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Classifying Manufacturing Firms in Lebanon: An Application of Altman's Model

El Khoury, Rim [a] *, Al Beaïno, Roy [b]

[a]Notre Dame University, Zouk Mosbeh, Lebanon
[b]Bank of Beirut, Beirut, Lebanon

Abstract

This study analyzes whether Altman Z-score can accurately classify manufacturing companies operating in Lebanon. The empirical analysis examines eleven manufacturing companies over a period of 3 years from 2009 till 2011. Firms are classified according to Altman Z-score models and then compared to their actual classification. The study found that the Altman Z' Score (1983) can serve as a barometer for classifying Lebanese manufacturing companies within the same sub-business sector. This finding can be used by banks for classifying their clients, by companies for evaluating their performance, and by investors for selecting stocks. First, small banks that cannot afford buying those expensive rating systems can employ the Z' score to quantify the risk of the customers applying for a loan. Second, companies can set up for a manufacturing industry benchmark, make self-evaluation to track their ranking, and take necessary corrective actions ahead of time. Third, investors can employ the Z' Score as a valuation tool to compare different companies.

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Keywords: Bankruptcy models, classification, barometer, manufacturing firms, emerging country;

1. Introduction

Economists and experts had been trying to work on models measuring performance or distress separately. However, performance evaluation and distress analysis might be the dual of each other since a company that is in distress implies that it is not performing well and vice versa. This study will use Altman model of 1983 designed for predicting bankruptcies of manufacturing firms, as a classification rather than a bankruptcy tool. The main purpose is to classify a sample of Lebanese manufacturing companies based on the score calculated, and then to compare the model classification to the financial institution classification (the bank classification). The sample consists of four small and medium companies referred by MMDs and seven large companies referred by CBDs. The objective is to see whether Z model can be used as a barometer for accurately classifying Lebanese manufacturing companies.

This study can serve in many ways if Z' score can serve as a barometer. First, financial institutions, mainly banks that lack a classification model can use this tool to classify their clients and to decide whether a loan will be granted to them. Second, the model can also help companies to track their performance versus their competitors in the market. Companies can compare the various variables in the model to investigate more their competitive edge and

* Corresponding Author: El Khoury, Rim. Tel.: +961- 70-038-040
E-mail address: rkhoury@ndu.edu.lb

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reveal their weaknesses. Such information will be useful to help companies taking necessary actions to maintain or to improve their scores. Third, investors can use it as a valuation tool to choose the safest company to invest in.

The paper will proceed as follows. Section 2 will provide a brief literature review, while section 3 will discuss the methodology and data. Findings will be presented in section 4, followed by a conclusion in section 5.

2. Literature Review

2.1. Univariate Analysis

Back to the history of financial distress analysis, early studies for bankruptcy prediction were univariate studies. These studies focused on individual ratios and compared ratios of failed companies with those of successful firms.

FitzPatrick (1932) compared 13 ratios of failed and successful firms and found that the two significant ratios are Net Worth to Debt and Net Profits to Net Worth. However, Smith and Winakor (1935) analyzed ratios of 183 failed firms from a variety of industries and found that Working Capital to Total Assets was the best predictor of financial problems. Similarly, Merwin (1942) found Smith and Winakor's ratio to be the best indicator in addition to the Current Ratio and Net Worth to Total Debt. By studying a sample of 79 failed and 79 operating companies, Beaver (1966) took the study a step further and presented empirical evidence that certain financial ratios can discriminate between matched samples of failed and non-failed firms. He found that Net Income to Total Debt was the strongest predictor of bankruptcy followed by net income to sales. However, in these researches, financial distress is counted by a single variable. Ratios, if considered independent of each other, will not permit to express the whole situation in a single measure. Therefore, it is essential to have a multidimensional perspective where the important ratios are combined together to have a look at the big financial picture of the company. In line with the above, Altman, in 1968, came up with a multivariate model based on multivariate discriminate analysis. More specifically, he developed his five predicted factors and set the base for other researchers to examine the validity of such a model.

