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**Research Article / *Araştırma Makalesi***

# ANALYSIS OF THE FACTORS WHICH AFFECT FINANCIAL FAILURE AND BANKRUPTCY WITH GENERALIZED ORDERED LOGIT MODEL*

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## ABSTRACT

*The aim of the paper is to determine the factors that lead to financial failure and bankruptcy. For this aim, Altman-Z score values were found with the help of financial ratios of 139 manufacturing companies listed on BIST (Istanbul Stock Exchange) during 2017 and companies were divided into three categories as distress, grey and safe zone according to bankruptcy risks. Altman-Z score values, which can warn companies like the early warning system, are estimated with the Generalized ordered logit model, which also takes into account the assumptions of parallel lines. According to analysis results, an increase in ratios of operating profit margin, asset turnover, net profit margin, and acid-test increases the probability of the company being in a safe zone. Meanwhile, an increase in the financial leverage ratio decreases that probability.*

***Keywords:*** *Altman-Z Score, Financial Failure and Bankruptcy, Generalized Ordered Logit Models.*

# FİNANSAL BAŞARISIZLIK VE İFLASI ETKİLEYEN FAKTÖRLERİN GENELLEŞTİRİLMİŞ SIRALI LOGİT MODELİ İLE ANALİZİ

## ÖZET

*Bu çalışmanın amacı finansal başarısızlık ve iflasa yol açan faktörleri belirlemektir. Bu amaçla 2017 yılı içinde BİST (Borsa İstanbul)'te kote edilen 139 tane imalat sanayi şirketine ait finansal oranlar yardımıyla Altman-Z skor değerleri bulunmuş ve şirketler iflas risklerine göre tehlikeli gri ve güvenli olarak üç kategoriye ayrılmıştır. Erken uyarı sistemi gibi şirketleri uyarabilen Altman-Z skor değerleri, paralellik varsayımlarını da dikkate alan Genelleştirilmiş sıralı logit modeli ile tahminlenmiştir. Analiz sonuçlarına göre, Faaliyet kâr marjı, aktif devir hızı, net kâr marjı, asit-test oranlarında meydana gelen bir artış tehlikeli bölgede olma olasılıklarını azaltırken güvenli bölgede yer alma olasılığını arttırdığı sonucuna varılmıştır. Finansal kaldıraç oranındaki artış ise bu olasılığı düşürür.*

***Anahtar Kelimeler:*** *Altman-Z Skor Yöntemi, Finansal Başarısızlık ve İflas, Genelleştirilmiş Sıralı Logit Modeli.*

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## 1. Introduction

In recent years, one of the consequences of global competition is that many companies suffer financial failures. In order to prevent this failure, it is very important for companies to care and anticipate proactive approaches. Therefore, the prediction of financial failure and bankruptcy is very important in revealing the financial structure of companies. The findings from these methods are prioritized for the company management, shareholders, lenders, and external auditors of the company to make a safe decision about the company, such as future partnerships, growth or downsizing, and sustainability of the companies. So much so that forecasting methods work like a mechanism that reduces or prevents the costs that will arise after the company suffers financial failure without giving sufficient warning.

The report published jointly by the Brooking Institute and Financial Times shows that the growth momentum of the world economic indicators and the growth trends in developed and emerging markets are experiencing a rapid and synchronized loss of momentum. The synchronization mentioned here means the absence of a safe haven for investors to escape from the slowing country economies or the absence of a locomotive that can revive the world economy. The start of synchronization makes the economic failures, the violence in the competition, and the geopolitical positions of the countries even more risky. In the past, when synchronization was getting stronger, it first triggered the financial crisis of 1929, the great recession in the economy, and then the Second World War (Yıldızoğlu, 2019).

Economics crises are no longer stay only in the country but also cause global effects. In a report published by International Monetary Fund (IMF) titled as "April 2019, World Economic Outlook, Growth Slowdown, Precarious Recovery", it is said that regression in U.S. Economy which had become evident in the last quarter of 2018 will continue as well in 2019, Germany from the European Union has slipped back into negative growth, negative effects of Brexit uncertainty on European Union and the United Kingdom and the slow growth status in Chinese economy that caused by the sanctions against them weaken the expectation of optimistic economic recovery towards the last quarter of 2019. In addition, the trade war between the United States and China threatens the economy of European Union countries. Rise of market data in economies indicates a currency or debt crisis that may spread from Argentina and Turkey with a chain effect will increase geopolitical crises and will cause a global recession by jeopardizing the optimistic expectations from happening. In the IMF report, it is determined that the world economy stands on a very fragile point and downward trend in trade is very strong (IMF, April 2019).

