

Construction of an EPS Predictor Model with 360 Degree Approach for the Pharmaceutical Industry

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Abstract

With globalization, foreign countries are investing huge capital in India, making India as one of the largest producers of generic drugs in the world. The main objective of the study was to construct a multiple regression model which could predict the EPS of pharmaceutical companies in India. The model was constructed by selecting four pharma companies, namely Sun Pharmaceutical Ltd., Lupin Limited, Cipla, and Dr. Reddy's Laboratories. The study used generalized moment of methods (econometric technique) to predict the EPS of these companies with a 360 degree view by considering various variables like Altman Z score, Ohlson O score, Zmijewski's score, Graham's number, market price per share, profit after tax, retained earnings, and dividend yield. The model predicted EPS with an accuracy of 96.62%. A very high positive correlation was found between EPS and Zmijewski score and a mild positive correlation was found between EPS and Graham's number, depicting that higher value investing yields higher EPS. Thus, Zmijewski model was the most suitable for prediction of bankruptcy of pharmaceutical companies. The study also showed that pharma companies issued more shares when they registered higher profits, thus decreasing the EPS value with increasing PAT. The study asserted that the suggested model will give an overall idea about the earnings an investor would yield when buying pharma stocks in India. The pharmaceutical sector was thus inferred to be stable to make investments and generate profits by speculating or holding securities.

Keywords : bankruptcy, Altman Z Score, Ohlson O Score, Zmijewski Y Score, Graham's Number, EPS, MPS, DY, PAT, RE, value investing

JEL Classification : G10, G11, G14

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The Indian stock market is very volatile and is affected by a lot of external factors and other markets in the world. In such a case, understanding the risk and return relationship of the stocks with various sectors and markets becomes essential. With globalization, markets have become very volatile and highly interdependent on each other, and any change in the global world affects the market and the economy as a whole.

In the recent years, there have been a lot of developments in the pharmaceutical industry. From its nascent stage in 1970s, the pharmaceutical industry in India has become more mature. With ageing global population and increase in expenditure on healthcare, the demand for the pharmaceutical products has increased over the years. Lower cost of production has attracted foreign investment, making India the third largest producer of pharmaceutical medicines. Around 70% to 80% of the domestic production is dominated by generic drugs, majorly for export purposes. Also, the spending pattern of the industry has changed and companies now spend close to around 18% of their revenue on R&D.

The global pharmaceutical sector is known to be highly dynamic and is characterized by high research and development expenditure and high regulation. The world's population is aging, and as a result, the need for effective treatments and medications is on the rise, and pharmaceutical products can help with that issue by offering effective solutions to debilitating conditions and diseases. The World Health Organization valued the

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global pharmaceutical industry at US \$300 billion as on April 4, 2016, making it one of the world's most important markets and its value is expected to increase to \$400 billion in the next 3 years.

With globalization, foreign countries are investing huge capital in India, making India one of the largest producers of generic drugs in the world. Cheap labour, strong government support, and low production cost are the favourable conditions for foreign investment in the sector. Most of the drugs manufactured in India are generic drugs and are exported to the United States and other developed economies. Manufacturing cost in India is approximately 35% to 40% of the cost in the U.S., making India one of the top global generic drug exporters in the world in terms of volume. Such favourable factors make the Indian pharmaceutical sector attractive for investment in the near future.

Review of Literature

The research studies carried out on the pharmaceutical industry in India measured the performance of these companies on the basis of ratios, Du Pont Analysis, or other bankruptcy models. Most of the studies used a single model to predict the bankruptcy and sensitivity of the pharmaceutical companies. With the literature review, an attempt is made to establish two things : (a) what factors affect the price of pharma stocks in India ? and (b) what statistical tools could yield prediction accuracy?

Most of the studies used the Altman Z Score for predicting bankruptcy of pharmaceutical companies in India as this model is used for manufacturing companies. Other studies also tried to establish a relationship between market value of the companies and the fundamental accounting variables of the companies.

The first part of literature review deals with factors which affect the profitability of pharma companies in India. Financial factors play a major role in determining the market value of the shares ; hence, the accounting variables of the company should be given utmost importance to ensure higher market value.

