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Does Executive Compensation Negatively Affect Firm Performance in a Crisis?

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Abstract

The goal of this research is to assess the effect of types of executive compensation on firm performance in the recent COVID-19 crisis in the Netherlands. The reason for this is that good corporate governance mechanisms depend on organizational and environmental circumstances, which differed during the COVID-19 crisis. Hence, this research answers the following research question: 'What is the role of certain forms of executive compensation on firm performance during the COVID-19 crisis in the Netherlands?'. The research has been conducted using a fixed-effects regression analysis from panel data about the Netherlands' 67 largest listed firms. It can be concluded that incentive executive compensation positively impacts return on equity during crisis times. Furthermore, total executive compensation negatively impacts Tobin's Q during crisis times. However, most effects of types of executive compensation on firm performance were non-significant in crisis times. Thus, if firms want to alter their executive compensation, they should apply incentive-style compensation structures to improve firm performance during crisis times.

Keywords: Corporate Governance, COVID-19 Crisis, Firm Performance, Executive Compensation

JEL codes: G34 & M12

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1. Introduction

The role of corporate governance on firm performance in regular times has been widely discussed in the literature. However, less research has been done on the role of corporate governance on firm performance in crisis times, especially in the most recent crisis, the COVID-19 pandemic.

Most research on corporate governance on firm performance in crisis times focuses on the financial/credit crisis. Van Essen et al. (2013) suggest that firm- and country-level good governance prescriptions may not hold in a financial crisis. Using data from the EU, Van Essen et al. (2013) found that CEO duality positively affects firm performance in the financial crisis. On the contrary, Grove et al. (2011) found that CEO duality had a negative effect on a bank's financial performance in crisis times. Engelen et al. (2012) show that age diversity, expertise diversity, and background diversity have a relationship with firm financial performance during the financial crisis in Dutch listed companies. Yeh et al. (2011) researched the effects of corporate governance in financial institutions during the 2007-2008 credit crunch. This research found that financial institutions with more independent directors of the audit and risk committees performed better during the crisis (Yeh et al., 2011).

Furthermore, incentive compensation and the distance in ownership and control have had a negative impact on corporate performance during the financial crisis (van Essen et al., 2013). However, Grove et al. (2011) showed that executive incentive pay is positively related to financial performance in the wake of the financial crisis. Furthermore, the effect of some types of executive compensation differs in crisis and non-crisis times (Mehran, 1992), which is in line with the finding that good governance prescriptions may not hold in a financial crisis (van Essen et al., 2013). This shows that there are contradictions in the effect of executive compensation mechanisms on firm performance in crisis times and between crisis and non-crisis times.

Out of the previously mentioned results, firms may want to adapt or prepare their corporate governance mechanisms in or for crisis times. Therefore, it is of interest to research whether these relationships hold for more than only the financial crisis. Moreover, Shen et al. (2020) found that COVID-19 negatively affects firm performance in China. Thus, this research will focus on corporate governance in the most recent crisis, namely the COVID-19 crisis.

Furthermore, it is of interest to know whether types of executive compensation affect firm performance in crisis times, because of the contradicting view of recent research. For this reason, this research focuses on the effect of types of executive compensation on firm performance in the COVID-19 crisis in the Netherlands. Hence, the research question is as follows: What is the role of certain forms of executive compensation on firm performance during the COVID-19 crisis in the Netherlands?

This research contributes to research for several reasons. First, Van Essen et al. (2013) suggest that more research is needed to understand optimal governance. Second, the recent new crisis may lead to new insights into the field of corporate governance. Therefore, this research's contribution is twofold. First, it contributes to the literature by assessing types of executive compensation on firm performance. Second, it contributes to the literature by applying insights from previous research into the most recent crisis, the COVID-19 crisis. Furthermore, the practical contribution of this research is that organizations will have an increased understanding on how to organize their corporate governance mechanisms in times of or prior to crises. In summary, research in this area contributes to the understanding of corporate governance in crisis times.

2. Literature review and theoretical framework

2.1 Agency theory

To get a better understanding of corporate governance and its mechanisms, the agency theory has to be defined first. The agency relationship is a relationship between an agent and a principal, the principal wants the agent to operate the firm in the best interest of the principal (Jensen & Meckling, 1976). However, this is not necessarily the case. The agent may operate in the best interest of him-/herself if it focuses on maximizing utility (Jensen & Meckling, 1976). Therefore, the principal imposes monitoring and incentives to ensure that the agent acts in the best interest of the principal (Jensen & Meckling, 1976). The principal imposes these actions to reduce the agency costs, the costs of an agency relationship (Jensen & Meckling, 1976). The reduction of the agency costs and relationship is named the agency theory (Jensen & Meckling, 1976). In corporate governance, this principal-agent relation also exists between groups. Thus, there is a conflict of interest in corporate governance. According to Maurovic and Hasic (2013), this problem occurs in three forms: 1) between directors (agents) and shareholders (principals), 2) between majority shareholders (agents) and minority shareholders (principals) and 3) between directors/majority shareholders who participate in corporate governance (agents) and stakeholders who do not take part in the management of the company (principals). To reduce agency costs, organizations implement corporate governance mechanisms to account for the agency problem (Maurovic & Hasic, 2013).

2.2 Resource dependence theory

The resource dependence theory focuses on the impact non-executive directors can have on the resources, the external environment, and market uncertainties (Abdullah et al., 2020). Thereby, Abdullah et al. (2020) mention the following: "… non-executive directors are able to raise the business's opportunities to generate funds or enhance the business's reputation and status." (p. 487). Thus, non-executive directors can increase the access to resources of the company, which affects the performance of the company. According to Van Essen et al. (2013), a board of directors provides resources to the company. Therefore, the board of directors and corporate governance cope with the resource dependence theory.

2.3 Stewardship theory

The stewardship theory argues that the board of directors on their own, without the protection of separation (like the agency theory suggests), maximize shareholder interests (Donaldson &

Davis, 1991). The company managers are referred to as stewards of the shareholders (Abdullah et al., 2020). In addition, the managers are motivated, knowledgeable, and experienced on their own and therefore create higher shareholder returns (Donaldson & Davis, 1991). Therefore, this theory has an impact on corporate governance mechanisms.

2.4 Corporate Governance

Good corporate governance accounts for the described theories. According to Ho (2005), corporate governance is defined as follows:

> Corporate governance is defined … as the structure and processes among the board of directors, shareholders, top management and other stakeholders, and involves the roles of the stewardship process and exercising strategic leadership, and the objectives of assuring accountability and improving performance. (p. 212)

Firms focus on good corporate governance mechanisms to ensure accountability and performance.

There are several firm and country good corporate governance mechanisms that strengthen corporate value/firm performance in ‘regular times. These mechanisms are as follows: board diversity, board independence, CEO characteristics, remuneration, oversight, and other topics (such as CEO duality) (B. Khan et al., 2018). Other researchers imply different mechanisms for enhancing firm performance using corporate governance mechanisms. These mechanisms include independence and vigilance of the board, the separation of leadership, incentive alignment between managers and owners, and legal protection of creditors and minority shareholders (Jensen & Murphy, 1990; Porta et al., 1998). However, Ho (2005) defines the following corporate governance mechanisms: board structure, ownership, managerial compensation, social responsibility, board politics, and the impact of internationalization.

Board structure

The board of a company is responsible for overseeing the executive managers on behalf of the shareholders (Uadiale, 2010). The performance of the board and therefore the firm depends on the effectiveness of the board (Uadiale, 2010). The following factors impact board effectiveness: board composition, quality, size, duality, diversity, information asymmetries, and board culture (Brennan, 2006).

The effect of board composition on firm performance provides contradicting views in research, most researchers indicate that there is a positive impact on firm performance

(Brennan, 2006). However, there are also a few studies that indicate that board composition negatively affects firm performance (Brennan, 2006). The quality of the board is mostly assessed using the educational background (Hambrick & Mason, 1984). Hambrick and Mason (1984) found that a firm’s performance is more variable in firms with managers who had less education.

