Original Article

Technical Analysis and Price forecast of NSE-listed stocks in Pharmaceutical Sector

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Abstract - *The stock market is the most attractive place today to make money for those who understand finance. The most critical factor when making Investments in stocks are intended to forecast future market patterns, volume fluctuations and the uncertainty or risk involved. Therefore, technical analysis plays a hand. The very important task of predicting future price ups and downs and thus enabling investors to make the most of their investments. For performing technical analysis, various techniques such as beta calculations, relative strength index, exponential moving averages and predicting future market patterns using mean and standard deviation can be used. This paper focuses on the technical review of major pharmaceutical companies listed on the National Stock Exchange (NSE). The shares' price movements are subject to a cyclical trend that repeats itself over various intervals. This analysis therefore uses the past data to measure the indices concerned and to forecast future price trends using Brownian motion price forecasting model and Monte Carlo simulation.*

Keywords - *Beta calculations, Relative Strength Index, Exponential moving averages and Moving Average Convergence and Divergence, Price forecasting, Brownian motion model, Monte Carlo Simulation.*

I. INTRODUCTION

India is the largest global supplier of generic medicine. Industries in the Indian pharmaceutical industry supply about 50 percent of the global market for different vaccines, 40 percent of the generic demand in the US and 25 percent of all medicines in the UK. It is estimated that the Indian pharmaceutical industry will grow to US$ 100 billion and that the demand for medical devices will grow to US$ 25 billion by 2025. Drug formulations, biologicals, bulk medicines, intermediates, Ayush & herbal products and surgical products are included in pharmaceutical exports. In 2019, India's domestic pharmaceutical industry turnover reached Rs 1.4 lakh crore (US$ 20.03 billion), rising from Rs 129,015 crore (US$ 18.12 billion) in 2018 by 9.8 percent.

In a time and age of ageing populations, the continuing production of innovative and highly lucrative drugs and increasing health care costs, pharmaceutical companies have become the top players in the health care market. This is the reason why investments in pharmaceutical companies' stocks and shares continue to be cost-effective. A company's earning capacity, which depends on the investment climate and factors relevant to particular markets, management quality, competition, operating performance, capital structure, profitability and dividend policy, is used to estimate the real value of a stock. In order to choose a business to invest in, many individuals choose fundamental analysis and technical analysis to help make their purchasing and selling decisions.

II. LITERATURE REVIEW

- Lorig, Matthew and Zou, Bin (2019) investigates trading strategies based on exponential moving averages (ExpMAs) of an underlying risky asset. study carries out several Monte Carlo experiments in order to investigate how the performance of optimal ExpMA strategies is affected by variations in model parameters and by transaction costs.
- Zoicas-Ienciu, and Adrian (2016) discusses the arbitrariness involved by technical trading rules and the impossibility to prove them. The paper analyzes whether technical analysis could be consistent with rational investment behavior and what are the plausible economic arguments for its abnormal profits.
- Mishra and Sibanjan (2016)) tries to estimate the effectiveness of technical trading strategies and examine the extent to which trading profitability using technical analysis indicators explains the 'risk premium' or 'risk compensation' for capitalizing in equity markets as against assets that are comparatively risk-free using multiple regression analysis.
- Nikhil Kaushik & Dr. Madhur Raj Jai (2015) examined the top 6 pharmaceutical companies in Indian market and used technical analysis tools like MACD, ROC, RSI etc. to examine these stocks. The conclusion put equal emphasis on technical analysis to be conducted along with fundamental analysis.
- Suresh A.S. (2015) tried to maintain balance between both fundamental and technical analysis by stating their importance. In fundamental analysis the author focused on candlesticks, bar charts, moving averages etc. to reach at buy and sell criterion.

