Candlestick Technical Analysis on Select Indian Stocks: Pattern detection and Efficiency Statistics

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Abstract: Financial markets generate vast data every trading day. There are markets for equity shares, commodities, fixed income securities and currencies etc. Further, we do have organised markets for financial derivatives. The exponential growth of financial markets is the order of the modern-day. Developments in information and communication technology (ICT) helped the growth of financial markets and its operations to greater heights. One of the financial market analysis is Candlestick Technical analysis also known as Japanese candlestick charting. It is the oldest form of financial market analysis originated in Japan. This study measured the occurrence and tested the efficiency of various bullish reversal candlestick patterns on 17 stocks of India’s leading stock market benchmark index NIFTY 50 for the period of 16 years from 2000 to 2015. Data mining with backtesting methodology is used to find the top 10 candlestick patterns with respect to the frequency of occurrence during the study period. The efficiency of technical analysis is evaluated using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, a multi-criteria decision making (MCDM) method on the backtested results for the 5-day holding period. The results of the study show that hammer (HMR), long engulfing pattern (LEB) and Rising window (RSW) are the top three ranked candlestick patterns.

Keywords: Technical Analysis, Candlesticks, TOPSIS and Indian stocks.

I. INTRODUCTION

Data analysis in financial markets is the most critical part. Financial market data analysis is mainly of two types one is fundamental analysis, and the other is technical analysis. Technical analysis is also known as chart based study of financial market asset price data. Security Price and volume data namely open, high, low, close and daily traded number of shares are plotted as in a chart form (fig.1) with which visual studies are possible [17, 1].

![Fig.1. A Candlestick Chart](image1)

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Market Participants, Professional Traders and practitioners use the data for forecasting the future direction of the price and trading decisions [2]. The price data plotting is done as a single plot or image for a particular time frame minute, daily, weekly or monthly. Plotted data will look like a candle (fig.2)

![Fig.2. Bullish and Bearish Candlestick Depiction](image2)

The practice of using candlestick like plotting data was developed and adopted by Munehisa Homma (1724-1803) a Rice trader in Dojima Rice exchange, Japan. Munehisa Homma assumed that price action reflects the sentiment of the market participants. The changing and trending way of prices resulted in different shaped candles. By observing and studying the shape of a single candle or a set of candlestick patterns, we can understand that after a pattern occurrence, there used to be a significant level of price change. Therefore candlestick patterns are considered as a leading signal provider about and impending price action of security in the near term. Candlestick charting technique was widely used technique in South Asia till the late 1980s; Charles H Dow introduced charting in the west in the 1900s; afterwards, it slowly gained popularity and importance in the west. Candlestick techniques will have applications in various markets and different time frames. The effectiveness of technical analysis is one of the most argued topics in modern-day financial market analysis. There are arguments for and against technical analysis. A considerable number of researchers have proven that technical analysis is indispensable to some extent in reality. Studying and analysing past prices in addition to other data, one can make above-average returns. In a detailed study on 90 years of US-listed stocks data by using a mix of 26 different technical indicators [16], found that technical analysis is a dependable tool. Nowadays, the application of machine learning and computational intelligence techniques in analysing and predicting the stock market trend. Some of the models and systems are hidden Markov model, neural network, neuro-fuzzy system, genetic algorithm, mining association rules, support vector machine (SVM), principal component analysis (PCA) and rough set theory etc., [3]. Candlestick patterns are plenty in numbers and are described in natural language. It is challenging to adopt in computational methods [18]. Though candlestick
The study evaluates in Malaysian stock adjusted for split and bonuses. Every share split and bonus is identified to determine the effect of these events on the stock price. The analysis is conducted using a combination of statistical and machine learning techniques.

II. DATA AND METHODOLOGY

This study uses a data set of NIFTY 50 index member stocks from January 2000 to December 2015. The stock price data used is of the type daily or end of day (EOD). Every stock has nearly 3980 daily data points.

