The effect of gender diversity in boardrooms on securities fraud in the United States

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Abstract

This study examines whether gender diversity in boardrooms has an effect on the propensity of firms to commit securities fraud in the United States from the period 2000 until 2004. Using a logistic regression no significant effect was found of gender diversity in boardrooms on the propensity of firms to commit fraud. Another logistic regression was performed to see whether the critical mass theory affects the effect of gender diversity in boardrooms on securities fraud. Again, no significant effect was found. Lastly, there was also no significant effect found that there are differences between the effect of gender diversity in boardrooms on the propensity of firms to commit securities fraud for male-dominated and female-dominated industries. Several robustness checks were performed and support the initial results found. In sum, no evidence is found that gender diversity in boardrooms affected securities fraud in the United States between 2000 and 2004 in the data set used.

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1 Introduction

In recent years, gender diversity on the work floor in corporate America has been a topic of debate. Although gender diversity in top positions has been positively changing from the late 90s to now, changes have been happening at an extremely slow pace. This slow positive change in gender diversity did cause researchers to look into implications for companies that implemented a more gender-diverse board of directors. The research into the implications for firm behavior and results has mixed results. For example, Gordini and Rancati (2017) and Campbell and Mínguez-Vera (2008) showed that having more women in boardrooms positively affects firm value. Other research, however, has pointed out that there are no cognitive differences between males and females and that therefore there will not be a difference in firm behavior because of gender diversity in boardrooms (Triana, Miller, & Trzebiatowski, 2014; Khan & Vieito, 2013). Next to gender diversity in top leadership positions was the recent discussion about corporate fraud in the United States. An article published by the New York Times, sparked interest after it stated that according to research by Dyck, Morse, and Zingales (2023) fraud is more common than people think it is and that around 10% of all companies in the United States commit securities fraud (Livni, 2023).

So, although some studies state that there are no cognitive differences between males and females, others show that there are differences between genders that could influence the propensity of firms to commit fraud. Studies show that there are differences between males and females in terms of ethical behavior standards and risk aversion and that these differences could lead to less fraudulent behavior (Dawson, 1997; Bennett et al., 2005; Hoffman, 1998; Barber & Odean, 2001). Others also have done research on the effects of diversity in general and found positive effects of diversity when used in the board of directors (Cox Jr, 2001). Because of this mixed evidence in the current literature and the current debate about gender diversity and corporate fraud, it is interesting to look at the effect of gender diversity on securities fraud in the United States. Therefore, my research question will be:

"What is the effect of gender diversity on corporate securities fraud committed by companies between 2000 and 2004 in the United States?"

The group of companies that committed securities fraud is based on a paper by Dyck, Morse, and Zingales (2010). The company data, for both fraudulent firms and non-fraudulent firms, is from Compustat, and the board of directors data is from Boardex. With this data, I performed several logistic regression analyses to study the effect of gender diversity on corporate securities fraud. Not only will this study focus on the effect of gender diversity on corporate securities fraud, but this study will also examine how the critical mass theory affects the effect of gender diversity on corporate securities fraud, and how the effect of gender diversity on corporate securities fraud might differ between male-dominated industries and female-dominated industries.

With this study, I want to add to the current literature as there is a minimal amount of research done on the effect of gender diversity in boardrooms on fraud, and specifically on securities fraud. This study,

furthermore, focuses on the United States, while other research on gender diversity and securities fraud focused on firms in China (Cumming et al., 2015). This study will therefore be scientifically relevant as it fills in a knowledge gap that exists in the current literature. Furthermore, this study adds to the current discussion about gender diversity in leadership positions of firms. It is interesting for corporate firms to see if board diversity does influence the propensity of firms to engage in corporate fraud. If it does companies could, for example, be more likely to change the gender distribution in their board of directors. Therefore, this research is also relevant for practical application by firms.

The remainder of this study is structured as follows. Section 2 discusses the institutional background of this study, which discusses the board of directors in corporate America and the role of the board of directors in companies. Section 2 also discusses the past and current state of gender diversity in boardrooms in the United States. Section 3 discusses the current literature about gender diversity in boardrooms and the effect on securities fraud, other types of fraud, and financial performance. Section 4 develops the theory on which the research question and Hypotheses are based. This includes theories about ethical and risk aversion differences between men and women, and diversity in general. Section 5 discusses the developed Hypotheses, while Section 6 discusses the different data sources used, the variables and their summary statistics, and the methodology used to test the Hypotheses. Section 7 shows the results of the different Hypotheses, with the robustness checks done in Section 8. Section 9 contains a discussion of the implications, limitations, and suggestions for further research. Lastly, Section 10 concludes.

2 Institutional background

In this section, the institutional background of the board of directors and gender diversity in the United States will be discussed. First, the board of directors in the United States will be discussed together with the role the board plays in corporate companies. Next, the past and current state of gender diversity in boardrooms in the United States will be discussed, as gender diversity has been changing substantially in the past years.

2.1 The Board of Directors in the United States

Worldwide, there are two types of board of director systems that are used most frequently. In Europe, the most frequent one is having a top management board, which includes in-house directors, and another supervisory board, which includes independent directors. The United States, where this study focuses on, does not use this two-part board system (Cumming et al., 2015). In the United States, the usual corporate structure looks like the following. There is a board of directors, which is actually more like the supervisory board in the two-part board system, and a management team. In the two-part board system, the management cannot be part of the supervisory board, while in the United States, a lot of CEOs, CFOs or COOs are part of the board of directors (Cumming et al., 2015). Another difference is that the supervisory board in Europe can only contain independent directors, while in the United States, the board of directors has outside directors as well as directors who are not independent (for example other employees apart from management) (Cumming et al., 2015).

The board of directors gets chosen by the shareholders of the company and mainly exists to protect the shareholder's interests and make sure that the company acts in these shareholders' interests. Mizruchi (1983) and Boivie et al. (2021) describe the roles of the board of directors in the United States. Mizruchi (1983) states that the board of directors is the center of control within the firm. One of these control mechanisms the board of directors has is the hiring and firing of the CEO. By having control of the hiring and firing of this CEO, the board can practice influence on the strategy of the company. When this strategy is not executed well, the board can choose to fire the CEO. The article of Mizruchi (1983) gives a good overview of the role of the board of directors in U.S. companies. However, since the article stems from the 80s, it is wise to also look at more recent articles about the role of the board of directors in companies, as over the years, some things might have changed.

Boivie et al. (2021) studies the difference between what scholars state the board of directors' responsibilities are versus what the board of directors thinks their responsibilities are. Boivie et al. (2021) states that in the literature, there is mostly a focus on the monitoring function that the board of directors has to ensure management is acting in the interests of the shareholders. Furthermore, the literature mostly focuses on the resource dependency function and the strategic function to help management make decisions. Boivie et al. (2021) performed a grounded theory style research on how the board of directors views their primary func-

tions. Some directors saw their prime function as protecting the shareholders' interests, while other directors saw their prime function as assisting management with making the best strategic decisions for the firm. One thing management all agreed on was the fact that they should approach their membership as directors more as a strategic partnership with firm management. The underlying reason for this is that directors do not think that management operates in an opportunistic way.

To conclude, the board of directors is crucial for corporate firms because of its supervisory powers and its powers to influence firm strategy. Furthermore, in the United States, the board of directors can seat inside employees, contrary to the two-part system that exists in European companies. Lastly, as Boivie et al. (2021) showed, the board of directors sees their position as a strategic partnership with firm management.

2.2 Gender diversity in the board of directors in the U.S.

In recent decades, there has been a shift in gender diversity in the job market of Western countries: more women have been participating, pay rates between men and women started to converge, and women have been entering typically male industries or jobs that would have traditionally been taken by men (Albanesi, 2023). As this thesis's objective is to study the effect of gender diversity in board rooms on the propensity of a firm to commit securities fraud in the United States, it is interesting to look further into the past and current state of board diversity in American corporate firms, which this section will discuss.

First the past state of gender diversity in the United States. In the early 2000s, there was a change in top management functions happening. However, this change was happening extremely slowly. For example, in 1999 women only held 11.1% of board seats of Fortune 500 companies, while women around the 2000s did make up 47% of the labor force and were almost 50% of business degree holders (Arfken et al., 2004). Arfken et al. (2004) even states that in the early 2000s at the rate gender diversity in boardrooms was moving then, gender equality in boardrooms would only have been reached in 2064. Burke (1997) researched why gender diversity was moving so slowly and what the reasons were that women were not seated in boardrooms. Most people Burke (1997) interviewed wanted a more diverse board of directors, however, women encountered barriers, like for example the 'old-boys network'. Since the early 2000s, when these articles were published, a lot has changed in regard to gender diversity in the United States. States and the Securities and Exchange Commission have been imposing diversity laws for boardrooms, which brings us to the current state of gender diversity in boardrooms in the United States.

The current state of gender diversity in U.S. corporate boardrooms has increased positively in recent years. The Harvard Law School Forum on Corporate Governance (2021) states that in the recent five years, the U.S. government has imposed legislation that increased the percentage of women on corporate boards of directors. For example, in 2018 a bill was passed in the state of California, which requires corporate organizations which are headquartered within the state to have at least one woman on the board of directors. However, these legislative laws, which also apply a penalty when this board diversity is not followed by the company, are rare (The Harvard Law School Forum on Corporate Governance, 2020). Most of the states in the United States

do not have legislation in place to promote gender diversity in boardrooms. However, not only legislative factors have been a driver for the board diversity increase, but also cultural factors and corporate governance goals have been of substantial positive influence on gender diversity in boardrooms of corporate firms in the United States. Although positive changes are happening, the changes are still happening at a slow rate. A reason why the change of gender diversity in American boardrooms is going relatively slow at the moment has been studied by Reddy and Jadhav (2019). Reddy and Jadhav (2019) states that there is existing gender bias in corporate boardrooms. This gender bias is mostly an effect of the attitudes of male CEOs and male board chairmen towards female board members and female leaders. Research from Reddy and Jadhav (2019) has shown that male CEOs and chairmen thought that women were unqualified for the job and would bring a women's agenda to the boardroom. Not only the attitudes of male colleagues explain the slow growth of gender diversity in corporate America. Reddy and Jadhav (2019) shows that external factors also play a role. These external factors can include firm size, board size, industry, and social and cultural characteristics. Larger firms and larger boards tend to have more women on the board of directors than smaller firms and boards. Men-dominated industries tend to have fewer women on board. Lastly, when a firm has connections with other firms that have women on their board of directors, the firm itself is likely to also have women on the board of directors.

To conclude, even though changes in corporate America have been happening in terms of more gender diversity in boardrooms, the changes have been slow, and it will definitely take a substantial time before full equality in boardrooms will be established.

3 Literature review

This section places this study in the current literature. As I research the effect of gender diversity in boardrooms on securities fraud in the United States between the years 2000 and 2004, this section will discuss existing papers about the effect of gender board diversity on securities fraud but also the effect of gender diversity on other types of fraud and on the financial performances of firms.

3.1 Gender diversity in boardrooms and securities fraud

There is only one paper published so far in the current literature that researches the effect of gender diversity on securities fraud. This is the paper of Cumming et al. (2015). Cumming et al. (2015) researched the effect of gender diversity in boardrooms on securities fraud of Chinese firms. The authors used a logistic regression model to estimate this effect and used the female director ratio and the logarithmic transformation of this variable as their main independent variables. They found a negative and significant effect of gender diversity on securities fraud, meaning that in their sample of Chinese firms, more gender diversity within boardrooms diminishes the probability of firms committing securities fraud. They also researched the effect of male-dominated industries versus female-dominated industries. They find that the effect of gender diversity on the propensity of firms to commit fraud is stronger in male-dominated industries than in female-dominated industries. They also performed several robustness checks, including propensity score matching, and found results that correspond with their hypotheses. They base their results on theories on risk aversion, ethics, and diversity, which will be elaborated further in Section 4. Their study is based in China, which could have different effects of gender diversity on securities fraud than in the United States, as China has a different board approach than the United States. In China, boards have a two-part system as explained in Section 2. Even though there is a difference in board definitions, there still might be an effect of gender diversity on securities fraud in the United States, as U.S. boards include both of the boards that are used in China.

Joo, Lawrence, and Parhizgari (2021) did research on the effect of gender diversity in boardrooms on securities litigation risk. Securities litigation is all lawsuits that are connected to security laws. This does include securities fraud but also includes other topics like going-public and going-private transactions (Holland & Knight, n.d.). The authors hypothesize that independent female directors do better at monitoring management and helping line up management's interests with those of the shareholders, which results in a reduced risk of securities litigation. The authors found a significant negative effect of female independent directors in the board on the risk of securities litigation. Because of potential endogeneity between female independent directors and the company that they serve because of self-selection, the authors perform several robustness checks including using an instrumental variable and propensity score matching. All the robustness checks show the same result namely that more female independent directors on the board reduces the risk of a securities lawsuit being filed against a firm.