Board diversity consists of several dimensions namely nationality, gender, level of education, field of education, expertise, socioeconomic background, and age (Engelen et al., 2012). However, most of the focus on diversity is on gender and ethnic diversity (Daily & Dalton, 2003). In the literature, there are mixed findings on the effect of diversity on firm performance (Abdullah et al., 2020; Engelen et al., 2012).

A larger board size reduces environmental uncertainties because there is more access to resources than on smaller boards (Goodstein et al., 1994). In addition, it provides more diversity, because of the different backgrounds of board members (Goodstein et al., 1994). On the other hand, a larger board slows down the decision-making process (Yermack, 1996). The effect of board size on firm performance shows mixed results as well (Uadiale, 2010).

Board independence potentially reduces the agency problem, because independent board members can improve the process of decision-making (Yeh et al., 2011). A board member is considered independent when the person is not an employee or shareholder of the company currently or in the past (Hooghiemstra & van Manen, 2004). Thereby, the person has no other interests in the company (Hooghiemstra & van Manen, 2004).

Board ownership tends to reduce the agency relationship because the board member is a shareholder him-/herself (Uadiale, 2010). Thus, an executive-shareholder will not take actions that are harmful to the firm's value. So, this suggests it improves firm performance. However, there are contradicting views on the effect of board ownership on firm performance (Uadiale, 2010).

Board politics can generate benefits to a company because the board can have an impact on the laws and regulations of the government (Brogaard et al. in Abdullah et al., 2020). However, the effect of board politics on firm performance is mixed (Abdullah et al., 2020). Maaloul et al. (2018) find that board politics have a positive impact on firm performance. However, Ling et al. (2016) find that political connections are negatively related to the return on assets.

Executive compensation/Remuneration

Firms design mechanisms such as compensation plans for executives to enhance firm value and cope with agency and moral hazard problems (Bebchuk & Fried, 2003). Therefore, the prediction is that CEO compensation positively affects firm value. Conyon and He (2012), confirm this relationship.

The performance or variable compensation puts focus on the firm's objectives. As mentioned by Grove et al. (2011), executives have a higher impact on annual earnings than on stock performance. Thereby, a performance bonus is short-term focused, because it is assessed on accounting measures like earnings per share (Grove et al., 2011). In addition, Grove et al. (2011) found that incentive pay or variable pay positively affects firm value during non-crisis times.

Stock-based/equity-based variable compensation can account for agency costs by aligning the interests of the stakeholders and the shareholders (Grove et al., 2011). So, this leads to a positive impact on firm value, as supported by Hall and Liebman (1998). However, stock-based compensation has some drawbacks. Grove et al. (2011) state that: "Excessive stock-based compensation relative to other forms of compensation (such as salary) may encourage risk-taking" (p. 423). So, the stock-based compensation and salary have to be in balance with each other. Furthermore, Mehran (1992) found that there is a positive relationship between stock-based compensation and leverage, which implies that incentive compensation leads to more risk-taking behavior. Second, other researchers imply that stock options lead to managers focusing on the short-term and taking more risks, which can worsen the long-term firm value and therefore performance (Agrawal & Mandelker, 1987; Peng & Roell, 2008).

Furthermore, several variables could be used to assess the effect of executive compensation on firm performance. Grove et al. (2011) use two variables for operationalizing executive compensation. The variable long-term mix includes the fraction of total annual CEO compensation of performance plans, stock options, and restricted stock grants (Grove et al., 2011). The variable accounting mix uses the fraction of total annual CEO compensation of performance plans and annual bonuses (Grove et al., 2011). Van Essen et al. (2013), bases the variables used in the study of Grove et al. (2011) on two variables; variable pay and stock options. Variable pay is the fraction of the CEO variable cash bonus to total CEO cash compensation and stock option is a binary variable whether firms use stock options plans or not (van Essen et al., 2013). Furthermore, Sheikh et al. (2018), use total compensation and cash compensation for determining executive compensation.

Firm performance

Most mechanisms described before affect firm performance. Researchers use different variables for assessing firm performance. Bhagat and Bolton (2008) use return on assets (ROA), stock return, Tobin's Q, Last 2 years' performance for ROA, Tobin's Q, and industry performance. However, Saleh et al. (2021) only uses return on assets, return on equity and earnings before interest and taxes as firm performance measures. In addition, the excess/abnormal return and non-performance assets ratio are used as performance measures (Grove et al., 2011; van Essen et al., 2013). In summary, the firm performance can be assessed various ways. However, most papers use stock return, return on equity, return on assets, abnormal returns, and Tobin's Q. Return on equity and return on assets are considered accounting-based firm performance metrics and stock return, abnormal return, and Tobin's Q are considered market-based firm performance metrics.

2.5 The effect of Corporate Governance in Crisis times

Good corporate governance mechanisms during 'regular' times are described in the previous section. However, Van Essen et al. (2013) found that good corporate governance mechanisms depend on organizational and environmental circumstances. Therefore, good corporate governance mechanisms differ in crisis times. Thus, practitioners should alter their corporate governance decisions in or prior to crises, to cope with the crisis. In addition, good corporate governance mechanisms in crisis times could positively affect firm performance (van Essen et al., 2013).

COVID-19 crisis

The most recent crisis is the COVID-19 crisis. COVID-19 is caused by the SARS-CoV-2 virus. In March 2020, the World Health Organization (WHO) declared the virus a global pandemic (*Coronavirus Disease (COVID-19)*, n.d.). The COVID-19 crisis and the lockdown to reduce the spread of the virus had deep effects on the lives of people around the world, for example, accessibility to education, food insecurity, depression of the global economy, mental health challenges, and well-being of people (Onyeaka et al., 2021). Therefore, the COVID-19 crisis changed the environmental and likely also organizational circumstances. Thus, using the theory from Van Essen et al. (2013), this suggests that good corporate governance mechanisms differed during the COVID-19 crisis. For this reason, this research focuses on the most recent COVID-19 crisis.

The COVID-19 crisis caused, as mentioned before, a depression of the global economy. This means that firms generally have a lower economic performance. Thus, the effect of types of executive compensation on firm performance may differ. The reason for this is that some compensation plans for example affect the leverage of firms, because of decisions of the board. A lot is known about the effects of good corporate governance during the credit crisis. However, little is known about corporate governance mechanisms during the most recent COVID-19 crisis. Therefore, this research focuses on types of executive compensation on firm performance during the COVID-19 crisis.

2.6 Executive compensation on firm performance in crisis times

In this section, three hypotheses are developed based on the effect of types of executive compensation on accounting- and market-based firm performance metrics. In addition, the hypotheses are developed on how the effect of executive compensation might differ in crisis times, based on the previous section.

As explained in the previous section, stock options lead to more risk-taking and a higher leverage ratio. A higher leverage ratio is most likely more profitable in an economic upswing, however this has negative effects on the firm performance in an economic downswing, due to higher interest rates and cost of debt (Mehran, 1992; van Essen et al., 2013). Thus, the expectation is that stock options negatively affect firm performance during the COVID-19 crisis. Therefore, the hypothesis is as follows:

H1: Stock options negatively affect firm performance during the COVID-19 crisis, ceteris paribus

Executive cash compensation focuses more on the past and short-term. This could lead to a temporary increment in performance, however this is at cost of the long-term performance (Grove et al., 2011). In addition, Grove et al. (2011) found that variable executive pay has a positive impact on firm performance before the crisis, but no effect during crisis times. Furthermore, Fahlenbrach and Stulz (2011) found that CEOs in the banking industry, with good incentive alignment, performed worse in the crisis time. Thus, this suggests that executive cash compensation negatively affects firm performance in crisis times. Therefore, the hypothesis is as follows:

H2: Executive cash compensation negatively affects firm performance during the COVID-19 crisis, ceteris paribus

The majority of executive directors' salaries are based upon base salary. The rest of the total executive compensation mainly consists of stock options, cash compensation, and pension benefits. Base salary has no incentive effect and for this reason is not expected to increase company performance in crisis as well as non-crisis times. Furthermore, it is mentioned in the literature that incentive compensation leads to an increase in the value of the firm in non-crisis times (Conyon & He, 2012). Because the literary expectations are that stock options and cash compensation have a negative effect on company performance in crisis times and base salary has little incentive, it is expected that total executive compensation also has a negative effect on firm performance in crisis times. Therefore, the hypothesis is as follows:

H3: Total compensation negatively affects firm performance during the COVID-19 crisis, ceteris paribus

All in all, this research focuses on the effect of types of executive compensation on firm performance during an economic downswing (the COVID-19 crisis) when there are different good corporate governance mechanisms than in regular times.

