

Predicting Bankruptcy on Oil Companies Before and After the Pandemic Using Two Altman's Z-Score Models. Industrial and Emerging Markets. Evidence from Greece



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ABSTRACT: Purpose This paper is prepared with the aim of establishing whether there is a possible bankruptcy of the Greek oil companies Listed on the Athens Stock Exchange in the last six years 2016-2021. This period under consideration also includes the two years of the 2019-2020 pandemic.

Design/methodology/approach -The effort of this study is carried out using the Altman Z-Score model bankruptcy model for Emerging Markets. This paper focuses on bankruptcy, a situation which is a consequence of financial failure. Bankruptcy can happen to any organization or government body. The consequences of bankruptcy, as is known, are many and important. The main ones are the possible increase in unemployment, the decrease in the standard of living and in general the creation of a climate of economic discomfort.

Findings - The results of this study indicate that the exit of the Greek economy from the Memorandum of the IMF and Eurozone lenders had a positive effect on the Greek oil companies listed on the Athens Stock Exchange, which is known as an emerging market. We must also note that the two years of the pandemic did not have a significant negative effects on bankruptcy issues for the same companies.

Practical implications -The use of the two Altman's Z-Score model in this study, helps the stockholders and investors to have a conclude financial icon for stocks and bonds and make the right decisions.

Originality/value -In order to avoid bankruptcy and therefore the negative consequences that accompany it, many economic scientists have made efforts to predict it. Its prediction can be lifesaving and ultimately prevent it. Among the many important models that have been made, for predicting bankruptcy is the Altman Z-Score bankruptcy model that has stood out because of its very good results in bankruptcy prediction. This particular model is implemented in Greece which is a country with such a strong economic crisis, which has plagued the Greek Economy since 2010, but also during the pandemic period where almost all corporate firms are struggling daily with bankruptcy. Specifically, the Z-Score Altman model will be applied comparatively for the years 2016-2021 to the companies ELIN S.A., MOTOR OIL and REVOIL S.A.E.P., ELPE S.A., which are listed on the Athens Stock Exchange, in order to establish whether there has been or if there is the possibility of bankruptcy of these companies during the time period of our study.

KEYWORDS: Bankruptcy, Emerging Markets, Industrial, Financial Analysis, Corporate

JEL: G1, G3, G33

1. INTRODUCTION

In 2010, the Greek economy accepted the invasion of the global financial crisis, which continues even today, a fact that is also confirmed by the significant increase in the ratio of the amount of national debt to GDP, which has greatly increased from the corresponding values of 2010. Another factor contributing to the economic crisis is the continuous increase in food price levels due to the rapid increase in the price of energy products. This increase in the price of oil products, as well as the significant reductions in the stock market price and therefore the capitalization of companies that were listed on the Athens Stock Exchange,

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was also the motivation for our engagement in this study. Therefore, following the continuous increase of taxation, but also of austerity measures, the risk of corporate failure and bankruptcy becomes greater and therefore the existence of valid methods for predicting possible bankruptcy is deemed necessary. The timely and valid prediction of bankruptcy provides the organization with the possibility of taking structural measures to deal with and ultimately avoid it.

This paper deals with the prediction of the probability of bankruptcy in the oil companies sector that are listed on the Athens Stock Exchange, which is characterized as an emerging market during 2016-2021. This time period is crucial for the Greek Economy because it starts 2016 one year after the end of Memorandum and it stops 2021 at the end of the pandemic Covid-19. For this purpose, Altman's bankruptcy Z- Score model, specialized for emerging markets, is used. A rational and timely bankruptcy prediction analysis is a very important evaluation tool for investors and of course for listed companies themselves. The information on forecasting probabilities can become important financial tools which, with their proper use, can lead to rational decision-making by both investors and businesses, which can often prevent a bad financial event. Bankruptcy prediction models are becoming important tools for the accounting and management of a business. The classification and capabilities of bankruptcy prediction can be used for the purposes of bankruptcy prediction, detecting a fraud to the company and managing the company performance from the prediction onwards. The constantly changing economic environment of a company creates many and complex causes of corporate bankruptcy. Today's automated corporate bankruptcy forecasting systems examine financial ratios as predictors of a company's performance and assess the likelihood of success of the company's goals.

