than they really are in terms of characteristics such as ability, judgment, or prospects for successful life outcomes (Hirshleifer et al., 2012). In the existing literature, terms like overestimation, optimism, and overconfidence are often used interchangeably. There are several behavioural biases that are commonly associated with overconfidence. One such bias is the better-than-average effect, where most individuals tend to view themselves as above-average in intelligence or skills (Svenson, 1981). Another bias, the illusion of control, arises from an exaggerated belief in one's ability to control external events (Langer, 1975). Besides the illusion of control, a substantial level of commitment to a positive outcome and abstract reference points that hinder performance comparison between individuals can result in overconfidence (Malmendier and Tate, 2005). Researchers have been exploring the reasons behind the widespread occurrence of overconfidence and the intriguing aspect of why individuals often fail to learn from their past mistakes (Bhandari and Deaves, 2006).

Ben-David et al. (2013) propose an alternative view of overconfidence, defining it as a general miscalibration in beliefs. This miscalibration is commonly associated with the bias of overestimation, where individuals tend to overestimate the accuracy of their own beliefs or underestimate uncertainty in risky situations, leading to narrower subjective probability distributions (Ben-David et al., 2013). In practical terms, this means that miscalibrated investors end up underestimating the volatility of their firm's future cash flows.

Thus, overconfidence refers to a person's belief in their judgment, cognitive abilities, rational reasoning, and intellect, leading them to exaggerate their predictive abilities and the accuracy of information they possess. This overconfidence can significantly impact decision-making processes (Pompian, 2012). When investors make decisions about investments, they often face a trade-off between the expected return and the associated risks. Consequently, an investor's perspective on risk can influence their investment choices (Nofsinger, 2022; Pompian, 2012). An overconfident investor tends to underestimate the level of risk involved, leading to potentially sub-optimal asset allocation decisions (Dittrich, Güth, & Maciejovsky, 2005). Rational investors engage in trading only when the expected gains outweigh the transaction costs. However, overconfident investors tend to overestimate the accuracy of their information, leading them to anticipate higher gains from trading (Barber and Odean, 2001). Extensive past research has consistently shown that greater levels of overconfidence are

associated with increased trading activity (Barber and Odean, 2001; Deaves et al., 2009; Grinblatt and Keloharju, 2009; Pikulina et al., 2017). Moreover, these studies also indicate that men tend to trade more frequently than women, leading to a greater reduction in their overall returns (Barber and Odean, 2001).

3.1.1 CEO overconfidence

A considerable and increasing amount of evidence indicates that a significant proportion of top-level corporate executives display signs of overconfidence in their decision-making (Malmendier and Tate, 2015). Given that CEOs are the key decision-makers within the company, it is probable that overconfidence is even more prevalent among them (Graham et al., 2013). Moreover, according to existing literature, executives tend to exhibit higher levels of overconfidence compared to the average population (Malmendier and Tate, 2005). This is attributed to the likelihood that top corporate executives meet two particular conditions. Firstly, according to Langer (1975), individuals tend to be most optimistic about outcomes they believe they can control. Considering a CEO's authority in making significant strategic choices and determining the fate of substantial investments or mergers, this position may lead them to believe they can control the outcome, potentially causing them to underestimate the possibility of failure (Malmendier and Tate, 2005). Secondly, Weinstein (1980) suggests that individuals are more likely to overestimate outcomes they are strongly committed to. Given that a considerable portion of executive compensation is tied to the company's performance, specifically through stocks and options, it is natural to expect CEOs to be highly committed to the results of their corporate decisions, not only due to financial reasons but also for personal motivation (Malmendier and Tate, 2005).

Researchers have explored various methods to measure CEO overconfidence. One of the most commonly used approaches, initially introduced in Malmendier and Tate (2005) and later revisited in Malmendier and Tate (2008; 2011), revolves around analysing the decisions made by executives concerning their personal portfolios of company stock options. This approach is grounded in the fact that top executives in the US receive significant stock and option grants as part of their compensation (Hall and Murphy, 2003), resulting in a lack of diversification in company-specific risk. Due to constraints on selling, vesting periods, and contractual limitations on short-selling, these executives have limited means to address this issue. A rational and risk-averse executive would typically opt to exercise their vested stock options before they expire to achieve diversification (Malmendier and Tate, 2015). However, overconfident executives tend to overestimate their firms' future performance, leading them to hold onto options, anticipating future stock price appreciation.

Another way to assess CEO overconfidence in existing literature is by examining managerial forecasts of earnings as a potential approach for researchers to observe overconfident beliefs (Otto, 2014). In this context, Otto (2014) gauges CEO overconfidence by analysing the percentage of a company's voluntary earnings forecasts that later turn out to be higher than the actual earnings. Similarly, Malmendier and Tate (2008) use a different method to measure CEO overconfidence. They analyse the

portrayal of CEOs in the business press and count past articles from prominent business publications like the Wall Street Journal or BusinessWeek. By examining the frequency of words suggesting overconfidence relative to words that do not imply overconfidence, they gauge CEO beliefs. Interestingly, this alternative measure shows a positive correlation with option-based measures and forecast-based measures (Malmendier and Tate, 2015).

Existing literature has extensively explored the implications of executive overconfidence, revealing varied findings on its impact. Malmendier and Tate (2005) suggest that when managers exhibit overconfidence, it can lead to distortions in corporate investment decisions. These confident managers tend to overestimate the returns of their investment projects and view external funding as unnecessarily costly. Consequently, they tend to invest excessively when internal funds are abundant, but they scale back on investment when external financing becomes necessary. This is in line with the overinvestment hypothesis, and it is also supported by Aktas et al. (2019) and Chen et al. (2020). Chen et al. (2020) discovered that CEO overconfidence's positive impact on cash level and value is primarily influenced by a company's investment environment. Similarly, Aktas et al. (2019) found that CEO overconfidence has a positive (negative) effect on cash value in financially constrained (unconstrained) firms, especially those with significant growth opportunities. This is supported by the research of Ben-David et al. (2013), where they found that companies led by overconfident Chief Financial Officers tend to make more investments, rely more on debt, are less likely to pay dividends, and favour share repurchases. Additionally, these companies lean towards using a relatively higher proportion of long-term debt in comparison to short-term debt. Furthermore, Deshmukh et al. (2013) back this up, demonstrating that an overconfident CEO also views external financing as costly and, therefore, builds financial slack by reducing current dividend payouts to meet future investment requirements.

When further examining the link between debt structure and overconfidence, Huang et al. (2016) found that companies with overconfident CEOs tend to favour shorter debt maturities and rely more on short-term debt, contradicting the results of Ben-David et al. (2013). Additionally, Lin et al. (2020) discovered that firms with highly overconfident CEOs have lower loan spreads. They also observed that this reduction in spreads is more noticeable when the loan contracts involve collateral or covenants. Ho et al. (2016) found that banks led by overconfident CEOs were more prone to easing lending standards and increasing leverage before a crisis. Consequently, these banks became more vulnerable to the shock of the crisis. In times of crisis, these banks tend to face more loan defaults, significant declines in operating and stock returns, increased expected default probability, and a higher chance of CEO turnover or failure compared to other banks. This indicates that CEO overconfidence could be the reason behind the varying levels of risk-taking behavior observed across different banks.

The research conducted in Malmendier and Tate (2008) investigates the relationship between CEO overconfidence and merger decisions. They discovered that the likelihood of making an acquisition increases by 65% when the CEO is classified as overconfident. This effect is particularly pronounced in cases where the merger aims to diversify the company's portfolio and does not require external funding.

Brown and Sarma (2007) also support the significance of CEO overconfidence in explaining acquisition decisions. Additionally, Ferris et al. (2013) found that CEO overconfidence plays a crucial role in various aspects of international merger activity. It explains the number of offers made by a CEO, the frequencies of non-diversifying and diversifying acquisitions, as well as the use of cash to finance merger deals.

In a study conducted by Galasso and Simcoe (2011), they explored the connection between CEOs' attitudes and beliefs and their firms' innovative performance. The findings revealed that CEOs who displayed overconfidence were more inclined to pursue innovation. Moreover, this effect was particularly pronounced in industries with higher levels of competition. Another study by Hirshleifer et al. (2012) discovered that firms led by overconfident CEOs experienced greater return volatility and showed a higher level of investment in innovation. Interestingly, these firms achieved greater success in terms of innovation relative to their research and development expenditures. However, this pattern was mainly observed in industries known for their innovative nature. These results suggest that overconfident CEOs can effectively capitalize on growth opportunities related to innovation.

Humphery-Jenner et al. (2016) conducted research on the impact of overconfidence on compensation structure. According to their findings, firms tend to offer incentive-heavy compensation contracts to overconfident CEOs. This is because they want to benefit from these CEOs' positive views of the company's prospects, and the strength of this relationship is influenced by the CEO's bargaining power. Otto (2014) also examines the link between CEO optimism and CEO compensation. By analysing data from US firms, the study presents evidence that CEOs displaying optimistic behavior in their option exercise and earnings forecasts receive smaller stock option grants, fewer bonus payments, and less total compensation compared to their peers. Campbell et al. (2011) shows that when a CEO´s optimism (i.e., overconfidence) goes above (below) the interior optimum level, it leads the CEO to overinvest (underinvest). As a result, if the board of directors acts in the best interests of shareholders, CEOs with extremely high or low optimism face a higher likelihood of forced turnover compared to those with moderate optimism. In Goel and Thakor (2008), CEO turnover is also investigated and a model is developed that demonstrates how overconfident managers, who occasionally make value-destroying investments, have a greater chance of being intentionally promoted to CEO under value-maximizing corporate governance than rational managers. Additionally, their research indicates that the board tends to dismiss both excessively cautious and excessively overconfident CEOs.

In summary, existing research extensively documents the prevalence of overconfidence among CEOs and its multi-faceted implications on corporate decision-making, from investment and financing choices to M&A activity and innovation. Various methods, such as option-based measures, managerial forecasts, and media portrayals, have been employed to measure CEO overconfidence. Despite its potential downsides, such as distorted investment behaviour and excessive risk-taking, overconfidence can also serve as a driver for innovation and aggressive growth strategies, indicating a complex relationship between CEO overconfidence and corporate performance.

3.2 Gender quota mandates

Changes in the representation and status of women on company boards requires changes in the policy and procedures that firms use when selecting directors. Numerous nations have addressed the issue of gender inequality in boardrooms by implementing compulsory quotas. Back in 2003, Norway took the pioneering step of introducing a gender quota, making it mandatory for 40% of directors in Norwegian firms to be female (Ahern and Dittmar, 2012; Matsa and Miller, 2013). The primary objective of this reform was to increase the presence of women in top positions within the corporate sector and reduce the gender pay gap in that field (Bertrand et al., 2019). In the wake of Norway's example, several other countries, including Belgium, France, Germany, Iceland, India, Israel, Italy, and Portugal, have also implemented comparable quotas (von Meyerinck et al., 2019).

Many researchers have taken advantage of this exogenous shock to board composition to investigate the effects of the Norwegian quota. Ahern and Dittmar (2012) discovered that due to constraints caused by the quota, there was a noticeable decrease in the stock price when the law was announced, along with a considerable decline in Tobin's q during the subsequent years. Yang et al. (2019) employed a difference-in-differences approach, using firms from Finland, Sweden, and Denmark as a control group. The findings suggest that requiring more female board representation has a negative impact on accounting performance and firm risk. Furthermore, Matsa and Miller (2013) suggests that companies impacted by the quota experienced a decrease in their short-term profits following its implementation. Bøhren and Staubo (2014) observed that imposing gender diversity on corporate boards is linked to a decline in firm value. This effect is most noticeable in smaller, younger, profitable companies that are not publicly listed and have only a small number of female directors.

However, in a recent study, Eckbo et al. (2022) presents evidence indicating a limited impact of Norway's gender quota on firm performance. They argue that by considering the collective movement of stocks when evaluating if event-related price changes are significant, and by refining the approach taken by Ahern and Dittmar (2012) to ensure it is exogenous to the announcement of the quota, the changes in stock returns and Tobin's q are not significant. Additionally, Eckbo et al. (2022) addresses two frequently cited pieces of evidence supporting the negative valuation impact of the quota suggested in Ahern and Dittmar (2012). To begin with, Matsa and Miller (2013) observed a decrease in the performance of public companies compared to unregulated private entities. Alternatively, the findings of Eckbo et al. (2022) suggest that this decrease in ROA is not directly linked to the quota. Next to that, both Ahern and Dittmar (2012) and Bøhren and Staubo (2014) argued that the quota led many companies to delist to bypass its requirements. Contrarily, Eckbo et al. (2022) reveal that businesses only delisted due to reasons such as mergers and acquisitions or bankruptcy. Additionally, Eckbo et al. (2022) argues that the inclusion of year fixed effects removes the statistical significance of the deficiency in female directors as observed in the study by Bøhren and Staubo (2014). Considerable debate remains regarding the impact of gender diversity on corporate boards and the implementation of a (Norwegian) gender quota.