- Sakshi Varshney (2014) studied the aims at extracting and analyzing the price movements of selected companies stocks. The author emphasized on two indicators to portray the technical analysis of the selected companies.
- Shirur S. (2013) stated the reason why finance managers arrive at wrong decisions like the subprime crisis. The reason explained by author was, investors are dealing with the fundamental analysis issues while the tools used are applicable for technical analysis.

III. RESEARCH OBJECTIVES

- To study the fundamentals of two stocks in pharmaceutical sector and examine best criterion for the selection of a particular stock.
- To implement various analysis tools like Beta value, RSI, MACD, EMA to understand volume, demand for a stock, sentiment, support and resistance in the market respectively to arrive at technical analysis signals like BUY, HOLD and SELL for any given stock and arrive at final investment decision.
- To implement Brownian Motion model to past prices of Sun Pharmaceuticals Ltd. and Dr. Reddy's Laboratories Ltd. for finding future prices and examine various forecasted price trends and analyze the same to arrive at a final investment decision.

IV. RESEARCH METHODOLOGY

The data to be examined is derived from the official NSE website. The data collected and being analysed is the secondary data. Time period taken for technical analysis was from 1/05/2020 to 1/06/2020, the data was collected, and a weekly chart was analysed. The charts used for the study are taken from the software for technical analysis and the data used is past data collected from the NSE website. The techniques prescribed by various textbooks, scientific websites and applications are the various approaches used for technical research. In order to predict the potential behaviour price of the selected companies, the closing price of the stock is considered for evaluation. The stocks which are studied include:

- Sun Pharmaceuticals Ltd.
- Dr Reddy's Laboratories

A. Beta

The value of Beta reflects the volatility, or the systematic risk associated with a stock or portfolio with the market as whole.

$$Beta(\beta) = \frac{Covariance(x,y)}{Variance(y)}$$

Following rules are used to interpret beta:

If the beta value is 1 The share's movement will be along with the market.

If the beta value is >1 The share's movement will be more volatile than the market.

If the beta value is <1 The share's movement will be less volatile than the market.

B. Moving Average Convergence and Divergence (MACD)

MACD is a momentum indicator that follows trend and shows the relationship between two moving averages of prices. The MACD is calculated by subtracting the 26-day exponential moving average (EMA) from the 12-day EMA. The "signal line" is defined as a nine-day EMA of the MACD.

$$MACD = 12 \, Period \, EMA - 26 \, Period \, EMA$$

It is of three Types: Cross over, Divergence, Dramatic Rise

Crossovers

When the MACD falls below the signal line, it indicates a bearish signal, which implies that it may be time to sell. Conversely, when the MACD rises above the signal line, the indicator provides a bullish signal, which suggests that the price of the asset are likely to experience upward momentum. To avoid getting "faked out" or entering into a position too early many traders wait for a confirmed cross above the signal line before entering into a position, thus shielding them from potential losses.

Divergence

Whenever the security price diverges away from the MACD. It signals the end of the current trend.

Dramatic rise

When the MACD rises unexpectedly that is when the shorter moving average pulls away from the longer-term moving average, it is an indication that the security is overbought and will return to normal levels soon enough.

C. Exponential Moving Average (EMA)

An exponential moving average (EMA) is a type of moving average (MA) that gives more weight and preference to the most recent data points. The moving averages used for technical analysis are by nature lagging indicators as they indicate after the event has occurred.. The EMA reduces the negative impact of lag to some extent. Since the EMA calculation puts greater weight on the latest data, it holds the price dear and reacts more quickly to any changes in price.

$$EMA(n) = Price(N) \times k + EMA(n-1) \times (1-k)$$

The EMA for various periods provides resistance to the prices and thus help a trader make BUY or SELL decision

D. Relative Strength Index (RSI)

The relative strength index (RSI) is a momentum indicator used in technical analysis that measures the extent of recent price changes. RSI oscillates between zero and 100. RSI when above 70 is considered overbought and when below 30 is considered oversold.

$$RSI = 100 - \left(\frac{100}{1+RS}\right)$$

Where,

RS = Average Gain / Average Loss
Average Gain = (Total Gains/n)

Average Loss = (Total Losses/n)
n = number of RSI periods

E. Monte Carlo Simulation

In a process that cannot easily be predicted due to the presence of random variables Monte Carlo simulations are used to model the probability of various outcomes. It is a technique used to analyse the significance of risk and uncertainty in forecasting and prediction models.