2.2. Multivariate Analysis and Altman Z-models

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 New York's Stern School of Business to measure the distance to default of manufacturing companies. The Z-score is a multiple discriminant analysis which combines ratios in a multivariate context. By taking a sample of 66 companies, Altman examined a list of twenty two possible ratios and finally chose five after numerous tests for the discriminant function.

Altman (1968) defined his distress function into: $Z= 1.2\ X_1 + 1.4X_2 + 3.3\ X_3 + 0.6X_4 + X_5$

Where: X_1 = working capital/total assets; X_2 = retained earnings/total assets; X_3 = earnings before interest and taxes/total assets; X_4 = market value equity/ total debt; and X_5 = annual sales /total assets.

Altman divided the critical values in 3 sections, too healthy (Z> or equal to 2.99), grey area or possibility of bankruptcy ($1.81<Z<2.99$), and bankruptcy (Z less than 1.81). Firms within the grey area are considered marginal cases that need to be watched. Altman advocates the use of the lower bound (1.81) as a more realistic cut-off Z-score; so the firm is considered to be solvent and financial healthy if its Z-score is greater than 1.81, otherwise, the company has a high probability of default. However, its main limitation was that the original model requires stock price data so it was only applicable to publicly manufacturing companies. Therefore, in 1983, Altman revised his original 1968 model to be applicable for private manufacturing firms. In this modified model, the book value of equity is used in the 4^{th} variable instead of market value of equity and a new weight is reassigned for all variables.

$Z'= 0.717\ X_1 + 0.847\ X_2 + 3.107\ X_3 + 0.420\ X_4 + 0.998\ X_5$

It is assumed that a score below 1.23 indicates a distress condition, while a score greater than 2.9 indicates a financially sound position. Grey area is between 1.23 and 2.9, the midpoint is 2.06, and the cut-off score is 1.23.

The previous two models were applicable to manufacturing firms. Therefore, in order to predict the likelihood of bankruptcy for non-manufacturing firms in emerging countries, Altman developed in 1993 the Z" Model. In this

model, the 5th variable has been omitted since it tends to be significantly higher for retail and service firms as compared to manufacturing firms, which would under-predict bankruptcy. Furthermore, the book value of equity is used in the 4th variable and the new modified model is: $Z'' = 6.56\ X_1 + 3.26\ X_2 + 6.72\ X_3 + 1.05\ X_4$. For private non-manufacturing firms, a score of 2.6 or greater indicates that a firm is in a safe area, a score of 1.1 or lower suggests a distress zone, and the grey area is ranging from 1.1 to 2.6. In the emerging market model, a constant term of 3.25 is added to standardize the scores.

2.3. Empirical evidence

Altman models have been establishing themselves as leading multivariate predictors of corporate failure and have been the subject of numerous tests. Many researchers tested the validity of Altman models, but their prediction ability was mixed. Moriarty (1979), in a study of public accounting professionals, found that Altman's score misclassified over 50 percent of the firms as bankrupt and 29 percent as not bankrupt. Furthermore, Grice and Ingram (2001) found the score not as effective in predicting bankruptcy for non-manufacturing as for manufacturing companies. Sauer's (2002) found that using Z-score for companies' successive years' accounts can highlight where a company's financial condition is deteriorating. He stated that Z-score is an early alert procedure designed to provide time for firm management to adjust its strategy and operation. Using 56 defaulted companies, Jayadev (2006) affirmed the viability of using Z-score for internal rating of commercial banks to several borrowers.