Of course, even when a company is one step before bankruptcy, it should be considered whether some possible actions can be taken immediately, in order to be able to meet its obligations, such as: a) Cash-equivalent investment portfolio liquidation as a more immediate action, b) Search for financing with a guarantee of its assets or alternative financing such as sale and leaseback, venture capital etc, c) Profitable sale of a not profitable enough entity of the company and if it is deemed necessary to proceed with the sale of a profitable one, as long as this ensures its existence, d) Pressure on suppliers and creditors to extend or revise their repayments, e) Merger with another company or sale of a minority share of stocks, f) Negotiating an extension of the repayment period of existing loans, g) Reorganization of the loan portfolio.

2. LITERATURE REVIEW

Bankruptcy systems have two fundamental objectives: (a) to provide an efficient collective creditor remedy when a debtor is insolvent; and (b) to provide a means for financially rehabilitating over indebted individuals.¹

Corporate bankruptcy refers to the bankruptcy of large- and medium-sized businesses, which for convenience I assume to be organized as corporations. For corporations in financial distress, both the size of the pie and its division depend on whether the corporation liquidates versus reorganizes in bankruptcy and corporate bankruptcy law includes rules for deciding whether reorganization or liquidation will occur. When corporations liquidate, the size of the pie is all of the firm's assets. The size of the pie reflects the doctrine of limited liability, which exempts corporate shareholders from liability for the corporation's debts beyond loss of their shares. The proceeds of liquidating the corporation's assets are used to repay creditors.²

As it is known the bankruptcy of a corporate firm is the final stage before it definitively closes its operation. Before bankruptcy the financial distress of a company is the situation where such an entity, without the burden of debt financing service would have reported positive earnings. Given that upon the crystallization of insolvency, the debt of a company becomes a sunk cost. This would render question of the continued existence of the entity irrelevant.³

According to the existing literature, the prediction of a bankruptcy follows various models that have to do with both the company's characteristics and the basic economic indicators of a state economy. The prediction of a bankruptcy can be directly related to the course of a national economy. The issue that arises is whether the sequence of a pattern of bankruptcy for a business, will have the same effectiveness if it is applied in a different period than the one designed. Bankruptcy forecasts for an organization or a company should be constantly harmonized with the general economic data and the conditions of the external environment that the company faces. (Grice & Dugan, 2001)

¹ Whitford, W.,C., (2001) "International Encyclopedia of the Social & Behavioral Sciences" <https://www.sciencedirect.com/referencework/9780080430768/international-encyclopedia-of-the-social-and-behavioral-sciences#book-description> (accessed 12/11/2023)

² White M., J.,(2005). "Economic Analysis of Corporate and Personal Bankruptcy Law". Working Paper 11536 <http://www.nber.org/papers/w11536> National Bureau of Economic Research 1050 Massachusetts Avenue Cambridge, MA 02138 USA

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The problem of predicting a bankruptcy is a classic problem of economic science. The risk of predicting a future bankruptcy lies in the variations presented in the general national or international economic environment. It therefore becomes important to analyze the stability and accuracy of the models that determine a bankruptcy for a company. (Altman, 2000).

Altman (2005) has employed a new version of his original model: the EMS model. This is an enhancement of the revised Altman's score model (Z' score) (Altman, 1993), resulting in an EMS and its associated rating. This rating was modified according to three main factors: the firm's vulnerability to currency devaluation, its industry affiliation, and its competitive position in the industry (Altman & Hotchkiss, 2006). According to Altman (2005), the EMS requires the firm to have publicly traded equity and it is primarily for manufacturing firms.

