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The relationship between CEO compensation and firm performance and the role of economic crises

Abstract:

This study investigates the relationship between CEO compensation and firm performance. Additionally, this study focuses on the described relationship in terms of economic crises, specifically the 2008 financial crisis and the COVID-19 crisis. A sample from the S&P500 is analyzed over the period 2006-2023. Therefore, this study provides both a robust analysis over multiple years and a more current look at the relationship between CEO compensation and firm performance. The inclusion of economic crises in this framework provides additional knowledge on how uncertainty and economic downturns affect this relationship. The findings show that there is a positive significant relationship between CEO compensation and firm performance, accounting for different observables as control variables. Also, incentive-aligning variable compensation is found to have a statistically significant relationship to firm performance. This is in line with existing theory regarding incentive alignment and the principal-agent theory. Furthermore, the findings do not show that the relationship between CEO compensation and firm performance is stronger post-crisis compared to pre-crisis in regard of the COVID-19 crisis. Finally, the relative impact of the 2008 financial crisis does not show any statistical difference from the way the COVID-19 crisis affected the relationship between CEO compensation and firm performance.

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1. Introduction

The relationship between CEO compensation and firm performance has long been of interest in economic literature. The 1980s marked the beginning of academic work on this relationship because of contributions in regard of the development of the agency theory (Jensen & Meckling, 1976), which explores conflicts of interest between, in this context, a firm's shareholders and managers. Because a CEO is the firm's highest ranking executive officer, this person is particularly interesting for investigating the agency theory. The early 2000s put emphasis on the relationship between CEO compensation and firm performance, in specific with regard to the agency theory (Bebchuk & Fried, 2004) and the alignment of interests (e.g., because of the corporate scandals that occurred at Enron and WorldCom[1]). Furthermore, the global financial crisis of 2008 proved again the importance of strategic corporate governance structures, also with regard to compensation practices. This lead to extensive research on how compensation practices could contribute to corporate risk-taking behavior and financial instability, the consequences of which were felt around the world (Yang et al., 2014). More recently, the economic crisis that followed from the COVID-19 pandemic instigated new research relating to this topic (Morrison et al., 2024; Carter et al., 2024; Khatib & Nour, 2021). Economic crises can have, and have previously demonstrated to have, a significant importance for economic stability, corporate governance structures, shareholder value and organizational performance. Therefore it is especially interesting to further investigate the relationship between CEO compensation and firm performance in light of economic crises. CEO compensation is not composed of only a base salary that reflects a CEO's individual performance. In fact, compensation packages can be a strategic tool used by firms to align the incentives of both its shareholders and high-ranking executives.

For this research, data from publicly listed firms in the S&P500 is analyzed for the years 2006-2023, therefore contributing to existing literature in various ways. Firstly, by estimating the relationship between CEO compensation and firm performance using data from 2006-2023, a large sample size is created through which the research can be conducted. This leads to robust estimates. Then this relationship is estimated only for the post-COVID year, to see whether these are in line with the robust model. Former research has been focused on years prior to the COVID-19 crisis. This enables us to do two things, one being the inclusion of more recent years in this research compared to existing literature. The other is that the impact of the COVID-19 crisis on the relationship between CEO compensation and firm performance can be investigated. Furthermore, this enables us to compare the impact of both the COVID-19 crisis and the financial crisis of 2008, by comparing pre- and post-crisis differences in the relationship of interest. This has not been included in a similar research framework before, and can provide important implications for attaining incentive alignment

[1] Enron and WorldCom were two of the largest corporate scandals in the early 2000s, involving significant financial fraud and leading to the collapse of both companies. These scandals highlighted the misalignment of interests and irresponsible corporate behavior, underscoring the need for better alignment between CEO and shareholder interests to mitigate such risks.

between a firm's shareholders and the CEO through corporate governance practices. These crises are particularly relevant because of their respective impact and recency. These economic crises have impacted societies and firms all around the globe. Understanding the dynamics of CEO compensation is important for improving corporate governance practices. Especially in the context of economic crises it is vital to understand the role of CEO compensation in the dynamics between shareholder and executive incentives.

Altogether, this research investigates primarily how CEO compensation relates to firm performance. Given the additional focus on how fixed and variable compensation relate to firm performance, implications can be derived which can be used for aligning interests of a CEO and a firm's shareholders, helping firms to stabilize through long-term CEO incentives in times of economic uncertainty. Finally, this research examines how economic crises impact the relationship between CEO compensation and firm performance. From this, we can get a better understanding of how crises affect the dynamic between CEO compensation and firm performance. Additionally, we can get a better understanding of whether these observable differences are temporary or permanent. By including economic crises in the research context, an additional layer of social and scientific relevance is attained. We expect CEO compensation to be positively related to firm performance because of increased external, financial motivation for the highest ranking executive officer in a firm. Because variable incentives are more long-term focused, it is expected that to some extent, the incentives of the firm's shareholders and the CEO are aligned, which decreases risks associated with the principal-agent problem, i.e. moral hazard. Finally, this research aims to investigate whether pre- and post-crisis differences exist in the relationship between CEO compensation and firm performance. The main research question is described below. Four sub-questions have been formulated to help answer the main research question. These are also described below.

How does CEO compensation relate to firm performance, how does this differ before and after the COVID pandemic, and how is this relationship affected by crises in general?

1) *How do CEO compensation incentives and organizational performance of firms align in the post-COVID era?*
2) *What compensation structures can enhance the alignment of CEO and firm incentives?*
3) *How does the relationship between CEO compensation and firm performance differ after the COVID pandemic compared to before the pandemic?*
4) *Did the COVID crisis affect the relationship between CEO compensation and firm performance the same as the global financial crisis of 2008?*

This paper is structured as follows: first a discussion will follow on existing literature, setting the theoretical framework for this study by means of a literature review. Apart from setting the theoretical

framework, the discussion of existing literature builds towards the introduction of the hypotheses. These support the sub-questions through which the main research question will be answered. Next, the data and methodology of this study will be discussed, after which the results will be presented. Finally, in the conclusion we come to a final recapitulation of the main findings of this study and their implications, as well as a discussion of the most relevant limitations and suggestions for future work.

2. Literature Review and Hypothesis Development

2.1 CEO Compensation and Firm Performance

Many studies have been conducted regarding the relationship between CEO compensation and firm performance. The four main reasons that explain the relationship between CEO compensation and firm performance consist of the following: (1) CEOs who receive higher compensation, in theory, are more extrinsically motivated to maximize firm performance because of the financial incentives (Bebchuk & Fried, 2003; Core et al., 1999). Additionally, variable compensation structures for CEOs contribute positively to a firm's performance through their incentive-aligning properties, leading to both extrinsic and extrinsic motivation (Jensen & Murphy, 1990; Morrison et al., 2024). Therefore, this comes down to the alignment of interests between a firm's shareholders and the CEO; (2) Talent attracts talented people, hence high-performing firms attract high-performing CEOs, who are paid above-average because either they outperform their peers, have more experience, or have better credentials through which they can positively impact the firm's ambitions. This comes down to the human capital theory (Judge et al., 1995); (3) Larger or complex firms, or firms that operate in volatile industries, have CEO that are subdued to higher levels of pressure and a higher level of risk they take on by leading the firm. CEOs are compensated for this. These larger or more complex firms require CEOs with stronger leadership skills to handle stress, that can give direction to larger teams and make difficult decisions. In this regard, effective leadership ensures that the firm can maintain its operational efficiency, contributing to firm performance (Hambrick & Mason, 1984).

Smirnova and Zavertiaeva (2017) find that in the context of large European firms, CEO compensation is positively correlated with firm performance, and vice versa. Gao and Li (2015) conduct research into both privately-held and public firm CEO compensation and they come to two primary findings. Firstly, CEOs in public firms receive annual compensation that is 30% larger than CEOs in private firms, and secondly that there is a positive relationship between CEO compensation and a firm's accounting performance, with the relationship being significantly stronger for public firms than is the case for private firms. Thus, the first hypothesis states:

H1: CEO compensation relates positively to firm performance in the post-COVID era

It can be expected that certain qualities of CEOs contribute to both their compensation and firm performance. Specifically, certain qualities can influence CEO compensation, and with these qualities it could be that a CEO is better able to run a company in such a way, that it contributes positively to firm performance. However, previous research has shown that among other variables, educational background, firm tenure and job tenure, which are proxies for human capital investment, have little explanatory power for the determination of CEO compensation (Core et al., 1999).

However, Judge et al. (1995) found that the educational level of executives is in fact a significant determinant of an executive's financial success, which can be expected to be directly linked to an executive's compensation. Jensen and Murphy (1990) find that CEOs with longer tenures have higher compensation packages, because of a variety of reasons. The first reason is that because of a longer tenure, CEOs accumulate more stock options, restricted stock and LTIPs (long-term incentive plans), which results in higher compensation compared to CEOs with shorter tenures. Additionally, a longer tenure enables a CEO to gain more experience in that position, and firm-specific knowledge, which makes them more valuable to the firm for which they are employed. This increased value is then reflected in higher total compensation.

In terms of CEO compensation components, Core et al. (1999) base their study on three different measurements: total compensation, cash compensation and salary. Total compensation is the most complete measurement, as this embodies a CEO's salary, bonus, (restricted) stock grants, long-term performance plans and option awards. Given this, total compensation consists of both fixed and variable compensation. They find a positive correlation between CEO compensation and firm performance, and argue that variable compensation components align CEO's interests with those of a firm's shareholders, motivating CEOs to maximize firm performance. Morrison et al., (2024) is a more recent study that finds that variable compensation are crucial for aligning CEO and shareholder interests, contributing to increased firm performance. This encourages CEOs to focus on sustainable growth instead.

