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# CONTENTS

Sr. No.	TITLE & NAME OF THE AUTHOR (S)	Page No.
1.	AN ANALYSIS OF THE DETERMINANTS OF MINING INVESTMENT IN ZIMBABWE: BASED ON THE FLEXIBLE ACCELERATOR MODEL LYMAN MLAMBO	1
2.	FINANCIAL PERFORMANCE OF INDIAN GENERAL INSURANCE COMPANIES IN PRE RECESSION PERIOD DR. S.M.TARIQ ZAFAR & RITIKA AGGARWAL	7
3.	POSTAL SAVINGS IN INDIA – A COMPARATIVE ANALYSIS USING REGRESSION AND ARIMA MODELS S.NEHRU & S. RAJARAM	15
4.	FDI IN RETAILING: BOOST EMPLOYMENT OPPORTUNITIES FOR INDIA'S YOUTH DR. V.SELVAM	21
5.	KERALA BUILDING AND OTHER CONSTRUCTION WORKERS WELFARE FUND BOARD - A MACRO PICTURE DR. ABDUL NASAR VP, DR. ABOOBACKER SIDHEEQUE KT & DR. MUHAMMED BASHEER UMMATHUR	25
6.	GROWTH AND PERFORMANCE OF MICRO, SMALL AND MEDIUM ENTERPRISES IN INDIA IN POST GLOBALIZATION PERIOD R. PONMANI & DR. R. ANNAPOORANI	39
7.	MICRO-FINANCE: A CHANGING PARADIGM IN THE NEW ECONOMIC SCENARIO IN THE CONTEXT OF WOMEN EMPOWERMENT DR. V.V. SUBBA RAO & T. MADHUSUDHAN RAO	42
8.	BAMBOO CULTIVATION IN DIMAPUR, NAGALAND – GROWERS PERCEPTION DR. P. NATARAJAN & IMTINUNGSANGJAMIR	47
9.	USE OF Z-SCORE ANALYSIS FOR EVALUATION OF FINANCIAL HEALTH OF INDIAN OIL REFINERIES DR. A. VIJAYAKUMAR & P.GOMATHI	53
10.	IMPACT OF PSYCHOLOGICAL FACTORS ON EMPLOYEE TURNOVER INTENTION MUHAMMAD RIZWAN, MARIA SHAHID, HAMNA SHAFIQ, SUMAIRA TABASSUM, RAFIA BARI & JAVERIA UMAR	63
11.	WOMEN ENTREPRENEURSHIP IN INDIA JYOTI KANDPAL BHATT, NEERAJ SHARMA & DEEPIKA GOEL	70
12.	THE ROLE OF LOCAL INSTITUTIONS FOR SUSTAINABLE LIVELIHOODS: THE CASE OF HAOR FISHERMEN IN BANGLADESH ROMAZA KHANUM	75
13.	STRUCTURAL CHANGE IN NORTHERN STATES OF INDIA TINA SINGH	80
14.	INDIAN IPO MARKET - QUO VADIS RASHI M. GOPLANI	84
15.	FINANCIAL PERFORMANCE EVALUATION OF PRIVATE SECTOR BANKS IN INDIA: A COMPARATIVE STUDY DR. KUSHALAPPA. S & PRADEEP R BHANDARY	91
16.	EMOTIONAL INTELLIGENCE OF FEMALE FACULTY IN COLLEGES P.YASODHA	95
17.	EFFECTIVE EDUCATION FOR DIFFERENTLY ABLED CHILDREN IN REGULAR STREAM: PERCEPTIONS OF TEACHERS DR. K. PARTHASARATHY	99
18.	WOMEN EMPOWERMENT THROUGH SELF- HELP GROUPS IN PUDUCHERRY: A CASE STUDY OF YANAM DR. R.UMA DEVI	104
19.	HINDRANCES TO MICROFINANCE SUSTAINABILITY IN RAJOURI DISTRICT OF JAMMU AND KASHMIR AASIM MIR	112
20.	A STUDY ON FACULTY STRESS IN SELECT COLLEGES IN KANCHIPURAM DISTRICT B.SATHYA & DR. M.MURUGAN	115
21.	GROWTH, PERFORMANCE AND DETERMINANTS OF AGRICULTURAL VARIATION IN PUNJAB: AN INTER DISTRICTS STUDY JASPAL SINGH, NIRMAL SINGH & KULVINDER SINGH	119
22.	PROMOTING ORGANIC FARMING: AN ANALYSIS OF STATUS AND ISSUES OF UTTARAKHAND ORGANIC COMMODITY BOARD SHALINI SINGH & VISHNU SHANKER MEENA	127
23.	RESEARCH ON THE VARIABLES THAT HAVE AN IMPACT ON EMPLOYEE SATISFACTION AND TURNOVER INTENTION MUHAMMAD RIZWAN, NIMRA SHAHZAD, QANDEEL SHEIKH, SANIA BATOOL, MARYAM RIAZ & SAMINA SIDDIQUE	131
24.	THE DETERMINANTS OF LEVERAGE OF THE LISTED COMPANIES IN SRI LANKA: AN EMPIRICAL STUDY S.ANANDASAYANAN, V.A.SUBRAMANIAM, A.SIREERANHAN & M.RAVEESWARAN	139
25.	THE IMPACT OF COMMERCIAL BANKS' ACTIVITIES ON RURAL ECONOMIC DEVELOPMENT IN NIGERIA OKE, MARGARET ADEBIPE & SAMUEL, IYIOLA KEHINDE OLUWATOYIN	144
26.	THE PERFORMANCE OF SMALL MEDIUM ENTERPRISES (SME's) OPERATED BY WOMEN AND MEN IN THE NON AGRICULTURE ROLE ENTERPRISE IN NANDI COUNTY, KENYA STEPHEN K. CHELOGOI & EVERLINE C.TUM	150
27.	ACCESS TO AND IMPACT OF CREDIT ON HOUSEHOLDS WELFARE IN NIGERIA UGWUANYI, HILLARY CHIGOZIE & OMEJE, AMBROSE NNAEMEKA	154
28.	BOARD GENDER DIVERSITY AND PERFORMANCE OF LISTED COMMERCIAL BANKS IN KENYA UMULKHER ALI ABDILLAH & MUGANDA MUNIR MANINI	159
29.	INDIAN TEA PRODUCTION: AN ANALYSIS P.V.ANIL	166
30.	THE IMPACT OF THE BRAND TRUST, BRAND ATTACHMENT, BRAND COMMITMENT ON BRAND LOYALTY MUHAMMAD RIZWAN, WAQAR AHMAD BHATTI, SAMRAIZ TAHIR, CH. SAJID ALI, FARAZEEN HASEEB PEERZADA, AFFIFA NAZ & QURAT-UL-AIN ZAHRA	169
	REQUEST FOR FEEDBACK	175

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## USE OF Z-SCORE ANALYSIS FOR EVALUATION OF FINANCIAL HEALTH OF INDIAN OIL REFINERIES

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**ABSTRACT**

Altman's 'Z' score analysis has been applied by financial analysts to evaluate the general trend in the financial health of an enterprise over a period. Some of the individual accounting ratios used frequently to predict the financial performance of an enterprise may only provide warnings when it is too late to take a corrective action. Further single ratio does not convey much of the sense. There is no internationally accepted standard for financial ratio against which the results can be compared. Therefore, **Edwin I Altman** combined a number of accounting ratios (liquidity, leverage, activity and profitability) to form an index of the profitability, which are effective indicators of corporate performance predicting bankruptcy well over a year or two in advance. The analysis shows that the financial health of oil refineries in India during the study period was lying in too healthy zone. It may be attributed to the positive changes in the net operating profit from the increased sales volume and market capitalization of the equity, maintaining sufficient working capital and effective utilization of capacity.

