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## **AN INTEGRATED DEA & FUNDAMENTAL ANALYSIS OF PHARMACEUTICAL INDUSTRY A CASE STUDY OF SELECTED INDIAN COMPANIES**

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### **ABSTRACT**

In last decades demand for health care services such as prescription medication is increased dramatically. This research provides a comprehensive analysis of selected Indian pharmaceutical industry. Globally, the Indian pharmaceutical industry is the third largest in terms of volume and fourteenth largest in terms of value in the world (Panchal *et al.*, 2014).

The main objective of this research is to analyze pharmaceutical companies and comparing their efficiency by data envelopment analysis (DEA). In this paper, an integrated fundamental analysis and DEA model is developed to analyze the pharmaceutical sector. Fundamental analysis is used to assess the financial statements. It is done for predicting the future performance of a company.

**Keywords:** *Pharmaceutical Companies, Data Envelopment Analysis (DEA), Fundamental Analysis*

### **INTRODUCTION**

Technical analysis and fundamental analysis are the two main methods used to analyze securities and make investment decisions. Fundamental analysis is a method of evaluating securities that attempts to measure the intrinsic value of a stock; accordingly fundamental analysts study everything from the overall economy and industry conditions to the financial condition and management of companies. While technical analysis is the evaluation of securities by means of studying statistics generated by market activity, such as past prices and volume and technical analysts do not attempt to measure a security's intrinsic value.

In fundamental approach the analysts try to examine the economic, financial and other qualitative and quantitative factors related to a security in order to determine its intrinsic value. They attempt to evaluate characteristics that can affect the volatility of security's value.

The main part of fundamental analysis involves delving into the financial statements. Also known as quantitative analysis, this involves looking at revenue, expenses, assets, liabilities and all the other financial aspects of a company.

Fundamental analysts look at this information to gain insight on a company's future performance. Usually, investors focus on a single number such as net income or earning to evaluate performance. They frequently rely on earnings to forecast the market value of a stock. Many of analysts believe that earnings are not as relevant as they once were. Fundamental analysis is the process of evaluating a public firm for its investment worthiness by looking at its business at the basic or fundamental financial level (Thomsett, 1998).

It involves examining a firm's financials and operations, especially sales, earnings, growth potential, assets, debt, management, products, and competition. Fundamental analysis may also include analyzing market behavior (Doyle *et al.*, 2003; Piotroski, 2000). Diversity of fundamental indicators can confuse the analysts to make final decision. We present an integrated approach for this problem, using data envelopment analysis.

Data Envelopment Analysis (DEA) was introduced by Charnes, Cooper and Rhodes (CCR) to assess the relative efficiency of organizational units with multiple inputs to produce multiple outputs (Charnes *et al.*, 1978). They defined the efficiency of the unit under evaluation as the ratio of the sum of its weighted outputs to the sum of its weighted inputs. Recently, the Data Envelopment Analysis method is becoming popular for assessing the relative efficiency of decision-making units (DMUs). DEA is a technique of

## **Research Article**

mathematical programming that enables the determination of a DMU's efficiency based on its inputs and outputs, and compares it to other units involved in the analysis.

DEA has become one of the most popular fields in operation research, with applications involving a wide range of context (Thanassoulis, 2001). DEA is one of the most popular fields in operation research (Emrouznejad *et al.*, 2008). Since the seminal work of Charnes, Cooper and Rhodes (1978), there was literally exponential growth in the publication's quantity. DEA is a methodology of several different interactive approaches and models used for the assessment of relative efficiency of DMU and for the assessment of efficiency frontier. It supplies important information for managing the operations of efficient and inefficient units.

The main objective of this research is to analysis pharmaceutical companies. We want to present a data envelopment analysis on financial information such as sales, profit, earning per share, market price etc. according to our presented approach, investors can easily get idea about the pharmaceutical companies.

### **Indian Pharmaceutical Industry**

Over the last 30 years, India's pharmaceutical industry has evolved from almost nonexistent to a world leader in the production of high quality generic drugs. India has garnered a worldwide reputation for producing high quality, low cost generic drugs. The industry currently meets India's demand for bulk drugs and nearly all its demand for formulations, with the remainder supplied by foreign multinational corporations.