Finally, in line with human-capital theory, Hambrick and Mason (1984) suggest that the characteristics of top executives significantly affect firm performance. Managers that are better able to direct people or large teams, deal with stress or lead larger or more complex firms will in general earn higher compensation, while these top executives are able to deal with these more difficult circumstances and therefore positively contribute to firm performance.

2.2 Principal-Agent Theory and Incentive Alignment

The principal-agent theory was developed and introduced through contributions of various researchers. Jensen and Meckling (1976) introduced the concept of agency costs and specified the principal-agent relationship within the context of the firm. They introduced a framework for elaborating on the conflicts of interest between executives (i.e., agents) and shareholders (i.e., principals) and how these

conflicts of interest that arise can be mitigated.

According to Jensen and Meckling (1976), mechanisms for aligning interests between the agent and principal can consist of equity ownership by executives, through which their personal gains will be in line with the firm's objectives. This results in incentive alignment, reducing the risks associated with the principal-agent theory. Secondly, performance-based compensation can be implemented. Based on this, executives can receive compensation that is tied to certain performance metrics of the firm. This ensures that at least some part of CEO compensation is contingent on achieving firm-specific objectives, which aligns the interests of the CEO with a firm's shareholders. In the same regard, incentive contracts can be introduced that either reward or penalize CEOs based on the achieved firm performance. Finally, they offer debt financing as a potential remedy in the principal-agent theory, as managers will become under pressure to generate sufficient cash flows to meet the financial obligations of the debt, reducing the chances of wasteful expenditures.

Mirrlees (1976) also made important contributions through empirical research, with a focus on deriving optimal incentive schemes in case of asymmetric information between the agent and principal. To put this in the perspective of contract theory, i.e. designing contracts that ensure the alignment of interests of both parties, moral hazard can be reduced or eliminated altogether.

Bebchuk and Fried (2003) question Mirrlees' (1976) finding that optimal contracting can explain compensation practices adequately, because the greater a manager's power or influence within a company, the greater is his ability to exert that power in order to negotiate a higher compensation. This is introduced as the managerial power theory. The consequence of this, as explained by a later publication of Bebchuk and Fried (2004), is that CEO compensation is not adequately tied to a firm's performance outcomes. CEOs can receive substantial compensation when their firm performs poorly, which is not in support of incentive alignment. Stock options and bonuses are also critiqued by them, because these compensation components can be structured in ways that do not incentivize long-term performance. Their theory does not directly undermine the potential of stock options and bonuses, but in case of complex and non-transparent compensation structures, it can be counter-effective. Potential solutions are offered in terms of increased transparency, stronger shareholders rights in determining executive compensation, independent board oversight and increasing the use of performance-based metrics.

Jensen and Murphy (1990) state that the way in which CEOs are compensated is of more importance than the magnitude of their compensation. One of the central argument they propose to mitigate the principal-agent problem, is that stock ownership by CEOs is crucial for the alignment of their incentives with those of shareholders. In this structure, a CEO's compensation or wealth is at least partially directly tied to the firm's performance. Stock options are alternative tools which are described as effective, because they also provide direct financial incentives for CEOs to increase the company's stock price. Hence, Jensen and Murphy advocate for compensation structures that heavily lean towards performance-based incentives. In this regard, what can be considered as performance-

based incentives are, among others, a bonus, stock awards, option awards and LTIPs. These are also the compensation components that are regarded as variable CEO compensation in this study. Thus, the second hypothesis states:

H2: Variable incentive based CEO compensation affects firm performance positively, as opposed to fixed incentives

It is important to note that a bonus, as a cash-compensation component, can influence firm performance through CEO compensation in different ways. This depends mostly on the number of years the bonus is tied to. In theory, a one-year bonus leads to better firm performance on the short-term instead of the long-term. In comparison to this, a three to five year bonus incentives longer-term firm performance more than a one-year bonus. In short, while short-term bonuses drive more immediate performance and long-term bonuses drive sustainable growth, both contribute to the alignment of interests between CEOs and shareholders.

2.3 CEO Compensation and Firm Performance before, during and after COVID-19

Following the real options theory, managers have the tendency to defer investments when uncertainties become increasingly important. This may result in firms missing out on projects that could have been profitable (Zeng et al., 2016). Since the COVID-19 crisis lead to increased external risks and uncertainty, firms retained more cash in case of emergencies. This cash retention takes up investment opportunities and therefore distorts a firm's sustainable development. This lead to a decline in revenue and firm performance (Shen et al., 2021). The primary cause for the reduction in corporate revenue and performance was the implementation of quarantine measures. Additionally, the crisis impacted executive compensation practices as firms adjusted their governance structures to more performance- and incentive-based incentives to cope with the economic uncertainty and better align the CEO's interests with firm performance (Zattoni & Pugliese, 2021). Khatib and Nour (2021) find that the economic crisis that followed from the COVID-19 pandemic affected various firm characteristics, such as firm performance, governance structure and leverage levels. However, they did not find any significant differences for these variables when comparing pre-crisis and post-crisis results. This implies that there could have been temporary changes during the crisis, after which firms may have returned to their pre-crisis compensation practices.

Regarding the effect of economic crises on CEO compensation, Carter et al. (2024) claim that firms dealt with increased financial pressure during and following the COVID-19 crisis. Specifically, altering executive compensation structures through a reduction of the base salary and coinciding equity grants was necessary in order to build up more resistance against the financial pressure firms were facing (Carter et al., 2024). This is in line with stakeholder theory, which emphasizes that

companies should balance the interests of all stakeholders. By aligning CEO incentives with the sustainable performance of the firm, these changes ensure that executives are motivated to make decisions that benefit all stakeholders. Additionally, the decline of stock prices lead to the reduction of equity incentives for executives (Carter et al., 2024), hence there was a need for the revision of compensation packages for CEOs. Therefore we expect the relationship between CEO compensation and firm performance is stronger post-COVID compared to pre-COVID. Thus, the third hypothesis states:

H3: The relationship between CEO compensation and firm performance is weaker pre-COVID, compared to post-COVID

2.4 The effect of Economic Crises on CEO Compensation and Firm Performance

Yang et al. (2014) find that in pre- and post-crisis periods, different patterns exist in the relationship between CEO compensation and firm performance. Their research is conducted in relation to the global financial crisis of 2008. Regarding the pre-crisis period, they find that there is a weak link between CEO compensation and firm performance. This suggests that there may have been misalignment of incentives because CEO compensation was not strongly enough tied to firm performance metrics. According to Yang et al. (2014), this was due to the fact that the rationale behind compensation packages was mainly to attract and retain talent, rather than linking executive performance to the firm's performance metrics. The financial crisis of 2008 lead to more awareness of this misalignment of incentives and the risks this brought with it. This lead to a shift in compensation practices, specifically the composition of compensation packages. Hence, the result was that executive compensation became more strongly tied to performance-based variable compensation components, such as stock options and bonuses that were linked to specific, often more long-term oriented, financial metrics of the firm (Yang et al., 2014). In the post-crisis period, regulatory changes, public awareness and political pressure lead to more strict and transparent firm practices relating to executive compensation. Among other things, requirements for the disclosure of compensation details and justification of compensation packages were sharpened. This with the goal of being able to hold people or firms accountable for any corporate mismanagement practices. In conclusion to their research, a difference in the relationship between CEO compensation and firm performance was observed in the post-crisis period, relative to the pre-crisis period (Yang et al., 2014), with the shift occurring during the financial crisis.

Malik and Shim (2019) confirm the shift in the composition of executive compensation packages over the duration of the financial crisis of 2008. They state that pre-crisis, the link between CEO compensation and firm performance was weaker than during the post-crisis period, and that pre-crisis, CEO compensation consisted of a relatively larger share of fixed components, such as base

salaries and guaranteed bonuses. The shift that occurred during the crisis was that compensation packages became more linked to the firm's financial performance and therefore more variable (Malik & Shim, 2019). Therefore excessive, misaligned compensation elements were reduced. By changing compensation practices with regard to these non-performance-related elements of CEO compensation, the risk of moral hazard was reduced (Bebchuk & Fried, 2003).

Given that after the global financial crisis of 2008 the importance of corporate governance structures and compensation practices are described in literature to have improved significantly, it can be expected that that the financial crisis of 2008 had a lasting impact on the relationship between CEO compensation and firm performance. The financial consequences of the misalignment of incentives between CEOs and a firm's shareholders, and the moral hazard that followed from this leading up to the financial crisis of 2008, leads to the assumption that the global financial crisis had a stronger impact than the COVID-19 crisis. Thus, the fourth hypothesis states:

H4: The global financial crisis of 2008 affected the relationship between CEO compensation and firm performance more strongly than the COVID-19 crisis

3. Data and Methodology

3.1 Data

Because of data accessibility and availability reasons, the focus of this research lies on companies that are listed on the S&P500. This is a stock market index that includes the stock performance of the 500 largest publicly traded firms in the United States. The focus on the S&P500 is economically relevant, because being the 500 largest publicly traded firms in the USA, they all are some of the largest firms in the respective industries each operates in. Because of the relevance of the S&P500, it is a reliable benchmark for investigating the impact of financial crises on CEO compensation and firm performance. The collected data ranges from the year 2006 to the year 2023. In total, over all these years, there are a total of 1,579 different firms in the dataset.

The data used for this research is collected from Wharton Research Data Services (WRDS). The data relating to CEO compensation and characteristics are drawn from ExecuComp. Firm related variables are drawn from Compustat, as well as industry categorizations firms operate in. The firm related variables primarily relate to income statement and balance sheet information, which is used to calculate the ROA for respective firms. The focus is on industrial companies, which includes firms that operate in manufacturing, retail, construction and other commercial operations other than financial services. Firms that operate in financial services generally have significantly different business models, their performance is more dependent on macroeconomic conditions, and since the 2008 financial crisis the financial sector is heavily regulated. An example of this is the Dodd-Frank Act, which has impacted the guidelines within firms operate and their compensation structures. These

regulations can introduce confounding factors that influence the relationship between CEO compensation and firm performance.