3. Methodology and Empirical Strategy

This section describes the research approach, which includes the data collection and analysis as well as the operationalization of the research question to ensure the reliability of the research. In addition, the validity of the research is ensured by using and describing renowned data sources and often-used dependent, independent, and control variables. Lastly, the final model, with the used variables, is mentioned.

3.1 Data collection

The data for this research has been gathered from Factset and Refinitiv Eikon. Factset is a global financial services company which is specialized in providing data about financial markets. Therefore, Factset is an often-used platform for retrieving data in economic/financial academic research.

Refinitiv Eikon is a global financial services company that provides news, information, and analytics about financial markets. Therefore, Refinitiv Eikon is an often-used platform for retrieving data in economic/financial academic research.

The sample includes data from the largest Dutch-listed firms. The data covers the period of 2018, 2019, 2020, and 2021. The COVID-19 rules and regulations were in 2020 and 2021. 2018 and 2019 were non-crisis times. The dataset is panel data because the dataset covers multiple measurements in time over multiple variables. Twenty-two firms had an initial public offering after 2018. To ensure balanced panel data, these firms have been removed from the dataset because including these companies leads to non-randomly missing data. In addition, eleven firms contained missing data. These firms have been excluded from the dataset. The dataset preparation has been done using R. The R-script is in Appendix 1: Data wrangling. The final sample contains 67 companies with in total 268 observations. The final sample is listed in Appendix 2: Final Sample of Dutch Companies.

3.2 Dependent variables

In this study, the effect of executive compensation on firm performance is assessed. However, there are several metrics for measuring firm performance. In this research, the most applied measures of firm performance are used. Thus, the dependent variables are stock return, abnormal return, return on assets (ROA), return on equity (ROE), and Tobin’s Q (Bhagat & Bolton, 2022; Saleh et al., 2021; van Essen et al., 2013).

3.3 Independent variables

The variables for measuring executive compensation have been described in the literature review. For this research, the most used independent variables for board/executive compensation will be used. The independent variables for this research are stock options, cash compensation, and total executive compensation (Grove et al., 2011).

3.4 Control variables

Control variables are used in the model to ensure the validity of the study. This is done to reduce the effect of confounding variables and missing variables. The most used control variables for firm performance are firm size, firm age, board size, board independence, institutional ownership, and ownership concentration (Shen et al., 2020). In addition, the following firm control variables are included to limit the effect of confounding variables: leverage, return volatility, multinationalism, and industry performance (Brunello et al., 2001; Core et al., 2006). Furthermore, the following executive control variables are mentioned in the literature: board education, board gender, board age, and board nationality (Brunello et al., 2001; Engelen et al., 2012).

3.5 Model

The research is conducted using multiple regression analysis. The models are estimated using Ordinary Least Squares (OLS), as done often in literature (al Farooque et al., 2020; K. Khan et al., 2020). The variables used are described in Table 3-1. When a variable is excluded, it is mentioned in the description.

Table 3-1 Variables used in this study

Variable name	**Abbreviation**	**Variable type**	**Description**
Return on assets	ROA	DV (dependent variable)	The EBIT divided by the total assets
Return on equity	ROE	DV	The EBIT divided by the total equity
Stock return	SR	DV	The ending stock price (t=1) minus the initial stock price (t=0) plus dividends divided by the initial stock price.
Abnormal return	AR	DV	The stock return (%) minus the expected industry return.
Tobin's Q	TQ	DV	Enterprise value divided by the total asset replacement value

Stock options	SO	IV (independent variable)	Dummy variable whether stock options are used or not
Cash compensation	CC	IV	The amount of executive variable cash compensation to market capitalization
Total compensation	TEC	IV	The total executive compensation to market capitalization
Firm size	FS	CV (control variable)	Logarithm of total assets. Has been excluded due to multicollinearity.
Firm age	FA	CV	Logarithm of the time since the initial public offering of the firm.
Board independence	BI	CV	Ratio of non-executive directors on the board divided by total directors
Institutional ownership	IO	CV	The percentage of shares owned by institutions
Ownership concentration	OC	CV	The percentage of shares held by the largest shareholder
Firm leverage	FL	CV	Total company's debt divided by the shareholder's equity
Board size	BS	CV	The number of members on the supervisory board
Multinationalism	M	CV	Dummy whether the firm operates internationally or not. Has been excluded due to a lack of variance.
Sector	S	CV	The sector in which the firm operates. Dummy variables. Has been excluded due to the fixed-effects model (time-invariant).
Return volatility	RV	CV	The 5-year beta of the firm. Has been excluded due to the fixed-effects model (time-invariant).
Industry performance	IP	CV	The performance of the industry in Alpha sector rank provided by Refinitiv.
Education of the board	BE	CV	Board-specific skills, the percentage of board members that have industry-specific or financial/economic knowledge.
Executive age	EA	CV	The age of the executive. Time-invariant due to data availability Refinitiv Eikon.

			Has been excluded due to the fixed-effects model.
Gender of the board	BG	CV	The percentage of women on the board.
Nationality of the board	BN	CV	The percentage of board members that have a cultural background different from the location of the corporate headquarters.

The models have been tested on the assumptions of linearity, exogeneity, homoskedasticity, non-autocorrelation, non-stochasticity, and no (perfect) multicollinearity. For the linearity, a residuals vs fitted model has been plotted. The models are linear as the residuals are spread around the zero line. In addition, the line through the model is almost linear and no outliers are detected.

The exogeneity has been tested using a Hausman test. The Hausman test returns a low P-value, so the null hypothesis is rejected. This implies that one model is inconsistent, so we have to use the fixed-effects model.

The homoskedasticity has been tested using a Breusch-Pagan test. The Breusch-Pagan test returns a very low P-value, so we reject the null hypothesis of homoskedasticity. The standard errors need to be corrected for heteroskedasticity.

Non-autocorrelation has been tested using the Breusch-Godfrey test. Durbin-Watson has not been used, because this test only accounts for autocorrelation up to order one. The test returns a very low P-value, so we reject the null hypothesis, which means there is serial correlation in the dataset. The standard errors need to be corrected for heteroskedasticity and serial correlation. So, Newey-West standard errors should be used.

The non-stochasticity of the independent variables has been tested using the Dickey-Fuller test. The Dickey-Fuller test returns a very low P-value, so the model is stationary and has no unit root.

Lastly, multicollinearity has been tested using the Variance Inflation Factor (VIF). The variable firm size (FS) has a VIF higher than five, which implies that there is severe multicollinearity. The variable firm size (FS) correlates highly with board size (BS) and total executive compensation (TEC). Therefore, this variable has been removed from the model. Appendix 3: VIF values of the model shows the VIF values before and after the removal of FS.

As mentioned before, the fixed-effects model is most appropriate. However, this model accounts for the time-invariant variables. Therefore, the time-invariant variables return volatility (RV), executive age (EA) and the sector dummy variables have been automatically excluded from the model. In addition, the multinationalism variable has been removed, because all firms in the dataset operate internationally. A variable to account for multinationalism like the percentage of sales abroad is not possible to include because neither Refinitiv Eikon nor Factset, provides data on that.

In conclusion, the models are estimated using fixed-effects with Newey West standard errors to account for serial correlation and heteroskedasticity. The assumption testing has been done with R, the R-script is in Appendix 4: Data analysis. The final model, with the used variables, is as follows:

$$FP_{it} = \beta_1 SO_{it} + \beta_2 CC_{it} + \beta_3 TEC_{it} + \beta_4 FA_{it} + \beta_5 BI_{it} + \beta_6 IO_{it} + \beta_7 OC_{it} + \beta_8 FL_{it} + \beta_9 BS_{it} + \beta_{10} IP_{it} + \beta_{11} BE_{it} + \beta_{12} BG_{it} + \beta_{13} BN_{it} + year_{it} + \varepsilon_{it}$$

4. Results

The goal of the results section is to gain insight into the role of types of executive compensation on firm performance in the Netherlands during the COVID-19 crisis. The results are described using the five dependent variables for the crisis and non-crisis times. The non-crisis time has no effect on the hypotheses. However, the non-crisis time is of interest for the difference between the crisis and non-crisis times. To get insights into the variables, the summary statistics during crisis and non-crisis times of the variables are shown in Table 4-1.

