

Review Article

A Relationship Between Altman's Z Scores and Stock Price Performance: A Review on Listed Companies in Best-30 Index

Mustafa Özyeşil

Istanbul Aydin University, Anadolu Bil Vocational School, Business Management Department, Istanbul, Turkey

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Abstract - Conventional financial analysis includes ratios and calculations that are considered to be valid for each firm where they do not develop a model specific to the firm. Therefore, in traditional financial analysis, it is possible that the signals received about the company may be misleading and/or late to take the required measurements. Therefore, a model specific to the company needs to be developed. For this purpose, the Altman Z Score model was developed by Edward Altman in 1968, which analyzes the financial performance of a firm from different aspects instead of a single indicator, and the weighting of indicators can be changed according to the firm.

The main objective of this study is to find out whether investors are using z scores in order to perform market timing. Therefore, the new version of the Altman model developed for the emerging countries applied on the non-financial firms listed in the BIST-30 index, and these firms are classified as risky, safety and grey according to their z scores. In the final section of the application, the relationship between scores and stock returns will be analyzed, and the results obtained for firms will be interpreted.

Keywords - Bankruptcy, Financial Fragility, Financial Analysis, Altman Z-Score, Financial Ratios, Financial Statements Basis Estimation

Jel Codes:G30, G33

I. INTRODUCTION

In business life, it may be seen that many companies that are considered too big to fail have closed shutters over time. Even the companies with high credibility in the eyes of the investors and financial institutions may suffer from bankruptcy issues. This misconception of investors or financial institutions about the firm's financial performance is, in fact, due to the insufficient valuation/analysis of the firm. Financial performance indicators can be varied. Focusing on only one and/or a few of them and ignoring others may lead information users to wrong financial decisions. As a result of the incomplete or incorrect

analysis, if the losing party is an investor, a bad investment may be mentioned, while for the financial institution, bad credit may be mentioned. If the financial institution becomes unable to get back its loan from borrowers, it will have to meet financial liabilities to the depositors who previously granted the fund, based on its own resources.

Therefore, it is necessary to make analyzes that reveal the financial performance of the company in various aspects. For example, the results of an analysis based on only asset criteria size may be misleading if a large part of the asset size is financed by the debt (high leverage ratio), this will likely increase a firm's financial fragility and bring difficulty in repaying the debt, especially for short-term ones. This situation may lead to bankruptcy. As a result, the size of assets alone cannot provide sufficient clues for the overall financial situation of any given firm. Similarly, the analysis based on the period's net profit and loss item, which is a component of the income statement, may have misleading results. In accordance with local accounting practices called GAAP principles, it is clear that the net profit and loss item for the period will not reveal the real cash-generating power of a firm. However, in the project and especially in credit valuation, the real cash-generating power of the firm should be taken into consideration rather than the profitability level of the firm.

In order to eliminate these deficiencies in financial analysis and to measure and reveal the degree of financial risk of a firm simultaneously with different indicators, a financial indicator called Altman Z was developed in 1968 by Edward Altman, an academician at New York University. Thus, in order to estimate the bankruptcy risk accurately, he tried to analyze the ratio analysis analytically by using the predetermined weights of the ratios that measure different financial aspects (Altman, 1968: 589). In the Altman Z model, the firm's financial risk level is calculated analytically by considering all liquidity, profitability, leverage, and operational performance ratios. Thus, instead of just one financial metric mentioned above, it is possible to include more than one indicator at the same time. The Altman model was originally developed for the financial statements of



companies in developed countries. However, in the literature, many studies have been done about the Z model over time. One of these studies is the new model developed by Meeampol et al. in 2014 for the developing countries

In this study, the new version of the Altman Z model developed for the emerging countries will be applied to the non-financial firms listed in BIST-30 index.