The S&P500 includes a broad range of firms across industries, making it less susceptible to certain types of bias. Firstly, because of the inclusion of different sectors it reduces sector bias. This also reduces performance bias, as the broad representation of firms in the S&P500 ensures the balancing of performance metrics. Therefore, they are better able to reflect overall market conditions and trends. Although only large companies are included in the S&P500, it is much more complex to gather reliable data of smaller firms. Additionally, because of the aspect of economic crises, it can be assured that this research focuses on firms that have an impact on the economy. Hence, variability from the inclusion of smaller firms is prevented, reducing size bias (Shumway & Warther, 1999). The S&P500 is regularly updated, hence including only the largest and impactful firms. This ensures that the stock index reflects current market leaders, reducing survivorship bias, which would occur when only firms that have survived over time are included.

3.2 Dependent Variables

The main dependent variable in this research is firm performance. A proxy for firm performance is taken, being return on assets (ROA). ROA measures the efficiency with which a company is using its assets to generate earnings. ROA is a standardization of firm performance, as it is displayed as a percentage, enabling the comparison between firms across industries. ROA excludes effects of financial leverage through debt, which makes it a good indicator of operational performance of a firm from its core business activities. Alareeni and Hamdan (2020) confirm the use of ROA as a proxy for performance of firms that are listed on the S&P500, in the context of estimating the relationship between the corporate disclosure of ESG (Environmental, Social and Governance) and firm performance, estimated by ROA, ROE (return on equity) and Tobin's Q. Anderson and Reeb (2003) also take the ROA as a proxy for firm performance. In their paper, they compare firm performance between (non-)founding-family firms in the S&P500. Finally, Hendriks et al. (2023) also take the ROA as a proxy for firm performance, this time including it as a control variable in investigating the effect of CEO compensation on employee engagement. Hence, the decision of focusing on ROA as a firm performance measurement for this research is supported by literature. The formula of ROA is as follows:

$$ROA = \frac{Net\ Income}{Total\ Assets} \quad (\mathbf{1})$$

3.3 Independent Variables

The main independent variable is CEO compensation. Multiple variables in the WRDS dataset ExecuComp relate to CEO compensation. Our primary focus is on total compensation, which includes

salary, bonus, other annual compensation, the total value of restricted stock granted, the total value of stock options granted, LTIPs (long-term incentive plans) and all other total compensation. This is the most complete CEO compensation metric, and a combination of both fixed and variable compensation[2]. The fixed compensation components consist of the base salary, other annual compensation[3] and all other compensation. The variable compensation components consist of the bonus, LTIPs, (restricted) stock grants and option grants. It must be noted that the dataset does not contain observations for the variables other annual compensation and LTIPs (Appendix A, Table A.4). That implies that in terms of total CEO compensation, these cannot have been of influence in the determination of this. However, this could be due to incomplete data or measurement errors, therefore introducing bias with regard to the second hypothesis.

The main difference between stock awards, option awards and LTIPs consists of the following. Option awards are generally granted to (some of) a firm's employees with a fixed exercise price, through which these employees gain the right to buy these shares during some period in the future (Aboody & Kasznik, 2000). Stock awards provide direct equity ownership. They do not require an exercise price (Ofek & Yermack, 2000). LTIPs are compensation structures that reward long-term performance, typically over a period of three to five years (Westphal & Zajac, 1993). This can be done through various instruments, such as stock options, stock awards and cash bonuses, tied to firm performance goals that should be achieved over this period of time.

3.4 Control Variables

3.4.1 Firm Characteristics

As explained before, size bias is reduced because only large firms are included in the S&P500, given that smaller firms generally introduce more variability (Shumway & Warther, 1999). Despite this, firm size is introduced as a control variable in the model. Between the larger firms that are present in the S&P500, there are notable differences in size. In literature, different proxies are used to estimate firm size. Total assets, total sales, number of employees, and market value of equity can also be used as proxies for this (Dang et al., 2018; Hendriks et al., 2023). Specifically, regarding the appropriateness of total assets, Dang et al. (2018) emphasize the stability and comprehensive nature of total assets, and therefore a firm's full resource range, which is important for understanding a firm's capacity for daily operations, investments, and future growth. Hendriks et al. (2023) support this reasoning, given that the use of total assets provides a broad representation of the scale of a firm's operational capacity and resources. Hall and Weiss (1967) use $1/\log(total\ assets)$ as a proxy for firm size. They do this

[2] The distinction between fixed and variable CEO compensation is needed for investigating the second hypothesis, as explained before.
[3] From WRDS it does not readily appear what the exact origin is of other annual compensation. Examples of this could be perquisites (e.g. use of company car and memberships for sporting facilities).

because their focus is on family firms in the S&P500, resulting in non-linearity. By taking the reciprocal of the natural logarithm of a firm's total assets, they aimed to realize linearity in the relationship between firm size and firm performance, improving the fit of their regression model. Because the focus of this paper is on the whole S&P500, we are not confronted with similar non-linearity issues. However, we have to account for large differences in the quantity of a firm's total assets. Because of the large absolute differences regarding this between firms, a firm's total assets are divided by 1,000 before taking the natural logarithm. Therefore firm size is determined through $\log(total\ assets/1000)$. This is done to improve the comparability of the results given that large differences in firms' assets exist. By including firm size in the model we control for these differences in firm size that remain in the dataset.

Because ROA excludes leverage effects for firms, we introduce the debt-equity ratio to control for any relative differences in leverage between firms. This gives an indication of a firm's financing structure and with that, the degree of debt that a firm implements to stimulate its operational performance. It is also an indication for the level of risk of a firm's operations, because of the financial risks that are associated with debt, i.e. liquidity risks through interest, refinancing risk, and default risk as a result of strained cash flows. A debt-equity ratio with value 1 indicates that a firm uses an equal amount of debt and equity to finance its operations and stimulate growth.

3.4.2 CEO Characteristics

Gender is included as a control variable, because there may be differences in CEO compensation or firm performance between males and females. Another control variable is the age of a CEO. Specifically, this is the age of a CEO at the annual report date. The final control variable that relates to CEO characteristics is the tenure of a CEO. It is measured as the number of years a CEO has been holding his position as CEO of a respective firm, again measured at the annual report date. Although the experience of a CEO, in theory, is partly embedded in the age of a CEO, CEO tenure is a more direct measure of experience, specific to the role of being CEO at a firm. These control variables are included in order to isolate the relationship between CEO compensation and firm performance.

3.4.3 Sector Characteristics

As explained before, the S&P500 is comprised of large firms in different sectors on the US stock market. The sectors in which firms operate are included as control variables in this research in order to help isolate the relationship between CEO compensation and firm performance, because by doing this we can account for potential confounding effects. There are different sector categorizations in the WRDS dataset. The broadest industry classification is included as dummy variables in the model.

These industries correspond with the Global Industry Classification Standard (GICS)[4]. This is a industry classification system that is frequently used in academic research (Bhojraj et al., 2003; Fan et al., 2016; Chan et al., 2007). The sector coefficients that will follow from the regression are relative to the reference industry "Materials". This is selected as the benchmark against which the other industries are estimated in terms of how they affect firm performance and therefore potentially introduce bias in the relationship between CEO compensation and firm performance. The materials sector is not volatile, nor is it typically as stable as some other sectors. However, it is normally sensitive to economic cycles, making it a good benchmark for comparison across sectors in different economic market conditions.

3.5 Research Method

3.5.1 CEO Compensation and Firm Performance

The main research method consists of multiple regression analysis. The collected data is panel data and as explained before, the data ranges from the year 2006 to the year 2023. The research method depends on the question at hand. The main division in this research consists of the relationship between CEO compensation and firm performance, including fixed versus variable compensation incentives on one hand, and the inclusion of economic crises on the other hand.

In order to investigate the main research component and the first hypothesis, we formulate firm performance as the dependent variable, and CEO compensation as the main independent variable. It is expected that when investigating this relationship, CEO compensation could only reasonably affect firm performance with the inclusion of a lag. The rationale is that the actions taken by a CEO that are motivated by their total compensation take time to manifest. Thus, total CEO compensation is included by taking the value of its natural logarithm for firm *i* in fiscal year *t*-1. The same rationale is followed for the inclusion of firm-specific controls. As explained, it is expected that both CEO compensation and firm size increase with firm size, hence we include it as a control variable for firm *i* in fiscal year *t*-1. Additionally, because ROA is a firm performance metric that leaves out any debt effects, we include the debt-equity ratio to control for differences in the relative leverage between firms. This way, leverage is included for firm *i* in fiscal year *t*-1. Next, CEO characteristics are added to the model as control variables; a CEO's gender, age and tenure in the position as CEO. These are all factors of which can be expected to have an effect on CEO compensation, hence why they are included as control variables to isolate the relationship between firm performance and CEO compensation. Finally, sector dummy variables are included in the model. What follows is the following equation (2), with which we will investigate the first hypothesis. It is important to note that

[4] The Global Industry Classification Standard (GICS) is a hierarchical industry classification system, which consists of the following eleven sectors: energy, materials, industrials, consumer discretionary, consumer staples, health care, financials, information technology, communication services, utilities and real estate.

in order to investigate the first hypothesis, the post-COVID year 2023 is analyzed. In addition to this, the same equation (2) is implemented for all years 2006-2023, in order to investigate whether the post-COVID trend is in line with the multi-year trend, which is assumed to be more robust because of reduced yearly variance.