India's pharmaceutical industry is one of the fastest growing segments of the Indian economy with an average annual growth rate of 14 percent at least from 2000 until 2010 (Greene, 2010). The Indian pharm industry has been growing at a compounded annual growth rate of more than 15 per cent over the last five years and has significant growth opportunities (Seetharaman & Narayanan, 2013).

This rank is very high in the world, in terms of technology, quality and range of medicines manufactured from simple headache pills to sophisticated antibiotics and complex cardiac compounds, almost every type of medicines are now made indigenously.

India's biopharmaceutical industry clocked a 17 percent growth with revenues of Rs.137 billion (\$3 billion) in the 2009-10 financial year over the previous fiscal. Bio-pharma was the biggest contributor generating 60 percent of the industry's growth at Rs.8,829 crore, followed by bio-services at Rs.2,639 crore and bio-agri at Rs.1,936 crore (Times, 2010).

The number of Indian pharmaceutical companies are increasing. The industry meets around 70 per cent of the country's demand for bulk drugs, drug intermediates, pharmaceutical formulations, chemicals, tablets, capsules, orals, injectable and so on.

### ***The Selected Companies and their Fundamental Analysis***

Analysis of a company consists of measuring its performance and ascertaining the cause of this performance. Quantitative indicators of company analysis are the financial indicators and operational efficiency indicators. Financial indicators are the profitability indicators and financial position indicators which are analyzed through the income and balance sheet statements, of the company, respectively. According to availability of information we considered the following companies:

**Sun Pharmaceutical Industries:** Sun Pharmaceuticals was established by Mr. Dilip Shangvi in 1983 in Vapi with five products to treat psychiatry ailments. Cardiology products were introduced in 1987 followed by gastroenterology products in 1989. Today it is the largest chronic prescription company in India and a market leader in psychiatry, neurology, cardiology, orthopedics, ophthalmology, gastroenterology and nephrology.

Over 72% of Sun Pharma sales are from markets outside India, primarily in the US. The US is the single largest market, accounting for about 50% turnover; in all, formulations or finished dosage forms, account for 93% of the turnover. Manufacturing is across 26 locations, including plants in the US, Canada, Brazil, Mexico and Israel. In the US, the company markets a large basket of generics, with a strong pipeline awaiting approval from the U.S. Food and Drug Administration (FDA).

Sun Pharma was listed on the stock exchange in 1994 in an issue oversubscribed 55 times. The founding family continues to hold a majority stake in the company. Today Sun Pharma is the second largest and the

## **Research Article**

most profitable pharmaceutical company in India, as well as the largest pharmaceutical company by market capitalization on the Indian exchanges.

**Dr. Reddy's Laboratories:** The company was founded by Anji Reddy, who previously worked in the mentor institute, Indian Drugs and Pharmaceuticals Limited, of Hyderabad, India. Dr. Reddy's manufactures and markets a wide range of pharmaceuticals in India and overseas. The company has over 190 medications, 60 active pharmaceutical ingredients (APIs) for drug manufacture, diagnostic kits, critical care, and biotechnology products.

Dr. Reddy's began as a supplier to Indian drug manufacturers, but it soon started exporting to other less-regulated markets that had the advantage of not having to spend time and money on a manufacturing plant that would gain approval from a drug licensing body such as the U.S. Food and Drug Administration (FDA). By the early 1990s, the expanded scale and profitability from these unregulated markets enabled the company to begin focusing on getting approval from drug regulators for their formulations and bulk drug manufacturing plants in more-developed economies. This allowed their movement into regulated markets such as the US and Europe. In 2014, Dr. Reddy Laboratories was listed among 1200 of India's most trusted brands according to the Brand Trust Report 2014, a study conducted by Trust Research Advisory, a brand analytics company.

**LUPIN:** It is founded in 1968 and is the seventh-largest company by market capitalization; and the 10th-largest generic pharmaceutical company by revenue globally.

Lupin is the fifth-largest generic pharmaceutical company in the US by prescription-led market share and 3rd largest Indian pharmaceutical company by revenue. It has the distinction of being the fastest growing generic pharmaceutical player in the US and Japan; and is the 4th fastest growing generic pharmaceutical player in South Africa.