The earliest and most cited articles predicting corporate failure were written by Beaver (1966) and Altman (1968). His work was based on different financial ratios, the features of which have been thoroughly studied. Beaver (1966) compared and evaluated 30 different financial ratios and concluded that the next six performed superior in profile analysis. These are respectively; cash flow for total debt, net income for the total asset, total debt for the total asset, current rate, credit range (Jacobs, 2007).

Negative economic changes in the global world also create negative effects on the internal economies of countries. Companies, factories, private and public sectors receive their share swiftly from the stirs happening on a global level. In fact, arising negative economic

fluctuations (crises, disasters, recessions caused by wars, etc.) cause companies to fail and eventually lead to going bankrupt.

The present study has been constructed with the data obtained from the dataset, financial statements and annual reports of 139 manufacturing companies that have been quoted on BIST (Istanbul Stock Exchange) in 2017. First, Altman-Z score values were calculated by using this dataset. Altman-Z score values classify companies as distress, grey and safe zone in order to find the financial stress level of the companies. Risk probabilities were predicted with an econometric model that explains the risk probabilities and the factors affecting the financial success of companies in terms of variable financial ratios. Ordered logit model was preferred considering the fact that variable dependent takes on more than one value and has an ordinal nature.

## 2. Financial Failure and Bankruptcy

Financial success and failure are classified according to the levels of financial stresses that affect companies. Level of financial stress can be estimated with total equity of the companies and determining how much liquidity creation power they have. This shows us whether the financial stress the company is having severe or mild. If financial stress that the company is experiencing is severe, if they got into a situation where it is inevitable to escape financial failure, they may go bankrupt. Even though in some studies financial failure and bankruptcy have been used as if they were synonymous actually bankruptcy is the last resort to fix financial failure (Kınay, 2010).

To determine whether companies are having financial failure or are they going bankrupt is important in terms of market value and prestige. However, company failing financially does not mean it is going bankrupt. Bankruptcy, which companies file as their last resort means complete dissolution of company. Everything is over for the company in case when the creditor appeals to Supreme Court and the Court accepts it (Aktaş, 1997).

Over the years studies were conducted where the Altman-Z score model was used in order to determine the factors which are affecting the financial failure of companies according to the economic situation of countries by Beaver (1966), Altman (1968), Meyer & Pifer (1970), Wilcox (1971), Edmister (1972), Blum (1974), Libby (1975), Sinkey (1975), Altman & Loris (1976), Deakin (1977), Hayden (2002), Kidane (2004), Jayadev (2006), Jacobs (2007), Kınay (2010), Pranowo et al. (2010), Terzi (2011), Ahlgren & Goldman (2012) Siddiqui (2012), Rama (2013), El Khoury & Al Beaïno (2014), Güriş et al. (2017), Karadeniz & Öcek (2019), Gülençer & Hazar (2020), with these studies, since development of the Altman-Z score model (1968), it has been reliably used.

## 3. Literature

Kınay (2010), Using the financial ratios of 156 industrial companies, Altman-Z score values were found and analyzed using the ordered logit model. At the end of the study, the financial risks of the companies were estimated.

Pranowo et al. (2010), Empirically examined the dynamics of public financial distress of public companies in Indonesia for the period 2004-2008. As a result, the management of public companies stated that the deterioration and cash flow problem that negatively affects

the financial flow is a sign of financial distress. He states that he should monitor the financial variables that recognize and affect financial distress in the early period and that these variables are Altman-Z score values. These values are the current ratio, productivity, leverage, and capital.

Çolakoğlu (2011), in her thesis, she used the Mincer wage equation for two countries and estimated the results with a generalized ordered logit model.

Terzi (2011), stated that she obtained very good results from the Z score model used by food companies in BIST to determine the risk of financial failure.

Siddiqui (2012), taken the progress of the development of the Altman-Z score method to determine the financial distress and/or bankruptcy status of businesses and banks as the main subject in his article. In the literature comparisons he made in the article, he reached the conclusion that the Z score model used in the applications gave the best results.

Rama (2013), in his master's thesis, he investigated whether Altman's Z score model is effective in predicting the failure of South African companies traded on the Johannesburg Stock Exchange (JSE). It was determined that the model would not be suitable when the Altman-Z score values were in the negative and gray area range, and the model would be suitable when the Altman-Z score values were in the safe range. He concluded that the Altman-Z score model should be used by credit managers as a tool in assessing credibility, as it is accurate and practically applicable to predict company failure for companies listed in JSE.