The next part deals with bankruptcy prediction of these pharma companies. A study conducted by two researchers - Sheela and Karthikeyan (2012a) evaluated the financial health of pharmaceutical companies in India using the Altman Z - score model. The research was conducted on three pharmaceutical companies - Ranbaxy, Dr. Reddy's Laboratories, and Cipla Ltd. It was found that Cipla and Dr. Reddy's Laboratories were in a good status with a safe financial position and will not fall bankrupt. On the other hand, Ranbaxy showed a good financial position, however, prediction of bankruptcy was uncertain for the study period of the research. Z-score helps in providing a relative comparison about the position of the company as compared to ratios which give only absolute figures. This study established the stability of Cipla Ltd. and Dr. Reddy's Laboratories.

Another study was conducted by Devi and Maheswari (2015) on pharma companies in India, which is known to be one the most promising and growing industry. The research made an attempt to measure the financial performance of the top pharmaceutical companies like Cipla Ltd., Aurobindo Pharma Ltd. for the study for the period from 2009-2010 to 2013-2014. Profitability ratio, long-term solvency ratio, and short-term solvency ratio were measured. It was concluded that Cipla Ltd. showed higher profitability and consistency than Aurobindo Pharma Ltd.

Gerritsen (2015) aimed to assess the accuracy rate of bankruptcy prediction models for The Dutch Professional Football Industry. Three accounting based bankruptcy models were used; Altman Z Score, Ohlson O Score, and Zmijewski Score and were tested on the Dutch Football Clubs between the period from 2009 - 2010 to 2013 - 2014. It was concluded from the study that none of the accounting based bankruptcy models were accurate ; however, Zmijewski score was found to be the most precise amongst the three models. The author also established from the study that Zmijewski model had the highest correlation and accuracy in predicting the EPS of the company.

The study conducted by Shastri (2014) made an attempt to identify efficient pharmaceuticals stocks in India. The stocks were studied using historic price movement for technical and fundamental analysis in order to get the

results. Using these techniques, the researcher tried to predict the future performance of the companies. It was also concluded that Sun Pharmaceuticals and Dr. Reddy's Laboratories were the most efficient securities among the market leaders. Furthermore, the researcher made an attempt to emphasize that 85% of the drugs manufactured in India are exported to mainly USA and Russia, thus depicting that India's pharmaceutical industry is highly dependent on foreign markets.

The result of study about the bankruptcy model was validated by another study conducted by two researchers - Kumar and Kumar (2012) to depict an empirical comparison of bankruptcy models. Three models were analyzed for assessing the distress of industrial corporations. The models were Z-Score model, O-score model, and Zmijewski's model; these models were used to predict probability if a firm would fall bankrupt within two years. It was concluded that none of the models showed a satisfactory accuracy, however, amongst the three models, the O-Score produced most positively correlated results with traditional analysis as it used binary logistic regression.

Attempts were also made to measure the financial performance of the pharmaceutical industry by two researchers - Sheela and Karthikeyan (2012b) by taking top three companies Cipla Ltd., Dr. Reddy's Laboratories, and Ranbaxy for the period from 2003-2012. These companies were compared on the basis of Du Pont Analysis for examining the financial performance of these companies. It was found out that Cipla had the highest ROE and ROI followed by Dr. Reddy's and Ranbaxy Laboratories, respectively.

Bhanawat (2003) used various statistical techniques to study the health of pharmaceutical companies in India during six years, that is, from 2004-2005 to 2009-2010. The techniques used were ratio analysis, multi discriminate analysis (Altman Z Score), mean, standard deviation, and coefficient of variation. It was found that 2009-2010 was a successful year for these companies and all companies were far from bankruptcy. The pharmaceutical companies were found to be good investments.