**KEYWORDS**

Assessment of Financial Health, Altman-Z-Score, Profitability, Solvency and Indian Oil refinery.

**INTRODUCTION**

In this study, an attempt has been made to have an insight into the financial stability and operational health of the selected oil refineries during the post liberalization period. Altman's 'Z' score analysis has been applied by financial analysts to evaluate the general trend in the financial health of an enterprise over a period. Some of the individual accounting ratios used frequently to predict the financial performance of an enterprise may only provide warnings when it is too late to take a corrective action. Further single ratio does not convey much of the sense. There is no internationally accepted standard for financial ratio against which the results can be compared. Therefore, **Edwin I Altman** combined a number of accounting ratios (liquidity, leverage, activity and profitability) to form an index of the profitability, which are effective indicators of corporate performance predicting bankruptcy well over a year or two in advance. In this direction a variety of studies have been conducted, over the period, by applying Multiple Discriminate Analysis (MDA) to predict the corporate failure, as for instance by, **Mansur A. Mulla (2002)**, **Selvam et.al (2004)**, **Vijayakumar(2007)**, **Dheenadhyalan (2008)**, **Srinivasan and Tiripura sundari (2011)** and **Maheswara Reddy and Reddy(2011)**.

**REVIEW OF LITERATURE**

**Mansur A. Mulla (2002)** made a study of the financial health of Shri Venkatesh Co-operative Textile Mills Ltd., Arunageri of Dharwad District. The 'Z' score analysis was applied to evaluate the general trend in financial health of a firm over a period by using many of the accounting ratios. From the study it was concluded that the textiles mill under study was just on the verge of financial collapse. On the one hand, current assets declined because of the negative profitability performance, on the other hand, the current liabilities were on the increase because of poor liquidity performance of the mill. **Selvam et al. (2004)** analyzed the financial health of India Cements Ltd. This study was mainly based on secondary data. The required accounting information about India Cements Ltd for the Z- score analysis was obtained from the Prowess Corporate Data Base of CMIE, Chennai for a period of 5 years (1998-2002). "Z" score analysis was applied to evaluate the general trend in the financial health of India Cements Ltd by using ratio analysis. The analysis showed that the cement company under the study was just on the verge of financial collapse. The financial health of the company was never in the too healthy zone during the study period. They suggested India Cements Ltd to take steps to improve the financial health of the company. **Dheenadhyalan (2008)** adopted Z score to predict the corporate failure of Steel Authority of India Ltd. The Z score of SAIL showed a rising trend throughout the study period and it was concluded that the financial health of SAIL was good.

**Srinivasan and Tiripurasundari (2011)** used Z-score to measure the financial health of fourteen south Indian Cement industries. Three modes (Altman, Springate and Fulmer Model) of z-score were used in the study in order to measure the 'fiscal fitness' of the companies. According to all the three methods, Rain Commodities Ltd and Zuari Cement Ltd were rated as failure from the sample of fourteen South Indian cement companies. The possible reasons for a company to be rated as failure may be excess debt and excess working capital, that may weaken the financial health of that particular company. **Maheswara Reddy and Reddy (2011)** considered five ratios and assigned a weight for each ratio and produced a single number which indicates the financial health of the business concerns. He made an attempt to predict the financial health of two selected sample pharmacy companies (Aurobindo Datong Bio-Pharmacy Ltd and Ranbaxy Laboratories Ltd) for five years from 2005 to 06 to 2009-10 using modified Altman's model. The finding of the study was that the overall financial health of both companies was good. **Vijayakumar(2012)** in his study made an attempt to assessing the financial health of Indian Automobile companies using Altman Bankruptcy Model. The analyses of operational efficiency using the model revealed that except few companies, the financial health of Indian automobile companies were good during the study period.

**ALTMAN Z SCORE MODEL**

One of the objectives of the study is to predict the financial health and viability of the selected oil refineries during the post liberalization period to improve its operational efficiency and effectiveness, productivity and profitability. The data collected are first analyzed with the help of five accounting ratios. These different ratios are combined into a single measure 'Z' score analysis with the help of Multiple Discriminate Analysis (MDA). The formula used to evaluate the 'Z' score analysis as established by Altman is:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5$$

Where 'Z' is the overall index

$X_1$  - ratio of working capital to total assets (WC/TA)

$X_2$  - ratio of net operating profit to net sales (NOP/S)

$X_3$  - ratio of earnings before interest and tax total assets (EBIT/TA)

$X_4$  - ratio of market value of equity to book value of debt

$X_5$  - ratio of sales to total assets (S/TA)

The following accounting ratios are used as variables to combine them into a single measure (Index), which is efficient in predicting bankruptcy.

$X_1$ : The ratio of working to total assets. It is the measure of the net liquid assets of a concern to the total capitalization.

$X_2$ : The ratio of net operating profit to net sales (NOP/S). It indicates the efficiency of the management in manufacturing, sales, administration and other activities.

$X_3$ : The ratio of earnings before interest and tax to total assets. It is a measure of productivity of assets employed in an enterprise. The ultimate existence of an enterprise is based on the earning power.

$X_4$ : The ratio of market value of equity to book value of debt. It is reciprocal of the familiar debt-equity ratio. This measure shows how much assets of an enterprise can decline in value before the liabilities exceed the assets and the concern becomes insolvent.

$X_5$ : The ratio of sales to total assets. The capital turnover ratio is standard financial measure for illustrating the sales generating capacity of the assets.

According to **Altman (1968)**, the following three situations are considered for studying the financial health of selected oil refineries in India.

i) The "Z" score below 1.8 units is considered to be bankruptcy zone. Failure is certain and extremely likely and would occur probably in two years.

ii) If a unit's 'Z' score is 1.8 or above but less than 3.0, its financial viability is considered to be healthy. The failure in this situation is uncertain to predict.

iii) The 'Z' scores 3.0 and above indicates too healthy zone. Its financial health is very viable and would not fall.