In the second part of the study, the studies in the national and international literature about the Altman Z model are examined and interpreted. In the third part, information about the sample structure and the data used in the analysis are provided. In the fourth part of the study, the developed version of the Altman Z model for developing countries is applied for Best-30 firms for the 2015-2018 period, and the z score is calculated for each year. Calculated z scores and annual stock price performance of the firm are compared, and it was examined whether there is a relationship between them. In the last part of the study, the results obtained are analyzed and interpreted.

A. Research importance

In this study, it is tested whether the new version of the Altman Z model is used in investment timing. We tried to find out whether Z-scores, which are calculated according to the model, are accepted as a signal and whether investors adjust their portfolio decisions accordingly. Especially, it is investigated whether an investment methodology was followed by buying stocks of companies with high Z scores and selling lower ones. In this respect, the study aims to contribute to the existing literature with new findings.

B. Research implications

Due to an insufficient number of observations used in the analysis, the findings could not be statistically confirmed. Therefore, it was preferred to make observational comments on the chart. Statistically significant results are expected to be obtained from studies with a longer analysis period and more cross-sections (number of firms).

Furthermore, it will provide different and meaningful results according to the country type in the analyzes to be made between developed and emerging countries.

II. LITERATURE REVIEW

A. Studies In The International Literature Related To Altman Z Model

Altman (1968), in his study, tried to establish a connection between traditional financial analysis and statistical techniques and, in this context, tried to measure the quality of ratio analysis as an analytical technique. For this purpose, during the analysis period, he has formed 2 categories as bankrupt and non-bankruptcy firms and analyzed 33 firms in each group, and analyzed 66 firms in total. In the category which is named as the first group, there are manufacturing companies that declared

bankruptcy between 1946-1965. The asset size of the companies in this group varies between 0.7 Million USD and 25.9 Million USD, and the average asset size of the group is 6.4 Million USD. Group 1 is heterogeneous due to different asset sizes and industry types, so group 2, which includes non-bankruptcy, is carefully classified by industry and asset size, and its asset size range is limited to 1-25 million USD.

In the model, he developed five financial ratios that show the financial performance of a firm in various aspects. These ratios are, respectively, Working Capital / Total Assets Ratio, Retained Profits / Total Assets Ratio, Profits Before Interest and Taxes / Total Assets Ratio, Market Value of Equity / Book Value of Liabilities and Sales / Total Assets Ratio. He stated that each financial ratio differs from the other in terms of importance depending on the sample studied, and each weighted differently in terms of importance. He found out that the importance of each ratio will be different according to the relevant situation, so the order of importance of ratios used in the analysis is not clear and constant. Although high leverage is considered important as it will increase the financial risk of a firm, it will not pose a risk for firms with high positive cash flow. Therefore, he concluded that the weight of each ratio should be revised according to the financial position of the analyzed firm. In this way, he established the discriminant function and determined the risk degree of the firms according to the Z score calculated. He specified 3 basic ranges for the Z score as follows and stated that the financial risk level of the firms would be determined depending on the related range.

- If the Z score is higher than 2.99, then the firm is considered as good in terms of financial health.
- If the Z score is between $1.81 < Z < 2.99$, it is assumed that the firm is not in poor condition but must be carefully monitored,
- Finally, if the company's Z score is less than 1.89, it is emphasized that the firm should be considered risky.

He has proved that the discriminant-ratio model created in his study can explain 95% of firms' risk of bankruptcy. The fact that the analysis was conducted only on publicly traded manufacturing companies with a certain asset size range was defined as the limitation of the model. As a result of this study, this discriminant-ratio model was determined as successful, but it was concluded that especially the ratios should be revised according to the company analyzed.

Altman et al. (2017) examine the performance of the Z model in predicting bankruptcy and other financial shocks at the level of international banks. They carried out revisions to the Z model and applied the modified model on a sample that included 31 European and 3 other countries. All companies in the sample, except the USA and China, are operating in the private sector, and all of them are included in the manufacturing industry. They also stated that other models competing with the Z score model

were successful, but it would be very difficult to generalize the results without international analysis. As a result of the study, the predictive power of the traditional Z score model was determined to be 75%. However, it was stated that the predictive power of the model could be increased up to 90% thanks to the modifications to be made by classification in the model.