The findings from studies regarding California SB 826 in existing literature appear to show less disagreement. One potential explanation for this might be that the gender quota in California is a relatively recent development, resulting in fewer research efforts dedicated to it. Alternatively, this could be attributed to variations in the research context. Notable previous studies by Hwang et al. (2021), Greene et al. (2020), and von Meyerinck et al. (2019) have examined the impact of SB 826. Greene et al. (2020) focused on publicly traded companies headquartered in California, observing a significant negative stock market reaction when the law was enacted. This was specifically noticeable in firms needing to appoint additional female directors, particularly in California-based firms when compared to control firms in other states. Hwang et al. (2021), in their study of Russell 3000 firms, found that the costs of adding female directors were higher when the pool of female candidates was limited or when the firm's governance was weaker. As for von Meyerinck et al. (2019), they documented substantial negative announcement returns related to the implementation of the gender quota for California firms, along with significant spillover effects for non-California firms.

3.3 Hypothesis

While research on CEO overconfidence and gender quota mandates is vast, the intersection between these two areas is relatively underexplored. CEO overconfidence is characterized by an amplified belief in one's capabilities and the outcomes of decisions. This heightened self-assurance, especially among top corporate leaders, could influence choices, leading to potential overinvestment or underinvestment based on external factors. Conversely, gender quota mandates, exemplified by Norway's pioneering initiative and California's SB 826, strive to redress gender disparities in corporate boardrooms. The outcomes and efficacy of these mandates are subject to debate, with studies producing diverse conclusions regarding their influence on company performance. As the conversation about gender diversity policies persists, it's important to acknowledge fundamental psychological differences between genders that could potentially shape these results.

Specifically, psychological studies have established that men generally manifest greater overconfidence than women, notably in male-centric domains like finance (Barber and Odean, 2001). This is further explored by Chen et al. (2019) who investigated the correlation between CEO overconfidence, as indicated by option exercise behavior, and female board representation. Their findings suggest male CEOs in firms with female directors are less inclined to retain deep-in-the-money options, implying that female board presence may counteract a CEO's overconfidence concerning the firm's prospects. This attenuation is especially pronounced in industries abundant with male CEO overconfidence, with female directors being linked to more cautious investment strategies, well-considered acquisition choices, and stronger financial performance. Additionally, prevailing gender stereotypes can lead to biases, with women in traditionally male roles often being expected to underperform due to perceived mismatches between traits and job requirements (Heilman, 2012).

Connecting these insights, it becomes evident that gender quotas, leading to enhanced board diversity, can potentially temper male CEO overconfidence. Female board members, often more cautious in decision making, may mitigate the negative impacts associated with overconfident CEOs. The risk aversion characteristic of female directors could further modulate corporate decisions in companies led by overconfident CEOs. With these comprehensive insights and particularly focusing on California's SB 826, the following hypothesis emerges: *After the implementation of SB 826, male CEOs of California companies exhibit reduced overconfidence in comparison to male CEOs of companies based outside California.*

4. Data, sample construction and methodology

This study seeks to examine the impact of SB 826 on the overconfidence of male CEOs in California companies, compared to male CEOs from companies outside California. For this purpose, I gathered quantitative data from sources like Compustat, BoardEx, ISS, and ExecuComp. The following sections will provide details on the sample selection, data sources, methodology, variable construction, and data analysis.

4.1 Sample selection and data sources

Per the mandates of SB 826, every publicly traded company headquartered in California and registered on major exchanges is required to adhere to this regulation. To pinpoint the CEOs influenced by SB 826, I used ExecuComp to collect data on male CEOs from California-based companies listed on major exchanges between 2014 and 2021. From this, I gathered information on their stock and option holdings, option exercise behavior, and CEO characteristics like age, tenure, and gender. This data was then combined with a dataset from ISS, offering insights into board characteristics (e.g., board independence, board size, and female director representation). For accounting details, I sourced data from Compustat, while stock return data came from CRSP. I excluded CEOs of financial firms and those of firms labelled as 'durable' in the Fama and French 12 industry classification since there were no records of CEOs from 'durable' California-based companies having available stock and option holdings information in the specified period. The final sample incorporated 192 CEOs with non-missing data, representing 159 California-based companies and covering 642 firm-years.

A potential concern when assessing the impact of SB 826 in California against firms in states without a similar gender quota policy is the rising nationwide attention about gender diversity within corporate boards (Greene et al., 2020). This suggests that changes observed in California firms might simply reflect broader gender diversity trends, rather than the distinct influence of SB 826. To address this concern, I utilized a control sample approach similar to Greene et al. (2020). This involves creating a sample of firms not directly impacted by SB 826, specifically excluding those headquartered in states that consistently voted for the Democratic presidential nominee from 2000 to 2016.[1] This decision stems from the likelihood of these states introducing similar legislation aligned with their political stance. Supporting this, von Meyerinck et al. (2019) highlighted that firms in states predominantly leaning Democratic experienced adverse spill-over effects on performance due to SB 826, indicating an increased probability of introducing a board gender quota in the future.

Furthermore, when examining, for instance, the Norwegian gender quota, previous studies like those by Ahern and Dittmar (2012) and Matsa and Miller (2013) relied on foreign and privately held firms for their control groups. These selections present as somewhat flawed control samples, given their exposure

[1] The following states are included as control sample: AK, AL, AR, AZ, CO, FL, GA, IA, ID, IN, KS, KY, LA, ME, MI, MO, MS, MT, NC, ND, NE, NH, NM, NV, OH, OK, PA, SC, SD, TN, TX, UT, VA, WI, and WV.

to distinct corporate governance guidelines and regulatory environments (von Meyerinck et al., 2019). Additionally, foreign firms operate under varying macroeconomic conditions (Ferreira, 2015). One notable benefit of the California context is the ability to select control firms from a broad array of publicly listed US companies based outside of California. This approach bypasses the constraints inherent to the Norwegian setting. I employed the same data collection methods for non-California CEOs as I did for CEOs of California firms. This resulted in a sample of 703 CEOs from 529 non-California firms, accounting for 2,267 firm-years. Consequently, the overall pooled sample consists of 895 CEOs across 688 firms, representing 2,909 firm-years.

4.2 Methodology

To analyse the data, I utilized a difference-in-differences (DID) approach, which is a statistical technique used in quasi-experimental settings to estimate causal effects. This method involves comparing a group that received a treatment with an untreated group over time (Lechner, 2011). The fundamental concept behind DID is estimating a counterfactual outcome for the untreated group, which helps us understand what would have occurred if they had been subjected to the same treatment as the treated group. It is essential to acknowledge that the treatment and control groups may differ for various reasons. DID, however, calculates the relative change in outcomes between the treated and untreated groups instead of focusing on absolute pre- and post-treatment results for each group independently. This approach provides credible estimates of the average treatment effect on the treated by making comparisons under ceteris paribus conditions (i.e., all else equal) (Lechner, 2011).

For this study, the DID method enables to isolate the impact of the signing of SB 826 from other intervening variables. It does so by keeping the time variation and pre-treatment differences between the quota and non-quota companies constant. This approach assures that we can draw more robust conclusions about the effect of SB 826 on CEO overconfidence of California firms. To ensure the success of estimating causal effects in the context of DID, a requirement is the fulfilment of the 'parallel trends' assumption. In simple terms, this means that when no treatment is applied, both the treated and untreated groups should exhibit similar trends in the outcome variable (Rambachan & Roth, 2023). It is important to note that the groups do not necessarily need to have identical outcome means, as DID accounts for these pre-treatment differences. However, it is essential that no time-variant unobservable factors influence the outcome; there should be no hidden variable that affects the outcome differently for the groups over the studied time periods (Rambachan & Roth, 2023).

In order to guarantee the validity of the parallel trends assumption for this study, it is important that the pre-treatment trends in CEO option moneyness show a similar pattern between California firms and non-California firms. While the actual levels of pre-quota CEO option moneyness may not necessarily be identical for both groups, it is important to avoid any noticeable divergence in pre-treatment trends. This particular assumption will be thoroughly addressed in Section 5.2.

Moreover, it is of importance for this research that the enactment of SB 826 is considered exogenous, implying that the introduction of the quota among specific companies should not be in response to those companies' gender equality policies. In the instance of SB 826, the approval of Governor Brown's signature on the bill remained uncertain until the very last day, with no prior announcements or comments. Consequently, the quota's implementation came as an unexpected surprise, making it unlikely that California corporations had anticipated it. Hence, the treatment can be deemed exogenous, making the signing of SB 826 a particularly suitable subject for DID analysis.

To investigate the effects of SB 826 on the option holding and exercise behaviour of CEOs in California-based companies, in contrast to firms in states without a comparable gender quota policy, I utilized the following general difference-in-difference equation:

$$CEO\ Option\ Moneyness_{i,t} = \alpha + \beta_1 CA\ Firm_{i,t} + \beta_2(Post_t \times CA\ Firm_{i,t}) + \gamma Z_{i,t} + \delta_t + \lambda_i + \varepsilon_{i,t}$$

where the dependent variable *CEO Option Moneyness* refers to the calculated moneyness of a CEO's stock options. The overconfidence measure will be explained in detail in the following section. The variable *CA Firm* takes the form of a dummy variable, assuming a value of one for CEOs of California-based firms, and zero for others. Meanwhile, the variable *Post* is also a dummy, adopting a value of one during the time span following the enactment of SB 826, and zero for periods preceding that. Given that the sample period extends from 2014 to 2021, *Post* assumes a value of 1 for observations within 2018-2021, and 0 for those within 2014-2017. I specifically designate 2018 as the transition year since it marks the introduction and signing of SB 826, coinciding with the ExecuComp database's recording of executive compensation data at year's end. Z is a vector of firm, CEO and board characteristics that could potentially influence the CEO's option holdings and exercise decisions. δ_t represents year fixed effects and λ_i represents firm fixed effects. I incorporate these fixed effects in line with previous literature examining the impact of quotas, such as the studies by Ahern and Dittmar (2012) and Matsa and Miller (2013). By including year and firm fixed effects, the equation controls for time-specific and firm-specific factors that could potentially influence the coefficients.

I use robust firm-clustered standard errors to address possible heteroskedasticity and autocorrelation issues. This approach addresses the serial correlation often found in the time-series data of within-firm variations, which is commonly observed in difference-in-differences variables (Ahern and Dittmar, 2012). To prevent multicollinearity complications, I created a correlation matrix (not tabulated) to assess the correlation between variables. A significantly high correlation can signal a spurious relationship leading to misleading regression results. Therefore, if certain control variables correlate too much, one should be removed from the regressions. The correlation matrix revealed no alarming correlations among the control variables.

5.2 Variable construction

5.2.1 CEO overconfidence

Managers who willingly choose to be exposed to the firm's idiosyncratic risk are likely to be confident about the firm's future prospects (Malmendier and Tate, 2005). In this context, a CEO who voluntarily retains stock options after the vesting period in which exercise becomes permissible is viewed as overconfident (Hirshleifer et al., 2012). This perception arises from the fact that risk-averse individuals, who prefer diversification, tend to exercise their executive options early (Malmendier and Tate, 2005).

By considering the link between voluntary retention of stock options and CEO overconfidence, a comprehensive understanding of managerial decision-making and risk preferences can be achieved. However, it is important to note that the ExecuComp data used to create the option-based measure has certain limitations. It lacks the level of detail found in the proprietary data used in Hall and Murphy (2002) and Malmendier and Tate (2005), as it does not provide specific information about a CEO's options holdings and exercise prices for each option grant. To address this limitation, I adopt a modified version of the Malmendier and Tate (2005) overconfidence measure, following Campbell et al. (2011), Hirshleifer et al. (2012), and Chen et al. (2019).

To approximate the average CEO stock option moneyness (*CEO Option Moneyness*), I employ the following steps. First, I calculate the average realizable value per option by dividing the total realizable value of the exercisable options by the number of exercisable options (OPT_UNEX_EXER_EST_VAL/ OPT_UNEX_EXER_NUM). Next, I subtract the average realizable value from the fiscal year-end stock price (PRCC_F) to determine the average exercise price of the options. The estimated moneyness of the options is then calculated as the stock price divided by the estimated average exercise price minus one. To mitigate the potential impact of outliers, the option moneyness variable is winsorized at the 1st and 99th percentiles. Similar to Hirshleifer et al. (2012), it is not important for this research whether CEOs are, on average, overconfident. The tests rely upon substantial differences in the degree of confidence across CEOs.

5.2.2 Control variables

In this analysis, I consider various control variables related to firms, boards, and CEOs that could potentially influence CEO overconfidence, particularly as seen through their option holding and exercise behavior. One such factor is firm size, as it has been observed that highly skilled CEOs often prefer to work for larger firms in order to have a greater impact (Edmans and Gabaix, 2011; Chen et al., 2019). Additionally, managing larger and more complex firms requires enhanced managerial skills and expertise. Similarly, firms with more growth opportunities provide a greater chance for talented CEOs to create value, making it more likely for such CEOs to be appointed (Edmans and Gabaix, 2011; Graham et al., 2013). Consequently, talented CEOs are more prone to exhibit overconfidence (Chen et

al., 2019). Furthermore, research has indicated that the size of a firm plays a significant role in determining CEO salary (Gabaix and Landier, 2008). In this study, we measure firm size using annual (*Sales)* while growth opportunities are measured by Tobin's q (*Tobin's Q*). The regressions will utilize the natural logarithm of sales. Additionally, I include the control variable *Leverage*. Given that risk-averse managers may perceive higher leverage to be associated with increased career concerns and stricter monitoring by debt holders. The potential consequence is that leverage might diminish the intended impact of risk-related components in managerial incentive contracts (Kim et al., 2017). This, in turn, could potentially influence the CEO's decision regarding the holding of options.