$$ROA_{i,t} = \beta_0 + \beta_1 ln(CEO\ Compensation)_{i,t-1} + \beta_2 (firm\ size)_{i,t-1} + \beta_3 \left(\frac{Debt}{Equity}\right)_{i,t-1} + \beta_4 Gender_{i,t} + \beta_5 Age_{i,t} + \beta_6 Tenure_{i,t} + \beta_{7\dots16}(sector\ dummy\ variables) + \varepsilon_{i,t} \quad (\mathbf{2})$$

For the second hypothesis, we deconstruct CEO compensation into fixed and variable compensation to account for incentive-aligning compensation practices. The fixed and variable compensation components are isolated as explained in paragraph 3.3. It must be noted again that in the dataset, no observations are present for the variables other annual compensation and LTIPs (Appendix A, Table A.4). Therefore, these variables are left out in determining fixed and variable compensation. This results in equation (3), which is used to investigate the second hypothesis:

$$ROA_{i,t} = \beta_0 + \beta_1 ln(Fixed\ Compensation\ Components)_{i,t-1} + \beta_2 ln(Variable\ Compensation\ Components)_{i,t-1} + \beta_3 (firm\ size)_{i,t-1} + \beta_4 \left(\frac{Debt}{Equity}\right)_{i,t-1} + \beta_5 Gender_{i,t} + \beta_6 Age_{i,t} + \beta_7 Tenure_{i,t} + \beta_{8\dots17}(sector\ dummy\ variables) + \varepsilon_{i,t} \quad (\mathbf{3})$$

3.5.2 CEO Compensation and Firm Performance Before and After Economic Crises

For investigating both the third and fourth hypothesis, corresponding with equation (4) and (5), the one-year lags for CEO compensation, firm size and firm leverage have been taken out. Adding the lags, similar to the models described before, creates interpretability issues when investigating economic crises. Given that the economic crises are split into pre- mid- and post-crisis scenarios, using lagged variables leads to the inclusions of the first during-crisis and post-crisis years (i.e., the first mid-crisis year of COVID is *t*=2020, in this case the lagged variables are *t*=2019, a pre-crisis year). In other words, in case of lags, firm performance during the crisis relates to CEO compensation pre-crisis. This may prevent us from fully capturing the conditions of the different phases of a crisis. The decision to take out the lags in the models corresponding to economic crises is supported by the robustness check from Table B.3. This corresponds to equation (11), as described in section 3.7. With this robustness check, the validity of the original model is verified. Therefore, this robustness check supports the decision to take out the lags in case of economic crises.

In order to investigate the third hypothesis, a distinction is made between pre-crisis, during a crisis and post-crisis situations. The main focus of this part of the research is the COVID-19 crisis. The

years 2018 and 2019 are considered as pre-crisis, the years 2020 to 2022 are considered during the crisis and the year 2023 is taken as the post-crisis scenario. The above described equation (2) is adjusted and then used to estimate how CEO compensation affects firm performance for the given scenarios, i.e. during the crisis and post-crisis, relative to the pre-crisis scenario. The pre- and post-crisis differences are shown through an interaction effect between the binary variable that denotes the post-crisis scenario relative to the pre-crisis scenario, and the natural logarithm of CEO compensation. This results in equation (4). This equation includes the mid- and post-COVID scenarios, which are relative to the pre-COVID scenario. Both the mid- and post-COVID scenarios have a corresponding interaction effect with the one-year lagged CEO compensation variable.

$$ROA_{i,t} = \beta_0 + \beta_1 ln(CEO\ Compensation)_{i,t} + \beta_2 (firm\ size)_i + \beta_3 \left(\frac{Debt}{Equity}\right)_{i,t} + \beta_4 Gender_{i,t} + \beta_5 Age_{i,t} + \beta_6 Tenure_{i,t} + \beta_{7\dots16}(sector\ dummy\ variables) + \beta_{17}(During\ COVID) + \beta_{18}(After\ COVID) + \beta_{19}\big((During\ COVID) * ln(CEO\ Compensation)_{i,t}\big) + \beta_{20}((After\ COVID) * \big(ln(CEO\ Compensation)_{i,t}\big)) + \varepsilon_{i,t} \quad (\mathbf{4})$$

As an addition to the third hypothesis and as a preliminary step for investigating the fourth hypothesis, the relationship of interest of the third hypothesis is also applied to the 2008 financial crisis. Here, 2006 and 2007 are considered pre-crisis, 2008 and 2009 are considered during the crisis and 2010 to 2012 is considered post-crisis. Consequently, in order to investigate the fourth hypothesis, the difference in impact of both the 2008 financial crisis and the COVID-19 economic crisis is estimated with regard to the relationship between CEO compensation and firm performance. Equation (2) is again used to derive the equation through which we can estimate the relative impact of these crises on the relationship of interest. The goal is coming to the conclusion which of these crises had a larger impact on the relationship between CEO compensation and firm performance. If the coefficient for the financial crisis related interaction effect is significantly different from that for the COVID-19 related interaction effect, it indicates differing impacts of the two crises on the relationship between CEO compensation and firm performance. The result is an adjusted version of equation (4), where another interaction effect is introduced that denotes the financial crisis. The result is equation (5).

$$ROA_{i,t} = \beta_0 + \beta_1 ln(CEO\ Compensation)_{i,t} + \beta_2 (firm\ size)_{i,t} + \beta_3 \left(\frac{Debt}{Equity}\right)_{i,t} + \beta_4 Gender_{i,t} + \beta_5 Age_{i,t} + \beta_6 Tenure_{i,t} + \beta_{7\dots16}(sector\ dummy\ variables) + \beta_{17}(After\ COVID) + \beta_{18}(After\ Financial\ Crisis) + \beta_{19}\left((After\ COVID) * ln(CEO\ Compensation)_{i,t}\right) + \beta_{20}(After\ Financial\ Crisis * ln(CEO\ Compensation)_{i,t}) + \varepsilon_{i,t} \quad (\mathbf{5})$$

3.6 Sample descriptives

The descriptive statistics are shown in Table 1 for the total sample for all years 2006-2023. Initially, the dataset contained problematic outliers for the debt-equity ratio and ROA. Because of the extent of these outliers and given that these are continuous variables, these values have been winsorized. In practice, this means that the largest 1% deviations, both positive and negative outliers, are recoded to the values corresponding with the 1st and 99th percentile. A negative debt-equity ratio in itself is unusual and typically indicates a unique situation in a company's financial structure. An explanation could be that for these firms, accumulated losses exceed the sum of total capital and retained earnings, thus equity becoming negative. With significant historical losses, this can be common for a firm that is in financial distress (Luo et al., 2021). As explained, winsorizing ROA and the debt-equity ratio helps to mitigate the influence of outliers on the analysis, as extremely high leverage ratios may distort the role of firm leverage as a control variable in investigating the relationship between CEO compensation and firm performance. Similarly, extreme outliers for ROA can distort the estimation of the relationship between CEO compensation and firm performance. CEO compensation, as well as fixed and variable compensation are not winsorized, but because the natural logarithm of these variables is taken. This solves on the one hand skewed distribution issues, and on the other hand helps in accounting for potential outliers. Regarding firm size, given that a firm's assets are divided by 1,000 before taking the natural logarithm, as a consequence of scaling firm size some firms end up with negative values. Despite this, by compressing the range of firm sizes in the dataset, this transformation improves the interpretability and consistency of the data. Furthermore, it can be noted that since gender is binary, about 95% of the sample contains male CEOs, as opposed to slightly less than 5% female CEOs. The average CEO age is close to 57 and the average CEO tenure is 7.72 years. In order to guarantee consistency in terms of internal validity, all variables have been levelled in terms of the number of observations, resulting in a uniform 23,029 observations for all variables.

3.6.1 Descriptive Statistics

Table 1 *Descriptive statistics over all years 2006-2023*

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
ROA (winsorized)	23,029	0.04	0.11	-0.52	0.30
CEO compensation (USD in thousends)	23,029	7,528.37	32,845.06	0.00	4,773,420.00
Ln(CEO Compensation)	23,029	8.39	1.18	-6.91	15.38
Total Assets	23,029	22,665.83	136,663.50	0.00	4,325,437.00
Firm size (natural log of total assets/1000)	23,029	1.13	1.85	-13.82	8.37
Debt/Equity ratio (winsorized)	23,029	0.85	2.69	-10.26	17.44
Gender (1=male)	23,029	0.95	0.21	0	1
Age	23,029	56.73	7.45	27	93
Tenure	23,029	7.72	7.64	0	56
Sector: Energy	23,029	0.05	0.23	0	1
Sector: Materials	23,029	0.07	0.25	0	1

Sector: Industrials	23,029	0.18	0.38	0	1
Sector: Consumer discretionary	23,029	0.16	0.37	0	1
Sector: Consumer staples	23,029	0.06	0.24	0	1
Sector: Health care	23,029	0.12	0.33	0	1
Sector: Financials	23,029	0.11	0.31	0	1
Sector: Information Technology	23,029	0.13	0.34	0	1
Sector: Communication services	23,029	0.04	0.20	0	1
Sector: Utilities	23,029	0.01	0.07	0	1
Sector: Real estate	23,029	0.07	0.26	0	1

CEO compensation displayed in 1000s. Note that CEO compensation displayed both as a continuous variable and the transformed variable to the natural logarithm as it will appear in the models. Firm size is displayed as the natural logarithm of a firm's total assets divided by 1,000. Firm leverage and ROA are winsorized at the 1% level to limit the impact of outliers and improve comparability. One outlier remains for the continuous variable CEO compensation (4,773,420). The natural logarithm will be applied to the models, therefore reducing the scale of the outlier relative to the other data points and mitigating its effect on the analyses. The subsequent models have been verified to be robust in case of excluding this outlier. The outlier originates from Blackstone Inc. in 2007. Blackstone profited greatly from the housing bubble in the USA, hence it is considered to be of importance given that part of this research is focused on economic crises. The robustness of the models regarding this outliers confirms the validity of this decision.