The correlation matrix of all the variables gathered in the dataset are shown in Table 4-2. All variables are shown because the correlation matrix supports omitting firm size (FS), because of the high correlation with firm size, board size (BS) and total executive compensation (TEC).

Table 4-1 Summary Statistics of the Variables Used in the Model

	ROA	ROE	TQ	SR	AR	SO	CC	TEC	FA
Min	-48.37	-73.12	0.01	-71.01	-5085.32	0.00	0.00	37.66	-0.60
1st Q	0.85	5.49	0.46	-14.63	-92.39	1.00	44.62	526.16	1.87
Median	4.98	13.30	0.80	6.96	8.71	1.00	270.56	1619.61	3.14
Mean	4.75	19.41	1.33	13.28	12.69	0.85	598.10	2699.44	2.83
3rd Q	8.97	22.24	1.40	33.21	90.96	1.00	804.12	3484.36	3.53
Max	38.07	824.00	13.88	403.24	6736.34	1.00	9192.17	23320.48	4.76

	BI	IO	OC	FL	BS	IP	BE	BG	BN
Min	33.33	8.96	0.00	-8.02	2.00	2.00	0.00	0.00	0.00
1st Q	98.91	39.21	5.88	29.40	5.00	31.00	16.67	22.86	0.00
Median	100.00	52.74	12.22	64.28	6.00	54.00	37.50	33.33	24.58
Mean	94.96	52.52	18.70	106.37	6.76	54.48	38.95	30.39	28.22
3rd Q	100.00	65.19	25.00	117.90	8.00	79.25	55.95	40.00	46.08
Max	100.00	100.00	73.00	921.74	20.00	100.00	100.00	67.00	100.00

Table 4-2 Correlation Matrix

	Year	ROA	ROE	SR	AR	TQ	SO	CC	TEC	FS	FA	BI	IO	OC	FL	BS	IP	RV	BE	EA	BG	BN	[2]SBM	SCC	SCNC	SE	SF	SH	SI	SRE	ST
Year	1.00																														
ROA	0.04	1.00																													
ROE	-0.03	0.32	1.00																												
SR	0.25	0.33	0.07	1.00																											
AR	0.09	0.17	0.05	0.41	1.00																										
TQ	0.08	0.29	0.05	0.49	0.07	1.00																									
SO	0.03	0.01	0.01	0.07	0.08	0.12	1.00																								
CC	-0.10	0.04	0.04	0.00	0.06	-0.11	-0.07	1.00																							
TEC	-0.07	-0.11	-0.04	-0.16	-0.04	-0.13	-0.15	0.66	1.00																						
FS	0.05	0.00	0.02	-0.07	-0.06	-0.23	0.01	-0.34	-0.54	1.00																					
FA	0.11	0.16	-0.03	-0.05	0.02	-0.19	0.28	-0.01	-0.03	0.14	1.00																				
BI	0.01	0.10	0.06	0.12	0.10	0.08	-0.09	-0.06	-0.11	0.05	0.00	1.00																			
IO	-0.11	0.18	-0.02	0.07	0.12	0.19	0.23	-0.01	-0.07	-0.12	-0.08	0.13	1.00																		
OC	0.01	0.03	-0.08	-0.15	-0.02	-0.15	-0.22	0.05	0.21	-0.21	0.01	-0.11	-0.09	1.00																	
FL	-0.06	-0.09	0.34	-0.13	-0.06	-0.20	-0.06	0.01	-0.06	0.22	-0.12	-0.06	0.05	-0.13	1.00																
BS	0.05	-0.04	0.05	-0.12	-0.08	-0.20	0.05	-0.19	-0.28	0.57	0.19	-0.31	-0.12	-0.10	0.27	1.00															
IP	0.02	0.38	0.15	0.32	0.14	0.04	-0.05	0.11	-0.08	0.09	0.08	0.10	-0.12	-0.08	-0.10	-0.03	1.00														
RV	0.00	-0.05	-0.01	-0.08	-0.07	-0.02	0.07	-0.18	0.02	0.03	0.03	-0.18	0.04	-0.06	0.06	0.05	0.00	1.00													
BE	0.07	-0.07	-0.06	0.14	0.08	0.10	0.03	0.04	0.09	-0.12	-0.02	-0.22	-0.12	-0.04	0.13	0.05	-0.16	0.03	1.00												
EA	0.00	0.02	0.03	0.07	0.03	-0.03	0.06	-0.15	-0.08	0.11	0.23	0.00	-0.03	-0.06	0.08	0.08	0.02	0.24	0.20	1.00											
BG	0.23	0.02	0.05	0.03	0.06	-0.05	0.05	-0.32	-0.20	0.28	0.24	0.17	0.04	-0.22	-0.12	0.20	-0.02	-0.01	-0.21	0.09	1.00										
BN	0.04	0.12	-0.03	0.06	-0.05	0.11	0.16	-0.20	-0.32	0.47	0.01	-0.08	0.06	-0.12	-0.08	0.45	0.04	0.05	-0.09	0.04	0.19	1.00									
SBM	0.00	0.08	-0.04	0.05	0.09	-0.03	0.03	0.04	0.05	-0.09	-0.10	0.20	0.13	-0.06	0.11	-0.08	0.10	0.06	0.03	-0.09	0.13	0.00	1.00								
SCC	0.00	-0.02	-0.06	0.01	0.01	-0.08	-0.04	0.03	0.10	-0.15	-0.09	0.14	0.02	0.08	0.08	-0.19	0.00	0.04	0.15	0.25	-0.05	-0.17	-0.10	1.00							
SCNC	0.00	0.07	0.01	-0.08	-0.03	-0.08	-0.08	-0.11	-0.08	0.10	0.21	-0.03	-0.04	0.17	-0.02	0.18	-0.13	-0.27	0.06	-0.10	0.04	0.01	-0.15	-0.11	1.00						
SE	0.00	-0.03	-0.04	-0.15	-0.04	-0.06	0.13	0.01	0.16	0.02	0.05	-0.08	0.08	0.10	0.03	0.08	-0.04	0.05	-0.03	0.17	0.01	0.07	-0.12	-0.09	-0.12	1.00					
SF	0.00	-0.02	0.00	0.00	0.01	-0.22	-0.33	0.06	-0.12	0.53	-0.21	0.17	-0.11	-0.22	0.17	0.02	0.11	-0.02	-0.08	-0.13	-0.02	-0.01	-0.13	-0.10	-0.13	-0.11	1.00				
SH	0.00	-0.01	-0.03	-0.03	-0.11	0.06	0.04	-0.02	-0.03	-0.02	-0.02	-0.17	-0.20	-0.11	-0.11	0.09	0.03	-0.04	-0.02	0.02	0.06	0.30	-0.08	-0.06	-0.09	-0.07	-0.07	1.00			
SI	0.00	-0.14	0.14	0.03	-0.04	-0.01	-0.01	0.00	0.04	-0.17	0.03	-0.07	0.01	0.03	0.07	-0.03	0.02	0.24	0.03	0.10	-0.04	-0.07	-0.21	-0.16	-0.22	-0.18	-0.19	-0.12	1.00		
SRE	0.00	-0.08	-0.06	-0.07	-0.01	-0.11	0.11	-0.04	-0.03	-0.07	0.08	-0.08	-0.20	-0.07	-0.06	-0.10	0.03	-0.11	-0.10	-0.18	0.10	-0.25	-0.09	-0.07	-0.10	-0.08	-0.09	-0.05	-0.14	1.00	
ST	0.00	0.16	-0.01	0.18	0.07	0.46	0.17	0.02	-0.08	-0.13	0.01	0.18	0.11	-0.15	-0.15	-0.16	0.09	-0.08	-0.08	-0.16	0.04	0.02	1.00	-0.11	-0.16	-0.12	-0.13	-0.09	-0.22	-0.10	1.00

[2] Sectors: SBM= Basic materials, SCC=Consumer Cyclicals, SCNC= Consumer Non-Cyclicals, SE=Energy, SF=Financials, SH=Healthcare, SI=Industrials, SRE=Real Estate, ST= Technology

Accounting-based dependent variables

Firstly, the accounting-based dependent variables (ROA and ROE) are regressed. Table 4-3 shows the estimates and the two-sided t-statistics of the independent and control variables. Appendix 5: Detailed Regression Crisis Times Results and Appendix 6: Detailed Regression Non-Crisis Times Results show the full crisis and non-crisis models of the accounting-based dependent variables.