While applying Monte Carlo simulation the future is predicted a lot many times. The end result of the simulation is the distribution of outcomes that can be analysed after thousands or millions of random trials.

F. Brownian Motion Model

Forecasting future prices is done using a simple formula, 'Price Today = Price Yesterday x er'. Here r is the random variable and Brownian motion can help us model such randomness. The formula to calculate 'r' has two parts:

1) Drift

It corresponds to the direction in which the rates of return have been headed in the past. It is the best approximation for the future. It is given by formula:

$$Drift = \mu - 0.5\sigma^2$$

Where,

μ: the average of the stock's logarithmic daily returns.

σ^2: the variance of the stock's logarithmic daily returns.

Volatility

It is the random component in the Brownian motion. It is given by stocks historical volatility multiplied by 'Z' of a random number between 0 and 1. The random number from 0 to 1 is a percentage. If we assume future returns are distributed normally then 'Z' of percentage between 0 and

1 gives us the number of standard deviations away from the mean. For example, the distance between the mean and events with the probability of less than 99.7% is 3 standard deviations. It is given by formula:

$$Random\ Variable = \sigma \times Z(Rand(0;1))$$

The final equation for the current stock price can be written as:

$$Price\ Today = Price\ Yesterday \times e^{(\mu - 0.5\sigma^2)+(\sigma \times Z(Rand(0;1)))}$$

V. ANALYSIS AND INTERPRETATION

A. Fundamental Ratios

Fundamental analysis is a study of measuring the intrinsic value of a security or asset and analyzing the variables that could influence its price in the future. This kind of analysis has its basis on external events and influences, as well as industry trends and financial statements.

a) Sun Pharmaceuticals Ltd.

The profitability and efficiency ratios present a positive picture of the company. Sun Pharma's current ratio over the last 5 financial years has been approximately 2 times which implies that the Company has been maintaining enough cash to fulfill its short-term obligations.

The long-term debt to equity ratio over the last 5 financial years has been 0.05 times which signifies that the company's level of debt is very low and can meet its obligations from the operations.

The interest coverage ratio over the last 5 financial years has been around 15 times which gives insight that the company has been generating sufficient for the shareholders after fulfilling its debt obligations. The dividend payout ratio of the company is also very high.

Table 1. Fundamental ratios of Sun Pharmaceuticals Ltd.

Profitability Analysis					
Year	2020	2019	2018	2017	2016
Operating Profit Margin (%)	21.28	21.7	21.23	32.22	28.63
Net Profit Margin (%)	12.7	9.17	8.18	22.24	15.95
Efficiency Analysis					
Year	2020	2019	2018	2017	2016
Return On Capital Employed (%)	10.54	10.87	10.33	21.12	18.83
Return On Net Worth (%)	9.21	6.43	5.67	19	13.78
Liquidity and Credit Analysis					
Year	2020	2019	2018	2017	2016
Debt Equity Ratio	0.17	0.24	0.26	0.22	0.25
Long Term Debt Equity Ratio	0.04	0.04	0.05	0.04	0.09
Current Ratio	1.5	1.82	1.74	2.03	2.28
Interest Cover	18.41	10.05	9.56	23.63	14.87
Cash Flow Analysis					
Year	2020	2019	2018	2017	2016
Dividend Payout Ratio Net Profit	--	21.67	44.41	4.15	19.11
Earning Retention Ratio	100	86.95	73.22	96.31	86.3

Table 2. Fundamental ratios of Dr Reddy's Laboratories Ltd.

