

CAN ALTMAN Z-SCORE MODEL PREDICT BUSINESS FAILURES IN GREECE?

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Abstract

This paper analyses whether Altman Z-score models, can predict correctly company failures. The empirical analysis examines all listed in the Athens Exchange companies, during the period 2002-2008 and discontinuations of operation for these companies during the same period. It is investigated whether Z-score models can predict bankruptcies for a period up to three years earlier. Our study shows that Altman model performs well in predicting failures. This is in line with other findings. The empirical results are interesting since they can be used by company management for financing decisions, by regulatory authorities and by portfolio managers in stock selection.

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JEL Classification: G33:G14

1. Introduction

1.1 Examined issues

In the study we examine if z-score alone can predict business failure for the examined companies in the examined period. To examine this we investigate whether z-scores one up to four years before bankruptcy can predict business failures or financial problems. Our study is interesting because if discriminant analysis is useful, then financial analysts and portfolio managers can use it for stock picking and asset allocation. Discriminant analysis can also be a valuable tool for investors. Companies that have high probabilities to bankrupt should trade at a discount to their value. If this is correct, then our paper makes an interesting contribution to bankruptcy literature, by linking z-score with business failure prediction and asset allocation in Greece.

1.2 Previous research

Multivariate prediction of bankruptcy as established by using univariate analysis of bankruptcy predictors was initially developed by Beaver (1967, 1968) who found that a number of indicators could discriminate between matched samples of failed and nonfailed firms for as long as five years prior to failure. Altman (1968) defines five predicted factors and sets the base for other researchers to examine the validity of multivariate models. Following to the Beaver and Altman research seems to verify the validity of Altman models, but their prediction ability is found gradually lower. Begley et.al (1996) examines the altman z-model and concludes that the model performs better in US data during the 1980s than during the 1990-1995 period. Similar are the findings of Grice and Ingram (2001), who also find better performance for manufacturing companies.

2. Data Issues and Methodology

2.1 Data

In order to test the credit risk of the construction companies in Greece, we examine two Z-score models, in particular the z-score model developed in Altman (1993).

The financial data used are annual and cover the period of 1999-2006. To compute the market value used, we take the market value of the company on 31 December of each year. The prices were taken by EFFECT S.A. database and we use the Athens stock exchange daily report to identify when the company share price was suspended. From our sample we exclude companies that were listed for less than three years, and companies that merged.

On total, the examined sample consists of 373 companies, listed on the Athens Stock exchange in the examined period, 45 of them bankrupted or their shares were suspended permanently and 328 companies did not bankrupt or had their shares permanently suspended.

The examined cases of companies that **bankrupted or their shares were suspended permanently** are the following (Table 1).

Table 1. Companies that their shares were suspended permanently, or get bankrupt

	COMPANY NAME	SECTOR
1	Alfa Alfa	Diversified
2	Connection	Apparel
3	Datamedia	Information Technology
4	Elephant	Retail
5	Ipirotiki	Publishing
6	Microland	Retail
7	Rainbow	Information Technology
8	Sea Farm Ionian	Fisheries
9	Stabilton	Real Estate
10	Alte	Metal Products
11	Alisida	Footwear
12	Mesochoritis	Construction
13	Betanet	Construction
14	Leventakis	Construction
15	Gener	Construction
16	Galis	Leisure
17	Daos Plastics	Chemicals
18	Daring	Metal Products
19	Diekat	Construction
20	Dinamiki Zois	Fitness
21	Hellenic Fisheries	Fisheries
22	Empedos	Construction
23	Ergas	Construction
24	Etma	Chemicals
25	European Technical	Construction
26	Themeliodomi	Construction
27	Ideal	Information Technology
28	Intersat	Construction
29	Kerameia Allatini	Building Materials
30	Korasidis	Retail
31	Korfil	Textiles
32	Lannet	Communications
33	Multirama	Retail
34	Balafas	Real Estate
35	NEL	Ferries
36	Plias	Information Technology
37	Pouliades	Wholesale
38	Promota	Promotion
39	Saos	Ferries
40	Space	Information Technology
41	Corinth Pipeworks	Metal Products

	COMPANY NAME	SECTOR
42	Tasoglou	Wholesale
43	Texnodomi	Construction
44	Steel Sheet Co	Metal Products

The number of companies that get bankrupted and/or their shares were suspended permanently are the following (Table 2).