Almamy et al. (2016) investigated the performance of the expanded Z-Score model to predict the financial position of UK companies. For this purpose, discriminant analysis was conducted in the UK in the period 2000-2013 to test which ratios are more meaningful in estimating the financial risk of firms. They contributed to the literature by adding a new variable to Altman's Z-Score model (Altman 1968). As a result of the studies, it has been found that when the cash flow is combined with the original Z-Score, a more successful model for estimating the financial situation of the firms in the UK has obtained. In the study, they determined that the predictive power of the model they named as J-UK model was 82.9%. It was found that their model predicted financial crises more successfully than the original Z Score model.

Elliott et al. (2014) used the double-hidden Markov model in the study and tried to measure the real credibility of the firms by using the Z score calculated from the financial ratios of the firms and the information obtained from the published credit ratings of the firms. They obtained the actual credibility information from the data observed over time by using the filtering method and EM algorithm. The mentality that lies under the logic of the model is to filter and re-submit the most appropriate predictions for the model to automatically.

Hayes. Al (2010) conducted an analysis summarizing the Z-score model and carried out calculations on firm groups consisting of financial data of 17 retail firms for consecutive 2 fiscal years. In line with the literature, the Altman Z score was regarded as successful in predicting the future financial risks of the firms with a 94% accuracy ratio in determining the risk of bankruptcy or shock except for two banks in the sample.

V. Chouhan et al. (2014) emphasized that the financial ratios are not sufficient for the profitability analysis of the shareholders and the credibility analysis of the financial institutions. In the study, the importance of the Altman Z model was emphasized, but due to the nature of the explanatory variables, it was stated that the estimation of financial shocks could not give a clear result. For this purpose, they examined and analyzed Altman Z Model again in their studies. Some of the ratios used in the Altman Z Model were preferred in the model they established. For this purpose, the companies in the BSE-30 index were classified as financially healthy and problematic. Then, the Z model was first applied to 10 of these companies, and the analysis period for each application was considered as 5 years. Significant changes in the ratios were analyzed by the Kolmogorov-Smirnow test, and it was determined that the changes in the Z Score did not affect the firms.

B. Studies In The National Literature Related To Altman Z Model

Soba et al. (2016), in their study, conducted an analysis to classify firms as unsuccessful, successful, and at-risk businesses by applying Altman Model to measure financial failure in the companies listed in Borsa Istanbul (Best). For this purpose, the Altman Z model was used to measure the financial failure levels of 9 large enterprises registered in BIST between 2011 and 2015. As a result of the study, among the major companies operating in Borsa Istanbul between 2011 and 2015, the lowest risk group analyzed by the Altman method and the lowest risk-free and insolvent loans were identified as BIMAS and TKNSA, respectively.

Kulalı (2016) stated that the most widely preferred model among accounting-based bankruptcy forecasting models was the Altman Z-Score model, and therefore he used this model in his study. In this study, the data of companies that were listed in Borsa İstanbul and applied for bankruptcy between 2000 and 2013 were used. As a result of the analysis, it was concluded that the Altman Z-Score model had a very high predictive power.

Mammaldi and Helhel's (2017) purpose of their study is to estimate bankruptcy for tourism companies. They examined Altman Z " Score Model to determine the probability of bankruptcy for tourism companies that have been ranked among the top 100 firms by reaching a certain stage in the implementation of talent management policies. Instead of establishing a regression relationship between talent management and financial failure, they tried to make a general performance assessment of the tourism companies included in the sample, rather than making a general conclusion about the tourism sector. They examined the 2017 ranking of the list and determined that there are 6 tourism companies on the list. Three companies, including Hyatt and Marriott International hotels and The Cheesecake Factory restaurant, since their data are fully available for analysis, were included for the period 2013-2016. According to the results of the analysis, they found out that The Cheesecake Factory performed better than the other two companies. Therefore, they concluded that talent management policies and financial success are in parallel.

