

TESTING THE EFFICIENCY OF OSCILLATORS IN INDIAN STOCK MARKET

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ABSTRACT

Technical analysis of stock prices is the study of market actions, generally through charts, with the objective to predict the future price trend. The market action includes two primary sources of information viz. Prices and volume. Oscillators, the momentum indicators, are important part of the technical analysis. These indicators are bounded in a range and provide indications about overbought or oversold conditions. This study aims to test the efficiency of four popular oscillators viz. Relative Strength Index (RSI), William's R, Stochastic and MACD in Indian stock market. The study takes the sample of 3 years daily prices for the 50 stocks that are part of a CNX Nifty index. This study adds to the existing literature on technical analysis. The results of the study are relevant to traders as well as retail investors.

KEYWORDS: Technical Analysis, Oscillators, RSI, MACD, Stochastics, William's R

INTRODUCTION

Technical analysis is a set of techniques, mostly using charts, used to forecast stock prices or stock price movements with the help of study of historical prices and volume information. Murphy (1999) defines technical analysis as "Technical analysis is a study of market action, primarily through the use of charts, for the purpose of forecasting future price trends." He further states that market action includes information about price, volume and open interest (in case of futures and options). Edwards et al. (2007) define technical analysis as "Technical analysis is the science of recording, usually in graphic form, the actual history of trading (price changes, volume of transactions, etc.) in a certain stock or in the "Averages" and then deducing the from that pictured history the probable future trend". Pring (2002) suggest that "the technical approach to investment is essentially a reflection of the idea that prices move in trends that are determined by the changing attitudes of investors toward a variety of economic, monetary, political and psychological forces". Hence technical analysis can be explained as a study of stock prices and volume to indirectly study the effect of the effect of many factors on the stock prices, in order to predict the future price trend.

One of the basic assumptions of technical analysis is that stock prices move in the trend. Another assumption that technical analysis make if that trends remain intact until reversed (Murphy, 1999). Keeping these two assumptions in mind, it can be inferred that technical analysis assumes that stock prices will remain on a particular trajectory, whether upwards or downwards, till the time there is a confirmation of the reversal of such trajectory. Often these trends are stretched and reach into the extreme zone of an uptrend or downtrend. Astute traders would take positions contrary to trends when prices reach in such extreme zones. The oscillators such as Rate of Change (ROC) oscillator and Relative Strength Index (RSI) are expected to help the investors to identify whether the price has reached such extreme zones. If the investors are able to identify the extreme level of stock prices they can take opposite trades and earn abnormal profits.

The objective of this paper is to test whether the trades suggested by the oscillators can earn significantly higher profits than a simple buy and hold strategy in Indian context. This study is important for two reasons. Firstly, literature on technical analysis is mostly limited to the western countries. There is only a handful of studies in Indian context. Secondly, there is hardly any study which focuses on oscillators in Indian context. Therefore, this study attempts to bridge the gap.

LITERATURE REVIEW

Chong et al. (2011) investigate the profitability of Rate of Change (ROC) oscillator for stock indices in eight countries viz. USA, UK, Germany, Hong Kong, Japan, South Korea, Taiwan, and China. They compare Simple Moving Average (SMA), Exponential Moving Average (EMA), Bollinger Bands, and ROC for these indices. Their results suggest that in developing markets such as China, Taiwan etc. EMA outperforms the ROC.

Metghalchi and Gomez (2013) investigates the predictive ability of six technical analysis method viz. Moving Average (MA), Relative Strength Index (RSI), Parabolic Stop and Reverse (PSAR), Directional Movement System (DMS), Stochastic, and Moving Average Convergence and Divergence (MACD). These six methods are a mix of technical tools and oscillators. The results of the study suggest that if the transaction cost is lower than 0.50%, the investors will benefit from technical analysis rules.

In a similar vein, Chong et al. (2010) test four technical trading indicators on BRIC countries and find that technical trading works only for Russian market after the transaction cost are considered. Similarly, Park and Irwin (2010) conclude that technical trading rules are not profitable in U.S. futures markets. Metghalchi et al. (2012) test the moving average rule in European markets and find that for smaller exchanges the technical analysis works better than that for larger exchanges.

