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FINANCIAL DISTRESS AND GOVERNANCE STRUCTURE

by

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Abstract

Topics of financial distress and corporate governance structure have attracted many researchers before. However, no one combined the three distress models of Altman (1968), Ohlson (1980) and Zmijewski (1984) with corporate governance variables. The main goal of this paper is to answer the following question: what is the impact of corporate governance variables on financial distress for traded U.S manufacturing companies? By comparing results of three different regressions using three different financial distress models, we found different significant relationships between the distress models and the governance variables. Managerial ownership has a negative relationship to financial distress and significance at 1% level with the model using the Altman Z-Score. The other significant relationship to financial distress, at 5% level, was the positive relationship between the Ohlson O-score and number of committees, the latter is new in the field as it was not used in this context before. Furthermore, the compensations of both the CEO and directors are found to be positively related to financial distress in the model using the Altman Z-score, where CEO compensation was found significant at 10% level with adjusted p-values and directors' compensation significant at the 5% level both with standard and adjusted p-values. Similarly, in the model using the Zmijewski score, the CEO compensation was found to have a positive impact on financial distress and significance at the 5% level. Overall, we find various relationships between corporate governance variables and financial distress.

Keywords: financial distress, corporate governance, Altman Z-score, Ohlson O-score, Zmijewski score

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1 Introduction

"More often than not, a C.E.O is merely a puppet whose strings are pulled by a board of directors."

- *Mokokoma Mokhonoana, South African author*

Every large company has a board of directors. It controls and checks the actions of the CEO and the rest of management. They are there for the shareholders, to make strategies, and to ensure profitability. The board of directors is the core of a company and without it, any large company would not survive.

A board consists of multiple members, most of the time between six and twelve. They are, in a listed company, appointed by the shareholders. Executive directors, for example the CEO, are elected by the board of directors, and they are responsible for setting out the strategy and goals of a company. As one can imagine, boards come in different flavors. Not only the board size can be different, the compensation of the board members or the fact if they are inside or outside directors can also differ. An inside director is somehow related to the company, for example being an employee or major shareholder.

Financial distress is an everlasting threat and problem for organizations and shareholders. If a company is too deeply financially distressed, it will go bankrupt. Financial distress can emerge unexpectedly due to poor performance of the company, bad market conditions or inefficient management. However, another source of distress on which this research focuses on, is the structure of governance in a company. Relating back to how boards come in different flavors, the main topic in this paper is the question what structure is overall the best to keep a company out of financial distress, and what can other firms learn from this.

Distress in this paper is measured by well-established models. The models measure the company's profitability, liquidity, and leverage and based on that they produce a score indicating whether it is likely to default or not. The three models which are key in this research are the Altman Z-score (Altman 1968), Ohlson O-score (Ohlson 1980) and Zmijewski score (Zmijewski 1984). Where Altman provides a score with which the companies can be segregated into three categories of financial health, Ohlson and Zmijewski give the probability of default.

Research on the link between firm performance and corporate governance variables, and the link between bankruptcy and corporate governance is conducted, where multiple relations are found. Financial distress measures are scores that use multiple performance ratios, applying to many performance categories, and thus we hypothesize that there is a connection between corporate governance variables and financial distress indicators too. The main contribution of our paper is to investigate this link.

This is done by measuring the impact of the above-mentioned variables on the financial distress models cross-sectionally using 143 small- and medium-cap companies of the S&P 1000 classified as Industrials in the Global Industry Classification Standard Economic Sector (S&P Global 2018). The research question is as follows: *what is the impact of corporate governance variables on financial distress for traded U.S manufacturing companies?*

We find that managerial ownership, i.e. the percentage of outstanding shares held by executives, is negatively related to financial distress in all models, with significance in Altman's model. CEO-chair duality and Size of Board are found to be positively related to financial distress in all three models but not significant in any. The proportion of outside directors is positively related to financial distress in Ohlson's and Zmijewski's model, but negatively in Altman's model. However, none of these are significant. The number of committees is negatively related to financial distress in Altman's and Zmijewski's model, but positively related using the O-score, with 5% significance. CEO compensation is positively related to financial distress with 5% and 10% levels of significance using the Zmijewski and Altman Z-score respectively. Lastly, average directors' compensation is positively related in Altman's and Zmijewski's model, with the former at 5% level of significance, but negatively related to financial distress using the O-score.

2. Literature Review

2.1 Research on the distress models

In this section the three dependent variables in this study are elaborated upon. The original research papers are used as the main sources. Being aware that many improvements have been suggested over the years for these models, the original papers are still preferred in this paper. One of the reasons is the ease of collecting data, e.g. the original Altman Z-score for a company can be found in online databases while adjusted Altman Z-scores would have to be computed individually for each company by collecting the data for every parameter. Similarly, this is the case for Ohlson and Zmijewski. A further reason is our sample industry, manufacturing firms, the same industry as used in developing the original Altman Z-score.

2.1.1 Altman Z-score model (1968)

Over 50 years ago Edward Altman published the first multivariate model for predicting financial health for manufacturing companies. His original model was focused on U.S. manufacturing firms and financial health referred to the probability of bankruptcy (Altman 1968). The original model used a relatively small sample of 66 manufacturing companies, divided into 33 firms that had filed for bankruptcy during 1946 and 1965, and 33 firms that still existed in 1966. From previous research, Altman created a list of 22 variables that could potentially explain bankruptcies, of which five were used in the final model to construct the original Z-score model, which is discussed in more detail in the methodology section of this paper. The model turned out to be extremely accurate in predicting bankruptcy, classifying 95 percent of the sample correctly. There are two possible ways for the model to fail, a *Type I error* where a bankrupt firm is classified as non-bankrupt (false positive), and a *Type II error* where a non-bankrupt firm is classified as bankrupt (false negative). Based in part on the probability of these errors occurring, Altman could set cutoff points to classify firms in zones. For a Z-score of 2.99 or higher the firm was clearly in the non-bankrupt sector, between 1.81 and 2.99 he coined it “zone of ignorance” or gray zone since errors were observed in this zone. A Z-score of 1.80 or lower hence implies bankruptcy. The model could predict bankruptcy up to two years prior with accuracy, with rapidly decreasing accuracy after that.

2.1.2 Ohlson O-score (1980)

James Ohlson (1980) critiqued Altman for his Multivariate Discriminant Analysis (MDA) approach, he argued for example that the predictors should have the same variance and covariance for both bankrupt and non-bankrupt firms, as well as that they should be normally distributed. Moreover, the Z-score is an ordinal ranking, relating to the three zones, which Ohlson argued had little intuitive interpretation. Lastly, MDA matched the two groups of firms, bankrupt and non-bankrupt, according to criteria such as size and industry, which are somewhat arbitrary. Ohlson was not sure on his last point however, stating that it is not obvious what is lost or gained by (different) matching procedures. To avoid the aforementioned problems, Ohlson introduced a logit function. The dependent variable measures the same as Altman's Z-score: a value showing the probability of bankruptcy. A cutoff point of 0.38 was introduced to minimize the type I and type II errors. In the methodology section the model is elaborated.