TABLE 1: ALTMAN'S Z-SCORE

Category	Z- score	Zone	Situation
I	Below 1.8	Bankruptcy zone	Certain to fall
II	1.8 to 2.99	Healthy zone	Uncertain to predict
II	3.0 and above	Too healthy zone	Not to fall

Source: Journal of Finance

## STATEMENT OF THE PROBLEM

A common statistical way of standardizing data on one scale so that a comparison can take place is using a Z score. The Z score is like a common yard stick for all types of data. Each Z score corresponds to a point in a normal distribution and as such is sometimes called a normal deviate since a Z score will describe how much a point deviates from a mean or specification point. Z score means statistical measure that quantifies the distance a data point is from the mean of a data set. In a more financial sense, Z score is the output from a credit-strength test that gauges the likelihood of bankruptcy. The formula may be used to predict the probability that a firm will go into bankruptcy within two years. Z scores are used to predict corporate defaults and an easy-to-calculate control measure for the financial distress status of companies in academic studies. The Z score uses multiple corporate income and balance sheet values to measure the financial health of a company. The Z score has been proved successful in the real world. It correctly predicted 72 per cent of bankruptcies two years prior to the event. So, Altman Z score model has been applied to predict the financial soundness of the selected oil refineries during the post liberalization period to improve its operational efficiency and effectiveness, productivity and profitability.

## SELECTION OF OIL REFINERY INDUSTRY

The Indian oil and gas sector is one of the six core industries in India and has very significant forward linkages with the entire economy. Petroleum Refining Industry is a generator of fuel required for energy purposes in all sorts of industry. Hence, this industry can be regarded as the heart of economy. It is a source of energy for domestic, industrial, agricultural and transport services and as feed stock for fertilizer, chemical and other industries. It has also created an impetus for allied sectors such as engineering, procurement, construction firms, project management consultancy firms and other such service providers. The rapidly growing number of petroleum and petrochemicals industries in the country during the last three decades have generated considerable employment at all levels. The petroleum sector in India is particularly favorable to foreign investment because the industry is one of the fastest growing segments, and it has shown a staggering growth rate of around 13 per cent in the recent past. Apart from the tremendous growth rate in the Indian petroleum industry today, it also boasts of technology of international standards, easy availability of infrastructure at very cheap rates, high demand for petroleum products, and increased spending habits of the middle-class people. All these factors make investments in the Indian petroleum sector an attractive proposition for foreign investors. India is the 22<sup>nd</sup> largest producer in the world and fifth largest petroleum refining country with a share of 3 per cent of global capacity. The expansion of Indian petroleum retail market is triggered by the growth in automobile sales that has resulted in major foreign investments. The growth is estimated to sustain and the market is likely to expand further by 20 million every year till 2030, placing India at the world map in terms of being the biggest automobile market. This has encouraged the researcher to analyze the financial health of Oil Refinery Industry in India.

## SAMPLING DESIGN

Keeping in view of the scope of the study, the oil refineries operating in India were considered for the study. It was decided to include all the companies working in India under private sector as well as public sector from the year 1994-95. However, owing to several constraints such as non-availability of financial statements or non-working of the company in a particular year etc., it was decided to restrict the number of sample companies to seven. The Capitaline and CMIE database publish key financial data of Indian corporate sector systematically. Hence Capitaline and CMIE databases proved to be complimentary to finalize the sample for the study. The exhaustive list of oil refineries in India from Capitaline was cross checked with CMIE database to sort out companies to fit in as the sample for the study. The comprehensive list of companies prepared from the database was modified by sorting out the firms using the following criteria: which were not in operation for a year during the period of study; which were in operation but non-availability of data for the whole study period; which were merged with another company during the period of study and which were not listed in Bombay Stock Exchange. There are 20 refineries operating in India. Of these, 17 refineries are in the public sector and 3 are in private sector. Out of the oil refineries operating in India, only 15 companies' data are available in the databases. Among the 15 companies, 9 companies are listed in a stock exchange, and 2 of them are merged companies, and so the remaining seven companies have been taken for the present study. The selected companies includes in the present study are: Indian Oil Corporation Ltd (IOCL), Bharat Petroleum Corporation Ltd (BPCL), Hindustan Petroleum Corporation Ltd (HPCL), Mangalore Refinery and Petrochemicals Ltd (MRPL), Essar Oil Ltd (EOL), Chennai Petroleum Corporation Ltd (CPCL) and Reliance Industries Ltd (RIL). The period from 1996-97 to 2010-11 is selected for the study of selected Indian oil refineries. This 15-year period is chosen in order to have a fairly long, cyclically well balanced period, for which reasonably homogeneous, reliable and up-to-date data would be available.

## SOURCE OF DATA

The study is mainly based on secondary data. The data analyzed and interpreted in this study related to all companies selected are collected from "Capitaline" and "PROWESS" databases, which are the most reliable on the empowered corporate database of Bombay Stock Exchange and Centre for Monitoring Indian Economy (CMIE) respectively. Besides Capitaline and proweS databases, relevant secondary data have also been collected from BSE Stock Exchange Official Directory, CMIE Publications, Annual Survey of Industry, Business Newspapers, Reports on Currency and Finance, Libraries of various research institutions and the Internet. As the study required a variety of data, various websites have been comprehensively searched.



**DISCUSSION****ASSESSMENT OF FINANCIAL HEALTH - WHOLE INDUSTRY**

The 'Z' scores with respect to the selected oil refineries have been computed and presented in Table 2. Further, the scores obtained over the period have been presented graphically in Figure 1. It is imperative from the analysis that the 'Z' scores for the oil refineries in India are more than 3.00 during the entire study period. It implies that the selected oil refineries were in too healthy zone during the post liberalization period. The highest score was 6.35 in 2007-08 and the lowest score was 3.41 in 1998-99. It is evident from the table that the 'Z' scores of the selected oil refineries witnessed very good financial health during the study period as the scores are between 3.00 and 6.00. It may be attributed to the positive changes in the net operating profit from the increased sales volume and market capitalization of the equity, maintaining sufficient working capital and effective utilization of capacity.

**INDIAN OIL CORPORATION LTD**

In order to ascertain the financial health of Indian Oil Corporation Ltd, 'Z' score has been computed and presented in Table 3. The scores obtained over the period have also been presented graphically in Figure 2. During the entire period of post liberalization, the 'Z' scores of Indian Oil Corporation Ltd are greater than 3.0. The 'Z' scores of Indian Oil Corporation Ltd ranged from 3.96 in 1997-98 to 7.53 in 2003-04. It may be inferred from the table that a sharp decline was faced by the company at the end of the study period due to excess debt, poor turnover and excess working capital.

**HINDUSTAN PETROLEUM CORPORATION LTD**

Table 4 depicts 'Z' scores of Hindustan Petroleum Corporation Ltd for the period from 1994-95 to 2008-09. The general trend in the financial health of the company has been depicted graphically in Figure 3. The 'Z' scores of Hindustan Petroleum Corporation Ltd are more than 3.0 during the entire period of post liberalization and it was in too healthy zone throughout the study period. The 'Z' score ranged from 4.62 in 2008-09 to 13.45 in 1995-96. It may be inferred from the table that the company after enjoying sound financial health at the initial phase and during mid way, a sharp decline was faced at the end of the study period. It is evident from the table that the 'Z' scores of Hindustan Petroleum Corporation Ltd witnessed the very good financial health during the study period as the scores lie between 4.00 and 13.00. It may be attributed to the positive changes in the net operating profit from the increased sales volume, market capitalization of the equity, maintaining sufficient working capital and effective utilization of capacity.

