Archives of Business Research – Vol. 11, No. 2
Publication Date: February 25, 2023
DOI:10.14738/abr.112.14085.
Willey, T., Bhagwat, Y., & DeBruine, M. (2023). An Investigation of the Altman Z-Score Measure and Return on Equity (ROE) of Firms in the Energy Industry. Archives of Business Research, 11(2). 149-155.

An Investigation of the Altman Z-Score Measure and Return on Equity (ROE) of Firms in the Energy Industry

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Abstract

This research measures the relationship between the Altman Z-Score, a measure of a firm's financial health, and the Return on Equity (ROE), a measure of a firm's profitability for a sample of companies in the Energy industry. The period of the study covers 2014 to 2020 and uses linear regression to examine the relationship between ROE (dependent variable) and the Z-Score (independent variable). Our initial data set contains three hundred and twenty-nine (329) energy-related firms traded on fifty-one (51) world markets. Our initial hypothesis is that a positive and statistically significant relationship exists between the two variables over the examined period. Further research will look at the relationship in other sectors of the markets.

Keywords: Altman Z-Score, Corporate Performance, Return on Equity, Energy, Financial Distress

INTRODUCTION

This research measures the relationship between the Altman Z-Score, a measure of a firm's financial health, and the Return on Equity (ROE), a measure of a firm's profitability for a sample of companies in the Energy industry. The period of the study covers 2014 to 2020 and uses linear regression to examine the relationship between ROE (dependent variable) and the Z-Score (independent variable). Our initial data set contains three hundred and twenty-nine (329) energy-related firms traded on fifty-one (51) world markets.

MOTIVATION AND CONTRIBUTION

Literature Review

The Altman Z-Score (Altman, 1968 and 1974) is the most cited measure of financial health of firms in previous studies. The Z-Score is a unique indicator of financial success due to the combination of financial ratios that are combined into a single value which indicated the likelihood a firm would go into financial distress and/or bankruptcy using multiple discriminant analysis (MDA). Beaver (1968) examined the roles financial ratios played separately on future outcomes of companies. Examples of previous research using the Altman

method include firms in China (Wang and Campbell, 2010A and 2010B), India (Pradhan, 2014), Sri Lanka (Gunathilaka, 2014) and Australia (Thai, et al., (2014).

The literature on using the Altman Z-Score and the associated predictive power of the method is quite prevalent. Previous studies include Deakin (1977), Beynon and Peel (2001), Neophytou et al. (2001) and Chung et al. (2008). Ohlson (1980) used logit regression methods, while Frydman et al., (1985) recursive partitioning to measure financial distress. Agarwal and Taffler (2007) found that MDA remains as the most frequently cited method for bankruptcy prediction. Additionally, Tandiontong and Mathius (2017), found the existence of a partial correlation between stock market returns in Indonesia and the Altman Z-Score, the beta of a stock and inflation.

Aziz and Dar (2006) reviewed 89 articles on bankruptcy prediction between 1968 and 2003 and reported multi-variable models were the most prevalent. The reliability of the Z-Score model was tested by Altman and McGough (1974), Altman (1982), Levitan and Knoblett (1985) and Koh and Killough (1990). Finally, Sherbo and Smith (1990) proposed that the Z-Score model has endured and continues to be relevant in today's business economy. Considering the previous and current literature, this study uses the Altman Z-Score as our indicator of financial health. The components of the model are Figure 1.

The dependent variable and the measure of a firm's profitability and financial success, the return on equity (ROE), is used in our study. Studies that used this ratio include Chen and Dodd (1997), Chen et al, (2005) and Damodaran (2007). Stowe et al., (2002) stated that the ROE is a widely used metric by companies to make corporate investment decisions.

Research Question and Hypothesis

Our research question: does the ROE of higher (lower) performing firms in the Energy Sector also coincide with higher (lower) Z-Scores? Our null hypothesis is there is no significant and statistical relationship between the two variables. Our Alternative Hypothesis is that there is a significant statistical relationship between ROE and the Altman Z-Score.

Methodology and Data

The study uses the Altman Z-Score Model as a predictor of financial distress and bankruptcy.

The Altman Z-Score (1968) is shown in Figure 1.

$$Figure\ 1:\ Altman\ Z-Score = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

Where:
X1 = Net Working Capital/Total Assets (TA)
X2 = Retained Earnings/TA
X3 = Earnings Before Interest and Taxes (EBIT)/TA
X4 = Market Value of Equity/Total Liabilities (TL)
X5 = Sales/TA

Descriptive Analysis

Table 1: Median, Mean and Standard Deviation of Z- Scores

Year	2014	2015	2016	2017	2018	2019	2020
Mean	3.32	2.94	2.58	2.81	2.95	2.66	2.14
Median	2.61	2.22	2.04	2.23	2.34	2.13	1.68
Std. Dev.	2.26	2.28	2.05	2.08	2.17	2.08	1.77
Coefficient of Variation (CV)	0.68	0.77	0.80	0.74	0.73	0.78	0.83