Poyraz and Uçma (2006) analyzed the financial failure levels of tourism, textile, agricultural products, food, and transportation sectors which are described as the main export sectors against 1994 and 2001 crises based on Altman Z (score) value model. In addition, they tried to compare and estimate the financial failure potentials of exporting sectors in crisis environments and in the normal course of the economy. They analyzed the tourism sector and found that there are no significant fluctuations in the Altman z (score) values of the sector, both in crisis periods and in the normal course of the economic conjuncture. However, they didn't observe significant effects of the financial crisis periods on the tourism sector, which is exposed to high bankruptcy risk in each period. When they examined the textile sector, they observed that the z (score)

values of the sector during the financial crisis periods were determined as 2.4850 for 1994 and 1.9478 for 2001. Based on the findings, they concluded that the textile sector had been affected positively in terms of Altman z (score) values during financial crisis periods. They also examined the agricultural products-food sector. They calculated the z value as 3.856 for the 2001 year that stands out as a z value that was not reached even in the 1994 crisis.

Especially in the national literature, it is seen that the majority of studies on the Altman Z model consist of backtests to measure the power of the Altman Z score in estimating the bankruptcy risk of firms.

In such studies, in general, the financial statements of the bankrupt firms in the last 5 years before the bankruptcy are analyzed, and the z-scores of the firms are calculated separately for each year, and the power of the z-score to signal the bankruptcy is analyzed.

This study differs from the previous literature in two aspects:

- In this study, a backtest application is not made over the companies that went bankrupt. Only the new version of the Z model that is recommended for developing countries is applied to non-financial institutions listed on the Borsa Istanbul -30 index (BIST-30) for the 2015-2018 analysis period. In this way, the financial risk zone of these firms is determined.
- Another feature that distinguishes this study from other previous studies is whether the z scores can be used by investors for investment timing. This study, it is analyzed how an investor who perceives Z scores as a signal about the financial position of the firm reacts to the stock price of the firm according to the low or high z score of the firm. Since the high Z score indicates a strong financial structure and a low risk of bankruptcy, the primary expectation in this study is the implementation of the investment methodology in which investors purchase stocks with high z-scores while they sell stocks with low z-scores.

III. DATA AND METHODOLOGY

A. Sample construction

The analysis will be based on a sample that includes non-financial firms listed in one of Borsa Istanbul's indexes called Best-30. Since the financial statements of the financial institutions differ significantly, the financial institutions are excluded from the analysis in order to ensure the standardization of the calculations. When financial institutions and investment trusts are excluded, 23 firms are included in the final sample. The analysis period will be determined as 2015 – 2018 to find out movements observed in the Altman Z score of the firms over time. Related financial ratios are calculated for each separately.

B. Methodology

In this study, the following model will be used based on 5 main indicators explaining the bankruptcy risk of a firm in different aspects (Altman, 1968: 594) :

$$Z = .012X1 + .014X2 + .033X3 + .006X4 + .999X5 \quad (1)$$

The notations in the formula are described as follows (Altman, 1968: 594).

X1 = Working Capital / Total Assets,

X2 = Retained Profits / Total Assets,

X3 = Earnings Before Interest and Taxes / Total Assets,

X4 = Market Value of Shareholders' Equity / Book Value of Liabilities,

X5 = Sales / Total Assets,

In the literature, Altman's Z score was adjusted for the emerging countries. Since sample firms are included in Turkey, an emerging country, in this study, the adjusted Z score model will be applied. According to the emerging market score model, Altman's Z score can be adjusted as follow (Meeampol et al., 2014:1230):

$$Z_2 = 3.25 + 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4 \quad (2)$$

According to the Z score, the financial risk level of the firms can be outlined as follow:

- Z score is higher than 2,6 means Safety Zone,
- Z score is ranked between 1.1 < Z Score < 2.6 means Grey Zone.”
- If Z score is lower than 1.1, it means “Distress Zone.”

