Development of an Algorithm for Stock Market Trading

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Abstract- Stock market is a highly volatile market where stocks of different public limited companies are traded. Investors often use their judgement and more often tools like fundamental and technical analysis to take decisions on buying and selling of stocks. Most of the algorithms developed for stock market trading are based on price movements. In this paper we attempt to study the price movements and the fundamentals of top four auto stocks traded on the National Stock Exchange to find out the steps to develop an algorithm that would suit and protect the investor's requirements.

Keywords – Algorithmic trading, Stock market, Fundamental Analysis, Technical Analysis

1. INTRODUCTION

In today's era of computerisation one has to accept certain decisions are better taken by computers than our own human intellect. The reason being, that the analytical speed of computers is manifold as compared to the human brain. Having said so, we cannot forget that computers decisions are based on a program developed by human intellect.

While studying the high frequency trading (HFT) , various algorithms being used for trading like VWAP (Volume Weighted Average Price) , TWAP (Time Weighted Average Price) and also specialised algorithms like the Zero Intelligence Plus (ZIP) algorithm developed by Dave Cliff in HP lab, most of them seem to be based on the technical aspects or movements of stock.

This paper makes an attempt to analyse the technical movements of stock prices of four auto stocks listed on the National Stock Exchange (NSE). It further tries to analyse the fundamental aspects of the auto companies by studying their annual reports and using six ratios as a yardstick for comparison.

2. PAST RESEARCH

Peter Gomber and Markus Gsell have compared human traders with algorithmic trades showing a stark difference between the way the two behave and their trading approach. Archit , Kaushik and Anshul have described various algorithms in their paper and have also attempted to say that large institutional investors have an advantage over small investors due to trading algorithms. This also establishes a need for protection of the small investor's interest and shows as to why regulatory authorities like the Securities Exchange Board of India) SEBI has begun with the approval of algorithms before implementation.

Terrence , Charles and Albert in their paper study the relationship between algorithmic trading and liquidity and prove that trading via algorithms improves liquidity and enhances the informativeness of quotes. Andrei A.

Kirilenko and Andrew W. Lo in their paper of Moody's law versus Murphy's law have well established that algorithmic trades have made a permanent mark in the stock markets but it shoulders a greater responsibility on the regulators of the market. Andrei , Mehrdad and Albert S. Kyle study the flash crash which shows the vulnerability of the market due to computerised trades.

Many more papers and articles were studied all leading to mainly the permanency that Algorithmic Trading has established in the market and a strong financial trading system to counter the volatility and liquidity impact that it may cause.

3. FUNDAMENTAL VERSUS TECHNICAL ANALYSIS

Fundamental and Technical Analysis can be called to be opposite approaches for arriving at a decision. Users of fundamental analysis believe that if the fundamentals of the company like the balance sheet, the income statement, the overall growth of the company are strong then the stock price will be on a rise in future and such a company is a stable company to invest. Technical analysis believers observe and analyse the movements in the stock prices and take a decision on certain indicators based on price movements.

When we try to judge as to which approach we should follow and choose the better of the two, both the approaches seem rational to take a final decision. When we observe the various algorithms developed like VWAP, TWAP, POV, ZIP we find the basis is more related to the price movements in the past which tapers more towards technical analysis. But technical analysis ignores the fact that prices movements can also be related to behavioural finance where the investors are pulled to a stock due to variety of reasons making it overvalued. Over a period of time a company with strong fundamentals only will be able to maintain the correct price for its stock.

Keeping the above in mind this paper attempts to study certain stocks through a technical and fundamental approach and tries to rationalise that if a blend of both approaches is taken a suitable algorithm can be developed.

4. DATA SET

To analyse the two approaches we have taken the follow dataset –
1. Stock Index – NSE
2. Stock Segment – Auto Industry. Auto Industry is classified into two-wheelers, three-wheelers and four-