Profitability Analysis					
Year	2020	2019	2018	2017	2016
Operating Profit Margin (%)	14.1	20.57	16.46	17.41	23.02
Net Profit Margin (%)	11.56	12.62	6.62	9.1	13.68
Efficiency Analysis					
Year	2020	2019	2018	2017	2016
Return On Capital Employed (%)	11.09	13.65	8.1	9.41	18.48
Return On Net Worth (%)	12.98	13.9	7.53	10.53	16.95
Liquidity and Credit Analysis					
Year	2020	2019	2018	2017	2016
Debt Equity Ratio	0.11	0.24	0.4	0.4	0.27
Long Term Debt Equity Ratio	0.01	0.16	0.2	0.04	0.09
Current Ratio	1.33	1.31	1.31	1.05	1.37
Interest Cover	19.61	26.78	18.14	25.51	35.61
Cash Flow Analysis					
Year	2020	2019	2018	2017	2016
Dividend Payout Ratio Net Profit	19.32	20.52	42.16	26.23	19.27

b) Dr Reddy's Laboratories Ltd

The profitability and efficiency ratios show that the company has been performing really well in the last 5 years. Dr. Reddy's current ratio over the last 5 financial years has been approximately 1.3 times which indicates that the company has been maintaining sufficient cash to meet its short-term obligations.

Over the last 5 financial years the long-term debt to equity ratio has been very low which implies that the company's level of debt is very low and can fulfill its obligations from the operations.

The interest coverage ratio over the last 5 financial years has been around 25.13times which indicates that the company has been making enough money for the shareholders after fulfilling its debt obligations. The dividend payout ratio of the company is also very high and satisfactory.

B. Technical Analysis: Perusal of Chart and Indicators

To have an overall picture of the price of the stocks the most applied indicators are Moving Average Convergence and Divergence, Relative strength index, Beta value, Exponential Moving Average. The RSI and Moving averages are momentum oscillators they give information regarding the price trend of a stock and the strength of that trend; it also conveys the information regarding trend reversal. Beta coefficient states the change in price of a stock with respect to change in prices in the market, and thus it serves a s a great tool which throws light upon the volatility associated with stock.

Table 3. Values corresponding to key technical analysis tools

Stock	Beta	RSI	MACD	EMA 20	EMA 50	EMA 100
Sun Pharmaceuticals Limited	0.58	67.7141	4.0990	467.39	463.04	461.68
Dr. Reddy's Laboratories	0.11	57.7725	40.3928	3960.28	3902.42	3875.18

Sun Pharmaceuticals Ltd.

The beta value of sun pharmaceuticals ltd. is less than one which goes to show that the volatility of the stock is much lower in comparison to the market. All the three exponential moving averages i.e. 20-day, 50 day and 100 day, all lie below the price line which indicates a BUY signal in short term, medium term, long term. Thus, the exponential moving average as an indicator is pointing towards a capital BUY signal. The value of Relative Strength Index (RSI) is around 67 conveys it is hovering around 70 that means the stock can enter the overbought region in any future periods. In this case, the RSI signal might sustain itself i.e. it keeps floating between 50 and 70 given the strong BUY signal from exponential moving average. The MACD line is below the signal line but both lines have also crossed each other, and it can be clearly seen that they are broadening. The crossover of both the lines reflect a change in the bearish sentiment and broadening reflects strong bullish sentiment of the market. It also goes to show that the trend that followed is going to be sustained. Thus, giving a strong BUY signal. Hence, the bottom line of the technical analysis of Sun Pharmaceuticals is the indication of a strong BUY signal.

Fig. 1 Technical chart of Sun Pharmaceuticals Ltd.

Dr Reddy's Laboratories Ltd.