IV. CALCULATIONS AND FINDINGS

BASIC DESCRIPTIVE INFORMATION OF THE SAMPLE CAN BE SHOWN IN TABLE 1 AS FOLLOW:

Table 1. Basic Descriptive Information of the Sample Firms

Equity Code	Equity Name	Industry	Closing Price (TRL)	Market Value (mn TRL)	Market Value (mn \$)	Free Float Ratio (%)	Capital (mn TRL)
ARCLK	Arçelik	Durable Consumer Goods	19,74	13.339	2.317	25,00	676
ASELS	Aselsan	Defense	19,12	21.797	3.786	25,80	1.140
BIMAS	BimBirleşikMağazalar A.Ş	Retail - Trade	46,10	27.992	4.862	67,90	607
DOHOL	Doğan Holding	Holdings	1,68	4.397	764	35,80	2.617
EKGYO	EmlakKonut GYO	REIT	1,32	5.016	871	50,60	3.800
EREGL	EreğliDemirÇelik	Iron and Steel Industry	7,36	25.760	4.474	47,60	3.500
PHOTO	Ford Otosan	Automotive industry	67,85	23.809	4.136	17,80	351
SCHOOL	Koç Holding	Holdings	20,54	52.087	9.047	26,40	2.536
KOZAA	KozaAnadolu Metal	Other	9,60	3.726	647	44,90	388
KOZAL	KozaAltın	Mining	77,45	11.811	2.052	30,00	153
KRDMD	Kardemir (D)	Iron and Steel Industry	2,34	1.826	317	92,00	780
PETKM	Petkim	Petrochemical Industry	3,65	7.709	1.339	48,00	2.112
PGSUS	Pegasus HavaTaşımacılığı	Airlines	74,95	7.667	1.332	36,20	102
SAHOL	Sabancı Holding	Holdings	9,07	18.507	3.214	47,60	2.040
SISE	Şişe Cam	Glass Industry	4,46	10.035	1.743	32,50	2.250
SODA	Soda Sanayii	Chemical Products.	5,73	5.730	995	38,00	1.000
TAVHL	TAV Holding	Airlines	27,50	9.990	1.735	44,40	363
TCELL	Turkcell	Telecommunication	13,16	28.952	5.029	49,00	2.200
THAO	TürkHavaYolları	Airlines	13,69	18.892	3.281	49,40	1.380
TAKEN	Tekfen Holding	Construction - Contracting Services	18,27	6.760	1.174	50,80	370
TOASO	TofaşFabrika	Automotive industry	24,38	12.190	2.117	24,10	500
TTKOM	Türk Telekom	Telecommunication	6,94	24.290	4.219	15,00	3.500
TUPAC	Tüpraş	Petrochemical Industry	123,30	30.877	5.363	48,90	250

Source: www.isyatirim.com

Z scores of the BIST – 30 firms for 2015-2018 are shown in Table 2 as follows:

Table 2. Z scores of the Sample Firms for the 2015-2018 period

Equity Code	2018/12	2017/12	2016/12	2015/12
ARCLK	2,24	2,53	2,72	2,97
ASELS	4,56	4,23	4,00	3,35
BIMAS	3,10	3,52	2,76	3,53
DOHOL	3,14	0,02	1,16	1,80
EKGYO	4,36	5,56	4,72	4,28
EREGL	5,13	6,11	4,15	3,85
FROTO	1,92	2,17	1,73	1,87
KCHOL	2,02	1,89	1,73	1,63
KOZAA	8,70	8,27	6,21	4,53
KOZAL	27,14	22,93	13,95	15,64
KRDMD	2,29	0,83	0,41	0,53
PETKM	3,23	4,55	2,65	3,04
PGSUS	0,88	1,54	0,44	1,89
SAHOL	- 1,08	- 1,38	- 1,25	- 1,51
SISE	2,14	2,52	2,17	2,58
SODA	6,31	8,78	7,98	6,93
TAVHL	1,14	0,85	0,65	0,89
TCELL	2,33	2,64	2,62	2,47
THYAO	0,25	0,17	- 0,38	0,08
TKFEN	2,33	1,87	1,29	1,39
TOASO	1,77	1,56	1,22	1,37
TTKOM	0,75	1,74	1,24	1,20
TUPRS	2,45	1,69	1,03	1,21