Table A.1 from Appendix A shows the descriptive statistics for ROA and CEO compensation relating to the COVID-19 crisis. As explained before, the crisis is split into three scenarios, i.e. pre-crisis, mid-crisis and post-crisis. It is interesting to see that the average CEO compensation during COVID is higher than in the pre- and post-crisis scenarios. Table A.2 from Appendix A shows the descriptive statistics for ROA and CEO compensation relating to the financial crisis of 2008. In this case, as opposed to the COVID-19 crisis, the average CEO compensation during the crisis is smaller than the pre- and post-crisis scenarios. Regarding the ROA, the same is true.

3.6.2 Correlation Matrix

The correlation matrix for the main variables is shown in Appendix A, Table A.3. None of the variables seem to be highly-correlated to each other. The highest correlations exists between CEO compensation and firm size (0.59) and the age and tenure of CEOs (0.46). The debt-equity ratio is negatively correlated to firm performance (-0.04), although the correlation is weak. The debt-equity ratio is positively correlated with CEO compensation (0.07) and firm size (0.14). This implies that firms with relatively less leverage are in general smaller firms, achieve better results in terms of their ROA, but the CEO receives lower compensation. The age of a CEO is positively correlated with ROA (0.03), CEO compensation (0.09), firm size (0.10) and gender (0.03). This implies that older CEOs in general receive higher compensation, are more often males, lead larger firms and realize better firm performance compared to younger CEOs. However, there are probably other confounding factors embedded in this variable such as experience, that are difficult to quantify. As expected, CEO tenure is also positively correlated with firm performance (0.04). Longer tenure leads to more (company-specific) experience, enabling a CEO to realize better firm performance. CEO tenure is negatively

correlated with CEO compensation (-0.08) and firm size (-0.11), implying that more tenured CEOs work at smaller firms and receive less compensation. This might have something to do with loyalty and fast-changing environments in larger firms. Finally, gender is negatively correlated with ROA (-0.01), CEO compensation (-0.03), firm size (-0.02) and the debt-equity ratio (-0.02). This implies that female CEOs generally realize better firm results, receive higher compensation, and lead larger firms with more leverage. The regression results will have to shed light on whether ROA significantly relates to these other variables.

3.7 Robustness Tests

As the first robustness check, reverse causality will be investigated. It can be expected that there is reverse causality, primarily between CEO compensation and firm performance. Because reverse causality can lead to distorted regression results, we investigate this further turning around the relationship of interest, controlling for the same variables in both scenarios. CEO compensation will be the dependent variable and ROA in year *t*-1 the main independent variable. First we look at how ROA relates to the natural logarithm of CEO compensation, and check for significance. This results in equation (6). As a second step, the firm specific control variables are added to the model, specifically firm size and the debt-equity ratio. This results in equation (7). As a third step, the CEO specific control variables are included, namely gender, age and tenure, as well as the industry dummy variables. The result is equation (8).

$$ln(CEO\ Compensation)_{i,t} = \beta_0 + \beta_1 ROA_{i,t-1} + \varepsilon_{i,t} \quad (\mathbf{6})$$

$$ln(CEO\ Compensation)_{i,t} = \beta_0 + \beta_1 ROA_{i,t-1} + \beta_2 (firm\ size)_{i,t-1} + \beta_3 \left(\frac{Debt}{Equity}\right)_{i,t-1} + \varepsilon_{i,t} \quad (\mathbf{7})$$

$$ln(CEO\ Compensation)_{i,t} = \beta_0 + \beta_1 ROA_{i,t-1} + \beta_2 (firm\ size)_{i,t-1} + \beta_3 \left(\frac{Debt}{Equity}\right)_{i,t-1} + \beta_4 Gender + \beta_5 Age + \beta_6 Tenure + \beta_{7\dots16} (sector\ dummy\ variables) + \varepsilon_{i,t} \quad (\mathbf{8})$$

As the second robustness test, equation (2) is replicated, but with another dependent variable. Instead of the ROA, Tobin's Q will be the dependent variable, in order to investigate whether the results from equation (2) will hold in this altered scenario. Tobin's Q is a firm performance indicator which is used to assess the relative market value of a firm, in relation to the replacement cost of its assets (Hayashi, 1982). The market value of a firm consists of its equity, i.e. the market capitalization, plus the market value of its debt. The replacement cost of the firm's assets is what it would cost if the firm's assets

were to be rebuilt from scratch, at today's prices. This accounts for both tangible and intangible assets. The interpretation of Tobin's Q is that if the value is greater than one, i.e. when the firm's market value exceeds its replacement cost, its assets are highly valued. This could be the case because of competitive advantage, branding, or efficient processes. On the other hand, if Tobin's Q is less than 1, there may be certain inefficiencies because of which the firm's assets are undervalued. Equation (9) for estimating Tobin's Q is as follows:

$$Tobin's\ Q = \frac{Market\ Value\ of\ the\ Firm}{Replacement\ Cost\ of\ the\ Firm's\ Assets} \quad (\mathbf{9})$$

The following equation is equation (10), which as explained is derived from equation (2). Similar to CEO compensation, the natural logarithm of Tobin's Q is estimated because of a skewed distribution of the variable. This is done in order to get a more normally distributed spread of the variable.

$$Ln(Tobin's\ Q) = \beta_0 + \beta_1 Ln(CEO\ Compensation)_{i,t-1} + \beta_2(firm\ size)_{i,t-1} + \beta_3\left(\frac{Debt}{Equity}\right)_{i,t-1} + \beta_4 Gender + \beta_5 Age + \beta_6 Tenure + \beta_7 \dots \beta_{16}(sector\ dummy\ variables) \quad (\mathbf{10})$$

A third robustness check consists of the elimination of lagged effects in our original model. Specifically, the lagged effects of CEO compensation, firm size and the debt-equity ratio are taken out of the equation. This way, it can be analyzed whether the inclusion of lagged effects which are implemented to help partially answer the main research question through equation (2) is biased. Lagged explanatory variables can introduce bias in regression analysis. They can cause endogeneity, omitted variable bias or measurement errors (Bellemare et al., 2017) which has to be accounted for. Equation (11) is derived from equation (2), in this case with no lagged effects.

$$ROA_{i,t} = \beta_0 + \beta_1 ln(CEO\ Compensation)_{i,t} + \beta_2(firm\ size)_{i,t} + \beta_3\left(\frac{Debt}{Equity}\right)_{i,t} + \beta_4 Gender_{i,t} + \beta_5 Age_{i,t} + \beta_6 Tenure_{i,t} + \beta_{7\dots16}(sector\ dummy\ variables) + \varepsilon_{i,t} \quad (\mathbf{11})$$

A fourth and final robustness check focuses on the control variable firm size. In this study firm size is determined through taking the natural logarithm of a firm's total assets. However, as explained in paragraph 3.4.1, firm size can be determined in a various ways (Dang et al., 2018; Hendriks et al., 2023). This is done to help mitigate potential bias choosing a variable that is not representative of actual firm size. In this instance, the natural logarithm of a firm's total assets is replaced by the number of a firm's employees. Similar to previously, the natural logarithm of the number of employees is lagged by one year. This results in equation (12), which is derived from equation (2). The formula

does not appear different from equation (2), because although a different proxy for firm size is taken, the role of the control variable in the model is unchanged.

$$ROA_{i,t} = \beta_0 + \beta_1 ln(CEO\ Compensation)_{i,t-1} + \beta_2 (firm\ size)_{i,t-1} + \beta_3 \left(\frac{Debt}{Equity}\right)_{i,t-1} + \beta_4 Gender_{i,t} + \beta_5 Age_{i,t} + \beta_6 Tenure_{i,t} + \beta_{7\dots16}(sector\ dummy\ variables) + \varepsilon_{i,t} \quad (\mathbf{12})$$

4. Results

4.1 Results on Firm Performance

As explained, the first developed model is based on equation (2) and contains the full model with firm performance as the dependent variable and CEO compensation as the main independent variable. All control variables, being CEO characteristics, firm characteristics (lagged by one year) and industry classifications are included in the model. The regression results are shown in Table 2. For completeness, the results are derived for the post-COVID scenario in model (1) and for all years 2006-2023 in model (2). Between the two models, the results are similar, except that in model (1) tenure and age are not significantly related to ROA, as well as a weaker relationship between CEO compensation and ROA. In general, this shows that although the link between CEO compensation and firm performance is weaker when only the ROA for 2023[5] is observed, the results are consistent with the trend observed in model (2). The weaker relationships can be explained as limiting the dataset to *t*=2023 reduces the sample size, increasing the impact of yearly variability and failing to capture long-term trends. The results from model (2) reveal that CEO compensation relates positively to firm performance at the 1% significance level. Based on this, it can be stated that higher CEO compensation is associated with increased firm performance, as measured by the ROA. This is in line with previously discussed literature findings (Core et al., 1999; Jensen & Murphy, 1990; Bebchuk & Fried, 2003).

Given that the first hypothesis expected CEO compensation to be positively related to firm performance in the post-COVID era, support for this hypothesis is found, as well as the confirmation of the general trend for all years 2006-2023. Additionally, firm size is significant at the 1% level, indicating that larger firms have increased firm performance. Theoretically, ROA should be independent of firm size. Because ROA is a ratio of net income to total assets given equation (1), it normalizes performance relative to a firm's asset base. An explanation for this could be that larger firms benefit more from economies of scale, have greater market power and better access to capital markets relative to smaller firms, all of which can positively contribute to firm performance (Polychroniou & Trivellas, 2018). The debt-equity ratio appears in model (2) as being negatively

[5] In this case, *t*=2023 is the only observed year for ROA. However, CEO compensation, firm size and the debt-equity ratio are lagged to the previous year at time *t*-1=2022.

related to firm performance, significant at the 5% level. This suggests that firms that take on relatively more debt (i.e., have more leverage) in general have lower firm performance. Leverage, in theory, can either influence firm performance positively because it enables the creation of opportunities for firm growth and expansion (Rothaermel, 2001), or negatively because of interest obligations and risks associated with financial distress (Jensen & Meckling, 1976).