**BHARAT PETROLEUM CORPORATION LTD**

Table 5 depicts the 'Z' scores of Bharat Petroleum Corporation Ltd for the period from 1994-95 to 2008-09. Further, using the data points, the scores obtained over the period has been plotted on a graph in Figure 4. From Table 5 it is clear that the Z score of Bharat Petroleum Corporation Ltd witnessed very good financial health as the scores obtained are more than 5.0 during the entire period of study. The 'Z' score of Bharat Petroleum Corporation Ltd ranged from 11.56 in 1994-95 to 5.08 in 2008-09. Maximum utilization of the available capacity and avoidance of excess working capital helps to improve the operating profit and the sales have been achieved according to the target and all these helped to keep the company financially fit.

**MANGALORE REFINERY AND PETROCHEMICALS LTD**

Table 6 reveals the financial health of Mangalore Refinery and Petrochemicals Ltd for the period from 1994-95 to 2008-09. Further, the scores obtained over the period have been presented graphically in Figure 5. It is evident from the table that the 'Z' scores of Mangalore Refinery and Petrochemicals Ltd witnessed poor financial health during the first phase of the study as the scores obtained are below the 1.8. The company remained in the bankruptcy zone from 1994-95 to 2002-03, except in 1996-97 as it had below 1.8 score. It was also found the worst financial health was in 2000-01. This may be due to under trading, excess working capital, negative operating profit and poor ratio of turnover. It is noticed from the table that there was a sudden improvement in the financial health of the company in 2003-04 because of which it entered too healthy zone. The company remained in too healthy zone during the period from 2003-04 to 2008-09. The highest score obtained was 11.42 in 2007-08 and the lowest score was 0.60 in 2000-01. It has shown very good improvement in the financial soundness at the tail end of the study period. This improvement may be attributed to the positive changes in the net operating profit from the increased sales volume and market capitalization of the equity and maximum utilization of the available capacity.

**CHENNAI PETROLEUM CORPORATION LTD**

The 'Z' scores of Chennai Petroleum Corporation Ltd for the period from 1994-95 to 2008-09 was computed and presented in Table 7. The general trend in the financial health of the company has been depicted graphically in Figure 6. It is clear from the analysis that the 'Z' scores of Chennai Petroleum Corporation Ltd is more than 3.0 during the entire period of study except in the years 1995-96, 1996-97 and 1997-98. In the year 1998-99, the financial health slightly improved and entered the too healthy zone. The highest 'Z' score was obtained in the year 2008-09 and the lowest score was 2.70 in 1996-97. It is noticed from the table that the 'Z' scores of Chennai Petroleum Corporation Ltd has shown improvements at the end of the study. It may be attributed to the positive changes in the net operating profit from the increased sales volume, effective utilization of capital and market capitalization of the equity, maximum utilization of the available capacity and avoidance of excess working capital.

**ESSAR OIL LTD**

The 'Z' scores with respect to Essar Oil Ltd for the period from 1994-95 to 2008-09 was computed and presented in Table 8. Further, using the data points, the scores obtained over the period has been plotted in a graph in Figure 7. It is clear from the analysis that the 'Z' scores for Essar Oil Ltd is less than 1.8 during the entire study period except in the year 1994-95 and 2008-09. It is understood that the financial health of the Essar Oil Ltd was never in too healthy zone during the post liberalization period except in the year 2008-09. The company remained in the bankruptcy zone from 1995-96 to 2007-08 as it had below 1.8 scores. It is also found that this is attributable to poor turnover, excess working capital, underutilization of the capital, poor market capitalization and over non-operating expenses. It is also found that the worst financial health was in 2002-2003 and 2003-04. The possible reasons for its poor financial health are excess debt and excess working capital that may weaken the financial health of the company. It is also witnessed from the table that the "Z" Score of Essar Oil Ltd is more than 1.8 in 1994-95 and 2008-09. It may be inferred from the figure that a sharp decline was faced during the midway and started picking up at the end of the study period. The company has got enough scope to improve its financial health further more in the years to come as it has seen improvements at the tail end of the study period. In the year 2008-09 the company has moved from bankruptcy zone to too healthy zone.

**RELiance INDUSTRIES LTD**

The financial health of Reliance Industries Ltd using 'Z' score has been disclosed in Table 9. Further, the scores obtained over the period have been presented graphically in Figure 8. It is evident from the table that the "Z" scores of Reliance Industries Ltd are in healthy zone during the initial period of the study as the 'Z' scores lie between 1.8 and 3.00. The 'Z' scores of Reliance Industries Ltd for the study period ranged from 2.07 in 1998-99 to 7.66 in 2007-08. It is noticed from the table that there was a sudden improvement in the financial soundness of the company and it entered the too healthy zone in 1999-2000. The company remained in too healthy zone till the end of the study period but there was a sudden fall in the Z score of the company in the year 2008-09 due to excessive use of working capital, failure to achieve adequate sales and poor turnover of the company.

**CONCLUSION**

The assessment of financial health of Indian oil refineries has been made by using Altman's Z score. The analysis shows that the financial health of oil refineries in India during the study period was lying in too healthy zone. It may be attributed to the positive changes in the net operating profit from the increased sales volume and market capitalization of the equity, maintaining sufficient working capital and effective utilization of capacity.

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TABLE 2: 'Z' SCORE OF SELECTED OIL REFINERIES IN INDIA [WHOLE INDUSTRY]

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.20	0.25	0.34	2.55	2.28	5.62
1995-96	0.18	0.27	0.33	2.61	1.86	5.26
1996-97	0.33	0.22	0.34	1.22	1.59	3.71
1997-98	0.17	0.28	0.29	1.44	1.48	3.65
1998-99	0.19	0.22	0.32	0.69	2.00	3.41
1999-00	0.24	0.17	0.26	0.66	2.34	3.67
2000-01	0.24	0.15	0.27	0.69	2.60	3.94
2001-02	0.16	0.14	0.27	0.75	2.56	3.89
2002-03	0.14	0.11	0.33	1.11	3.07	4.77
2003-04	0.14	0.10	0.39	2.31	3.10	6.04
2004-05	0.22	0.07	0.36	1.63	3.51	5.80
2005-06	0.24	0.05	0.22	1.28	3.52	5.32
2006-07	0.20	0.07	0.35	1.30	3.99	5.91
2007-08	0.28	0.10	0.38	1.97	3.63	6.35
2008-09	0.17	0.07	0.20	0.92	4.30	5.66

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net sales

X<sub>3</sub>: Earnings before interest and taxes to total assets

X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 1: 'Z' SCORE OF SELECTED OIL REFINERIES IN INDIA (WHOLE INDUSTRY)