3.2 Gender diversity in boardrooms and other types of fraud

In this subsection, the effect of gender diversity in boardrooms on other types of fraud will be discussed, specifically financial statement fraud. Even though this study discusses the effect of gender diversity on securities fraud, it is useful to look at other kinds of fraud as some of these underlying theories also might explain why gender diversity might influence securities fraud.

Maulidi (2023) researched the effect of gender diversity in boardrooms on financial statement fraud. Maulidi (2023) hypothesizes that differences in ethical behavior and risk aversion between males and females are the reason that females who take on leadership positions, like on the board of directors, can influence the propensity of fraud negatively. (Maulidi, 2023) states that females are more ethical in their behavior and perspectives and are more risk averse and therefore should decrease the probability of firms committing fraud. Maulidi (2023) performed a probit model and found that indeed, gender diversity in boardrooms has a negative effect on the propensity of firms to commit fraud. Because of possible endogeneity bias and sample selection, a robustness check was also performed. To check for possible sample selection bias and account for this sample selection bias, Maulidi used Heckmann's two-stage correlation model and used an inverse mills ratio (IMR) to account for all unobserved factors between the control group and the treatment group. Performing this robustness check, the coefficient for 'female' was still negative and statistically significant, which is in line with the results found by Maulidi.

Wang et al. (2022) performed research on female corporate leaders and the effect that they had on fraud. Female corporate leaders are defined in this study as females who are on the board of directors, the supervisory board, or senior managers. This study thus focuses not solely on females on the board of directors, but since it does include female directors, it is still relevant to discuss this study as it still partly relates to the research done in this study. Wang et al. (2022) uses a bivariate probit model to estimate the effect of female corporate leaders on the fraud propensity of the firms. The bivariate probit model is used because fraud depends on two latent variables according to Wang et al. (2022) namely: fraud commission and fraud detection. Wang et al. (2022) finds that more female corporate leaders have a negative and significant effect on fraud commission and a positive and significant effect on fraud detection. As a robustness check, the authors estimated the effect of the separate categories of female corporate leaders, and as this study focuses on the board of directors, I will only discuss the robustness check results on the board of directors. The author furthermore separated the female board of directors into independent female directors and non-independent female directors. For independent female directors, there is a negative effect on fraud commission and a positive effect on fraud detection. Both of the effects are statistically significant. For non-independent female directors, there is no significant effect on fraud commission, but there is a significant positive effect on fraud detection.

Wahid (2019) researched the effect of gender diversity in boardrooms on financial misconduct, which includes fraud in the study of Wahid. Wahid argues that more gender diversity in boardrooms can improve firm performance because of a larger pool of director candidates that are available, which ultimately leads to better candidates being chosen. Furthermore, more gender diversity can also lead to a change in board

dynamics which can alter coherence or create creative conflict (see Section 4.3 for a more extensive discussion on this diversity effect). The author performs a logistic regression and eventually finds a negative and significant effect of board gender diversity on financial misconduct. The author also uses an instrumental variable approach to account for possible endogeneity. The instrumental variables used as a proxy for gender diversity in boardrooms are the female population at the firm's headquarters and the location of the headquarters itself. The robustness checks display the same effect as in the logistic regression namely a negative and significant effect of gender diversity in boardrooms on financial misconduct.

Lastly, Arnaboldi et al. (2021) researched the effect of gender diversity in banks' boardrooms on bank misconduct. They measure bank misconduct with fines. As fraud is in its definition always misconduct, but misconduct is not always fraud, I only focus on Hypothesis 2 of the paper of Arnaboldi et al. (2021) as the dependent variable for this hypothesis is criminal fines. The authors base their hypothesis on several theories regarding risk aversion differences and ethical differences between men and women (this is elaborated more extensively in Sections 4.1 and 4.2). Opposite of what all previous research above found, using a probit model, the authors find a weakly significant negative effect of gender diversity on criminal fines, which turned insignificant once more control variables were added. As a robustness check, the authors performed a pooled probit model and used another definition for gender diversity. They used not only the percentage of female directors, but this percentage interacted with the size of the banks ranked by quartiles. They eventually created two variables, namely an interaction variable of female times the first quartile and another interaction variable of female times the other three quartiles. These two interaction variables are used as a proxy of gender diversity in the banks, as larger firms are more frequently fined, but are also more gender diverse than smaller banks. The effect in the first quartile (the smaller banks) turns out to not be significant, while the effect of gender diversity on the criminal fines in the other three quartiles is negative and significant.

3.3 Gender diversity and financial performance

As securities are financial instruments that hold some kind of value, for example, stocks, bonds, or options, and because this study focuses on securities fraud, the effect of gender diversity in boardrooms on the financial performance of firms is looked into more extensively. In this section, I, therefore, look into the effect of gender diversity in boardrooms on the financial performance of firms, specifically firm value.

Firm value is defined as the market value of all outstanding securities of the firm (which also includes debt). Campbell and Mínguez-Vera (2008) researched the effect of gender diversity in boardrooms on the firm value of Spanish firms. They performed a 2SLS panel data regression to see whether gender diversity in boardrooms has an effect on firm value, which is captured by Tobin's Q. They hypothesize that more women in boardrooms will have a positive effect on Tobin's Q due to the agency theory, resource dependency theory, and the stakeholder theory. To measure gender diversity in boardrooms, the authors used four different measures. First of all, they use the percentage of women that are on the board. Second, they used a dummy variable as a measure of gender diversity in boardrooms. The dummy takes the value '1' when there is at

least one woman on the board of directors and '0' otherwise. Third, the authors use the Blau index to capture gender diversity. Lastly, the authors use another diversity index, namely the Shannon index, as a robustness check to capture gender diversity. They find positive and significant effects for the percentage measure and both the Blau and Shannon indexes. The effect for the dummy is not significant. The underlying reason for this insignificant effect is according to the authors that a woman on the board is, per se, not an influence on the firm's value. As the other variables do measure more diverse boards and a mixture of genders on the board than the dummy, the authors suggest that this is probably the reason why these variables are significant compared to the insignificant dummy. Gordini and Rancati (2017) performed the exact same analyses as Campbell and Mínguez-Vera (2008), but on Italian firms. Gordini and Rancati (2017) also found the same effects of the different measures of gender diversity on Tobin's Q, so no significant effect for the gender diversity dummy, but positive and significant effects for the percentage measure and the Blau and Shannon indexes. Overall, Campbell and Mínguez-Vera (2008) and Gordini and Rancati (2017) find a positive effect of gender diversity in boardrooms on the firm's value.

4 Theory development

This section will discuss the theories that explain why more women in boardrooms would decrease the probability of firms committing securities fraud. I build further on the theories used in the papers of Cumming et al. (2015) and Maulidi (2023). These theories are that men are more likely to commit fraudulent crimes because of differences between men and women regarding ethical behavior, opportunistic behavior, and risk aversion. Furthermore, there are also (gender) diversity benefits in general that will be discussed.

4.1 Ethical differences

The existing literature is torn between finding no effect in different perceptions of ethics between men and women (Kidwell et al., 1987; Valentine & Rittenburg, 2007), and studies that do find a difference between men and women. An explanation for the contradicting findings is given by McCabe et al. (2006). They state that many researchers treat the complex variable that gender is, as a dichotomous variable, namely sex. However, the authors claim that gender must not be seen as a dichotomous variable, but as a variable that also considers individual social, personal, and situational aspects of gender. Because the literature is split about the ethical behavioral differences between men and women, and as there are still many papers that do find a difference in ethical behavior between men and women, I regard ethical differences as one of the underlying theories of why more gender diversity in boardrooms influences the propensity of firms to commit fraud.

McCabe et al. (2006) uses the gender identity theory to try to explain the effect between gender and ethical behavior. Gender identity theory states that gender is a multifaceted variable, which consists of the sex of a person, their psychological and personal traits, and their gender-role attitude. McCabe et al. (2006) finds that when treating gender as a dichotomous variable, that only is based on the sex of a person, there are no differences between the ethical perception of men and women. But when they treat gender as a multifaceted variable that includes the aspects that are named above, they find that women indeed behave more ethically than men. Another argument in favor of a difference between men and women regarding ethics is made by the gender socialization theory explained by Dawson (1997). Dawson (1997) discovered in his research that women tend to behave more ethically in their decision-making than men. He states that these discrepancies between men and women can be explained because of their differences in upbringing. Girls learn more frequently from a young age to behave inclusively and avoid hurting people, as compared to boys. Bennett et al. (2005) also find differences in ethical decision-making between men and women. He argues that females have a higher ethical sensitivity which implies that females more often and quicker deal with feelings of guilt compared to their male counterparts. Hoffman (1998) found that the way women react to ethical issues versus how men react to the same situation can be different when the situation differs. Hoffman (1998), however, does not explain or make statements of in which situations women might respond differently. But that they do respond differently to ethical dilemmas in some situations, is given according to Hoffman

(1998).

To conclude this section, there has been some research that finds no differences between men and women in their ethical behavior. According to McCabe et al. (2006), this can be explained by the fact that some researchers treat gender as a dichotomous variable. Discussing different literature, that focuses on gender being a multifaceted variable, points out that there are differences between genders in ethical perceptions. These differences between genders in ethical perceptions might influence the propensity of committing fraud when both genders are seated in board rooms.

4.2 Risk aversion

Risk aversion is also a factor that can explain why more women in boardrooms might influence the propensity of firms to commit fraud. When someone is more risk-averse, they are less willing to commit fraud as they fear being caught for the crime more than people who are less risk-averse.

Jianakoplos and Bernasek (1998) found that single women are more risk averse than single men in regards to financial decision-making. They researched this by looking at the wealth over the years and the difference between this wealth when held by women and men. When the wealth increased by both genders, the amount of risky wealth held by women increased less than it did for men. Palvia et al. (2015) did research on risk aversion and different levels of conservatism of female CEOs in comparison to male CEOs using data from the financial banking crisis. They found that, after controlling for several factors like bank asset risk, women are more conservative and hold more equity capital than their male counterparts. They also found that when a bank was led by a female CEO, they were less likely to fail in the banking crisis, than when the bank was led by a male CEO. Overall they thus find an effect that female CEOs are more conservative and make less risky financial decisions than their male counterparts. Nelson (2015) found, unlike the previous researchers, more mixed evidence. She states that it is important to look at the context and, just like described in the ethics part above, the differences in characteristics between males and females. However, she states that there is still some effect, but that it may be smaller than expected and depends on the different contexts. Risk aversion could therefore still be a mechanism that explains why gender diversity lowers fraud levels. Lastly, Schubert et al. (1999) also states that the differences in risk aversion between males and females are context dependent. They state that there, again just as with ethical decision-making, are different conditions that are connected to being male or female that might influence risky decisions and financial decision-making. This means that there is still a chance that women are less prone to making risky decisions, but that this attitude can also change within the female group itself. This does not, however, mean that having women on your board could not change the propensity of the firm committing fraud in general, as there can still be an effect because of the risk aversion levels of women differing from those of men, but this effect might change firm to firm as different firms hire different women.

Connected to risk aversion is another phenomenon namely overconfidence. Research has pointed out that, even at a young age, there are differences in confidence levels between boys and girls. Dahlbom et al. (2011)

researched how young kids predicted their grades and boys were more overconfident in predicting their results compared to girls. This psychological phenomenon that men are in general more overconfident than girls was also researched in business settings. Barber and Odean (2001) found that in the field of finance, men trade more excessively, which reduces their net return more than women. The authors, therefore, conclude that men are more overconfident in terms of finance than women. This overconfidence of men in business settings could lead to men making more risky decisions as they are more confident that these decisions would turn out in their favor compared to women. Furthermore, J. Chen et al. (2019) researched overconfidence in male CEOs and found that when the male CEO had a board of directors with females in it, his overconfidence was lower than when the board only contained male directors. J. Chen et al. (2019) also found that female directors were linked to less aggressive investment policies, better acquisition decisions, and better financial performances of the firms they are on the board of. Or otherwise said: female directors make decisions with less risk as they outweigh the pros and cons of a decision and take into account more alternatives than their male counterparts do (Maulidi, 2023). When placing this phenomenon in the corporate fraud environment, this would mean that men would be more confident in comparison to women, that if they committed fraud (that would be risky) they would pull it off. Having more women in boardrooms may therefore decrease the propensity of firms to commit fraud.

In conclusion, more risk aversion, together with less overconfidence, are two theoretical mechanisms of why women could have an effect on firms committing less fraud.

4.3 Diversity

The last underlying theory of why gender diversity could potentially influence the propensity of firms to commit fraud is because of diversity in general. Diversity improves the working environment as it helps with a broad perspective on different issues and therefore offers better problem-solving abilities as there are more and more diverse resources to solve the problem with (Cox Jr, 2001). More diversity in the workplace could also lead to more creative conflict according to Gurin et al. (2004). According to Cumming et al. (2015), diversity could also have a significant effect on trust, and could therefore together with this increase in creative conflict, increase board members checking on each other and therefore the propensity of fraud getting less, as there is more awareness.