The emerging market scoring model (EMS) for rating emerging market credits is based first on a fundamental financial review derived from a quantitative risk model; and second, on our assessments of specific credit risks in the emerging market in order to arrive at a final modified rating. The investor can then utilize this rating after considering the appropriate sovereign yield spread, to assess equivalent bond ratings and intrinsic values (Altman, E. I. 2005 An emerging market credit scoring system for corporate bonds).

Francesco Paolone (2015) in his work concluded that the results seek to evaluate the impact of global financial crisis on Chinese manufacturing and non-manufacturing publicly traded companies. As demonstrated in this study with the EMS (Altman et al., 1995; Altman & Hotchkiss, 2006), the Chinese scenario is composed by the 68.86% of the entire sample with no risk of financial distress during the global crisis, and only 9.47% has a reasonable risk of financial distress.

Meeampol S., Lerskullawat P., Wongsorntham A., Srinammuang P., Rodpetch V., Noonoi R., (2014) in their work found out that both models can completely predict the sign of a possible bankruptcy that may occur and effective when two years of information were used than one year. The Z-Score model achieved 89.66% (2010) and 80.77 (2011), while EM-Score model, 75.86% (2010) and 46.15% (2011) prediction accuracy when it is applied to forecast bankruptcies on the underlying sample.

Djaja A., R., (2020) in his work find out that the Altman Z-Score Emerging Market model can predict the distress category of oil companies in Indonesia. Companies that are in the area of bankruptcy have negative EBIT, high debt levels, and low current assets. So many variables X1 to X4 are negative. In this case, it is necessary to review the ideal ratio for companies in the oil and gas industry because each company's financial strategies are different depending on the industry. For oil and gas service companies, the low service utilization for oil and gas projects also affects profitability and current assets. However, the low utilization of oil and gas service companies does not significantly affect corporate debt usage.

3. METHOD

Our study try to present the most used current tools such as the two Altman's Z-Score models to predict corporate distress in emerging markets. Edward Altman composed modeling using financial statement ratios and multiple discriminant analyses to predict bankruptcy in manufacturing companies listed on the Stock Exchange. The modeling conducted by Altman uses five financial ratios for its calculations⁴:

$$Z = 1.2 * X_1 + 1.4 * X_2 + 3.3 * X_3 + 0.6 * X_4 + 1.0 * X_5 \quad (1)$$

$$X_1 = \text{Working Capital} / \text{Total Assets} \quad (2)$$

Where Working Capital = Current Assets - Current Liabilities

$$X_2 = \text{Retained Earnings} / \text{Total Assets}, \quad (3)$$

$$X_3 = \text{ROA} \quad (4)$$

$$\text{ROA} = \text{Earnings before Taxes and Interest} / \text{Total Assets}, \quad (5)$$

$$X_4 = \text{Market Value of Equity} / \text{Total Liabilities}, \quad (6)$$

$$X_5 = \text{Sales} / \text{Total Assets}. \quad (7)$$

Safe Zone: $Z > 2.99$, Gray Zone: $1.81 < Z < 2.99$, Red or Distress Zone: $Z < 1.81$

In 2005, Altman introduced the Z-Score model with an approach to emerging markets and could be used for manufacturing and non-manufacturing companies⁵. The model is called the Emerging Market System (EMS), the formula can be seen in

$$Z'' = 3,25 + [6,56 * (X_1) + 3,26 * (X_2) + 6,72 * (X_3) + 1,05 * (X_4)] \quad (8)$$

Whereas:

$$X_1 = \text{Working Capital} / \text{Total Assets}$$

Where Working Capital = Current Assets - Current Liabilities,

⁴ Ross, S. A., Hillier, D. J., Westerfield, R. W., Jaffe, J., and Jordan, B. D., (2018). "Corporate Finance". 12th Edition McGraw Hill.