The beta value is 0.11 which means that the volatility of the stock is much lower when compared to the market benchmark. All the three exponential moving averages i.e. 20-day, 50 day and 100 day, all lie below the price line which indicates a BUY signal in short term, Medium term and long term. Thus, the exponential moving average as an indicator is pointing towards a BUY signal. The value of Relative Strength Index (RSI) is around 58 which indicates that the RSI value is meandering in the acceptable levels. Thus, the RSI provides the insight that there is not going to be any trend reversal. Thus, the RSI indicator is providing a BUY signal. The MACD line is above the signal line which reflects a bullish sentiment and is pointing towards the BUY signal. Thus, the overall technical analysis for the Dr. Reddy laboratories ltd. show that the pointer is inclined towards a BUY signal.
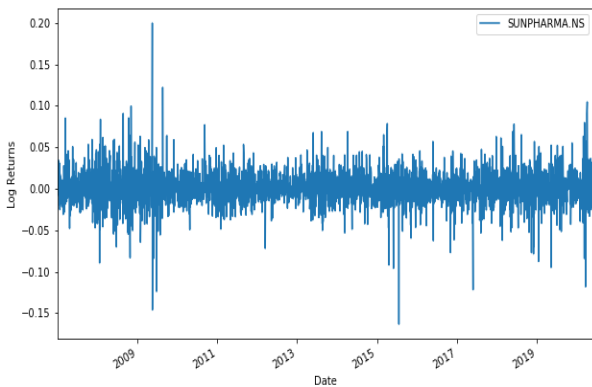

Fig. 2 Technical Analysis of Dr Reddy's Laboratories Ltd.

C. Price Forecasting and Brownian Motion model

Monte Carlo Simulations are performed on the log return of share prices. The log returns are simulated for a random value of Z and graph portraying 10 different price trends was achieved using python algorithm.

a) Sun Pharmaceuticals Ltd

The historical data for the Sun Pharmaceutical's past performance was extracted from yahoo finance. The time period for which the simulations are carried out is from 1 Jan 2007 to 1 June 2020.

The average of daily returns for Sun Pharma Ltd. is 0.00062. The variance and standard deviation are 0.000434 and 0.020829 respectively. The value of the drift component of the Brownian motion is 0.000403.

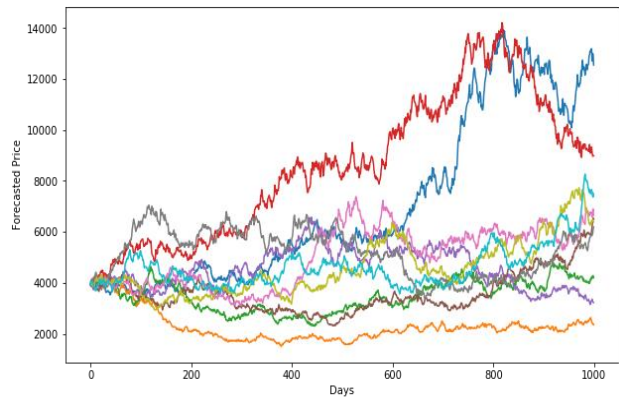**Fig. 3 Forecasted prices with ten iterations for Sun Pharmaceuticals Ltd.**

Fig. 4 Graph of Daily Log returns for Sun Pharmaceuticals Ltd.

b) Dr Reddy's Laboratories Ltd

The historical data for the Dr. Reddy's Laboratories past performance was extracted from yahoo finance. The time period for which the simulations are carried out is from 1 Jan 2007 to 1 June 2020.

The average of daily returns for Dr. Reddy's Laboratories Ltd. is 0.000515. The variance and standard deviation are 0.000345 and 0.018582 respectively. The value of the drift component of the Brownian motion is
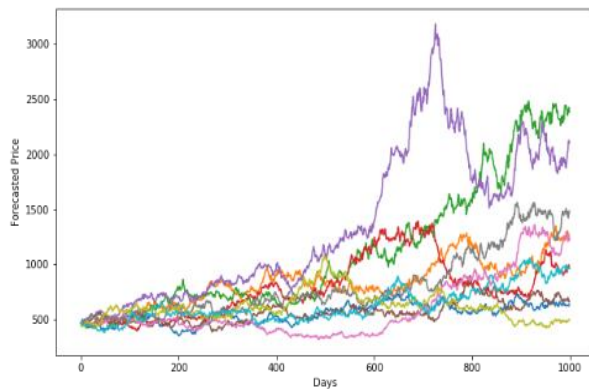