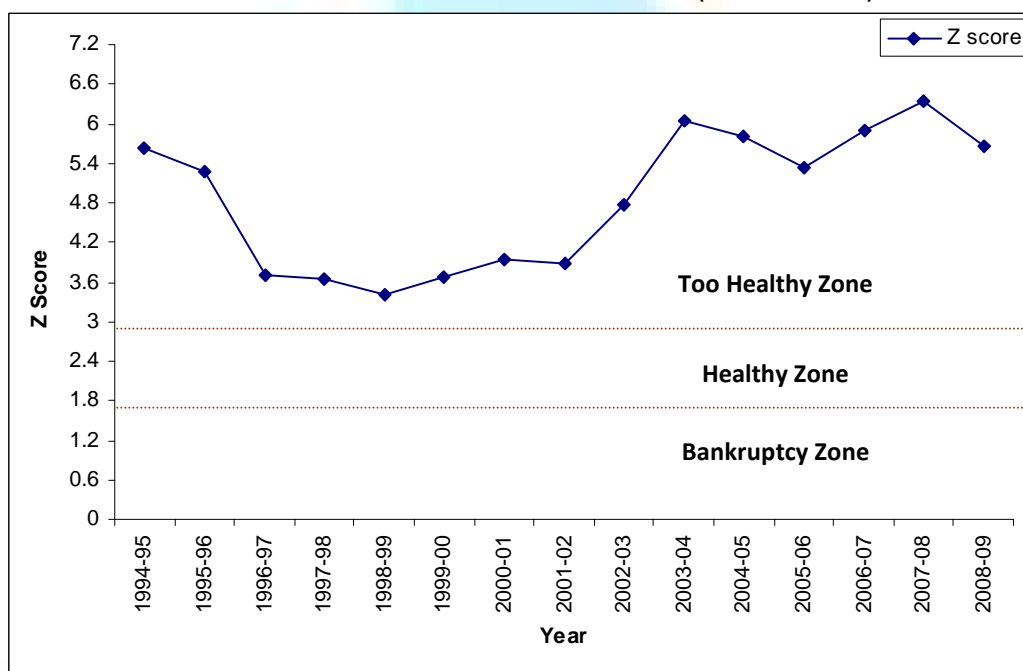


TABLE 3: 'Z' SCORE OF INDIAN OIL CORPORATION LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.26	0.06	0.36	1.35	3.20	5.24
1995-96	0.34	0.07	0.37	2.13	2.88	5.79
1996-97	0.49	0.07	0.33	1.10	2.79	4.78
1997-98	0.18	0.09	0.30	0.99	2.41	3.96
1998-99	0.21	0.10	0.38	0.68	2.85	4.23
1999-00	0.31	0.09	0.34	0.59	3.33	4.65
2000-01	0.36	0.06	0.31	0.36	3.35	4.44
2001-02	0.14	0.09	0.37	0.51	3.35	4.46
2002-03	0.24	0.12	0.52	0.77	3.71	5.36
2003-04	0.22	0.12	0.54	2.84	3.80	7.53
2004-05	0.27	0.08	0.31	1.76	3.54	5.95
2005-06	0.23	0.07	0.30	1.53	3.46	5.59
2006-07	0.18	0.09	0.40	1.06	3.84	5.57
2007-08	0.29	0.07	0.34	0.91	3.53	5.14
2008-09	0.12	0.05	0.20	0.62	3.70	4.69

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net sales

X<sub>3</sub>: Earnings before interest and taxes to total assets

X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 2: 'Z' SCORE OF INDIAN OIL CORPORATION LTD

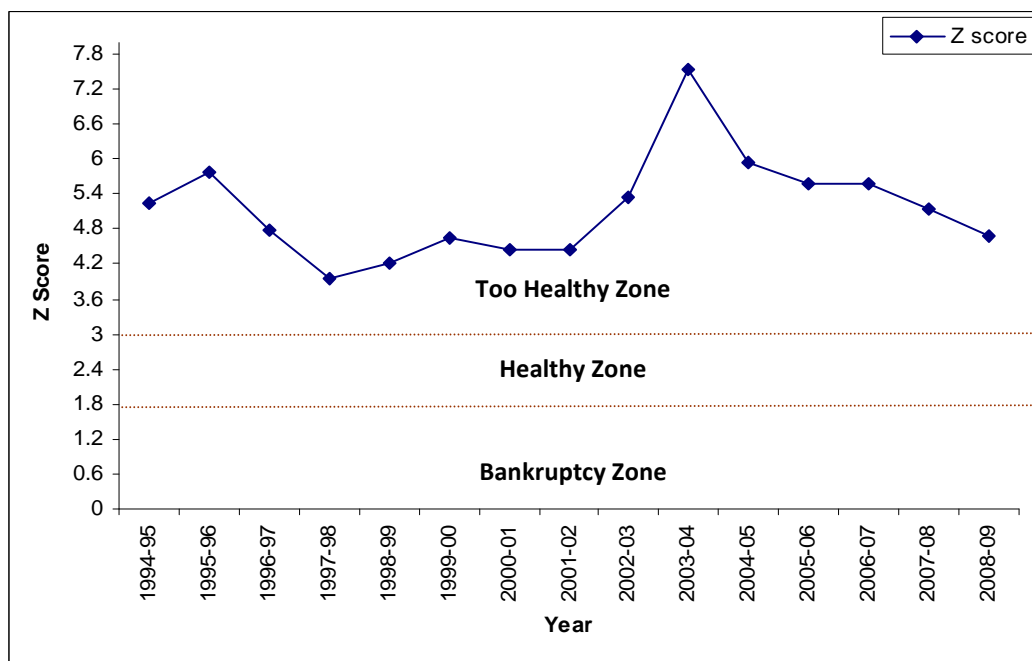


TABLE 4: 'Z' SCORE OF HINDUSTAN PETROLEUM CORPORATION LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.15	0.09	0.60	6.23	4.46	11.53
1995-96	0.31	0.10	0.68	8.62	3.75	13.45
1996-97	0.46	0.10	0.57	3.19	2.96	7.28
1997-98	0.05	0.09	0.44	4.67	2.59	7.85
1998-99	0.10	0.09	0.53	1.85	3.72	6.30
1999-00	0.28	0.07	0.43	0.91	3.90	5.58
2000-01	0.36	0.06	0.40	0.90	4.83	6.56
2001-02	0.17	0.06	0.34	1.86	4.91	7.34
2002-03	0.10	0.08	0.52	4.31	6.76	11.77
2003-04	0.23	0.09	0.56	6.12	6.12	13.11
2004-05	0.28	0.05	0.33	2.89	6.17	9.72
2005-06	0.24	0.02	0.11	0.98	5.03	6.37
2006-07	0.08	0.05	0.33	0.50	4.85	5.81
2007-08	0.30	0.04	0.22	0.32	4.13	5.01
2008-09	0.15	0.04	0.23	0.24	3.95	4.62

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net sales

X<sub>3</sub>: Earnings before interest and taxes to total assets;