Table 2. Number of Companies that get bankrupt and/or their shares were suspended permanently

Year	No of Companies
2003	12
2004	9
2005	9
2006	4
2007	10
Total	44

Companies belonging in the financial sector (banks, investment companies) were excluded.

2.2 Examined model

The most well-known quantitative model for predicting bankruptcy is Altman's Z-score, which was developed in 1968 by Edward I. Altman, professor at Stern School of Business. The Z-score is a set of financial ratios in a multivariate context, based on a multiple discriminated model, for the firms where a single measure is unlikely to predict the complexity of their decision making or the scope of their entire activities.

Altman examined a list of twenty two possible ratios, and finally has chosen five that had the best results when they were applied together were selected after numerous tests for the discriminant function. This model was later modified to the Altman (1993) model that uses the same variables multiplied by different, however, factors.

The discriminant function is:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

Given that

X_1 = Working Capital / Total Assets, (WC/TA)

X_2 = Retained Earnings / Total Assets, (RE/TA)

X_3 = Earnings Before Interest and Taxes / Total Assets, (EBIT/TA)

X_4 = Market Value Equity / Book Value of Total Liabilities, (MVE/TL) and

X_5 = Sales / Total Assets, (S/TA)

Altman defined a “grey area” which is between 1.81 and 2.99. Firms, with z-scores within this range, are considered uncertain about credit risk and considered marginal cases to be watched with attention. Firms with Z scores below 1.81 indicate failed firms. Although, the cut-off point was set at 2.675, Altman advocates using the lower bound of the zone-of-ignorance (1.81) as a more realistic cut-off Z-Score. So if $Z < 1.81$, then the company has a high probability of default. On the other hand, the company is solvent, meaning that it is financial healthy. Some credit analysts, private underwriting agents, financial analysts, auditors and firms themselves were concerned that since the original model requires stock price data (X_5), it was only applicable to publicly traded entities.

3. Results

We examine the validity of the model by examining the percentage of cases that fall within the predictable range of companies. For example, bankrupted companies must fall within the price range that is expected to be for these companies (e.g.smaller than 1.8) , while non-bankrupted companies must fall withing the price

range that is expected to be for those companies. Cases not predicted correctly are defined as Type 2 error cases. Our results show some support for Altman model.

Altman model findings

Examining the Altman (1993) model we find out that it can predict the majority of companies that will get bankrupt, even when the z-scores of these companies are computed up to six (2) years earlier.

Table 3. Altman z score prediction statistics, Bankrupted Companies

Bankrupted Companies				
Year	All	Correctly Classified	Type 2 error	% correct
-4	44	9	35	20%
-3	44	17	27	39%
-2	44	23	21	52%
-1	44	29	15	66%

Success rate for failed companies varies from 66% (year -1) and gradually diminishes to 52%, 39% and 20% for year -2, -3 and -4 respectively. Therefore, z-score gives a good indication of problems, at least one year before the company will exhibit financial problems. However, the model performs poorly when prediction time horizon increases. Data for non-banrupted companies are illustrated on the following table.

Table 4. Altman z score prediction statistics, Non Bankrupted Companies

Non Bankrupted Companies				
Year	All	Correctly Classified	Type 2 error	% correct
-4	244	190	54	78%
-3	215	149	66	69%
-2	193	121	72	63%
-1	168	91	77	54%

The model gives a good indication for companies that will not face problems even in longer span time-horizons. The model has been successful in classifying the majority of non-banrupted companies in all the examined periods (-1, -2, -3 and -4 years). In particular, 78% of companies are correctly classified for the long time span (4 years) a percentage that gradually diminishes to 54% for a year time span.

Overall the model succeeds to identify bankrupted and non-bankrupted companies. Aggregated data are illustrated on the following table.

