The effect of CEO gender on firm performance in Europe

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Abstract:

In this paper, the effect of CEO gender on firm performance in Europe is studied using the OLS method on unbalanced panel data from European firms listed on the Stoxx Europe 600 index between the years 2003 and 2023. The dependent variable firm performance is measures as Return on Assets (ROA). Additionally, this paper analyzes if the effect of CEO gender on firm performance varies across different Global Gender Gap indexes (GGGI). The results show no significant effect between CEO gender and Firm performance. However, the effect of CEO gender on firm performance seems to vary across different Global Gender Gap indexes, with a higher GGGI indicating a more positive effect on firm performance when the CEO of the firm is female. It could be the case that other factors which play more critical roles in influencing firm performance, were omitted. Selection bias might also play a role while female CEOs are not randomly selected, but chosen by stakeholders or the board. Further research is needed to study these possible omitted factors.

Keywords: CEO, Firm performance, Executive gender, Global Gender Gap Index

JEL: J16, G34, M12, G30

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1. Introduction

In the beginning of the 20th century – only a few generations back – women in the Netherlands were subordinate to men. They had to take care of the family, were not allowed to vote and it was impossible for a woman to divorce her husband. Besides, women were not seen suitable for managerial roles, no matter how experienced they were. (Nwanazia, 2018) A female CEO was an unthinkable concept in this time period. During the first feminist wave – lasting from 1870 until 1920 – the number of girls who entered schools increased and in 1919 women were allowed to vote. The Netherlands is an example of how women were treated across different countries in Europe. Between 1906 and 1984, all women in Europe gained the right to vote. (Österreichische NationalBibliothek, n.d.) Only in the last 40 years, women became CEOs of corporate businesses. The women who made it as executives at corporate firms, had to compete against their mainly male colleagues who were not used to women leading businesses. It is therefore very interesting to study how female executives perform compared to there male competitors. Khan & Vieito (2013) show that in the United states, the gender of the CEO of a firm matters in terms of firm performance. They looked at data containing the five most well paid executives from companies listed on the S&P 1500 Index between 1992 and 2004 and found that firms with female CEOs are associated with an increase in firm performance compared to the firms managed by male CEOs. However, very little research has been conducted on the effect of CEO gender on firm performance for Europe as a whole.

The relationship between CEO gender and firm performance is not certain while for example Niessen (2006) studied women who manage mutual funds and found that women usually show investment styles that are less extreme and more stable compared to men, which may possibly lead to a higher Return on Assets (ROA). On the other side, it may be that other factors play more critical roles in influencing ROA, such as in the paper of Miloloža (2018), where they studied the impact of leadership styles on financial performance of enterprises, and found significant results.

Many studies on how female executives perform are conducted in the US, such as the research of Khan & Vieito (2013).When looking at other countries, Sun & Zou (2021) conducted a study on the effect of CEO gender on firm performance on Chinese listed firms between 2002 and 2018, and came to a similar conclusion. Pimentel et al. (2020) studied the same effect on the largest listed companies in the European Union between 2010 and 2017, but they did not find a significant effect, suggesting that CEO gender has no influence on firm performance.

While most studies about the performance of female executives have focused on the United states, such as Khan & Vieito (2013), there are researchers that studied this topic focusing on other countries, such as Sun & Zou (2021) and Pimentel et al. (2020) However, most studies focus on the effect of female representatives in the directory board of a firm instead of looking at the CEO of the firm, like the research of Amin et al. (2023) and Marinova et al. (2016). Since there is not much literature available on the effect of

the gender of the CEO on firm performance, more research on different contexts is needed to test the generalizability of the original finding of Khan & Vieito (2013).

Therefore, the research question that this study aims to answer is: *Does CEO gender has a significant effect on firm performance in Europe?* To answer this question, a similar research method as Khan & Vieito (2013) is used. To test if CEO gender has a significant effect on firm performance in Europe, three regressions are conducted with firm performance measured as *ROA* as the dependent variable, a dummy for whether the CEO of a firm is female as the independent variable and *Firm Size, Total Compensation, Ownership*, year dummies, country dummies and firm dummies as control variables. Instead of looking at firms in the S&P 1500 in the years 1992 to 2004 like Khan & Vieito (2013), this study will be looking at firms with the Stoxx Europe 600 index in the years 2003 to 2023. The Stoxx Europe 600 index is the European equivalent of the S&P 500 index and represents 17 different countries across Europe. The final sample contains unbalanced panel data with 599 observations from 61 different firms and 8 European countries. The firm characteristics are obtained from the Compustat Global database, CEO gender and other CEO characteristics are obtained from the BoardEx database, the market values of the firms are collected form Workspace DataStream, and the Global Gender Gap Indexes are obtained from the Global Gender Gap Report 2023. (World Economic Forum, 2023) Both the Compustat and BoardEx databases are obtained from Wharton Research Data Services.

Additionally, a second question is asked: *Does the effect of CEO gender on firm performance varies across different Global Gender Gap indexes?* In an attempt to answer this question a fourth regression is conducted where the Global Gender Gap Index (GGGI) of each country, and an interaction effect between the gender dummy and the GGGI are added.

The results of this paper show no significant effect between CEO gender and firm performance. This result suggests that the fact that the position of CEO is occupied by a woman, has no influence on the return on assets of the company. To answer the first research question: CEO gender does not seem to have a significant effect on firm performance in Europe. These results are similar to the study of Pimentel et al. (2020), but oppose the studies of Khan & Vieito (2013), Sun & Zou (2021) and La Rocca et al. (2024). Comparing the studies of Pimentel et al. (2020), Khan & Vieito (2013) and Sun & Zou (2021) with the findings of this study, results in the assumption that US and Chinese firms differ from European firms when it comes to the effect of CEO gender on firm performance, with US and Chinese firms showing a positive effect on firm performance when the CEO of a company is female, and no such effect for European firms.

It could be the case that other factors which play more critical roles in influencing firm performance, were omitted. Selection bias could have also possibly played a role. Further research is needed to study these possible omitted factors and selection bias.

The interaction effect between the dummy variable whether the CEO of the firm is female and the Global Gender Gap Index shows a positive and significant effect. This indicates that the effect of CEO gender on firm performance seems to vary across different Global Gender Gap indexes, with a higher GGGI marking a more positive effect

on firm performance when the CEO of the firm is female. This finding supports the second research question.

This opposes the findings of La Rocca et al. (2024) who used a Gender Parity Index variable in their study, which contains the ratio of women to men enrolled at tertiary level in public and private schools and found a negative but not significant effect for the Gender Parity Index, indicating that there was no additional effect of females in CEO duality on firm performance when the ratio of women enrolled at tertiary level in public and private schools rises.

The positive effect found could be related to the remarks of Klasen (2018). Klasen (2018) appoints the increasing economic growth of a country when the gender gaps in that country are reduced. A higher Global Gender Gap Index, indicating a smaller gender gap, signals more economic growth, in which females possibly have more opportunities to use their skills and suffer less from discrimination.

The paper is organized as follows: Section 2 discusses the literature review. Section 3 describes the data and Empirical Strategy. Section 4 explains the results, and Section 5 presents the conclusion and discussion.

2. Literature Review

2.1. CEO gender and firm performance

It is not clear what the theoretical relationship between firm performance and the CEO being female is. Vandegrift & Brown (2005) conducted experiments where they let the participents first play games of change and later on tournaments. They find men made riskier choices in the game of change and that women are more risk averse. This characteristic can influence financial decision making and therefore firm performance. Besides, Niessen (2006) studied women who manage mutual funds and found that women usually show investment styles that are less extreme and more stable compared to men, which may possibly lead to a higher return on assets. At the same time, taking not enough risk could lead to less optimal performances. On the other side, it may be that other factors play more critical roles in influencing ROA, such as in the paper of Miloloža (2018), where they studied the impact of leadership styles on financial performance of enterprises, and found significant results.