X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 3: 'Z' SCORE OF HINDUSTAN PETROLEUM CORPORATION LTD

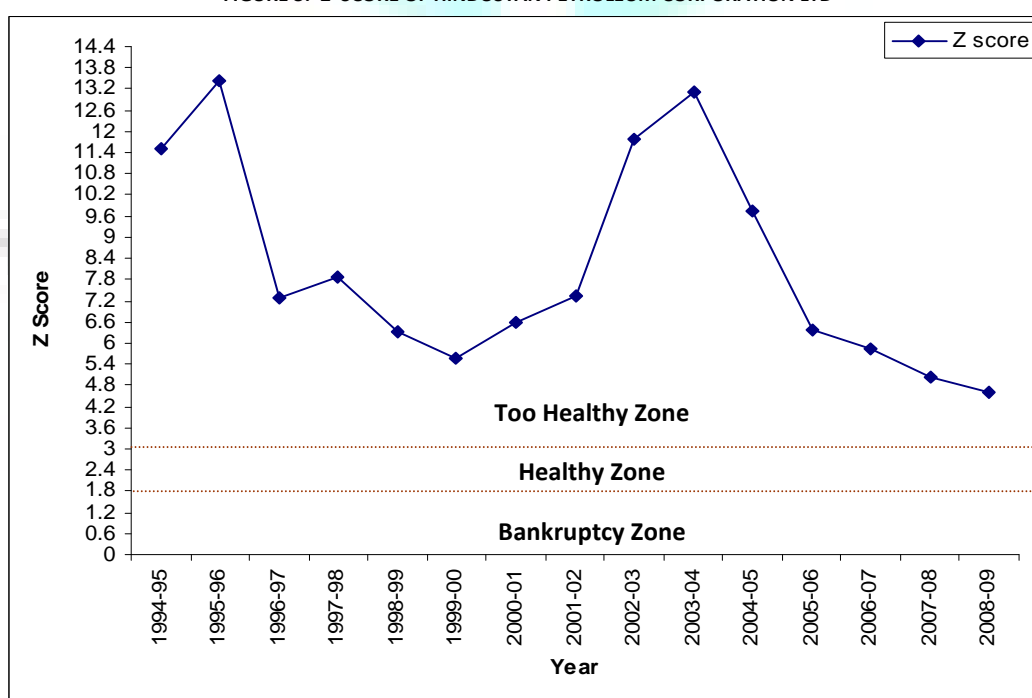


TABLE 5: 'Z' SCORE OF BHARAT PETROLEUM CORPORATION LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.01	0.08	0.54	6.44	4.49	11.56
1995-96	0.16	0.09	0.65	4.98	4.10	9.97
1996-97	0.32	0.08	0.52	2.42	3.06	6.40
1997-98	-0.03	0.08	0.47	2.33	2.96	5.81
1998-99	0.09	0.08	0.55	1.09	4.60	6.41
1999-00	0.19	0.07	0.41	0.93	5.48	7.07
2000-01	0.24	0.06	0.39	0.80	5.57	7.06
2001-02	0.09	0.07	0.41	1.55	5.07	7.19
2002-03	0.05	0.08	0.48	1.24	6.03	7.88
2003-04	-0.01	0.09	0.52	3.22	6.25	10.06
2004-05	0.14	0.04	0.26	1.68	6.21	8.34
2005-06	0.27	0.02	0.09	0.92	4.86	6.15
2006-07	0.13	0.06	0.35	0.60	5.09	6.22
2007-08	0.23	0.05	0.27	0.58	4.55	5.69
2008-09	0.09	0.04	0.22	0.37	4.36	5.08

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net salesX<sub>3</sub>: Earnings before interest and taxes to total assets;X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 4: 'Z' SCORE OF BHARAT PETROLEUM CORPORATION LTD

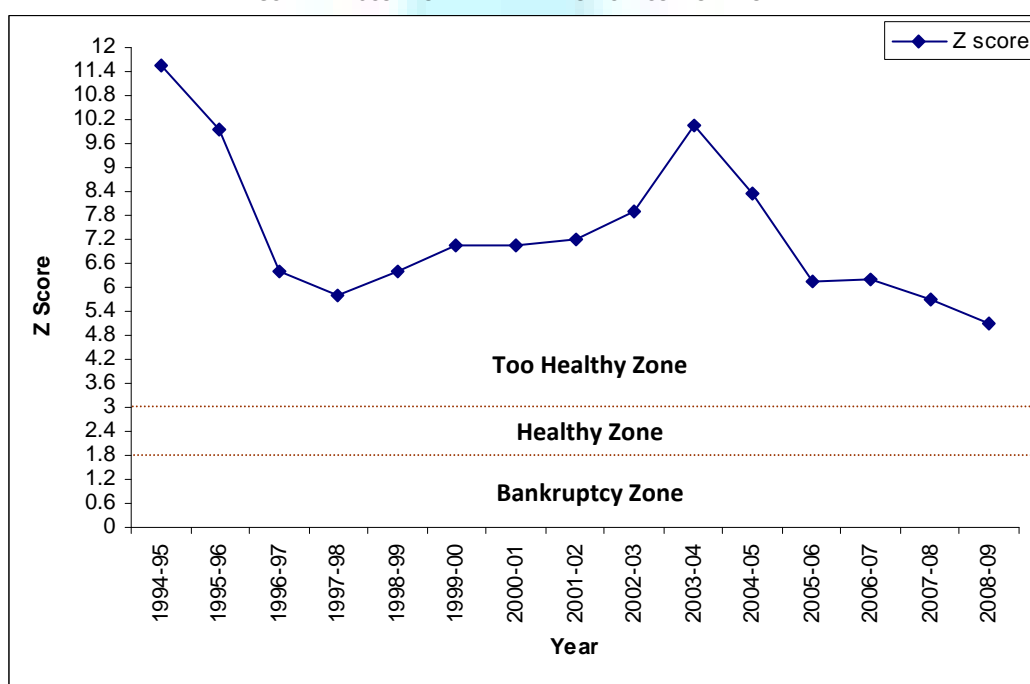


TABLE 6: 'Z' SCORE OF MANGALORE REFINERY AND PETROCHEMICALS LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.13	0.65	-0.01	0.27	0.13	1.18
1995-96	-0.03	0.67	-0.01	0.37	0.25	1.25
1996-97	0.33	0.64	0.34	0.16	0.36	1.84
1997-98	0.43	0.57	0.23	0.13	0.32	1.68
1998-99	0.33	0.27	0.18	0.10	0.40	1.29
1999-00	0.20	0.07	0.01	0.11	0.47	0.86
2000-01	-0.03	0.05	0.01	0.07	0.49	0.60
2001-02	0.00	0.06	0.07	0.06	0.89	1.08
2002-03	0.08	0.06	-0.04	0.16	1.34	1.61
2003-04	0.17	0.12	0.35	1.19	1.99	3.82
2004-05	0.22	0.14	0.62	1.43	3.67	6.08
2005-06	0.28	0.06	0.29	1.33	4.95	6.90
2006-07	0.31	0.07	0.46	1.47	6.28	8.59
2007-08	0.33	0.08	0.59	4.03	6.39	11.42
2008-09	0.46	0.08	0.51	2.19	6.35	9.59

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net salesX<sub>3</sub>: Earnings before interest and taxes to total assets;X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 5: 'Z' SCORE OF MANGALORE REFINERY AND PETROCHEMICALS LTD