Managers may develop excessive overconfidence as a result of strong past performance (Hirshleifer et al., 2012). To address this concern, I include controls for stock returns (*Stock Return,* a market-related measure) and return on assets (*ROA*, an operating measure). Accounting for stock returns is also important as fluctuations in option moneyness are closely tied to changes in stock prices. Since I use an approximate measure of 'average moneyness', I cannot assess the exercise timing relative to expiration or grant dates due to limited availability of specific grant dates, expiration dates, or strike prices. Therefore, including controls for stock returns helps avoid conflating measures of overconfidence with stock market returns (Malmendier and Tate, 2015). To minimize the influence of outliers, I apply winsorization at the 1st and 99th percentiles for the aforementioned accounting variables. For detailed variable definitions, see Appendix A.

Prior studies indicate that boards possess the power to let go of CEOs who exhibit excessive self-doubt or overconfidence. This suggests that board assessments can shape CEO decisions (Goel and Thakor, 2008). To address the potential impact of corporate governance on CEO overconfidence, I included control variables such as *Board Independence* and *Board Size*, drawing from Chen et al. (2019).

In this study, I incorporated various CEO characteristics as control variables, as prior research has shown their significance in influencing individual behavior and decision-making (Bertrand and Schoar, 2003; Goergen et al., 2015; Chen et al., 2019). Recognizing the influence of CEO age on risk-taking behavior and firm performance (Serfling, 2014), I factor in *CEO Age* as a control. I also include *CEO Tenure*, indicating the duration a CEO has served, to reflect the role of experience in decision-making processes. To separate the measurement of overconfidence from potential ownership and incentive effects of stock option exercise (Chen et al., 2019), I control for CEO stock ownership by including the variable *CEO Ownership*. This variable acknowledges the increased incentives CEOs might have as their personal financial interests align more with the success of the company when they possess a larger share of its stocks. Additionally, I control for the variable *CEO Chairman*, which is set to one if the CEO also chairs the board, and zero otherwise. This control variable helps in accounting for potential entrenchment that could amplify biased perspectives, as highlighted by Banerjee et al. (2015).

5.2.3 Alternative options-based measures

To affirm the findings were not solely reliant on the selected measure of CEO overconfidence, I established two alternative measures of overconfidence derived from the personal portfolio decisions of CEOs: *Holder 67* and *Net Buyer*. The first measure, *Holder 67*, uses the timing of option exercises to identify overconfidence. The second measure, *Net Buyer*, relies on the habitual acquisition of company stock.

Due to the absence of detailed data regarding a CEO's options holdings and corresponding exercise prices for each grant, the *Holder 67* measure as proposed by Malmendier and Tate (2005) is not feasible. As an alternative, I have employed the approach presented by Campbell et al. (2011), Malmendier et al. (2011), and Hirshleifer et al. (2012). According to this definition, the *Holder 67* measure is indicated by a value of one if the *CEO Option Moneyness* measure reaches at least 67% in two or more years. In such cases, the CEO is classified as overconfident from the first occurrence of the *CEO Option Moneyness* measure being at least 67%. To focus on a "permanent" rather than a 'transitory' overconfidence effect, this measure identifies CEOs who consistently exercise options late. CEOs with a tenure shorter than 2 years were not considered for this measure. Previous research suggests that overconfidence varies significantly among individuals and tends to remain stable over time (Klayman et al., 1999). These assumptions are important for this study as the overconfidence measure heavily relies on them. While the measure may be less precise than the measure of Malmendier and Tate (2005), Campbell et al. (2011) demonstrates that it produces similar results.

The second alternative measure of overconfidence, *Net Buyer*, adopts a modified approach inspired by Malmendier and Tate (2005). In this research, CEOs are classified as overconfident if they were net buyers of company stock in more years than years they were net sellers in the sample. This measure takes into account the behavior of CEOs who continue to purchase company stock, even when their existing exposure to company-specific risks is already substantial. To ensure the accuracy of the analysis, I excluded CEOs with a tenure of only one or two years, as their inclusion could potentially introduce a bias to the outcomes.

5.2.4 Additional measures

To enhance the robustness of the findings, I have integrated additional measures to examine the effects of SB 826's requirements on CEO overconfidence. Specifically, the variables *Gap* and *Add Female* were utilized. The variable *Gap*, as seen in von Meyerinck et al. (2019), Green et al. (2020) and Hwang et al. (2021), measures the difference between the required number of female directors to comply with SB 826 by the end of 2021 and the number of female directors on the board before the implementation of SB 826. As my research setting differs from the mentioned papers, I approach *Gap* differently. In this study, *Gap* is defined as the difference between the required amount of female board directors by the end of 2021 and the actual number of female directors within each respective year.

I included the variable *Gap* in this study, as previous research by Green et al. (2020) suggests that larger gaps between the mandated number of female directors and the pre-SB 826 requirements result in more negative firm returns. This finding makes it interesting to explore how various levels of *Gap* might influence CEO overconfidence. Additionally, von Meyerinck et al. (2019) and Hwang et al. (2021) also looked into this measure. Meyerinck et al. (2019) discovered that firms with a greater ´shortfall´ of female directors experienced sharper declines in shareholder wealth compared to firms closer to the legislative requirements. Hwang et al. (2021) found a significantly negative result when *Gap* was interacted with a California-headquartered firm indicator, indicating that the market reaction, as reflected in stock prices, varied based on the female director gap in California-headquartered firms. Given these insights, I predict that a wider 'gap' might negatively influence CEO overconfidence.

The variable *Add Female* is defined as a dummy variable, set to one if the variable *Gap* is positive, and zero otherwise. According to Greene et al. (2020), adding a female director to the board of directors, as required by SB 826, is associated with a statistically significant decline in firm value. Hence, drawing from this study, I expect the required addition of at least one female director to have a negative influence on CEO overconfidence.

5. Empirical results

In this section, the findings of the paper are presented. I start with the descriptive statistics of the data. This is followed by an overview of SB 826 requirements and their representation in this dataset. The methodology for constructing the matched control sample is then explained. Subsequently, we delve into the results of the regressions examining the hypothesis, and then conclude with the outcomes of the robustness tests.

5.1 Descriptive statistics

Table 1 breaks down the sample details of the pooled dataset year-by-year and by industry for both California and non-California firms. Panel A highlights the number and percentage of firm-year observations, accompanied by the average CEO option moneyness over the years. Panel A indicates that observations for California and non-California firms are fairly balanced throughout the sample period. It is worth noting that the number of firm observations for both groups appears smaller when compared to studies like Hwang et al. (2021) and Greene et al. (2020) that also investigate SB 826. This discrepancy stems from our reliance on the Standard & Poor's (S&P) ExecuComp database, which exclusively includes firms from the S&P 500, S&P 400 mid-cap, and S&P 600 small-cap indices. While companies in the ExecuComp database account for roughly 88% of the market capitalization of publicly traded firms in the U.S., they represent only 25% of firms in the Compustat database (Cadman et al., 2010). This indicates that the ExecuComp database does not include a significant portion of all firms, possibly resulting in a representation biased towards the largest firms in terms of market value. However, when compared with similar research relying on the ExecuComp database, such as Chen et al. (2019)[2], the number of observations of the original dataset in this study appear more in line.

Furthermore, Panel A highlights a progressive increase in the CEO option moneyness for California firms over the sample duration. In contrast, non-California firms maintain a relatively steady rate. This divergence creates a noticeable gap in CEO option moneyness between the treatment and control groups. A deeper dive into Panel B might shed light on this. Panel B outlines the sample distribution across the 12 Fama–French industries, excluding the durable and financial sectors (Fama-French industries 1 and 2). Here, we observe notable differences in the distribution of firm-year observations between California and non-California firms. A significant chunk of California firm data stems from the Business Equipment (Computers and Software) and Healthcare industries, constituting 45% and 22%, respectively. In these industries, California firms display the most pronounced CEO option moneyness, with values standing at 155.1% for Business Equipment and 172.7% for Healthcare industries. While non-California firms also exhibit the highest CEO option moneyness in these industries, the proportion

[2] Chen et al. (2019) report an annual average of 700 observations across all 50 states, whereas my study focuses on only 36.

Table 1. Sample details by year and industry.

Panel A. By year

	California firms			Non-California firms		
Year	No. of obs.	%	Average CEO option moneyness	No. of obs.	%	Average CEO option moneyness
2014	95	14.80%	1.077	322	14.78%	0.902
2015	88	13.71%	1.106	288	13.19%	0.846
2016	83	12.93%	1.157	298	13.85%	0.929
2017	73	11.37%	1.198	269	12.53%	0.907
2018	79	12.31%	1.344	241	11.03%	0.721
2019	77	11.99%	1.728	252	11.60%	0.983
2020	76	11.84%	2.229	247	11.42%	1.082
2021	71	11.06%	2.338	252	11.60%	1.016
Total	642	100.00%	1.492	2,169	100.00%	0.922

Panel B. By Fama–French 12 industries

	California firms			Non-California firms		
Year	No. of obs.	%	Average CEO option moneyness	No. of obs.	%	Average CEO option moneyness
Non-Durables	33	5.14%	1.510	129	5.95%	0.851
Manufacturing	28	4.36%	1.040	421	19.41%	0.779
Energy	8	1.25%	0.155	132	6.09%	0.527
Chemicals	16	2.49%	0.649	134	6.18%	0.540
Business Eq.	287	44.70%	1.551	291	13.42%	1.215
Telecom	14	2.18%	0.816	36	1.66%	0.884
Utilities	13	2.02%	0.952	69	3.18%	0.499
Shops	52	8.10%	1.151	340	15.68%	1.074
Healthcare	143	22.27%	1.727	206	9.50%	1.198
Other	48	7.48%	1.909	411	18.95%	0.946
Total	642	100.00%	1.492	2,169	100.00%	0.922

Note. The table presents information on the amount of observations and CEO option moneyness of the treatment (California firms) and the control group (non-California firms) in different industries and years. In Panel A, the table shows the number of firm-year observations and percentage of California and non-California firms, as well as the average CEO option moneyness, for each year. Panel B reports the same information as Panel A, but across the Fama–French 12 industries (financial and durable firms are excluded).

of observations for them is comparatively lower. The bulk of data for non-California firms comes from the Manufacturing, Wholesale & Retail (Shops) and Other industries, which account for 19%, 16% and 19% of the observations, respectively. Notably, these industries exhibit a more moderate average CEO option moneyness (76.7%, 108.4% and 94.6% respectively). Hence, one reason for the observed variance in average CEO option moneyness could be attributed to the contrasting industry focuses between California and non-California firms. Specifically, California firms predominantly operate within the Business Equipment and Healthcare industries, while non-California counterparts are largely concentrated in the Manufacturing, Wholesale & Retail and Other industries.

Table 2 showcases the descriptive statistics for the pooled sample of CEOs from both California and non-California firms. Detailed definitions for these variables can be found in Appendix A. The average CEO option moneyness stands at 105.2%, a value noticeably higher than the 68.6% average CEO option moneyness reported by Chen et al. (2019). This disparity could stem from the different study period chosen by Chen et al. (2019), spanning 1998-2013. Their timeframe captures events like the 2001–2002 dotcom bubble burst and the 2007–2009 financial crisis. During such downturns, CEOs tend to exhibit reduced overconfidence, which might have contributed to the lower average option moneyness in their study.

Considering the alternative overconfidence measures, *Holder 67* and *Net buyer*, about 54.8% of the sample is deemed overconfident according to the *Holder 67* measure. This is comparable to findings

Table 2. Descriptive statistics.