El Khoury & Al Beaïno (2014), Altman analyzes whether the Z-score can correctly classify manufacturing companies operating in Lebanon. The empirical analysis examines 11 manufacturing companies over 3 years, from 2009 to 2011. Companies are classified according to Altman Z-score models and then classified according to their actual classification. The study found that the Altman-Z score could act as a barometer to classify Lebanese manufacturing companies in the same sub-sector. This finding can be used by banks to classify companies, investors to select their stocks to evaluate their customers' performance. First, small banks that cannot afford to purchase these expensive rating systems can use the score value of Z to measure the risk of customers applying for a loan. Second, companies can set up a manufacturing industry benchmark, self- assessment to track their rank, and take the necessary corrective action ahead of time. Third, investors can use the score of Z as a valuation tool to compare different companies.

Akay & Timur (2017), in their study, they analyzed the factors affecting the happiness of men and women with the generalized ordered logit model.

Karadeniz & Öcek (2019), in their studies, they analyzed whether the tourism companies listed on the stock exchange in Istanbul carry the risk of financial failure or not with the Altman-Z score method. Whether there is a difference between the tourism companies was tested with the Mann Whitney U test and it was concluded that there was a difference.

Erdem (2020), in his study, he analyzed it using a generalized ordered logit model to determine the probability of fraud in the financial statements. It is concluded that there are differences in the number of key audit subjects disclosed by companies that are likely to cheat in the financial statements determined based on the Beneish score.

Gülençer & Hazar (2020), in their studies, they analyzed the financial failure risks of

technology firms traded in the stock market with the Altman-Z score method. They found the z score value of technology firms above 2.6 and stated that they were not financially risky.

## 4. Estimation Methods

### 4.1. Altman-Z Score Model

The Altman-Z score model is one of the most practical methods for determining whether a public company will go bankrupt or not. A most important advantage of the Altman-Z score is that it is working with ratios that show the financial status of the company and using a formula that can easily calculate the static value in order to determine the level of financial failure. Altman-Z score is used for determining the probability of bankruptcy in manufacturing and non-manufacturing industries. On the other hand, it is not successful at analyzing financial companies whose annual reports have different structures such as banks and insurance companies. Altman-Z score which is developed by Edward Altman 1968 is an analysis that can estimate the structure of the financial status of a company and forecast the bankruptcy within the next two years. In his original study, Altman has applied his discriminate analysis to 66 companies whose net worth was more than 1 million dollars and divided all companies into two groups as successful and unsuccessful. Then, he defined 22 financial ratios with annual reports. In order to estimate Z values as static, five independent variables that do not have a correlation with each other were determined. Altman-Z score is determined with the multiplication analysis of ratios and estimated with multiplication of coefficients. Altman-z score model and its variables are stated as below (Altman, 1968);

$$Z_{orj} = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \quad \textbf{(1)}$$

$X_1$- It is ratio frequently looked on with the purpose of overcoming financial ratios. Working Capital/Total Assets ratio is a measure of net liquid assets to total capitalization.

$X_2$-It is the total amount of reinvested earnings and/or losses of a firm over its entire life.

$X_3$- Basically, it is a measure of the true productivity of the firm's assets, independent of any tax or leverage factors.

$X_4$- Equity is measured by the combined market value of all shares of stock, preferred and common, while debt includes both current and long-term. The measure shows how much the firm's assets can decline in value (measured by the market value of equity plus debt) before the liabilities exceed the assets and the firm becomes insolvent.

$X_5$-The capital-turnover ratio is a standard financial ratio illustrating the sales-generating the ability of the firm's assets. It is one measure of management's capacity to deal with competitive conditions. Altman-Z score discrimination values for public companies are stated as below (Altman, 1968);

$Z<1.81 \rightarrow$ **Distress Zone:** The company is at serious risk in terms of economic status.

$1.81 < Z < 2.99 \rightarrow$ **Grey Zone:** The risk of financial distress is low.

$2.99 < Z \rightarrow$ **Safe Zone:** There is no risk of financial distress.

In here it is determined that "a company in the distress zone has a very high chance to go bankrupt", "financial failure risk of a company in the grey zone is low", and "a company in the safe zone has no risk of financial failure" (Altman, 1968).

With discrimination of companies into three categorical levels by Altman-Z score method, dependent variable has become ordinal. Ordered logit model was preferred considering the fact that dependent variable takes on more than one value and has an ordinal nature. Some of the literature studies on this field are Johnsen & Melicher (1994), Theodossiou et al. (1996), Lennox (1999), Kaiser (2001), Bernhardsen (2001), Boes & Winkelmann (2004), Charitou et al. (2004), Kınay (2010), Williams (2016), Akay & Timur (2017).

**4.2. Generalized Ordered Logit Model**

In regression equations with the qualitative dependent variable, the ordered logit model is one of the methods that are used in cases where the dependent variable takes more than one value and order is important. There is a certain ordering among qualitative dependent variable levels in ordered logit models (Long, 1997; Das & Rahman, 2011).