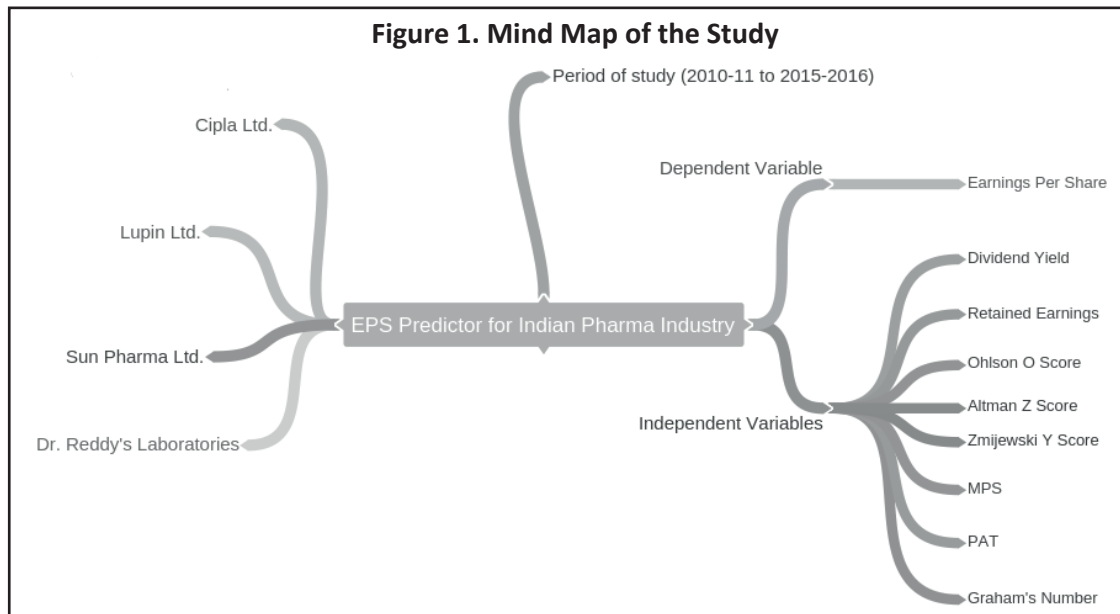
A similar study was conducted by Srinivasan (2012) to examine the determinants of share price in India. The study used panel data with time series of annual values of the determinants of the share price over the period from 2006-2011 and cross-sectional data related to six major sectors in India - banking, pharmaceutical, IT and ITES, manufacturing, energy, and infrastructure. The techniques used in the data were fixed effect and random effect. It was concluded that dividend per share had a negative and significant correlation with share price of infrastructure, pharmaceutical, manufacturing, and energy sectors. It was also found that the earnings per share and price-earnings ratios were important determinants of share price for banking, energy, manufacturing, infrastructure, and pharmaceutical companies.

Three researchers - Ghosh, Krishna, and Ramachandran (2016) made an attempt to predict EPS of PSU banks using econometric tools on various determinants of the EPS of PSU banks. The researchers used panel data regression and artificial neural network to develop the model. Out of the 13 variables, book value and Graham's number were found to be cardinal in the prediction of EPS. Graham's number has also been used in the current study and is expected to have a high impact in the pharma industry as well.

The studies conducted in the past have shown that pharmaceutical companies are a good source of investment and the top performing companies are far from bankruptcy, making these stocks a good source of investment. As inferred from the studies, Zmijewski model predicts bankruptcy with higher accuracy, thus proving it to be an important factor in predicting the prices of stocks of the pharma companies.

Research Methodology

The study is concerned with the analysis of financial health of top performing pharmaceutical stocks of India. The companies considered are : Lupin, Sun Pharma, Dr. Reddy's Laboratory, and Cipla during the financial year 2010-2011 to 2015-2016. The data were collected from secondary sources such as company website, Ace analyser (online database), and other certified websites. Various models like Altman Z-Score, Ohlson O Score, Zmijewski mode, and Graham's number have been used in the study. Eight independent X-variables (Altman Z Score,



Ohlson O Score, Zmijewski Score, Log value of *RE*, Log value of *PAT*, Graham's number, *MPS*, and *DY* have been used to predict the dependent *Y* variable (EPS from bankruptcy and profitability point of view) in EViews software (Student Lite Version 7).

Generalized moments of method (GMM) is used on the panel data to develop a model which can predict the EPS of the pharmaceuticals company from an overall view, taking into consideration bankruptcy, value investing, and earnings factor. This model was developed by Lars Peter Hansen in 1982 and is used for estimating parameters. It is applied where parameter of interest is finite dimensional and full shape of distribution function of data might not be known. GMM is also known to be consistent, asymptotically normal, and efficient amongst all the estimators.