Variables	N	Mean	SD	P10	Median	P90
Overconfidence variables						
CEO Option Moneyness	2,811	1.052	1.407	0.066	0.617	2.402
Holder 67	2,587	0.548	0.498	0.000	1.000	1.000
Net Buyer	2,234	0.640	0.480	0.000	1.000	1.000
Firm characteristics						
Sales (million $)	2,811	10979.85	23548.99	453.04	3003.27	22849.00
Leverage	2,811	0.302	0.201	0.029	0.288	0.537
Stock Return	2,811	0.152	0.353	-0.247	0.114	0.576
ROA	2,811	0.060	0.073	-0.010	0.055	0.140
Tobin's Q	2,811	2.436	1.695	1.163	1.895	4.377
Board characteristics						
Board Independence	2,811	0.818	0.096	0.667	0.857	0.909
Board Size	2,811	9.300	1.967	7.000	9.000	12.000
Gap	1,295	0.869	0.824	0.000	1.000	1.000
Add Female	1,295	0.613	0.487	0.000	1.000	1.000
CEO characteristics						
CEO Age	2,811	57.485	6.569	50.000	57.000	66.000
CEO Chairman	2,811	0.455	0.498	0.000	0.000	1.000
CEO Tenure	2,811	8.690	7.221	1.916	6.448	18.413
CEO Ownership	2,811	0.016	0.039	0.001	0.004	0.034

Note. The table presents descriptive statistics of the study's variables for the total sample (California firms and non-California firms). Appendix A provides the definition of each variable.

from prior studies.[3] Conversely, *Net Buyer* labels CEOs as overconfident for around 64.0% of the entire sample, a percentage notably higher than what earlier studies have indicated.[4] Shifting to the average sample characteristics, firms report on average *Sales* of $10979.85 million (median of $3003.27 million), a *Leverage* of 30.2% (28.8%), annual *Stock Return* of 15.2% (11.4%), a *ROA* of 6.0% (5.5%), and a *Tobin's Q* of 2.44 (1.90). The director's board typically comprises around 9 directors, boasting an average *Board Independence* of 81.8% (85.7%). CEOs, on average, are 57.5 (57.0) years old with a tenure lasting 8.7 (6.4) years. About 37.9% of CEOs also serve as the Chairman of the board, and they typically own around 1.6% (0.4%) of the firm's stocks.

Table 2 indicates that both the variables *Gap* and *Add Female* possess fewer observations. This makes sense since the data for these variables begins only after SB 826. Prior to the SB 826, firms wouldn't have been aware of the need to increase female director representation by the end of 2021. The table illustrates an average *Gap* of 0.869 female directors across the sample, along with an average *Add Female* of 0.613. This indicates that 61.3% of the firm-year observations post-SB 826 must include at least one female director to meet SB 826 requirements. However, these observations need to be considered cautiously, considering that non-California firms are not subject to SB 826 mandates.

Table 3 showcases the comparison of the descriptive statistics between CEOs of California and non-California firms in the pooled sample before the signing of SB 826. It provides the means, medians, and the differences in these values. I use t-tests and Wilcoxon-Mann-Whitney tests to examine these

[3] The *Holder 67* measure used by Malmendier and Tate (2005), along with a similar measure by Hirshleifer et al. (2012), categorizes 51.3% and 61.1% as overconfident, respectively.

[4] The *Net Buyer* measure, also constructed by Campbell et al. (2011), labels 40.8% of CEOs as overconfident.

Table 3. Comparing descriptive statistics of California and non-California firms.

	California firms			Non-California firms			Difference	
Variables	N	Mean	Median	N	Mean	Median	Mean	Median
Overconfidence variables								
CEO Option Moneyness	339	1.130	0.764	1,177	0.896	0.532	0.234***	0.232***
Holder 67	302	0.623	1.000	1,077	0.448	0.000	0.175***	1.000***
Net Buyer	261	0.521	1.000	924	0.642	1.000	-0.121***	0.000***
Firm characteristics								
Sales (million $)	339	6720.31	1966.81	1,177	11344.71	3142.86	-4624.40***	-1176.05***
Leverage	339	0.208	0.188	1,177	0.306	0.291	-0.098***	-0.103***
Stock Return	339	0.181	0.128	1,177	0.116	0.094	0.065***	0.034***
ROA	339	0.058	0.054	1,177	0.056	0.055	0.002	-0.001
Tobin's Q	339	2.681	2.193	1,177	2.110	1.738	0.571***	0.455***
Board characteristics								
Board Independence	339	0.792	0.818	1,177	0.819	0.857	-0.027***	-0.039***
Board Size	339	8.578	9.000	1,177	9.408	9.000	-0.830***	0.000***
Gap	73	1.397	1.000	269	1.361	1.000	0.036	0.000
Add Female	73	0.795	1.000	269	0.792	1.000	0.003	0.000
CEO characteristics								
CEO Age	339	56.463	56.000	1,177	57.466	57.000	-1.003**	-1.000**
CEO Chairman	339	0.410	0.000	1,177	0.518	1.000	-0.108***	-1.000***
CEO Tenure	339	9.830	7.497	1,177	8.348	6.169	1.482***	1.328**
CEO Ownership	339	0.019	0.005	1,177	0.017	0.004	0.002	0.001**

Note. The table presents the means and medians of the study's variables for the treatment group (California firms) and the control group (non-California firms) pre-SB 826. For each variable, the difference between the two subsamples are reported. Appendix A provides the definition of each variable. There are t-tests (Wilcoxon–Mann–Whitney tests) conducted to test for differences in the means (medians). Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

differences. The table reveals an average CEO option moneyness of 113.0% for California firms and 89.6% for non-California firms within this sample, prior to the implementation of the quota. As illustrated in Table 3, California firms in the pooled sample generally report lower sales, potentially indicating that they operate on a smaller scale. Additionally, these firms show stronger financial performance metrics in terms of a higher average *Tobin's Q* and *Stock Return*. They also tend to have less independent directors, fewer board members, and CEOs who are comparatively younger with longer tenures. These CEOs are also less frequently serving as Chairmen of the board compared to those in non-California firms. Both California and non-California firms show similar values of *ROA*, and their CEOs hold comparable levels of stock ownership in the companies.

The table additionally shows that aside from *ROA* and *CEO Ownership*, California and non-California firms exhibit no significant differences in the variables *Gap* and *Add Female*. The values for *Gap* and *Add Female* presented in Table 3 correspond only to observations from the year 2017, which is the final year before SB 826 was enacted. This implies that under the compliance requirements of SB 826, California firms have *Gap* and *Add Female* values that are similar to those of non-California firms not subject to the law. These results suggest that before the introduction of SB 826, both sets of firms had comparable levels of gender diversity.

Table 3 highlights significant differences in observable characteristics between California and non-California firms. This indicates that both the treatment and control groups vary not only in terms of CEO option moneyness but also in their observable characteristics. Ensuring the validity of the findings requires comparability between these groups in terms of characteristics. To achieve this comparability, I employ propensity score matching.

5.2 Construction of matched control sample

While it is not an assumption of the Difference-in-Differences methodology that California and non-California firms, as well as their CEOs, must be comparable before the implementation of SB 826, the robustness of the study's findings would certainly benefit if these firms and CEOs were comparable. However, notable differences in observable characteristics between California and non-California firms do not support this ideal scenario. Balancing tests have been conducted to assess this further, with results detailed in Table B of the Appendix. These tests confirm that the pooled dataset lacks sufficient comparability. In particular, the results in Panel A, which compares CEOs of California and non-California firms in the pooled sample, indicate significant differences between these two groups regarding firm, board and CEO characteristics.

To construct a control sample of non-California firm-year observations that closely resemble California firm-years in observable characteristics, I first determine the likelihood of a CEO being from a firm in California. This is done using a logit model (not tabulated), taking into account the control variables detailed in Section 4.3.2. I proceed by constructing a treatment group and a control group of observations using the nearest-neighbour approach, based on the predicted probabilities, also known as propensity scores, derived from the logit model. In this method, each California firm-year is paired with three firm-years from non-California firms that have the closest matching propensity scores. I employ a matching method with replacement, meaning a CEO from the control sample might act as a matched control for multiple treatment CEOs. However, I include each control CEO in the sample only once. To assure the treatment and control groups are nearly identical in observations, I set a strict criteria: the maximum difference (i.e., the calliper) between the propensity score of a California firm-year and its matched counterparts should not surpass 0.01 in absolute value. Following these steps, the final sample includes 1,608 firm-years. Of these, 631 are CEOs from California firms (forming the treatment group), and the remaining 977 are CEOs from non-California firms (the control group).

Table B in the Appendix presents a diagnostic test to ensure that the observations in both the treatment and control groups are comparable pre-SB 826 based on observable characteristics. This test evaluates the difference in means for every observable characteristic between the treatment and the matched control groups. Panel B displays the results, indicating that in comparison to Panel A, all variable differences become statistically insignificant post-matching, with the exception of *CEO Age* at the 10% level. This suggests that the propensity score matching technique has resulted in a balanced dataset, supporting the assumption that the two groups of firms are comparable before the signing of SB 826.

The evident disparity in CEO overconfidence and the differing industries of California versus non-California firms underscored the need to employ a balancing test and propensity score matching in the pooled dataset. Table C1 in the Appendix presents a detailed breakdown of the matched sample, segmenting it year-by-year and by industry for both California and non-California firms. Panel A and Panel B depict the same information as presented in Table 1. Compared to Table 1, Panel A continuous

to display a relatively consistent distribution of observations across the sample years. What is immediately noticeable in Panel B is the rise in average CEO option moneyness across all years and the Fama-French 12 industries compared to the pooled sample. With a more balanced distribution of observations across industries, this supports the idea that the observed differences in average CEO option moneyness are linked to the distinct industry concentrations of California and non-California firms. Specifically, overconfidence seems more prevalent in industries where California firms operate compared to those of non-California firms. The matched sample data reveals that when non-California firms are paired with California firms based on firm, board, and CEO attributes, there's an increase in average CEO option moneyness for CEOs of non-California firms across all years and industries compared to the pooled sample data.

Table C2 in the Appendix showcases the comparison of the descriptive statistics between CEOs of California and non-California firms of the matched sample. It provides the means, medians, and the differences in these values (t-tests and Wilcoxon-Mann-Whitney). An interesting observation post-matching is that several of the differences in means and medians seen in the pooled sample become statistically insignificant. This same trend was evident in the differences in means as documented in the balancing tests in Table B in the Appendix. This highlights the efficacy of the matching technique in reducing the initial differences and attaining increased comparability between the treatment and control groups.

However, even after employing propensity score matching, Table C2 displays persistent statistically significant differences in the medians of the variables *ROA* and *Tenure*, albeit on the 10% level. This mirrors findings from prior studies.[5] This observation underscores the difficulty in achieving absolute comparability between CEOs of California and non-California firms. It suggests the potential presence of additional factors that might influence these control variables. As a result, when evaluating results related to these variables, it's important to consider this persistent disparity.

In comparison to the pooled sample's average *CEO Option Moneyness* of 113.0% for California firms and 89.6% for non-California firms (as displayed in Table 3), Table C2 in the Appendix reveals that, following the matching process, the average CEO Option Moneyness for both groups undergoes a shift in value and becomes more closely aligned: 111.2% for California firms and 122.2% for non-California firms. After matching, the notable difference in the mean of CEO option moneyness between the treatment and control groups decreases. However, the continued significance in median differences highlights a sustained variation between how the data is centred for the two groups. This observation raises the question of whether there might be systematic differences in CEO option moneyness that could affect the interpretation of the treatment effects.

Noteworthy, Table C2 shows that after the matching process, clear statistical differences emerge between California and non-California firms in terms of *Gap* and *Add Female*. In the year just before

[5] von Meyerinck et al. (2019) and Greene et al. (2020) highlight a similar concern, as they continue to find differences in financial characteristics, such as ROA.

the enactment of SB 826 (2017), California firms exhibit an average *Gap* of 1.352 female directors, with around 78.9% of the (firm-year) observations needing to add at least one female director to comply with the quota requirements. Conversely, non-California firms average a *Gap* of 1.765 female directors, with 89.0% of them needing to introduce at least one more female director in the following years if they had to comply with the quota requirements. This variation is generally expected over the years post-SB 826; since non-California firms aren't bound by SB 826, the values for *Gap* and *Add Female* should be naturally higher. Remarkably, these differences become statistically significant after matching firms based on observable characteristics, a distinction that did not exist prior to matching. However, the notable differences in the averages for *Gap* and *Add Female* underscore the efficacy of propensity score matching in minimizing observable differences aside from gender composition on boards. This increases the likelihood that any variance in CEO option moneyness across the two groups is a result of the mandate to incorporate more female directors onto the board.

5.3 Sample details by SB 826 requirements

Table 4 displays sample details for both California and non-California firms, categorized by year, relating to the requirements of SB 826. The goal is to shed light on the efficacy of SB 826 in increasing the presence of female directors. While SB 826 is not applicable to non-California firms, their figures are included for a comparative evaluation of the mandate's impact on board gender diversity. This table outlines the total number of female directors, their percentage representation on boards, and the values for the variables *Gap* and *Add Female* across the sample years. Here, the percentage of female directors is calculated based on the total board size.

Panel A provides an overview of SB 826 requirements by year for the pooled sample. Before the implementation of SB 826 in October 2018, both California and non-California firms were already showing a steady increase in the number and percentage of female board directors. As a result, the variables *Gap* and *Add Female* decreased over the years for both groups, suggesting that board gender diversity was improving even before the announcement of SB 826. The positive trend in female directors persisted throughout the sample period, suggesting that SB 826 has indeed fostered greater board gender diversity. Furthermore, Panel A reveals that the percentage of female directors in California firms rose at a faster rate than in non-California firms. Likewise, the values for *Gap* and *Add Female* dropped more rapidly for California firms. This is expected since only California firms were mandated to meet the SB 826 quota. Interestingly, by the end of 2021, the deadline for compliance, there still were noticeable *Gap* (0.41) and *Add Female* (33.8%) values for California firms. This indicates that 33.8% of California firms needed to add at least one more female director to meet SB 826 requirements. Some firms may have struggled with the mandate due to the costs of board expansion, challenges in attracting female directors (Greene et al., 2020), or a limited pool of suitable female candidates compared to males (Chen et al.,

Table 4. Sample details of SB 826 requirements by year.