⁵ Altman, E. I. (2005). "An Emerging Market Credit Scoring System for Corporate Bonds". *Emerging Market Review*, 6(4), 311-323

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X_2 = Retained Earnings / Total Assets,

X_3 ROA

ROA = Earnings Before Interest and Taxes / Total Assets,

X_4 = Book Value / Total Liabilities,

(9)

The interpretation of the emerging market Z-Score model after discounting the constant 3.25 from the score (equation No.2) are:

Safe Zone: $Z'' > 2.60$, Grey Zone: $1.1 < Z'' < 2.60$, Red or Distress Zone: $Z'' < 1.1$

X_1 : This shows the ability of a company to promptly settle its short-term obligations when they become due. In addition, it should be noted that it has significant weight also at the univariate level, as the inability to repay short-term obligations is one of the most frequent causes that lead companies to bankruptcy. In fact, in addition to liquidity, this indicator also takes into account size, since a company that suffers continuous operating losses is expected to have a decrease in its Current Assets in relation to its Total Assets. As per Working Capital we have to mentioned that if Working Capital < 1 the company faces liquidity problems since it is unable to repay its short-term obligations and urgently needs support. If Working Capital = 1 or > 1 the company is able to pay off its short-term obligations. If Working Capital = 0 the case is particularly serious for an industrial enterprise, but it is a common phenomenon for a commercial enterprise or a service enterprise (Altman Edward I., 2000).

X_2 : This ratio presents the degree of self-financing and measures the ability of a company to accumulate profits from the use of its assets. In addition, this fraction also reflects the degree of leverage. Companies with high prices of retained capital typically have a history of profitability, finance their assets through retained earnings, and maintain a low level of debt, while having the ability to weather a loss-making period more easily (Altman Edward I., 2000).

X_3 : This is one of the most important performance indicators. It relates to the efficiency of a business's operation, as it measures its ability to generate profits by using its assets as efficiently as possible, without taking into account any type of tax, interest or other leverage factor. Since the existence of a firm is based on the earning power of its assets, this ratio seems particularly appropriate for studies dealing with corporate failure. Earnings Before Taxes and Interest (EBIT): The sum of profits or losses before taxes and interest from the normal operation of a business during a fiscal year (Altman Edward I., 2000).

X_4 : This is an indicator of capital structure and solvency and shows the size of the coverage of foreign funds by equity and, by extension, the security that the company offers to its lenders. When used for companies listed on the Stock Exchange, the calculation is carried out with the Market Value of the Equity Capital instead of the Total Equity Capital, studying at the same time the capitalization, which the previous studies did not take into account. Total Equity: This is the capital belonging to the shareholders and includes Share Capital, Reserves and Retained Earnings. Market Value of Equity: It is the product of the number of shares in circulation, preferred and common, times the value of the share on the Stock Exchange. In this paper, the closing price of the last trading day of each year in the Stock Markets has been used (Altman Edward I., 2000).

X_5 : This ratio belongs to the category of closed capital flow rate indicators. This indicator essentially shows whether there is an overinvestment of capital in the company in relation to the amount of its sales. High values of these indicators mean that the financial organization intensively uses its assets in order to make sales. Otherwise, the low prices are an indication of either non-intensive use of its assets or possibly "bad" investments that do not contribute to the financial result, in which case it should either increase the degree of their use or liquidate part of its assets elements, respectively. In addition, it is a measure of the management's ability to deal with competitive conditions. A failure to increase the company's market share translates into a low or declining index price. It is pointed out that this indicator is the least statistically significant indicator (Altman Edward I., 2000).

4. FINDINGS AND DISCUSSION

Before we preset our analysis we have to mentioned that the two Z-Score Models have a different orientation from which they see the issue of the bankruptcy of industrial enterprises. The first model focuses mainly on bankruptcy issues of listed companies per se, while the second model focuses mainly on bankruptcy aspects of bonds issued for lending by industrial companies listed on Emerging Market Exchanges. It is clear, however, that both models are of equal interest to shareholders and future investors, whether they are going to invest in shares or bonds of such companies. In this topic of our study we present the results of the two Z-Score models in the tables 1 and 2 and the courses in the figures 1 and 2. Comparing the two findings of our analysis we can observe a significant difference of the two Z-Score values around the average year Z-Score that described below. In the first analysis we used $Z = 1.2*X_1 + 1.4*X_2 + 3.3*X_3 + 0.6*X_4 + 1.0*X_5$ the Altman's Z-Score for Industrial Companies listed in Stock Exchange Markets and we try to find out if there were or not a probability of bankruptcy during 2016-2021 for the Greek Oil Companies listed in Athens Stock Exchange Market. All our annual results during 2016-2021 for Z-Score for the Greek Oil Companies listed in Athens Stock Exchange Market are referred below to the table 1 and their course showed in figure 1 that extract from table 1.