On the other hand, a fixed effect model assumes constant coefficient between variables and a constant coefficient model is formulated. This reduces the accuracy of variables and also, using dummy variables can cause the problem of multicollinearity. Hence, the GMM was preferred over the fixed effect model to get high accuracy results.

The mind map of the study is depicted in the Figure 1 (please refer to Appendix Table 1 and Appendix Table 2 to refer to the data input used in building the model).

Objectives of the Study

(1) To Predict EPS of Pharmaceutical Companies with a 360 Degree View : The aim of the study is to predict the EPS of pharmaceutical companies considering probability of bankruptcy, accounting variables, value investing (fundamental valuation using Graham's number), and moment of methods.

(2) To Check the Cross Functionality of all the Three Bankruptcy Models : Altman Z Score model uses multivariate discriminant analysis and was developed to predict bankruptcy of manufacturing companies; Ohlson O Score Model uses logit analysis and is considered more accurate than Altman. It also uses dummy variables to predict bankruptcy in the next two years with precision. Zmijewski Model uses probit analysis and is mostly used by accounting researchers.

(3) To Check which Bankruptcy Model is Suitable for the Pharmaceutical Sector : The study aims at understating which model works best for pharmaceutical companies and gives the highest accuracy result.

Methodology

(1) Period of the Study : A sample of top four pharmaceutical companies in India - Cipla Ltd., Lupin Ltd., Sun Pharma Ltd., Dr. Reddy's Laboratories was examined for 6 financial years, that is, from 2010-2011 to 2015-2016 for the purpose of the present study (refer to Appendix Table 3 for the list of companies that are a part of Nifty Pharma). A study of six years seems to be appropriate for establishing a trend.

(2) Data Collection : The study has been conducted using a sample of top four pharmaceutical companies by using market capitalization. The data were collected from secondary data source, Ace Analyzer.

Analysis and Results

The collected data was processed to calculate values for all the bankruptcy models. The results have been listed

Table 1. Bankruptcy Measurement of Top 4 Pharmaceutical Companies Over the Years

Year	Particulars	Sun Pharma	Lupin	Cipla	Dr. Reddy's
2011	Altman (Z score)	6.94	7.01	5.46	5.45
2011	Ohlson (Y Score)	2.84	2.21	2.38	1.96
2011	Zmijewski Score (X Score)	5.07	4.88	4.51	4.44
2011	Graham's No.	139.26	169.85	148.79	648.03
2012	Altman (Z score)	7.35	7.54	5.10	5.68
2012	Ohlson (Y Score)	2.69	2.30	2.49	2.15
2012	Zmijewski Score (X Score)	5.04	4.91	4.51	4.43
2012	Graham's No.	167.50	183.99	172.00	689.60
2013	Altman (Z score)	8.39	7.91	5.13	4.92
2013	Ohlson (Y Score)	1.89	2.95	2.32	1.58
2013	Zmijewski Score (X Score)	4.29	5.31	4.56	3.84
2013	Graham's No.	91.87	261.77	215.89	872.87
2014	Altman (Z score)	8.39	8.29	4.55	5.03
2014	Ohlson (Y Score)	0.61	3.39	1.88	1.39
2014	Zmijewski Score (X Score)	1.49	5.67	4.14	3.55
2014	Graham's No.	0.00	425.25	220.80	1178.25
2015	Altman (Z score)	5.77	10.02	5.40	5.12
2015	Ohlson (Y Score)	0.84	3.02	1.67	1.13
2015	Zmijewski Score (X Score)	3.08	5.38	3.90	3.36
2015	Graham's No.	0.00	489.40	213.03	1171.36
2016	Altman (Z score)	5.72	7.43	4.54	4.42
2016	Ohlson (Y Score)	2.50	3.12	1.84	0.96
2016	Zmijewski Score (X Score)	3.05	5.32	3.97	3.17
2016	Graham's No.	0.00	608.18	244.29	1098.09