Panel A: Original sample

	California firms					Non-California firms				
Year	N	Num. female directors	Pct. female directors	Gap	Add female	N	Num. female directors	Pct. female directors	Gap	Add female
2014	95	1.19	13.4%	1.78	87.4%	335	1.38	14.0%	1.66	88.7%
2015	88	1.28	14.3%	1.67	86.4%	299	1.53	15.4%	1.49	84.6%
2016	83	1.41	15.3%	1.59	85.5%	314	1.60	16.3%	1.44	83.4%
2017	73	1.66	18.7%	1.40	79.5%	284	1.66	17.2%	1.37	79.6%
2018	79	1.78	19.6%	1.27	74.7%	250	1.85	19.0%	1.22	73.6%
2019	77	2.06	22.8%	1.00	67.5%	263	2.13	22.0%	0.95	67.7%
2020	76	2.42	26.1%	0.76	57.9%	259	2.43	25.3%	0.72	57.3%
2021	71	2.80	30.4%	0.41	33.8%	263	2.60	26.7%	0.62	51.3%

Panel B: Post-matching sample

	California firms					Non-California firms				
Year	N	Num. female directors	Pct. female directors	Gap	Add female	N	Num. female directors	Pct. female directors	Gap	Add female
2014	95	1.19	13.4%	1.78	87.4%	141	1.10	12.3%	1.88	92.3%
2015	88	1.28	14.3%	1.67	86.4%	144	1.18	12.5%	1.81	89.9%
2016	82	1.41	15.3%	1.59	85.4%	139	1.33	14.3%	1.65	89.5%
2017	71	1.70	19.2%	1.35	78.9%	122	1.23	13.8%	1.76	89.0%
2018	78	1.81	19.9%	1.24	74.4%	119	1.46	16.1%	1.58	80.9%
2019	76	2.07	22.8%	1.00	67.1%	100	1.74	19.3%	1.32	79.3%
2020	74	2.45	26.2%	0.74	56.8%	103	2.06	22.9%	0.97	72.5%
2021	67	2.82	30.4%	0.40	34.3%	109	2.33	25.3%	0.75	58.0%

Note. This table presents information on the number of female directors, the percentage of female directors and the value for the variables *Gap* and *Add Female* over the sample years for the treatment group (California firms) and the control group (non-California firms). The percentage of female directors is the percentage of female directors compared to board size, *Gap* is the difference between the mandated number of female directors the board must have by 2021 and the number of female directors in the respective year and *Add Female* is a dummy variable set to one if *Gap* is positive, and zero otherwise.

2019). Alternatively, certain firms may have chosen to endure the penalties rather than appoint an additional female director.

The findings in Panel B underscore that post-matching, when California and non-California firms are matched based on firm, board, and CEO characteristics, non-California firms demonstrate comparatively inferior performance in meeting SB 826 requirements compared to non-California firms in the pooled sample. This suggests that when non-California firms are matched based on characteristics, they demonstrate weaker adherence to SB 826 standards compared to the pre-matched non-California sample, despite not being directly subject to the regulatory obligation. Overall, the observed changes are greater for California firms than control firms indicating that the increase in female directors is not due to a general trend of increasing female board representation in all firms, which is also suggested by Greene et al. (2020).

5.4 Parallel trends assumption

Difference-in-differences analysis is used in natural experimental contexts where a policy change, like a board quota, impacts a treated group but leaves a similar control group unaffected (Bertrand et al., 2003; Yang et al., 2019). To accurately estimate causal effects in the context of DID, as previously noted in Section 4.2, it is crucial to adhere to the 'parallel trends' assumption. This means that, before any treatment, the pre-treatment trends in CEO option moneyness for California firms (treatment group) should closely mirror those of non-California firms (control group). Essentially, without any treatment, both groups would ideally exhibit similar trajectories in the outcome variable.

The parallel trend assumption hinges on the idea that, without intervention, the patterns between the treatment and control groups would remain consistent both before and after the intervention date. While I cannot directly verify this assumption, since we do not know what might have occurred without intervention, I can indirectly assess it by comparing pre-treatment trends between the groups. If these trends are consistent, it is plausible to assume they would continue similarly without any intervention. To evaluate the parallel trend assumption, I examine both the pooled sample data and the matched sample data.

Figure 1 presents the average CEO option moneyness for both California and non-California firms over the sample period from 2014 to 2021 of the pooled sample, highlighted by a distinct line marking the signing of SB 826 in 2018. The horizontal axis displays years that are one year ahead of the present year in the sample, given that the ExecuComp data records observations at the end of the year. For the parallel trend assumption to be valid, the trajectories for both groups should appear consistent before the 2018 signing. As depicted in Figure 1, both the treatment and control groups show consistent trajectories, confirming that they experienced similar shifts in CEO option moneyness prior to SB 826. This visual representation validates the parallel trend assumption for the pooled sample, adding weight to the validity of the difference-in-differences analysis.

The parallel trend assumption for the matched sample is visually examined in Figure 2, which displays the trends of CEO option moneyness for California and non-California firms before the treatment period. Prior to the treatment, the control group shows higher average CEO option moneyness than the treatment group. This is a divergence from the trends observed in the pooled sample as shown in Figure 1. However, following the implementation of SB 826, there's an observable shift where the treatment group displays higher CEO option moneyness than the control group, mirroring the trend seen in the pooled sample.

Figure 1. Option moneyness of CEOs of California and non-California firms, pooled sample.

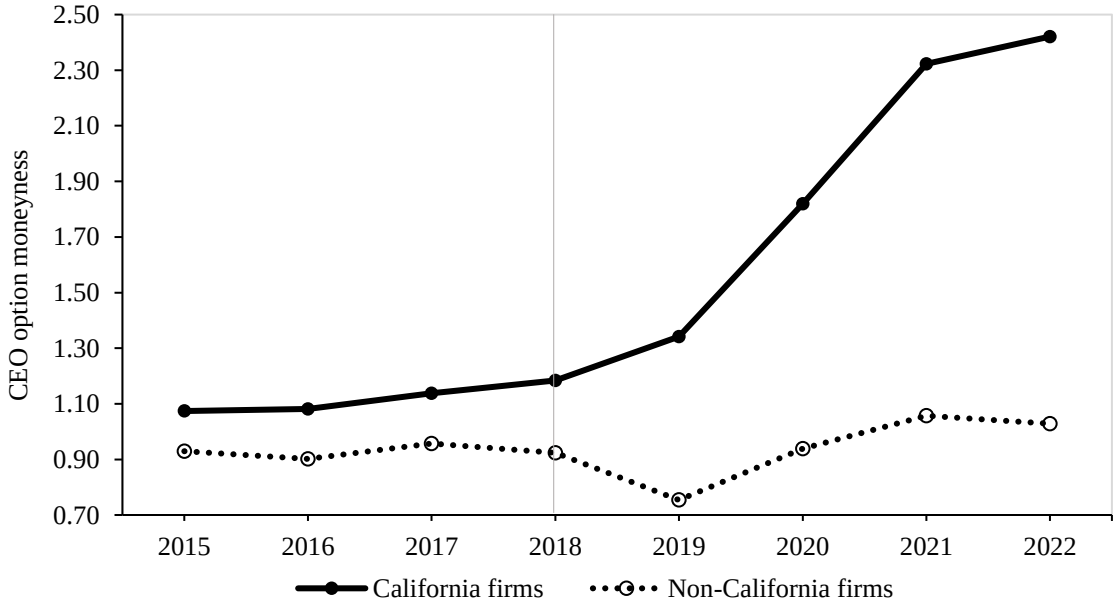
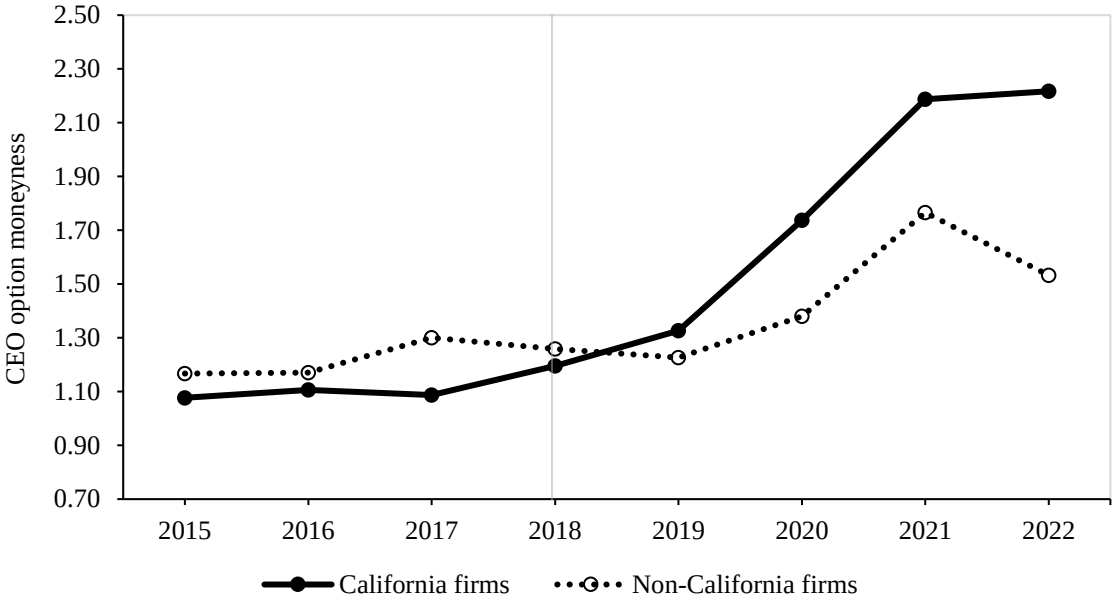


Figure 2. Option moneyness of CEOs of California and non-California firms, matched sample.



When comparing the pre-treatment trends of the matched sample with the pooled sample (as shown in Figure 1), the parallel trend is less distinct in the matched sample. Even though the treatment and control groups do not perfectly follow a parallel trend, the sample aligns more closely in terms of firm, board and CEO characteristics, as highlighted in Sections 4.4 and 5.1. Although the parallel trend assumption in the matched sample is not perfect, I believe it is sufficiently robust given that the alignment of firm characteristics reinforces the credibility of the matched sample. It is important to note that while this assumption largely holds, a cautious approach to interpretation remains essential.

The parallel trend assumption's validity in both datasets is vital for credible (DID) analysis and treatment effect estimates. Figure 1 demonstrates parallel trends in CEO option moneyness pre-SB 826 in the pooled sample, affirming the assumption. Although the matched sample's parallel trend is less distinct, its reinforced similarity in firm characteristics supports its robustness. Thus, we can proceed with the DID analysis.

5.5 SB 826 and CEO overconfidence

In this section, I present the regression results testing the central hypothesis. The prediction was straightforward: after the implementation of SB 826, CEOs of California companies should exhibit reduced overconfidence in comparison to CEOs of companies based outside California. Table 5 presents OLS regressions that try to assess the difference in CEO option moneyness, the measure of overconfidence, between California and non-California firms in the matched sample after SB 826 was signed. All regression models take into account firm and year fixed effects. Statistical significance is established using robust firm-clustered standard errors, which are reported in parentheses.

Table 5. Testing CEO overconfidence with the matched sample.

	Dependent variable: CEO Option Moneyness		
	(1)	(2)	(3)
CA Firm	-0.287	0.255	0.304
	(0.744)	(0.722)	(0.772)
CA Firm x Post	0.414***	0.405***	0.365***
	(0.143)	(0.122)	(0.123)
Ln(Sales)		-0.277*	-0.234
		(0.145)	(0.146)
Leverage		-0.379	-0.257
		(0.358)	(0.355)
Stock Return		0.397***	0.424***
		(0.088)	(0.087)
ROA		1.007*	0.995*
		(0.589)	(0.585)
Tobin's Q		0.509***	0.498***
		(0.033)	(0.033)
Board Independence			-0.994
			(0.637)
Board Size			-0.038
			(0.034)
CEO Age			-0.011
			(0.011)
CEO Chairman			0.092
			(0.139)
CEO Tenure			0.043***
			(0.011)
CEO Ownership			-0.056***
			(0.018)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of observations	1,608	1,608	1,608
R-squared	0.727	0.803	0.809

Note. This table presents OLS regression results exploring the difference in male CEO overconfidence between California and non-California firms after SB 826 (years 2018-2021) of the matched sample. The control sample includes non-California firms headquartered in states less likely to be sympathetic to California political ideals, as proxied by Presidential election results over the past five elections. These states include AK, AL, AR, AZ, CO, FL, GA, IA, ID, IN, KS, KY, LA, ME, MI, MO, MS, MT, NC, ND, NE, NH, NM, NV, OH, OK, PA, SC, SD, TN, TX, UT, VA, WI, and WV, respectively. The dependent variable is the CEO's stock option moneyness (*CEO Option Moneyness*), which is the measure for overconfidence. The regressions explore the interaction effect of the variables *CA Firm* and *Post. CA Firm* is a dummy variable set equal to one for California firms, and zero otherwise. *Post* is a dummy variable that equals one in the period is after the signing of SB 826 (2018 and up), and zero otherwise. Regression (1) includes no control variables, Regression (2) controls for firm characteristics, while Regression (3) also includes board and CEO characteristics as controls. Variable definitions can be found in Appendix A. All regressions include firm and year fixed effects. Statistical significance is denoted by robust and firm-clustered standard errors in parentheses. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

Regression (1) examines the difference in CEO option moneyness for California CEOs post-SB 826 compared to their counterparts in non-California states, without incorporating control variables. Regression (1) indicates a positive coefficient, significant at the 1% level, with a value of 0.414. This implies that following SB 826's adoption, CEOs of California firms had, on average, a 41.4 percentage point increase in CEO option moneyness in comparison to CEOs from firms outside California not influenced by SB 826.