**Cipla:** It was founded by Dr. Khwaja Abdul Hamied as 'The Chemical, Industrial & Pharmaceutical Laboratories' in 1935 in Mumbai. The name of the Company was changed to 'Cipla Limited' on 20 July 1984. In the year 1985, US FDA approved the company's bulk drug manufacturing facilities. Led by the founder's son Yusuf Hamied, a Cambridge-educated chemist, the company became a global icon for its role in defying Western multinational pharmaceutical companies in order to provide generic AIDS and other drugs to treat poor people in the developing world. In 1994, Cipla launched Deferiprone, the world's first oral iron chelator. In 2001, Cipla offered medicines (antiretrovirals) for HIV treatment at a fractional cost (less than \$350 per year per patient). In 2012, the company slashed prices of three life-saving cancer drugs by 50-64%.

**Ranbaxy:** It is an Indian multinational pharmaceutical company that was incorporated in India in 1961. The company went public in 1973 and Japanese pharmaceutical company Daiichi Sankyo acquired a controlling share in 2008. As of 2013, Ranbaxy was exporting its products to 125 countries with ground operations in 43 and manufacturing facilities in eight countries. In 2011, Ranbaxy Global Consumer Health Care received the OTC Company of the year award. In the 2012, 2013 and 2014 Brand Trust Reports, Ranbaxy was ranked 161st, 225th and 184th respectively among India's most trusted brands. ([www.wikipedia.org](http://www.wikipedia.org), n.d.)

The needed data for this work were collected from ([www.bse.com](http://www.bse.com); Seetharaman & Narayanan, 2013). We calculate and summarized financial ratios of five years according to table 1. Then we assess the efficiency of selected companies with DEA.

Financial indicators are usually calculated by dividing one item of the relationship with the other; accordingly they are called ratios. The ratio analysis is one of the most useful and common methods for analyzing the financial statement. Ratio enables the mass of data to be summarized and simplified. Ratio analysis is an instrument to diagnosis the financial health of an enterprise.

A ratio is only a comparison between numerator and denominator. The term ratio refers to the numerical or quantitative relationship between two indicators and is obtained by dividing the former by the latter. Ratio analysis is an important and age old technique of financial analysis. The data given in financial statements ratio are relative form of financial data and very useful to cheek upon the efficiency of a firm. Some ratios indicate the trend or progress or downfall of the firm.

**Research Article**

**Table 1: Average of 5 Years Financial Indicators for Selected Companies**

		Sun Pharmaceutical Industries	DrReddys Laboratories	Lupian	Cipla	Ranbaxy
Per Share Ratio	E.P.S	34.12	43.65	42.77	11.69	-12024
	D.P.S	9.15	9.25	8.44	2.16	0.20
Profitability Ratio	GP Ratio	12.63	17.69	19.27	19.10	9.61
	NP Ratio	36.62	15.12	16.18	16.18	-6.43
	ROE	22.58	14.66	23.30	19.54	9.77
	ROA	173.95	340.09	153.06	69.87	68.23
	D/P Ratio	0.25	0.20	0.02	0.19	0.01
	P/E Ratio	30.96	26.46	23.24	24.80	12.06
Liquidity & Solvency Ratio	PEG Ratio	0.02	206.78	-212.14	27.07	-0.05
	Current Ratio	2.78	1.72	2.24	2.57	1.11
	Quick Ratio	2.25	1.15	1.15	1.43	0.28
	Debt to Equity	0.01	0.16	0.47	0.88	1.47

$$EPS = \frac{Net\ Income}{Shares}$$

$$DPS = \frac{Divided\ Income}{Shares}$$

$$GP = \frac{Gross\ Profit}{Net\ Sales}$$

$$NP = \frac{Net\ Profit}{Net\ Sales}$$

$$ROE = \frac{Annual\ Net\ Income}{Average\ Shareholders\ Equity}$$

$$ROA = \frac{Annual\ Net\ Income}{Total\ Assets}$$

$$Dividened\ Payout\ Ratio = \frac{DPS}{EPS}$$

$$P/E\ Ratio = \frac{Share\ Price}{EPS}$$

$$PEG\ Ratio = \frac{P/E\ Ratio}{Annual\ Earning\ Per\ Share\ Growth}$$

$$Current\ Ratio = \frac{Current\ Assets}{Current\ Liabilities}$$

$$Quick\ Ratio = \frac{Quick\ Assets}{Current\ Liabilities}$$

$$Debt\ Equity\ Ratio = \frac{LongTerm\ Debt}{Shareholders\ Fund}$$

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### Data Envelopment Analysis