Gender diversity also has some general benefits for the board of directors which could explain why there would be less fraudulent behavior when there are women present in boardrooms. For example, gender diversity in boardrooms has a positive effect on the corporate social responsibility ratings of a firm (Bear et al., 2010). Corporate social responsibility helps a company to hold itself accountable for its actions, where the company tries to be aware of the implications its actions have on society, the environment, or economics. Bear et al. (2010) also found that corporate social responsibility is a mediator for the relationship between the firm's reputation and gender diversity in boardrooms. Furthermore, corporate social responsibility has been linked to corporate fraud by Harjoto (2017). Harjoto (2017) found that firms with a higher corporate social

responsibility rating have a lower probability of fraud and have lower severity of the fraud. Researchers have also found a positive effect of gender diversity in boardrooms on corporate social performance (Boulouta, 2013; Hafsi & Turgut, 2013). Corporate social performance can be defined as principles, practices, and outcomes of business decisions and the relationship with stakeholders and the effects that these principles, practices, and outcomes have on the stakeholders, as well as the externalities they might cause (Wood, 2016). As firms have a higher corporate social performance, they are not trying to 'harm' their stakeholders intentionally or unintentionally with their actions. This could include not committing fraud, as securities fraud would have a serious negative impact on the stakeholders (for example on the shareholders). Lastly, according to Hillman and Dalziel (2003), the qualities that females bring with them on the board of directors actually make sure that there is more effective monitoring of management, this actually means fewer chances of managers committing fraud as they are getting controlled more effectively.

To conclude, there are two different mechanisms for why gender diversity could have a negative effect on the propensity of firms to commit fraud. First of all, through diversity in general. Diversity improves the working environment as it can create a broad perspective on issues. Because of this broader perspective on issues, diversity could also give rise to creative conflict. This creative conflict, together with changes in trust because of this higher diversity, could lead to more awareness and checking on other board members and could therefore reduce the probability of fraud. Gender diversity in itself also could have some mediators in why it would reduce fraud. Namely, gender diversity has a positive effect on corporate social responsibility and corporate social performance, which could lead to less fraudulent behavior in firms. Gender diversity in boards also ensures that managers are monitored more effectively therefore reducing the chances of fraud. In conclusion, diversity also can account for why more females in boardrooms would actually lead to less fraudulent behavior.

5 Hypotheses development

5.1 Hypothesis 1

Based on the theories explained in Section 4, I predict that gender diversity, so more women in boardrooms, will lower the propensity of firms to commit fraud. The fact that women are more ethically sensitive and risk-averse than their male counterparts could lead to female executives who are less likely to commit fraud. Furthermore, diversity can also have a positive effect on the board of directors as it could lead to more discussion and better monitoring and therefore reduce the probability of fraud. Taking all of this into consideration, the first hypothesis is:

H1: Gender diversity has a negative effect on the propensity of firms to commit fraud

5.2 Hypothesis 2

An important factor to take into account in this study is the concept of the critical mass theory. The critical mass theory explains why more women in boardrooms might influence the propensity of firms to commit fraud more strongly. Kramer et al. (2006) stated that women who are currently the only female on the board of directors feel like they are there to serve tokenism. Furthermore, when women are the only female on the board of directors, there is more focus on them as a person and there is a close focus on their behavior. This gives a higher chance for women to be scrutinized and makes it harder for women to speak up when they are the only female directors. This could eventually lead to the fact that one woman on the board of directors might not influence firm behavior. The critical mass theory explains that until a certain threshold is reached, the positive characteristics and skills women bring to a boardroom are not found in research done (Kramer et al., 2006). However, when this threshold of a certain number of women on the board of directors is reached, the effects of gender diversity in boardrooms will be noticeable in research done (Joecks et al., 2013). Joecks et al. (2013) found that first, gender diversity negatively influenced firm performances, but after a critical mass of 30% of women on the board of directors was reached, the effects switched to a positive effect. Brahma et al. (2021) researched the effect of gender diversity in boardrooms on the financial performance of firms also taking the critical mass theory into account. The authors found a positive effect of gender diversity on firm financial performances but found that when there were 3 or more women on the board of directors, this relationship was highly significant and stronger than when there were only two female directors or only one female director on the board of directors. The second hypothesis will therefore be the following:

H2: The negative effect of gender diversity on the propensity of fraud is stronger when there are more women on the board of directors.

5.3 Hypothesis 3

Gender diversity in boardrooms is different for male-dominated industries and female-dominated industries. Reddy and Jadhav (2019) states that females are more likely to be on the board of directors in industries that are female-dominated, like for example retail and media. Female directors are thus less likely to be seated on the board of directors of companies that are in male-dominated industries. However, females could therefore have more influence on reducing the propensity of committing fraud in male-dominated industries than in female-dominated industries. This concept is explained by Lenard et al. (2017) and Cumming et al. (2015), who both found evidence that the effect of gender diversity on fraud is stronger in male-dominated industries than in female-dominated industries. Cumming et al. (2015) explains that sex segregation theories form the theoretical reasoning behind why the effect of gender diversity might be stronger for male-dominated industries. Segregation theories show that for different industries, a different level of masculinity is demanded to achieve a successful business. Cumming et al. (2015) further argues that because of the higher masculinity that is required in male-dominated industries for success, workers accept taking higher risks and committing fraudulent activities to achieve this success that is required in male-dominated industries. This higher risk-taking behavior can be better held in check by a gender-diverse board of directors. Therefore, more gender diversity in boardrooms would have a greater effect on the propensity of committing fraud in male-dominated industries than a full-man board of directors would have. The last hypothesis that will be researched will therefore be:

H3: The negative effect of gender diversity in boardrooms on the propensity of firms to commit fraud will be stronger in male-dominated industries, than in female-dominated industries.

6 Data & Methodology

6.1 Data

To test the Hypothesis I used the following data. First, to determine which companies committed a crime, I used a research paper by Dyck et al. (2010). A list was assembled by Dyck et al. (2010) containing 216 companies that committed securities fraud in the years 1996-2004 that had more than 750 million in total assets. Dyck et al. (2010) uses this threshold of 750 million in total assets as it is more likely for bigger firms to get public scrutiny for their actions, and therefore there will be fewer unobserved fraud cases if the firms are larger in size. After this, I used the Compustat database to get information on the company characteristics of these companies that committed fraud but also to get information on companies who did not commit fraud during the time period 1996-2004. The data on the board characteristics is from Boardex. To get to my final dataset for this study, I had to make several different changes. First, I decided to merge the Compustat data containing firm characteristics of all companies in the years 1996-2004 with total assets that were higher than 750 million with the Boardex data. Doing this, I discovered that the Boardex data only started in 1999. Since 1999 was the starting year of the Boardex data, very little information was available on companies. To avoid biased data by keeping 1999 in, I decided to leave this year out of the final dataset and focus on the years 2000-2004. I eventually merged the data of Compustat and the Boardex data based on the CIK (Central Index Key) codes of each company. After this, I merged the previously merged dataset with an Excel sheet containing all the firms from the list of Dyck et al. (2010) that committed securities fraud during the period 2000-2004. Because of the dropped years and the fact that for some companies no data was available in the Boardex or Compustat databases, I ended up with 83 firms that committed securities fraud in the years 2000-2004. This merged dataset is the end data set and will be used for the logit regression analyses. This end data set contains 6,333 firms in total, with 83 firms that committed securities fraud in the years 2000-2004 and 6,250 firms that did not commit securities fraud.

After having composed my base dataset, I generated the independent variables and the control variables. The independent variables are: *a dummy variable 'Female', the female gender ratio, and a categorical variable 'Females' that contains 4 categories namely: no females, one female, two females, and three (or more) females.* The control variables are: *Firm size, return on assets (ROA), leverage, age of the board, nationality mix, the board size, independent director ratio, whether the CEO is also chairman of the board, education, and experience.* Lastly, I also included year-fixed effects and industry-fixed effects.

The control variables firm size and the industry (proxied by the North American Industry Classification System (NAICS) code) are downloaded from Compustat. The financial indicators: ROA and debt-asset ratio are from Wharton Research Data Service (WRDS). The age of the board, nationality mix, the board size, independent director ratio, whether the CEO is also chairman, education, and experience on other boards are all downloaded from BoardEx. The control variables downloaded from Compustat had no missing observations. For the financial indicators, I succeeded in getting the financial ratios for almost every observation

in the dataset except for 635 observations for the ROA and 632 observations for the debt-asset ratio. The control variables downloaded from Boardex had no missing observations for the variables, except for the nationality mix variable. This control variable has 48 missing observations.

6.2 Variables

6.2.1 Dependent variable

The dependent variable in this research is securities fraud. To measure securities fraud I created a dummy variable. The dummy takes value 1 if the company committed fraud, and 0 otherwise. To determine the companies that committed fraud, I used the paper of Dyck et al. (2010). This paper focuses on companies that have committed securities fraud. Securities fraud is also known as stock or investment fraud and although it can come in many different forms, with all securities fraud the investor gets deceived or the market gets manipulated (Federal Bureau of Investigation, 2017). The appendix of the paper of Dyck et al. (2010) contained 216 firms that committed securities fraud in the US between the period of 1996 and 2004. I dropped the observations of firms that committed fraud between 1996 and 1999 as explained above and eventually ended up with a list of 83 firms that committed securities fraud between 2000 and 2004. Securities fraud takes place within a class-action period, which is the period in which The fraud has been taking place. Because these frauds could be discovered and become public later, and as the lawsuits will therefore also be filed later, I used the year of the filing date of the lawsuit as the year that the dummy variable for fraud takes 1.

6.2.2 Independent variables

The independent variable in this thesis will be gender diversity in boardrooms. To test Hypothesis 1 and Hypothesis 3 I used two different variables that measure gender diversity. The raw data on both variables used to measure gender diversity is from Boardex and was initially the ratio of male board members. As this is not the measure I want to use in this study to capture gender diversity, I generated the dummy 'Female' that takes zero when there is no female in the boardroom of the company, which means that the male ratio is 1, and takes value one when there is at least one female in the board of directors. Furthermore, I also used the ratio of female board members as a measure of gender diversity. I generated this variable by subtracting the male ratio of 1.

For Hypothesis 2, I predict that the effect of board diversity on fraud will be stronger because of the critical mass theory. I, therefore, created the categorical variable 'Females' with four categories that display the number of women in boardrooms. The critical mass theory is explained by Brahma et al. (2021) and Joecks et al. (2013). Both state that there are more women necessary in a board room to positively influence firm performances. In the research of Brahma et al. (2021), this number is two, while in the research of Joecks et al. (2013), this number is three. To make the categories that are stated above, I needed to generate the total number of females on the board of directors. To get to this number, I multiplied the female ratio

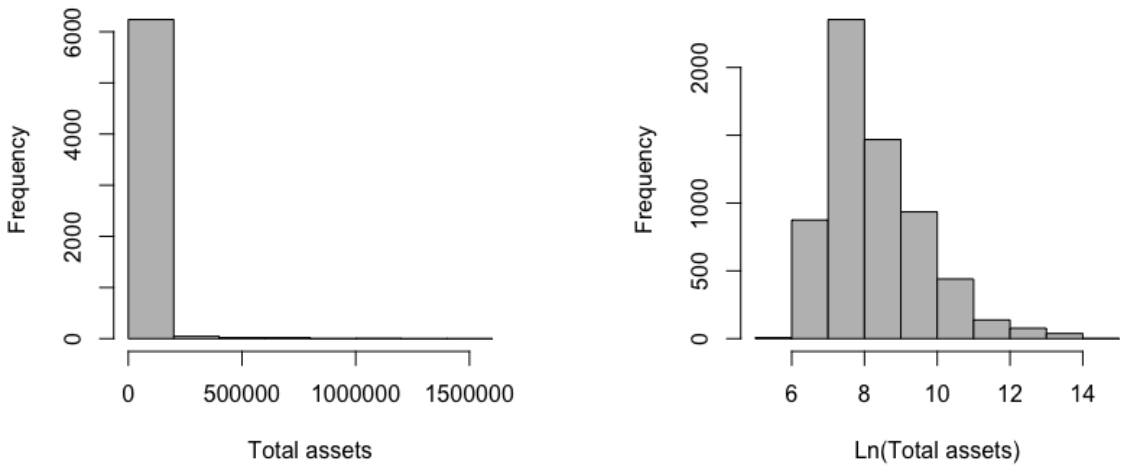
by the total number of directors. Next, I generated a categorical variable with Stata. The base category is when the board of directors does not contain any women. The category 'Females = 1' has one woman on the board of directors, 'Females = 2' has two women on the board of directors, and 'Females = 3' has three or more females on the board of directors.

6.2.3 Control variables

This section will discuss the control variables in the model. The control variables can be divided into firm-specific control variables and board-specific control variables. In this section, first, the firm-specific control variables will be discussed. These are firm size, ROA, and leverage. Next, the board-specific variables will be discussed namely: the average age of the board, education, independent director ratio, whether the CEO is also the board chairman, nationality mix, size of the board, and experience.