A. Data Collection

The NIFTY 50 is a leading benchmark index in India consisting of 50 companies representing diversified industry sectors. Because of the long duration of 16 years of study, only 17 stocks (Table 1) continuously remained as a member of the index, only these stocks were considered as the sample for this study.

Table I List of sample stocks

| Sl. No | Stock | Industry sector |
|-------|-------|-----------------|
| 1     | ACC   | Cement          |
| 2     | AMBUJACEM | Cement        |
| 3     | BHIL  | Industrial manufacturing |
| 4     | CIPLA | Pharma          |
| 5     | HDFC  | Fin. services   |
| 6     | HDFCBANK | Fin. Services  |
| 7     | HEROMOTOCO | Automobiles |
| 8     | HINDALCO | Metals        |
| 9     | HINDLEVER | FMCG          |
| 10    | INFY  | IT services     |
| 11    | ITC   | FMCG            |
| 12    | M&M   | Automobiles     |
| 13    | RELIANCE | Energy      |
| 14    | SBIN  | Fin. services   |
| 15    | TATAMOTORS | Automobiles |
| 16    | TATAPower | Power     |
| 17    | TATASTEEL | Metals      |

The study considers daily historical data of seventeen sample stocks identified from the previous step. The daily data of the share consists of OPEN, HIGH, LOW, CLOSE and Volume data points for every share for the 16 years of period extracted from NSE India and CMIE Prowess database. The data is adjusted for split and bonuses. Every stock has roughly 3983 data points for the sixteen years. The sample period underwent various economic events like the dotcom bubble, global financial crisis 2007-2009 periods. The sample period also has gone through country-specific and global geopolitical events.

B. Methodology

The collected EOD data 17 stocks are incorporated in the candlescaner software. Candlescaner is a technical analysis software package to identify, explore and analyse candlestick patterns in financial market data. It has the capability of measuring efficiency and based on which trading strategies can be designed for further refinement and usage. By using the software, the collected data are subjected for backtesting to identify occurrences of 34 (Table 2) different bullish reversal and bullish continuation patterns for 5-day trading basis. The efficiency of the candle patterns is studied within the five days of its occurrence. The occurred patterns are classified as given in Table 3.

Table II List of Bullish Reversal and Bullish continuation Patterns

| Sl. No | Candlestick Pattern     | Forecast     |
|--------|-------------------------|--------------|
| 1      | Abandoned Baby          | Bullish Reversal |
| 2      | Belt Hold               | Bullish Reversal |
| 3      | Doji Star               | Bullish Reversal |
| 4      | Engulfing               | Bullish Reversal |
| 5      | Hammer                  | Bullish Reversal |
| 6      | Harami Cross            | Bullish Reversal |
| 7      | Harami                  | Bullish Reversal |
| 8      | Homing Pigeon           | Bullish Reversal |
| 9      | Inverted Hammer         | Bullish Reversal |
| 10     | Kicking Up              | Bullish Reversal |
| 11     | Last Engulfing Bottom   | Bullish Reversal |
| 12     | Matching Low            | Bullish Reversal |
| 13     | Meeting Lines           | Bullish Reversal |
| 14     | Morning Doji Star        | Bullish Reversal |
| 15     | Morning Star            | Bullish Reversal |
| 16     | Piercing                | Bullish Reversal |
| 17     | Southern Doji           | Bullish Reversal |
| 18     | Takuri Line             | Bullish Reversal |
| 19     | Tasuki Line             | Bullish Reversal |
| 20     | Three Inside Up         | Bullish Reversal |
| 21     | Three Outside Up        | Bullish Reversal |
| 22     | Three stars in south    | Bullish Reversal |
| 23     | Three White Soldiers    | Bullish Reversal |
| 24     | Tri star                | Bullish Reversal |
| 25     | Turn Up                 | Bullish Reversal |
| 26     | Tweezier Bottom         | Bullish Reversal |
| 27     | Unique three-river bottom | Bullish Reversal |
| 28     | Gapping Up Doji         | Bullish continuation |
| 29     | Rising Window           | Bullish continuation |
| 30     | Separating lines        | Bullish continuation |
| 31     | Side-by-side white lines | Bullish continuation |
| 32     | Strong Line             | Bullish continuation |
| 33     | Upside three Gap methods | Bullish continuation |
| 34     | Upside Tasuki Gap       | Bullish continuation |

The top 10 most occurring candle patterns and their efficiency data are given in table 4, and the detailed statistics are given in table 5.