A most important assumption for the ordered logit model is parallel lines. In the model, parameters must not change at different category levels, in other words, it must have parallel slopes. However, there are cases where parallel lines assumption is violated for every independent variable in the model. In this case, by relaxing the assumption generalized ordered logit model is used, which is an alternative to the proportional odds model (Fullerton, 2009).

When studies on ordered logit model are analyzed, it is mostly seen that parallel lines assumption is overlooked, required testing is not performed. Not testing the model will cause ordered logit model results to be falsely interpreted. In models where parallel lines assumption is not provided, generalized ordered logit model must be used. For parallel lines assumption, the Wald test of Brant (1990) is used.

In generalized ordered logit model, when the dependent variable takes on the values between Yi, 1, 2,..., m, it divides into M-1 number of categorical levels. For each categorical level, coefficients and constants are estimated. Slope coefficient of categorical factors is βk and cumulative distribution function is shown as below (William, 2006);

$$P(Y_i < k) = F(-X\beta_k) \qquad k = 1,2,...,m \tag{2}$$

Probability of any category (m) in generalized ordered logit model is stated as below (Fu,1999);

$$P(Y = m|X) = \begin{cases} F(\tau_1 - X\beta_1) & m = 1 \\ F(\tau_m - X\beta_m) - F(\tau_{m-1} - X\beta_{m-1}) & 1 < m \le M-1 \\ 1 - F(\tau_{M-1} - X\beta_{M-1}) & m = M \end{cases} \tag{3}$$

F corresponds to logistic cumulative distribution function (cdf), β to a logit coefficient and changes freely between logit equations, X to independent variable vector, τ to cut-off point and m to category logit equation (Fullerton, 2009).

In generalized ordered logit models, estimated coefficients can not be interpreted directly. Marginal effects are calculated to define whether a change in the value of independent variables would have an effect on the probability of different results. The probability function is defined as below (Güriş & Çağlayan, 2005);

$$P(Y=1|X)=F(X\beta) \quad \textbf{(4)}$$

Marginal effects are calculated by taking partial derivatives with respect X and stated as below (Güriş & Çağlayan, 2005);

$$\frac{\partial P(Y=1|X)}{\partial X_k}=\frac{\partial F(X\beta)}{\partial X_k}=\frac{dF(X\beta)}{dX\beta}\frac{\partial X\beta}{\partial X_k}=f(X\beta)\beta_k \quad \textbf{(5)}$$

The marginal effect is the slope of the probability curve to Xk (k number of the independent variables) when other variables are stationary P(Y=1|X). The slope coefficient is βk. f (Xβ) is the logistic distribution function. The direction of the marginal effect is determined by the sign of βk as for f(Xβ) function is always positive. When the sign of such parameter is negative and increase in the independent variable by one decreases the probability value when it is positive an increase in the independent variable by one increases the probability value. Marginal effect for logit model is stated as below (Güriş & Çağlayan, 2005);

$$\frac{\partial P(Y=1|X)}{\partial X_k}=\lambda(X\beta)\beta_k=\frac{e^{(X\beta)}}{1+e^{(X\beta)^2}}\beta_k=P(Y=1|X)[1-P(Y=1|X)]\beta_k \quad \textbf{(6)}$$

## 5. Dataset and Application

The present study was constructed with the data obtained from the dataset, financial statements and annual reports of 139 manufacturing companies that had been quoted on BIST (Istanbul Stock Exchange) in 2017. These data were obtained from websites of companies, KAP (Public Disclosure Platform) and BIST website. First, Altman-Z score values were calculated by using this dataset. Bankruptcy risks of companies were sorted into three categories as "distress-gray-safe" with calculated Z score values and it was enabled to foresee potential failure in financial structures of companies. Generalized ordered logit model was used to analyze obtained Z score values. Therefore, risk probabilities and factors affecting the financial success of companies in terms of variable financial ratios were estimated by achieving a model that describes it best. The zone of distribution of companies and Altman-Z score values were presented in Table 1.