Table 5. Altman z score prediction statistics, All Companies

All Cases				
Year	All	Correctly Classified	Type 2 error	% correct
-4	288	199	89	69%
-3	259	166	93	64%
-2	237	144	93	61%
-1	212	120	92	57%

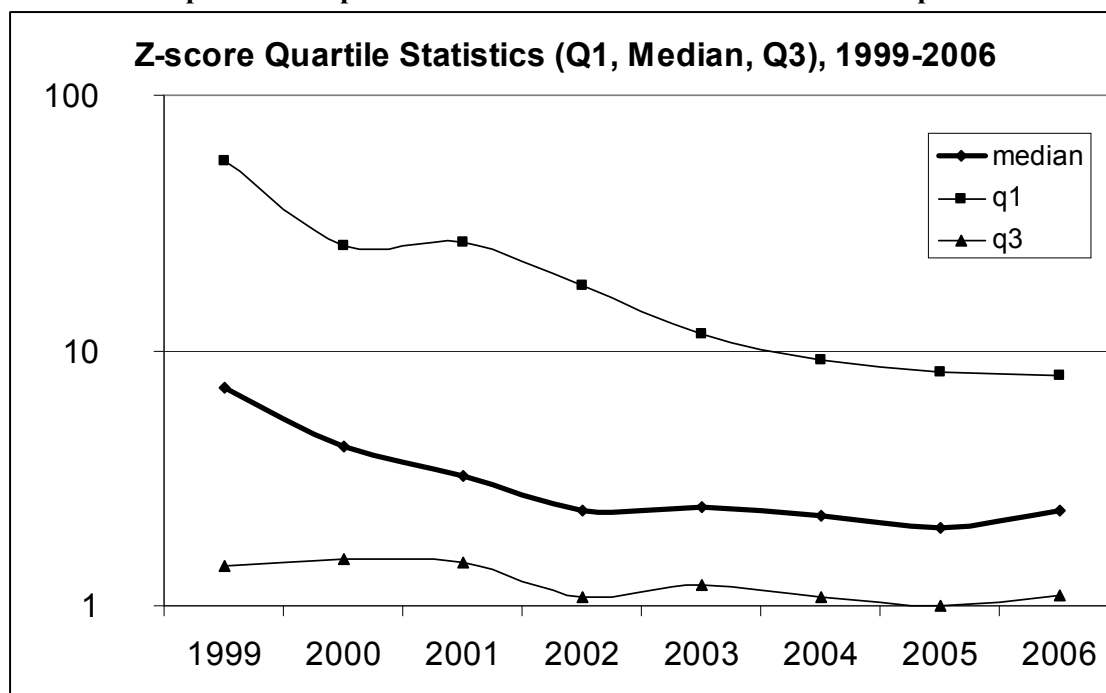
The model succeeds to identify bankrupted and non-bankrupted companies by 57%-69% depending on the time horizon examined (1-4 years).

It is noted that the model takes account of market values. The ability of the model to take account of market values, together with redefined beta factors, seems to give it an additional strength. However, the model also has weaknesses, main being its volatile results.