Table III Candle efficiency classification

| Signal Type | Returns                        |
|-------------|--------------------------------|
| False       | - Negative to 0 %              |
| Low         | 0 to 2.0 %                     |
| Medium      | 2 to 3.5 %                     |
| High        | Above 3.5 %                    |

The top 10 most occurring candle patterns and their efficiency data are given in table 4, and the detailed statistics are given in table 5.

Table IV Top 10 Candle Pattern Signal Efficiency in % (Full Sample Data)

| Pattern name | Code  | False | Low  | Med. | High |
|--------------|-------|-------|------|------|------|
| Strong line  | SLN   | 16.60 | 21.80| 17.40| 44.30|
| Harami       | HMI   | 15.80 | 24.80| 17.20| 42.50|
Based on the weights set, positive ideal solution and the farthest distance from the negative ideal solution (NIS) to determine the best alternative. TOPSIS method has become a popular decision making (MCDM) methods due to its theoretical rigorosity, a sound logic that represents the human criteria decision technique. The raw data is normalized to eliminate deviations with different measurement units and scales. The normalized decision matrix can be computed by multiplying the importance weights of each criterion, the weighted normalized decision matrix can be computed by

### III. RETURNS AND ANALYSIS

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, is one of the well-known multiple criteria decision making (MCDM) methods. The TOPSIS method introduces the shortest distance from the positive ideal solution (PIS) and the farthest distance from the negative ideal solution (NIS) to determine the best alternative. TOPSIS method has become a popular multiple criteria decision technique due to its theoretical rigorosity, a sound logic that represents the human rationale in the selection and the fact that it has been proved in as one of the most appropriate methods in solving traversal rank.

#### Table V Candle Pattern Occurrence statistics (Full sample Data)

| S.no | Pattern Name | Code | No. of occurrences | % of the total occurrence | Avg. freq. (days) |
|------|--------------|------|--------------------|--------------------------|------------------|
| 1    | Strong Line  | SLN  | 1568               | 18.39%                   | 46               |
| 2    | Harami       | HMI  | 1035               | 12.14%                   | 69               |
| 3    | Engulfing Bottom | LEB | 909                | 10.66%                   | 79               |
| 4    | Rising Window | RSW | 729                | 8.55%                    | 98               |
| 5    | Turn Up      | TUP  | 699                | 8.20%                    | 103              |
| 6    | Engulfing    | ENG  | 674                | 7.90%                    | 106              |
| 7    | Three Inside Up | TNP | 487                | 5.71%                    | 147              |
| 8    | Tasuki Line  | TSL  | 394                | 4.62%                    | 182              |
| 9    | Homing Pigeon | HPN | 369                | 4.33%                    | 194              |
| 10   | Hammer       | HMR  | 277                | 3.25%                    | 259              |

TOPSIS can be expressed in a series of steps as follows. The observation of the returns efficiency by different candlestick patterns is listed in table 6. The weights assigned for ‘False’ as 10 %, ‘Low’ as 10%, ‘Med’ as 20 % and ‘High’ as 60%. Based on the weights set, positive ideal solution and negative ideal solution have been concluded.