Many studies on how female executives perform are conducted in the US, such as the research of Khan & Vieito (2013). Khan & Vieito (2013) evaluated whether firms managed by female CEOs exhibit the same performance as firms managed by male CEOs. Khan & Vieito (2013) looked at data containing the five most well paid executives from companies listed on the S&P 1500 between 1992 and 2004 and conducted a two staged least square analysis with ROA as measurement for firm performance as dependent variable, a dummy for whether the CEO of a firm is female as independent variable, and the logarithm of Total Compensation, a Firm Size component, the logarithm of the percentage of the company's shares owned by the CEO, a dummy indicating whether the firm is classified as a new technology firm and different years as control variables. After performing the regression, Khan & Vieito (2013) find a positive and

significant effect for the dummy indicating whether the CEO is female, meaning that firms with female CEOs are associated with an increase in firm performance compared to the firms managed by male CEOs. Khan & Vieito (2013) believe that the characteristics of women, especially risk averseness, are the cause of this positive and significant finding. According to Khan & Vieito (2013), women's risk averse attitude affects financial decisions.

When looking at other countries, Sun & Zou (2021) conducted a study in China to show that the transition of political leadership can affect CEO gender gaps in firm performance. After collecting accounting information and CEO characteristics from listed firms in China between 2002 and 2018, they performed regression analyses with firm performance as dependent variable, a gender dummy variable indicating whether the CEO is female as independent variable, an interaction effect between the gender dummy variable and a dummy variable indicating whether the observation was before or after the transition of political leadership in China in 2012, and various control variables. Six different measures for firm performance were used: gross profit margin, gross profit margin for primary business, net profit margin, net profit margin for primary business, gross investment return and investment return adjusted by the risk-free interest rate. Each different measure for firm performance was tested on three different window samples each, being a 1-year, 2-year and 3-year window sample, resulting in the performance of eighteen regressions. The control variables used in the regressions were Cashflow, Market-to-Book ratio, Capital Expenditure, the logarithm of firm total assets, PPE, sales market share, leverage, a Turnover dummy, corporate governance and firm and year fixed effects. In every regression, the gender dummy variable had a positive and significant effect. This concludes that when looking at Chinese listed firms, firms with a female CEO perform better than firms with a male CEO. Sun & Zou (2021) hypothesize that the main reason for this result is the better political connection female leaders had on average before the transition of political leadership in 2012. The paper highlights that they cannot rule out all the selection bias, but because they found that firms with female CEOs and firms with male CEOs did not differ significantly at the industry level and because the results are still robust after controlling for firm characteristics, they assume that there is no selection bias at industry level.

La Rocca et al. (2024) studied gender dimensions between CEO duality and firm performance in Europe. They used publicly listed firms from 23 European countries between 2014 and 2020. They performed a regression with ROA as firm performance as dependent variable, a CEO Duality dummy variable which contains 1 if the CEO and board chair of a firm are the same person, a Women in CEO Duality dummy variable containing 1 if there is CEO Duality and this person is a woman, a Gender parity index variable containing the ratio of women to men enrolled at tertiary level in public and private schools, and various control variables: Board independence, Board size, CEO tenure, Firm age, Firm size, Tangibility, Tobin Q, Debt, Cash holdings, GDP growth and Credit market size. They conducted multiple tests and regressions with these variables and found that when a woman holds both the role of CEO and board chair, this had a positive effect on firm performance. La Rocca et al. (2024) suggest that the reason for

this positive and significant effect is that women in the roles of both CEO and board chair can reduce managerial opportunism because of their more ethical behavior and feeling for social responsibility compared to men, which prevent them from misusing their power. Managerial dominance seems less likely when women run a business.

Pimentel et al. (2020) studied the effect of CEO gender and the percentage of women on boards on firm performance. They looked at the largest listed companies in the European Union between 2010 and 2017 and had a final sample containing 308 companies. They used the OLS method with firm performance measured with two different indicators: Return on Assets and Tobin's Q, a dummy indicating whether the CEO is female and a variable displaying the percentage of women on a board as independent variables and board size, the percentage of independent board members, a dummy whether the CEO is on the board, the percentage of board members with a specific or business study, the percentage of female managers in the company, the percentage of female workers in the company, the debt ration of the company, firm size and a location dummy as control variables. After performing several regressions, a significant negative relationship was found between the CEO of a company being female and Tobin's Q. This relationship was also negative when they used ROA as measure for firm performance, but this effect was not significant. These results indicate that CEO gender has no influence on the company when studying accounting results. Moreover, they find a positive effect of the amount of female board members and firm performance, but this effect is again not significant. However, they analyzed that female CEOs negatively influence the market value of the company. They suggest that this phenomena is due to discrimination by shareholders and investors because there is only a negative influence in Tobin's Q, but not in ROA which indicates that shareholders and investors assume that female CEOs will perform worse than their male competitors.

Moreover, when looking at studies about diversity in the boardroom, Marinova et al. (2016) studied whether gender diversity in Dutch and Danish boardrooms in 2007 had a positive effect on firm performance. They conducted an two-stage least-squares regression with Tobin's Q as the measure for firm performance. Board gender diversity is measured in percentage of women on the board and a dummy variable indicating if there is at least one women on the board. In contrast with the other papers focusing on CEOs, they find no relation between board diversity and firm performance.

2.2 Global Gender Gaps

The Global Gender Gap Index (GGGI) benchmarks the national gender gaps on economic, political, education- and health-based criteria. The Global Gender gap score of 2023 is 68.4%, which is an improvement of 0.3% compared to the year before. (World Economic Forum, 2023) The paper of Mastracci (2017) studies the most important factors of the Global Gender gap index. The study analyzes the data on the World Economic Forum by using hedonic regression. The paper finds that women who work in public sector management, administration and politics account for a large portion of gender inequality. Policies to increase the representation of women in these three

industries mitigate the inequality measured by the GGGI. Besides, economic indicators likewise consume a big part of the Global Gender Gap Index. The study concludes that the representation of women in elective offices and public sector management is very important to reduce the gender gap.

The review of Klasen (2018) underscores the importance of gender gap research and emphasizes that it is very difficult to find a reliable effect of gender gaps on economic performance. Accounting studies often overestimate such effects. However, theoretical and empirical literature show that gender gaps in education reduce economic growth. There appears to be much less literature available on employment gaps, but the published literature indicates that employment gaps also reduce economic growth. Furthermore, micro evidence suggests that gender gaps also reduce efficiency on farms and in firms. Klasen (2018) concludes that further research is needed.

La Rocca et al. (2024) use a Gender Parity Index variable in their study, which contains the ratio of women to men enrolled at tertiary level in public and private schools. They add this variable and an interaction effect between this variable and their Women in CEO Duality variable because they believe the effect of gender dimensions between CEO duality and firm performance varies across different Gender Parity Indexes. They eventually find a negative but not significant effect, indicating that there was no additional effect of females in CEO duality on firm performance when the ratio of women enrolled at tertiary level in public and private schools rises.

2.3. Selection bias

On of the problems when studying CEO gender on firm performance is selection bias. Women are not randomly selected to become the CEO of a firm, but are chosen by stakeholders or by the board. This can distort the relationship between CEO gender and firm performance. If certain types of firms are more likely to have female CEOs, the observed effect of CEO gender on ROA might actually be due to these other underlying factors rather than gender itself. For example, if firms that already performing well are more likely to hire a female CEO, the observed effect on ROA might be biased by these pre-existing factors. This makes it very hard to test if the gender of the CEO really makes a difference when it comes to financial firm performance.

Bagues et al. (2017) show an example of such selection bias. Bagues et al. (2017) study how committee decision-making is affected if there is a larger presence of female evaluators. They analyze this using information of applications to professorships in Italy and Spain. They find that a larger number of females in evaluation committees does not increase quality or quantity of the female candidates who qualify. Besides, female evaluators do not seem to be more favorable toward female candidated, whereas male evaluators are less favorable towards female candidated at the moment a female evaluator joins the committee. This phenomenon is a direct example of selection bias. If committees with more men are less likely to appoint a woman in a high position, the effect of gender on firm performance could be affected by the fact that more men were in the decision-making committee.

Vallbé & Ramírez-Folch (2023) describe another example of selection bias. They studied the effect of judges' gender on decisions regarding intimate-partner violence in

Spain between 2010 and 2018. They faced selection bias due to the fact that when lawyers knew the judge, they could advice their clients to delay their petitions until a more favorable judge presides. In the study of Vallbé & Ramírez-Folch (2023), it was very unlikely that this would happen due to a random rotation system wich randomly assigns judges to cases. However, their was still a small change of selection bias, and very little to do against it.

A possibility to try adressing selection bias in this research is to add control variables. (Elwert & Winship, 2014) In this study, firm characteristics and country-specific factors are added to try to adress selection bias.