Zhang et al. (2006) developed a modified Z-score for 1,001 Chinese firms and found the Z-score to be a useful tool in terms of the distress-prediction model in credit evaluation for business loans in the banking industry. Sandin and Porporato (2007) aimed to predict the bankruptcy of a number of companies listed in the Buenos Aires Stock exchange in 1990 and concluded that the Z-score ratio is the most highly recommended as the key prediction of bankruptcy in an emerging economy. Agarwal and Taffler (2007) tested the predictive ability of UK-based Z-score for 232 failed companies listed in the London Stock Exchange. Their results indicated that Z-score has true prediction activities and concluded that the Z-score if carefully developed will continue to have significant value concerning corporate credit risk and firm financial health. Furthermore, Alexeev and Kim (2008) found that the Z-Score seems to be a predictor of financial distress in firms one year prior to bankruptcy, but they cautioned that Z-Score predictions for periods longer than one year have lost some of their significance.

Despite all its numerous advantages, Z-score faced some criticisms, mainly that it works better for some industry than for others, especially manufacturing and public firms. Despite this criticism, many studies advocate the use of Z-score as a device measuring financial risk, rather than failure (Altman, 2002)

3. Research Methodology

Since the sample of companies used in this study is made out of Lebanese private manufacturing firms, the Altman model of 1968 designed for public firms cannot be used. Therefore, this study will use Altman Z' model of 1983 designed for private manufacturing firms. Despite the fact that Lebanon is an emerging country, Altman model developed for firms operating in emerging countries (Z'') is designed for non-manufacturing firms. Therefore, Z'' might bias the results in case it is applied on a sample of manufacturing firms[†].

The first step is in standardizing the financial statements to create a single platform for studying the balance sheet and the statement of financial position for both the corporate and the middle and small companies.

3.1. The Model and Variables

The Z' Score model of 1983 for private firms is

[†] Lebanese Manufacturing firms were classified according to Altman Model of 1993, but the classification obtained was completely different than the actual classification and the classification based on Z' score. Therefore, the results will not be reported here.

$Z' = 0.717\ X_1 + 0.847\ X_2 + 3.10\ X_3 + 0.420\ X_4 + 0.998\ X_5$

Given that: X_1: Working capital / Total Assets.
X_2: Retained earnings/ Total Assets.
X_3: Earnings before Interest and Tax/Total Assets.
X_4: Book value of Equity/ Total Liabilities.
X_5: Sales / Total Assets.

The variables are defined as follows:

X_1 : Working capital / Total assets: It measures the firm's ability to meet its maturing short-term obligations. Working capital is defined as the difference between current assets and current liabilities.

X_2 : Retained earnings / Total Assets: it measures the cumulative profitability of the firm over time which indicates the efficiency of the management in manufacturing, sales, administration and other activities.

X_3 : Earnings before interest and taxes / Total Assets: It measures the true productivity of the company's assets and the managements' overall effectiveness, independent of taxes and leverage factors.

X_4 : Book Value of equity / Book Value of total debt: it defines how much the company's assets can fall in value before the company becomes insolvent.

X_5 : Sales / Total Assets: it measures management capability in dealing with competitive conditions; it is a standard financial ratio illustrating the sales generating ability of the firms' assets. This ratio varies greatly from one industry to another and is omitted when non-manufacturing firms are studied.

3.2. Data and Sample Construction

Data used in this research is audited financial statements (statement of financial position and income statement) over a period of 3 years from year 2009 till 2011. This data is used by the banks in Lebanon for the purpose of evaluating and grating loans to these companies, thus ensuring its transparency and reliability. The sample size is made out of a total of 11 companies; 4 small and medium firms referred by MMD1 to MMD4, and 7 large or corporate companies referred by CBD1 to CBD7. MMD companies are those that are granted a loan ranging from 100,000 USD till 5,000,000 USD and are studied by the Middle Market Department, while CBD are those companies that are granted loans above 5,000,000 USD and are studied by the Corporate Banking Department. Due to unavailability of data, there will be a classification for 3 years for CBDs and only for two years for MMDs.