Firm size First, firm size is added as a control variable as bigger firms can be more likely to commit corporate fraud as research suggests that they are more pressured to meet financial targets than smaller firms (D. Chen et al., 2021). This could lead to a higher probability of bigger firms committing fraud. The firm size will be measured by the total assets of the firm. It is good to note that the companies used in this study already have total assets that are bigger than 750 million, as Dyck et al. (2010) uses this threshold for computing the list of companies that committed fraud. However as the assets in the dataset vary from 750 million to much more, I did decide to use total assets as a proxy for firm size as this may still influence the outcome of the analyses.

To see whether I should use a natural logarithm for the total assets (as the papers of Cumming et al. (2015) and Maulidi (2023) also use the natural logarithm of the total assets), I analyzed the distribution of total assets and observed the following. As Figure 1a shows, the distribution of total assets is very skewed with outliers that are much higher than most total assets of firms. When the total asset variable has been transformed into the natural logarithm of total assets, the histogram as seen in Figure 1b has a more normal distribution and will therefore be more fit to use as a control variable in the regression analysis.



(a) Histogram of total assets

(b) Histogram of ln(total assets)

Figure 1: *Histograms of total assets and ln(total assets)*
Note: These figures show the difference between the distribution of the variable total assets on the left, and the variable of the natural logarithm of total assets on the right

ROA

Return on asset is the net income of a company divided by its total assets. It is a measure of profitability in relation to the company's total assets. When this measure is higher, the profitability of the company is better. This means that the company is in less financial distress and is more financially stable and would therefore be less likely to commit fraud in order to 'save' the company (Cumming et al., 2015). I predict that ROA will have a negative effect on the propensity of firms to commit fraud, as a higher ROA means less financial distress and lower incentives to commit fraud to save the company. The ROA variable is downloaded from the Wharton Research Data Service database showing multiple financial ratios. This variable is shown in percentages but is only available on a monthly basis instead of yearly in the database. Therefore to get to a yearly ROA, I decided to generate the mean yearly ROA per company and use this in the analyses.

Leverage

Like the ROA, leverage (or debt-asset ratio) is also used to measure the financial health of the company. When the leverage ratio is above 1, it means that the company has more debt than that it has assets. The higher this ratio, the more debt the company has compared to its assets, and it thus indicates poorer financial health. This may lead to employees wanting to save the company from this poor financial health and therefore committing fraud (Cumming et al., 2015). The debt-asset ratio is downloaded from the same database as the ROA ratio. This ratio was only available in monthly numbers per company instead of the yearly numbers that I want to use in my analyses. Hence, I also calculated the mean leverage for the company per year based on these monthly numbers.

Age of the board

The age of the board stands for the mean age of the board members. Xu et al. (2018) did research into the effect of the age of the board members on corporate fraud and found that a higher mean board age has a negative effect on the chance of corporate fraud. The reason behind this effect can be that older board members are better monitors and could therefore detect possible fraud quicker as they are more likely to have previous board experience and are more likely to have a greater general ability to deal with difficult executives (Xu et al., 2018). Furthermore, Xu et al. (2018) argues that older directors are more motivated than younger directors to perform well at monitoring the company, especially because of the possibility of a loss of income or reputation. Therefore, the mean age of the board is added to the model as a control variable.

As there was no mean age available in the Boardex database, I generated this variable by using the variable time to retirement. Boardex assumed a retirement age of 70 for every director. Using this time-to-retirement variable, I was able to generate the age in years of each board member by taking the 70 years and subtracting the time to retirement. After this, I generated the mean age for the whole board of directors of a company for a certain year.

Nationality mix

Some previous studies have argued that diversity of nationalities or ethnicities in boardrooms could lead to better firm performances, which could also include a decrease in the propensity of firms to commit fraud. Different ethnicities in boardrooms could lead to improvement in the information that is given to the executives as diversity leads to multiple different unique viewpoints of information, which could influence firm performances (Carter et al., 2010; Fernández-Temprano & Tejerina-Gaite, 2020). There is no evidence yet of the effect of ethnic diversity on the propensity of firms to commit fraud, but as it can still influence firm performance, the variable is still added to the analyses. The nationality mix in the boardroom is used as a proxy to measure ethnic diversity in the boardroom. The data is downloaded from BoardEx and is the number of people from another nationality that are present in the boardroom.

Board size

There are mixed results in research done on the effect of board size on fraud or on the performance of firms. For example, Cumming et al. (2015) states that there is a negative effect of board size on fraud as a larger board is easier to control by the CEO. However, other evidence suggests that when board size increases so does the capacity of the board to monitor the firm and detect fraud. However, this could also be outweighed by miscommunication because of a larger board, and poorer decision-making (Guest, 2009). In conclusion, it could influence the propensity of firms to commit fraud in multiple ways and is still an important measure to add to the analyses as control variables. Board size is the number of people on the board per year per firm and is downloaded from the Boardex database.

Independent director ratio

Independent directors are directors who do not also work at the firm of the board, they therefore have no other affiliation with the company except being on the board as a director. There are several studies that suggest

that when the number of independent directors on the board increases, the propensity of firms committing fraud decreases (Kuang & Lee, 2017; Cumming et al., 2015). Independent directors have a positive effect on the effectiveness of the governance of the board of directors (Cumming et al., 2015). Therefore I added a ratio of independent directors relevant to the total number of directors on the board as a control variable.

CEO

The control variable CEO displays whether the CEO is also the board chairman or not. CEO duality gives the CEO a high amount of leverage and significant power in the decision-making process. CEO duality is added as a control as research shows that this duality can have harmful effects on the company according to the underlying agent theory (Elsayed, 2007). CEO duality can cause a switch in incentives of the board from what is best for the firm to what is best for the CEO. This can have negative effects and is therefore added as a control variable to the analyses (Krause et al., 2014; Maulidi, 2023). This effect might be negative but it can also obviously be positive, as it depends on the CEO's intentions.

To get to the CEO duality dummy, I downloaded the Boardex dataset that contained the role of the individual board members. From this, I generated a dummy variable that took value one when in the company the CEO was also the chairman of the board of directors and zero otherwise.

Education

Education can influence risk aversion. According to Cumming et al. (2015), directors and managers who have more education (and are older), are more risk-averse than their less educated (and younger) colleague directors. Luo et al. (2020) found that when women are in a CFO position and have a higher education, the prevalence of financial statement fraud is lower. Haron et al. (2021) also states that different levels of education can help create board diversity, which again can create a more open communication environment. The education of the board of directors is also crucial as the board supervises top management in carrying out the corporate strategy. As the board of directors supervises the top management on behalf of the shareholders, the shareholders want to ensure that the directors' education is actually high and good (Haron et al., 2021). Because of this possible effect of education, it is important to add it as a control variable to the analyses.

Education is measured by the mean number of qualifications of the board of directors per year. This number of qualifications displays a minimum of undergraduate-level qualifications or above. As the data set in Boardex was at the individual level and not the company level, I generated the mean of all the board members' qualifications per year, to get to the mean qualifications per board per year.

Experience

Experience will be measured by three different variables. First by the variable tenure, so the mean time of all board members sitting on the board. Second, the variable mean current boards which measures the mean of how many other boards the directors were sitting on in the years 2000-2004. Lastly, the variable mean past boards will be used which measures the mean of how many past boards the directors have sat on in the years 2000-2004. I used these three variables to measure the experience of board members because multiple

studies pointed out that these three variables can have a possible effect on the propensity of fraud.

First, is the tenure, which is the time the board member is sitting on the board of the company. Two possible effects of fraud can come from the longer time that the director sits on the board. Roden et al. (2016) state that directors who have been sitting on the firm's board longer, have more knowledge of the firm and can therefore give better and more efficient advice about decisions or make better decisions. However, after a longer time on the board, directors can actually lose their independence, which is important in making decisions and monitoring management. After a longer time, the director is therefore more likely to favor the managers' wishes above those of the shareholders, which the board of directors actually serves. Eventually, Roden et al. (2016) find that a longer tenure period causes a larger probability of the firm committing fraud. The tenure period is the mean tenure period of the board of directors per year and is generated by Stata with individual board member data as a basis.

Second, J. Chen et al. (2022) finds that rookie independent directors increase the likelihood of corporate fraud. They define a rookie director as a director whose employment in the past as a director is less than three years. Furthermore, Jiang et al. (2016) find that directors who are on more boards of directors are more motivated to fulfill their duties and be good directors. So, more experience on other boards also has the probability to lower the propensity of firms to commit fraud. Therefore I add the mean current boards the board of directors per firm is on, and the mean past boards the board of directors were on per firm per year.

Fixed effects In the regression analyses, I am using two different kinds of effects, namely year-fixed effects and industry-fixed effects. I follow the existing literature of Cumming et al. (2015) and Maulidi (2023) who both added industry-fixed effects and year-fixed effects in their analyses. I add these fixed effects because there is a possibility that in some years more fraud was committed or that certain industries are more prone to fraudulent behavior than others. Therefore, I control for year-fixed effects and industry-fixed effects.

6.2.4 Summary statistics

Table A.1 displays the summary statistics (Mean, Standard Deviation, Minimum, and Maximum, and the number of observations). There are a few things that stand out when looking at the descriptive statistics. Only 1.3% of the number of firms that are in the dataset have committed fraud, and 69% of the firms have 1 female or more on their board of directors. Furthermore, as the number of women on the board of directors rises, the less frequent it is for firms to have this number of women on their board of directors: 40.4% the observations have one female on the board of directors. This percentage falls to 21.5% for two females and even to 7.0% for three or more females. To research a possible initial sight of the effect between gender diversity and the propensity of fraud, the mean and standard deviation are calculated for two subsections (Fraud=0 and Fraud=1), which are displayed in Table 1. Table 1 shows a possible opposite effect than predicted in the Hypotheses. When looking at all the female independent variables in Table 1, all the means are higher for companies that committed securities fraud. The mean difference is only significant at the 10% level for the

'Female' variable, but again this predicts that the mean females in boardrooms are actually higher for the firms who committed fraud. For the other female variables, the mean difference is not significant indicating that the means are not statistically significantly different from each other. Opposite to the predictions, it seems that based on the differences in the means, firms that have more women in their boardrooms may actually be more likely to commit fraud. Table 1 also displays the mean and standard deviation of the control variables and the differences between the fraud groups. The differences in means for the mean time on board, age, CEO duality, number of directors, nationality mix, ROA, and leverage, are not statistically significant, which means that these means between the two fraud groups are not significantly different from each other. The differences in means of the variables mean current boards, mean past boards, education, independent director ratio, and the natural logarithm of total assets are significantly different between fraud groups.

Table A.2 displays a correlation matrix. The stars indicate whether the correlations are significant at the 10%, 5%, or 1% significance level. The correlation table is used to check for possible multicollinearity problems, which is a high correlation between the independent variables. The categories of the categorical variable 'Females' are excluded as it is not possible to correlate categorical variables with continuous variables because the covariance cannot be calculated. Therefore, the correlation matrix checks for multicollinearity between the independent variables 'Female' and 'Female Ratio'. Multicollinearity can lead to less reliable statistical interpretation of the independent variables and therefore to bias of the model. As seen in Table A.2 the correlations between the independent variables 'Female' and 'Female Ratio' are high (bigger than 0.7). Because of this higher correlation, I decided to run two different models with each model having one independent variable instead of the two independent variables together in one model. The correlation matrix shows that only the 'Female' independent variable is significantly correlated to the dependent variable 'Fraud', while 'Female Ratio' is not significantly correlated to the dependent variable 'Fraud'. This gives some initial evidence that there might not be an effect between the female gender ratio and the propensity of firms to commit fraud. Furthermore, the dummy 'Female' is also positively correlated to the variable 'Fraud' which, just like the descriptive statistics from Table 1, gives some initial evidence that there might be a positive effect between having a female on the board of directors and the propensity of firms to commit fraud. However, as Table A.2 only describes the correlations, it is too early to conclude something about the effect of gender diversity on fraud without further analyses. Furthermore, the correlation matrix displays that almost every control variable has a significant correlation with the dependent variable fraud, and with almost each of the independent variables that are used in this study. This gives partial evidence that these covariates are indeed wise to add to the regression analyses, as left out they might bias the results. Lastly, no caution is needed about possible multicollinearity between the covariates as this cannot lead to a biased interpretation of the effect of the independent variables on fraud.

6.3 Methodology

This section will discuss the different methods used for testing the hypothesis. The main method that will be used is a logistic regression model as the dependent variable, fraud, in this analysis is a dummy variable and takes values 0 or 1. Using a logistic regression model is a better option than using a linear model, also called the linear probability model. The linear probability model can predict probabilities below zero or above one, and with a logistic regression model, this is not possible. Therefore, to ensure the best possible and most trustworthy estimates of the model, I use the logistic regression model.