2.4. Research hypotheses

Niessen (2006) found that women who manage mutual funds usually show investment styles that are less extreme and more stable compared to men, which may lead to higher returns on assets. Vandegrift & Brown (2005) also found that woman are more risk averse, which may have a positive influence on financial decision making. Besides, the studies of Khan & Vieito (2013) and Sun & Zou (2021) both found significant and positive effects of the CEO of a company being female on firm performance in the US and China. Pimentel et al. (2020) do not find a significant effect of CEO gender on firm performance in Europe, but they used different control variables compared to the studies of Khan & Vieito (2013) and Sun & Zou (2021). Based on the above, the first alternative hypothesis is proposed to answer the first research question:

Hypothesis 1: *Firms managed by female CEOs, on average, perform better than firms managed by male CEOs.*

La Rocca et al. (2024) used the Gender Parity Index variable in their study, which contains the ratio of women to men enrolled at tertiary level in public and private schools. They add this variable and an interaction effect between this variable and their Women in CEO Duality variable because they believe the effect of gender dimensions between CEO duality and firm performance varies across different Gender Parity Indexes.

Besides, Klasen (2018) remarks that a reduction of the gender gap, indicating a high GGGI, brings economic growth. This economic growth could possibly create more possibilities for women to use their skills and suffer less from discrimination.

Due to selection bias, it is additionally very important to add control variables such as firm characteristics and country-specific factors to the regression. (Elwert & Winship, 2014) A gender equality index can function as a country-specific, social and economical condition. In this study, the Global Gender Gap Index (GGGI) will be used to control for gender equality and like the study of La Rocca et al. (2024), it is expected that the effect that is studied in the first hypothesis, varies across this gender equality index. Based on this, the second alternative hypothesis is developed to answer the second research question:

Hypothesis 2: *The effect of CEO gender on firm performance is higher in countries with more gender equality.*

3. Data and Empirical Strategy

3.1 Sample and data collection

Instead of looking at firms in the S&P 1500 in the years 1992 to 2004 like Khan & Vieito (2013), this study will be looking at firms with the Stoxx Europe 600 index in the years 2003 to 2023. The Stoxx Europe 600 index consists of the 600 highest-valued public firms in Europe and is the European equivalent of the S&P 500 index and represents 17 different countries across Europe. (STOXX, 2024) The firm characteristics are obtained from the Compustat Global database, CEO gender and other CEO characteristics are obtained from the BoardEx database, the market values of the firms are collected form Workspace DataStream, and the Global Gender Gap Indexes are obtained from the Global Gender Gap Report 2023. (World Economic Forum, 2023) Both the Compustat and BoardEx databases are obtained from Wharton Research Data Services. Unbalanced Panel data is used with 599 observations from 8 countries and 61 firms in the final sample. Observations with no data on *Total Assets, Sales, Market Value, Net Income, Ownership* and *Total Compensation* were removed.

Five datasets were downloaded: two datasets obtaining CEO characteristics from the BoardEx database, one dataset with firm characteristics from the Compustat Global database, one dataset from Workspace DataStream with the Market Values of the firms, and one dataset from the World Economic Forum with the GGGI values. After these five datasets were merged, various variables were multiplied by a thousand or a million to make sure all financial data were in the same unit. After this, the variable *Year* was created out of the *Annual Report Date* variable, which was in the merged datasets. Next, observations who did not contain "CEO" in their role name were deleted as well as observations containing "Division", "Deputy", "Regional" and "Co" in their role name. This was done to make sure there were only CEOs in the data, and that there only exists one CEO per firm per year. Thereafter, *Return On Assets (ROA)* was calculated by dividing *Net Income* by *Total Assets* and multiplying this by 100. Following, the variable *Ownership* was created by dividing *Shares CEO* by *Market Value* and multiplying this by 100. With these calculations completed, the variable *Firm Size* was created and calculated with the following formula in line with Khan & Vieito (2013):

$$\text{Firm Size Component} = 0.975 * \text{LN(Total Assets)} + 0.945 * \text{LN(Sales)} + 0.909 * \text{LN(Market Value)} \quad (1)$$

The dummy variable *Female CEO* was created by giving an observation the value 1 if the gender of the CEO is female, and value 0 if the gender of the CEO is male. After this, country and year dummies are generated and an *Age* variable is created in which the year in the *Day of Birth* variable is subtracted from the year of the observation. Then, two variables were created: the natural logarithm of *Total Compensation* and the natural logarithm of *Ownership*. Whereafter a new variable capturing the first lag of the natural logarithm of *Total Compensation* was created. Thereafter, firm dummies and the variable

GGGI were created. The *GGGI* variable contains the value of the Global Gender Gap Index that matches the country of the observation. Lastly, the interaction variable between *Female CEO* and *GGGI* was created. Tabel 1 shows an overview of the description and sources of the different variables.

Table 1: Variable description and source

Variable	Desciption	Source
Firm performance	The return on assets of a firm in percentages, calculated by dividing net income by total assets and multiplying by 100.	Compustat
Female CEO	Female CEO = 1 if the CEO of a firm is female and 0 for male.	BoardEx
Total Compensation	The sum of salary and bonus a CEO gets in a given year.	BoardEx
Firm Size	A component which indicates the size of a firm, calculated with the following formula: Firm Size = 0.975 ∗ LN(Total Assets) + 0.945 ∗ LN(Sales) + 0.909 ∗ LN(Market Value).	Compustat
Ownership	The percentage of the company's shares owned by the CEO.	BoardEx
Market Value	The value of the firm on the market, calculated by multiplying share price with the number of shares outstanding.	Workspace DataStream
Sales	Annual Sales of a firm.	Compustat
Total Assets	The total value of all assets reported on the balance sheet.	Compustat
Net Income	The net income based on a firm's consolidated statements.	Compustat
Shares CEO	Value of shares held by the CEO at the end of the reporting period based on the closing stock price of the Annual Report Date.	BoardEx
Global Gender Gap Index	Benchmarks the national gender gaps on economic, political, education- and health-based criteria.	World Economic Forum
Age	The age of a CEO.	BoardEx
TimeRole	The amount of years a CEO has been in its role.	BoardEx

3.2 Methodology

To answer the research question, a similar research method as Khan & Vieito (2013) is used. To test if CEO gender has a significant effect on firm performance, four OLS regressions are conducted. The following is estimated for the first regression:

$$FirmPerformance_{it} = \beta_0 + \beta_1 FemaleCEO_{it} + \beta_2 LN(TotalCompensation_{it-1}) + \beta_3 FirmSizeComponent_{it} + \beta_4 LN(Ownership_{it}) + \alpha_i + \sum_{k=2}^{n} \delta_k D_{kt} + \epsilon_{it} \quad (2)$$

All variables above are in line with the study of Khan & Vieito (2013). $FirmPerformance_{it}$ is the dependent variable defined as *Return on Assets*, the independent variable $FemaleCEO_{it}$ is a dummy variable that has value 1 when the CEO of the firm is a woman and zero otherwise. $Ln(TotalCompensation_{it-1})$, $FirmSize_{it}$, $Ln(Ownership_{it})$ and $\sum_{k=2}^{n} \delta_k D_{kt}$ are the control variables. $TotalCompensation_{it}$ is the sum of salary and bonus a CEO got in the given year, $FirmSize_{it}$ represents the size of the firm, based on *Total assets, Sales* and *Market Value*, $Ownership_{it}$ is the percentage of the company's shares owned by the CEO, D_{kt} are dummy variables for the different years where k represents the different years in the sample, α_i represents firm fixed effects and ϵ_{it} represents the error term. The variables are estimated over the different firms (i) and years (t),

Different than Khan & Vieito (2013), a lag for one year back is used for the natural logarithm of *Total Compensation* to prevent reversed causality. It could be the case that firm performance influences the compensation of the CEO, instead of the other way around. By lagging *Total Compensation* by one year, it is more likely that firm performance does not influence the Total Compensation variable.