The results show that stock options have a significant positive effect on the ROE. When a firm applies stock options, the ROE is 71.767 points higher, ceteris paribus. On the contrary, stock options have no significant effect on ROE in non-crisis times. Furthermore, stock options have no significant effect on ROA in crisis times. However, stock options have a significant positive effect on ROA in non-crisis times. So, stock options affect ROA positively in non-crisis times and have no significant effect on ROA in crisis times. Thus, based on accounting-based firm performance metrics, the first null hypothesis cannot be rejected because the significant t-value falls on the opposite side of the critical area of the distribution.

H1: Stock options negatively affect firm performance during the COVID-19 crisis, ceteris paribus

Cash compensation has a significant positive impact on the ROE and a non-significant impact on the ROA in crisis times. In addition, for one-point increase in CC, the ROE increases by 0.027 points, ceteris paribus. So, this suggests that cash compensation improves ROE in the short term. Both the effects are insignificant for non-crisis times. Thus, based on the significant ROE and insignificant ROA, the second null hypothesis cannot be rejected too because the significant t-value of the ROE falls on the opposite side of the critical area of the distribution. In addition, the ROA is insignificant, which further supports the decision to not reject the null hypothesis.

H2: Executive cash compensation negatively affects firm performance during the COVID-19 crisis, ceteris paribus

Total executive compensation has no significant impact on the ROA and ROE. Furthermore, total executive compensation has no significant effect on accounting-based firm performance metrics in non-crisis times. Therefore, the third null hypothesis cannot be rejected based on accounting-based firm performance metrics.

H3: Total compensation negatively affects firm performance during the COVID-19 crisis, ceteris paribus

Table 4-3 Fixed effect model results accounting-based dependent variables crisis time

Fixed Effect	ROA			ROE		
	Estimate	T-stat		Estimate	T-stat	
SO	7.161	1.755	.	71.767	2.267	*
CC	0.002	1.623		0.027	2.475	*
TEC	-0.001	-1.859	.	-0.008	-1.878	.
FA	3.879	0.543		19.869	0.875	
BI	-0.002	-0.014		0.463	0.846	
IO	-0.135	-2.491	*	-0.671	-1.905	.
OC	0.166	0.679		-4.153	-1.789	.
FL	-0.038	-2.701	**	-0.112	-0.880	
BS	0.021	0.035		2.917	1.310	
IP	0.036	1.747	.	0.333	2.330	*
BE	0.101	3.478	**	0.243	2.284	*
BG	0.188	3.105	**	0.734	2.815	**
BN	0.023	0.430		0.065	0.403	

Please see Table 3-1 for the definitions of the variables.

.p < .10
*p < .05
**p < .01 (two-tailed test)

Market-based dependent variables

Second, the market-based dependent variables (SR, AR, and TQ) are regressed. Table 4-4 shows the estimates and the two-sided t-statistics of the independent and control variables. Appendix 5: Detailed Regression Crisis Times Results and Appendix 6: Detailed Regression Non-Crisis Times Results show the full crisis and non-crisis models of the market-based dependent variables.

The results show that stock options have no significant impact on all three market-based dependent variables. However, in non-crisis times, stock options have a highly significant (P-value <0.01) and impactful positive impact on SR and AR. Therefore, firms should apply stock options in non-crisis times to increase the stock return and abnormal return. However, stock options have no significant effect on TQ in crisis and non-crisis times. Hence, based on market-based firm performance metrics, the first null hypothesis cannot be rejected because the variable is not significant for the market-based firm performance metrics.

H1: Stock options negatively affect firm performance during the COVID-19 crisis, ceteris paribus

Cash compensation has no significant effect on SR, AR and TQ in crisis times. These results aligns with the result of the accounting-based ROA. The cash compensation has no significant effect on SR and TQ in non-crisis times. However, there is a significant negative effect of cash compensation on AR in non-crisis times. Therefore, based on market-based firm performance metrics, the second null hypothesis cannot be rejected, because the variable is not significant for the market-based firm performance metrics.

H2: Executive cash compensation negatively affects firm performance during the COVID-19 crisis, ceteris paribus

Total executive compensation has a significant negative impact on TQ. For every point increase in TEC, the TQ decreases by 0.0001, ceteris paribus. This implies that the higher the total executive compensation, the lower the TQ, ceteris paribus. TEC has no significant impact on SR and AR, which is in line with the accounting-based results. Furthermore, TEC has no significant effect on market-based performance metrics in non-crisis times. Hence, the third null hypothesis cannot be rejected based on the market-based firm performance metrics, except for TQ.

H3: Total compensation negatively affects firm performance during the COVID-19 crisis, ceteris paribus

Table 4-4 Fixed effect model results market-based dependent variables crisis time

Fixed Effect	SR			AR			TQ		
	Estimate	T-stat		Estimate	T-stat		Estimate	T-stat	
SO	-7.198	-0.185		515.341	0.615		0.281	0.880	
CC	0.004	0.295		0.144	0.489		0.000	1.751	.
TEC	-0.010	-1.837	.	-0.141	-0.999		-0.000	-2.385	*
FA	-180.364	-1.464		-316.210	-0.548		-1.581	-1.992	.
BI	-0.133	-0.153		-20.264	-1.358		-0.007	-1.063	
IO	-0.491	-0.626		13.885	1.825	.	-0.011	-1.853	.
OC	0.354	0.183		28.258	1.154		-0.021	-1.396	
FL	-0.289	-2.667	*	-1.995	-1.554		-0.001	-1.436	
BS	-7.455	-1.429		-143.349	-1.900	.	-0.126	-1.443	
IP	0.527	2.064	*	9.506	3.189	**	0.000	0.257	
BE	0.742	2.553	*	2.391	1.071		0.009	1.885	.
BG	1.148	2.831	**	14.006	2.450	*	0.019	2.817	**
BN	0.541	1.334		16.017	1.286		0.019	2.440	*

Please see Table 3-1 for the definitions of the variables.

.p < .10
*p < .05
**p < .01 (two-tailed test)

5. Discussion & conclusion

This section assesses the link between executive compensation and firm performance, based on a sample of 67 Euronext Amsterdam listed firms. The existing literature showed varying results. First, the results of the effect of total executive compensation are somewhat in line with previous findings because it has no significant negative effect on accounting- as well as market-based firm performance (except Tobin's Q). Incentive compensation has a positive effect on firm performance and total executive compensation mainly consists of a base salary which has little to no incentives (Conyon & He, 2012). This may explain why total executive compensation has no effect on firm performance during crisis times.

Second, in contrast to the literature, stock options lead to a positive effect on accounting-based firm performance metric ROE and no significant effect on market-based firm performance metrics and the ROA (Mehran, 1992; van Essen et al., 2013). This suggests that the leverage ratio and increased risk-taking caused by stock options had no negative effect on firm performance during the COVID-19 crisis. This may indicate that the incentive effect of stock options cancels out the negative effect of the risk-taking.

Third, the results of the significant positive effect of cash compensation on the return on equity is not in line with previous research which suggested a negative effect (Fahlenbrach & Stulz, 2011). However, the research of Fahlenbrach and Stulz (2011) was focused on the banking industry. In addition, this research focuses on short-term firm performance due to the recency of the COVID-19 crisis, so long-term effects are not taken into account. Thereby, previous research found that cash compensation focuses more on the short term (Grove et al., 2011). The non-significant effects of cash compensation on stock return, abnormal return, Tobin's Q, and return on assets are in line with the literature (Grove et al., 2011).