Let  $x_{ij}$  denote the observed magnitude of i-type input for entity j ( $x_{ij} > 0$ ,  $i = 1, 2, \dots, m$ ,  $j = 1, 2, \dots, n$ ) and  $y_{rj}$  denote the observed magnitude of r-type output for entity j ( $y_{rj} > 0$ ,  $r = 1, 2, \dots, s$ ,  $j = 1, 2, \dots, n$ ). Then, the Charnes-Cooper-Rhodes (CCR) model is formulated in the following form for the selected entity k:

$$\begin{aligned} \text{Max } R_k &= \frac{\sum_{r=1}^s u_r y_{rk}}{\sum_{i=1}^m v_i x_{ik}} \\ \text{s.t.} \\ \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} &\leq 1, \quad j = 1, 2, \dots, n \end{aligned}$$

$$u_r \geq \varepsilon, \quad r = 1, 2, \dots, s$$

$$v_i \geq \varepsilon, \quad i = 1, 2, \dots, m$$

Where:

$v_i$  : is the weights to be determined for input i;

$m$  : is the number of inputs;

$u_r$ : is the weight to be determined for output r;

$s$  : is the number of outputs;

$R_k$ : is the relative efficiency of  $DMU_k$ ;

$n$  : is the number of entities;

$\varepsilon$  : is a small positive value.

The relative efficiency  $R_k$ , of one decision-making unit k, is defined as a ratio of the weighted sums of their outputs and the weighted sums of their inputs. As for the decision-making unit k, for which a maximum in objective function is sought, the first condition is true, meaning that it is obviously  $R_k \leq 1$ , for each  $DMU_k$ . The weights  $v_i$  and  $u_r$  show the importance of each input and output and are determined in the model so that each DMU is efficient as much as possible. Given that the condition (2) is true for every DMU, it means that each of them lies on the efficiency frontier or beyond it.

If  $\text{Max } R_k = R_k^* = 1$ , it means that efficiency is being achieved, so we can tell that  $DMU_k$  is efficient. Efficiency is not achieved for  $R_k^* < 1$  and  $DMU_k$  is not efficient in that case.  $DMU_k$  is to be considered relatively inefficient, if it is possible to expand any of its outputs without reducing any of its inputs, and without reducing any other outputs, or if it is possible to reduce any of its inputs without reducing any output and without expanding some other inputs.

Using a simple transformation developed by Charnes and Cooper, the above CCR ratio model can be reduced to a LP form. In this model, the denominator has been set equal to 1 and the numerator is being maximized.

$$\begin{aligned} \text{Max } Z_k &= \sum_{r=1}^s u_r y_{rk} \\ \text{s.t.} \\ \sum_{i=1}^m v_i x_{ik} &= 1 \\ \sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} &\leq 0, \quad j = 1, 2, \dots, n \\ u_r &\geq \varepsilon, \quad r = 1, 2, \dots, s \\ v_i &\geq \varepsilon, \quad i = 1, 2, \dots, m \end{aligned}$$

## Research Article

### The Case Study

We consider the financial ratios as inputs if their reductions are preferred or as outputs if their increases are preferred. There are two exceptions for current and quick ratio because their too small or too large numeric values are undesirable. According to experts opinion and traditionally the ideal amount for current ratio is almost 2 and for quick ratio almost 1. Two new indicators are defined as:

$$CR \text{ Deviation} = |2 - Current \text{ Ratio}|$$

$$QR \text{ Deviation} = |1 - Quick \text{ Ratio}|$$

Therefore, in the DEA model we considered inputs and outputs according to table 2. Also in table 1 we have negative numbers that are correct in table 2. Basic DEA models are not capable of completing an analysis with negative numbers and all numbers must be non-negative and preferably strictly positive (no zero values).

This has been defined as the “positivity” requirement of DEA. One of the more common methods for eliminating the problems of non-positive values in DEA (for ratio models), is the addition of a sufficiently large positive constant to the values of the input or output that has the non-positive number. This approach has been advised by Bowlin to make the negative numbers or zero values to a smaller number in magnitude than the other numbers in the data set (Bowlin, 1998).