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Table 1: Annual Results of Altman's Z-Score for Industrial Companies listed in Stock Exchange Market. Evidence from Greek Oil Companies listed in Athens Stock Exchange Market 2016-2021

Years & Zones	2016	Zone	2017	Zone	2018	Zone	2019	Zone	2020	Zone	2021	Zone	Average Companies Z
Greek oil companies													
Motor Oil	3.52	Safe	4.21	Safe	4.92	Safe	4.24	Safe	2.24	Gray	2.95	Safe	3.68 Safe
Elin Oil	9.22	Safe	9.18	Safe	11.44	Safe	9.71	Safe	9.25	Safe	8.35	Safe	9.53 Safe
Revoil	4.42	Safe	7.39	Safe	7.78	Safe	6.56	Safe	6.00	Safe	7.12	Safe	6.55 Safe
Elpe	1.70	Red	0.98	Red	2.33	Gray	2.08	Gray	1.12	Red	1.91	Gray	1.69 Red
Average Year Z	4.72	Safe	5.44	Safe	6.62	Safe	5.65	Safe	4.65	Safe	5.08	Safe	5.36 Safe

Source: Authors' Calculation from published Annual Financial Statements and Financial Reports

From the above table 1 we can say that the most results of Z-Score model are in Safe zone for all the four examined Greek oil companies. In the second place we find out the Gray Zone and four cases are recorded in Red Zone only for ELPE Oil. It is worth pointing out that only REVOIL and ELIN Oil had Z-Score values in Safe Zone. The appearance of the gray areas from the application of the first Altman's Z-Score model comes mainly from the existing low values of all the used indicators. As for the few red zones appearing in our study we can tell that, they came from two main sources. The first concerns the indicator X_1 which in some years shows negative working capital in the numerator. The second concerns the X_3 ROA ratio which has negative profitability in the numerator in some years.

From the below figure 1 we observe that two of the examined oil companies REVOIL and ELIN Oil had values for Z-Score that are over Average Z-Score yearly. The other two Oil companies MOTOROIL and ELPE Oil had values for Z-Score that are under Average Z-Score yearly, even though they are much bigger companies in assets and they are older companies.