The sample used consisted, like Altman, of bankrupt and non-bankrupt US industrial firms. However, due to technological advances the sample size was vastly bigger with 105 bankrupt and 2058 non-bankrupt firms. The model turned out to be accurate too, with an accuracy rate of the sample of 96% and 85% for the hold-out sample. The Ohlson model has the most explanatory variables with nine variables.

2.1.3 Zmijewski (1984)

According to Mark E. Zmijewski there are two common biases in financial distress models, oversampling and using complete data, a *choice-based sample bias* and *sample selection bias* respectively. With oversampling is meant that the probability of bankruptcy is overstated. According to the Business Failure Record of 1982 the frequency rate of failures never exceeded 0.75 percent since 1934, meaning that in a random sample of 1000 firms only about 7 to 8 would, according to statistical rules, fail. This shows it is hard to get enough firm data to research. This is worsened by the fact that data for financially distressed firms are often unavailable.

The sample population were all the firms, except financial, service and public administration firms, listed on the American and New York Stock Exchanges during the period 1972 to 1978. 1600 complete data, meaning all the necessary information is available, non-bankrupt firms and 81 complete data bankrupt firms were available. A firm was considered

bankrupt if it filed a bankruptcy petition during the period 1972 to 1978. Splitting this into an estimation and prediction sample, there were 40 bankrupt and 800 non-bankrupt firms in the estimation sample. Again, the details of this model are explained in the methodology section of this paper. The accuracy rate for the estimation sample was around 99 percent, with a correct classification for non-bankrupt firms around 99.9 percent but a correct classification for bankrupt firms significantly lower, around 20 till 40 percent. This model again was on a 0 to 1 score, Zmijewski classified a score of 0.5 or higher as bankruptcy.

2.2 Research on governance structures

A sufficient amount of research has been done on corporate governance structures in relation to firm performance or bankruptcy, but none so far has focused on governance structures in relation to financial distress scores. The main consensus in the existing literature on why other predictors than financial reports should be used as indicators of financial distress is that annual statements are ex post, meaning they lag behind reality, and can be "window dressed" by accounting ambiguity (Lee and Yeh 2004). Many of the papers researching governance structure and firm performance can be used as a fundament for obtaining our independent variables. To structure this paper well, the independent variables are presented in the methodology section together with the existing literature background.

3. Methodology

3.1 Research Question

As stated in the introduction, the main research question is what impact corporate governance variables have on financial distress for a company. In this section we first go over the dependent variables, i.e. the financial distress models, and then the independent variables, i.e. the corporate governance variables, together with the existing literature background.

3.2 Dependent Variables

As dependent variables the three financial distress models discussed previously are used, namely the Altman (1968), Ohlson (1980) and Zmijewski (1984) models, in three different regressions with the same independent variables.

3.2.1 Altman Z-score

As is said in the literature review, the Altman Z-score is a bankruptcy prediction model introduced by Altman in his original paper in 1968 (Altman 1968). The model consists of five coefficients presented in the original paper as follows:

$$Z = 0.012X_1 + 0.014X_2 + 0.33X_3 + 0.006X_4 + 0.999X_5$$

Where:

X_1-working capital/total assets.

X_2-retained earnings/total assets.

X_3-EBIT/total assets.

X_4-market value of equity/book value of debt.

X_5-sales/total assets.

The coefficients are ratios measuring the company performance. Altman described X_1 as the liquidity ratio measuring the company's ability to pay its current obligations. The working capital is defined as the difference between the current assets and the current liabilities. X_2

measures cumulative profitability over time. X_3 tests the how much of an operating income is produced by the total assets, X_4 is the leverage ratio and X_5 measures the overall profitability of the company. The obtained Z-score indicates whether the company is in distress and how close it is to go bankrupt. A lower score indicates higher risk of bankruptcy. More specifically, Altman made three so-called zones of discrimination. A Z-score higher than or equal to 2.99 is considered the safe zone, a Z-score between 1.81 and 2.99 the gray zone and a Z-score lower than 1.81 the distress zone.

3.2.2 Ohlson O-score

The second bankruptcy prediction model which is used as the dependent variable in this research is the Ohlson O-score. The model consists of an intercept and nine coefficients. In the original work of Ohlson (1980) the model is presented as follows:

$$O = -1.32 - 0.407X_1 + 6.03X_2 - 1.43X_3 + 0.0757X_4 - 2.37X_5 - 1.83X_6 + 0.285X_7 - 1.72X_8 - 0.521X_9$$

Where:
X_1-log(total assets/GNP-price level index).
X_2-total liabilities/total assets.
X_3-working capital/total assets.
X_4-current liabilities/current assets.
X_5-dummy variable taking value of 1 if total liabilities exceed the total assets, 0 otherwise.
X_6-net income/total assets.
X_7-funds provided by operations/total assets.
X_8-dummy variable taking value of 1 if net income was negative for last two years, 0 otherwise.
X_9-$(NI_t-NI_{t-1})/(|NI_t|+|NI_{t-1}|)$ where NI_t is net income from the most recent period.

Contrary to Altman, Ohlson's score only has two zones, bankrupt or not bankrupt. In this research, an O-score that is transformed into a probability of default (PD) is used which also changes the original interpretation with the cutoff point at 0.38 to a cutoff point at 0.5. A company with the score exceeding the new cutoff point of 0.5 is considered to be in the high risk

of bankruptcy. The following formula is used to convert the Ohlson score in a logistic cumulative distribution function (Hillegeist et al. 2004), where *o* stands for the Ohlson O-score and *e* for an exponential function.[1]

$$\mathrm{PD} = \frac{e^{o}}{1+e^{o}}$$

As it was the case in Altman's paper, the coefficients in the Ohlson model are the ratios representing different categories of companies' performance. X_1 measures the size of the company, X_2 and X_5 both test the leverage effect while X_6 and X_9 focus on the profitability aspect. The remaining four coefficients (X_3, X_4, X_7 and X_8) are measuring company's liquidity.

3.2.3 Zmijewski Score

The third financial distress model and the last one which is used as the dependent variable in this paper is the Zmijewski score. The model, introduced in 1984, is composed of an intercept and three coefficients. In the original paper (Zmijewski 1984) the model of financial distress looks as follows:

$$ZM=-4.336-4.519X_1+5.679X_2+0.004X_3$$

Where:
X_1-net income/total assets.
X_2-total debt/total assets.
X_3-current assets/current liabilities.

The Zmijewski model consists of three ratios measuring the company's performance. X_1 is the classic "ROA" ratio which measures the return on assets and is considered as a profitability ratio. X_2 measures the leverage effect and X_3 tests the firm's liquidity. Similar to the O-score used in this paper, the Zmijewski model produces a probability of going bankrupt, meaning the higher

[1] Due to many observations having a PD lower than zero or higher than one, it was not possible to transform the PD into the original O-score for all observations, hence we decided to use PD.

score a company obtains, the higher distress level and bankruptcy risk it has. Zmijewski set the cutoff point to 0.5, where a score higher than 0.5 means the firm is about to enter bankruptcy.