Next, this research opens opportunities for future research. First, this research focused on the short-term effects of types of executive compensation on firm performance during the COVID-19 crisis. However, some results are expected to show up in the long-term. Therefore, a research focusing on the long-term effects on firm performance may demonstrate different results.

Second, apart from looking for the effect of executive compensation on firm performance, future research should take control variables board gender and board education into account. Since board gender has a significant positive effect on all firm performance dependent variables during crisis times. In addition, board education has a significant positive effect on almost all firm performance variables. This stresses the importance of having a gender-diverse and well-educated board during crisis times. Therefore, another research into the effect of diversity and education could lead to new insights.

Third, the effect of types of executive compensation may differ per crisis type. There is relatively little research on corporate governance in crisis times. However, most research is based on the credit crisis. There could be a difference in good corporate governance mechanisms per crisis type because the COVID-19 crisis is a health related crisis, which may cause different organizational and environmental circumstances than the credit crisis (van Essen et al., 2013).

The implications of this study are that types of executive compensation mainly have no effect on firm performance (except for ROE and TQ). However, if practitioners desire to alter their executive compensation during crisis times, they should focus on incentive compensation of executives because incentive compensation can positively affect firm performance (ROE) during crisis times. Thereby, practitioners should apply different corporate governance mechanisms during crisis times compared to non-crisis times.

This study has potential limitations. First, the study has a small sample size, due to the fact it only focuses on the Netherlands and because most of the data had to be gathered by hand because Utrecht University has no access to BoardEx. This small sample size increases the standard error, which may lead to lower statistical power, resulting in a type II error.

Second, methodological triangulation has not been used. The literature often uses a second methodology to validate the results of the research. Not applying methodological triangulation may affect the validity of this research.

Third, the results of this study are hardly generalizable due to the two-tier board system in the Netherlands. In contrast to the Netherlands, the Anglo-Saxon board model applies a one-board system. Thus, the results of this study are harder to compare with the results of Anglo-Saxon studies.

In conclusion, this research focused on answering the following research question: ‘What is the role of certain forms of executive compensation on firm performance during the COVID-19 crisis in the Netherlands?’. The results show that stock options and cash compensation positively affect accounting-based firm performance, the return on equity. Total executive compensation negatively affects the Tobin’s Q in crisis times. However, most results were found insignificant, which indicates that there is no significant effect of the type of executive compensation on firm performance in crisis times. Given these points, if a firm decides to alter its compensation structure, it is advisable to focus on incentive executive compensation during crisis times and focus less on the low stimulus total executive compensation.

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Appendix 1: Data wrangling

```
library("readxl")
library(dplyr)
library(tidyr)
library(lubridate)
library(writexl)
library(zoo)
library(tidyverse)
library(naniar)
library(fastDummies)

data <- read_excel("Thesis data.xlsx",
                   sheet = "Blad1")

#fill columns
data<-data %>%  fill(Company, .direction = "down")
data<-data %>%  fill(ISIN, .direction = "down")
data<-data %>%  fill(Symbol, .direction = "down")

#add measurement number
data<-data %>%
  group_by(`Company`)%>%
  mutate(measurement.number=row_number())

#change year column with values 2018, 2019, 2020, 2021
data<-data %>%
  mutate(Year=(2022-measurement.number))

#change POSIXct to date
data$Date<-  as.numeric(as.POSIXct(data$Date))

#missing data is NA
is.na(data) <-data=="#N/B"
is.na(data) <-data=="#N/A"
is.na(data) <-data=="NULL"
is.na(data) <-data=="#DELING.DOOR.0!"
is.na(data) <-data=="#WAARDE!"

#change market cap and TEC to numeric
data$`Market cap`<- as.numeric(data$`Market cap`)
data$TEC<- as.numeric(data$TEC)
data$S<- as.character(data$S)

#remove empty columns
data=subset(data,select=-c(SOP,TC, `IPO date`))

#omit na
naommiteddata<-na.omit(data)
```

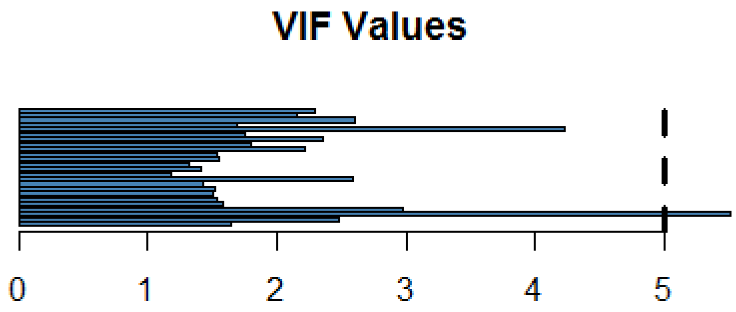
```
#change columns according to methodology
#Firm age = natural log firm age
#total compensation divided by market cap
#cash compensation divided by market cap
naommiteddata<-naommiteddata %>%
  mutate(CC=CC/(`Market cap`/1000000))%>%
  mutate(TEC=TEC/(`Market cap`/1000000))%>%
  mutate(FA=log(FA))

#remove columns which are not needed for regression
naommiteddata=subset(naommiteddata,select=-c(Date,ISIN,Ticker,Symbol,`Instrument
name`, `Samenvoegde datum en instrument name`,M, `Market cap`,`Total assets
reported`,Re,SP,SRPercent, `OP%`,FS ))

#create dummy for sector, remove first dummy for multicollinearity issues
naommiteddata<- dummy_cols(naommiteddata, select_columns =
c("S"),remove_first_dummy = FALSE)
naommiteddata<- rename(naommiteddata, SBM="S_Basic Materials", SCC="S_Consumer
Cyclicals", SCNC="S_Consumer Non-Cyclicals", SE="S_Energy", SF="S_Financials",
SH="S_Healthcare", SI="S_Industrials", SRE="S_Real Estate", ST="S_Technology")


write_xlsx(naommiteddata, "DATA.xlsx")
```

Appendix 2: Final Sample of Dutch Companies

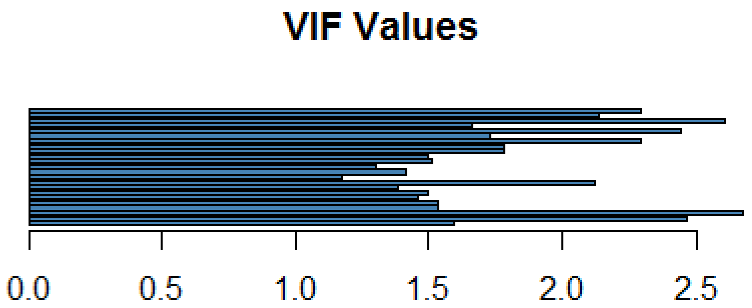
AALBERTS NV	HEINEKEN
ABN AMRO BANK N.V.	HEINEKEN HOLDING
ACCELL GROUP	HOLLAND COLOURS
ACCSYS	IMCD
ADYEN	ING GROEP N.V.
AEDIFICA	INTERTRUST
AEGON	JUST EAT TAKEAWAY
AHOLD DEL	KENDRION
AIR FRANCE -KLM	KPN KON
AJAX	LUCASBOLS
AKZO NOBEL	NEDAP
ALFEN	NN GROUP
AMSTERDAM COMMOD.	NSI N.V.
APERAM	OCI
ARCADIS	ORDINA
ARCELORMITTAL SA	PERSHING
ASM INTERNATIONAL	PHARMING GROUP
ASML HOLDING	PHILIPS KON
ASR NEDERLAND	POSTNL
AVANTIUM	RANDSTAD NV
B&S Group	RENEWI
BAM GROEP KON	SBM OFFSHORE
BASIC-FIT	SHELL PLC
BE SEMICONDUCTOR	SIF HOLDING
BOSKALIS WESTMIN	SIGNIFY NV
BRUNEL INTERNAT	SLIGRO FOOD GROUP
CORBION	TKH GROUP
CORE LABORATORIES	TOMTOM
DSM KON	UNILEVER
FLOW TRADERS	VASTNED
FORFARMERS	VOPAK
FUGRO	WERELDHAVE
GALAPAGOS	WOLTERS KLUWER
HEIJMANS	