Gender is not significantly related to firm performance in model (2). The age of a CEO relates negatively to firm performance, although the significance is not strong. Certain confounding factors could have been embedded in the age of a CEO, such as experience and risk-aversion, which would generally be expected to relate positively to firm performance. However, it could be the case that beyond a certain point, age could negatively affect firm performance, because of limitations in innovative or strategic ability, health, energy, or adaptability issues (Hambrick & Mason, 1984; Yim, 2013). However, the exact role of CEO age in investigating the relationship between CEO compensation and firm performance is outside the scope of this research. CEO tenure affects firm performance positively at the 1% level, conform expectations because it relates to CEO experience.

It must be noted again that the industry coefficients are relative to the benchmark sector materials. The significant industry coefficients suggest that in general, firm performance varies across different industries and the ROA is influenced by industry-specific factors.

What must additionally be noted here is that neither constant of both models in Table 2 is significant. This can have specific implications, while it does necessarily have to affect the accuracy of the model and its predictors. A non-significant constant value suggests that the mean value of ROA, the dependent variable, is not significantly different from zero when all independent variable have value zero. Given that it is unlikely that CEOs receive no compensation, nor that firm size or CEO age has value zero, the consequences for the reliability and robustness of these results are assumed to be limited.

Table 2 *The relationship between CEO compensation and firm performance: OLS regression estimates*

Independent Variables	Model (1)	Model (2)
Ln Compensation$_{t-1}$	0.008*	0.009***
	(0.004)	(0.001)
Firm size$_{t-1}$	0.008***	0.005***
	(0.003)	(0.001)
Debt-Equity ratio$_{t-1}$	-0.002**	-0.002***
	(0.001)	(0.000)
Gender	0.006	-0.003
	(0.010)	(0.003)
Age	-0.000	-0.000*
	(0.000)	(0.000)
Tenure	0.000	0.001***

	(0.000)	(0.000)
Sector: Energy	0.017*	-0.048***
	(0.010)	(0.004)
Sector: Industrials	-0.028***	-0.014***
	(0.009)	(0.002)
Sector: Consumer discretionary	-0.006	0.004*
	(0.008)	(0.002)
Sector: Consumer staples	0.004	0.010***
	(0.009)	(0.003)
Sector: Health care	-0.069***	-0.049***
	(0.012)	(0.003)
Sector: Financials	-0.044***	-0.026***
	(0.008)	(0.002)
Sector: Information Technology	-0.012	-0.018***
	(0.009)	(0.002)
Sector: Communication services	-0.068***	-0.045***
	(0.016)	(0.004)
Sector: Utilities	-0.035***	-0.028***
	(0.011)	(0.003)
Sector: Real estate	-0.049***	-0.032***
	(0.006)	(0.002)
Constant	-0.006	-0.011
	(0.043)	(0.011)
Observations	1,335	21,262
R^2	0.110	0.062
F-statistic	11.46	73.21
(p-value)	0.000	0.000

This is the full model for the first hypothesis, including controls for CEO characteristics, firm characteristics and sector characteristics. Model (1) is limited to the post-COVID scenario. *Model (2) includes all years 2006-2023. CEO compensation, firm size and the debt-equity ratio are lagged by one year. All independent variables are regressed against the ROA. ROA and the debt-equity ratio are winsorized at the 1% and 99% level. Note that some observations are dropped due to missing data. Standard errors are shown in parentheses. ***p<0.01, **p<0.05, *P<0.10.*

4.2 Results on Compensation Structures and Incentive Alignment

The regression results of how fixed and variable compensation affect firm performance can be found in Table 3. In Table 3 under model (1), the results without controls are shown. In this model, both fixed and variable compensation are positively related to firm performance, and they exhibit a similar strength in how they relate to firm performance, with the results being significant at the 1% level. In model (2), firm characteristics are included as controls. In this case, both fixed and variable compensation are significant at the 1% level and positively related to firm performance. It must be noted that the constant of this regression is not significant, the consequences of which are assumed to be limited. Additionally, model (3) includes both CEO characteristics and industry classifications as controls. The second hypothesis predicted that variable, incentive based compensation is positively related to firm performance. In the case of the full model being model (3), fixed compensation is not

significantly related to firm performance, while variable compensation is positively related to firm performance and significant at the 1% level. This may be explained by potential correlation with control variables that were not yet included in the limited models (1) and (2), but have been included in model (3). This supports the observation that in the full model, fixed compensation is not significantly related to firm performance, while variable compensation is. Consequently, support is found for the second hypothesis. Finally, in model (3), firm size and the debt-equity ratio are significant at the 1% level. The results suggest that ROA increases with firm size and decreases with the amount of leverage a firm takes on.

Table 3 *Compensation components as corporate governance structures: OLS regression estimates*

Independent Variables	Model (1)	Model (2)	Model (3)
Ln Fixed Compensation$_{t-1}$	0.007***	0.004***	0.000
	(0.001)	(0.001)	(0.001)
Ln Variable Compensation$_{t-1}$	0.007***	0.003***	0.004***
	(0.001)	(0.001)	(0.001)
Firm size$_{t-1}$		0.006***	0.006***
		(0.001)	(0.001)
Debt-Equity ratio$_{t-1}$		-0.002***	-0.002***
		(0.000)	(0.000)
Gender			-0.003
			(0.003)
Age			-0.000
			(0.000)
Tenure			0.001***
			(0.000)
Sector: Energy			-0.049***
			(0.004)
Sector: Industrials			-0.013***
			(0.003)
Sector: Consumer discretionary			0.005**
			(0.002)
Sector: Consumer staples			0.009***
			(0.003)
Sector: Health care			-0.049***
			(0.003)
Sector: Financials			-0.025***
			(0.002)
Sector: Information Technology			-0.017***
			(0.003)
Sector: Communication services			-0.047***
			(0.004)
Sector: Utilities			-0.029***
			(0.003)

Sector: Real estate			-0.033***
			(0.002)
Constant	-0.064***	-0.014	0.024*
	(0.009)	(0.009)	(0.012)
Observations	19,668	19,668	19,667
R^2	0.013	0.019	0.057
F-statistic	85.25	56.98	61.94
(p-value)	0.000	0.000	0.000

*Each model introduces an additional set of control variables, starting with no controls for model (1), controls for firm characteristics for model (2) and controls for CEO characteristics and industry categorizations for model (3). Fixed and variable CEO compensation, firm size and the debt-equity ratio are lagged by one year. All independent variables are regressed against ROA. ROA and the debt-equity ratio are winsorized at the 1% and 99% level. Note that some observations are dropped due to missing data. Standard errors are shown in parentheses. ***p<0.01, **p<0.05, *P<0.10.*

4.3 Results on the COVID-19 Crisis

Regarding the part of this study that is focused on crisis effects, the third hypothesis predicted that the relationship between CEO compensation and firm performance is weaker in the pre-COVID scenario compared to the post-COVID scenario. This refers back to equation (4). The regression results relating to this are shown in Table 4, model (1). The results show that with regard to the previously described model (2) from Table 2, the coefficients show a similar trend. With regard to the COVID-19 related effects on the relationship between CEO compensation and firm performance, the pre-COVID scenario is the reference. The interaction effect between the mid-COVID classifier and the natural logarithm of CEO compensation is insignificant. The same is true for the interaction effect between post-COVID and the natural logarithm of CEO compensation. This is not in line with previously discussed literature (Carter et al., 2024; Zattoni & Pugliese, 2021). However, this might be due to measurement errors (i.e., different data, variable definition of compensation), omitted variables, time period used for analysis, or other sample-related characteristics. Given that the third hypothesis predicted the relationship between CEO compensation and firm performance to be weaker pre-COVID compared to post-COVID, we do not find any support for this.

4.4 Results on the relative impact of the COVID-19 and 2008 Financial Crises

As explained before, the second part of the crisis related research is focused on investigating potential differences in how the financial crisis of 2008 and the COVID-19 crisis affect the relationship between CEO compensation and firm performance. This refers back to equation (5). The results are shown in Table 4, model (2). No significant differences are found for the interaction effects. The interaction effects capture potential differences in the relationship between CEO compensation and firm performance during the post-crisis periods relative to their respective pre-crisis periods for both the COVID crisis and the financial crisis of 2008. Therefore no conclusions can be drawn on whether the

relationship between post-crisis CEO compensation and firm performance is stronger compared to the pre-crisis scenario. Consequently, we cannot draw any conclusions on the relative effects of both crises on the relationship between CEO compensation and firm performance. The fourth hypothesis predicted that the financial crisis has a larger impact on the relationship of interest compared to the COVID-19 crisis. Thus, given the results we do not find support for the fourth hypothesis.

Furthermore, as opposed to model (1) from Table 4, the relation between CEO age and firm performance is significant at the 1% level. Furthermore, with the inclusion of both crises, a significant negative relationship between the male gender and firm performance is found. Given that this result was not found to be significant in model (1), it implies that this negative relationship is captured by effects related to the financial crisis of 2008, and that in general male CEOs realized worse firm performance relative to firms that had female CEOs. The potential reasons behind this relationship is outside the scope of this research.