6.3.1 Hypothesis 1

Hypothesis 1 states that gender diversity has a negative effect on the propensity of firms to commit fraud. The probability of a firm committing fraud is estimated with the following regression for hypothesis 1:

$$Pr(fraud) = \alpha_1 + \theta_1 * Female + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (1)$$

$$Pr(fraud) = \alpha_2 + \theta_2 * FemaleRatio + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (2)$$

The dependent variable in Hypothesis 1 is fraud and takes the value one if the firm has committed fraud and zero when it has not. Gender diversity is measured in regression (1) by a dummy variable that takes the value one when there is one woman or more sitting on the board of directors and zero when there are no women on the board of directors. Gender diversity in regression (2) is measured by the female-gender ratio on the board of directors. X displays a vector that contains the control variables. δ_t displays the time-fixed effects that are used in this model, while γ_i displays the industry-fixed effects.

6.3.2 Hypothesis 2

Hypothesis 2 predicts that the negative effect of gender diversity in boardrooms on the propensity of firms to commit fraud will be stronger because of the critical mass theory. Because of this change in the independent variable, the probability of a firm committing fraud is estimated with the following regressions for Hypothesis 2:

$$Pr(fraud) = \alpha_0 + \theta_1 * i.Females + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (3)$$

The dependent variable is the same as the regression used in Hypothesis 1, namely fraud, and takes value one if the firm has committed fraud and value zero when the firm has not committed fraud. The independent variable gender diversity is measured by the categorical variable 'Females' which has four different categories. The base category is 'No Female' and is when there are no females on the board of directors. The other three categories are 'Females = 1' when there is one woman on the board of directors, 'Females = 2' when there are

two women on the board of directors, and 'Females = 3' when there are three or more women on the board of directors. X is again a vector that contains the various control variables that are explained in section 6.2.3. Again, δ_t displays the time-fixed effects that are used in this model, and γ_i displays the industry-fixed effects.

6.3.3 Hypothesis 3

Hypothesis 3 predicts that the negative effect of gender diversity in board rooms on the propensity of firms to commit fraud will be greater in male-dominated industries, than in female-dominated industries.

To test this Hypothesis, the dataset is divided into two subsections based on the different industries. This is based on a list from the United States Bureau of Labor Statistics and the United States Census Bureau using the North American Industry Classification System to create a dummy that takes value one when the industry is female-dominated and zero otherwise. An industry is classified as a female-dominated industry when 50% or more of the workers are female, which is the same approach Cumming et al. (2015) has taken to classify the industries in their research. Table A.3 displays a list of industries that are classified as female-dominated.

The probability of firms committing fraud will also be estimated with the following regressions:

$$Pr(fraud_{female}) = \alpha_0 + \theta_1 * Female + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (4)$$

$$Pr(fraud_{female}) = \alpha_0 + \theta_2 * FemaleRatio + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (5)$$

$$Pr(fraud_{male}) = \alpha_0 + \theta_1 * Female + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (6)$$

$$Pr(fraud_{male}) = \alpha_0 + \theta_2 * Female + \beta * X + \delta_t + \gamma_i + \varepsilon \qquad (7)$$

Table 1: Descriptive Statistics by level of Fraud

	Fraud = 0			Fraud = 1			
Variable	Mean	SD	N	Mean	SD	N	Mean difference
Female	0.687	0.464	6,250	0.807	0.397	83	-0.120***
Females = 1	0.403	0.491	2,521	0.470	0.502	39	-0.067
Females = 2	0.215	0.411	1,341	0.253	0.437	21	-0.038
Females = 3	0.069	0.254	432	0.084	0.280	7	-0.015
Female Ratio	0.098	0.086	6,250	0.109	0.070	83	-0.011
Mean time on board	7.654	3.869	6,250	7.363	3.232	83	0.291
Mean current boards	3.416	1.225	6,250	4.015	1.369	83	-0.600***
Mean past boards	7.562	3.030	6,250	9.434	2.835	83	-1.872***
Education	2.461	0.734	6,250	2.780	0.638	83	-0.319***
Age	59.568	3.772	6,250	58.949	3.907	83	0.620
Independent directors	0.814	0.107	6,250	0.838	0.095	83	-0.025**
CEO duality	0.632	0.482	6,250	0.675	0.471	83	-0.043
Number of Directors	10.432	3.197	6,250	10.735	3.178	83	-0.302
Nationality Mix	0.074	0.142	6,202	0.088	0.133	83	-0.014
ROA	0.111	0.090	5,615	0.109	0.100	83	0.002
Leverage	0.671	0.228	5,618	0.631	0.251	83	0.040
Ln(total assets)	8.285	1.316	6,250	8,974	1.520	83	-0.689***

Note: This table displays the mean, standard deviation, and the number of observations for all the independent variables and all control variables used to test the Hypotheses, divided into two groups by the level of fraud

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

7 Empirical results

This section will discuss the results that are displayed in the models below. First, Table 2 shows the results for the testing of Hypothesis 1, where Model (1) shows 'Female' as a dummy variable and Model (2) the 'Female Ratio' of the total board members as the independent variables. Second, Table 3 displays the results for the testing of Hypothesis 2, where the critical mass theory is taken into account. Lastly, Table 4 shows the results of the effect of gender diversity on the propensity of fraud for the male-dominated industries and female-dominated industries respectively. For Hypothesis 3, the same independent variables as in Hypothesis 1 are used, so the female dummy and the female ratio. All models contain industry-fixed effects and year-fixed effects.

7.1 Results Hypothesis 1

Hypothesis 1 proposes that gender diversity has a negative effect on the propensity of firms to commit fraud. To test this hypothesis, I performed two logistic regressions with two different independent variables that are used to measure gender diversity. The results are displayed in Table 2. Model (1) uses a dummy variable that takes the value '1' when there is one female or more on the board of directors of a firm and takes the value '0' otherwise. Model (2) uses the percentage of females on the board of directors as the independent variable. First, I will discuss the results of Model (1) of Table 2 and the corresponding average marginal effects, which are shown in Table A.4. As Table 2 displays, the coefficient of the Female is positive. This would mean that having at least one female on the board of directors of a firm would actually increase the propensity of those firms to commit securities fraud. More specifically, at least one woman on the board of directors would increase the propensity of firms committing fraud, on average by 1.3 percentage points, compared to having no women on the board of directors, ceteris paribus. However, since the coefficient is not significant at the 10% level, no final conclusions can be taken from the results of Model (1). The results of Model (1) are, because of the non-significance, not consistent with Hypothesis 1. Next, Model (2) of Table 2 shows, together with the corresponding average marginal effects from Model (2) of Table A.4, that the effect of the female ratio in the board of directors has a negative effect on the propensity of firms to commit fraud. More specifically, on average, a one percent rise in the female ratio decreases the propensity of firms to commit fraud by 5.7 percentage points ceteris paribus. However, this effect is again not statistically significant at the 10% level. Therefore, no evidence was found that the female ratio decreases the propensity of firms to commit fraud. Although both coefficients are not statistically significant, one thing that needs closer attention is the fact that the Female coefficient is positive, while the Female ratio coefficient is negative. A possible explanation for this phenomenon could be that for reducing fraud, it does not matter whether there are women on the board yes or no (which the dummy variable indicates), but that the number of women on the board is crucial, which may indicate that the critical mass theory indeed is an important factor for the deterrence of fraud. However, since the coefficients are not significant, no final conclusions about this

possible effect of the critical mass theory can be taken. Overall, no evidence is found that gender diversity has an effect on the propensity of firms to commit fraud. Hypothesis 1 is therefore rejected.

7.2 Results Hypothesis 2

Hypothesis 2 predicted that the effect of gender diversity on fraud will be influenced by the critical mass theory. This means that having more women in boardrooms will have a stronger negative effect on the propensity of firms to commit fraud. To test Hypothesis 2, I created a categorical variable with four different categories namely when there is no female present, one female present, two females present, and three or more females present on the board of directors. The results are displayed in Model (1) of Table 3 with the corresponding average marginal effects in Model (1) of Table A.5. The effect of having one female on the board of directors is positive, and specifically, on average, having one female on the board of directors increases the propensity of fraud by 1.7 percentage points, compared to not having a female on the board of directors, ceteris paribus. However, the effect is not significant at the 10% significance level. When looking at the 'Females = 2' variable in Table 3 and Table A.5 we see that the effect of having two females on the board of directors is negative. Specifically on average, having two females on the board of directors decreases the propensity of fraud by 0.6 percentage points compared to having no women on the board of directors, ceteris paribus. However, this effect is not statistically significant at the 10% level. The variable 'Females = 3' in Table 3 and Table A.5 shows the effect of having three women or more on the board of directors on the propensity to commit fraud. On average, having three women or more on the board of directors decreases the propensity of committing fraud by 0.9 percentage points, compared to not having women on the board of directors, ceteris paribus. However, as with the other variables, this effect is also not significant at the 10% significance level. As all coefficients of the independent variables in Model (1) are insignificant, the analyses performed cannot provide evidence for the effect of the critical mass theory and that this theory affects the effect of gender diversity on the propensity of firms to commit fraud. I therefore also reject Hypothesis 2.

7.3 Results Hypothesis 3

Hypothesis 3 predicts that the effect of gender diversity will have a stronger negative effect on the propensity of a firm to commit fraud when that company is in a male-dominated industry in comparison to when that company is in a female-dominated industry. The results for the male-dominated industry analysis are displayed in Model (1) and Model (3) of Table 4 with the corresponding average marginal effects displayed in Model (1) and Model (3) of Table A.6. The results for the female-dominated industry analysis are displayed in Model (2) and Model (4) of Table 4 with the corresponding average marginal effect displayed in Model (2) and Model (4) of Table A.6. For the analyses, I used the two same measures of gender diversity as in Hypothesis 1, so the dummy of whether there is at least one female on the board of directors and the female ratio of directors.

First, a closer discussion of Model (1) and Model (2) and the corresponding average marginal effects

in Table A.6. Both coefficients of 'Female' are positive, and the average marginal effects are lower for the male-dominated industry compared to the female-dominated industry. In the male-dominated industry, on average, having a female on the board of directors increases the propensity of firms to commit fraud by 1.1 percentage points compared to not having a female on the board of directors, ceteris paribus. In the female-dominated industry, on average, having a female on the board of directors will increase the propensity of firms to commit fraud by 26.0 percentage points compared to not having a female on the board of directors, ceteris paribus. This would indicate that having a female on the board of directors in a male-dominated industry has a greater negative effect on the propensity for firms to commit crimes, as the male-dominated industry coefficient is positive but lower than the coefficient for female-dominated industries. However, while the coefficient of 'Female' for the female-dominated industries is significant at the 1% level, the coefficient for the male-dominated industries is not. Therefore, no final conclusions can be taken about whether having a female on the board of directors has indeed a stronger effect on the propensity of firms to commit fraud.

Second, a closer discussion of Model (3) and Model (4) of Table 4 and the corresponding average marginal effects in Tables A.6. Again, just like with Hypothesis 1, both coefficients are now negative instead of positive. For the male-dominated industries, on average, a one percent increase in the female ratio on the board of directors decreases the propensity of firms to commit fraud by 5.4 percentage points, ceteris paribus. For the female-dominated industries, on average, a one percent increase in the female ratio on the board of directors decreases the propensity of firms to commit fraud by 7.2 percentage points, ceteris paribus. This would indicate that contrary to the predictions, more women in boardrooms would have a more negative effect on the propensity of firms to commit fraud in female-dominated industries. However, both coefficients are not significant at the 10% significance level. Therefore, again, no conclusions can be taken about whether having a higher percentage of females on the board of directors has indeed a stronger effect on the propensity of firms to commit fraud.

To further look into the question of whether there is a difference in the effects of gender diversity on the propensity to commit fraud between male-dominated and female-dominated industries, I performed a pairwise non-linear Wald test. To be able to run this test, I removed the industry-fixed effects from the regression analyses. It is not possible to run this Wald test including the industry-fixed effects as the base categories of the industry codes on which the two subsamples are based are different, because the male regression does not contain the female-dominated industry codes, and the other way around. The results of this pairwise non-linear Wald test are displayed in Table A.7. For both 'Female' and 'Female Ratio', the p-values are not significant at the 10% level. There is therefore no statistical evidence that the effect of gender diversity on the propensity of firms to commit fraud differs between male-dominated industries and female-dominated industries. Hypothesis 3 is therefore also rejected.