Table 2. GMM Results for Panel Data with Seven Independent Variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	90.12515	38.74734	2.325970	0.0335
ZMJ	19.59912	4.448967	4.405320	0.0004
REL	-36.92127	11.27964	-3.273266	0.0048
OHS	-4.829508	2.683904	-1.799434	0.0908
PATL	-10.00477	2.977884	-3.359691	0.0040
DY	-4968.292	1541.261	-3.223524	0.0053
MPS	-0.008731	0.002754	-3.169947	0.0059
GRHM	0.170316	0.014870	11.45352	0.0000

Constant

All 7 seven variables have significance greater than 90%

Effects Specification		S.D.	Rho
Cross-section random		24.11931	0.9863
Period random		0.000000	0.0000
Idiosyncratic random		2.845462	0.0137

96.62% accuracy of prediction

Change of chnage is way below threshold of 10

Weighted Statistics			
R-squared	0.976527	Mean dependent var	1.623218
Adjusted R-squared	0.966258	S.D. dependent var	15.74475
S.E. of regression	2.892173	Sum squared resid	133.8347
Durbin-Watson stat	1.333489	J-statistic	16.00000
Instrument rank	9	Prob(J-statistic)	0.000063

Presence of positive auto-correlation

The test failed however, has very low impact

below for all the four companies considering the time period from 2010-2011 to 2015-2016. Also, other variables were arranged in a panel form to generate results.

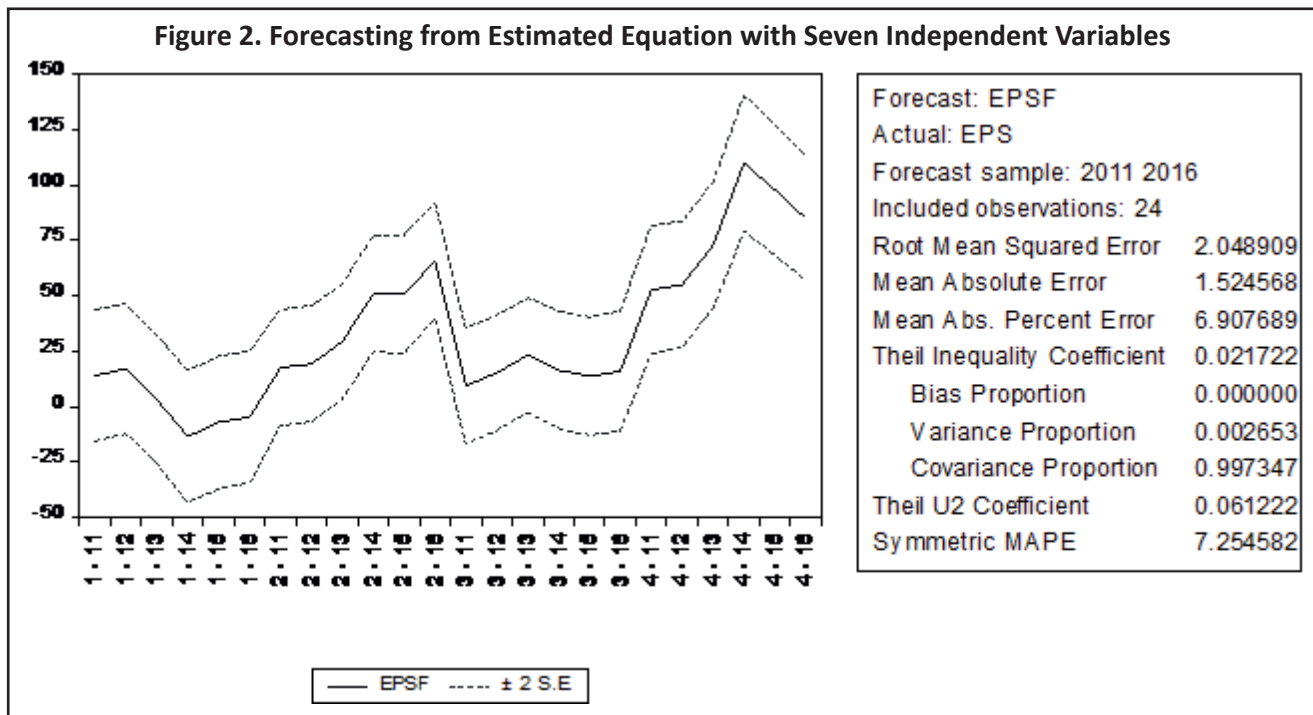
It can be inferred from the Table 1 that since the Altman Z Score has an occurrence of less than 90%, the test was run again with only seven variables excluding the Altman Z- Score to develop a model with only significant variables for prediction of EPS of pharmaceutical companies.