After conducting this regression, a second OLS regression is conducted:

$$FirmPerformance_{it} = \beta_0 + \beta_1 FemaleCEO_{it} + \beta_2 LN(TotalCompensation_{it-1}) + \beta_3 FirmSizeComponent_{it} + \beta_4 LN(Ownership_{it}) + \alpha_i + \sum_{k=2}^{n} \delta_k D_{kt} + \sum_{j=2}^{8} \gamma_j C_{ji} + \epsilon_{it} \quad (3)$$

In this regression, the 8 different European countries are added to the regression as dummy variables C_{ji} containing the value 1 if the observation is in the given country j, and 0 otherwise. By adding countries as dummy variables, the results are controlled for possible differences between different countries, meaning that these differences will not affect the relationship between CEO gender and firm performance. Besides, there can be studied if the explanatory power of firm performance will increase after adding these dummies, and the difference in firm performance between the European countries can be analyzed.

Thereafter, a third OLS regression is conducted:

$$FirmPerformance_{it} = \beta_0 + \beta_1 FemaleCEO_{it} + \beta_2 LN(TotalCompensation_{it-1}) + \beta_3 FirmSizeComponent_{it} + \beta_4 LN(Ownership_{it}) + \sum_{k=2}^{n} \delta_k D_{kt} + \sum_{j=2}^{8} \gamma_j C_{ji} + \sum_{m=2}^{61} \theta_m F_{mi} + \epsilon_{it} \quad (4)$$

In this regression, firm fixed effects are added to the previous regression by adding firm dummy variables F_{mi} for every firm *m* that occurs in the data. A firm dummy variable contains the value 1 when the observation is from the given firm, and 0 otherwise. By adding firm fixed effect, the results are controlled for possible differences between different firms, meaning that these differences will not affect the relationship between CEO gender and firm performance. Besides, there can be studied if the explanatory power of firm performance will increase after adding these firm dummies.

Lasty, a fourth regression is conducted, estimating the following:

$$FirmPerformance_{it} = \beta_0 + \beta_1 FemaleCEO_{it} + \beta_2 GGGI_{it} + \beta_3 FemaleCEO_{it} \times GGGI + \beta_4 LN(TotalCompensation_{it-1}) + \beta_5 FirmSizeComponent_{it} + \beta_6 LN(Ownership_{it}) + \alpha_i + \sum_{k=2}^{n} \delta_k D_{kt} + \sum_{j=2}^{8} \gamma_j C_{ji} + \epsilon_{it} \quad (5)$$

In this regression, the variable *Global Gender Gap Index (GGGI)* and the interaction effects between the *GGGI* and *Female CEO* are added to the second regression. *GGGI* stands for the Global Gender Gap Index, which benchmarks the national gender gaps on economic, political, education- and health-based criteria. With this interaction effect, there can be studied if the effect of CEO gender on firm performance varies across different Global Gender Gap indexes, which will answer the second hypothesis.

These four regressions where variables are increasingly added will be conducted to see if a significant effect between CEO gender and firm performance will appear.

3.3 Summary statistics

Table 2 represents the descriptive statistics of the sample. The first thing that stands out is the very little representation of women in the sample, namely only 2.3%. These statistics are due to the facts that there are generally less female CEO in Europe. In 2019, only 4.7% of the companies on the Stoxx Europe 600 index had a female CEO. (European Women on Boards, 2020) When looking globally, only 5.8% of CEOs on the Fortune's Global 500 list were female. (Hinchliffe & Abrams, 2023) This very low percentage of females in the sample make it more difficult to find a statistically significant effect when performing an OLS regressions of CEO gender on firm performance. Biases and interpretation challenges could occur. When comparing to the empirical literature, the sample of Sun & Zou (2021), who studied CEO gender on firm performance on Chinese listed firms, contains 8.4% female CEOs, Khan & Vieito (2013), who studied CEO gender on firm performance in the S&P 1500, only have around 1.2% females in their data sample and Pimentel et al. (2020), who studied CEO gender on firm performance for European companies between 2010 and 2017, had 3.4% female CEOs in their sample.

Moreover, the minimum and maximum values of *Total Assets, Market Value, Sales, Net Income* and *SharesCEO* differ a lot, which is quite logical considering that they are al in billions of euros, the average *Market Value* is 31.2 billon euros, a CEO earns on average 2.8 million euros and owns on average 0.5% of the company shares.

La Rocca et al. (2024) only have an average *ROA* of 0.046 in their sample, but this is easily explained when observing that they define *ROA* as the ratio of earnings before interest and taxes (EBIT) to total assets, while in this study, *ROA* is calculated by dividing *Net Income* by *Total Assets* and multiplying this by 100. Pimentel et al. (2020) on the other side, have an average *ROA* of 69.08, which they also measure in another way. Pimentel et al. (2020) use the control variable *Firm Size* as well, but they calculate this by taking the natural logarithm of *Total Assets*, instead of using formula 1.

Table 2: Descriptive statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Obs.	Mean	Std. Dev.	Min	Max
ROA	599	4.15	4.08	-21.61	18.31
FemaleCEO	599	0.023	0.15	0	1
GGGI	599	0.78	0.05	0.70	0.91
TotalCompensation	599	2.77e+6	1.56e+6	2000	10.15e+6
FirmSize	599	67.19	2.79	58.05	72.71
Ownership	599	0.49	3.05	5.52e-06	48.90
Age	522	57.40	6.70	34	75
Total Assets	599	43.94e+9	42.32e+9	0.71e+9	235.49e+9
Market Value	599	31.20e+9	35.48e+9	0.70e+9	339.80e+9
Sales	599	27.43e+9	28.55e+9	0.96e+9	189.54e+9
Net Income	599	1.60e+9	2.43e+9	-8.64e+9	18.60e+9
SharesCEO	599	51.06e+6	0.17e+9	1000	1.84e+9

The table reports descriptive statistics for continuous and dummy variables used in the empirical analysis. All financial data is in euros.

Table 3 shows the statistical differences between male and female CEOs. These mean differences are compared using t-tests. A t-test is a method which can determine if there exists a significant difference between the means of two groups. It takes the variability and sample size of each group into account when producing a t-value, which is then compared with a critical value to determine if the difference between the means of the two groups are statistically significant. The t-statistic is shown in the fifth column of Table 3 and the stars behind these values correspond to a significance level of 10% for one star, 5% for two stars and 1% for three stars. If the t-statistic contains at least one star, the null hypothesis of no difference between the means of the two groups can be rejected an the alternative hypothesis stating that the two means are different can be adopted.

Table 3 shows a significant difference between male and female CEOs regarding *Age, Time in Role, Total Compensations* and *Net Income*. On average, male CEOs are 57

years old whereas female CEOs are 51 years old, which is a significant difference of 6 years. Khan & Vieito (2013) display similar statistics, the female CEOs in their dataset are on average 53 years old whereas the male CEOs are 58 years old, which represents a significant difference of 5 years.

Moreover, male CEOs in the sample appear to be much longer in their role as CEO compared to their female competitors, 7 years versus 3 years, which gives a significant difference of 4 years. In the data sample of Khan & Vieito (20123), there is no significant difference between females in males when it comes the time spend in their role as CEO. Female CEOs have been in their role for 12.5 years on average, compared to 13.7 years for the male CEOs.

Furthermore, male CEOs obtain a lot more compensation for their work compared to female CEOs. Male CEOs obtain on average 2.8 million dollars, where female CEOs receive 1.7 million dollars. This might have been reasonable if women worked at smaller firms, but Table 3 shows no significant difference between the size of the firm female and male CEOs in the sample work at. However the net income of companies with female CEOs, which is 0.5 billion euros, is statistically lower than the net income of companies with male CEOs, which is 1.6 billion euros. Khan & Vieito (2013) did not test the difference in *Total Compensation* between male and female CEOs, but they did find a significant difference between the amount of company shares male and female CEOs own. With 8.96% versus 5.15%, the female CEOs on average own a bigger share of the company they work at. Khan & Vieito (2013) also found a significant difference in the size of the firms male and female CEOs lead. In their study, on average, male CEOs lead bigger firms with a mean of 20.0 compared to 18.2 for female CEOs.