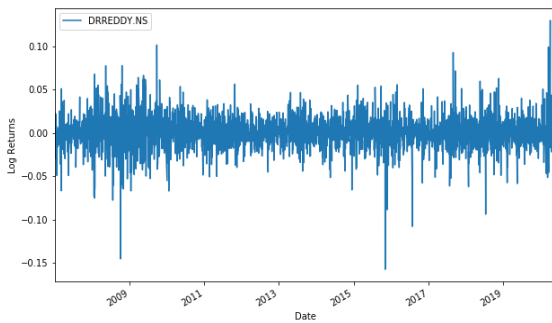**Fig. 5 Forecasted prices with ten iterations for Dr Reddy's Laboratories Ltd.**

Fig. 6 Graph of Daily Log returns for Dr Reddy's Laboratories Ltd.

VI. LIMITATION

The analysis in the study is done only for the stocks that are enlisted on the NSE. The study showcases limited technical analysis methodologies to incur a buy or sell selection criterion. The charts taken into consideration are weekly charts thus portray information for a limited timeframe.

EMA puts more faith in the recent price data but there is an ambiguity in the view that whether importance should be given to recent data points because sometimes it reflects a bias and provides a trader with false alarms. The EMA calculation based totally on the historical price data and it is often believed that markets are efficient.

To calculate the beta coefficient, it is assumed that the stock prices are normally distributed. A stock with a low beta decreases the volatility of the portfolio but the stock might be in long-term downtrend and thus adding it to the portfolio brings no gain to the investor. Since beta value is derived using historical data points, it becomes less significant for investors looking to predict future movements of a stock. Beta value is not useful for analysing a long-term trend of the stock as the volatility depends on various factors like the stage of growth the company is in and others.

The insights from the indicator are reliable only when they confirm to the long-term trend. RSI values are valuable only in oscillating markets where the stock price is alternating between bullish and bearish price trends.

VII. CONCLUSION

- The key performance indicators for both Sun Pharmaceuticals ltd. and Dr. Reddy's laboratories show a positive scenario for the companies. Also, the key ratios i.e., liquidity ratio, solvency ratio, etc. show an increase in trend for the last 5 years. Thus, the bottom line is that both firms have very strong fundamentals which is supported by fundamental analysis carried out in brief for this study.
- The Technical Analysis carried out in the study show a BUY signal for both the companies which are Sun Pharmaceuticals Ltd and Dr Reddy's Laboratories Ltd. The analysis of various technical indicators like RSI, Beta, MACD, EMA can provide a trader with foreseeable input regarding the stock prices. Thus,

helps an investor decide his entry and exit points regarding a stock and increase profits.

- The forecast of price trends provides us with very good insight with respect to the future price of Sun Pharmaceuticals Ltd. The future price range for Sun Pharma vary between Rs.450 to Rs.3000. None, of the price trends in the forecast show a considerable loss, not even in the worst-case scenario. Thus, the graph gives a green signal for future investments in sun pharma. This analysis holds true given the stock is experienced only with idiosyncratic risk.
- The 10 different forecasts that are obtained for Dr. Reddy's laboratories ltd. show up price range which has its lower bound around Rs.2000 and a higher bound of R.10000 for next 1000 days after July 1, 2020 in the future. Considering the beta value of the stock and strong fundamentals of the company the price trends close to the extreme bottom seem less probabilistic. Thus, while analyzing the forecast one can vouch for price trends which show a positive rate of change of prices. Thus, the investment in Dr. Reddy's for long term can turn out to be a profitable decision.

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