**Table 1: Discrimination Zones and Altman-Z Score Values of Companies.**

| Companies | Z score | Zones of discrimination | Companies | Z score | Zones of discrimination | Companies | Z score | Zones of discrimination |
|---|---|---|---|---|---|---|---|---|
| ADANA | 2.08 | Grey | EGPRO | 2.71 | Grey | OTKAR | 3.08 | Safe |
| ADEL | 3.85 | Safe | EGSER | 3.85 | Safe | PARSN | 1.38 | Distress |
| AEFES | 1.63 | Distress | ENKAI | 4.18 | Safe | PENGD | 1.59 | Distress |
| AFYON | 1.64 | Distress | ERBOS | 3.80 | Safe | PETKM | 4.12 | Safe |
| AKCNS | 3.22 | Safe | EREGL | 4.27 | Safe | PETUN | 3.64 | Safe |
| AKENR | -0.16 | Distress | ERSU | 3.23 | Safe | PNSUT | 2.49 | Grey |
| AKSA | 2.73 | Grey | ESCOM | 14.58 | Safe | PRKME | 8.72 | Safe |
| AKSUE | 1.11 | Distress | FMIZP | 20.63 | Safe | RYSAS | 0.60 | Distress |
| ALCAR | 7.11 | Safe | FRIGO | 1.54 | Distress | SARKY | 4.53 | Safe |
| ALKA | 6.38 | Safe | FROTO | 4.96 | Safe | SASA | 3.90 | Safe |
| ALKIM | 6.34 | Safe | GEDZA | 3.67 | Safe | SAMAT | 1.74 | Distress |
| ANACM | 1.81 | Distress | GENTS | 3.24 | Safe | SELEC | 4.11 | Safe |
| ARCLK | 2.82 | Grey | GEREL | 3.55 | Safe | SERVE | 1.67 | Distress |
| ARENA | 3.61 | Safe | GOLTS | 1.93 | Grey | SILVR | 4.02 | Safe |
| ARMDA | 3.25 | Safe | GOODY | 4.44 | Safe | SISE | 2.31 | Grey |
| ARSAN | 2.28 | Grey | GUBRF | 2.08 | Grey | SKTAS | 0.72 | Distress |
| ASELS | 4.36 | Safe | HEKTS | 4.14 | Safe | SNPAM | 29.01 | Safe |
| ASLAN | 7.42 | Safe | HURGZ | 2.05 | Grey | SODA | 6.04 | Safe |
| ASUZU | 1.74 | Distress | IHEVA | 2.16 | Grey | SONME | 215.4 | Safe |
| AYGAZ | 4.38 | Safe | IHLAS | 1.34 | Distress | TATGD | 4.28 | Safe |
| BAGFS | 0.97 | Distress | INDES | 4.24 | Safe | TCELL | 2.71 | Grey |
| BAKAB | 2.65 | Grey | INTEM | 2.85 | Safe | TEKTU | 0.81 | Distress |
| BANVT | 5.02 | Safe | ISDMR | 4.40 | Safe | THYAO | 1.28 | Distress |
| BIMAS | 8.28 | Safe | IZMDC | 1.71 | Distress | TOASO | 3.37 | Safe |
| BOLUC | 3.48 | Safe | IZOCM | 5.19 | Safe | TRCAS | 1.24 | Distress |
| BOSSA | 1.95 | Grey | KAPLM | 2.50 | Grey | TRKCM | 2.38 | Grey |
| BOYP | 1.42 | Distress | KAREL | 2.82 | Grey | TTRAK | 4.10 | Safe |
| BRISA | 1.10 | Distress | KARSN | 1.33 | Distress | TUKAS | 3.11 | Safe |
| BRSAN | 1.82 | Distress | KARTN | 10.51 | Safe | TUPRS | 3.31 | Safe |
| BFREN | 13.36 | Safe | KENT | 12.75 | Safe | ULKER | 2.22 | Grey |
| BSOKE | 0.64 | Distress | KLMSN | 2.20 | Grey | UNYEC | 5.88 | Safe |
| BTCIM | 1.08 | Distress | KNFRT | 4.45 | Safe | VAKKO | 3.02 | Safe |
| BUCIM | 3.67 | Safe | KONYA | 11.22 | Safe | VANGD | 3.50 | Safe |

**Table 1 continued**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CCOLA | 2.08 | Grey | KORDS | 2.64 | Grey | VESBE | 3.19 | Safe |
| CELHA | 3.11 | Grey | KOZAA | 6.35 | Safe | VESTL | 1.78 | Distress |
| CEMTS | 4.43 | Grey | KRDMA | 1.31 | Distress | YATAS | 5.03 | Safe |
| CIMSA | 2.02 | Grey | KRDMB | 1.26 | Distress | YUNSA | 2.70 | Grey |
| CLEBI | 2.74 | Safe | KRDMD | 1.55 | Distress | ZOREN | 0.46 | Distress |
| CMBTN | 2.94 | Grey | KRSTL | 2.87 | Grey | | | |
| CMENT | 3.07 | Safe | KRTEK | 1.61 | Distress | | | |
| DERIM | 2.11 | Grey | KUTPO | 4.06 | Safe | | | |
| DEVA | 1.68 | Distress | LOGO | 7.11 | Safe | | | |
| DGATE | 5.76 | Safe | MERKO | 1.49 | Distress | | | |
| DGZTE | 4.42 | Safe | MGROS | 2.46 | Grey | | | |
| DOAS | 3.77 | Safe | MNDRS | 1.66 | Distress | | | |
| DOBUR | 3.95 | Safe | MRDIN | 6.23 | Safe | | | |
| DYOBY | 2.25 | Grey | MRSHL | 5.26 | Safe | | | |
| ECILC | 5.72 | Safe | NETAS | 2.63 | Grey | | | |
| EGEEN | 10.47 | Safe | NUHCM | 3.11 | Safe | | | |
| EGGUB | 3.93 | Safe | OLMIP | 3.06 | Safe | | | |