(i) From the Table 2, it can be inferred that the estimate coefficients of all the independent variables are statistically significant at the 10% level (p - values for computed t -statistics are greater than 0.01 but less than 0.1).

(ii) C' is called the common intercept which is the average of all individual intercepts. Here, the constant value in predicted equation is 90.12515.

(iii) The overall regression fit, as measured by the adjusted R -Square value (number of independent variables greater than 1) of 96.62% indicates a very accurate fit.

(iv) The computed value of Durbin Watson statistic in the constant coefficient model is 1.33, which indicates presence of positive autocorrelation.



(v) The Hansen test (J-statistic) for no over-identification has failed, however, it has a minuscule impact because the value of the test is way below 1000. The null hypothesis fails and has a very low impact.

(i) In Figure 2, the root mean squared error is standard deviation of the residuals (prediction errors). It measures how spread out the residuals are. The value is 2.048909, which is way below the threshold value 10.

(ii) Mean absolute error measures how close forecasts or predictions are to eventual outcomes. The error value is 1.524568 against a threshold of 10, thus reducing the error to a large extent.

(iii) The mean absolute percent error is 6.907689, which is also below 10 ; hence, it is acceptable.

(iv) The values of 'bias proportion,' 'variance proportion,' and 'covariance proportion' are 0.0000, 0.002653, and 0.997347, respectively. Since the values of bias and variance proportion are low and that of covariance proportion is high, the forecast can be considered satisfactory.

(i) The Figure 3 is a graph of the actual and fitted values for the dependent variable along with the residuals.

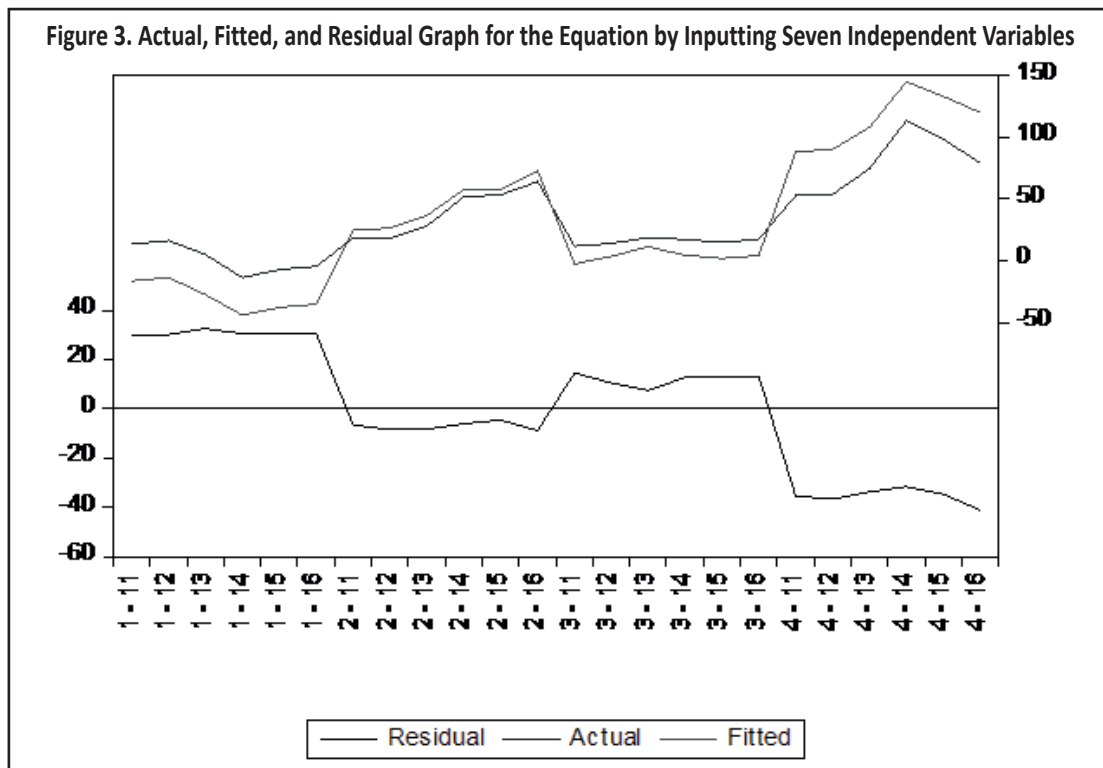
(ii) Checking the residual series confirms the existence of heteroscedasticity.