wheelers segment. It can be further classified as passenger, utility and commercial vehicles.
3. Stock Sub Segment – Commercial Vehicles. Light Commercial Vehicles and Heavy Commercial Vehicles (LCV and HCV)
4. Top 5 companies chosen for analysis based on highest market capitalisation as on 31st March 2014.
   a. Tata motors
   b. Eicher motors
   c. Tata motors (D)
   d. Ashok Leyland
   e. SML Isuzu
   In the above scenario, Tata Motors (D) has not been considered for analysis. Reason being Tata motors (D) stands for a stock of Tata Motors with differential voting rights. (Tata Motors raised about Rs 4,200 crore via a two part rights issue, the first part had on offer ordinary shares priced at Rs 340 a share, that's a 20% of discount to the stock price on the day of announcement.) So to have comparable companies we have eliminated the differential voting rights stock of Tata motors and retained only the normal stock. So we would be analysing stocks of 4 companies – Tata motors , Eicher motors , Ashok Leyland and SML Isuzu.
5. Period and source of data chosen for analysis –
   a. Fundamental analysis – The annual reports of the 4 companies for the period ending 31st March 20143 have been taken. The Balance sheet, profit and loss account and overall growth has been analysed. 6 major ratios have been used to critically examine the financial fundamentals of the company.
      i. ROCE (Return on Capital Employed) - This ratio will be of peculiar interest to investors. Keeping in mind the capital intensive nature of these companies ROCE was chosen over ROE (Return on equity) since ROE only analyses the profitability related to a company's equity. When we are analysing fundamentals we wanted to bring the companies on a similar platform to make them comparable.
      ii. D/E Ratio (Debt Equity Ratio) – As we have chosen the ROCE we have analysed companies debt percentage to analyse the burden the equity members have to bear and the return they expect in such a scenario.
      iii. ROA (Return on Assets) – This will indicate the management's efficiency in generating income from the assets employed. Auto industry being capital intensive in nature this ratio will help the investor take an informed decision.
      iv. GP (Gross Profit) Ratio – Chosen this ratio to check the operational profitability.
      v. NP (Net Profit) Ratio – Chosen this ratio to analyse the overall profitability in an easy way.

      vi. EPS (Earnings per Share) – As an equity investor EPS plays a very crucial role. While deciding this ratio there was a dilemma as to whether the P/E(Price Earnings Ratio) be considered or not. After due deliberation we have not taken the same for our analysis since we wanted to analyse the companies purely on their fundamentals and so decided not take stock price into consideration.
   We have restricted the fundamental analysis to these six ratios.
   b. Technical Analysis – For technical analysis the data set is taken for the first quarter of the financial year succeeding 31st March 2013. As in fundamental analysis we have restricted to annual reports of 31st March and not considered the further quarterly reports , we have restricted this data set also to the first quarter (April , May and June 2013).
6. Source for data –
   Annual report – Company's website
   Stock prices–Website of National Stock Exchange

5. DATA ANALYSIS AND INTERPRETATION

As mentioned above first the companies were analysed and ranked as per their fundamentals-

Table 1

Company	Symbol
Ashok Leyland Limited	ASHOKLEY
Eicher Motors Limited	EICHERMOT
SML Isiuzu Limited	SMLISUZU
Tata Motors Limited	TATAMOTORS

Table 2 Information as on 31st March 2014

	Tatamotors	Ashok Leyland	Eicher motors	SMLI suzu
ROCE	5.95	7.01	44.03	15.74
GP	-0.22	3.97	16.64	5.8
NP	0.64	3.45	15.63	3.6
ROA	59.98	16.74	303.76	182.49
D/E ratio	0.75	0.79	0	0.61
EPS	0.95	1.63	103.04	25.18

From the above information the overall ratios of Eicher motors actually very encouraging than others. It is almost six to seven fold as compared with its peers and so gets the first rank. Followed by Eicher motors is SMLIsuzu which is also showing comparatively strong fundamentals. Ashok Leyland can be ranked third followed by Tata motors. Since 2009 Tata motors is witnessing financial difficulties following the JLR (Jaguar and Land Rover) acquisition and in the month of January 2013 some negative announcements on profitability by JLR , its UK subsidiary, had some overall negative impact. Tata motors is the weakest when it comes to its fundamentals. If you study the annual report in detail then also these 6 ratios justify the financial position of the company well.
Ranking based on fundamentals
1. Eicher
2. SML Isuzu

3.   Ashok Leyland
4.   Tata motors

Now let us see as per the stock price movements how these companies performed in the following first quarter of financial year 2013-14

Table 3

Company	Underlying Close Price		
	April	May	June
ASHOKLEY	22.15	22.95	23.35
EICHERMOT	2551.85	3061.95	3690.35
SMLISUZU	304.85	304.55	302.9
TATAMOTORS	265.5	297.35	314.05

Table 4

Company	Change in price		Trend
	M1	M2	
	May and April	June and May	
ASHOKLEY	0.8	0.4	Upward
EICHERMOT	510.1	628.4	Upward
SMLISUZU	-0.3	-1.65	Downward
TATAMOTORS	31.85	16.7	Upward

If we analyse the market movement Eicher motors clearly shows an upward trend and the stock has considerably risen in price. Following that as per our fundamental analysis we expected SML Isuzu to take the second place but surprisingly Tata motors occupies the second place with a good increase in the price over the quarter. Similar to our fundamental analysis Ashok Leyland occupies the third position followed by SML Isuzu which occupies the last position , surprisingly contrary to its fundamentals showing a downward trend in the price.