3.3 Independent Variables

3.3.1 Managerial Ownership

Managerial ownership is the independent variable which has appeared in many research focused on the corporate governance structure. According to Bhagat and Bolton (2008) it has a positive impact on the company's performance. In the paper of Jensen and Meckling (1976) a similar conclusion is made, stating that with an increased managerial ownership the interests of shareholders and the managers are aligned having a positive impact on the performance of a company. Sheikh and Wang (2012) added that managerial ownership also reduces the agency cost of equity. In previous research, the percentage of shares owned by managers was taken (Wang and Deng 2006). In this paper, a proxy to this variable is used. In Bloomberg Terminal the *Amount of shares held by insiders* is taken, and measures the amount of shares held by executives, in relation to the total amount of outstanding shares.

3.3.2 CEO-chair Duality

A well-debated topic in governance structures is CEO-chair duality, meaning that the CEO is also chairman in the board of directors. Since the board of directors' main task is monitoring management, intuitively having the CEO in the board of directors would not make sense since it will lower board independence. However, research has also shown that CEO duality can increase so-called stewardship, strengthening leadership-action effectiveness (Davis, Schoorman, and Donaldson 1997). Other research also finds significant positive relations between CEO duality and company performance (Bhagat and Bolton 2008; Rus 2018). Daily and Dalton (1994) however showed that it is positively related with bankruptcy, while Simpsons and Gleason (1999) find that the combination of CEO and chairman into one position reduces the probability of financial distress. Note however, the CEO can be in the board without being a chairman, in that case the value of this variable would also be zero (i.e. no CEO-chair duality).

3.3.3 Size of Board

The number of board members is another corporate governance factor influencing the firm's performance and is deeply elaborated in previous research on this topic. Rus (2018) stated that the size of board has a negative relation with probability of distress. However, Lipton and Lorch (1992) added that boards consisting of a larger amount of directors are less efficient than smaller boards since it encourages the free rider problem among directors. Furthermore, Yermack (1996) concluded similarly that smaller-board companies perform financially better and that directors have more incentives related to compensation and threat of dismissal which is in line with what Wang and Deng (2006) stated. On the other hand, Adams and Mehran (2003) concluded that larger boards have a positive impact on firm's performance since bigger boards can more effectively monitor managers and provide better expertise. The size of board is computed by taking the absolute number of directors.

3.3.4 Proportion of Outside Directors

This variable could also be called *Board Independence*, since an outside director is independent of the company. According to the U.S. Securities and Exchange Commission, an independent director is "*(...) a person other than an officer or employee of the company or its subsidiaries or any other individual having a relationship, which, in the opinion of the company's board of directors, would interfere with the exercise of independent judgment in carrying out the responsibilities of a director.*" (U.S. Securities and Exchange Commission 2003) The views on this in relation with company performance and bankruptcy are mixed. Intuitively, one would think outside directors "care less" about the company and thus may not give their full effort. However, one could also imagine that outside directors, being independent from management, can bring new insights to the company and not get carried away in the same style of thinking at a company. Outside directors can bring knowledge, a broad vision and independence from management (Sheikh and Wang 2012). Rus (2018) found a significant positive relation between the proportion of outside directors and the probability of distress, while other research found that healthy companies have a higher percentage of outside directors (Elloumi & Gueyié 2001). The famous agency theorist Fama argued that independence between management and board is a crucial attribute of the board's monitoring role (Fama and Jensen 1983).

Since no data could be found for board members that are independent as stated by the U.S. Securities and Exchange Commission, a proxy is used for this independent variable as well. On the Bloomberg Website on the board information page of a company, say *company x*, the *Primary Company* of the board members is given. If the primary company is not the same as *company x*, the board member is considered to be an *outsider* for this variable. The proportion of outside directors is then calculated by the number of *outsiders* divided by the total number of board members.

3.3.5 Number of Committees

This is a variable which has not been used in this context in any broader known research. Board committees are a support body for the board of directors which is specializing in the one specific area e.g. audit committee. The number of committees varies from one to another company and it is interesting to research whether the bigger number of committees provides better expertise and increase efficiency of the firm or just consumes more money than it is actually worth it.

3.3.6 CEO Compensation

CEO compensation is very popular variable in the research on corporate governance structure. In the regression the absolute value of USD earned by CEO per annum is used. Main (1991) stated that there is positive relationship between the executive salary and the returns. For convenience, this variable is divided by one million.

3.3.7 Average Directors' Compensation

This is similar to the CEO Compensation variable, the average absolute value in USD of the directors in the board is used. Not too much research has been done on this specific subject, but Brick, Palmon and Wald (2006) discovered that excess compensation is associated with underperformance. Similar to CEO compensation, this variable is divided by one hundred thousand.

3.4 Hypotheses

Continuing from the aforementioned independent variables, we can formulate our hypotheses. An overview of the hypotheses is given in Table 1 on the next page.

Managerial ownership is proven to be positively related to performance of the firm in past research. Since a board which owns shares themselves have an extra incentive to do well, we formulate the following hypotheses:

Hypothesis 1: Managerial ownership is negatively related to financial distress.

CEO-chair duality has been known to decrease the independence of the board that is why we think that

Hypothesis 2: CEO-chair duality is positively related to distress.

Following the research of Yermack (1996) and Rus (2018), we think that smaller boards are more efficient and that directors in those boards have more incentives to perform better, that is why

Hypothesis 3: Size of board is positively related to distress measures.

We believe outside directors can bring fresh views to the company, freeing it from internal biases. Our next hypothesis is

Hypothesis 4: The proportion of outside directors and financial distress is negatively related.

We think that the number of board committees specialized in certain areas of running business provides more expertise, therefore,

Hypothesis 5: There is a negative relation between the number of committees and distress.

We combine the independent variables CEO compensation and average directors' compensation into one hypothesis, since we believe they have the same effect. We follow the research of Main (1991) and state

Hypothesis 6: There is a negative relation between compensation and financial distress.

Table 1: Overview of hypotheses

Hypothesis	Independent variable	Relation to financial distress
1	Managerial Ownership	Negative
2	CEO-Chair Duality	Positive
3	Size of Board	Positive
4	Proportion of Outside Directors	Negative
5	Number of Committees	Negative
6	Compensation	Negative

3.5 Regressions

As it was mentioned in the previous sections of the paper, the research is based on three financial distress models. Each model is based on a different financial distress model as dependent variable, which are the Altman, Ohlson and Zmijewski models. The regressions look as follows:

$$Z=\propto+\beta_1 MO+\beta_2 CD+\beta_3 SB+\beta_4 OD+\beta_5 NC+\beta_6 CC+\beta_7 DC+\varepsilon_Z$$

$$O=\propto+\beta_1 MO+\beta_2 CD+\beta_3 SB+\beta_4 OD+\beta_5 NC+\beta_6 CC+\beta_7 DC+\varepsilon_O$$

$$ZM=\propto+\beta_1 MO+\beta_2 CD+\beta_3 SB+\beta_4 OD+\beta_5 NC+\beta_6 CC+\beta_7 DC+\varepsilon_{ZM}$$