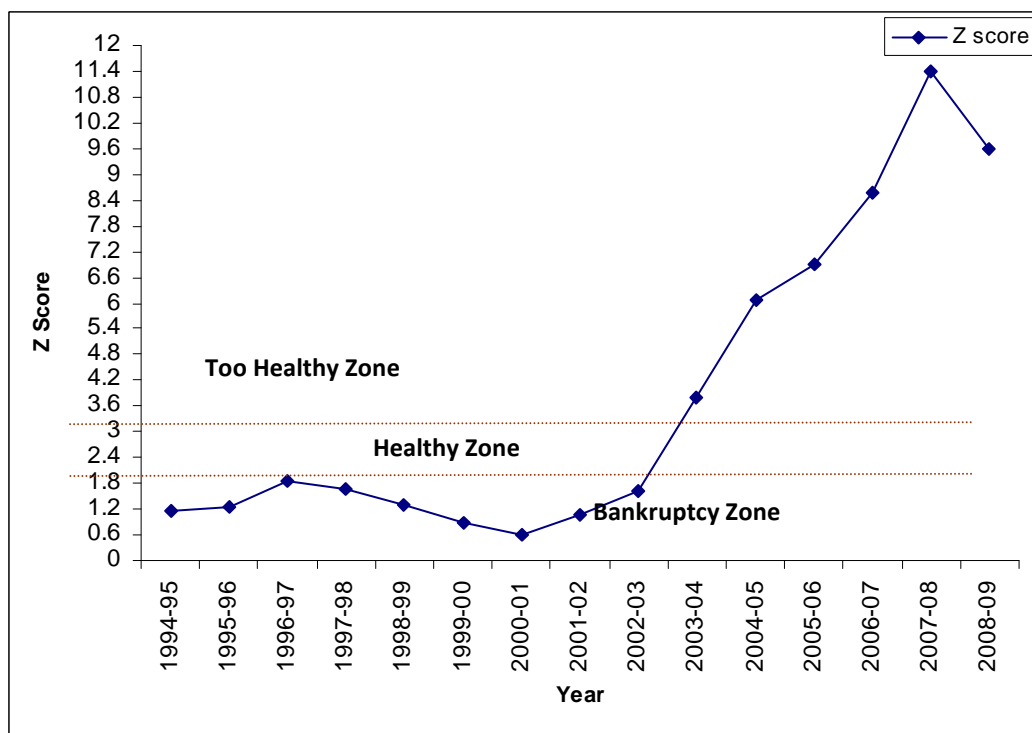


TABLE 7: 'Z' SCORE OF CHENNAI PETROLEUM CORPORATION LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.39	0.14	0.24	0.90	1.62	3.29
1995-96	0.39	0.17	0.22	0.68	1.48	2.94
1996-97	0.53	0.19	0.22	0.34	1.43	2.70
1997-98	0.45	0.20	0.21	0.55	1.49	2.90
1998-99	0.45	0.18	0.24	0.29	1.88	3.05
1999-00	0.49	0.09	0.22	0.30	2.56	3.65
2000-01	0.54	0.08	0.31	0.22	2.97	4.13
2001-02	0.45	0.07	0.22	0.24	2.72	3.70
2002-03	0.34	0.12	0.48	0.13	2.64	3.71
2003-04	0.26	0.12	0.38	0.55	2.38	3.70
2004-05	0.41	0.13	0.56	0.86	3.70	5.65
2005-06	0.53	0.08	0.37	0.72	5.06	6.75
2006-07	0.45	0.07	0.41	0.96	6.57	8.47
2007-08	0.62	0.11	0.67	1.05	5.58	8.03
2008-09	0.37	-0.05	-0.13	0.57	7.93	8.69

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net sales

X<sub>3</sub>: Earnings before interest and taxes to total assets;

X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed



FIGURE 6: 'Z' SCORE OF CHENNAI PETROLEUM CORPORATION LTD

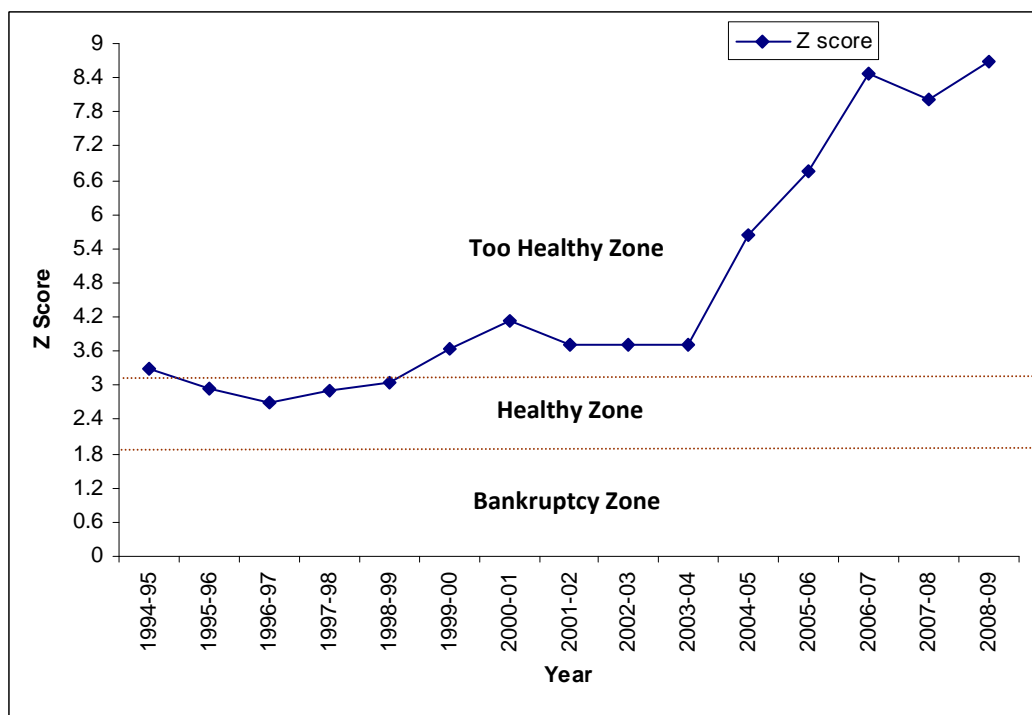


TABLE 8: 'Z' SCORE OF ESSAR OIL LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.27	0.32	0.21	0.21	1.53	2.54
1995-96	-0.08	0.33	0.08	0.31	0.39	1.04
1996-97	0.14	0.06	0.10	0.41	0.14	0.86
1997-98	0.07	0.35	0.03	0.20	0.09	0.75
1998-99	-0.01	0.34	0.02	0.14	0.07	0.55
1999-00	0.05	0.35	0.03	0.06	0.05	0.53
2000-01	-0.02	0.38	0.01	0.07	0.03	0.47
2001-02	-0.04	0.38	0.02	0.02	0.05	0.43
2002-03	-0.09	0.05	0.01	0.02	0.02	0.02
2003-04	-0.11	-0.07	0.01	0.06	0.13	0.03
2004-05	0.00	-0.21	0.01	0.39	0.00	0.19
2005-06	0.01	-0.14	-0.03	0.44	0.07	0.35
2006-07	0.07	-0.05	-0.01	0.42	0.04	0.46
2007-08	-0.03	0.03	-0.01	1.48	0.05	1.52
2008-09	-0.09	0.06	0.04	0.53	3.07	3.60