**Table 2: Considered Inputs and Outputs for DEA**

		Sun Pharmaceutical Industries	DrReddys Laboratories	Lupian	Cipla	Ranbaxy
Outputs	E.P.S +	12058.13	12067.66	12066.78	12035.70	0.01
	D.P.S	9.15	9.25	8.44	2.16	0.20
	GP Ratio	12.63	17.69	19.27	19.10	9.61
	NP Ratio +	43.06	21.56	22.62	22.61	0.01
	ROE	22.58	14.66	23.30	19.54	9.77
	ROA	173.95	340.09	153.06	69.87	68.23
	D/P Ratio	0.25	0.20	0.02	0.19	0.01
Inputs	P/E Ratio	30.96	26.46	23.24	24.80	12.06
	PEG Ratio +	212.17	418.93	0.01	239.21	212.10
	CR Deviation	0.78	0.28	0.24	0.57	0.89
	QR Deviation	1.25	0.15	0.15	0.43	0.72
	Debt to Equity	0.01	0.16	0.47	0.88	1.47

The results of DEA model is according to table3. According to the results Sun Pharmaceutical Industries, Dr Reddys Laboratories, Lupian and Ranbaxy are efficient. The most popular research stream in ranking efficient DMUs is called super-efficiency. In this direction, researchers focused on ranking efficient DMUs.

The research in this area was first developed by Andesen and Petersen (1993). In their research, they ranked efficient DMUs in such a way that superior efficient DMUs may have efficiency cores greater than unity.

Their approach became very popular and many research works extended their idea by addressing new issues such as outlier detection, sensitivity analysis and scale classification.

## Research Article

**Table 3: Companies Ranking According to DEA Approach**

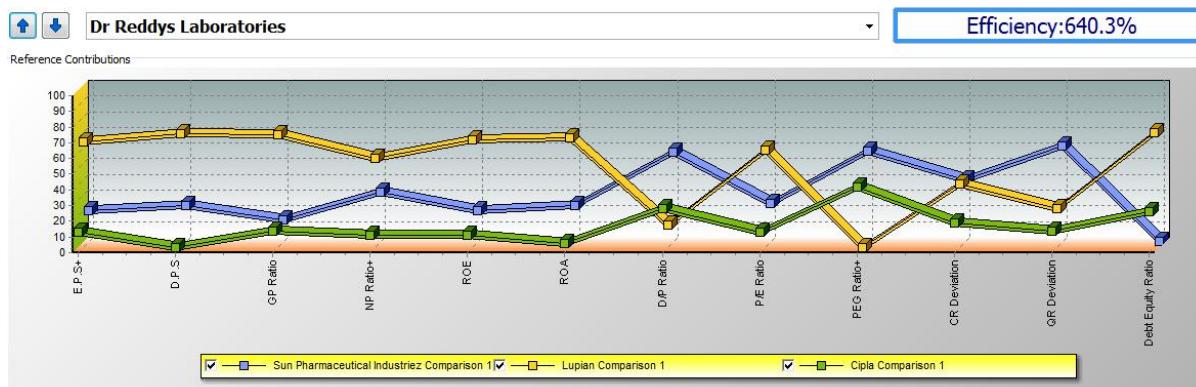
Companies Name	Efficiency Score	Super-Efficiency Score	Rank
Sun Pharmaceutical Industries	100	122.5	3
DrReddys Laboratories	100	640.3	2
Lupian	100	1000	1
Cipla	96.6	96.6	4
Ranbaxy	100	1000	1

According to super-efficiency scores, Ranbaxy and Lupian companies have the best performance and DrReddys Laboratories, Sun Pharmaceutical Industries and Cipla, were next ranked respectively.

## RESULTS AND DISCUSSION

Ratio analysis of firm's financial statement is of interest to many decision makers. Shareholders, creditor, financial executives etc. shareholders are interested with earning capacity of the firm, creditors are interested in knowing the ability of the firm to meet financial obligation and financial executives are concerned with evolving analytical tools that will measure and compare costs, efficiency liquidity and profitability with a view to making intelligent decisions.

In this paper, we present an integrated fundamental analysis and DEA model to analyze of pharmaceutical sector and a case study of selected Indian companies is presented. The comparison of these companies can be very useful. For example Dr Reddys Laboratories can improve its ranking to 1, by benchmark its fundamental indicators with other efficient companies; Figure 1.



**Figure 1: Suggested Benchmarking Indicators for Dr Reddys Laboratories**

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**Research Article**

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