Ranking based on technical
1.   Eicher
2.   Tata Motors
3.   Ashok Leyland
4.   SML Isuzu

6.DEVELOPMENT OF AN ALGORITHM

Now given a choice, we observe that both the techniques – fundamental and technical are based on different paradigms and so have provided different results. Generally in a stock market we will have different types of investors, some having the long term investment in mind as opposed to some having the short term investment. Fundamental analysis will be of greater use to long term planners as opposed to technical analysis which would mostly suit the short term requirement. But a blend of both will be more useful to investors. So an algorithm should be developed which can incorporate both these aspects.

Steps for development of the algorithm –
1. Inputs – Key financial ratio , trend of last one year's closing price movements
2. Algorithm
    TWAP or VWAP depending upon the amount of money being planned to invest and the market volatility.
    (HMM or ZIP can also be used as a base if more accurate results are expected)

But it will have its constraints restricted to the key financial ratios. This will ensure that investment takes place considering both the price movements as well as the strong fundamental aspects.
3. Application of the algorithm on the test data
4. Suitable modifications based on test data results
5. Application in real market scenario

A stop loss mechanism can also be red flagged in the algorithm wherein a retail investor is rest assured that the algorithm will not go beyond the risk appetite and loss bearing capacity of the investor.

7.CONCLUSION

Stock market is highly volatile and unpredictable in nature. Market sentiments can vary or fluctuate not only due to the performance and announcements of a company but also due to sentiments of investors towards a particular stock. The Capital Asset Pricing Model helps us arrive at a particular price the stock should ideally have and that is when we observe the efficient frontier and that the prices we find that the stock overvalued or undervalued. This happens due to the market sentiments. That's how we discuss about the Random Walk Theory. But in case the fundamentals of the stock are good then we can say that the price will remain stable and should not go downward beyond a particular limit. Having said so the current price trends are also important since no one wants to lose money that can be earned from a rising stock. An algorithm so developed to best suit the requirements of the investors and ensure benefit from both the approaches would be the ideal one.

REFERENCES

1. Terrence Hendershott and Ryan Riordan "Algorithmic Trading and Information" , University of Sydney 4th Annual Microstructure Conference, (June 21, 2011)
2. Gomber Peter ,Gsell Markus "Algorithmic trading engines versus human traders: Do they behave different in securities markets?" CFS Working Paper, No. 2009/10 Provided in Cooperation with: Center for Financial Studies (CFS), Goethe University Frankfurt (2009)
3. Archit Bansal , Kaushik Mishra , Anshul Pachouri "Algorithmic Trading (AT) - Framework for Futuristic Intelligent Human Interaction with Small Investors, International Journal of Computer Applications (0975 - 8887) (2010)
4. Human Interaction with Small Investors" International Journal of Computer Applications (0975 - 8887) Volume 1 – No. 21 (2010)
5. Terrence Hendershott , Charles M Jones and Albert J Menkveld Does Algorithmic Trading Improve Liquidity? The Joural of Finance VOL. LXVI, NO. 1 (February 2011)
6. Andrei A. Kirilenko and Andrew W. Lo "Moore's Law versus Murphy's Law: AT and its Discontents" , Journal of Economic Perspectives Volume 27, Number 2—(Spring 2013)
7. Andrei Kirilenko , Mehrdad Samadi , Albert S. Kyle "The Flash Crash: The Impact of High Frequency Trading on an Electronic Market" , Working paper series (January 12, 2011)
8. Book by Ernest P Chan, Quantitative Trading , Wiley Trading
9. Book by Kevin.S on Securities Analysis and Portfolio Management by PHI Learning

Web References
10. http://www.nseindia.com/live_market/dynaContent/live_watch/pre_open_market/pre_open_market.htm [Accessed on 2nd April 2014]
11. Sebi's   website   - http://203.199.247.102/cms/sebi_data/attachdocs/1391769435895.pdf [Accessed on 15th April 2014]
12. http://www.thehindu.com/business/markets/sebi-tightens-algorithmic-trading-norms/article4736556.ece [16th April 2014]
13. www.economictimes.com [Accessed during March and April 2011]
14. www.ft.com [Accessed during March and April 2014]