Appendix 3: VIF values of the model

VIF before exclusion



VIF after exclusion



Appendix 4: Data analysis

```
library("readxl")
library(tidyr)
library(Hmisc)
library(broom)
#install.packages("plm")
library(plm)
#install.packages("Rcpp")
library(Rcpp)
library(lmtest)
library(reshape2)
#install.packages("caTools")    # For Linear regression
#install.packages('car')        # To check multicollinearity
#install.packages("quantmod")
#install.packages("MASS")
#install.packages("corrplot")   # plot correlation plot
library(caTools)
library(car)
library(quantmod)
library(MASS)
library(corrplot)
library(writexl)
#install.packages("tseries")
library(tseries)
#install.packages("ggstatsplot")
library(ggstatsplot)
#install.packages("sandwich")
library(sandwich)
library(graphics)

mydata <- read_excel("DATA.xlsx")

# Create ID by group
mydata<- transform(mydata,
                ID = as.numeric(factor(Company)))

#exclude categorical company and sector
mydata=subset(mydata,select=-c(Company,S))
mydata$ROA<- as.numeric(mydata$ROA)
mydata$ROE<- as.numeric(mydata$ROE)
mydata$BI<- as.numeric(mydata$BI)
mydata$IO<- as.numeric(mydata$IO)
mydata$FL<- as.numeric(mydata$FL)
mydata$BS<- as.numeric(mydata$BS)
mydata$IP<- as.numeric(mydata$IP)
mydata$RV<- as.numeric(mydata$RV)
mydata$BE<- as.numeric(mydata$BE)
mydata$BG<- as.numeric(mydata$BG)
mydata$BN<- as.numeric(mydata$BN)
```

```
mydata$SCC<- as.numeric(mydata$SCC)
mydata$SCNC<- as.numeric(mydata$SCNC)
mydata$SE<- as.numeric(mydata$SE)
mydata$SF<- as.numeric(mydata$SF)
mydata$SH<- as.numeric(mydata$SH)
mydata$SI<- as.numeric(mydata$SI)
mydata$SRE<- as.numeric(mydata$SRE)
mydata$ST<- as.numeric(mydata$ST)
mydata$ST<- as.numeric(mydata$SBM)

#correlation matrix
correlation<-rcorr(as.matrix(mydata),type="pearson")
corrmatrix<-correlation$r
corrmatrix<-data.frame(corrmatrix)
write_xlsx(corrmatrix,"corrmatrix.xlsx")
corrpvalues<-correlation$P
corrpvalues<-data.frame(corrpvalues)
write_xlsx(corrpvalues,"corrpvalues.xlsx")

#detect outliers
# Create a boxplot of the dataset, outliers are shown as two distinct points
boxplot(mydata,xlab = "Variables", ylab = "Value")$out


attach(mydata)

Y <- cbind(ROA)
X <- cbind(SO, CC, TEC, FA, BI, IO, OC, FL, BS, IP, RV, BE, EA, BG, BN, SCC, SCNC,
SE, SF, SH, SI, SRE, ST)

#create a simple model to conduct assumption tests
model<-lm(Y~X, data=mydata)

# Set data as panel data
pdata <- pdata.frame(mydata, index=c("ID","measurement.number"))
pdata$ID<- as.numeric(pdata$ID)
pdata$measurement.number<- as.numeric(pdata$measurement.number)

# Descriptive statistics
summaryY<-summary(Y)
tableY<-format(summaryY, justify = "none")
tableY<-data.frame(tableY)
write_xlsx(tableY,"tableY.xlsx")
summaryX<-summary(X)
tableX<-format(summaryX, justify = "none")
tableX<-data.frame(tableX)
write_xlsx(tableX,"tableX.xlsx")

# Pooled OLS estimator
pooling <- plm(Y ~ X, data=pdata, model= "pooling")
```

```
summary(pooling)

# Between estimator
between <- plm(Y ~ X, data=pdata, model= "between")
summary(between)

# First differences estimator
firstdiff <- plm(Y ~ X, data=pdata, model= "fd")
summary(firstdiff)

# Fixed-effects or within estimator
fixed <- plm(Y ~ X, data=pdata, model= "within")
summary(fixed)

# Random effects estimator
random <- plm(Y ~ X, data=pdata, model= "random")
summary(random)

# LM test for random effects versus OLS
plmtest(pooling)
#is significant (reject H0), so use random effects

# LM test for fixed-effects versus OLS
pFtest(fixed, pooling)
#is significant (reject H0), so use fixed-effects

#Assumption 1: Linearity
plot(model, 1)
#model is linear

#Assumption 2: Exogeneity
#Hausman test
#Hausman test for fixed versus random effects model
phtest(random, fixed)
#Use fixed-effects because we reject H0 of using RE. We have endogeneity in the model


#Assumption 3a: Homoskedasticity
# White or Breusch Pagan test
#Breusch-Pagan
bptest(model)
##Very low p-value, so there is heteroskedasticity, so we need to correct SEs

#Assumption 3b: Non-autocorrelation
#Durbin Watson test
#dwtest(model)  #Breusch Godfrey is better
#Breusch Godfrey
bgtest(model, order=3)
##We reject H0, so there is serial correlation, so use Newey West Standard errors to correct
for autocorrelation and heteroskedasticity.
```

```
#Assumption 4: Independent Variables are non-stochastic
#Dickey-Fuller test for unit root
y <- data.frame(split(pdata$ID,pdata$Year)) # individuals in columns
purtest(y, index = c("ID", "measurement.number"),exo="intercept", pmax = 4, test =
"levinlin")
#Stationarity, There is no unit root, estimate in Fixed-effects


#Assumption 5: No perfect multicolinearity
#See correlation matrix, there is no perfect multicolinearity
vifmodel<-lm(ROA~SO+CC+TEC+ FA +BI+ IO+ OC+ FL+ BS+ IP+ RV+ BE+ EA+ BG+
BN+ SCC+ SCNC+ SE+ SF+ SH+ SI+ SRE+ ST,data=mydata)
vif(vifmodel)
vif_values <- vif(vifmodel)          #create vector of VIF values

barplot(vif_values, main = "VIF Values", horiz = TRUE, col = "steelblue") #create horizontal
bar chart to display each VIF value

abline(v = 5, lwd = 3, lty = 2)    #add vertical line at 5 as after 5 there is severe correlation
#High FS(5), removed

###We need to conduct Fixed-effects
###with Newey West SEs (to correct for heteroskedasticity and serial correlation)
within <- plm(Y ~ X, data=pdata, model= "within")
summary(within)
#NW_VCOV <- NeweyWest(model, prewhite = F, adjust = T)
#HAC adjusted within

#coeftest(within, vcov = NW_VCOV)
#coeftest(within, vcov=vcovHC(within, method = c("arellano"),cluster=c("group")))
coeftest(within, vcov=vcovNW(within))


###Conduct regression for crisis and non-crisis times
#Crisis: years 2020 and 2021
withincrisis<-subset(pdata,Year>=2020)
withincrisis <- plm(Y ~ X,  data=pdata,subset=(Year>=2020), model= "within") #analysis
summary(withincrisis)

#coeftest(withincrisis, vcov=vcovHC(withincrisis, method =
c("arellano"),cluster=c("group")))
crisiscoef<-coeftest(withincrisis, vcov=vcovNW(withincrisis),save = TRUE)
coeftest(withincrisis, vcov=vcovNW(withincrisis),save = TRUE)
#coeftest(withincrisis, vcov = NW_VCOV) #working old method
stars <- symnum(crisiscoef[, ncol(crisiscoef)], corr = FALSE, na = FALSE,
            cutpoints = c(0, 0.001, 0.01, 0.05, 0.1, 1),
            symbols = c("***", "**", "*", ".", " "))

out <- cbind(as.data.frame.matrix(crisiscoef), Stars = format(stars))
```

```
write_xlsx(out,"crisiscoef.xlsx")


#Non-Crisis: years 2018 and 2019
withinnoncrisis<-subset(pdata,Year<=2019)
withinnoncrisis <- plm(Y ~ X, data=pdata,subset=(Year<=2019), model= "within")
summary(withinnoncrisis)

#coeftest(withinnoncrisis, vcov=vcovHC(withinnoncrisis, method =
c("arellano"),cluster=c("group")))
noncrisiscoef<-coeftest(withinnoncrisis, vcov=vcovNW(withinnoncrisis),save = TRUE)
coeftest(withinnoncrisis, vcov=vcovNW(withinnoncrisis),save = TRUE)
#coeftest(withinnoncrisis, vcov = NW_VCOV) #working old method

#coeftest(withincrisis, vcov = NW_VCOV) #working old method
stars <- symnum(noncrisiscoef[, ncol(noncrisiscoef)], corr = FALSE, na = FALSE,
        cutpoints = c(0, 0.001, 0.01, 0.05, 0.1, 1),
        symbols = c("***", "**", "*", ".", " "))

out <- cbind(as.data.frame.matrix(noncrisiscoef), Stars = format(stars))
write_xlsx(out,"noncrisiscoef.xlsx")
```