X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net sales

X<sub>3</sub>: Earnings before interest and taxes to total assets;

X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 7: 'Z' SCORE OF ESSAR OIL LTD

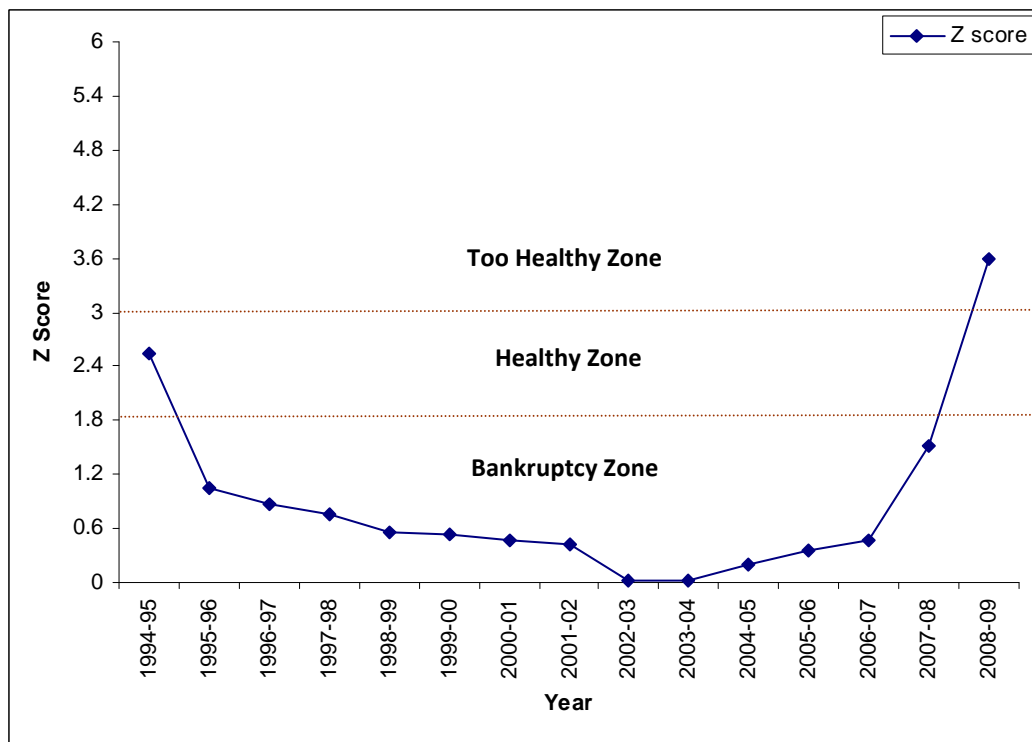


TABLE 8: Z' SCORE OF RELIANCE INDUSTRIES LTD

Year	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	Z score
1994-95	0.18	0.42	0.45	2.43	0.53	4.02
1995-96	0.18	0.43	0.35	1.21	0.44	2.60
1996-97	0.03	0.42	0.29	0.93	0.40	2.08
1997-98	0.06	0.56	0.32	1.20	0.48	2.62
1998-99	0.18	0.44	0.31	0.69	0.46	2.07
1999-00	0.19	0.42	0.40	1.72	0.62	3.35
2000-01	0.20	0.34	0.45	2.44	0.92	4.35
2001-02	0.30	0.28	0.48	1.01	0.97	3.03
2002-03	0.29	0.26	0.36	1.17	1.00	3.08
2003-04	0.21	0.27	0.38	2.16	1.01	4.03
2004-05	0.23	0.27	0.45	2.43	1.23	4.62
2005-06	0.14	0.24	0.44	3.03	1.24	5.09
2006-07	0.15	0.24	0.49	4.11	1.29	6.28
2007-08	0.19	0.29	0.59	5.41	1.18	7.66
2008-09	0.11	0.25	0.34	1.95	0.73	3.37

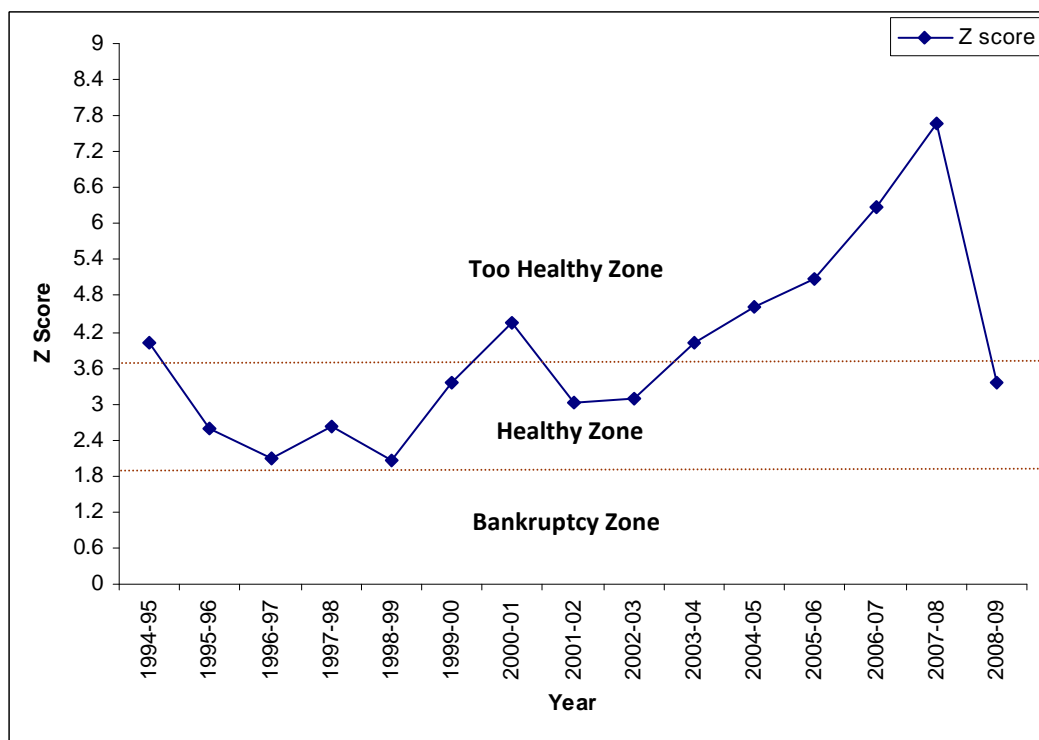
X<sub>1</sub>: Working capital to total assets; X<sub>2</sub>: Net operating profit to net sales

X<sub>3</sub>: Earnings before interest and taxes to total assets;

X<sub>4</sub>: Market value of equity to book value of debt; X<sub>5</sub>: Sales to total assets

Source: Computed

FIGURE 7: Z' SCORE OF RELIANCE INDUSTRIES LTD



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