Where:

Z-Altman Z-score

O-Ohlson O-score

ZM-Zmijewski score

$\propto$-Intercept

MO-Managerial ownership

CD-CEO-chair duality

SB-Size of board

OD-Outside Directors

NC-Number of committees

CC-CEO compensation

DC-Average directors' compensation

ε-Error term (residual)

4. Data

4.1 Sample Selection

In order to answer the research question, data are obtained from the widely-used in financial industry database Bloomberg[2] and Bloomberg Terminal, which contains all data needed to screen the companies' governance structure. The financial distress scores are taken from the database of YCharts[3], preferably the score on December 31st, 2018 was used. If this was not available, the score of January 31st, 2019 was used, if that was also not available the score of November 30th, 2018 was used. This research is focused on companies classified as Industrials by the Global Industry Classification Standard (GICS) from the S&P 1000 index consisting of 600 small-cap and 400 medium-cap companies as indicated on the S&P Dow Jones indices website (us.spindices.com 2019). The choice of small- and medium-cap companies (*SMCap*) compared to large-cap increases variety, allowing to obtain more interesting results. The research elaborates on industrial manufacturing companies, standing in line with the original work of Altman. As of end of financial year 2018, the S&P 1000 index consisted of 152 companies classified as Industrials by the GICS Economic Sector. Filtering out companies with incomplete data, the final sample of this research are 143 companies at one point in time, meaning we have a cross-sectional dataset.

Moreover, data are also collected for 102 large-cap manufacturing companies in the United States to compare to the small- and medium-cap companies. These firms are discussed in more detail in section 5.1.4 Large-cap companies.

4.2 Summary Statistics

This section focuses first on the statistics of the dependent variables and then the independent variables. As mentioned before, a Z-score higher than 2.99 is considered to be the safe zone. Our sample has a mean of 4.91 with a standard deviation of 4.96, a maximum of 28.49 and a minimum of 0.62. This shows we have a diverse dataset. Reflecting the previously-mentioned

[2] Bloomberg.com
[3] YCharts.com

average Z-score, the average Zmijewski score follows this, with a mean of -1.60 and standard deviation of 1.23. Ohlson O-score has a mean of 0.92 and standard deviation of 1.91, which is not in line with our expectations, after obtaining the average Z-score and Zmijewski score, since the average O-score of all the companies is higher than the border of financial distress, i.e. higher than 0.5. The full summary statistics of the dependent variables can be found in Appendix 1, the full summary statistics of the independent variables can be found in Appendix 2. Note again that *CC* (CEO Compensation) is in millions and *DC* (Director's compensation) is in hundred thousand.

In Table 2 below, the correlations between the dependent variables (i.e. the financial distress models) are shown, these correlations are not completely in line with our expectations, since we would expect the Altman Z-score to be positively correlated with the Ohlson O-score and negatively correlated with Zmijewski. However, only the latter is true. The correlation between Ohlson and Zmijewski is expected to be negative, but to the contrary it is positive. This is in line with our finding of the high average O-score discussed in the previous paragraph. One possible explanation for this is that we used small- and medium-cap companies and Ohlson includes a variable relating to company size that lowers the Ohlson score, the bigger the company is. In our sample with small- and medium-sized companies this would mean the Ohlson score will be higher. In section 5.1.4 the results underline this possible explanation.

Table 2: Cross-correlation of dependent variables (SMCap)

	Z	O	ZM
Z	1.000	-0.360	-0.689
O	-0.360	1.000	0.626
ZM	-0.689	0.626	1.000

5. Results

5.1 Regression results

In this section the three models are run, each model is presented in a specific section with a description and corresponding table. Moreover, OLS testing is performed and the sample of large-cap companies is considered.

5.1.1 Altman Z-score

Running our original three models, for every distress indicator a different corporate governance variable is significant in the model. The first investigated model is the one using the Altman Z-score as financial distress measure. Recall that a higher Z-score implies a lower probability of default. As seen in Appendix 3, the null hypothesis of homoscedasticity was rejected using the White test. Therefore, Table 3 has both standard and adjusted Huber-White p-values for each variable. Using the original regression, it is found that managerial ownership has a negative relation to financial distress and is significant at the 1% level. The other variables with a negative relation to distress are the proportion of outside directors and the number of committees. On the contrary, variables with a positive relation to financial distress are CEO-chair duality, size of board and both CEO and average directors' compensation, with the directors' compensation variable being significant at the 5% level. Using Huber-White robust standard errors, the new p-values obtained make both directors' and CEO's compensation significant at 5% and 10% levels of significance respectively.

The R^2 of the Altman Z model is 0.202 and the adjusted R^2 is 0.161 which means that the model explains around 16% of the variation in the dependent variable. The Z-score model has the highest R^2 and adjusted R^2 of the three models.

Table 3: Regression results Altman Z-score (SMCap)

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Adj. Prob.
C	11.544	2.790	4.138	0.000	0.000
MO	18.109	6.679	2.711	0.008***	0.193
CD	-0.819	0.833	-0.983	0.327	0.304
SB	-0.412	0.264	-1.563	0.120	0.112
OD	0.260	2.381	0.109	0.913	0.911
NC	0.278	0.479	0.581	0.562	0.548
CC	-0.196	0.156	-1.257	0.211	0.089*
DC	-1.692	0.768	-2.202	0.029**	0.038**
R-squared	0.202		Adjusted R-squared	0.161	

5.1.2 Ohlson O-score

In contrast to the Altman Z-score, CEO compensation and Director's compensation are not significant in this model, however the number of committees does have a positive significant relationship at 5% significance level to financial distress of 0.402, meaning that extra committees increase the probability of default. The regression results are given in Table 4 on the next page, and a White heteroscedasticity test is done in Appendix 4, showing no evidence of heteroscedasticity. Recall that a higher O-score implies a higher probability of default and similarly a higher level of financial distress. Albeit insignificant, managerial ownership has a negative relation to financial distress, just as average directors' compensation, this means respectively that a higher proportion of shares owned by executives or a higher average pay to the board members leads to lower financial distress. CEO-chair Duality has a positive but insignificant coefficient, meaning that a company with the CEO as chairman in the board has a higher probability of default. A larger size of board or a higher proportion of outside directors also increase the probability of default but these are also insignificant. In contrast to average directors' compensation, a higher pay to the CEO leads to a small and insignificant increase in probability of default. Note however that CEO compensation is in millions and average directors' compensation in hundred thousands, so average directors' compensation has a smaller absolute dollar value effect.

The R^2 is 0.119 and the adjusted R^2 is 0.073. This model thus explains around 7% of the variation in the dependent variable, ranking it the worst of the three models.