Peat et al. (2005) investigates the relationship between technical indicators and Australian market index. The results of the study show that the combination of the distance between the index, a simple moving average and an oscillator is the best combination.

Yazdi and Lashkari (2013) use the MACD indicator for the forex market. Their results suggest that the MACD works best in the EURUSD market. Further, the results suggest that MACD produces more profitable buy signals than sell signals.

The above literature suggests that there is a dearth of the studies on efficacy of oscillators, particularly in the Indian context. Secondly, the evidences so far are mixed. Therefore, there is a need to conduct a study on the effectiveness of oscillators in Indian stock market.

DATA AND METHODOLOGY

Sample Data

The study takes a daily of stock prices of top 50 companies which form part of the Nifty Index. The reason for using the sample of top 50 companies is to eliminate the liquidity concern. Since these stocks are very frequently traded on a daily basis on the National Stock Exchange of India, there is no concern about the availability of buyers and sellers and therefore the liquidity cost is minimized. Daily stock prices of these 50 companies are taken for a period of 3 years, starting from Apr 1, 2011 and ending on Mar 31, 2014. The reason for the given period is that in April

2014 the general elections for the Central Government of India were held, due to which the erstwhile ruling political party was replaced with another political party. This change has brought significant changes in the government economic and monetary policies. To reduce the effect of the shock in stock prices rising due to change of hands in the Central Government, the period before the general election has been taken for this study. During this period there was no change in the Central Government of the country and therefore it is expected that political shocks have been minimized in order to ascertain the true effect of the oscillators. For every company for each day four data points were extracted viz. Open price, high price, low price and the closing price. In total 149,800 data points were extracted. This comprises of 749 trading days over three years, four observations for each day for 50 companies.

Methodology

The objective of this paper is to test the efficiency of oscillators in Indian stock market. For this purpose, four oscillators have been chosen viz. Relative Strength Index (RSI), Moving Average Convergence and Divergence (MACD) crossover, Stochastic %K, and William's R. The following steps are performed to test whether oscillators provide significantly higher returns than buy and hold strategy:

- The first step in the analysis is to compute the values of these oscillators on a daily basis.
- The second step is to identify the trade based on each of these oscillators independently.
- In the third step the overall gains/ losses are computed for each oscillator for each company.
- Next is to compute the gain/loss of the buy and hold strategy is followed.
- The last step is to test whether the gain/loss under any of the oscillator is significantly higher than the gain/loss in the buy and hold strategy.

Below is the decrypt of the computation of the four oscillators:

Four oscillators RSI, MACD, Stochastic %K and William's R have been used in this study. Below is the method used to compute the values of each of the oscillators.

Relative Strength Index (RSI): To compute the values of RSI, the conventional day periodicity of 14 days has been used. RSI lies between 0 to 100. The following formula is used to compute RSI:

$$RSI = 100 - \{100/(1+RS)\}$$

Where, RS denotes the relative strength computed by the following formula:

$$RS = \text{Average gain in 14 days} / \text{Average Loss in 14 days.}$$

In order to compute RSI, following steps were performed:

- Firstly, the gain for each day is computed if the closing stock price for the day was higher than the closing price of the previous day. If the closing price of the day is lower than the closing price of the previous day, a loss is computed.
- In the second step, an average of all the gains is computed for a period of 14 days. Similarly, an average of all the losses is computed for a period of 14 days.

- Next step computes the RS on a rolling basis by dividing the average gain by the average loss computed in the previous step.
- In the last step the RSI is computed by using the above mentioned formula.

Moving Average Convergence and Divergence (MACD) crossover: To compute MACD the study uses the conventional periodicity of 26 days, 12 days and 9 days. Two line viz. MACD Line and Signal Line are used. Following steps were performed to compute MACD crossovers:

- A 26 day and a 12 day moving averages were computed based on the closing price of each stock.
- In the second step, the difference of the above two averages computed. This forms the MACD line for a stock.
- In the third step, the Signal line is computed by computing the 9 day moving average of the MACD Line.
- In the last step, the crossovers of MACD Line and Signal Line are computed.