Sorting of the qualitative dependent variable of the best model that will be formed with generalized ordered logit; it is coded as a company in the safe zone (3), company in the grey zone (2), company in the distress zone (1) in the model. Independent variables are financial ratios that are obtained from the financial statements of companies.

Financial ratios are classified as below in accordance with the use of purpose in the evaluation of companies' operational activities (Atlaş & Giray, 2005);

- Liquidity Ratio
- Financial Structure Ratios
- Operating Turnover Ratios
- Profitability Ratios

Most used independent variables, financial ratios in the model are; the model was constructed using liquidity ratio (current, acid-test, cash, debt, financing), financial structure ratios (total debt/equity, short-term debts/total debt, fixed assets /Equity), operating turnover ratios (stock turnover, accounts receivables turnover, trade liabilities turnover, asset turnover, equity turnover, current assets turnover), profitability ratios (gross profit margin, operating profit margin, net profit margin, return on assets, return on equity). After excluding values and variables that have high correlation each other, below-mentioned model was reconstructed for best model results.

The model constructed for the purpose of determining financial failure using generalized ordered logit is as below;

$$\mathbf{Z_i}=\boldsymbol{\beta_0}+\boldsymbol{\beta_1}\,(\textit{Operating Profit Margin})\mathrm{i}+\boldsymbol{\beta 2}(\textit{Asset Turnover})\mathrm{i}+\boldsymbol{\beta 3}(\textit{Acid-Test Ratio})\mathrm{i}+\boldsymbol{\beta 4}(\textit{Net Profit Margin})_{\mathrm{i}}+\boldsymbol{\beta_5}(\textit{Financial Leverage})\mathrm{i}+\mathbf{u_i} \quad \textbf{(7)}$$

$u_i$= it has error term and independent identical distribution. ($u_i$~ IID)

## 6. Findings and Discussion

Financial risks of companies were found with Altman-Z score values that obtained with using the data of companies which were quoted on BIST in 2017. Obtained Altman-Z score values took financial risk outputs as dependent variable and estimation and results were obtained Stata program. The results of 139 firms using the Ordered Logit model method are given in Table 2.

**Table 2: Ordered Logit Estimates for Altman-Z Score Values.**

| ***Numbers of observation:* 139** | | | ***LR (6):*136,21** | |
|---|---|---|---|---|
| ***Pseudo $R^2$:* 0,4775** | | | ***Prob.*:0,0000** | |
| **Altman-Z score values** | **Coefficient** | **Standard Error** | **z** | **P > \|z\|** |
| Operating Profit Margin | 8.246152 | 2.210658 | 3.73 | 0.000 |
| Asset Turnover | 5.195287 | 0.8750132 | 5.94 | 0.000 |
| Acid-Test Ratio | 2.206387 | 0.4820496 | 4.58 | 0.000 |
| Net Profit Margin | 7.620314 | 1.762706 | 4.32 | 0.000 |
| Financial Leverage | -0.1335266 | 0.0505366 | -2.64 | 0.008 |
| cut-1 | 5.772976 | 1.054348 | | |
| cut-2 | 8.518684 | 1.270997 | | |

*Note: Although the variables are statistically significant, the results of these 139 firms are not interpreted because are parallel line assumptions are violated.*

The parallel lines assumption test was applied to the obtained model with the Wald test and it is seen in Table 3 that paralel lines assumptions were violated.

**Table 3: Brant's Wald Test.**

| **All** | **Chi-square** | **P> Chi-square** | **df** |
|---|---|---|---|
| | 15.41 | 0.009 | 5 |
| Operating Profit Margin | 0.04 | 0.846 | 1 |
| Asset Turnover | 1.20 | 0.274 | 1 |
| Acid-Test Ratio | 7.32 | 0.007 | 1 |
| Net Profit Margin | 0.78 | 0.378 | 1 |
| Financial Leverage | 5.88 | 0.015 | 1 |

Due to the fact that the chi-square table value was lower than probability value (0,009<0,05), the H0 hypothesis which had determined that parallel lines assumption was valid was rejected with a 5% margin of error.