Table 4: Regression results Ohlson O-score (SMCap)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.547	1.135	-2.245	0.026
MO	-1.298	2.716	-0.478	0.634
CD	0.304	0.339	0.899	0.370
SB	0.151	0.107	1.405	0.162
OD	1.559	0.968	1.610	0.110
NC	0.402	0.195	2.063	0.041**
CC	0.062	0.063	0.983	0.328
DC	-0.235	0.312	-0.753	0.453
R-squared	0.119	Adjusted R-squared		0.073

5.1.3 Zmijewski

Lastly, the model with the Zmijewski score as the dependent variable is run. Appendix 5 shows no evidence of heteroscedasticity. The model is interpreted similarly to Ohlson's where we measure probability of default, so a higher score implies a higher risk of going bankrupt. As seen in Table 5, the only variable with a level of significance at 5% is CEO compensation which is positively correlated to distress. Similarly, the average directors' compensation has positive but insignificant correlation. Other variables showing positive effect on financial distress are Chair-CEO duality, proportion of outside directors, and size of board. The only two variables having negative correlation with financial distress are the number of committees and managerial ownership.

The R^2 for Zmijewski is 0.174 and the adjusted R^2 is 0.131, meaning that this model explains around 13% of the variation in the dependent variable, ranking it second below the Z-score model.

Table 5: Regression results Zmijewski (SMCap)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.601	0.704	-5.113	0.000
MO	-1.607	1.686	-0.953	0.342
CD	0.249	0.210	1.185	0.238
SB	0.081	0.067	1.218	0.225
OD	0.766	0.601	1.274	0.205
NC	-0.011	0.121	-0.092	0.927
CC	0.088	0.039	2.230	0.027**
DC	0.229	0.194	1.183	0.239
R-squared	0.174	Adjusted R-squared		0.131

For convenience Table 6 below summarizes the direction of the coefficients found. Note that these are the relationships between the independent variables and financial distress.

Table 6: Direction of relationships between financial distress and independent variables (SMCap)

Independent variable	Altman Z-score	Ohlson O-score	Zmijewski score
MO	-***/no sig.	-	-
CD	+	+	+
SB	+	+	+
OD	-	+	+
NC	-	+**	-
CC	+no sig./*	+	+**
DC	+**/**	-	+

* 10% significance, ** 5% significance, *** 1% significance
For Altman the first level stands for OLS Standard Errors, the second for adjusted SE

5.1.4 Large-cap companies

Besides the dataset of 143 small- and medium-cap companies, data was also collected for 102 large-cap manufacturing companies in the United States of America. The summary statistics are in Appendix 6. What is remarkable, and underlines our previous statement in the data section about the size factor in the Ohlson model, is that the mean O-score is now in line with Zmijewski and Altman. The Altman Z-score, Ohlson O-score and the Zmijewski score now all predict on average no bankruptcy for the companies.

The regression results of this sample are shown in the appendix, heteroscedasticity was not detected in any of the models. Of the three models, Zmijewski was found to be normally distributed at the 5% significance level, with a Jarque-Bera p-value of 0.06. All test and regression results can be found in Appendices 7 till 12 The Altman and Ohlson models both have a negative adjusted R^2 and no significant variables. Zmijewski has an adjusted R^2 of around 6% and there is a significant positive relationship between size of board and probability of default, in line with previous research (Lipton and Lorch 1992; Yermack 1996; Wang and Deng 2006).

5.2 Testing Hypotheses

5.2.1 Hypothesis 1: Managerial ownership is negatively related to financial distress

This hypothesis is confirmed by every model. The model with the Altman Z-score as the dependent variable has a significant correlation at the 1% level. In the other two models, the variable is insignificant. This adds to previous research that managerial ownership is positively related to firm performance.

5.2.2 Hypothesis 2: CEO-chair duality is positively related to distress

This is supported by all of the model. However, the variable of CEO-chair duality is not significant in any of the models.

5.2.3 Hypothesis 3: Size of board is positively related to distress measures

Size of board is found to be positively related to financial distress in all models, but none of the times the variable is significant. A positive relationship to financial distress means that a larger board is indeed less efficient, which confirms our hypothesis.

5.2.4 Hypothesis 4: The proportion of outside directors and financial distress is negatively related

The proportion of outside directors is positive in relation to financial distress in Ohlson and Zmijewski the models, meaning this hypothesis is not confirmed by those models. On the other hand Altman supports the hypothesis. However, this variable is not significant in any of the research.

5.2.5 Hypothesis 5: There is a negative relation between the number of committees and distress

This variable is relatively unique in research and no previous research with respect to financial distress has been conducted so far. We hypothesized that there would be a negative relation since committees add expertise. The results are conflicting, Altman indicates a negative relation with

financial distress and Ohlson and Zmijewski indicate a positive relation. The variable in the model of Ohlson is also significant at the 5% level, so we take that one most in account. Hypothesis 5 is thus not confirmed in this research.

5.2.6 Hypothesis 6: There is a negative relation between compensation and financial distress.

This hypothesis is divided into two sections: CEO compensation and average directors' compensation. In case of the model with Altman Z-score as dependent variable, both CEO compensation and directors' compensation have a positive relation to financial distress. The variable of directors' compensation is significant at 5% both with standard and adjusted-for-heteroscedasticity p-values. CEO compensation becomes significant at the 10% level with adjusted p-values. In the model with the Ohlson O-score as the dependent variable, both average directors' and CEO compensation are insignificant with directors' compensation being negatively related to the financial distress and the CEO compensation having positive relation. The model with Zmijewski score has both variables positively related to the distress, CEO compensation significant at 5% level and average directors' compensation not significant.

5.3 OLS violation tests

In this part OLS violation tests are performed. The goal of this section is to confirm applicability of the models used in this paper. The further investigation of possible OLS assumptions is presented in the specific sub-sections. Since the dataset is cross-sectional, only heteroscedasticity and non-normality are considered for violations of OLS assumptions. Additionally, multicollinearity and non-linearity are reviewed as well since they can still be possible problems.

5.3.1 Heteroscedasticity

The variance of the errors should be constant (i.e. homoscedasticity), otherwise it violates OLS assumption 2 (Brooks 2014). We use White's (1980) heteroscedasticity test, which for Altman gives an F-test p-value of 0.000, so the null hypothesis of homoscedasticity is rejected. For Ohlson we have a p-value of 0.101 and Zmijewski of 0.622, which indicate no evidence for the presence of heteroscedasticity for both of these models (Brooks 2014). In order to account for the

heteroscedasticity in Altman, Huber-White-Hinkley heteroscedasticity consistent standard error estimates were given besides the OLS standard errors.

5.3.2 Normality of Residuals

According to Brooks (2014), the normality assumption, meaning that the error terms are normally distributed with mean zero, is necessary to conduct hypothesis tests. We test this by performing a Jarque-Bera test for our three models. The detailed results including histograms can be found in appendices 13, 14 and 15.

For Altman and Ohlson the p-value of the Jarque-Bera test is 0.000, meaning that we can reject the null of normality. For the Zmijewski model the p-value is 0.515 so we cannot reject the null of normality at the 5% level (Brooks, 2014). Since it is not a problem for the results, no further actions are taken with regard to this violation.

5.3.3 Multicollinearity

The explanatory variables cannot be correlated with each other, so-called orthogonality, or multicollinearity would be present (Brooks 2014). The correlation matrix is shown below in Table 7. Since no correlation is higher than 0.8, we can use a rule of thumb to say that there is no near multicollinearity.