(iii) The actual value is the sum of residual and fitted values.

(iv) It is seen that the actual value is greater than fitted value for Sun Pharma and is the opposite for Dr. Reddy's Laboratory.

(v) The error is lower for Lupin and Cipla.

The equation for EPS is :



$$EPS = 90.1251457246 + 19.5991231989 * ZMJ - 36.9212659413 * REL - 4.82950817361 * OHS - 10.0047729034 * PATL - 4968.29164164 * DY - 0.00873070779763 * MPS + 0.170315735589 * GRHM \text{ ----- (1)}$$

Discussion and Conclusion

The study conducted depicts that the Altman Z Score does not fulfill a minimum threshold of 90% significance in predicting the EPS of the companies ; hence; the test was run again to obtain the final equation (1) with only seven significant variables for predicting the EPS. Zmijewski Score is found to have a very strong positive correlation with EPS and a significant impact on the prediction of EPS of the companies. Graham's number is also found to have a mild positive correlation with EPS and a greater intrinsic value should yield more returns to the investor.

Dividend yield is found to have negative correlation with EPS, however, it is a very small value to make a significant impact on the value. Another interesting fact found from the study is that EPS has a negative correlation with PAT. It can be inferred that as the profits of pharmaceutical companies increase, companies float greater number of shares in the market to generate cash to invest in R&D and other activities.

The Altman Z Score is used for prediction of bankruptcy for manufacturing companies, however, the model fails to have a significant impact on prediction of EPS of pharmaceutical companies. Ohlson model is used for predicting bankruptcy for companies in the next two years and is known to be more accurate than the Altman Z Score. Zmijewski Model is found to have the highest accuracy amongst the three models and is mostly used by accounting researchers and is found to have the highest impact on prediction of EPS of the companies.

Hansen test (J-Statistic) was performed to study the multivariate integration, which failed and the null hypothesis of “model is fit” is rejected. However, J-Statistic has very low occurrence. This shows the test has very low significance and can be overlooked while testing the fit of the model. Hence, it can be concluded that Zmijewski Score and Graham's number variables are the plausible reasons for a probable EPS prediction model

in the study. The study also proves that Zmijewski model is superior to Altman Z Score and Ohlson O Score, the popular choice of the past. The results of the test (performed with EViews 9.5 Student Version Software) create a multiple regression model with an accuracy of 96.62%.

Implications

While investing in any of the pharmaceutical stocks, an investor should consider this model to get an overall idea about the company to mitigate the risk of losing money. Pharmaceutical companies are concluded to be safe investments and low risk as the companies have passed the bankruptcy test and the scores are way below the threshold level. On the basis of this, investors can invest in pharma companies and yield returns in future with minimal risks.

Limitations of the Study and Scope for Further Research

The study was conducted by considering a sample of the top four performing pharmaceutical stocks in India. The data used were under consideration for a short span of time, which in turn offers lower probability of covering events. Secondary data were considered for the study ; hence, it was subject to errors. The limitations of various bankruptcy models, Altman Z Score, Ohlson O Score, and Zmijewski Score apply in the study. The limitations of value investing model - Graham's number also apply. The research can be extended to study various other sectors which can eventually help in building a balanced portfolio and also providing exposure opportunities in various sectors.