Table 2: Effect of gender diversity on fraud using a dummy and the female gender ratio

	(1) Fraud	(2) Fraud
Female	0.445	
	(0.357)	
Female Ratio		-2.018
		(1.739)
ROA	-2.106	-1.845
	(1.948)	(1.926)
Leverage	-0.739	-0.529
	(0.893)	(0.839)
Ln(Total Assets)	0.358***	0.411***
	(0.134)	(0.136)
Age	-0.070	-0.075
	(0.046)	(0.046)
Nationality Mix	-0.666	-0.745
	(0.854)	(0.833)
Number of Directors	-0.010	0.010
	(0.058)	(0.057)
Independent directors	2.128	2.746
	(2.009)	(2.079)
CEO duality	-0.067	-0.057
	(0.288)	(0.285)
Education	0.042	0.054
	(0.261)	(0.261)
Mean time on board	0.063	0.056
	(0.040)	(0.040)
Mean current boards	-0.146	-0.109
	(0.190)	(0.194)
Mean past boards	0.153**	0.132*
	(0.071)	(0.071)
Constant	-5.293	-5.833*
	(3.479)	(3.383)
Observations	2598	2598

Note: This table shows the results for Hypothesis 1 displaying the coefficients of two logit regressions where the independent variable is the dummy 'Female' in Model (1) and the female ratio of board members in Model (2). Robust standard errors are in parentheses and year and industry fixed-effects are included in both models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Effect of gender diversity on fraud taking the critical mass theory into account

	(1)
	Fraud
Females = 1	0.534
	(0.344)
Females = 2	-0.251
	(0.470)
Females = 3	-0.394
	(0.658)
ROA	-2.102
	(1.972)
Leverage	-0.745
	(0.875)
Ln(Total Assets)	0.424***
	(0.137)
Age	-0.075
	(0.046)
Nationality Mix	-0.620
	(0.866)
Number of Directors	0.031
	(0.058)
Independent directors	2.748
	(2.105)
CEO duality	-0.085
	(0.295)
Education	0.054
	(0.262)
Mean time on board	0.055
	(0.038)
Mean current boards	-0.126
	(0.199)
Mean past boards	0.136*
	(0.075)
Constant	-6.370*
	(3.496)
Observations	2598

Note: This table shows the results for Hypothesis 2 displaying the coefficients of the logit regression with the three different categories 'One Female', 'Two Females' and 'Three Females', the base category is where there are no females seated in the board of directors. Robust standard errors are in parentheses and year and industry fixed effects are included in all models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Effect of gender diversity on fraud for male-dominated and female-dominated industries

	(1) Fraud (male)	(2) Fraud (female)	(3) Fraud (male)	(4) Fraud (female)
Female	0.417	7.123***		
	(0.376)	(2.594)		
Female Ratio			-2.024	-1.855
			(1.953)	(7.358)
ROA	-1.368	-21.498**	-1.063	-8.514
	(2.007)	(9.463)	(1.998)	(9.063)
Leverage	-0.969	1.069	-0.780	0.490
	(1.126)	(2.369)	(1.048)	(2.095)
Ln(Total Assets)	0.297**	3.565**	0.352**	1.823**
	(0.139)	(1.440)	(0.142)	(0.720)
Age	-0.075	-0.067	-0.080	0.043
	(0.049)	(0.215)	(0.049)	(0.216)
Nationality Mix	-0.425	-15.779*	-0.489	-5.431
	(0.873)	(8.132)	(0.855)	(7.466)
Number of Directors	0.001	-0.007	0.024	-0.109
	(0.064)	(0.237)	(0.062)	(0.219)
Independent directors	1.224	1.512	1.740	5.657
	(2.104)	(5.574)	(2.206)	(4.152)
CEO duality	0.046	-2.035**	0.062	-1.289*
	(0.312)	(0.995)	(0.311)	(0.769)
Education	-0.032	5.085**	-0.024	3.195*
	(0.275)	(2.262)	(0.277)	(1.635)
Mean time on board	0.056	1.179**	0.052	0.351
	(0.041)	(0.526)	(0.042)	(0.257)
Mean current boards	-0.209	-0.899	-0.182	0.119
	(0.201)	(0.919)	(0.205)	(0.914)
Mean past boards	0.188***	-0.458	0.172**	-0.341
	(0.072)	(0.485)	(0.072)	(0.380)
Constant	-3.423	-38.401**	-4.007	-27.759
	(3.536)	(17.384)	(3.451)	(18.426)
Observations	2400	191	2400	191

Note: This table shows the results for Hypothesis 3 displaying the coefficients of four logit regressions where the independent variable is the dummy "Female" in Model (1) and Model (2) and the variable "Female Ratio" in Model (3) and Model (4). Model (1) and Model (3) display the effect in male-dominated industries, while Model (2) and Model (4) display the effect in female-dominated industries. Robust standard errors are in parentheses and year and industry fixed effects are included in both models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8 Robustness Checks

This section will discuss two different robustness checks, namely propensity score matching, and two different measures of gender diversity.

8.1 Robustness check 1: Propensity score matching

As seen in Table 1 for some variables there are substantial significant differences between the group of firms that committed fraud and the group that did not commit fraud. Furthermore, the group that committed fraud is much smaller than the group that did not commit fraud. To address this problem, and the bias it might cause in the estimations, I decided to use propensity score matching as a robustness check.

I used 'teffects psmatch' to get to the average treatment effect. The matching for Hypothesis 1 and Hypothesis 2 was done on several different characters, namely the one where the mean difference between the coefficients was significantly different between the two fraud groups as displayed in Table 1. These are the coefficients: mean current boards, mean past boards, education, independent directors, and the natural logarithm of the total assets. To see whether the matching was done with the right covariates, I decided to look at the differences in bias between the unmatched sample and the matched sample for every covariate. When using the characteristics mentioned above to match the sample, the mean bias numbers are the following. For the unmatched sample, the mean bias between the treatment and control group is 26.2%, while for the matched sample the bias is 13.3%. However, I noticed that the bias for the Return on Assets and the Time on the Board variables became much greater for the matched sample. To address this further, I decided to add these variables to the covariates to base the matching on. This fixed the bias and caused the mean bias to go even further down to 10.6%. The covariates that were used to match the sample to test Hypothesis 1 and 2 are therefore: mean current boards, mean past boards, mean time on the board, education, independent directors, return on assets, and the natural logarithm of the total assets.

Hypothesis 3 uses two different sub-samples, namely one for male-dominated industries and female-dominated industries. To initially examine which characteristics the matching should be based on, I summarized the control variables by fraud groups. The summary statistics are displayed in Table A.8 for male-dominated industries and in Table A.9 for female-dominated industries. Based on these differences between the treatment and control groups, I decided to base the male-dominated industry matching on the following characteristics: mean current boards, mean past boards, education, age, independent directors, leverage, and the natural logarithm of total assets. To further assess if these control variables are the right fit to base the matching on, I decided to look at the mean bias of the unmatched and matched samples. Again, the bias of the Return on Asset and the mean time on the board variables went up instead of down, so I decided to add these covariates to the matching characteristics. The mean bias of the unmatched sample is 28.0% while the mean bias of the matched sample is 11.2%. The covariates the male-dominated industry data is matched on are therefore: mean current boards, mean past boards, mean time on the board, return on assets, education,

age, independent directors, leverage, and the natural logarithm of total assets. Initially, the female-dominated sample matching was based on the variables education and the natural logarithm of total assets. Again, the bias between the unmatched and matched sample was examined and the following outcomes were observed. The total mean bias went down with matching the bias, however, for some variables, the bias went up. Therefore, the variables return on assets, meantime on boards, age, CEO, and nationality mix were added. This mean bias for the matched sample went down with adding these variables to 9.7%, while the mean bias for the unmatched sample was 24.4%. Therefore these variables were added to the characteristics to base the propensity score matching on for female-dominated industries.

First of all, Hypothesis 1 is tested again using propensity score matching. The average treatment effect result is displayed in Model (1) of Table 5. The effect of having one or more females on the board of directors has a positive effect on the propensity of firms to commit fraud, compared to having no women on the board of directors, this effect is however not significant. These findings are in line with the findings found in Hypothesis 1.

Second, Hypothesis 2 is tested again using propensity score matching. As propensity score matching is not possible with categorical variables, I created three different dummy variables that take the value one if there is one female, two females, or three or more females on the board of directors and take the value zero otherwise. These results are shown in Model (2), Model (3), and Model (4) of Table 5. Having one female, compared to having no females on the board of directors has a positive effect on the propensity of firms to commit fraud, ceteris paribus. Having two females on the board compared to having no females on the board has also a positive effect on the propensity of firms to commit fraud, ceteris paribus. Lastly, having three or more females, compared to having no females on the board, has a negative effect on the propensity of firms to commit fraud. This would be in line with the predictions of the critical mass theory that is hypothesized in Hypothesis 2 when more women are on the board of directors, as the positive effect reduces and eventually turns negative. However, only the coefficient of one female is significant at the 10% level, while the other two coefficients are not significant at the 10% level. The propensity score matching analysis does, therefore, not give enough evidence to conclude that the critical mass theory actually affects how gender diversity influences the propensity of fraud as only the one female coefficient is statistically significant. Therefore, the results of Hypothesis 2, discussed in 7.2, are robust, as Hypothesis 2 is also rejected with the propensity score analyses.

Third, Hypothesis 3 is also tested again using propensity score matching. The results of the propensity score matching are displayed in Model (4) and Model (5) of Table 5. Both of the coefficients are positive, with the male-dominated industry coefficient being lower than the female-dominated industry coefficient of female. This could indicate that indeed gender diversity has a greater negative effect in male-dominated industries. However, the coefficient of 'Female' for the female-dominated industries is not significant at the 10% level, while the coefficient of 'Female' for the male-dominated industries is. Therefore, no conclusions can be made about the difference in the effect of gender diversity between male-dominated and female-dominated industries, Hypothesis 3 is therefore still rejected.

8.2 Robustness check 2: Using different measures of gender diversity

For the second robustness check, different measures of gender diversity are used to test the robustness of Hypothesis 1 and Hypothesis 3. Specifically, the Blau index and the Shannon index are used to measure gender diversity. The Blau index can take values between 0 and 0.5, as there are two 'species' in the sample namely men and women. A Blau index of 0.5 means that there are an even number of women and men in the boardroom. It is calculated as follows: $Blau = 1 - \sum_{i=1}^{N} p_i^2$, where p is the proportion of board members in each category, so male and female, and n is the total number of board members. The minimum Blau value in my data sample is 0 and the maximum is 0.5 with a mean of 0.16. The Shannon index can take values between 0 and 0.693 as there are again two 'species'. A Shannon index of 0.693 means that, just like 0.5 with the Blau index, there are an even number of men and women in the sample. The Shannon index is calculated as follows: $Shannon = -\sum_{i=1}^{N}(p_i * ln(p_i)$. Because of the natural logarithm in the Shannon index, companies with zero diversity do not get a zero as a value but a missing value. Therefore every missing value is transformed into a zero value. Eventually, the minimum value of the Shannon index is 0, the maximum is 0.693 and the mean is 0.27.

First, Hypothesis 1. The results of the robustness check using the Blau and Shannon index are shown in Table 6. Both the Blau index and Shannon index have a negative effect on the propensity of firms to commit fraud. However, just like the other coefficients that were tested in Hypothesis 1, the Blau and Shannon index are also not statistically significant at the 10% level. Therefore, no conclusion can be taken about the effect of gender diversity on the propensity of firms to commit fraud, and Hypothesis 1 is still rejected.

Second, Hypothesis 3 is tested for robustness. The results are displayed in Table 7. For both the Blau and Shannon index, the coefficient for male-dominated industries is negative, while for female-dominated industries it is positive. This might indicate that indeed, for male-dominated industries gender diversity has a greater negative effect on the propensity of firms to commit fraud. However, none of the coefficients are significant at the 10% significance level and no conclusions can be made about the effect. Therefore, Hypothesis 3 is still rejected.

Table 5: Effect of gender diversity on fraud using propensity score matching

	(1) Fraud	(2) Fraud	(3) Fraud	(4) Fraud	(5) Fraud (male)	(6) Fraud (female)
ATE Female	0.006					
	(0.004)					
ATE One Female		0.007*				
		(0.004)				
ATE Two Females			0.001			
			(0.006)			
ATE Three Females				-0.003		
				(0.004)		
ATE Female					0.006*	
					0.004	
ATE Female						0.009
						0.007
Observations	5698	4001	2926	2059	4948	741

Note: This table shows the results for all three Hypotheses displaying the average treatment effect that is obtained by using propensity score matching. The independent variables are the variable 'Female' in Model (1), Model (5) and Model (6), to test Hypothesis 1 and 3 respectively. The independent variable is 'One Female' in Model (2), 'Two Females' in Model (3) and 'Three Females' in Model (4) to test Hypothesis 2. Robust standard errors are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Effect of gender diversity on fraud using the Blau index and the Shannon index

	(1) Fraud	(2) Fraud
Blau Index	-0.862	
	(1.184)	
Shannon Index		-0.244
		(0.767)
ROA	-1.859	-1.888
	(1.927)	(1.928)
Leverage	-0.553	-0.586
	(0.850)	(0.860)
Ln(Total Assets)	0.401***	0.389***
	(0.137)	(0.137)
Age	-0.074	-0.073
	(0.046)	(0.046)
Nationality Mix	-0.741	-0.734
	(0.835)	(0.839)
Number of Directors	0.010	0.008
	(0.057)	(0.057)
Independent directors	2.634	2.508
	(2.077)	(2.067)
CEO duality	-0.057	-0.059
	(0.285)	(0.285)
Education	0.052	0.049
	(0.260)	(0.260)
Mean time on board	0.058	0.059
	(0.040)	(0.040)
Mean current boards	-0.115	-0.123
	(0.193)	(0.192)
Mean past boards	0.136*	0.140**
	(0.071)	(0.071)
Constant	-5.768*	-5.663*
	(3.400)	(3.418)
Observations	2598	2598