Table 7: Cross-correlation independent variables

	MO	CD	SB	OD	NC	CC	DC
MO	1						
CD	0.144	1					
SB	-0.135	-0.159	1				
OD	-0.181	-0.078	0.325	1			
NC	-0.193	0.047	0.170	0.077	1		
CC	-0.250	0.117	0.402	0.176	0.214	1	
DC	-0.319	-0.052	0.260	0.308	0.252	0.371	1

5.3.4 Non-linearity

To check whether the functional forms of our models are linear, we use the Ramsey RESET test. The results of these tests for our three models is a p-value of the test statistics of 0.118, 0.466 and 0.037 respectively for Altman, Ohlson and Zmijewski. This means that only for the Zmijewski

model there is evidence for linearity in the regression equation at the 5% level. For the Altman and Ohlson equations there is evidence for non-linearity. The test results can be found in appendices 16, 17 and 18.

5.4 Limitations

The finding in the data of the high average Ohlson O-score, indicating that on average the firms will go bankrupt, is remarkable. However, apart from average directors' compensation the relationships between the O-score and the independent variables are in the same direction as for the other financial distress scores. For future research it could be interesting to see if the Ohlson model is suitable for small- and medium-cap firms too, or only for large-cap firms.

One could argue that the variable used in this research, proportion of outside directors, does not actually measure an *outsider*. Merely, it measures whether the board members are in the board of their primary company or not. The primary company is the company where the board member has a non-board function, e.g. CFO or Executive VP. However, despite not measuring the formal definition of an *outsider* as discussed in 3.3.4 Proportion of Outside Directors, the statement that these "outside" board members can bring in new views to the company still holds.

The famous saying *correlation does not imply causation* of course also holds in this research. More intuitively this problem could also be described as *wet streets cause rain*. The finding that higher pay to the CEO and the board has a positive relation to financial distress does not mean that higher payment causes financial distress. It can mean that the company is already in financial distress and wants to improve their performance by appointing a top CEO and experienced board members, which demands a high pay.

Similar to this, a negative relationship has been found between managerial ownership (shares held by executives) and financial distress. It is perfectly reasonable to assume that executives buy more shares, thus increasing managerial ownership, if the company is financially healthy. Therefore, concluding that a higher percentage of shares held by executives leads to a lower probability of financial distress should be done with extreme caution.

6. Summary and Conclusions

In this section, the main conclusions of this research are presented. The subsections are the implications telling how the research can be used, future research presenting recommendations for further research, and a summary and the interpretation of the main results.

6.1 Chapter Summary

The results presented in the section 5 show us the relations of our variables to financial distress. The most straightforward variable was managerial ownership which was negatively related to financial distress in all three models, achieving significance at 1% with OLS standard errors in the model with Altman Z-score as the dependent variable. This indicates that executives who hold more shares of their company tend to make the company financially better. However, as noted in limitations it could also be the other way round.

CEO-Chair duality appeared to be insignificant in all of the models, but in all models there was a positive relation to distress. We can conclude, in line with some previous research, that separation between CEO and Chair is favorable for financial performance.

Furthermore, size of board is positively related to distress in each of models. However, it is not significant in any of the models. Nevertheless, the research proves that small boards tend to perform better especially in financial aspect. Similarly, the proportion of outside directors adds up to the probability of the distress, except in Altman's model.

The variable that is unique in this research is the number of committees, which has conflicting results. The model with Altman Z score as the dependent variable concludes that the higher number of committees has a positive impact on companies' performance. However, models with scores of Ohlson and Zmijewski conclude the opposite where in the model using the Ohlson score as the dependent variable the number of committees is significant at 5% level of significance, making us to conclude that the higher number of committees has a positive impact on the financial distress which could be caused by the higher cost of having them than the value they actually produce.

When it comes to compensation, the models with Zmijewski and Altman Z-score indicate that both average directors' and CEO compensation is positively related to distress with Altman having directors compensation significant at 5% level with standard and adjusted p-values and

CEO compensation significant at 10% with adjusted for heteroscedasticity p-values. The model with Zmijewski as dependent variable has only CEO compensation significant at 5%. On the other hand, the model with Ohlson O-score shows that average directors' compensation has a negative impact on financial distress and CEO compensation has positive, however, none of this values is significant. In this case we conclude that the higher CEO and directors compensation has a negative impact on the company's performance, which is in line with some previous research.

6.2 Research Implication

The aim of research was to check the influence of corporate governance variables on the financial distress models, to create a possible best governance structure for companies. However, we found conflicting results between the three models used, and no variable was significant in all three models. Therefore, we cannot produce a straightforward recommendation for the style of governance structure.

6.3 Future Research

The relatively unique variable introduced in this research was the number of committees. Despite finding conflicting results between the models in the direction of the relation, the relationship between it and financial distress was found to be significant at the 5% level using Ohlson's O-score, with a positive relation. Altman and Zmijewski showed a negative but insignificant relation. A future research paper focused mostly on the number of committees, including for example the amount of members of committees and types of committees (e.g. financial, marketing), could yield to interesting insights for this sparsely researched variable.

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Appendices

Appendix 1: *Summary statistics (SMCap)*

	Z	O	ZM
Mean	4.905	0.924	-1.601
Median	3.462	0.813	-1.404
Maximum	28.490	10.960	2.352
Minimum	0.620	-6.333	-4.304
Std. Dev.	4.960	1.919	1.231
Observations	143	143	143

Appendix 2: *Summary statistics independent variables (SMCap)*

	MO	CD	SB	OD	NC	CC	DC
Mean	0.038	0.364	9.182	0.462	3.601	5.239	1.978
Median	0.020	0.000	9.000	0.444	3.000	4.872	2.013
Maximum	0.437	1.000	13.000	0.889	7.000	20.649	3.672
Minimum	0.003	0.000	4.000	0.000	2.000	0.444	0.405
Std. Dev.	0.062	0.483	1.694	0.175	0.840	2.921	0.577
Observations	143	143	143	143	143	143	143

Appendix 3: *White test Altman Z-score (SMCap)*

F-statistic	2.519	Prob. F(34,108)	0.000
Obs*R-squared	63.252	Prob. Chi-Square(34)	0.002
Scaled explained SS	236.401	Prob. Chi-Square(34)	0.000

Appendix 4: *White test Ohlson O-score (SMCap)*

F-statistic	1.346	Prob. F(34,108)	0.127
Obs*R-squared	42.571	Prob. Chi-Square(34)	0.149
Scaled explained SS	155.681	Prob. Chi-Square(34)	0.000

Appendix 5: *White test Zmijewski (SMCap)*

F-statistic	0.898	Prob. F(34,108)	0.631
Obs*R-squared	31.508	Prob. Chi-Square(34)	0.590
Scaled explained SS	29.426	Prob. Chi-Square(34)	0.691