	Indicates firms that have Z Score higher than 2,6
	Indicates firms that have Z Score between 1,1 and 2,6
	Indicates firms that have Z Score lower than 1,1

According to the results of the analysis, it is seen that the Z-Score of 8 companies is higher than 2.6 in all years in the analysis period. In other words, the firms are in the safe zone. It is seen that 5 firms in the sample remained in the gray zone according to the Z score for all years. 2 companies were located in the risky area according to the Z score for all years. The performance of other companies varies according to the years. The stock performances of the firms according to the region they are located in as a result of the Z score are analyzed separately and are shown in the graphs below. In the analysis, the stock returns of the firms are calculated over the year-end closing prices. The return of each share is compared with the market

average. The return of the Best-100 index is used as the benchmark indicator for the market average.

Stock and Best-100 returns are calculated through the following formula:

$$R_{it} = \frac{(P_{it} - P_{it-1})}{P_{it-1}} \quad (3)$$

The description of the notations in the formula is as follows:

R_{it} : The return of stock i&Bist - 100 at time t,

P_{it} : The closing price of the stock i&Bist - 100 at time t,

P_{it-1} : The closing price of the stock I & Best-100 at the time t-1 (previous year).

The stock price performance of safe companies are compared to Best-100 performance in Fig. 1 as follows:

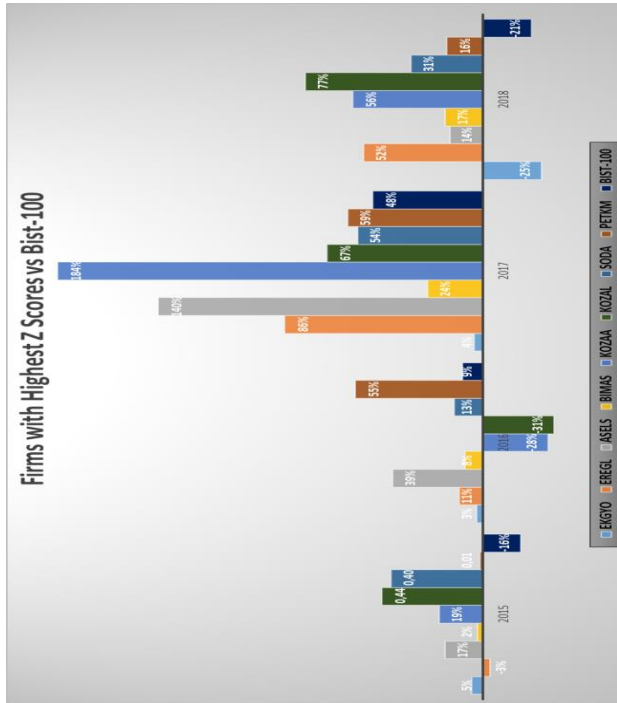


Fig. 1 Stock Price Performance of Companies Included in Safe Zone

In the figure above, each bar column shows the annual return of the companies with the highest Z score and the annual return of the Best - 100 index as margin. In other words, each bar indicates return compared to last year for each firm that has the highest z score. For instance, According to the results in the graph, the highest level of return was seen in KOZAA in 2017 with 184%. When we interpret the return obtained according to the formula stated in Equation 3, it will be concluded that KOZAA stocks increased by 184% in 2017 compared to the previous year. According to the findings, the stock price performance of the companies with the highest Z score and thus located in the safe zone is better than the performance of the BIST-100 in the last 4 years. In this respect, it may be expected that the return of the portfolio consisting of companies with high Z scores will be higher than the market average. The higher return of the companies which are financially more stable, liquid, and has lower the risk of bankruptcy for the medium and long term, can be explained by the that they provide confidence for their investor's thanks to these properties.