Table 3: Male vs. Female CEOs

	Female CEOs		Male CEOs		*T* test-mean difference
Variables	Obs.	Mean	Obs.	Mean	
ROA	14	3.47	585	4.16	0.62
Age	8	51.88	514	57.49	2.36**
Time in Role	14	2.99	585	7.04	2.23**
Total Compensation	14	1,73e+6	585	2,79e+6	2.54**
Owership	14	0.05	585	0.50	0.55
Shares of CEO	14	2.21e+6	585	52.2e+6	1.12
Firm Size	14	66.54	585	67.21	0.89
Sales	14	34.0e+9	585	27.3e+9	-0.88
Net Income	14	.46e+9	585	1.63e+9	1.78*

Age is the age of the CEO, Time in Role is the time the CEO is in that role in years, Total Compensation is the salary plus bonus the CEO receives per year in 1000 dollars, Shares of CEO are the total value of the company shares the CEO owns, Firm size represents the size of the firm, based on Total assets, Sales and Market Value, and Sales and Net Income are in millions of dollars.
Statistically significant at 1% level ***, 5% level ** and 10% level *.

Figure 1 to 3 show the mean of firm performance, measured as Return on Assets, over time. Figure 1 shows the mean of firm performance for the complete dataset. Table 2 shows an average ROA of 4.15, which can also be seen in Figure 1. In 2008 and 2020 there are large dips in Return on assets, probably corresponding to the global financial crisis between 2007-2009 and Covid-19 which started in 2019.

Figure 2 displays the mean value of firm performance over time for companies with a female CEO. According to Table 3, the average ROA for companies with a female CEO is 3.47, which also corresponds to what is shown in Figure 2. This figure shows a large peak in ROA in 2016 and dips for 2018 and 2022. These inexplicable variations might be due to the very low amount of women in the sample.

Figure 3 shows the mean value of firm performance over time for companies with a male CEO. Because almost all companies in the sample have male CEOs, namely 97.7%, this graph looks exactly like Figure 1 which displayed the mean of ROA for the complete dataset. The mean of ROA for companies with a male CEO is 4.16 according to Table 2, which is almost exactly the same as the average of 4.16 for the whole sample.

Figure 1: The mean value of firm performance over time

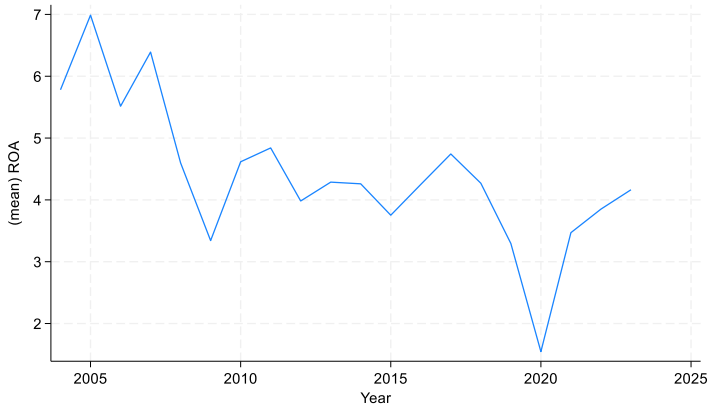


Figure 2: The mean value of firm performance over time for female CEOs

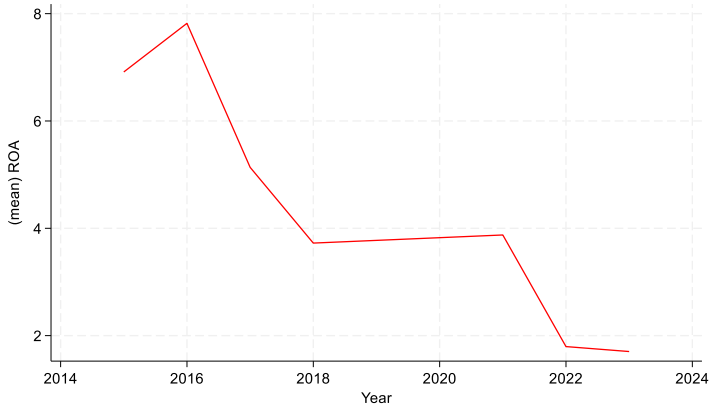
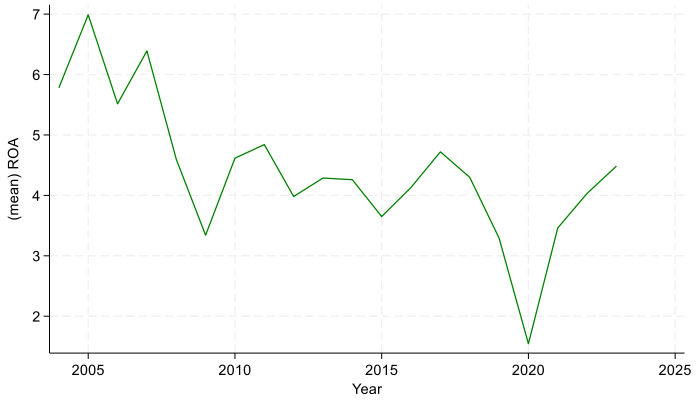


Figure 3: The mean value of firm performance over time for male CEOs



3.4 Statistical assumptions

For an Ordinary Least Squares (OLS) regression to provide valid estimates, several assumptions have to be met. The first assumption is linearity, which states that the relationship between the independent variable and de dependent variable has to be linear. To test this, the residuals can be plotted against the fitted values. If the residuals are randomly scattered and show no pattern, the assumption is satisfied. Figure 4 shows randomly scattered residuals, which means the assumption of linearity is satisfied for the sample.

The second assumption for an OLS model is that the observations should be independent of each other, which means that no correlation between the residuals of different observations is allowed. Because panel data is used, residuals should also not be correlated with their own lagged values, in other words, there should be no autocorrelation, which is a third assumption. To address these potential problems, robust standard error are used when performing the four regressions. Robust standard errors can address violations in normality, heteroskedasticity and autocorrelation.

The fourth assumption for an OLS model is homoscedasticity, meaning that the variance of the error term has to be constant across all levels of the independent variables. If the residuals plotted against the fitted values show a constant spread around zero, the assumption is satisfied. In Figure 4, one can observe that the fitted values are indeed spread constantly around the zero line, which means that the assumption of homoskedasticity is satisfied.

The fifth assumption is the one of no perfect multicollinearity, which means that the independent variables should not be perfectly correlated with each other. Correlation between independent variables occurs when independent variables are linear combinations of each other. To find out if the assumption holds, the Variance Inflation Factor (VIF) can be checked for all independent variables. A VIF below 5 indicates a low multicollinearity and is generally considered acceptable. When testing all independent variables, the interaction effect between Female CEO and GGGI has a very high VIF due to the correlation with GGGI. Furthermore, some country, firm and year dummies have a VIF above 5. To address this problem, GGGI and the dummy variables with high correlation, will be omitted when performing the regressions.

The sixth assumption for an Ordinary Least Squares model is the normality of the residuals. The residuals should be normally distributed. In Figure 5, the distribution of the residuals is displayed. The residuals are somewhat normally distributed, but certainly not perfectly. When performing the Shapiro–Wilk test, a p-value smaller than 0.05 appears, indicating that the assumption of normality is violated. To address this problem, robust standard error are used.

The last assumption assumes that the mean of the residuals is zero. The mean of the residuals in this study is 1.06e-08 which is nearly 0, so the assumption is satisfied.