Appendix 6: *Summary statistics (large cap)*

	Z	O	ZM
Mean	3.293	-0.037	-1.009
Median	3.100	0.305	-1.113
Maximum	12.330	6.391	2.013
Minimum	0.498	-17.810	-4.667
Std. Dev.	1.758	2.991	1.060
Observations	102	102	102

Appendix 7: *Regression results Altman Z-score (large cap)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.170	1.485	2.808	0.006
MO	-5.875	7.239	-0.812	0.419
CD	0.434	0.383	1.134	0.260
SB	0.065	0.085	0.766	0.446
OD	-1.115	1.318	-0.846	0.400
NC	-0.265	0.173	-1.536	0.128
CC	0.014	0.026	0.537	0.593
DC	-0.066	0.315	-0.210	0.834
R-squared	0.054	Adjusted R-squared		-0.016

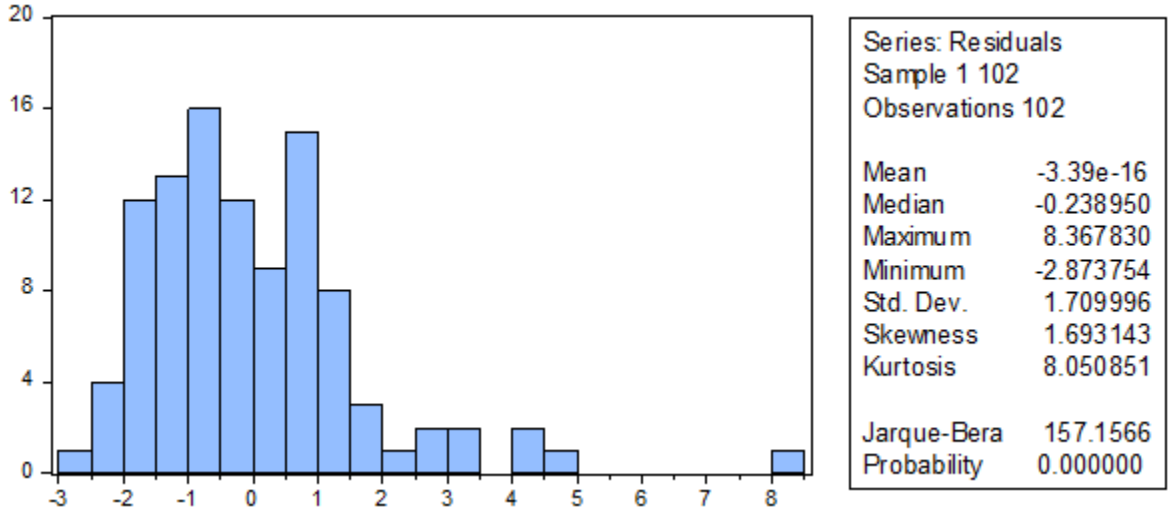
Appendix 8: *Regression results Ohlson O-score (large cap)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.282	2.518	0.112	0.911
MO	-3.256	12.273	-0.265	0.791
CD	0.459	0.649	0.708	0.481
SB	0.124	0.143	0.866	0.389
OD	-1.527	2.234	-0.683	0.496
NC	0.248	0.293	0.846	0.400
CC	0.024	0.043	0.548	0.585
DC	-0.866	0.534	-1.619	0.109
R-squared	0.061	Adjusted R-squared		-0.009

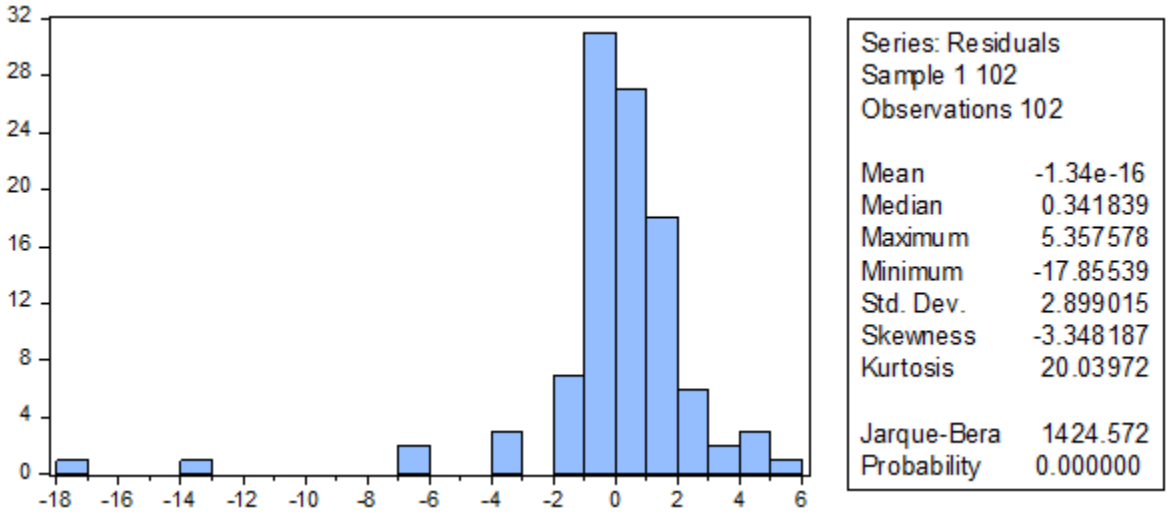
Appendix 9: *Regression results Zmijewski (large cap)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.581	0.861	-4.158	0.000
MO	-1.822	4.199	-0.434	0.665
CD	0.036	0.222	0.163	0.871
SB	0.145	0.049	2.959	0.004***
OD	0.146	0.764	0.192	0.849
NC	0.070	0.100	0.697	0.488
CC	0.006	0.015	0.424	0.673
DC	0.128	0.183	0.699	0.486
R-squared	0.124	Adjusted R-squared		0.059

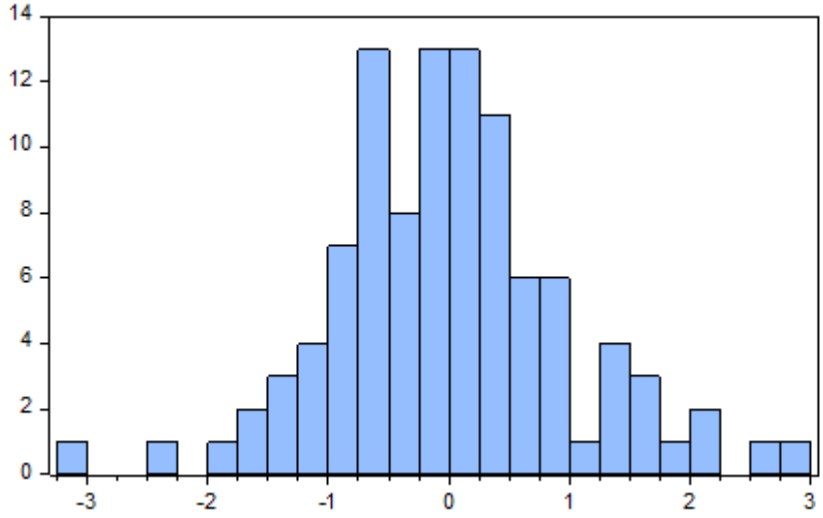
Appendix 10: *Normality of residuals Altman Z-score (large cap)*