#### Table VI Candlestick wise efficiency data

| Pattern | FALSE | LOW | MED | HIGH |
|---------|-------|-----|-----|------|
| SLN     | 16.60 | 21.80 | 17.40 | 44.30 |
| HMI     | 15.80 | 24.50 | 17.20 | 42.50 |
| LEB     | 20.60 | 21.30 | 17.30 | 40.70 |

### Table VII Normalised Matrices

| SLN     | 0.14686 | 0.480574 | 0.224337 | 0.070504 |
|---------|---------|----------|----------|----------|
| HMI     | -0.04005 | 0.178818 | 0.269204 | 0.211513 |
| LEB     | -0.68091 | 0.536455 | 0.246771 | 0.352521 |
| RSW     | -0.34713 | 0.00534 | 0.134602 | 0.571868 |
| TUP     | 0.391165 | 0.403807 | 0.         | 0.       |
| ENG     | -0.33378 | 0.212347 | 0.560843 | 0.250682 |
| TNP     | -0.01335 | 0.279404 | 0.538409 | 0.031335 |
| TSL     | -0.06676 | 0.223523 | 0.134602 | 0.242848 |
| HMR     | -0.21362 | 0.279404 | 0.111269 | 0.289851 |
| HMR     | -0.48064 | 0.212347 | 0.         | 0.540533 |

Determining the PIS and NIS upon the normalised matrix is respectively shown in table 8 and table 9.

#### Table VIII Positive Ideal Solution

| SLN     | 0.008011 | -0.02012 | -0.01795 | 0.282017 |
|---------|---------|----------|----------|----------|
| HMI     | -0.00267 | 0.010059 | -0.02692 | 0.197412 |
| LEB     | 0.061415 | -0.02571 | -0.02243 | 0.112807 |
| RSW     | 0.028037 | 0.02794  | 0         | -0.0188 |
| TUP     | -0.00668 | -0.01118 | -0.05384 | 0.32432 |
| ENG     | 0.026702 | 0.006706 | -0.08525 | 0.17391 |
| TNP     | -0.00534 | 0         | -0.08076 | 0.305518 |
| TSL     | 0.005588 | 0         | 0         | 0.178611 |
| HMR     | 0.014686 | 0         | 0.004487 | 0.150409 |

#### Table IX Negative Ideal Solution

| SLN     | 0.033378 | 0.026823 | 0.044867 | -0.10341 |
|---------|---------|----------|----------|----------|
| HMI     | 0.044059 | -0.00335 | 0.053841 | -0.0188 |
| LEB     | -0.02003 | 0.032411 | 0.049354 | 0.065804 |
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### Table X Ranking Solution

| di | di- | ci   | Rank | Pattern |
|----|-----|------|------|---------|
| 0.283415879 | 0.316058 | 0.527225 | 4 | SLN |
| 0.199510597 | 0.178699 | 0.472486 | 5 | HMI |
| 0.132895589 | 0.151191 | 0.5322 | 2 | LEB |
| 0.043820582 | 0.049827 | 0.532067 | 3 | RSW |
| 0.329015953 | 0 | 0 | 8 | TUP |
| 0.195627391 | 0 | 0 | 8 | ENG |
| 0.31605764 | 0 | 0 | 8 | TNP |
| 0.17869173 | 0.049386 | 0.216255 | 7 | TSL |
| 0.151190964 | 0.04535 | 0.230739 | 6 | HPN |
| 0.049826593 | 0.178611 | 0.781881 | 1 | HMR |

### IV. CONCLUSION

We discussed the use and effectiveness of candlestick technical analysis on 17 selected Indian NIFTY50 stocks. Technical analysis is a quantitative method in which analysis of price data takes place without any time series transformation of data. Based on TOPSIS model ranking patterns of 17 stocks during the study period hammer (HMR), long engulfing pattern (LEB) and Rising window (RSW) are the top three ranked candlestick patterns. There is scope for expanding this study with various other criteria for ranking. Trading return based performance and that too, with the stock specific method, will yield more robust results. Further, we conclude 20% of candlestick patterns are loss-making, 20 to 40% are low to average return earning patterns. 40 to 50% candlestick occurrences are high return yielding or highly efficient in nature. Candlestick technical analysis can be a useful trading tool provided proper stop-loss strategy is adopted to limit losses; thereby, efficiency could be considerably increased.

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