In cases where parallel slopes assumption is violated, ordered logit model outputs create problems due to not giving an adequate amount of confidence. Although excluding this variable from the model seems like a solution, instead of excluding because it is a variable that needs to be in the model generalized ordered logit model which relaxes the parallel lines assumption and at the same time does not disrupts the ordinal nature of qualitative dependent variable was preferred (Amemiya, 1985).

In generalized ordered logit model with the qualitative dependent variable, two separate logit model was preferred because of dependent variable having three category level. Generalized Ordered Logit model method results for 139 firms are given in Table 4.

**Table 4: Generalized Ordered Logit Model Estimations.**

| ***Numbers of observation:*** 139 | | | ***LR (12):*** 159,71 | | |
|---|---|---|---|---|---|
| ***Pseudo $R^2$:*** 0,5599 | | | ***Prob.:*** 0,0000 | | |
| | **Z score values** | **Coefficient** | **Standard Error** | **z** | **P > \|z\|** |
| 1 | Operating Profit Margin | 13.50409 | 5.118661 | 2.64 | 0.008 |
| | Asset Turnover | 8.085282 | 2.233756 | 3.62 | 0.000 |
| | Acid-Test Ratio | 5.040756 | 1.503638 | 3.35 | 0.001 |
| | Net Profit Margin | 5.892583 | 2.646852 | 2.23 | 0.026 |
| | Financial Leverage | -0.1725119 | 0.0992738 | -1.74 | 0.082 |
| | Constant | -10.14391 | 2.421819 | -4.19 | 0.000 |
| 2 | Operating Profit Margin | 9.571142 | 3.823095 | 2.50 | 0.012 |
| | Asset Turnover | 5.293932 | 1.132274 | 4.68 | 0.000 |
| | Acid-Test Ratio | 1.363878 | 0.5113433 | 2.67 | 0.008 |
| | Net Profit Margin | 10.17935 | 3.58008 | 2.84 | 0.004 |
| | Financial Leverage | -0.8278038 | 0.3499084 | -2.37 | 0.018 |
| | Constant | -7.073193 | 1.642494 | -4.31 | 0.000 |

*(***) 1% level of significance. (**) 5% level of significance. (*) 10% level of significance.*

For the qualitative dependent variable having three category levels in generalized ordered logit model, two model outputs were obtained. Since the results of the generalized ordered logit model cannot be directly interpreted, marginal effects or Odds Ratio must be calculated. Since the independent variables are continuous variables, only marginal effect results are given.

In order to interpret the effect of financial ratio variables that were mentioned in generalized ordered logit model on safe, grey and distress zones which were the Altman-Z score value discriminations, marginal effect values were found and presented in Table 5.

**Table 5: Marginal Effect Values for Generalized Ordered Logit Estimates.**

| | | dy/dx | Standard Error | z | P > \|z\| |
|---|---|---|---|---|---|
| **Operating Profit Margin** | 1(Distress) | -0.744485*** | 0.225999 | -3.29 | 0.001 |
| | 2(Grey) | -0.1385119 | 0.377021 | -0.37 | 0.713 |
| | 3(Safe) | 0.8829604*** | 0.3249684 | 2.72 | 0.007 |
| **Asset Turnover** | 1(Distress) | -0.4457223*** | 0.0699119 | -6.38 | 0.000 |
| | 2(Grey) | -0.0426554 | 0.0846639 | -0.50 | 0.614 |
| | 3(Safe) | 0.4883777*** | 0.051365 | 9.51 | 0.000 |
| **Acid-Test Ratio** | 1(Distress) | -0.2778848*** | 0.0554919 | -5.01 | 0.000 |
| | 2(Grey) | 0.1520639** | 0.0663861 | 2.29 | 0.022 |
| | 3(Safe) | 0.1258209*** | 0.0432505 | 2.91 | 0.004 |
| **Net Profit Margin** | 1(Distress) | -0.324844*** | 0.1224945 | -2.65 | 0.008 |
| | 2(Grey) | -0.6142251** | 0.28877 | -2.13 | 0.033 |
| | 3(Safe) | 0.9390692*** | 0.2722777 | 3.45 | 0.001 |
| **Financial Leverage** | 1(Distress) | 0.0095102* | 0.0050472 | 1.88 | 0.060 |
| | 2(Grey) | 0.0668567** | 0.281595 | 2.37 | 0.018 |
| | 3(Safe) | -0.0763668*** | 0.027886 | -2.74 | 0.006 |

*(***) 1% level of significance. (**) 5% level of significance. (*) 10% level of significance.*

The marginal effects of the generalized logit model where the Altman-Z score values shown in Table 5 for 139 firms are dependent variables and financial ratios are independent variables are interpreted as follows.