Appendix 11: *Normality of residuals Ohlson O-score (large cap)*

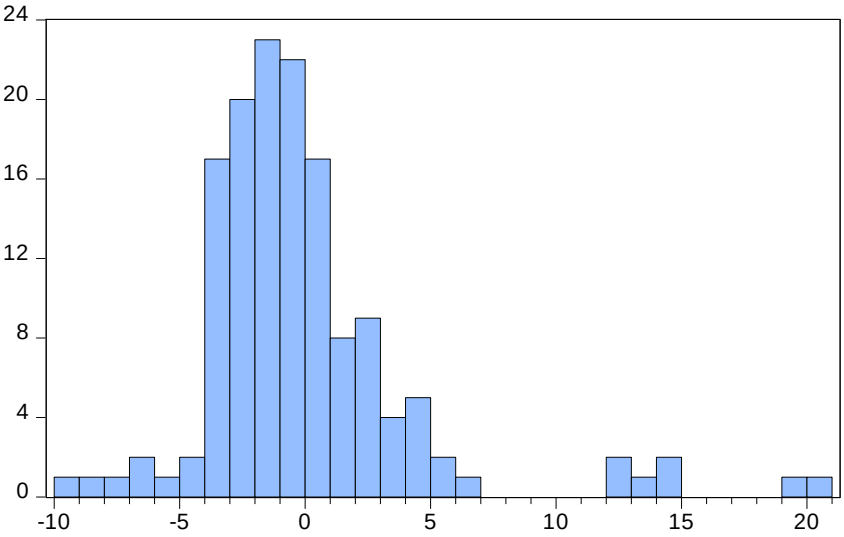


Appendix 12: *Normality of residuals Zmijewski (large cap)*



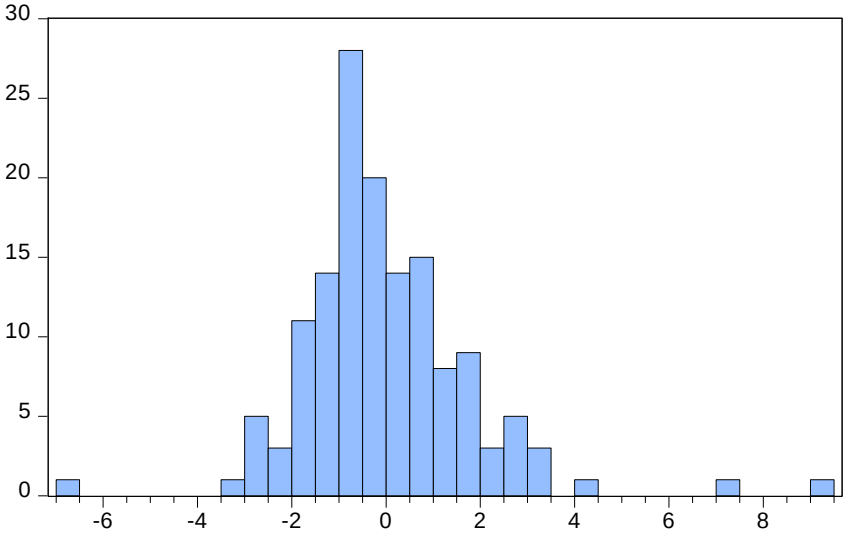
Series: Residuals	
Sample 1 102	
Observations 102	
Mean	9.30e-16
Median	-0.046485
Maximum	2.839833
Minimum	-3.195115
Std. Dev.	0.991851
Skewness	0.186799
Kurtosis	4.066400
Jarque-Bera	5.426337
Probability	0.066326

Appendix 13: *Normality of residuals Altman Z-score (SMCap)*



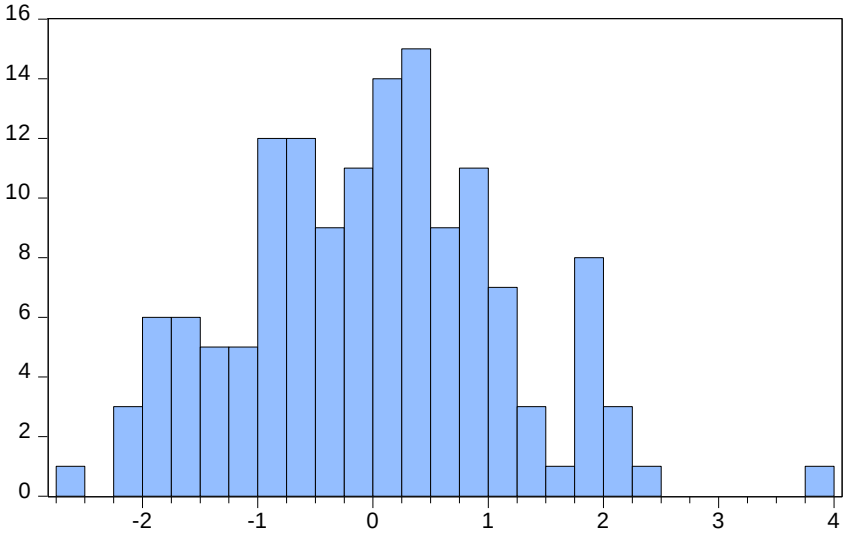
Series: Residuals	
Sample 1 143	
Observations 143	
Mean	1.13e-15
Median	-0.833890
Maximum	20.40724
Minimum	-9.072933
Std. Dev.	4.430592
Skewness	2.084615
Kurtosis	9.387087
Jarque-Bera	346.6401
Probability	0.000000

Appendix 14: *Normality of residuals Ohlson O-score (SMCap)*



Series: Residuals	
Sample 1 143	
Observations 143	
Mean	-2.56e-16
Median	-0.271978
Maximum	9.085749
Minimum	-6.967550
Std. Dev.	1.801763
Skewness	1.105538
Kurtosis	9.206476
Jarque-Bera	258.6465
Probability	0.000000

Appendix 15: *Normality of residuals Zmijewski (SMCap)*



Series: Residuals	
Sample 1 143	
Observations 143	
Mean	9.61e-17
Median	0.031204
Maximum	3.849058
Minimum	-2.501069
Std. Dev.	1.118573
Skewness	0.231235
Kurtosis	3.095776
Jarque-Bera	1.329014
Probability	0.514527

Appendix 16: *Ramsey RESET Test Altman Z-score*

	Value	df	Probability
t-statistic	1.572	134	0.118
F-statistic	2.470	(1, 134)	0.118
Likelihood ratio	2.612	1	0.106

Appendix 17: *Ramsey RESET Test Ohlson O-score*

	Value	df	Probability
t-statistic	0.732	134	0.466
F-statistic	0.535	(1, 134)	0.466
Likelihood ratio	0.570	1	0.450

Appendix 18: *Ramsey RESET Test Zmijewski*

	Value	df	Probability
t-statistic	2.109	134	0.037
F-statistic	4.448	(1, 134)	0.037
Likelihood ratio	4.669	1	0.031