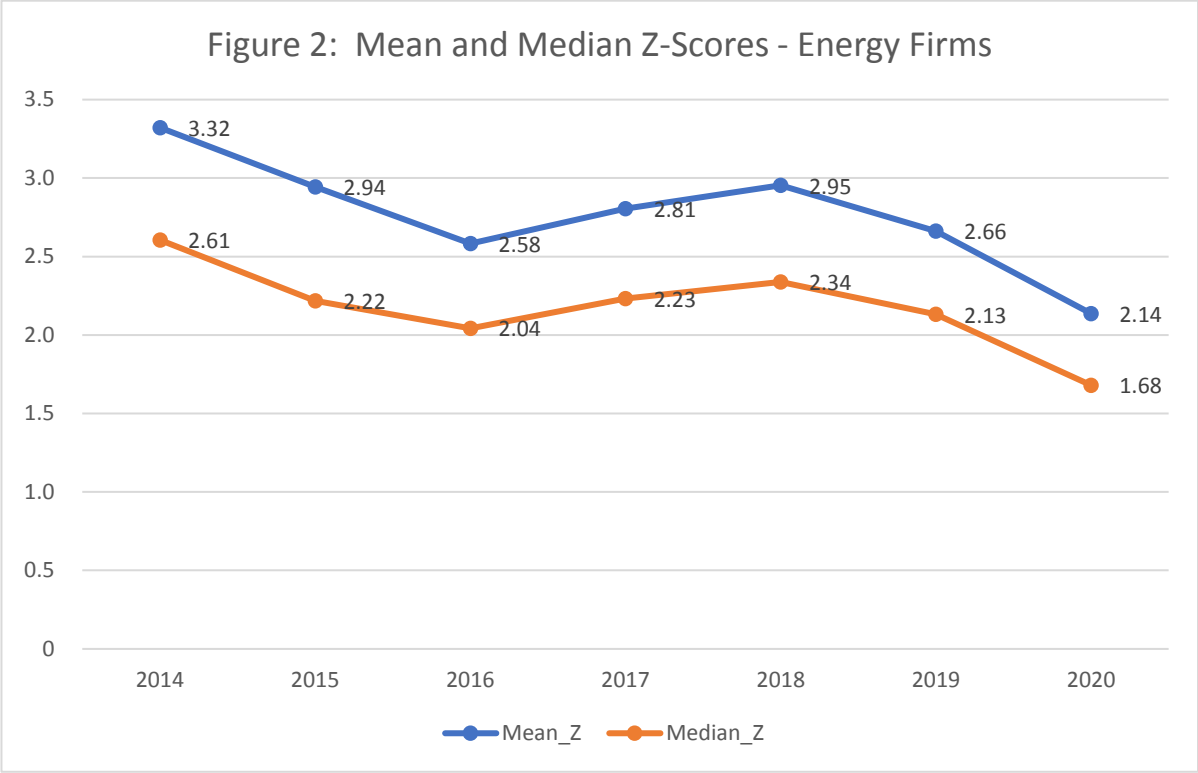


Table 1 shows the mean, median, standard deviation and a measure of relative variability (CV; defined as the Sample Standard Deviation/Sample Mean) for the Z-Scores for the seven-year period from 2014 to 2020. Z-Scores greater than 2.99 indicate strong financial health and low possibility for financial distress and/or bankruptcy (Altman, (1968)). Additionally, Altman (1968) states that Z-Scores less than 1.81 indicate poor financial health and a strong likelihood for bankruptcy. The so-called "zone of ignorance" with scores from 1.81 to 2.99, indicates an undetermined future financial success of the firm. Three of the seven years (43%) had average Z-Scores in the range of 2.94 and above, while fifty-seven percent of the remaining scores fell in the range of 2.14 to 2.81 (indicating the future success of the firm is undetermined). The absolute variability of the Z-Scores, measured by the sample standard deviation, and the relative variability of the Z-Scores, measured by the coefficient of variation, are stable over the sample period. The mean Z-Scores are greater than the median Z-Scores, due to extreme positive values for a large proportion of the Energy firms.

URL: http://dx.doi.org/10.14738/abr.112.14085

Table 2: Median, Mean and Standard Deviation of Return on Equity (ROE)

Year	2014	2015	2016	2017	2018	2019	2020
Mean	8.64%	4.45%	5.22%	8.1%	8.49%	5.7%	(3.5%)
Median	7.87%	4.57%	4.78%	8.3%	8.49%	6.16%	1.23%
Std. Dev.	21.01%	28.09%	16.98%	15.86%	13.95%	19.27%	19.97%
Coefficient of Variation (CV)	2.43	6.32	3.25	1.96	1.64	3.38	-5.71