In Regression (2), controls for firm characteristics are introduced. Like in Regression (1), I find a significant positive interaction effect on CEO option moneyness at the 1% level, albeit with a slightly smaller value of 0.405. The variables *Stock Return* and *Tobin's Q* display significant positive coefficients at the 1% level, while *ROA* shows a positive coefficient at the 10% significance level, implying that improved (stock market) performance and higher market valuation correspond to increased CEO option moneyness.

Lastly, in Regression (3), incorporating firm, board, and CEO controls, I continue to find a significant positive interaction coefficient at the 1% significance level (0.365), moderately lower than

in previous regressions. This reinforces the idea that including control variables offers a more nuanced understanding of the relationship among California firms, the introduction of SB 826, and CEO option moneyness. This belief is further validated by an increase in the R-squared value. The outcomes for the variables *Stock Return* and *Tobin's Q* remain consistent, holding their significance at the 1% level, while *ROA* retains its significance at the 10% level. The coefficient for *CEO Ownership* is significantly negative at the 1% level, suggesting that CEOs who hold a larger share of the firm's stock tend to have lower average CEO option moneyness, while *CEO Tenure* holds a significant positive coefficient (1% level), indicating longer tenures correspond to higher average CEO option moneyness.

In summary, the regression data from Table 5 suggests that post-SB 826, CEOs of California firms demonstrate higher CEO option moneyness than their counterparts in non-California firms, consistently showcasing a significant positive impact. This essentially means that post-SB 826, California firm CEOs display higher overconfidence than non-California firm CEOs, contradicting the main hypothesis. Subsequent sections will focus on robustness tests to further explore the variations in CEO option moneyness between California and non-California firms after the introduction of SB 826.

5.5.1 Robustness tests

5.5.1.1 Pooled sample and alternative matched samples

To confirm the validity of the regression findings detailed in Table 5 and to account for any potential biases arising from the matching process, I run additional regressions on the pooled sample, with the outcomes presented in Table 6. Mirroring the approach taken in Table 5, these regressions incorporate identical control variables and fixed effects.

The findings in Table 6 reflect those in Table 5, evident from the statistically significant and positive interaction coefficients for California firms post-SB 826 relating to CEO option moneyness. Importantly, the coefficients shown in Table 6 are significant at the 1% level, mirroring the level of significance observed in Table 5. This high level of significance underscores the pooled sample's ability to reveal distinct effects, much like the matched sample, providing a more nuanced understanding of how SB 826 impacts CEO option moneyness. The value of the coefficient in Regression (3) stands at 0.264, indicating a 26.4% increase in CEO option moneyness for CEOs of California-based firms as compared to CEOs outside California, following the enactment of SB 826. The findings of Table 6 also contradict the main hypothesis. Given the consistent interaction effects across all regressions, it's clear that the findings in Table 5 cannot be solely attributed to the sample's matching method.

Examining the control variables, *Stock return*, *Tobin's q* and *ROA* are significant at the 1 percent level, consistent with patterns seen in Table 5. The positive coefficient for *CEO Tenure* also reflect the trends in Table 5, indicating that CEOs with longer tenures typically have higher option moneyness. Interestingly, the coefficient for *CEO Ownership* no longer holds its significance.

Table 6. Testing CEO overconfidence with the pooled sample.

	Dependent variable: CEO Option Moneyness		
	(1)	(2)	(3)
CA Firm	-0.323	0.123	0.593
	(0.721)	(0.694)	(0.710)
CA Firm x Post	0.498***	0.311***	0.264***
	(0.100)	(0.088)	(0.088)
Ln(Sales)		-0.056**	-0.065
		(0.089)	(0.089)
Leverage		-0.342	-0.334
		(0.232)	(0.231)
Stock Return		0.350***	0.360***
		(0.056)	(0.055)
ROA		1.134***	1.163***
		(0.395)	(0.394)
Tobin's Q		0.531***	0.526***
		(0.026)	(0.026)
Board Independence			-0.979**
			(0.393)
Board Size			0.012
			(0.019)
CEO Age			-0.006
			(0.007)
CEO Chairman			-0.031
			(0.076)
CEO Tenure			0.029***
			(0.007)
CEO Ownership			-0.009
			(0.011)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of observations	2,811	2,811	2,811
R-squared	0.664	0.744	0.748

Note. This table presents OLS regression results exploring the difference in male CEO overconfidence between California and non-California firms after SB 826 (years 2018-2021) of the pooled sample. The control sample includes non-California firms headquartered in states less likely to be sympathetic to California political ideals, as proxied by Presidential election results over the past five elections. These states include AK, AL, AR, AZ, CO, FL, GA, IA, ID, IN, KS, KY, LA, ME, MI, MO, MS, MT, NC, ND, NE, NH, NM, NV, OH, OK, PA, SC, SD, TN, TX, UT, VA, WI, and WV, respectively. The dependent variable is the CEO's stock option moneyness (*CEO Option Moneyness*), which is the measure for overconfidence. The regressions explore the interaction effect of the variables *CA Firm* and *Post. CA Firm* is a dummy variable set equal to one for California firms, and zero otherwise. *Post* is a dummy variable that equals one in the period is after the signing of SB 826 (2018 and up), and zero otherwise. Regression (1) includes no control variables, Regression (2) controls for firm characteristics, while Regression (3) also includes board and CEO characteristics as controls. Variable definitions can be found in Appendix A. All regressions include firm and year fixed effects. Statistical significance is denoted by robust and firm-clustered standard errors in parentheses. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

for *CEO Tenure*. This shift in significance suggests that the pooled sample offers more defined effects than the matched sample. The regression results from the combined sample, displayed in Table 6, confirm the findings from the matched sample in Table 5. They demonstrate a consistently significant positive increase in CEO option moneyness for CEOs of California firms in contrast to those of non-California firms post-SB 826. To further ensure the robustness of these results, I employ two alternative matching approaches.

The first alternative method employs a calliper of 0.05, in contrast to the initial 0.01. While other matching criteria remain unchanged, this approach may identify more potential matches with similar propensity scores, which could have been overlooked with the stricter calliper of 0.01. This could potentially provide a better understanding of how SB 826 plays out across a wider group of CEOs.

The second method focuses on matching based solely on the nearest propensity score matched firm, rather than three. Although the covariates and a calliper of 0.01 are maintained consistent with the initial matched sample, this method seeks to offer a more direct and refined comparison, emphasizing the clarity of the treatment effect assessment and reducing the size of the control group. Similar to the

original matched sample, a control CEO may match multiple treatment CEOs but is only included once in the sample.

Table 7 presents the outcomes of the alternative matching methods. The same control variables and fixed effects from Regression (3) of Table 5 are incorporated, though the coefficients of control variables are not shown for brevity. Panel A displays the regression results from the first alternative matching approach (with a calliper of 0.05), while Panel B outlines the outcomes from the second approach (targeting the closest firm). Both alternative strategies produce results in line with the initial pooled and matched samples, though there's a minor dip in significance levels. This consistent outcome across varied matching methods hints at the robustness of the observed effects, despite the minor reduction in significance. The results are very insensitive to the use of alternative control samples.[6]

5.5.1.2 Alternative pre- and post-periods and CEO overconfidence measures

In this section, I explore the effects of SB 826 on the overconfidence levels of CEOs in both California-based and non-California firms, using different pre- and post-periods and CEO overconfidence measures. To identify the immediate effects of SB 826 on CEO option moneyness, I adopt alternative, shorter pre- and post-periods. This narrowed time frame aims to pinpoint the direct changes post-implementation, mitigating the influence of external variables that might arise over an extended duration. To ensure a robust analysis, I will utilize both the pooled and matched samples. The pooled sample captures broader trends and meaningful differences, while the matched sample isolates treatment effects and controls for confounding variables, prioritizing analysis quality.

Table 8 presents the regression outcomes, illustrating the impact of different timeframes before and after the implementation of SB 826 on CEO option moneyness. These regressions employ the same control variables as found in Regression (3) of Table 5, omitted here for brevity. Panel A represents the pooled sample, while Panel B highlights the matched sample. Regression (1) delves into the period from 2016 to 2019, designating 2018 and 2019 as post-SB 826 years. The interaction coefficient of the

Table 7. Testing CEO overconfidence with alternative matching.

	Dependent variable: CEO Option Moneyness	
	(1)	(2)
CA Firm	0.409	0.065
	(0.792)	(1.060)
Post x CA Firm	0.328**	0.429**
	(0.139)	(0.188)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	1,621	1,095
R-squared	0.766	0.785

Note. This table presents OLS regression results exploring the difference in male CEO overconfidence between California and non-California firms after SB 826 (years 2018-2021) with alternative matching approaches. The dependent variable is the CEO's stock option moneyness (*CEO Option Moneyness*), which is the measure for overconfidence. The regressions explore the interaction effect of the variables *CA Firm* and *Post. CA Firm* is a dummy variable set equal to one for California firms, and zero otherwise. *Post* is a dummy variable that equals one in the period is after the signing of SB 826 (2018 and up), and zero otherwise. Regression (1) contains a control sample matched based on a calliper of 0.05 and Regression (2) contains a control sample matched based on the nearest propensity score matched firm. Control variables are equal to the control variables used in Regression (3) of Table 5, not included for brevity. Variable definitions can be found in Appendix A. All regressions include firm and year fixed effects. Statistical significance is denoted by robust and firm-clustered standard errors in parentheses. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

[6] This is also supported by von Meyerinck et al. (2019).

variables, Post 2018-2019 and CA firm, indicate a significant and positive impact on CEO option moneyness in both pooled and matched samples (significant at the 1% and 5% levels, respectively). These results further confirm previous results, hinting that SB 826's influence on CEO option moneyness persists consistently for CEOs of California-based companies when compared to those outside California firms, regardless of whether the analysis spans 8 or 4 years.

In Regression (2), I narrow the focus to the 2017-2018 period, marking only 2018 as post-SB 826. Compared to results from Regression (1), the significance of the interaction effect diminishes in the matched sample, but persists in the pooled sample. This indicates that, within this concise two-year span, making concrete determinations about SB 826's differential impact on CEO option moneyness for California versus non-California firms is more challenging when CEOs are matched based on similar characteristics. However, given the continued significance in the pooled sample at the 10% level, conclusions can still be derived from this two-year timeframe.

The effectiveness and impact of SB 826 on CEO option moneyness is sensitive to the timeframe analysed and the nature of the sample. When considering a more narrowed period of 2017-2018, and when California and non-California CEOs are matched based on specific characteristics, the influence of SB 826 becomes less discernible. This highlights the importance of sample selection in drawing conclusions. However, using a broader, pooled sample within this 2-year timeframe, the impact of SB

Table 8. Testing CEO overconfidence with alternative pre- and post-periods.

Panel A: Pooled sample		
	CEO Option Moneyness	
	(1)	(2)
CA Firm	0.153	0.235
	(0.128)	(0.862)
Post 2018-2019 x CA Firm	0.377***	
	(0.146)	
Post 2018 x CA Firm		0.260*
		(0.141)
Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	1,372	662
R-squared	0.792	0.908
Panel B: Matched sample		
	CEO Option Moneyness	
	(1)	(2)
CA Firm	0.266	0.417
	(0.952)	(0.771)
Post 2018-2019 x CA Firm	0.357**	
	(0.168)	
Post 2018 x CA Firm		0.096
		(0.176)
Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	787	390
R-squared	0.839	0.952

Note. This table presents OLS regression results exploring the difference in male CEO overconfidence between California and non-California firms after SB 826 with alternative pre- and post-periods. Panel A represents the pooled sample, while Panel B highlights the matched sample. The dependent variable is the CEO's stock option moneyness (*CEO Option Moneyness*), which is the measure for overconfidence. The regressions explore the interaction effect of the variables *CA Firm* and *Post. CA Firm* is a dummy variable set equal to one for California firms, and zero otherwise. *Post* is a dummy variable that equals one in the period is after the signing of SB 826 (2018 and up), and zero otherwise. Regression (1) looks at the years 2016-2019, where *Post 2018-2019* is a dummy variable set equal to one for observations measured after the implementation of SB 826 (2018 and up), and zero otherwise. Regression (2) looks at the years 2017-2018, where *Post 2018* is a dummy variable set equal to one for observations in year 2018, and zero in year 2017. Control variables are equal to the control variables used in Regression (3) of Table 5, not included for brevity. Variable definitions can be found in Appendix A. All regressions include firm and year fixed effects. Statistical significance is denoted by robust and firm-clustered standard errors in parentheses. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

826 remains statistically significant, implying that a larger dataset may offer more consistent insights regarding the mandate's influence during this period. If we look to interpret the coefficients, you can say that, while looking at a 4-year and a 2-year timeframe that, based on the 1% and 10% significance levels of the regressions shown in Panel A of the pooled sample, that CEOs of California firms have around a 37.7 and 26.0 percentage points higher CEO option moneyness compared to CEOs of non-California firms after the signing of SB 826, respectively. This suggests that different timeframes do not influence the change in CEO option moneyness following SB 826, reinforcing the observation that CEOs of California firms continue to exhibit higher overconfidence compared to CEOs of non-California firms post the signing of SB 826.