Appendix 5: Detailed Regression Crisis Times Results

ROA

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	7.161	4.081	1.755	0.085	.
CC	0.002	0.001	1.623	0.110	
TEC	-0.001	0.001	-1.859	0.069	.
FA	3.879	7.140	0.543	0.589	
BI	-0.002	0.176	-0.014	0.989	
IO	-0.135	0.054	-2.491	0.016	*
OC	0.166	0.245	0.679	0.500	
FL	-0.038	0.014	-2.701	0.009	**
BS	0.021	0.597	0.035	0.972	
IP	0.036	0.021	1.747	0.086	.
BE	0.101	0.029	3.478	0.001	**
BG	0.188	0.060	3.105	0.003	**
BN	0.023	0.054	0.430	0.669	

ROE

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	71.767	31.652	2.267	0.027	*
CC	0.027	0.011	2.475	0.016	*
TEC	-0.008	0.004	-1.878	0.066	.
FA	19.869	22.712	0.875	0.386	
BI	0.463	0.547	0.846	0.401	
IO	-0.671	0.352	-1.905	0.062	.
OC	-4.153	2.321	-1.789	0.079	.
FL	-0.112	0.127	-0.880	0.383	
BS	2.917	2.226	1.310	0.196	
IP	0.333	0.143	2.330	0.024	*
BE	0.243	0.106	2.284	0.026	*
BG	0.734	0.261	2.815	0.007	**
BN	0.065	0.162	0.403	0.689	

SR

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	-7.198	38.955	-0.185	0.854	
CC	0.004	0.013	0.295	0.770	
TEC	-0.010	0.005	-1.837	0.072	.
FA	-180.364	123.184	-1.464	0.149	
BI	-0.133	0.869	-0.153	0.879	
IO	-0.491	0.785	-0.626	0.534	
OC	0.354	1.936	0.183	0.856	
FL	-0.289	0.108	-2.667	0.010	*
BS	-7.455	5.216	-1.429	0.159	
IP	0.527	0.255	2.064	0.044	*
BE	0.742	0.290	2.553	0.014	*
BG	1.148	0.406	2.831	0.007	**
BN	0.541	0.405	1.334	0.188	

AR

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	515.341	837.487	0.615	0.541	
CC	0.144	0.296	0.489	0.627	
TEC	-0.141	0.141	-0.999	0.322	
FA	-316.210	577.492	-0.548	0.586	
BI	-20.264	14.923	-1.358	0.180	
IO	13.885	7.608	1.825	0.074	.
OC	28.258	24.481	1.154	0.253	
FL	-1.995	1.284	-1.554	0.126	
BS	-143.349	75.449	-1.900	0.063	.
IP	9.506	2.981	3.189	0.002	**
BE	2.391	2.233	1.071	0.289	
BG	14.006	5.717	2.450	0.018	*
BN	16.017	12.457	1.286	0.204	

TQ

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	0.281	0.319	0.880	0.383	
CC	0.000	0.000	1.751	0.086	.
TEC	-0.000	0.000	-2.385	0.021	*
FA	-1.581	0.794	-1.992	0.051	.
BI	-0.007	0.006	-1.063	0.292	
IO	-0.011	0.006	-1.853	0.069	.
OC	-0.021	0.015	-1.396	0.169	
FL	-0.001	0.001	-1.436	0.157	
BS	-0.126	0.088	-1.443	0.155	
IP	0.000	0.002	0.257	0.798	
BE	0.009	0.005	1.885	0.065	.
BG	0.019	0.007	2.817	0.007	**
BN	0.019	0.008	2.440	0.018	*

Appendix 6: Detailed Regression Non-Crisis Times Results

ROA

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	15.060	5.186	2.904	0.005	**
CC	0.001	0.001	1.724	0.090	.
TEC	0.000	0.000	-0.117	0.907	
FA	3.809	4.219	0.903	0.371	
BI	-0.068	0.136	-0.497	0.621	
IO	0.064	0.062	1.027	0.309	
OC	-0.271	0.197	-1.377	0.174	
FL	0.007	0.008	0.845	0.402	
BS	0.298	0.736	0.405	0.687	
IP	0.014	0.013	1.085	0.283	
BE	0.005	0.058	0.089	0.929	
BG	0.107	0.095	1.127	0.265	
BN	-0.020	0.268	-0.076	0.939	

ROE

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	25.653	16.636	1.542	0.129	
CC	-0.012	0.007	-1.783	0.080	.
TEC	0.001	0.002	0.651	0.518	
FA	11.680	11.081	1.054	0.297	
BI	-0.082	0.443	-0.186	0.853	
IO	-0.833	0.393	-2.120	0.039	*
OC	0.350	0.733	0.478	0.634	
FL	-0.584	0.153	-3.807	0.000	***
BS	-5.880	4.686	-1.255	0.215	
IP	0.262	0.129	2.040	0.046	*
BE	0.357	0.246	1.452	0.152	
BG	0.656	0.356	1.840	0.071	.
BN	-0.532	0.420	-1.267	0.211	

SR

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	127.618	29.289	4.357	0.000	***
CC	0.000	0.007	-0.021	0.983	
TEC	-0.003	0.002	-1.413	0.163	
FA	31.405	22.503	1.396	0.169	
BI	0.591	0.486	1.216	0.229	
IO	0.137	0.663	0.206	0.838	
OC	-3.690	2.058	-1.793	0.079	.
FL	-0.059	0.052	-1.126	0.265	
BS	-6.928	4.671	-1.483	0.144	
IP	0.453	0.167	2.711	0.009	**
BE	-0.795	0.393	-2.021	0.048	*
BG	1.180	0.470	2.512	0.015	*
BN	0.576	0.831	0.692	0.492	

AR

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	3579.059	997.194	3.589	0.001	***
CC	-0.320	0.155	-2.071	0.043	*
TEC	0.029	0.061	0.471	0.640	
FA	-42.210	478.260	-0.088	0.930	
BI	-27.993	20.840	-1.343	0.185	
IO	14.347	11.217	1.279	0.206	
OC	-25.120	27.508	-0.913	0.365	
FL	-7.102	1.789	-3.970	0.000	***
BS	-354.116	153.953	-2.300	0.025	*
IP	2.306	2.962	0.779	0.440	
BE	19.195	11.549	1.662	0.102	
BG	36.461	23.002	1.585	0.119	
BN	101.039	56.460	1.790	0.079	.

TQ

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
SO	-0.045	0.482	-0.094	0.925	
CC	0.000	0.000	-0.153	0.879	
TEC	0.000	0.000	-0.767	0.446	
FA	-0.421	0.343	-1.226	0.225	
BI	-0.023	0.012	-1.908	0.062	.
IO	-0.007	0.013	-0.508	0.614	
OC	0.020	0.044	0.449	0.655	
FL	0.001	0.001	1.071	0.289	
BS	-0.136	0.098	-1.377	0.174	
IP	0.001	0.002	0.329	0.744	
BE	0.002	0.005	0.340	0.735	
BG	0.035	0.012	2.974	0.004	**
BN	0.007	0.016	0.439	0.663	