Note: This table shows the robustness check results for Hypotheses 1 and 2 displaying the coefficients of two logit regressions where the independent variable is the Blau index in Model (1) and the Shannon index in Model (2). Robust standard errors are in parentheses and year and industry fixed effects are included in both models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Effect of gender diversity on fraud using a dummy using the Blau index and the Shannon index in male-dominated and female-dominated industries

	(1) Fraud (male)	(2) Fraud (female)	(3) Fraud (male)	(4) Fraud (female)
Blau Index	-0.931	6.278		
	(1.305)	(8.928)		
Shannon Index			-0.301	7.349
			(0.849)	(6.780)
ROA	-1.075	-9.475	-1.114	-11.379
	(1.844)	(9.878)	(1.847)	(10.577)
Leverage	-0.793	-0.237	-0.820	-0.425
	(0.883)	(2.743)	(0.889)	(2.846)
Ln(Total Assets)	0.343**	2.077**	0.331**	2.325**
	(0.141)	(0.962)	(0.141)	(1.070)
Age	-0.079	0.082	-0.078	0.077
	(0.050)	(0.278)	(0.050)	(0.269)
Nationality Mix	-0.487	-9.054	-0.482	-11.512
	(1.015)	(10.948)	(1.017)	(11.623)
Number of Directors	0.023	0.016	0.021	0.077
	(0.062)	(0.348)	(0.062)	(0.357)
Independent directors	1.652	4.426	1.543	3.482
	(1.760)	(6.183)	(1.753)	(6.382)
CEO duality	0.060	-1.317	0.057	-1.440
	(0.315)	(1.196)	(0.315)	(1.243)
Education	-0.025	3.619*	-0.028	4.088*
	(0.259)	(2.108)	(0.259)	(2.289)
Mean time on board	0.053	0.492	0.053	0.629
	(0.045)	(0.367)	(0.045)	(0.407)
Mean current boards	-0.186	-0.384	-0.191	-0.700
	(0.185)	(1.438)	(0.184)	(1.486)
Mean past boards	0.175**	-0.186	0.178**	-0.142
	(0.072)	(0.601)	(0.072)	(0.610)
Constant	-3.922	-34.167*	-3.813	-37.068*
	(3.297)	(20.632)	(3.303)	(20.997)
Observations	2400	191	2400	191

Note: This table shows the robustness check results for Hypothesis 3 displaying the coefficients of two logit regressions where the independent variable is the Blau index in Model (1) and Model (2) and the Shannon index in Model (3) and Model (4). Model (1) and Model (3) display the effect in male-dominated industries, while Model (2) and Model (4) display the effect in female-dominated industries. Robust standard errors are in parentheses and year and industry fixed effects are included in both models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9 Discussion

This study researched the effect of gender diversity on the propensity of firms to commit securities fraud. The study was divided into three different Hypotheses. This section will discuss the different Hypotheses' results, their limitations, and their implications, and I will make recommendations for further research.

Overall, I could not find any evidence that supported the three Hypotheses that were the focus point of this study. For Hypothesis 3, I found some partial evidence that for female-dominated industries having a woman on the board of directors, compared to no women, actually increases the propensity of firms to commit fraud. However, these results were not robust when I performed propensity score matching as a robustness check. Using propensity score matching did give a positive effect and significant effect of having one female on the board of directors on the propensity to commit fraud for Hypothesis 2. However, since no other coefficient was statistically significant, this was not enough evidence to not reject Hypothesis 2. Since most of the results were insignificant, it is important to investigate further into why this is the case.

There are a few mechanisms that could explain why the vast majority of the results are not significant. In the first place, it is actually possible that there is no effect of gender diversity on securities fraud in the United States in the data set that I used. This could have several reasons. First, my data is focused on the years 2000-2004. It is only since about 2015, after the Me-Too movement, that women dared to speak up in business settings and use their voices more (Forbes, 2021). Even research points out that women find it easier to speak up for themselves when they are when there are more women around them (Kramer et al., 2006). It could therefore be for example that there is no effect of gender diversity on securities fraud in the years 2000-2004 because women did not dare to speak up and just went with the flow of the board of directors to be more likable and not be scrutinized. Second, it could be that in these years, there are just too few women on the board of directors in firms to have a result on firm performances and fraud. In the second place, it could actually be that the true effect is too small for the logistic regression model to pick up. For example, as previous research has pointed out, the critical mass theory might be an important factor in whether or not women seated on the board of directors would have an impact on firm performances or fraud. However, when testing this critical mass theory, the effects of more women in boardrooms on fraud become negative but stay insignificant. This might be because there are too few companies with more than two women on their board of directors compared to companies that don't have any women on their board of directors and therefore the logistic regression might not pick up this small effect. In the third place, the variation in the groups may be too large. The fact that the variation might be too large can be the underlying reason why the positive significant results from Hypothesis 3 have turned insignificant using propensity score matching as a robustness check. With propensity score matching, there is a bias-variance trade-off, meaning while the bias will go down, there is a possibility that the variance might go up and therefore result in non-significant results. Furthermore, the variation might already be too large in the other Hypothesis where the results turned out insignificant. Lastly, the sample size I used might be too small to detect the effect and the effect might turn out differently when more years of data were used.

As for the implications of this study, this study does add to the discussion of the effect of gender diversity and fraud by presenting contrary results to earlier research that did find a negative and statistically significant effect. However, this study also has limitations. First of all, this study cannot be generalized to different countries and in particular to European countries. The United States has a one-part board of directors system, while in Europe and many other countries, there is a two-part board of directors system. There is a difference in the composition of the board of directors between the two systems as the two-part has a supervisory board and a management board, while the one-part system has only one board of directors. The effect of the one-part system will therefore be most likely different than that of the supervisory one as the supervisory board only contains independent directors while the one-part system has in-house directors, independent directors, and management members on their board of directors. This might eventually influence the effect of gender diversity on fraud between the different systems and therefore the effect found in this study cannot be generalized to different countries. Second, as this study is based on the early 2000s, it could actually be that the effect of gender diversity on the propensity of fraud could be different nowadays than the effect (or lack thereof) that was found in this study. For example, women have been more empowered lately to stand for what they believe in, and since the early 2000s, there has been a rise in gender diversity in boardrooms. The effect nowadays could therefore be different than back then, when females in leadership positions were seen more as tokenism. Third, the actual effect of gender diversity on fraud is not measured, as the fraud definition that is used in this thesis is the fraud that is actually detected. According to (Dyck et al., 2023) the fraud that is detected is actually the tip of the iceberg, and more fraud is actually happening. The actual effect of gender diversity on securities fraud might therefore be different than the effect of gender diversity on observed securities fraud that is measured in every study. Fourth, having used a logistic regression model, it is still possible that there is omitted variable bias and that the results displayed in this study (that are statistically significant) are not the real results. As a robustness check, propensity score matching is done. Omitted variables could also play a role as the matching in this thesis is done on observed variables, it could, however, be that matching on unobserved variables would have given a further decrease in bias, and therefore better results.

For the implications that business leaders can take from this study, I would stress that further research is needed on securities fraud in the United States to see what the effect of gender diversity in boardrooms is on securities fraud. Furthermore, the existing literature on gender diversity and securities fraud occurring in China does show a negative effect on the propensity to commit fraud (Cumming et al., 2015). To be able for business leaders to make firm policies based on research, more research and more diverse research is necessary. Therefore I would recommend researchers, to further research securities fraud in the United States and how it is affected by gender diversity. I would also recommend doing this research based on more recent data, as gender diversity and fraud levels have been changing drastically in recent years.

10 Conclusion

This study researched the effect of gender diversity in boardrooms on the propensity of firms to commit fraud, specifically securities fraud, in the United States in the period 2000-2004. In the current literature, only one paper has been published that studies the effect between gender diversity and securities fraud. The paper is, however, set in China. This study, therefore, tries to fill the knowledge gap that exists in research on the effect of gender diversity on securities fraud in the United States. Furthermore, this paper adds to the current social discussion about gender diversity in leadership positions in corporations and might give incentives to top leadership for a more diverse workplace.

Using the underlying theories about ethical differences, differences in risk attitudes, and the positive effect of diversity in general, I predicted that a more gender-diverse board of directors would lead to a lower propensity of firms to commit securities fraud. Furthermore, previous research pointed out that women feel more encouraged to speak up when there are more women on the board of directors. Because of this, I predicted that the critical mass theory plays an important role and affects the effect of gender diversity in boardrooms on the propensity of firms to commit fraud. Lastly, I predicted that because of sex segregation theories, the effect of gender diversity in boardrooms would have a higher negative effect on the propensity of firms to commit securities fraud for male-dominated industries than for female-dominated industries.

Using a list put together by Dyck et al. (2010) of firms who committed securities fraud between the years 1996-2004 and data about firm characteristics and board of director characteristics from Compustat and BoardEx respectively, I eventually used a self-made dataset with 6,333 firms from the years 2000-2004. To research the effect of gender diversity in boardrooms on the propensity of firms to commit fraud, I performed several logit regressions. For Hypothesis 1, I found that there is no significant effect of having one or more women on the board of directors compared to no women on the board of directors. These results were also insignificant when instead of a dummy variable, I used the ratio of females on the board of directors as the independent variable. Hypothesis 1 was therefore rejected. For Hypothesis 2, I performed a logistic regression with a categorical variable that has four different categories, with the categories displaying whether there was no female, one female, two females, or three or more females on the board of directors. I used these categories to research if the critical mass theory affects the effect of gender diversity on securities fraud more strongly. No coefficient was statistically significant, so no final conclusions about the critical mass theory could be taken. Hypothesis 2 was therefore also rejected. Lastly, for Hypothesis 3, I split the dataset that I put together into two datasets based on the type of industry, so female-dominated industries versus male-dominated industries. For this Hypothesis, I performed two logistic regression models with the same independent variables as used to test Hypothesis 1. Only the dummy variable of females in the female-dominated industry sample was statistically significant. Therefore, no conclusions could be taken about the difference in the effect of gender diversity on the propensity of firms to commit securities fraud between male-dominated industries and female-dominated industries. Hypothesis 3 was therefore also rejected. Performing propensity score matching as a robustness check gave again some statistically significant results, but not

enough to be able to take conclusions from the analyses and not reject all three Hypotheses. The results are therefore robust. The other robustness check performed was using other measures of gender diversity, namely the Blau index and the Shannon index. Both the indexes gave no statistically significant results and Hypotheses 1 and 3 were therefore still rejected. The insignificance of almost all coefficients could have various reasons. First, there could be actually no effect of gender diversity on fraud. Second, it could be that the effect is too small to be picked up by the logistic regressions done in this study. Third, it could be that the variation in the different groups is too big. Lastly, the sample used might be too small to display an effect.

This study has some limitations. First, the results can not be generalized to different countries, especially countries in Europe, because of the different board of directors system the United States has. Second, the study was performed on data from the early 2000s. Since then, a shift has been continuously happening in regard to gender diversity in corporate leadership positions, therefore it could also be the possibility that the effects are different at the moment and the results of this study may also not be generalized to the current time. Lastly, there could still be omitted variable bias, which could have influenced the results.

As for the implications, it is necessary to stress that further research into this topic is needed to make conclusions about the effect of gender diversity on the propensity of fraud. Especially if business leaders want to make decisions regarding a gender-diverse workplace, further research is needed to give a whole view on this topic.

To conclude, in this study no significant effect is found that gender diversity influences the propensity of firms to commit securities fraud in the United States from the period 2000-2004. Further research is necessary to be able to generalize the results and for firms to make firm policies based on research.

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A Appendix

Table A.1: Descriptive Statistics

Variable	Mean	SD	Min	Max	N
Fraud	0.013	0.114	0	1	6,333
Female	0.689	0.463	0	1	6,333
Females = 1	0.404	0.490	0	1	2,560
Females = 2	0.215	0.411	0	1	1,362
Females = 3	0.070	0.254	0	1	439
Female Ratio	0.098	0.086	0	0.571	6,333
Mean time on board	7.650	3.861	0	25.429	6,333
Mean current boards	3.423	1.229	1	11.812	6,333
Mean past boards	7.586	3.035	1.556	25.429	6,333
Education	2.465	0.734	0.25	5.5	6,333
Age	59.560	3.775	42.329	73.555	6,333
Independent directors	0.814	0.107	0	1	6,333
CEO duality	0.633	0.482	0	1	6,333
Number of Directors	10.436	3.196	2	32	6,333
Nationality Mix	0.075	0.142	0	0.700	6,285
ROA	0.111	0.090	-0.405	0.889	5,698
Leverage	0.671	0.228	0.021	2.693	5,701
Ln(total assets)	8.294	1.321	5.092	14.210	6,333

Note: This table displays the mean, standard deviation, minimum, maximum and the number of observations for the independent variables and all of the control variables.