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About the Author

Uddepti Mandhyani (Student - Christ University, Bangalore) holds MBA (Finance) , with her thesis focusing on using Econometric Tools to Predict Earnings Per Share of Pharma Companies. Her research interests include Mergers, Acquisitions, Portfolio Management, International Financing, and Foreign Exchange Risk Management. She has 2 years of work experience with a renowned investment bank post her Bachelor in Commerce degree. She worked there as a Financial Analyst.

APPENDICES

Appendix Table 1. Panel Data Used for Developing the Model

Year	Code	EPS	Altman (z score)	Ohlson (Y Score)	Zmijewski Score (X Score)	Graham's No.	MPS	Dividend Yield	PAT(log value)	Retained Earnings (Log value)
2011	1	13.362	6.94	2.84	5.07	139.26	438.15	0.01	3.14	3.82
2012	1	16.391	7.35	2.69	5.04	167.50	568.00	0.01	3.23	3.89
2013	1	4.988	8.39	1.89	4.29	91.87	818.95	0.01	2.71	3.89
2014	1	-13.656	8.39	0.61	1.49	0.00	575.10	0.00	0.00	3.86
2015	1	-7.117	5.77	0.84	3.08	0.00	1021.00	0.00	0.00	4.35
2016	1	-4.46	5.72	2.50	3.05	0.00	826.10	0.00	0.00	4.33
2011	2	18.153	7.01	2.21	4.88	169.85	419.00	0.00	2.91	3.49
2012	2	18.009	7.54	2.30	4.91	183.99	529.00	0.00	2.91	3.56
2013	2	28.163	7.91	2.95	5.31	261.77	628.55	0.00	3.10	3.68
2014	2	51.834	8.29	3.39	5.67	425.25	933.15	0.00	3.37	3.84
2015	2	53.334	10.02	3.02	5.38	489.40	2008.40	0.00	3.38	3.95
2016	2	64.027	7.43	3.12	5.32	608.18	1479.25	0.00	3.46	4.06
2011	3	11.962	5.46	2.38	4.51	148.79	321.65	0.00	2.98	3.81
2012	3	13.999	5.10	2.49	4.51	172.00	305.10	0.00	3.05	3.87
2013	3	18.771	5.13	2.32	4.56	215.89	379.75	0.00	3.18	3.94
2014	3	17.292	4.55	1.88	4.14	220.80	382.80	0.00	3.14	4.00
2015	3	14.709	5.40	1.67	3.90	213.03	712.45	0.00	3.07	4.04
2016	3	17.401	4.54	1.84	3.97	244.29	511.95	0.00	3.15	4.08
2011	4	52.801	5.45	1.96	4.44	648.03	1639.05	0.00	2.95	3.77
2012	4	53.797	5.68	2.15	4.43	689.60	1764.75	0.00	2.96	3.82
2013	4	74.529	4.92	1.58	3.84	872.87	1766.50	0.00	3.10	3.88
2014	4	113.561	5.03	1.39	3.55	1178.25	2563.90	0.00	3.29	3.96
2015	4	98.556	5.12	1.13	3.36	1171.36	3488.75	0.00	3.23	4.02
2016	4	79.396	4.42	0.96	3.17	1098.09	3035.20	0.00	3.13	4.06

Appendix Table 2. Code and Companies

Code	Company
1	Sun Pharma Ltd.
2	Lupin Ltd.
3	Cipla Ltd.
4	Dr. Reddy's Laboratories

Appendix Table 3. List of Stocks in Nifty Pharma

S. No.	Company Name	Industry
1.	Aurobindo Pharma Ltd.	Pharma
2.	Cadila Healthcare Ltd.	Pharma
3.	Cipla Ltd.	Pharma
4.	Divi's Laboratories Ltd.	Pharma
5.	Dr. Reddy's Laboratories Ltd.	Pharma
6.	Glaxosmithkline Pharmaceuticals Ltd.	Pharma
7.	Glenmark Pharmaceuticals Ltd.	Pharma
8.	Lupin Ltd.	Pharma
9.	Piramal Enterprises Ltd.	Pharma
10.	Sun Pharmaceutical Industries Ltd.	Pharma

Source: www.nseindia.com