Table 4 *The relationship between CEO compensation and firm performance; COVID-19 effects; crises comparison: OLS regression estimates*

Independent Variables	Model	
	(1); H3	(2); H4
Ln Compensation	0.013***	0.012***
	(0.003)	(0.001)
Firm size	0.005***	0.006***
	(0.001)	(0.001)
Debt-Equity ratio	-0.002***	-0.003***
	(0.000)	(0.000)
Gender	-0.005	-0.008**
	(0.004)	(0.003)
Age	-0.000	-0.000***
	(0.000)	(0.000)
Tenure	0.001***	0.001***
	(0.000)	(0.000)
Sector: Energy	-0.059***	-0.034***
	(0.007)	(0.005)
Sector: Industrials	-0.015***	-0.009***
	(0.004)	(0.003)
Sector: Consumer discretionary	-0.003	-0.001
	(0.003)	(0.002)
Sector: Consumer staples	0.002	0.007**
	(0.004)	(0.003)
Sector: Health care	-0.039***	-0.049***
	(0.005)	(0.004)
Sector: Financials	-0.028***	-0.029***
	(0.004)	(0.003)
Sector: Information Technology	-0.015***	-0.016***
	(0.004)	(0.003)
Sector: Communication services	-0.044***	-0.046***

	(0.006)	(0.005)
Sector: Utilities	-0.026***	-0.029***
	(0.005)	(0.004)
Sector: Real estate	-0.035***	-0.033***
	(0.003)	(0.002)
During COVID	-0.019	
	(0.028)	
Post COVID	0.004	0.000
	(0.041)	(0.035)
(During COVID)*(Ln Compensation)	0.002	
	(0.003)	
(Post COVID)*(Ln Compensation)	-0.001	0.000
	(0.005)	(0.004)
Post Financial Crisis		0.038
		(0.024)
(Post Financial Crisis)*(Ln Compensation)		-0.003
		(0.003)
Constant	-0.051***	-0.023
	(0.026)	(0.014)
Observations	8,671	16,299
R^2	0.072	0.067
F-statistic	27.49	47.38
(p-value)	0.000	0.000

*These are the full models for the third and fourth hypothesis, including controls for CEO characteristics, firm characteristics and sector characteristics. CEO compensation, firm size and the debt-equity ratio are not lagged by one year in these models. ROA and the debt-equity ratio are winsorized at the 1% and 99% level. All independent variables are regressed against the ROA. Interaction effects are included for both models. Note that some observations are dropped due to missing data. Standard errors are shown in parentheses. ***p<0.01, **p<0.05, *P<0.10.*

4.5 Results on the Robustness Checks

The first robustness check consists of the investigation of potential reverse causality issues. This refers to equations (6) to (8). For investigating reverse causality, the natural logarithm of CEO compensation is the dependent variable and ROA at *t*-1 the main independent variable. The same controls are included as in the context of equation (2). The regression results are shown in model (1) to (3) in Appendix B, Table B.1. Regarding model (1) to (3), each model introduces an additional set of control variables, starting with no controls in model (1), controls for firm characteristics in model (2) and controls for CEO characteristics and industry categorizations in model (3). In all models from table B.1, ROA is positively related to CEO compensation and significant at the 1% level. Looking at model (3), in contrast to the original model (2) from Table 2, age is positively related to CEO compensation. Additionally, the negative coefficient for gender (-0.068) is being significant on the 1% level. In fact, this suggests that male CEOs receive lower compensation than female CEOs in the context of this study, which is an interesting finding. The results suggest that there is risk of reverse causality in the context of this research due to the significant two-way relationship between CEO compensation and

firm performance. Because we are unable to distinguish between these effects, this prevents us from making causal inferences.

The second robustness check is performed by replacing ROA with Tobin's Q, corresponding with equation (10). The regression results are detailed in model (1) in Appendix B, Table B.2. The results are similar to model (2) from Table 2, in specific the positive relationship between CEO compensation on the one hand, and Tobin's Q as the proxy for firm performance on the other hand, being significant at the 1% level. Firm leverage and age are negatively related to Tobin's Q. However, as opposed to model (2) from Table 2, firm size is now negatively related to firm performance and significant at the 1% level. No comparisons can be made on the strength of the relationships between CEO compensation and ROA versus Tobin's Q, because they have different scales (i.e., the logarithmic scale of Tobin's Q and the continuous scale of ROA). In conclusion, these results confirm the overall robustness of the results when replacing ROA with Tobin's Q as the proxy for firm performance, but it highlights potential issues with regard to causal inference.

The third robustness check that has been implemented aims to account for any bias in terms of the previous inclusion of lagged effects (Bellemare et al., 2017). In the model from equation (2) corresponding to the first hypothesis, CEO compensation, firm size and the debt-equity ratio were lagged by one year. For this robustness check, these lagged effects are taken out of the regression analysis. Additionally, this aims to support the decision to have taken out the lags for investigating the third and fourth hypotheses. The regression results are detailed in the model from Appendix B, Table B.3, corresponding with equation (11). Compared to the results of the original model (2) from Table 2, CEO compensation, firm size and leverage and CEO tenure are again significantly related to firm performance at the 1% level. CEO tenure (0.001), the debt-equity ratio (-0.002) and age (-0.000) have the same coefficients as before. CEO compensation (0.011 as opposed to 0.009) and firm size (0.006 as opposed to 0.005) appear to be more strongly related to firm performance now that the lagged effects are taken out of the equation. This confirms that the results of the original model remain robust when the lags are removed, which supports the validity of our findings.

The fourth and final robustness check investigates potential bias in the estimation of firm size, relating to equation (12). This is done to account for potential bias arising from selecting a proxy for firm size that is not accurately representative of firm size. Therefore, as a fourth robustness check, instead of a firm's total assets, the number of employees is taken as the proxy for firm size and determined for each respective firm. The natural logarithm is then taken in order to account for a skewed distribution , thereby normalizing the distributing, similar to what was previously done with total assets. The regression results for this are shown in model (2) in Appendix B, Table B.2. What appears in comparison to model (2) from Table 2 is that CEO compensation relates less strongly to ROA when the number of employees is taken as a proxy for firm size (0.007 instead of 0.009), in both scenarios significant at the 1% level. The results are similar in terms of how the other control variables in the model relate to firm performance, although firm size relates more strongly to firm performance

in this model (0.008 instead of 0.005). It cannot be said with certainty which proxy for firm size is more reliable. However, given that the results are similar in case of both firm size proxies, this suggests that both can be regarded as valid determinants of firm size. The robustness of the original model full model (2) from Table 2 is confirmed regarding this.

5. Limitations & Recommendations

The single most important limitation is a causality issue. The scope of this research does not allow for causal inferences because not all the relevant data is analyzed that could be of influence in terms of the effect of CEO compensation on firm performance. This has several implications, the first being causal ambiguity. We cannot state whether CEO compensation influences firm performance or firm performance influences CEO compensation, i.e. reverse causality. Furthermore, we cannot know with certainty if both influence each other and if so, in what regard, or if other factors drive both.

In fact, there are potential confounders that are unobserved in this study. Examples are the educational backgrounds of CEOs (e.g., through the number of qualifications, the highest level of education completed, or the successful completion of a management-degree), other governance structures (e.g., ownership structure and board composition), and other firm characteristics. Potential omitted variable bias is also discussed regarding the second hypothesis. This means that the results from this study have limited internal validity. Therefore, as the main assumptions of regression analysis, the Conditional Independence Assumption (CIA) does not hold, and the assumption of linearity cannot be confirmed. The assumption of linearity should also be investigated in this context. Also, more control variables should be added to the model.

In order to improve the internal validity of this study, there are a number of possibilities. Other statistical techniques could be implemented, such as instrumental variables (IV) to control for endogeneity (Dor et al., 2006). Endogeneity can arise from omitted variable bias, reverse causality, or measurement errors, which are most probably present in this study. Fixed effects models could help to account for unobserved heterogeneity. Time-series analysis could provide stronger evidence for causality (e.g., through the assessment of long-term effects or the modelling of dynamic relationships), in order to gather a more accurate understanding of the relationship between CEO compensation and firm performance. This way, this relationship can be analyzed over time. This can account for temporal precedence, which is a criterion for causality. Granger causality tests could be implemented to test for the prediction of time series, which could provide stronger evidence for causal inference.

In order to improve the external validity of this study, the sample could be diversified. The S&P500 is limited to firms that are headquartered in the USA. Therefore, the research context could be broadened to other regions. Furthermore, the economic crises in this study are different from more often occurring business cycles. The 2008 financial crisis had a specific cause, namely the collapse of the housing bubble in the USA, which lead to mortgage default and liquidity issues in many of the major financial institutions. The crisis associated with the COVID-19 pandemic also had a clear cause,

being the pandemic. By focusing on smaller, recurring cyclical fluctuations in market conditions, the generalizability of this study could be improved. Focusing on the origin of recurring crises could provide relevant contributions to existing literature on this subject. Finally, other performance measures for firms could be implemented to further investigate the consistency and reliability of the results, as well as expand on this study to other contexts. It depends on the research context which measures would qualify for this.

5. Conclusion

Referring back to the first part of the main research question, as explained in the introduction, we come to the conclusion that CEO compensation is significantly and positively related to firm performance. Thus, support is found for the first hypothesis. The robustness checks also confirm the significance of this positive relationship. However, given the robustness check for reverse causality, we cannot conclude whether the main effect of this relationship works through CEO compensation on firm performance or the other way around. Because of this, as well as risks associated with omitted variable bias and confounding factors through unobserved variables, we cannot draw any conclusions with regard to the causal interpretation of a potential effect of CEO compensation on firm performance.

The second hypothesis was focused on investigating whether variable compensation that aligns a CEO's interests with a firm's shareholders contributes positively to firm performance. Variable compensation is positively related to firm performance and significant at the 1% level, as opposed to fixed compensation. This suggests that incentive-alignment oriented compensation affects firm performance positively. However, in this context, reverse causality could also be at play. Additional research is required to further investigate this.