Table A.2: Correlation table

	Fraud	Female	Female Ratio	Mean time on board	Mean current boards	Mean past boards	Education	Age	Independent directors	CEO duality	Number of Directors	Nationality Mix	ROA	Leverage	Ln(Total Assets)
Fraud	1														
Female	0.0254*	1													
Female Ratio	0.0103	0.749***	1												
Mean time on board	-0.0135	-0.0194	-0.0764***	1											
Mean current boards	0.0599***	0.102***	0.115***	-0.221***	1										
Mean past boards	0.0753***	0.0340**	0.0619***	-0.251***	0.846***	1									
Education	0.0491***	0.114***	0.195***	-0.243***	0.373***	0.414***	1								
Age	-0.0230*	0.0439***	-0.0360***	0.412***	-0.146***	-0.182***	-0.164***	1							
Independent directors	0.0245*	0.230***	0.192***	-0.140***	0.186***	0.184***	0.225***	-0.00587	1						
CEO duality	0.00571	0.0502***	0.0758***	-0.0205	0.116***	0.0813***	0.137***	0.0361***	0.0446***	1					
Number of Directors	0.00796	0.356***	0.149***	0.0558***	0.0183	-0.0354***	-0.189***	0.217***	0.236***	0.0195	1				
Nationality Mix	0.0169	-0.0175	0.0193	-0.0817***	0.225***	0.229***	0.141***	-0.0372***	0.0279**	0.00442	0.0123	1			
ROA	-0.00362	0.0533***	0.0898***	0.0219*	0.0508***	0.0473***	0.104***	-0.0344***	-0.0867***	0.102***	-0.104***	0.100***	1		
Leverage	-0.0203	0.0951***	0.0485***	-0.0115	-0.0288**	-0.0543***	-0.210***	0.138***	0.162***	0.00641	0.259***	-0.138***	-0.356***	1	
Ln(Total Assets)	0.0604***	0.272***	0.237***	-0.0467***	0.317***	0.243***	0.198***	0.171***	0.136***	0.145***	0.437***	0.0885***	-0.106***	0.242***	1

Note: This table shows a correlation table between the main independent variables used in Hypothesis 1 and Hypothesis 3 and all of the control variables except for the different years and industries

* p<0.10, ** p<0.05, *** p<0.01

Table A.3: The female-dominated industries and their corresponding NAICS codes

NAICS	Industry	NAICS	Industry
311812	Commercial Bakeries	522220	Sales Financing
3113	Sugar and Confectionery Product Manufacturing	522210	Credit Card Issuing
315210	Cut and Sew Apparel Contractors	522390	Other Activities Related to Credit Intermediation
511120	Periodicals: Publishing or Publishing & Printing	522292	Real Estate Credit
511130	Books: Publishing or Publishing & Printing	621491	HMO Medical Centers
511140	Miscellaneous Publishing	721110	Hotels (except Casino Hotels) and Motels
511191	Greeting Cards	812331	Linen Supply
325611	Soap and Other Detergent Manufacturing	812191	Diet and Weight Reducing Centers
325612	Polish and Other Sanitation Good Manufacturing	541213	Tax Preparation Services
325620	Toilet Preparation Manufacturing	812112	Beauty Salons
452111	Retail-Department Stores	541810	Advertising Agencies
452990	Retail-Variety Stores	561450	Credit Bureaus
452910	Retail-Misc General Merchandise Stores	541430	Graphic Design Services
445110	Supermarkets and Other Grocery Retailers (except Convenience Retailers)	541860	Direct Mail Advertising
445120	Retail-Convenience Stores	561720	Janitorial Services
448110	Retail-Apparel & Accessory Stores	561710	Exterminating and Pest Control Services
448120	Retail-Women's Clothing Stores	561311	Employment Placement Agencies
448140	Retail-Family Clothing Stores	561320	Temporary Help Services
448210	Retail-Shoe Stores	561499	All Other Business Support Services
722513	Limited-Service Restaurants	812930	Parking Lots and Garages
722211	Retail-Eating Places	532230	Services-Video Tape Rental
722511	Full-Service Restaurants	721120	Casino Hotels
722110	Retail-Eating Places	623110	Nursing Care Facilities (Skilled Nursing Facilities)
446110	Retail-Drug Stores and Proprietary Stores	622310	Specialty (except Psychiatric and Substance Abuse) Hospitals
451211	Retail-Miscellaneous Shopping Goods	622110	General Medical and Surgical Hospitals
448310	Retail-Jewelry Stores	621511	Medical Laboratories
454110	Retail-Catalog & Mail-order Houses	621999	All Other Miscellaneous Ambulatory Health Care Services
453910	Retail Stores	621492	Kidney Dialysis Centers
522110	Commercial Banking	621498	All Other Outpatient Care Centers
522180	Savings Institutions and Other Depository Credit Intermediation	611691	Exam Preparation and Tutoring
522120	Savings Institution, Federally Chartered	611310	Colleges, Universities, and Professional Schools
522320	Financial Transactions Processing, Reserve, and Clearinghouse Activities	623312	Assisted Living Facilities for the Elderly
522294&522298	Federal & Federally-sponsored Credit Agencies	541910	Marketing Research and Public Opinion Polling
522299	International, Secondary Market, and All Other Nondepository Credit Intermediation	541219	Other Accounting Services
522291	Consumer Lending	541214	Payroll Services

Note: This table displays the industries and their corresponding NAICS code that, in this dataset, are defined as female-dominated according to the United States Bureau of Labor Statistics

Table A.4: Average marginal effects of gender diversity on fraud using a dummy and the female gender ratio

	(1) Fraud	(2) Fraud
Female	0.013	
	(0.010)	
Female Ratio		-0.057
		(0.050)
ROA	-0.060	-0.052
	(0.056)	(0.055)
Leverage	-0.021	-0.015
	(0.026)	(0.024)
Ln(Total Assets)	0.010***	0.012***
	(0.004)	(0.004)
Age	-0.002	-0.002
	(0.001)	(0.001)
Nationality Mix	-0.019	-0.021
	(0.024)	(0.024)
Number of Directors	-0.000	0.000
	(0.002)	(0.002)
Independent directors	0.060	0.078
	(0.057)	(0.059)
CEO duality	-0.002	-0.002
	(0.008)	(0.008)
Education	0.001	0.002
	(0.007)	(0.007)
Mean time on board	0.002	0.002
	(0.001)	(0.001)
Mean current boards	-0.004	-0.003
	(0.005)	(0.006)
Mean past boards	0.004**	0.004*
	(0.002)	(0.002)
Observations	2598	2598

Note: This table shows the results for Hypothesis 1 displaying the average marginal effects where in Model (1) the independent variable is the dummy 'Female' and in Model (2) the independent variable is the female ratio in the board of directors. Robust standard errors are in parentheses and year and industry fixed-effects are included in both models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Average marginal effects of gender diversity on fraud taking the critical mass theory into account

	(1)
	Fraud
Females = 1	0.017
	(0.010)
Females = 2	-0.006
	(0.011)
Females = 3	-0.009
	(0.014)
ROA	-0.059
	(0.056)
Leverage	-0.021
	(0.025)
Ln(Total Assets)	0.012***
	(0.004)
Age	-0.002
	(0.001)
Nationality Mix	-0.018
	(0.025)
Number of Directors	0.001
	(0.002)
Independent directors	0.078
	(0.059)
CEO duality	-0.002
	(0.008)
Education	0.002
	(0.007)
Mean time on board	0.002
	(0.001)
Mean current boards	-0.004
	(0.006)
Mean past boards	0.004*
	(0.002)
Observations	2598

Note: This table shows the results for Hypothesis 2 displaying the coefficients of the logit regression with the three different categories 'One Female', 'Two Females' and 'Three Females', the base category is where there are no females seated in the board of directors. Robust standard errors are in parentheses and year and industry fixed effects are included in all models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.6: Average marginal effects of gender diversity on fraud for male-dominated and female-dominated industries

	(1)	(2)	(3)	(4)
	Fraud (male)	Fraud (female)	Fraud (male)	Fraud (female)
Female	0.011	0.260***		
	(0.010)	(0.100)		
Female Ratio			-0.054	-0.072
			(0.053)	(0.284)
ROA	-0.037	-0.784*	-0.029	-0.328
	(0.054)	(0.461)	(0.054)	(0.394)
Leverage	-0.026	0.039	-0.021	0.019
	(0.030)	(0.083)	(0.028)	(0.080)
Ln(Total Assets)	0.008**	0.130***	0.009**	0.070***
	(0.004)	(0.044)	(0.004)	(0.023)
Age	-0.002	-0.002	-0.002	0.002
	(0.001)	(0.008)	(0.001)	(0.008)
Nationality Mix	-0.011	-0.576*	-0.013	-0.209
	(0.024)	(0.309)	(0.023)	(0.285)
Number of Directors	0.000	-0.000	0.001	-0.004
	(0.002)	(0.009)	(0.002)	(0.008)
Independent directors	0.033	0.055	0.047	0.218
	(0.057)	(0.199)	(0.059)	(0.147)
CEO duality	0.001	-0.074*	0.002	-0.050
	(0.008)	(0.041)	(0.008)	(0.031)
Education	-0.001	0.185***	-0.001	0.123**
	(0.007)	(0.070)	(0.007)	(0.052)
Mean time on board	0.001	0.043**	0.001	0.014
	(0.001)	(0.017)	(0.001)	(0.009)
Mean current boards	-0.006	-0.033	-0.005	0.005
	(0.005)	(0.038)	(0.006)	(0.035)
Mean past boards	0.005**	-0.017	0.005**	-0.013
	(0.002)	(0.016)	(0.002)	(0.014)
Observations	2400	191	2400	191

Note: This table shows the results for Hypothesis 3 displaying the average marginal effects of four logit regressions where the independent variable is the dummy "Female" in Model (1) and Model (2) and the variable "Female Ratio" in Model (3) and Model (4). Model (1) and Model (3) display the average marginal effects for male-dominated industries, while Model (2) and Model (4) display the average marginal effects for female-dominated industries. Robust standard errors are in parentheses and year and industry fixed effects are included in both models

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.7: Nonlinear Wald tests - Male-dominated and Female-dominated industries

Variable	Chi-squared statistic	p-value
Female	0.30	0.5831
Female Ratio	0.01	0.9085

Note: This table shows the results for the non-linear Wald test that is used to check whether the coefficients of the independent variables 'Female' and 'Female Ratio' are statistically different between the male-dominated and female-dominated subsamples

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

Table A.8: Summary statistics by fraud for male-dominated industries

	Fraud = 0			Fraud = 1			
Variable	Mean	SD	N	Mean	SD	N	Mean difference
Female	0.686	0.464	5475	0.792	0.409	72	-0.105*
Number of Directors	10.516	3.224	5475	10.750	3.214	72	-0.234
Mean time on board	7.663	3.819	5475	7.343	3.403	72	0.319
Mean current boards	3.441	1.225	5475	4.050	1.373	72	-0.610***
Mean past boards	7.608	2.980	5475	9.565	2.828	72	-1.957***
Education	2.483	0.729	5475	2.791	0.642	72	-0.308***
Age	59.627	3.726	5475	58.854	3.866	72	0.773*
Independent directors	0.816	0.106	5475	0.838	0.094	72	-0.022*
CEO duality	0.630	0.483	5475	0.681	0.470	72	-0.051
Nationality Mix	0.077	0.145	5475	0.094	0.138	72	-0.017
ROA	0.109	0.089	5475	0.109	0.100	72	0.000
Leverage	0.665	0.223	5475	0.609	0.237	72	0.056**
Ln(Total Assets)	8.301	1.313	5475	8.941	1.442	72	-0.640***

Note: This table displays the mean, standard deviation and the number of observations for the independent variable 'Female' and all control variables used in the logit model divided into two groups by the level of fraud for male-dominated industries

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

Table A.9: Summary statistics by fraud for female-dominated industries

	Fraud = 0			Fraud = 1			
Variable	Mean	SD	N	Mean	SD	N	Mean difference
Female	0.693	0.462	775	0.909	0.302	11	-0.216
Number of Directors	9.841	2.931	775	10.636	3.075	11	-0.795
Mean time on board	7.592	4.205	775	7.492	1.850	11	0.100
Mean current boards	3.239	1.213	775	3.786	1.381	11	-0.547
Mean past boards	7.234	3.344	775	8.572	2.859	11	-1.338
Education	2.311	0.750	775	2.707	0.634	11	-0.397*
Age	59.151	4.066	775	59.565	4.311	11	-0.414
Independent directors	0.799	0.114	775	0.840	0.103	11	-0.042
CEO duality	0.648	0.478	775	0.636	0.505	11	0.011
Nationality Mix	0.053	0.120	775	0.045	0.082	11	0.007
ROA	0.123	0.095	775	0.107	0.101	11	0.015
Leverage	0.712	0.258	775	0.777	0.299	11	-0.065
Ln(Total Assets)	8.171	1.330	775	9.195	2.030	11	-1.023**

Note: This table displays the mean, standard deviation and the number of observations for the independent variable 'Female' and all control variables used in the logit model divided into two groups by the level of fraud for female-dominated industries

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