3.3. Bank's Classification

The central bank of Lebanon has given the banks operating in Lebanon the option to use their tailored rating system to classify their clients in order to be able to precisely choose their risk exposure. Since all companies included in the sample are clients of one bank, the latter's classification of companies is explained. The financial institution we are dealing with uses Moody's analytic software to classify companies and to quantify risk. The factors taken into consideration in the assessment are grouped under two main branches: the non-financial factors and the financial factors. After the assessment, companies are classified according to a scale ranging from 1 to 10 with 22 different ranks set as follows: 1 ; 2- ; 2 ; 2+ ; 3- ; 3 ; 3+ ; 4- ; 4 ; 4+ ; 5- ; 5 ; 5+ ; 6- ; 6 ; 6+ ; 7– ; 7 ; 7+ ; 8 ; 9; and 10. Rank 1 represents the best rate while rank 10 represents a bankrupted company.

The Non-Financial Factors account for 55% of the total weight of the rating and include aspects such as (1) franchise positioning, (2) risk positioning, and (3) the operating environment with a weight of 25%, 60%, and 15% respectively. First, franchise positioning measures the resilience of the company according to its competitive edge and consists of (i) market position and sustainability and (ii) operational diversification. Second, risk positioning indicates the company's risk appetite and its ability to deal with various risk scenarios. It is measured by (i) the potential volatility of assets and/or cash flows, (ii) standards of corporate governance and management quality, (iii) the implementation of a good risk management, (iv) key relationship concentration, and (v) liquidity management. Third, the operating environment consists of (i) economic strength mainly reflected by GDP per capita, (ii) institutional strength, and (iii) susceptibility to event risk.

The Financial Factors include four factors which are profitability, liquidity, capital adequacy, and asset quality. First, profitability is the earning power of a company and the defense key to absorb losses stemming from market, operational and business risk. Second, liquidity tries to measure the company's ability to cover debt maturing in the near future with what is considered as highly reliable, readily available funds. Third, capital adequacy measures the capability of a company to meet its debtors through its operating cash flows and it is a key element in ratings consideration. Fourth, asset quality is a primary driver of earnings and capital formation for traditional companies.

4. Findings

4.1. Descriptive Statistics

4.1.1. Classification based on Z'-score

The Z' score of companies is presented in Table 1 for the 6 corporate companies and in Table 2 for the middle market companies.

Despite the fact that the average score is increasing from year 2009 to year 2010 (1.84 to 1.93) and from year 2010 to 2011 (1.93 to 2.22), Table 1 shows a decrease in the score of CBD1, CBD2, and CBD5 in year 2010 and CBD2, CBD4, CBD6 and CBD7 in year 2011.

CBD1 financial position fluctuates; its score decreased in year 2010 to reach the distress area, then improved to move back to the gray area. While CBD2 score slightly decreased with year, CBD6 score slightly fluctuated up and down, but both companies remained in the gray area. On the other hand, CBD3 increased its score gradually to join CBD7 as a financially healthy company in year 2011. CBD4 jumped to the gray area in 2011, before falling again to the distress zone in the third year. On the contrary, CBD5 was in the distress zone for two years before jumping to the gray area in 2011.

Table 1. CBDs Classification as per Altman Z' model 1983

CBD Altman Z'score	2009	Assigned Area	2010	Assigned Area	2011	Assigned Area
CBD1	1.83	Gray	1.15	Risk	1.23	Gray
CBD2	1.83	Gray	1.80	Gray	1.71	Gray
CBD3	1.78	Gray	1.90	Gray	3.14	Safe
CBD4	0.85	Risk	1.23	Gray	1.01	Risk
CBD5	0.84	Risk	0.68	Risk	1.88	Gray
CBD6	2.43	Gray	2.50	Gray	2.42	Gray
CBD7	3.30	Safe	4.26	Safe	4.15	Safe
Average	1.84		1.93		2.22	

Table 2 reports the Z' score classification for the medium sized companies over a period frame of two years. Results show that all MMDs are financially healthy (gray or safe areas), with a mean of 3.49. While there is a decrease in the score of three companies MMD1, MMD2, and MMD3 without change in their financial position in year 2, there is an increase in the score of MMD4, which moves from a gray area to a safe area.