For the distress zone, while an increase in financial leverage ratio increases the probability of being in this group, decreases the probability of being in the safe zone. The financial leverage ratio shows how much of the liquid and fixed assets are financed by foreign sources. As it is understood from here, this ratio is needed to be low. A high ratio exposes financial risks. An increase in financial leverage ratio increases the probability of companies being in distress zone by 1% and an increase in financial leverage ratio increases the probability of companies being in grey zone by 7%. Bhatti et al. (2010) The results they found in their studies on Pakistan were in line with the results we found in our study, and they found that high financial leverage leads to high risk. Karadeniz & İskenderoğlu (2011) stated in their studies that a high leverage ratio creates a risky situation for firms.

The increase in operating profit greatly reduces the possibility of companies being in a risky zone.An increase in operating profit margin decreases the probability of companies being in distress zone by 74% and an increase in operating profit margin decreases the probability of companies being in grey zone by 14%. Karadeniz & Öcek (2019) found a similar relationship between financial profitability and risk in their study comparing the financial ratios of businesses with and without financial failure risk.

For the distress zone, while an increase in operating profit margin, asset turnover, net profit margin, and acid-test ratios decreases the probability of being in this group, it increases the probability of being in the safe zone. The reason for that is potential increase in acid-test

ratio which is one of the liquidity ratios shows that the company's ability to pay short-term debts is in positive direction, net profit margin which is one of the profitability ratios shows the percentage of profit in net sales, which if this ratio increases it means that profitability of the company is increased as well. An increase in operating profit margin provides high profitability at the result of the sales subjected to operating. An increase in asset turnover decreases the probability of companies being in distress zone by 44%. An increase in asset turnover decreases the probability of companies being in grey zone by 4%. An increase in acid-test ratio decreases the probability of companies being in distress zone by 28%. An increase in acid-test ratio decreases the probability of companies being in grey zone by 15%. The results we found are Gu & Kim (2002) and Karadeniz et al. (2015) showed that similar to paper. An increase in net profit margin decreases the probability of companies being in distress zone by 32%. An increase in net profit margin decreases the probability of companies being in grey zone by 61%

It is seen that signs change inversely in operating profit margin, asset turnover, net profit margin and acid-test ratios of companies in the safe zone. An increase in operating profit margin, asset turnover, net profit margin, and acid-test ratios increases the probability of companies being in the safe zone. An increase in a financial leverage ratio of companies in the safe zone decreases the probability of being in the safe zone.

## 7. Conclusion

Financial crises that are occurring in globalizing world economies, economic stirs, wars, immigration affect all world socio-economic system. Due to the fact that these effects cause the recession, shrinkage in economies and increase in inflation, countries are forced to use austerity measures on monetary policies, rise in interest rates and make reforms on credit policies in order to get ahead of such problems. This environment of distrust affects young companies the most. Companies that are not yet growing stronger are not able to analyze these effects sufficiently enough and lead towards financial failure and bankruptcy in a short amount of time. Altman-Z score model has given reliable results since it has been beginning to use. By analyzing the financial structures of companies with this method, it enables us to reveal the factors that may cause potential future financial failure or bankruptcy.

In the study, companies were classified according to the 3 category level with the Altman-Z score method. The groups were analyzed with generalized ordered logit model in a way that financial ratios of companies would be independent variable.

The marginal values of coefficients that are obtained in estimated generalized ordered logit model were analyzed and it is seen that results are applicable to a financial basis. The probability of companies not being in the distress zone is because of the negative effect of an increase in operating profit margin, asset turnover, net profit margin, acid test ratio. It is seen that an increase in the financial leverage ratio increases the probability of companies being in the distress zone positively.

For the distress zone, while an increase in operating profit margin, asset turnover, net profit margin, and acid-test ratios decreases the probability of being in this group, it increases the probability of being in the safe zone. The reason for that is potential increase in acid-test ratio which is one of the liquidity ratios shows that the company's ability to pay short-term debts is in positive direction, net profit margin which is one of the profitability ratios shows the

percentage of profit in net sales, which if this ratio increases it means that profitability of the company is increased as well. An increase in operating profit margin provides high profitability at the result of the sales subjected to operating.

It is seen that signs change inversely in operating profit margin, asset turnover, net profit margin and acid-test ratios of companies in the safe zone. An increase in operating profit margin, asset turnover, net profit margin, and acid-test ratios increases the probability of companies being in the safe zone.

For the distress zone, while an increase in financial leverage ratio increases the probability of being in this group, decreases the probability of being in the safe zone. The financial leverage ratio shows how much of the liquid and fixed assets are financed by foreign sources.

An increase in the financial leverage ratio of companies in the safe zone decreases the probability of being in the safe zone.

When it is looked from a financial basis, the financial leverage ratio shows how much of the debt is paid by foreign sources and it is asked this ratio to be lower to run the company with its own sources.

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