The subject of the third and fourth hypotheses is the relationship between CEO compensation and firm performance and how this is affected by economic crises. The third hypothesis has a focus on the COVID-19 crisis, and the fourth hypothesis aims at comparing the effects of both the COVID-19 crisis and the financial crisis of 2008 on the relationship between CEO compensation and firm performance. No significant differences are found between the pre- and post-COVID scenarios in terms of the relationship between CEO compensation and firm performance, therefore finding no support for the third hypothesis. Given the fourth hypothesis, because a significant difference is not found for either the COVID-19 or the financial crisis, we are unable to draw any conclusions on the relative impact of both crises on the relationship between CEO compensation and firm performance. More research is required to further investigate this. It might be too early in the aftermath of the COVID-19 crisis to observe significant differences, as 2023 was selected as the only post-COVID year. There could be lagged effects that reveal themselves in the coming years. Therefore it could be expected that lagged effects will be revealed in 2024 and 2025.

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Appendix A

Table A.1 *Descriptive Statistics; COVID*

Variables; COVID	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
ROA pre-COVID (winsorized)	2,849	0.04	0.09	-0.52	0.29
ROA during COVID (winsorized)	4,477	0.04	0.08	-0.52	0.29
ROA post-COVID (winsorized)	1,345	0.04	0.10	-0.52	0.29
CEO compensation pre-COVID (USD in thousends)	2,849	8,177.20	8,419.71	40.07	140,310.80
CEO compensation during-COVID (USD in thousends)	4,477	9,622.87	9,695.47	31.43	166,594.80
CEO compensation post-COVID (USD in thousends)	1,345	9,231.98	11,767.89	0.00	186,994.10

CEO compensation displayed in 1000s. ROA is winsorized at the 1% and 99% level. Note that CEO compensation is not transformed yet to the natural logarithm as it will appear in the models.

Table A.2 *Descriptive Statistics; 2008 Financial Crisis*

Variables; 2008 Financial crisis	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
ROA pre-Financial crisis (winsorized)	1,693	0.06	0.10	-0.52	0.29
ROA during Financial crisis (winsorized)	2,295	0.02	0.12	-0.52	0.29
ROA post-Financial crisis (winsorized)	3,647	0.04	0.10	-0.52	0.29
CEO compensation pre-Financial crisis (USD in thousends)	1,693	8,785.44	116,095.10	0.00	4,773,420.00
CEO compensation during-Financial crisis (USD in thousends)	2,295	5,141.48	6,399.49	0.00	80,397.88
CEO compensation post-Financial crisis (USD in thousends)	3,647	5,877.21	6,094.79	6.65	84,442.23

CEO compensation displayed in 1000s. ROA is winsorized at the 1% and 99% level. Note that CEO compensation is not transformed yet to the natural logarithm as it will appear in the models.

Table A.3 *Correlation matrix of dependent, independent and main control variables*

		1	2	3	4	5	6	7
1	ROA	1.00						
2	Ln(CEO Compensation)$_{t-1}$	0.14	1.00					
3	Firm size$_{t-1}$	0.12	0.59	1.00				
4	D/E-ratio$_{t-1}$	-0.04	0.07	0.14	1.00			
5	Gender	-0.01	-0.03	-0.02	-0.02	1.00		
6	Age	0.03	0.09	0.10	0.01	0.03	1.00	
7	Tenure	0.04	-0.08	-0.11	-0.04	0.07	0.46	1.00

CEO compensation is transformed to the natural logarithm. The natural logarithm of CEO compensation, firm size and firm leverage are lagged by one year.

Table A.4 *Descriptive Statistics; Compensation components*

Variables; Compensation components	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
Salary	20,012	874.85	466.08	-	20,000
Other annual compensation	-	-	-	-	-
Other compensation	20,012	311.86	2,742	-758.69	252,772
Bonus	20,012	212.93	1,168	-8.72	76,951
LTIP	-	-	-	-	-
Stock awards	20,012	3,521	6,718	-7,230	280,200
Option awards	20,012	1,373	16,700	-2,018	2,283,989

CEO compensation components displayed in 1000s. Note that CEO salary is not transformed yet to the natural logarithm as it will appear in the models.

Appendix B

Table B.1 *Robustness checks for reverse causality: OLS regression estimates with CEO compensation as the dependent variable*

Independent Variables	Model (1)	Model (2)	Model(3)
ROA_{t-1}	1.679***	0.736***	0.710***
	(0.084)	(0.065)	(0.064)
Firm $size_{t-1}$		0.359***	0.380***
		(0.005)	(0.006)
Debt-Equity $ratio_{t-1}$		-0.005*	-0.005*
		(0.003)	(0.003)
Gender			-0.068***
			(0.024)
Age			0.005***
			(0.002)
Tenure			-0.006***
			(0.001)
Sector: Energy			-0.008
			(0.025)
Sector: Industrials			0.080***
			(0.017)
Sector: Consumer discretionary			0.141***
			(0.018)
Sector: Consumer staples			0.028
			(0.023)
Sector: Health care			0.282***
			(0.020)
Sector: Financials			-0.316***
			(0.025)
Sector: Information Technology			0.133***
			(0.024)
Sector: Communication services			-0.171**
			(0.070)
Sector: Utilities			-0.614***
			(0.051)
Sector: Real estate			-0.177***
			(0.025)
Constant	8.368***	8.012***	7.787***
	(0.009)	(0.008)	(0.083)
Observations	21,268	21,268	21,262
R^2	0.025	0.342	0.361
F-statistic	395.92	1689.07	595.81
(p-value)	0.000	0.000	0.000

These are the adjusted models for the robustness checks for reverse causality, including controls for CEO characteristics, firm characteristics and sector characteristics. ROA, firm size and the debt-equity ratio are lagged by one year. All independent variables are regressed against CEO compensation. Regarding model (1) to (3), each model introduces an additional set of control variables, starting with no controls for model (1), controls for firm characteristics for model (2) and controls for CEO characteristics and industry categorizations for

*model (3). ROA and the debt-equity ratio are winsorized at the 1% and 99% level. Note that some observations are dropped due to missing data. Standard errors are shown in parentheses. ***p<0.01, **p<0.05, *P<0.10.*

Table B.2 *Robustness checks for Tobin's Q; Firm size: OLS regression estimates*

	Tobin's Q	Firm size
Independent Variables	Model (1)	Model (2)
Ln Compensation$_{t-1}$	0.080***	0.007***
	(0.008)	(0.001)
Firm size$_{t-1}$	-0.070***	0.008***
	(0.004)	(0.001)
Debt-Equity ratio$_{t-1}$	-0.009***	-0.002***
	(0.001)	(0.000)
Gender	-0.015	-0.003
	(0.017)	(0.003)
Age	-0.005***	-0.000**
	(0.001)	(0.000)
Tenure	0.005***	0.001***
	(0.001)	(0.000)
Sector: Energy	-0.342***	-0.034***
	(0.014)	(0.004)
Sector: Industrials	-0.149***	-0.007***
	(0.012)	(0.003)
Sector: Consumer discretionary	-0.016	0.002
	(0.012)	(0.002)
Sector: Consumer staples	0.152***	0.013***
	(0.017)	(0.003)
Sector: Health care	0.257***	-0.041***
	(0.014)	(0.003)
Sector: Financials	-0.182***	-0.008***
	(0.014)	(0.002)
Sector: Information Technology	0.136***	-0.012***
	(0.014)	(0.003)
Sector: Communication services	-0.114***	-0.037***
	(0.019)	(0.004)
Sector: Utilities	-0.186***	-0.011***
	(0.021)	(0.003)
Sector: Real estate	-0.152***	-0.003
	(0.012)	(0.003)
Constant	0.273***	-0.005
	(0.077)	(0.010)
Observations	21,143	21,010
R^2	0.163	0.072
F-statistic	242.49	80.01
(p-value)	0.000	0.000

*These are the adjusted models for the robustness checks for Tobin's Q (model 1) and firm size (model 2), including controls for CEO characteristics, firm characteristics and sector characteristics. CEO compensation, firm size and the debt-equity ratio are lagged by one year. All independent variables are regressed against ROA. ROA and the debt-equity ratio are winsorized at the 1% and 99% level. Note that some observations are dropped due to missing data. Standard errors are shown in parentheses. ***p<0.01, **p<0.05, *P<0.10.*

Table B.3 *Robustness check for lagged effects: OLS regression estimates*

Independent Variables	Model
Ln Compensation	0.011***
	(0.001)
Firm size	0.006***
	(0.001)
Debt-Equity ratio	-0.002***
	(0.000)
Gender	-0.004
	(0.003)
Age	-0.000**
	(0.000)
Tenure	0.001***
	(0.000)
Sector: Energy	-0.046***
	(0.004)
Sector: Industrials	-0.013***
	(0.002)
Sector: Consumer discretionary	0.003
	(0.002)
Sector: Consumer staples	0.008***
	(0.002)
Sector: Health care	-0.052***
	(0.003)
Sector: Financials	-0.028***
	(0.002)
Sector: Information Technology	-0.019***
	(0.002)
Sector: Communication services	-0.044***
	(0.004)
Sector: Utilities	-0.029***
	(0.003)
Sector: Real estate	-0.033***
	(0.002)
Constant	-0.025***
	(0.011)
Observations	23,022
R^2	0.075
F-statistic	83.66
(p-value)	0.000

*This is the adjusted model for the robustness check for lagged effects, including controls for CEO characteristics, firm characteristics and sector characteristics. CEO compensation, firm size and the debt-equity ratio are not lagged by one year, as opposed to before. All independent variables are regressed against ROA. ROA and the debt-equity ratio are winsorized at the 1% and 99% level. Note that some observations are dropped due to missing data. Standard errors are shown in parentheses. ***p<0.01, **p<0.05, *P<0.10.*