Volatility of z-scores

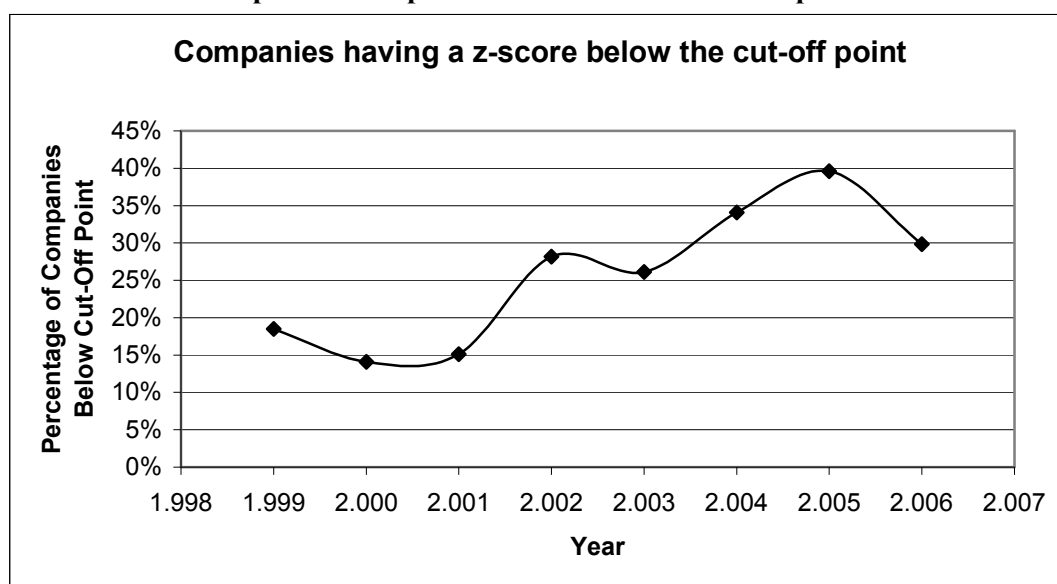
The estimated Z-factors vary over time. Z-scores appear higher during bullish markets, while they appear lower during bearish years. As seen on the following graph, average z-scores of both failed and non-failed compaies are high in 1999, and then they gradually decrease, to reach by 2005 the lowest levels.

Graph 1. Development of z-score for failed and non-failed companies



This development is universal among the examined companies. The examined companies z-score gradually increases or decreases at similar pace. This affects the percentage of companies that fall within illustrated on the following table.

Graph 2. Development of z-score for failed companies



Our results may indicate that bullish markets give even to financially distressed company the ability to survive. It is evidently correct, according to our opinion, since during bullish markets, financially distressed companies can raise capital easier, something that gives them the ability to cover their need in capital for the next 1-2 years. However, as these companies do not generate positive operating cash flows, the capital raised is not a panacea, so financial problems appear again whenever the macroeconomic conditions are bad and the companies can not raise capital.

It seems, therefore, that the ability of companies to raise capital does not improve significantly their financial prospects.

If companies have the ability to improve their financial position during good years in capital markets, while being unable to improve them in the long run, then Altman z-scores are useful tool for the company

management, either to proceed in company restructuring, or to proceed to a merger with other companies. At the same time, if Altman z-scores tend to return to historically low levels over a business cycle (6-10 years), then good financial and market years should provide the opportunity to portfolio managers to decrease their position in companies they identify to have low altman z-scores.

4. Conclusion

Nearly 15% of the listed companies bankrupt or the trading of their shares was suspended during the examined period. This high percentage of failure makes the investigation and prediction of company failures a useful tool for both financial managers and analysts, since the ability to predict these failures is valuable. For this scope in this paper we examine whether z-score model, developed by Altman 1993 can predict bankruptcies. We find evidence that this model is useful in identifying financially troubled companies that may fail up to 2 years before the bankruptcy. The model is useful, probably because it matches both accounting data and market value, having so an information content as identified in Dichev 1998. Overall model success rate is not statistically significant, but when it comes to failure cases it can predict 54% of them one year before failure. The predictive ability of Altman model is in line with findings by other researchers in Greece and in the United States. Christopoulos et. Al. (2007) finds that Altman is useful in predicting Greek telecom company failures, while Altman (2002) find supportive evidence in the US market. Vergos et al (2006) and Christopoulos et al (2006) also show that analysts' predictions and company announcements may affect considerably market prices up to 18 months before the announcement of negative financial results, something that leads to incorporation of probability of failure in company prices, and respective company altman z-score that are affected by market price of shares, well before the company will declare bankruptcy. In other words, analysts recommendations, as well as market rumors, that affect the company price may explain why Altman model is more useful than mere traditional financial analysis.

The empirical results are interesting for both portfolio managers and company management. If companies have the ability to improve their financial position during good years in capital markets, while being unable to improve them in the long run, then Altman z-scores are useful indication to the company management to proceed to a merger with other companies, so as to preserve the company value. Besides, if Altman z-scores tend to return to historically low levels over a business cycle, then bull markets should provide the opportunity to portfolio managers to decrease their position in companies they identify to have low Altman z-scores.

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