Table 9 explores alternative measures for overconfidence. In Panel A, the pooled sample is tested, while Panel B presents the matched sample. The analysis starts with the *Holder 67* measure in Regressions (1) and (2), transitioning to the *Net Buyer* measure in Regressions (3) and (4). The *Holder 67* measure is a dummy variable that's set equal to one when the CEO option moneyness measure reaches at least 67% for a minimum of two years. Once this threshold is met, the CEO is labelled as overconfident from the first time that the *CEO Option Moneyness* measure is at least 67%. On the other hand, the *Net Buyer* measure is a dummy variable set equal to one when the CEO more frequently buys than sells company stock during the sample period. Detailed descriptions of these measures are elaborated upon in Section 4.3.3.

To simplify and ensure clarity: In both Panel A and B, Regressions (1) and (3) utilize only fixed effects and exclude control variables. Meanwhile, Regressions (2) and (4) integrate the control variables in line with Regression (3) from Table 5. These regressions feature fewer observations than those in previous tables detailing CEO option moneyness measures. This reduction stems from excluding CEOs with less than 2 years of tenure for the *Holder 67* measure, and those with less than 3 years of tenure are left out for the *Net Buyer* measure, minimizing potential biases in the findings.

The regression results from both Regression (1) and (2) for the pooled and matched samples suggest that, using the *Holder 67* measure, there isn't a statistically significant difference between the percentage of CEOs from California-based firms and those from non-California firms who are labelled as *Holder 67* after the enactment of SB 826. This implies that post-SB 826, CEOs of California firms aren't more or less likely to have CEO option moneyness reach at least 67% for a minimum of two years.

Regressions (3) and (4) focus on the *Net Buyer* measure, which evaluates CEO overconfidence through stock buying and selling patterns, rather than option holdings and exercise behaviours. Much like the outcomes observed with the *Holder 67* measure, the regressions using the *Net Buyer* measure yield no statistically significant coefficients. This indicates that there is no discernible difference in overconfidence between CEOs of California firms and those of non-California firms based on this metric. In the aftermath of SB 826, it appears that CEOs of California firms neither buy nor sell their company stock more or less frequently than their counterparts in non-California firms.

Table 9. Testing CEO overconfidence with alternative CEO overconfidence measures.

Panel A: Pooled sample				
	Alternative CEO overconfidence measures			
	Holder 67		Net buyer	
	(1)	(2)	(3)	(4)
CA Firm	-0.351*	0.087	-0.073	-0.081
	(0.208)	(0.220)	(0.075)	(0.120)
Post x CA Firm	0.052	0.013	-0.029	-0.022
	(0.057)	(0.026)	(0.020)	(0.015)
Controls	No	Yes	No	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	2,587	2,587	2,234	2,234
R-squared	0.805	0.819	0.939	0.941
Panel B: Matched sample				
	Alternative CEO overconfidence measures			
	Holder 67		Net buyer	
	(1)	(2)	(3)	(4)
CA Firm	-0.336*	0.060	-0.077	-0.097
	(0.200)	(0.211)	(0.121)	(0.167)
Post x CA Firm	0.035	0.017	-0.055	-0.042
	(0.034)	(0.033)	(0.047)	(0.028)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1,477	1,477	1,266	1,266
R-squared	0.802	0.826	0.969	0.971

Note. This table presents OLS regression results exploring the difference in male CEO overconfidence between California and non-California firms after SB 826 with alternative CEO overconfidence measures. Panel A represents the pooled sample, while Panel B highlights the matched sample. The regressions explore the interaction effect of the variables *CA Firm* and *Post. CA Firm* is a dummy variable set equal to one for California firms, and zero otherwise. *Post* is a dummy variable that equals one in the period is after the signing of SB 826 (2018 and up), and zero otherwise. The dependent variable for Regressions (1) and (2) is the variable *Holder67* and in Regressions (3) and (4) the variable *Net Buyer*. *Holder 67* is a dummy variable that equals one if the *CEO Option Moneyness* measure is at least 67% in two or more years, in which case, the CEO is classified as overconfident from the first time that the *CEO Option Moneyness* measure is at least 67%. *Net Buyer* is a dummy variable equal to one if the CEO is a net buyer of company stock in more years than years they were net sellers in the sample. Regression (1) and (3) do not include controls, Regression (2) and 4 use the control variables used in Regression (3) of Table 5, not included for brevity. Variable definitions can be found in Appendix A. All regressions include firm and year fixed effects. Statistical significance is denoted by robust and firm-clustered standard errors in parentheses. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

In conclusion, the *Holder 67* and *Net Buyer* variables suggest that post-SB 826, CEOs of California firms show no difference in overconfidence compared to CEOs outside California, thereby not supporting the main hypothesis.

5.5.2 Additional tests

This section presents further tests related to the signing of SB 826, its requirements, and CEO overconfidence. These additional tests were carried out to gain a deeper understanding of the implications of the adoption of SB 826 and its impact on CEO option exercise and behaviour.

5.5.2.1 SB 826 requirements and overconfidence

Table 10 displays the results of regressions investigating SB 826 requirements, incorporating the variables *Add Female* and *Gap*. *Gap* represents the difference between the number of female directors needed for SB 826 compliance by the end of 2021 and the respective year. *Add Female* is a dummy variable set to one if *Gap* is positive, zero otherwise. The significance and relevance of these variables

Table 10. Testing CEO overconfidence with SB 826 requirements.

Panel A: Pooled sample		
	Dependent variable: CEO Option Moneyness	
	(1)	(2)
CA firm	0.330	0.405
	(0.301)	(0.385)
Add female	-0.036	
	(0.108)	
CA firm x Add female	-0.300	
	(0.187)	
Gap		0.003
		(0.140)
CA firm x Gap		-0.139
		(0.208)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	1,295	1,295
R-squared	0.878	0.877
Panel B: Matched sample		
	Dependent variable: CEO Option Moneyness	
	(1)	(2)
CA firm	0.467	0.579
	(0.451)	(0.493)
Add female	0.133	
	(0.323)	
CA firm x Add female	-0.649	
	(0.417)	
Gap		0.207
		(0.215)
CA firm x Gap		-0.463
		(0.289)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	726	726
R-squared	0.902	0.595

Note. This table presents OLS regression results exploring the difference in male CEO overconfidence between California and non-California firms after SB 826 with SB 826 requirements. Panel A represents the pooled sample, while Panel B highlights the matched sample. Regression (1) explores the difference in California and non-California firms in CEO option moneyness after SB 826 and the interaction effect between the variables *Add Female* and *CA Firm* and Regression (2) explores the interaction effect of the variables *Gap* and *CA Firm. CA Firm* is a dummy variable set equal to one California firms, and zero otherwise. *Add Female* is a dummy variable set to one if *Gap* is positive, and zero otherwise. The variable *Gap* is defined as the difference between the number of female directors needed to comply with SB 826 by the end of 2021 and the respective year. Control variables are equal to the control variables used in Regression (3) of Table 5, not included for brevity. Variable definitions can be found in Appendix A. All regressions include firm and year fixed effects. Statistical significance is denoted by robust and firm-clustered standard errors in parentheses. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

are explained in Section 4.3.4. Panel A features the pooled sample, while Panel B presents the matched sample. The control variables are consistent with those in Regression (3) of Table 5, not included for brevity. The regressions examine the years after SB 826 was enacted (2018-2021), looking at how CEOs of California companies respond when they expect to add female directors to meet SB 826 requirements.

Both Panel A and Panel B reveal that neither Regression (1) nor Regression (2) yield significant results. This suggests that the mandate for California firms to appoint a female director in compliance with SB 826 by the end of 2021 does not appear to influence *CEO Option Moneyness* (i.e., CEO overconfidence) in comparison to CEOs of non-California firms exempt from SB 826 requirements. Similarly, the results indicate that the requirement for CEOs of California firms to incorporate more female directors as per SB 826 regulations does not impact CEO option moneyness and, consequently, CEO overconfidence.

6. Discussion

This study has shed light on how SB 826 affects the overconfidence of CEOs in California as compared to their counterparts in non-California firms. In this section, the methods I used in my research will be revisited, addressing any potential limitations and discussing how the research design might shape the understanding of the results. Finally, the section concludes with recommendations for future research.

This study examines the impact of SB 826 on the overconfidence levels of CEOs in California-based firms relative to the CEOs of firms outside of California. The central hypothesis stated that, following the signing of SB 826, CEOs in California would display reduced overconfidence compared to CEOs of non-California firms. CEO overconfidence was tested using three metrics: *CEO Option Moneyness*, *Holder 67*, and *Net Buyer*. Findings from the pooled, matched, and alternative matched samples indicate that post-SB 826, the option moneyness for California CEOs was higher than for non-California CEOs across various timeframes, thereby contradicting the main hypothesis. In relation to the alternative overconfidence measures, the data indicates that there is no observable impact of SB 826 on CEO overconfidence among California firms compared to non-California firms after the implementation of SB 826.

The results can be interpreted as follows. When examining *CEO Option Moneyness*, a continuous variable, a significant increase is observed in the option moneyness for CEOs in California post-SB 826 compared to their counterparts outside California. Yet, this does not necessarily equate to a relative increase in overconfidence among California CEOs. The robustness tests, using alternative overconfidence measures such as *Holder 67* and *Net Buyer*, showed no significant change in overconfidence levels following the implementation of SB 826. This suggests that while CEOs in California may have witnessed a relatively larger increase in the moneyness of their option portfolio (or a higher percentage of deep-in-the-money options) after SB 826, suggesting a higher degree of confidence across California CEOs, there is no evidence of a relative increase in the percentage of overconfident CEOs in California compared to other states.

To my understanding, this paper stands out by being the first to explore how gender quotas affect managerial overconfidence, adding a new perspective to existing research in corporate governance and behavioural finance, while also contributing to the existing literature on California SB 826.

The findings offer new insights into the relation between board diversity and CEO overconfidence. Contrary to Chen et al. (2019), who suggested that the presence of female directors could mitigate CEO overconfidence as evidenced by fewer deep-in-the-money options held by male CEOs, my research shows a different result. Specifically, after the implementation of SB 826, male CEOs in California, as compared to their counterparts in other states, exhibit higher option moneyness, suggesting an increase in their holdings of deep-in-the-money options. This result suggests that the mere imposition of a gender quota, which mandates the appointment of female directors, may not have the same mitigating effect on

CEO overconfidence as the natural presence of female directors in a company. This indicates that for female board members to effectively mitigate CEO overconfidence, they should already be a part of the board of directors of the firm. In other words, the context matters: the obligation to include female directors, by itself, does not necessarily reduce CEO overconfidence.

In addition, my study contributes to the existing literature concerning gender quotas like SB 826, demonstrating that such mandates aimed at increasing board diversity may not necessarily influence specific CEO behaviours, such as overconfidence. This could be of importance for policymakers and stakeholders who might assume direct behavioural changes due to policy implementations.

This study has its limitations, which I hope future research to address. Primarily, the research is confined to a particular setting, focusing on California's gender quota, SB 826. While this approach helps mitigate endogeneity concerns, it remains uncertain if these findings can be extended to different quota regulations in other countries or states. Second, the measure of overconfidence based on stock option holding and exercise behaviour, while supported by prior literature, is still a proxy. CEOs might retain or exercise stock options for reasons other than overconfidence. For instance, they could be motivated by expectations of future stock price increases, vesting schedules, signalling, or personal financial and tax considerations.

Moreover, the use of ExecuComp data for creating the option-based measure introduces certain limitations. It does not provide specific information about a CEO's options holdings and exercise prices for each option grant, which required me to adopt an adapted version. While the adapted version effectively captures the overarching trend, it might introduce minor variations when interpreting individual CEO overconfidence. Another limitation associated with using the ExecuComp database is its exclusion of a considerable number of firms, potentially biasing the data towards the larger firms in terms of market value. This bias prompts questions regarding how accurately our results reflect the overconfidence of CEOs in smaller firms, which might limit the generalizability of the results.

An additional limitation of this study stems from the underlying assumption that SB 826 directly affects CEO overconfidence. This assumption might oversimplify the complex and multifaceted nature of how policy changes can potentially influence CEO option holdings and exercise behaviour.