Stochastic %K: Stochastic is a momentum oscillator that takes the range of high and low prices in consideration. Stochastic measures the close price of the stock relative to the range of high and low for a specified period. This study uses the conventional 14 days of computing the high low range. The following steps were performed to compute Stochastic oscillator:

- The high and low range is identified for each stock in the 14 day period preceding the current day.
- The closing price of the day is observed.
- Stochastic is computed by using the following formula:

$$\text{Stochastic} = (\text{Current close} - \text{Lowest Low}) / (\text{Highest high} - \text{Lowest Low}) * 100$$

William's %R: The basic principle behind William's R is similar to Stochastic. It compares the current close with the high and low range of price and suggests whether the price is excessively high or low. The study uses the conventional 14 day period to look for the range of high and low prices. The following steps were performed for this purpose:

- The high and low range is identified for each stock in the 14 day period preceding the current day.
- The closing price of the day is observed.
- William's %R is computed using the following formula:

$$\text{William's \%R} = (\text{Highest High} - \text{Current Close}) / (\text{Highest High} - \text{Lowest Low}) * (-100).$$

In order to identify trades, the below rules were followed:

- It was assumed that there is no stock in the portfolio at the beginning, i.e. on April 1, 2011.
- A buy trade is triggered when the oscillator crosses a particular point and moves in the oversold region. Following are the rules when buy is triggered under each of the oscillators. These are the conventional rules.
 - RSI: A buy trade is triggered when RSI goes below the level of 30

- MACD Crossover: A buy trade is triggered when the MACD line crosses the Signal line and goes above the Signal Line.
 - Stochastic %K: A buy trade is triggered when the Stochastic oscillator goes below the level of 20.
 - William's % R: A buy trade is triggered when the William's %R oscillator goes under -80.
- Similarly, a sell trade is triggered when the oscillator crosses a particular point and goes in overbought region. Following are the rules when sell is triggered under each of the oscillators:
- RSI: A sell trade is triggered when RSI goes above the level of 70.
 - MACD Crossover: A sell trade is triggered when the MACD Line crosses and goes below the Signal line.
 - Stochastic %K: A sell trade is triggered when the oscillator goes above the level of 80.
 - William's %R: A sell trade is triggered when the oscillator goes above -20.
- Short selling is not allowed. Therefore, only those stocks which are previously owned only can be sold. This is also inferred that the first trade for any stock is a buy trade.
 - All trades occur at the closing price.
 - It has been assumed that there is no transaction cost.
 - Investment horizon begins at April 1, 2011 and ends on March 31, 2014. On Mar 31, 2014 all holdings are liquidated at the closing price.

RESULTS

The below segment provides the preliminary statistics of the study.

Preliminary Statistics

Table I provides the preliminary statistics of the study.

Table 1: Preliminary Statistics

	Strategy				
	Buy and Hold	RSI	MACD	Stochastic %K	William % R
Average Return	24.21%	22.52%	11.92%	9.96%	15.14%
Minimum Return	-58.26%	-40.02%	-108.38%	-49.43%	-49.43%
Maximum Return	197.70%	92.54%	83.75%	110.44%	234.69%
Variance	35.54%	8.58%	18.38%	12.69%	22.10%
Average number of transactions per stock	NA	6.18	56.20	36.76	36.76

As per the above table, the buy and hold strategy earns the highest return, but also has the highest variance. The minimum return under buy and hold strategy comes to (-) 58.29% and the highest return is at 197.70%. The RSI strategy provides second highest return which is only slightly lower than the buy and hold strategy.

However, RSI strategy has much lower variance of 8.58% as compared to 35.54% under buy and hold strategy. With an average of 6.18 per stock over three years, it provides a minimum return of (-) 40.02% and maximum return of 92.54%.

The strategy based on MACD leads to the highest number of trades at an average of 56.20 trades per stock over a three year period. The average return under this strategy is close to a half of the average under RSI. It provides only an average return of 11.92% with a variance of 18.38%. The lowest return under this strategy is -108.38% with a high of 83.75%. Stochastic %K and William's %R provides the same number of trades, but has a different average return and variance. The average return under Stochastic %K is 9.96%, whereas the average return under William% R is 15.14%. The variance stands at 12.69% and 22.10% respectively.