The stock price performance of risky companies are compared to Best-100 performance in Fig. 2 as follows:

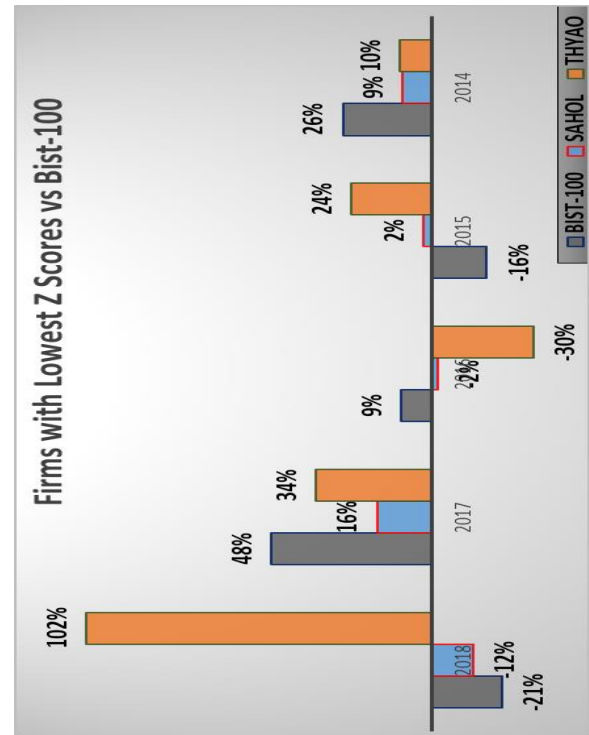


Fig. 2 Stock Price Performance of Companies Included in Risky Region

During the analysis period, THYAO and SAHOL companies, which appear in the risky region according to Z score over the years, perform worse than the Best-100 index return. THYAO seems to be more volatile than SAHOL. Although both stocks performed better than the Best-100 in 2015, it is seen that Best-100 generally provides a more balanced and higher return. Based on this finding, it can be concluded that there is a positive relationship between Altman Z Score and stock price performance.

v. CONCLUSION

The financial stability of firms is vital for all related parties, especially for investors. The fact that the firm is financially sound, liquid, and profitable is one of the basic criteria sought by individual and institutional investors who will invest in this firm. If the financial structure of the companies is bad and seems to go to bankruptcy, all the parties involved in commercial and financial transactions with the company will be adversely affected.

Therefore, many indicators are used which measure the financial position and performance of the firms and reveal the risk of bankruptcy. One of the most popular of these methods is the Z-score model developed by Altman. In the model, the firm's financial risk level is analyzed analytically in many different aspects. Information that covers liquidity, leverage, and profitability is used simultaneously in the model. According to the results of the model, firms are classified as safe, gray, and risk zones.

In order to contribute to current literature, in this study, the relationship between Altman Z score and stock price performance is applied to the firms listed in Borsa Istanbul 30 National Index (Best - 30). Financial institutions are excluded from the firms in Best-30, and 23 industrial firms are included in the final sample.

The new version of the Altman Z model created for the developing countries is used in the analysis. Stock price performance is calculated via the annual closing prices of the stocks and then compared to the market returns, and results are interpreted with the help of graphs.

As a result of the analysis, 8 firms are determined as safe since their Altman Z scores are higher than 2.6, while 2 firms are described as risky because of lower scores than 1.1.

According to the results of the analysis, the stock price performance of the firms with the highest Altman Z score is higher than the Best-100 National Index and the firms with the lowest Altman Z score.

Therefore, it can be expected that a stock portfolio of these firms will generate more returns than the portfolio of other stocks.

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