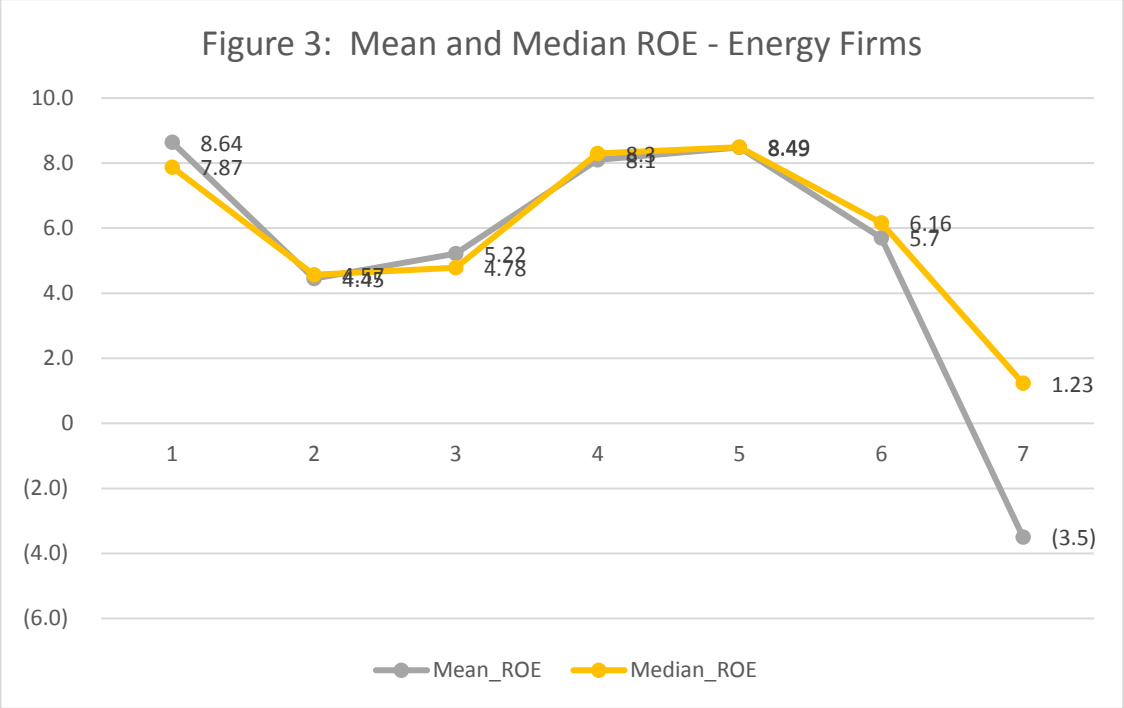


Table 2 shows the mean, median, standard deviation and the coefficient of variation for the ROE for the seven-year period from 2014 to 2020. The measure of profitability, specifically, the average and median return to the common stockholders of the firm, varies from 4.45% to 8.64% for the first six years of the sample period. The final year of our study, 2020, shows a downturn in the metric, decreasing to a small positive average return of 1.23% and a negative median return (-3.50%) for the final period. The trend line in financial success, as measured by the ROE, appears to be highly correlated with the price of crude oil of the period of our study (Figure 4).



Figure 4: Crude Oil Prices from 2014 to 2020 (Source: St. Louis Federal Reserve Bank)

Regression Analysis

Table 3: Regression Analysis

	Coefficients	Std. Error	T-Stat	P-value	Lower 95%	Upper 95%
Z-Scores	3.1854	0.2103	15.1461	0.0000	2.7729	3.5978

A linear regression was run over the period of 2014 to 2020 using this formula: ROE (dependent variable) = Constant + B*Altman Z-Score (independent variable), where B is the regression coefficient. The source of the financial data was S&P Global Market Intelligence. The industry classification was the Primary Energy sector, which included 262 firms with complete data available, for the period of our study. The top and bottom one percent of the outliers were removed for the analysis.

A total of 1,795 observations were used for the linear estimation of energy sector firms. The results show a positive coefficient (+3.19 rounded) and statistically significant results (T-Statistic is 15.15, p-value = 0.0001) for the impact of the Altman-Z score on the ROE of the firms. The standard error is low (0.21), as well.

Our results indicate that a statistically significant and positive relationship between the Altman Z-Score and the ROE of firms in the Energy Sector. As a result, many groups, (management, investors, lenders and other interested parties), may view the measure of financial success as a positive signal for profitability in this sector.

DISCUSSION

Limitations and Future Research

The study is limited to firms solely in the Energy Sector and no other economic sectors. Our focus is to measure the relationship between a measure of financial solvency and profitability in energy firms. Plans are to extend our analysis to other industries and additional time periods to expand the coverage of this relationship. For example, the impact of the world-wide pandemic on the profitability of companies.

URL: http://dx.doi.org/10.14738/abr.112.14085

Conclusions

The purpose of our research is to investigate and empirically test the relationship between the Altman Z-Score (a measure of financial health or success) and financial performance and profitability, measured by Return on Equity (ROE), for firms in the Energy Sector. Our findings show a positive and statistically significant relationship between the dependent variable (ROE) and the independent variable (Z-Score). Forty-three (43%) percent of the Z-Scores were greater than three (low likelihood of future financial distress) and the remainder fell in the inconclusive zone (Z-Scores between two and three). For the indicator of financial performance, for six of the seven years analyzed, eighty-six percent, of the observations were greater than 4.45% (mean) and (4.57%), (median), ROE. The final year of our study showed a significant decline in ROE for 2020. This decrease in profitability aligns with declining oil prices and a recession in the U.S.

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