Moreover, the method of sample selection and matching employed in this study might have influenced the observed results. With control states chosen based on political stance, there arises a valid concern about potential selection biases and external influences affecting the interpretations. The findings of this research are, in part, determined by the specific matching procedures and control samples used. Future research could explore alternative matching approaches or broaden the pool of control samples, encompassing different firm, board and CEO characteristics or geographical locations. Evaluating these alternative approaches could provide a more comprehensive understanding and validate the generalizability of the results derived from the current matching methodology.

In this study, the main focus was on male CEOs, largely because of the data availability. An avenue for future research would be to explore overconfidence among female CEOs. Given the limited data on

female CEOs in the ExecuComp dataset, subsequent studies might look into different datasets or even think about collecting data first-hand. A comparative analysis of overconfidence between male and female CEOs might give us a more detailed understanding of gender-related behavioural patterns in corporate decision-making. Additionally, it would be interesting to see if gender quotas have varied impacts depending on the gender of the CEO.

Next to that, the primary conclusions drawn from this research are heavily influenced by data on larger firms, reflecting the inherent limitations of the ExecuComp dataset. It remains an open question as to how gender quota policies, like SB 826, might influence CEO overconfidence in smaller listed firms not included in the ExecuComp dataset. Investigating these smaller firms could be interesting, as they often exhibit distinct corporate cultures and managerial dynamics compared to their larger counterparts.

7. Conclusion

This research aimed to identify how the California gender quota, SB 826, affects the overconfidence of CEOs in California as compared to CEOs in non-California firms without a similar gender quota policy. Based on a quantitative analysis of pooled and different matched samples of CEOs of California and non-California firms, I reject the main hypothesis. The findings did not provide supporting evidence to indicate that the signing of SB 826 led to reduced overconfidence among male CEOs in California compared to their counterparts outside California. In examining CEO option moneyness, the main indicator of overconfidence, I observed that post-SB 826, CEOs of California firms showed relatively higher option moneyness than CEOs of non-California firms. This suggests a higher degree of confidence among California CEOs. This result is robust for different matched control groups and timeframes. However, this did not necessarily imply a relative increase in overconfidence among California CEOs. When I delved into alternative measures of overconfidence, no significant differences were found between the treatment and control groups. Consequently, these findings provided the ability to directly address the central research question. The results indicate that California's gender quota (SB 826) did not impact the overconfidence levels of male CEOs in California compared to CEOs in states without a similar gender quota policy.

The outcomes of this study deviated from my predictions. Previous research suggested that female directors often contribute a more risk-averse perspective to the boardroom, typically adopting a more thoughtful and cautious approach to decision-making. This difference in behaviour was believed to potentially temper the overconfidence frequently seen in male CEOs. Consequently, I had anticipated that a gender quota, designed to improve board diversity by mandating the inclusion of more female directors, would help reduce male CEO overconfidence.

Yet, as the study progressed, it became clear that the identification and interpretation of CEO overconfidence was not consistent but instead, heavily contingent on the specific metric used for its measurement. Different measures produced different results, highlighting the complexity of assessing overconfidence and emphasizing the importance for future research to acknowledge the potential differences arising from different measures of overconfidence.

This study focused only on the California gender quota, SB 826. While this provided valuable insights into this specific legislative context, it raised the question of how similar or contrasting regulations in other states or countries might affect CEO overconfidence. Future research could explore different types of gender quotas or examine alternative laws that may impact CEO overconfidence. This would offer a more comprehensive understanding of how such policies affect CEO overconfidence across various regulatory settings.

To deepen the understanding of gender differences and their impacts, future research could explore the prevalence of overconfidence among female CEOs. Examining how gender quotas impact the levels of CEO overconfidence, focusing on variations between male and female CEOs, may yield interesting

findings on gender differences. In addition, including smaller publicly-listed firms that are typically not represented in the ExecuComp dataset could offer a more comprehensive view of how gender quota policies affect CEO overconfidence across different corporate environments.

In summary, this study makes significant contributions to various fields of research. Importantly, it is the first to explore the effects of gender quotas on managerial overconfidence, offering new perspectives to both corporate governance and behavioural finance. Moreover, the findings challenge existing perspectives, revealing that mandated gender quotas like California's SB 826 may not lead to a reduction in CEO overconfidence. This insight could be important for policymakers and stakeholders who might anticipate directly influencing CEO behaviour through such policies. Consequently, this research deepens our understanding of how gender quotas, board structure, and gender diversity affect CEO overconfidence in a broader context, providing a valuable addition to the existing body of literature.

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Appendix

Table A. Variable definitions/constructions.

Variables	Definition/Construction	Source
Overconfidence variables		
CEO Option Moneyness	First, calculate the average realizable value per option by dividing the total realizable value of the exercisable options by the number of exercisable options (Compustat items: *OPT_UNEX_EXER_EST_VAL* / *OPT_UNEX_EXER_NUM*). Next, the average realizable value is subtracted from the fiscal year-end stock price (Compustat item: *PRCC_F*) to obtain the average exercise price of the options. The estimated moneyness of the options is then calculated as the stock price divided by the estimated average exercise price minus one.	ExecuComp
Holder 67	A dummy variable that equals one if the *Moneyness* measure is at least 67% in two or more years, in which case, the CEO is classified as overconfident from the first time that the *Moneyness* measure is at least 67%.	ExecuComp
Net Buyer	A dummy variable equal to one if the CEO is a net buyer of company stock in more years than years they were net sellers in the sample.	ExecuComp
Supporting variables		
Gap	The difference between the number of female directors needed to comply with SB 826 by the end of 2021 and the number on the board prior to the signing of SB 826. (≥ 0)	ISS
Add Female	A dummy variable set to one if Gap is positive, and zero otherwise.	ISS
Post	A dummy variable that equals one in the period is after the signing of SB 826 (2019 and up), and zero otherwise.	ExecuComp
CA Firm	A dummy variable set equal to one for California firms, and zero otherwise.	ExecuComp
Firm characteristics		
Sales (million $)	Compustat item SALE	Compustat
Leverage	Compustat items (DLC + DLTT) / AT	Compustat
Stock Return	Compustat item (PRCC_F / PRCC_F(n-1)) - 1	Compustat
ROA	Compustat items NI / AT	Compustat
Tobin's Q	Compustat items ((PRCC_F * CSHO) + AT – CEQ) / AT	Compustat
Board characteristics		
Board Independence	The fraction of independent directors on the board.	ISS
Board Size	The number of directors on the board.	ISS
CEO characteristics		
CEO Age	The age of the CEO in years.	ExecuComp
CEO Chairman	A dummy variable that equals one if the CEO also chairs the board, and zero otherwise.	ExecuComp
CEO Tenure	The number of years the CEO has been in office.	ExecuComp
CEO Ownership	The fraction of the firm's stocks owned by the CEO.	ExecuComp

Note. This table reports variable definitions of all variables used in the paper as well as their data sources.

Table B. Balancing tests.

Panel A: Differences in firm, board and CEO characteristics all non-California firms				
	California firms	Non-California firms	Difference	*t*-statistic
Sales (in million $)	6720.31	11344.71	-4624.40	-3.41***
Leverage	0.208	0.306	-0.098	-8.47***
Stock return	0.181	0.116	0.065	3.29***
ROA	0.058	0.056	0.002	0.65
Tobin's Q	2.681	2.110	0.571	6.91***
Board Independence	0.792	0.819	-0.027	-4.37***
Board Size	8.578	9.408	-0.830	-6.80***
CEO Age	56.463	57.466	-1.003	-2.48**
CEO Chairman	0.410	0.518	-0.108	-3.52***
CEO Tenure	9.830	8.348	1.482	3.27***
CEO Ownership	0.019	0.017	0.002	0.77
Panel B: Differences in firm, board and CEO characteristics, closest 3 TA matches				
	California firms	Non-California firms	Difference	*t*-statistic
Sales (in million $)	6776.00	6745.90	30.1	0.02
Leverage	0.210	0.212	-0.002	-0.16
Stock Return	0.180	0.154	0.026	0.95
ROA	0.059	0.066	-0.007	-1.11
Tobin's Q	2.645	2.778	-0.133	-0.81
Board Independence	0.792	0.782	0.01	1.26
Board Size	8.598	8.676	-0.078	-0.56
CEO Age	56.503	57.688	-1.185	-1.94*
CEO Chairman	0.408	0.422	-0.014	-0.37
CEO Tenure	9.802	10.913	-1.111	-1.49
CEO Ownership	0.018	0.023	-0.005	-1.32

Note. This table reports differences in firm, board and CEO characteristics between California-headquartered firms and non-California firms pre-SB 826. The table reports the means and the results from tests for differences in means in characteristics between the two subsamples. Panel A shows balancing tests for the pooled sample. Panel B shows balancing tests for a sample in which we draw, for each firm headquartered in California, the three closest firms in terms of propensity scores. While the same firm may serve as a matched control firm to more than one California-headquartered firm, every control firm is included only once in the sample. Variable definitions can be found in Appendix A. Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.

Table C. Sample details by year and industry post-matching.

Panel A. By year						
	California firms			Non-California firms		
Year	No. of obs.	%	Average CEO option moneyness	No. of obs.	%	Average CEO option moneyness
2014	95	15.06%	1.077	141	14.43%	1.167
2015	88	13.95%	1.106	144	14.74%	1.171
2016	82	13.00%	1.087	139	14.23%	1.300
2017	71	11.25%	1.195	122	12.49%	1.259
2018	78	12.36%	1.326	119	12.18%	1.227
2019	76	12.04%	1.737	100	10.24%	1.380
2020	74	11.73%	2.187	103	10.54%	1.766
2021	67	10.62%	2.217	109	11.16%	1.532
Total	631	100.00%	1.457	977	100.00%	1.338
Panel B. By Fama–French 12 industries						
	California firms			Non-California firms		
Year	No. of obs.	%	Average CEO option moneyness	No. of obs.	%	Average CEO option moneyness
Non-Durables	32	5.07%	1.524	55	5.36%	1.375
Manufacturing	28	4.44%	1.040	179	18.32%	0.928
Energy	8	1.27%	0.155	40	4.09%	0.603
Chemicals	16	2.54%	0.649	42	4.30%	0.645
Business Eq.	285	45.17%	1.538	179	18.32%	1.724
Telecom	13	2.06%	0.851	11	1.13%	1.287
Utilities	13	2.06%	0.952	16	1.64%	0.560
Shops	52	8.24%	1.151	161	16.48%	1.419
Healthcare	136	21.55%	1.592	124	12.69%	1.507
Other	48	7.61%	1.909	170	17.40%	1.267
Total	631	100.00%	1.457	977	100.00%	1.338

Note. The table presents information on the amount of observations and CEO option moneyness of the treatment (California firms) and the control group (non-California firms) in different industries and years. In Panel A, the table shows the number of firm-year observations and percentage of California and non-California firms, as well as the average CEO option moneyness, for each year. Panel B reports the same information as Panel A, but across the Fama–French 12 industries (financial and durable firms are excluded).

Table D. Comparing descriptive statistics of California and non-California firms post-matching.

	California firms			Non-California firms			Difference	
Variables	N	Mean	Median	N	Mean	Median	Mean	Median
Overconfidence variables								
CEO Option Moneyness	336	1.112	0.763	546	1.222	0.602	-0.110	0.161*
Holder 67	300	0.620	1.000	497	0.456	0.000	0.164***	1.000
Net Buyer	259	0.521	1.000	426	0.598	1.000	-0.077*	0.000
Firm characteristics								
Sales (million $)	336	6776.00	1983.89	546	6745.90	1756.94	30.10	226.95
Leverage	336	0.210	0.193	546	0.212	0.194	-0.002	-0.001
Stock Return	336	0.180	0.125	546	0.154	0.101	0.026	0.024
ROA	336	0.059	0.054	546	0.066	0.065	-0.007	-0.011*
Tobin's q	336	2.645	2.187	546	2.778	2.080	-0.133	0.107
Board characteristics								
Board Independence	336	0.792	0.818	546	0.782	0.800	0.010	0.018
Board Size	336	8.598	9.000	546	8.676	9.000	-0.078	0.000
Gap	71	1.352	1.000	122	1.765	2.000	-0.413***	-1.000***
Add Female	71	0.789	1.000	122	0.890	1.000	-0.101*	0.000
CEO characteristics								
CEO Age	336	56.503	56.000	546	57.688	57.000	-1.185*	-1.000
CEO Chairman	336	0.408	0.000	546	0.422	0.000	-0.014	0.000
CEO Tenure	336	9.802	7.500	546	10.913	8.816	-1.111	-1.316*
CEO Ownership	336	0.018	0.005	546	0.023	0.007	-0.005	-0.002

Note. The table presents the means and medians of the study's variables for the treatment group (California firms) and the control group (non-California firms) pre-SB 826. For each variable, the difference between the two subsamples are reported. Appendix A provides the definition of each variable. There are t-tests (Wilcoxon–Mann–Whitney tests) are conducted to test for differences in the means (medians). Statistical significance is indicated by ***, **, and *, corresponding to the 1%, 5%, and 10% levels, respectively.