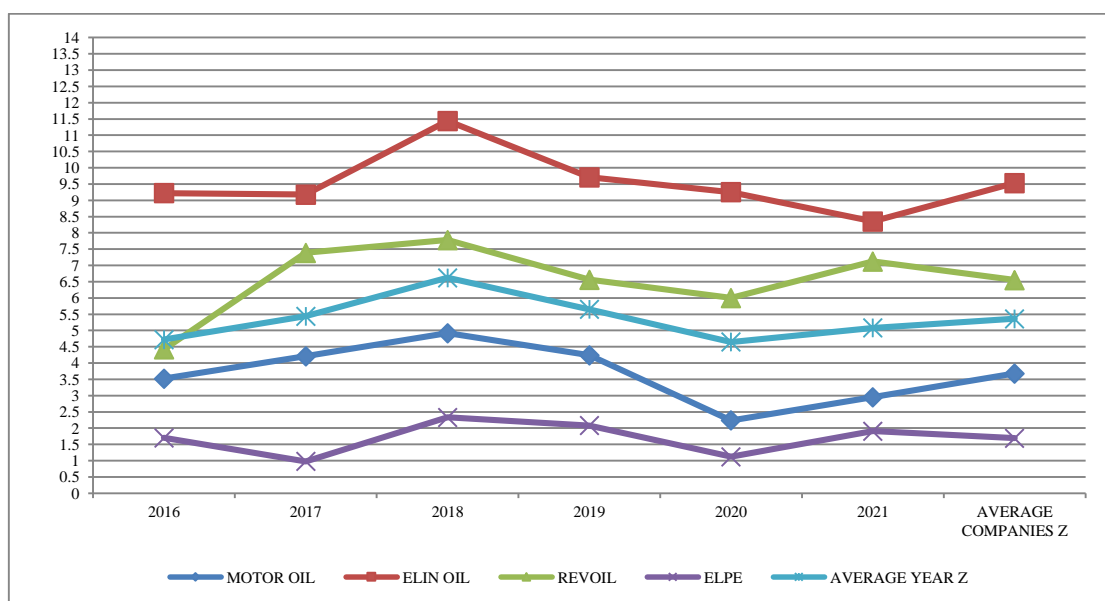


Figure 1: Annual Course of Altman's Z-Score for Industrial Companies listed in Stock Exchange Market. Evidence from Greek Oil Companies listed in Athens Stock Exchange Market 2016-2021

Source: Table 1

In our second analysis we used the Altman's Z-Score for Emerging Markets such as Athens Stock Exchange $Z'' = 3,25 + [6,56*(X_1) + 3,26*(X_2) + 6,72*(X_3) + 1,05*(X_4)]$ and we try to understand if there were or not a probability of bankruptcy for the Greek Oil Companies listed in Athens Stock Exchange Market. All our annual results during 2016-2021 for Z-Score for the Greek Oil Companies listed in Athens Stock Exchange Market are referred below to the table 2 and their course showed in figure 2 that extract from table 2.

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Table 2: Annual Results of Altman's Z-Score for Emerging Markets Evidence from the Greek Oil Companies listed in Athens Stock Exchange Market 2016-2021

Years & Zones Greek oil companies	2016	Zone	2017	Zone	2018	Zone	2019	Zone	2020	Zone	2021	Zone	Average Companies Z
Motor Oil	6.11	Safe	6.68	Safe	7.26	Safe	5.96	Safe	3.11	Safe	4.27	Safe	5.63 Safe
Elin Oil	1.86	Gray	1.71	Gray	1.44	Gray	1.21	Gray	2.21	Gray	4.01	Safe	2.07 Gray
Revoil	-3.11	Red	3.64	Safe	3.93	Safe	-0.18	Red	0.12	Red	0.64	Red	0.84 Red
Elpe	1.93	Gray	0.77	Red	3.12	Safe	2.71	Safe	0.85	Red	2.25	Gray	1.94 Gray
Average Year Z	1.71	Gray	3.21	Safe	3.94	Safe	2.42	Gray	1.57	Gray	2.79	Safe	2.62 Safe

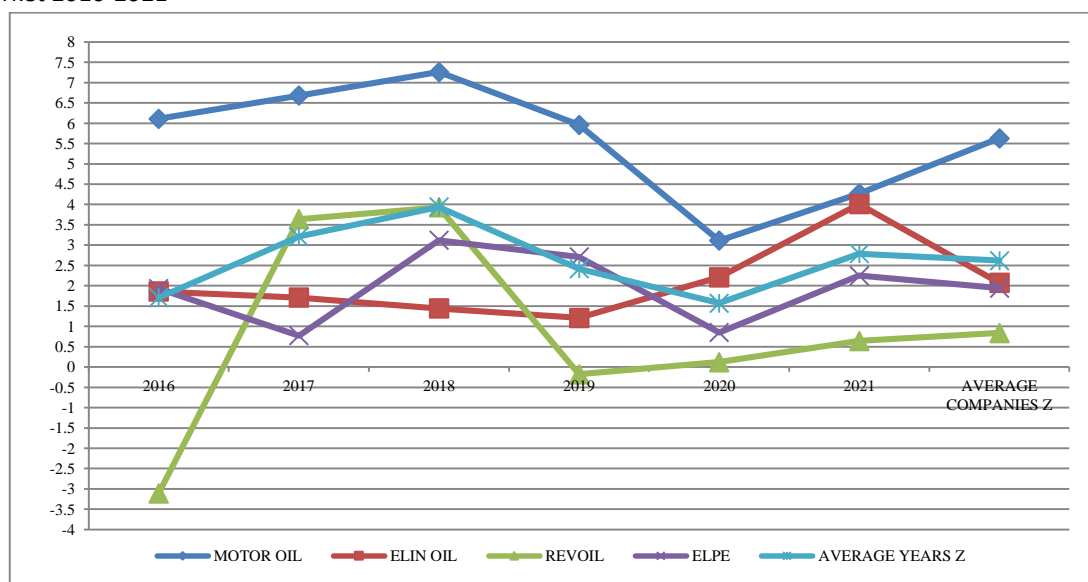
Source: Authors' Calculation from published Annual Financial Statements and Financial Reports