Figure 4: Residuals plotted against the fitted values

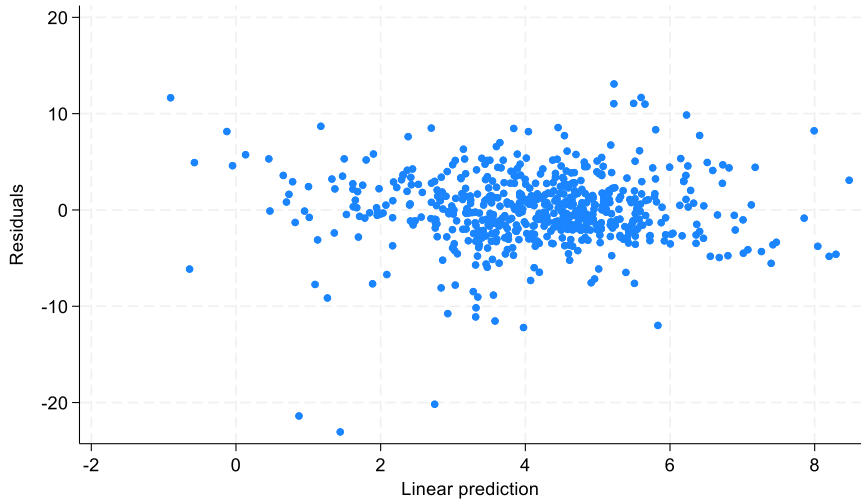
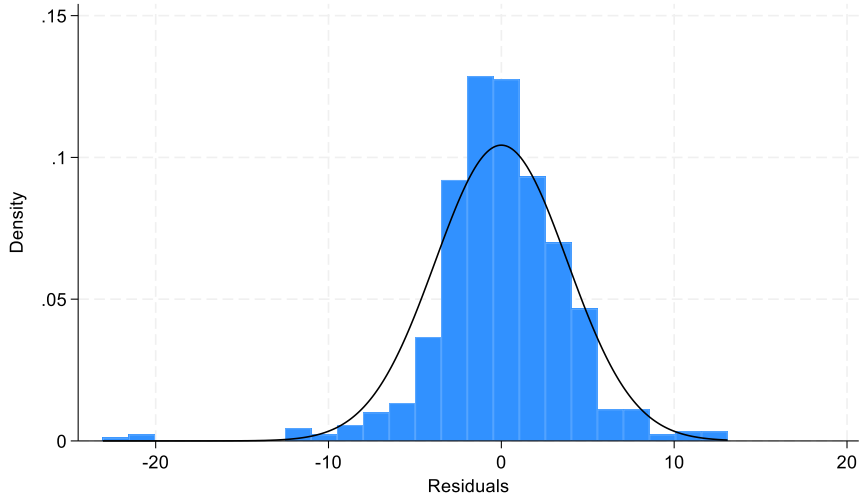


Figure 5: The distribution of the residuals



4. Results

4.1 Hypothesis 1

4.1.1 Base regression

Earlier in this paper, two alternative hypotheses were presented. The first hypothesis was: *Firms managed by female CEOs, on average, perform better than firms managed by male CEOs.* To test whether this alternative hypothesis can be accepted and the corresponding null hypothesis of no difference can be rejected, three regressions were conducted. Table 4 shows the main results of these regressions. In the first column, the first regression is shown, where the effect of CEO gender is tested on *ROA* with the first lag of the natural logarithm of *Total Compensation, Firm size,* the natural logarithm of *Ownership* and year dummies as control variables.

For every variable, a coefficient and standard error are given. A coefficient expresses the predicted change in the dependent variable for a one-unit change in the independent variable, while holding all other variables constant. A larger coefficient therefore means a bigger impact on the dependent variable if the independent variable changes by one unit. When a independent or control variable is in the form of a natural logarithm and the dependent variable is not, the coefficient of the control variable is interpreted as the unit change of the dependent variable associated with a 1% change in the independent variable. So when the control variable in the natural logarithm increases with 1%, the dependent variable increases in units with the value of the coefficient. This relationship reflects the elasticity of the dependent variable with respect to the independent variable, showing how sensitive the dependent variable is to relative changes in the independent variable. When interpreting the coefficient of a dummy variable, the coefficient represents the average difference in the dependent variable between the group represented by the dummy variable and the reference group, holding all other variables constant. So the dependent variable is expected to increase in units with the value of the coefficient for the group with the dummy characteristic, compared to the reference group.

A positive coefficient indicated a direct relationship where the dependent variable increases if the corresponding independent variables increases and vice versa, while a negative coefficient expresses an inverse relationship where the dependent variable decreases if the independent variable increases and the other way around. The variable *Female CEO,* indicating whether the CEO is female, has a positive coefficient of 0.203, indicating an average increase of 0.203% in ROA if the CEO of the company is female compared to the CEO being a male.

The standard error in Ordinary Least Squares (OLS) regressions indicates how much the sample mean varies form the true population parameter. It expresses how precise the sample estimate is by measuring the variability of an estimated coefficient. The standard error gives the value that the coefficient estimate typically would differ from the true coefficient. The standard error of *Female CEO,* as shown in Table 4, is 1.290, which means that the coefficient estimate would typically differ by about 1.290 units from the true coefficient.

To determine if the coefficient is statistically significantly different form zero, the t-test is performed by subtracting the estimated coefficient by the coefficient of the null hypothesis (which usually is zero), and dividing this by its standard error. The t-statistic shows how many standard errors away the coefficient estimate is from the value under the null hypothesis. A larger value of the t-statistic means that the coefficient is further away from the value of the null hypothesis, which indicates that is it more likely that the coefficient is statistically significant. So a large standard error makes it less likely that the estimated coefficient will be statistically significant.

From the t-statistic, the p-value is derived. The p-value illustrates the probability of observing a t-statistic as extreme or more extreme than the calculated value under the null hypothesis. A very small p-value indicates strong evidence against the null hypothesis. The threshold for determining whether the p-value is small enough to reject the null hypothesis, is the significance level. If the p-value is less than or equal to the significance level, the results are statistically significant, which means that the null hypothesis can be rejected. The stars behind the standard errors in Tabel 4 correspond to a significance level of 10% for one star, 5% for two stars and 1% for three stars. A result being significant on a certain level, for example on a 5% significance level, thus indicates that there is a probability of less than 5% that the result occurred by random chance alone. Such a significance level provides evidence that the result observed is statistically significant, meaning that the null hypothesis can be rejected and the alternative hypothesis adopted. There are no stars present behind the coefficient of *Female CEO*, meaning that the p-value of this variable is larger than 0.10 and that it does not have a significance level of 10% or lower. This indicates that there is not enough evidence to reject the null hypothesis and adopt the alternative hypothesis.

When looking at the control variables of the first regression in the first column of Table 4, one can observe that the first lag of the natural logarithm of *Total Compensation* has a positive coefficient of 0.841 with three stars, and a standard error of 0.251. If the *Total Compensation* of the previous year increases with 1%, *Return on Assets*, so firm performance, increases by 0.841%, due to the natural logarithm, and the coefficient estimate would typically differ by about 0.251 units from the true coefficient. The three stars indicate that the coefficient is significant on a 1% significance level which means that the null hypothesis of no influence on firm performance is rejected, and the alternative hypothesis of influence on firm performance is adopted. This means that one can say with statistical significance that firm performance increases with 0.841% when the *Total Compensation* a CEO received in the previous year increases by 1%.

The variable *Firm Size* has a positive coefficient of 0.119 without any stars, and a standard error of 0.0842. This means that *Return on Assets* increases by 0.119% if the *Firm Size* increases by one unit. However, the coefficient is not significant on a 10% significance level which means that the null hypothesis of no influence on firm performance cannot be rejected. The effect on firm performance cannot be assumed with statistical significance.

The natural logarithm of *Ownership* has a coefficient of 0.324 on a 1% significance level and a standard error of 0.0809. Because the coefficient is significant, the null

hypothesis of no influence on firm performance can be rejected and we can assume with statistical significance that *Return on Assets* increases with 0.324% if the percentage of company shares owned by the CEO increases with 1%.

The constant term in the first regression is -12.95 with a standard error of 5.822. The constant term, or intercept, represents the expected value of the dependent variable when all independent variables are equal to zero. It can be seen as the baseline level of the dependent variable before the influence of the independent variables. The constant term is significant on a 1% significance level, which means that the expected value of the dependent variable is statistically different from zero when all independent variables are zero.

The R-squared of an OLS regression measures the proportion of the variance in the dependent variable that is predictable form the independent variables. The R-squared of 0.122 in the first regression means that 12.2% of the variance in firm performance is explained by the regression model. R-squared can also be seen as an indicator of the explanatory power of the regression model. Which means that a higher R-squared indicates that the model is better in capturing the variance in the dependent variable.

In conclusion, when looking at the first regression, the coefficient of *Female CEO* is not significant, meaning that the null hypothesis of the gender of the CEO having no influence on firm performance cannot be rejected. In other words, firms managed by female CEOs, on average, do not necessarily perform better than firms managed by male CEOs. The coefficients of the control variables *Total Compensation* and *Ownership* are both positive and significant, indicating that both variables have a positive influence on the variation in firm performance.

4.1.2 Regression with country fixed effects

In the second regression, corresponding to the second column of Table 4, country fixed effects in the form of country dummies are added to the regression. By adding countries as dummy variables, the results are controlled for possible differences between different countries, meaning that these differences will not affect the relationship between CEO gender and firm performance. The countries represented in the sample are: Luxembourg, Finland, France, Germany, Italy, the Netherlands, Ireland and Spain. The country dummy for Luxembourg is left out to function as the reference country.