The next segment provides the result of testing of differences in average return under different strategies.

Testing of Average Return

Each of the strategies based on an oscillator is tested against the 'buy and hold' strategy. In order to test the average returns, t-test is used. The results of the testing are provided below:

- **RSI vs. Buy and Hold**

Table II provides the results of testing of average return under RSI and 'buy and hold' strategy. The average return under RSI is 22.52%, whereas under the 'buy and hold' strategy, it is 24.21%. The variance is 8.58% and 35.54% respectively. The t-statistic for testing of means comes at 0.179 with a p-value of 0.4288. The difference between average returns under two strategies is not significant at 5%.

Table 2: RSI Vs Buy and Hold

	<i>Buy and Hold</i>	<i>RSI</i>
Mean	24.21%	22.52%
Variance	35.54%	8.58%
t Stat	0.179	
p-value	0.4288	

- **MACD Vs. Buy and Hold**

Table III presents the results of testing of average return between the MACD and 'buy and hold'.

Table 3: MACD Vs. Buy and Hold

	<i>Return (Buy and Hold)</i>	<i>Return (MACD)</i>
Mean	24.21%	11.92%
Variance	35.54%	18.38%
t Stat	1.183	
p-value	0.1198	

The average return under MACD is 11.92% and that under 'buy and hold' strategy is 24.21%. The variance comes in 18.38% and 35.54% respectively. The t-statistic comes at 1.183 with a p-value of 0.1198. Hence, the difference in average return is significant only at the 12 % significance level. The difference between average return is not significant at 5% significance level.

- **Stochastic %K Vs. Buy and Hold**

Table IV presents the results of testing of difference between the return under Stochastic %K and 'buy and hold' strategy. The average return under Stochastic %K is 9.96% with a variance of 12.69% as compared to that under 'buy and hold' strategy where the average return is 24.21% with a variance of 35.54%. The t-statistic comes at 1.45 with a p-value of 0.075. The results suggest that the return under two strategies are different at a significance level of 8%.

Table 4: Stochastic %K Vs. Buy and Hold

	<i>Buy and Hold</i>	<i>Stochastic</i>
Mean	24.21%	9.96%
Variance	35.54%	12.69%
t Stat	1.450	
p-value	0.075	

- **William's %R Vs. Buy and Hold**

Table V presents the results. The average return under William's %R is at 15.14% with a variance of 22.10%. The t-statistic comes at 0.845 with a p-value of 0.2001. The results suggest that returns under the two strategies are not different at the 5 % significance level.

Table 5: William's %R Vs. Buy and Hold

	<i>Buy and Hold</i>	<i>William %R</i>
Mean	24.21%	15.14%
Variance	35.54%	22.10%
t Stat	0.845	
p-value	0.2001	

CONCLUSIONS

Oscillators are very widely used by the market participants to gauge the stock price movement and make predictions about it. This study investigates whether oscillators provide a significantly different return than the buy and hold strategy. The objective of this study is to test the efficiency of oscillators in providing better forecast ability to the trader/investor. Only when the strategy under an oscillator provides the highest return, there will be motivation to use the oscillator. In order to test the efficiency, the study uses four most widely used oscillators vs. Relative Strength Index (RSI), Moving Average Convergence and Divergence (MACD), Stochastic %K, and William's R.

The study takes the sample of three year's daily stock prices of 50 companies forming part of the CNX Nifty Index. The study finds that overall the oscillators fail to provide any significantly different return than the buy and hold strategy. In fact the average return is highest in buy and hold strategy, however, with much larger variance. Stochastic %K provides different returns than buy and hold strategy, but only with a significance of 8%. Other strategies fail to provide any significantly different results.

One of the biggest implications of the results of this study is that oscillators must be used with a caution. As a matter of fact, the principles of technical analysis also suggest that oscillators are secondary indicators and must be used only in conjunction with primary indicators which are price patterns such as head and shoulders, double bottom and top, triangle etc. Oscillators should be used only to confirm the price patterns. Traders and investors must be cautioned to use oscillators as a primary tool for taking a position.

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