From the above table 2 things changes comparing with the table 1 and we can say that the most results of Z-Score model are in Safe zone for all the four examined Greek oil companies. In the second place we find out the Gray Zone and seven cases are recorded in Red Zone, four for REVOIL and three for ELPE Oil. It is worth pointing out that only MOTOROIL had Z-Score values in Safe Zone.

From the below figure 2 things also changes comparing with the figure 1 and we observe that only of the examined oil companies MOTOROIL had values for Z-Score that are over Average Z-Score yearly. The values of Z-Score for the other three Greek Oil companies listed to the Athens Stock Exchange Market presented a volatility moving up and down of the Average value of Z-Score yearly.

The appearance of the gray areas from the application of the second Altman's Z-Score model comes also mainly from the existing low values of all the used indicators. As for the red zones appearing in our study we mentioned that, they are more than the results of the first Altman's Z-Score model but they came also from two main sources. The first concerns the indicator X_1 which in some years shows negative working capital in the numerator. The second concerns the X_3 ROA ratio which has negative profitability in the numerator in some years.

Figure 1: Annual Course of Altman's Z-Score for Emerging Markets. Evidence from the Greek Oil Companies listed in Athens Stock Exchange Market 2016-2021



Source: Table 2

5. CONCLUSION

The contribution of this study is to shed further light on how relevant is the impact of the exit from the Memoranda, that extracted from the economic crisis in Greece, until the pandemic stroked, in Greece and concerned the Greek oil companies listed in the Athens Stock Exchange. The Greek oil industry, in general, during the examined period of 2016-2021, seems not to have been locked in by the possibility of bankruptcy despite the fact that approximately 10 years ago, i.e. in the "heart" of the Greek economic crisis, it was in a particularly disadvantaged position, due to the decline in demand, the greater dependence on the internal market,

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and the lack of credit from banks. The appearance of the gray areas in our study comes mainly from the existing low values of all the used indicators and the two bankruptcy models and for this reason it is recommended to gradually make the necessary corrective financial moves for the future improvement and the transition of the Greek oil companies to continuously safe zone. As for the few red areas appearing in our study in both bankruptcy models, they came from two main sources. The first concerns the indicator X_1 which in some years shows negative working capital in the numerator. The second concerns the X_3 ROA indicator which has negative profitability in the numerator in some years. In the case of red zones, it is suggested that specialized corrective financial and financial corrective actions be taken immediately by the specific companies in which they appeared, so that there were no future risk of bankruptcy. The most occurrences of red zones in our second analysis is mainly due to the different coefficients used by Altman's second bankruptcy model, as well as to the one less indicator it includes, with the consequence that the two indicators X_1 and X_3 that affect negative values have more weight in the second model. Therefore, for further study in the future it would be of great interest to attempt a more comprehensive analysis of the companies of the Greek oil sector, which consists mainly of the companies Motor Oil, Elin and Revoil, Elpe, which are listed on the Athens Stock Exchange, with the aim of investigating and identifying those factors that have contributed in recent years to the significant strengthening of the sector at an economic level and the spectacular improvement of its competitiveness internationally.

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