One can see that the coefficients of the variables changed compared to the first regression. *Female CEO* has a coefficient of -0.835, indicating a decrease of 0.835% in ROA when the CEO of a firm is female compared to male. However, the coefficient is not significant on a 10% or lower significance level, meaning that the null hypothesis of the gender of the CEO having no influence on firm performance cannot be rejected.

Nevertheless, *Total Compensation, Firm Size* and *Ownership* all have positive coefficients and are all significant on a 1% significance level with corresponding coefficients 1.120, 0.266 and 0.240. Indicating that all three of these variables have a positive influence on the variation in firm performance, statistically speaking.

When looking at the country dummies, France, Germany, Italy, the Netherlands and Spain all have negative and significant coefficients, meaning that the firms in the sample located in these five countries on average have a lower *Return on Assets* compared to Luxembourg. Ireland and Finland also both have a negative coefficient, but these coefficient are not significant, meaning that the null hypothesis of no difference in *ROA* compared to Luxembourg cannot be rejected.

The constant term in the second regression has a significant value of -22.83, which is the expected value of *ROA* when all independent variables are equal to zero. The R-squared is 0.216, which indicates that 21.6% of the variance in firm performance is explained by the regression model. This is an increase of 9.4% compared to the first regression. Which means that the second regression model has a better explanatory power.

In conclusion, when looking at the second regression, the coefficient of *Female CEO* is not significant, meaning that the null hypothesis of the gender of the CEO having no influence on firm performance cannot be rejected. In other words, firms managed by female CEOs, on average, do not necessarily perform better than firms managed by male CEOs. The coefficients of the control variables *Total Compensation*, *Firm Size* and *Ownership* are all positive and significant, indicating that these variables have a positive influence on the variation in firm performance. The default country Luxembourg seems to have a higher average ROA then five of the seven other countries, and the explanatory power of the regression increased with 9.4% compared to the first regression.

4.1.3 Regression with country and firm fixed effects

In the third regression, corresponding to the third column of Table 4, firm fixed effects in the form of firm dummies are added to the regression. By adding firm fixed effect, the results are controlled for possible differences between different firms, meaning that these differences will not affect the relationship between CEO gender and firm performance.

Female CEO has a coefficient of -0.304, indicating a decrease of 0.304% in ROA when the CEO of a firm is female compared to male. However, the coefficient is not significant on a 10% or lower significance level, meaning that the null hypothesis of the gender of the CEO having no influence on firm performance cannot be rejected.

Firm Size and *Ownership* both have positive coefficients and are significant on a 1% significance level with corresponding coefficients 0.741 and 0.233. Indicating that these control variables have a statistically positive influence on the variation in firm performance.

Same as in the second regression, France, Germany, Italy, the Netherlands and Spain all have negative and significant coefficients, meaning that the firms located in these five countries on average have a lower *Return on Assets* compared to Luxembourg. The coefficients of Ireland and Finland again are not significant.

The constant term has a significant value of -38.51, which is the expected value of *ROA* when all independent variables are equal to zero. The R-squared is 0.585, which

indicates that 58.5% of the variance in firm performance is explained by the regression model. This is an increase of 36.9% compared to the first regression, and the highest R-squared yet. Which means that this regression model has the better explanatory power so far.

In conclusion, the coefficient of *Female CEO* is not significant, meaning that the null hypothesis of the gender of the CEO having no influence on firm performance cannot be rejected. So, firms managed by female CEOs, on average, do not necessarily perform better than firms managed by male CEOs. The coefficients of the control variables *Firm Size* and *Ownership* are positive and significant, indicating that these variables have a positive influence on the variation in firm performance. The default country Luxembourg seems to again have a higher average ROA then five of the seven other countries, and the explanatory power of the regression increased with 36.9% compared to the second regression, and has the highest explanatory power of the regressions so far with 58.5%.

Table 4: Main results

ROA	(1) Firm Performance	(2) Firm Performance	(3) Firm performance	(4) Firm performance
Female CEO	0.203	-0.835	-0.304	-23.54***
	(0.940)	(0.814)	(0.964)	(6.242)
Global Gender Gap Index (GGGI)				-
Female CEO x GGGI				27.62***
				(7.509)
Ln(TotalCompensation)_Lag1	0.841***	1.120***	0.197	1.080***
	(0.251)	(0.292)	(0.291)	(0.294)
Firm Size	0.119	0.266***	0.741***	0.284***
	(0.0842)	(0.101)	(0.207)	(0.101)
Ln(Ownership)	0.324***	0.240***	0.233**	0.237***
	(0.0809)	(0.0794)	0.197	(0.0794)
Finland		-0.0622	-	-0.0413
		(2.716)		(2.750)
France		-5.000***	-6.198***	-4.896***
		(1.764)	(1.860)	(1.814)
Germany		-9.015***	-7.438***	-8.950***
		(2.452)	(2.263)	(2.485)
Italy		-7.706***	-5.853*	-7.670***
		(1.922)	(3.297)	(1.967)
Netherlands		-4.778***	-4.080*	-4.735***
		(1.763)	(2.208)	(1.813)
Ireland		-1.830	1.045	-1.945
		(1.812)	(2.328)	(1.863)
Spain		-4.226**	-5.180***	-4.213**
		(1.836)	(1.834)	(1.885)
Year dummies	YES	YES	YES	YES
Firm dummies			YES	
Constant	-12.95**	-22.83***	-38.51***	-23.51***
	(5.822)	(6.594)	(12.87)	(6.615)
Observations	599	599	599	599

R-squared	0.122	0.216	0.585	0.222

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2 Hypothesis 2

The second hypothesis of this study stated: *The effect of CEO gender on firm performance is higher in countries with more gender equality*. To test whether this alternative hypothesis can be accepted and the corresponding null hypothesis of no effect of GGGI on firm performance when the CEO of a firm is female can be rejected, a fourth regression was conducted where the *Global Gender Gap Index (GGGI)* and the interaction effect between the *Female CEO* and *GGGI* were added to the second regression. *GGGI* benchmarks the national gender gaps on economic, political, education- and health-based criteria.

Female CEO has a significant and negative coefficient of -23.54. The coefficient is significant on a 1% significance level, which indicates that the *Return on Assets* decrease with 23.54% when the CEO of the firm is a female compared to a male at a significance level of 1%. This means that the null hypothesis stating that the gender of the CEO has no influence on firm performance can be rejected, and the alternative hypothesis stating that the firm performance is lower when the CEO of the firm is female, can be adopted.

The variable *GGGI* is omitted because of multicollinearity. Which means that GGGI is highly collinear with other variables in the model, most likely with the interaction effect between *Female CEO* and *GGGI*. This high correlation threatens the ability to estimate its unique contribution to firm performance. That is why the regression model excludes *GGGI* to ensure the stability of the estimates of the other variables. This exclusion makes it possible for the model to focus on the interaction term and other variables which do not have collinearity issues.

The interaction term *Female CEO x GGGI* has a positive coefficient with the value 27.62, which is significant on a 1% significance level. This means that for each unit increase in *GGGI*, the negative effect of having a female CEO on firm performance is reduced by 27.62%, and eventually reversed. This finding supports the second hypothesis and implies that in countries with higher gender equality firms with female CEOs have significantly better performance compared to those in countries with lower gender equality. The relation also works the other way around, being that in more gender-equal countries, the performance of firms with female CEOs improves relative to those with male CEOs.

Total Compensation, Firm Size and *Ownership* all have positive coefficients and are all significant on a 1% significance level with corresponding coefficients 1.080, 0.284 and 0.237. Indicating that all three of these variables have a positive influence on the variation in firm performance, statistically speaking.

Again France, Germany, Italy, the Netherlands and Spain all have negative and significant coefficients, meaning that the firms located in these five countries on average have a lower *Return on Assets* compared to Luxembourg. The coefficients of Ireland and Finland again are not significant.

The constant term has a significant value of -23.51, which is the expected value of *ROA* when all independent variables are equal to zero. The R-squared is 0.222, which indicates that 22.2% of the variance in firm performance is explained by the regression model. This is a higher R-squared compared to the first and second regression, but lower compared to the third regression.