Table 2. MMDs Classification as per the Altman Z' model 1983

MMD Altman Z'score	2009	Assigned Area	2010	Assigned Area
MMD1	2.70	Gray	1.28	Gray
MMD2	4.43	Safe	3.61	Safe
MMD3	4.37	Safe	4.15	Safe
MMD4	2.48	Gray	3.37	Safe
Average	3.49		3.10	

4.1.2. Banking Classification

Table 3 displays the rating based on the financial institution classification, where rank 1 represents the best rate and rank 10 represents a company facing major problems. The results show no change in the ranking of MMD companies in the two years. However, the results are different for CBDs. Year 2010 exhibits slight improvement in the scores of 2 companies; CBD4 improved from 5+ to 5 and CBD7 advanced from 4+ to 4 between 2009 and 2010. However, Year 2011 was marked with some major changes, both negative and positive. For instance, CBD1 has lost its 5+ grade and declined to become rated as 7-, and CBD4 declined from 5 to 5+. On the other hand, CBD2 advanced from 6- to 5+ and CBD3 from a 5 to 5-.

Table 3. CBDs and MMDs Classification as per Banking Classification

Altman Z'score	2009	2010	2011
CBD1	5+	5+	7-
CBD2	6-	6-	5+
CBD3	5	5	5-
CBD4	5+	5	5+
CBD5	5+	5+	5+
CBD6	4+	4+	4+
CBD7	4+	4	4
MMD1	5+	5+	N/A
MMD2	5-	5-	N/A
MMD3	5	5	N/A
MMD4	5+	5+	N/A

4.2. Findings

4.2.1. Altman Z' Model vs. Financial Institution for MMDs

Starting with MMDs findings, the Z' score seems to have a close ranking to that of the financial institution. Table 4 shows that these two models provide exact classification in 2009 and a single difference in 2010. More specifically, the Z' score rated MMD3 higher than MMD2, while the bank classification rated MMD2 higher than MMD3. The difference is too small where MMD2 and MMD3 diverted by 1 rank only.

Table 4. MMDs Classification: Altman Z' model vs. Financial Institutions

Models	2009				2010			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Altman Z'	MMD2	MMD3	MMD1	MMD4	MMD3	MMD2	MMD4	MMD1
Financial Institution	MMD2	MMD3	MMD1=MMD4		MMD2	MMD3	MMD4=MMD1	
Difference	Match				Mismatch		Match	

4.2.2. Altman Z' Model vs. Financial Institution for CBD

Moving to the CBD companies, Table 5 shows that Z' score did not show an exact classification for the sample chosen, but it provides an indication that a similar ranking to that of the financial institution can be achieved if the sample of companies is separated into sub-business sectors. CBD7 and CBD6 belong to the food industry, CBD3, CBD4 and CBD5 are wood manufacturers, while CBD2 and CBD1 stand alone.

Table 5. CBDs Classification: Altman Z' model vs. Financial Institutions

Models	1st	2nd	3rd	4th	5th	6th	7th
	Year 2009						
Altman Z'	CBD7	CBD6	CBD2= CBD1		CBD3	CBD4	CBD5
Financial Institution	CBD6= CBD7		CBD3		CBD1= CBD4= CBD5		CBD2

Year 2010							
Altman Z'	CBD7	CBD6	CBD3	CBD2	CBD4	CBD1	CBD5
Financial Institution	CBD7	CBD6	CBD3= CBD4		CBD5= CBD1		CBD2
Year 2011							
Altman Z'	CBD7	CBD3	CBD6	CBD5	CBD2	CBD1	CBD4
Financial Institution	CBD7	CBD6	CBD3		CBD5= CBD2= CBD4		CBD1

For example, in year 2010, the first 3 ranks in the Z' model come in line with the classification of the financial institution (CBD7, CBD6 and CBD3) and there is an exact positioning for CBD1 at the 6th rank. However, while CBD2 is placed in the 4th rank based on Z' Score, it has the last rank based on the financial institution ranking.

As for the third year, CBD7, CBD5 and CBD2 show exact classifications in both models. CBD1 and CBD3 show a one rank difference between the classifications of Altman Z' and the financial institution whereby these two companies have a better rank in the Altman Z' model. Furthermore, when comparing the ranking classification for CBD4 and CBD6, the order between these companies is always maintained, with one rank difference between the 2 models.

4.3. Discussion of the findings

Based on the main results found in the previous section, Altman Z' Score can accurately classify MMD companies similarly to the banking classification, since these two rankings provide similar classification. For a better understanding and analysis of the CBD companies, they are divided into subcategories based on their business activities. For instance CBD1 and CBD2 are two companies performing each a separate business activity, so they are treated separately. On the contrary, CBD6 and CBD7 belong to the food category and CBD3, CBD4 and CBD5 to the wood industry. By dividing the sample of CBD companies into subsamples based on their business activities and grouping them together, better results are obtained.

When comparing the ranking of CBD3, CBD4 & CBD5 based on two models and despite the ranking difference, we can clearly say that the order of ranking is maintained throughout the 3 years period. CBD3 has a higher rating than CBD4, higher than CBD5 in both models in year 2009 and 2010. The difference in ranking between the two models can be attributed to the fact that companies operating in other sectors are included within the sample.

With an overview over CBD6 & CBD7 that belong to the food category, there is a difference in the rank in year 2011 where Z' Score classified CBD6 at the 3rd rank and the financial institution classified it in the second rank. Despite this difference, CBD7 enjoyed higher rating than CBD6 in both models.

In line with the above, Altman Z' score can serve as a barometer for manufacturing companies, but to have a higher level of accuracy, it is recommended to apply it to subsamples where companies are performing the same business activity and sharing similar business conditions.

5. Conclusions

Previous researchers use Z score to predict bankruptcy, but this study will make a step forward to test whether the model can be used as a tool for classifying companies in Lebanon. If there is empirical evidence supporting this hypothesis, then bankruptcy models will have a new important function besides their original function of predicting bankruptcies. The results showed that the Altman Z' Score had a high level of accuracy in classifying companies similar to the classification of financial institutions. More specifically, the classification of Small and Medium companies based on Z' score was almost similar to the classification of financial institutions, while the classification of large companies based on Z' score was matching that of financial institutions when companies were separated within the same subsector. Therefore, there is an evidence that the Altman Z' score can act as a barometer in classifying companies. This finding can be beneficial for many players, from financial to non-financial institution, each according to its needs. First, although it is popular for every financial institution to use its own tailored model of credit rating or the Moody's rating, these models are very expensive. Therefore, Z' score will replace the credit rating model and it will help banks in correctly classifying their client applying for different types of loans and

assigning the proper risk. This is important since financial institutions are heavily investing in risk management especially after the financial crisis. Second, Z' score can serve as a benchmark for companies to compare themselves to various players in the same sub-industry. Therefore, companies can try to improve their classification over their peers by highlighting important factors that are limiting their score growth. Finally, investors that lack deep financial analysis tools can employ the Z' score to provide them additional direction toward investing.

This study suffers from some limitations. First, the Altman model was generated and applied to US companies. These companies differ from the Lebanese companies especially in the adoption of different accounting reporting standards. U.S companies use the Generally Accepted Accounting principles (GAAP) while Lebanese companies, follow European countries and use the International Financial Reporting Standards (IFRS). Second, the sample size was somehow small, and it would have been much better to have a sample size greater than 30 companies to comply with the rules of the normal distribution. Third, data related to MMDs were only limited to a period of two years. Getting data for more than this period would have added more confidence and reliability to the results obtained. Therefore, increasing the sample size and the period covered might provide better insights on the ability of Z' score to act as barometer for classifying companies.

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