In conclusion, the positive and significant coefficient of the interaction effect supports the second hypothesis which states that the effect of CEO gender on firm performance is higher in countries with more gender equality. The coefficients of the control variables *Total Compensation*, *Firm Size* and *Ownership* are positive and significant, indicating that these variables have a positive influence on the variation in firm performance. The default country Luxembourg seems to again have a higher average ROA then five of the seven other countries, and the explanatory power of the regression is higher compared to the first and second regression, but lower compared to the third regression.

4.3 Comparison with empirical literature

When comparing the results above with the empirical literature available on the effect of CEO gender on firm performance, differences as well as similarities can be observed. Same as in the study of Pimentel et al. (2020), who studied the effect of the CEO of a firm being female on firm performance, measured as ROA and Tobin's Q, in Europe between 2010 and 2017 also using the OLS method, no significant effect was found between CEO gender and ROA. Similar results were found despite the fact that Pimentel et al. (2020) used completely different control variables, being: board size, the percentage of independent board members, a dummy whether the CEO is on the board, the percentage of board members with a specific or business study, the percentage of female managers in the company, the percentage of female workers in the company, the debt ration of the company, firm size and a location dummy as control variables, whereas this study used the natural logarithm of the total compensation a CEO receives in the previous year, firm size, the natural logarithm of the percentage of company shares owned by the CEO, year dummies, country dummies and firm dummies. These two similar results, researched with different variables, indicate that there is no effect of CEO gender on firm performance in Europe.

This study followed the same method and used nearly the same control variables as the study of Khan & Vieito (2013), but found clashing results. Khan & Vieito (2013) studied the effect of CEO gender on firm performance in the United States, using the firms on the S&P 1500 in the years 1992 to 2004, and found a positive effect between the CEO of a company being female and firm performance measured as ROA. The opposing results between the study of Khan & Vieito (2013) and this study indicates that US firms differ from European firms when it comes to the effect of CEO gender on firm performance, with US firms displaying a positive effect on firm performance when the CEO of a company is female, and Europe having no such effect.

The results in this paper also oppose the results found by Sun & Zou (2021), who studied the effect of CEO gender on firm performance on Chinese listed

firms between 2002 and 2018. Sun & Zou (2021) performed several OLS regressions with different measures for firm performance, being: gross profit margin, gross profit margin for primary business, net profit margin, net profit margin for primary business, gross investment return and investment return adjusted by the risk-free interest rate. In every regression, the gender dummy variable had a positive and significant effect. The contrasting results between the study of Sun & Zou (2021) and this study indicate that Chinese firms differ from European firms when it comes to the effect of CEO gender on firm performance, with Chinese firms showing a positive effect on firm performance when the CEO of a company is female, and Europe having no such effect.

La Rocca et al. (2024) studied gender dimensions between CEO duality and firm performance in Europe between 2014 and 2020 using the OLS method. Their measure for firm performance is also ROA. They conducted multiple tests and regressions and found that when a woman holds both the role of CEO and board chair, this had a positive effect on firm performance. This result opposes the results found in this study which indicate a difference between the effect of females in CEO duality on firm performance and the effect of the CEO of a firm being female on firm performance in general in Europe, with a positive effect on firm performance for females in CEO duality, and no effect on firm performance in general for female CEOs.

The fourth regression of this study finds that the effect of a CEO being female on firm performance is higher in countries with more gender equality. This result could be due to the increasing economic growth of a country when the gender gaps in that country are reduced, as Klasen (2018) remarks. A higher Global Gender Gap Index, indicating a smaller gender gap, signals more economic growth, in which females possibly have more opportunities to use their skills and suffer less from discrimination.

La Rocca et al. (2024) used the Gender Parity Index variable in their study, which contains the ratio of women to men enrolled at tertiary level in public and private schools. They eventually find a negative but not significant effect for the Gender Parity Index in their regressions, indicating that there was no additional effect of females in CEO duality on firm performance when the ratio of women enrolled at tertiary level in public and private schools rises. This finding contradicts the result of this study, where the effect of a CEO being female on firm performance is higher in countries with a higher GGGI, which includes educational factors.

5. Conclusion and discussion

5.1 Conclusion

In this paper, the effect of CEO gender on firm performance in Europe is studied using companies from the Stoxx Europe 600 index from 2003 until 2023, in an attempt to answer the first research question: *Does CEO gender has a significant effect on firm performance in Europe?* In addition, a corresponding first alternative hypothesis is proposed: *Firms managed by female CEOs, on average, perform better than firms managed by male CEOs.* In order to answer this research question and corresponding

hypothesis, the Ordinary Least Squares method (OLS) method is used on a sample with unbalanced panel data containing 61 firms and 8 different European countries. Three regressions were conducted with firm performance measured as ROA as dependent variable, a dummy variable indicating if the CEO of the company is female as independent variable and the natural logarithm of the total compensation a CEO received in the previous year, firm size, the natural logarithm of the percentage company shares the CEO owns, year dummies, country dummies and firm dummies as control variables. In two of the three regressions, the dummy indicating if the CEO is female had a slightly negative effect and one regression showed a slightly positive effect. However, in all three regressions the gender dummy did not show a significant effect, which means that the null hypothesis stating no difference of CEO gender on firm performance cannot be rejected, and the first alternative hypothesis cannot be adopted. To answer the first research question: CEO gender does not seem to have a significant effect on firm performance in Europe.

This result is similar to the findings of Pimentel et al. (2020) who studied the same effect in Europe, using different control variables. However, this result opposes the studies of Khan & Vieito (2013), who studied the same effect in the US, Sun & Zou (2021), who studied the same effect in China and La Rocca et al. (2024), who studied the effect of gender on CEO duality on firm performance in Europe. Comparing the findings of La Rocca et al. (2024) with the results of this study, indicates a difference between the effect of females in CEO duality on firm performance and the effect of the CEO of a firm being female on firm performance in general in Europe, with a positive effect on firm performance for females in CEO duality, and no effect on firm performance in general for female CEOs. Comparing the studies of Pimentel et al. (2020), Khan & Vieito (2013) and Sun & Zou (2021) with the findings of this study, results in the assumption that US and Chinese firms differ from European firms when it comes to the effect of CEO gender on firm performance, with US and Chinese firms showing a positive effect on firm performance when the CEO of a company is female, and no such effect for European firms.

Additionally, a second research question is asked: *Does the effect of CEO gender on firm performance varies across different Global Gender Gap indexes?* The corresponding alternative hypothesis proposed is: *The effect of CEO gender on firm performance is higher in countries with more gender equality.* This research question is attempted to be answered by conducting a fourth regression where the Global Gender Gap Index (GGGI) and an interaction effect between the gender dummy and GGGI are added. The GGGI variable is omitted due to multicollinearity issues, but the interaction effect is positive and significant. Which means that the null hypothesis of no difference between CEO gender and firm performance for different Global Gender Gap indexes is rejected and the alternative hypothesis is adopted. The result suggests that the effect of a CEO being a female on firm performance is higher in countries with more gender equality.

This opposes the findings of La Rocca et al. (2024) who used the Gender Parity Index variable in their study, which contains the ratio of women to men enrolled at tertiary level in public and private schools and found a negative but not significant effect

for the Gender Parity Index, indicating that there was no additional effect of females in CEO duality on firm performance when the ratio of women enrolled at tertiary level in public and private schools rises.
The positive effect found could be related to the remarks of Klasen (2018). Klasen (2018) appoints the increasing economic growth of a country when the gender gaps in that country are reduced. A higher Global Gender Gap Index, indicating a smaller gender gap, signals more economic growth, in which females possibly have more opportunities to use their skills and suffer less from discrimination.

5.2 Discussion & limitations

A thread to the validity of this study could be that in the sample, only 2.3% of the CEOs were women. Although, this percentage comes close to the ones in similar studies and the 4.7% of female CEO's on the Stoxx Europe 600 index in 2019. (European Women on Boards, 2020) When looking globally, only 5.8% of CEOs on the Fortune's Global 500 list were female. (Hinchliffe & Abrams, 2023) Besides, the sample size in this study is very small, with only 599 observations across 61 firms and 8 European countries. This very low percentage of females and small sample size could cause biases and interpretation challenges.

Moreover, it could be that selection bias altered the results, while women are not randomly selected, but chosen by stakeholders or the board. Besides, it is possible that other factors which play more critical roles in influencing firm performance, were omitted. Further research is needed to study these possible omitted factors.

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