RESEARCH REVIEW JOURNALS
Volume-03
Issue-07
July-2018

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

Japanese Candlestick Trading Strategies: A Review of Literature

*1Prasad Kulkarni & 2Dr. Murugaiah V

*1Assistant Professor, Government First Grade College, Bettampady, Dakshina Kannada (India)
2Professor, Institute of Management Studies, Davangere University, Shivagangothri, Davangere (India)

ARTICLE DETAILS

Article History
Published Online: 05 July 2018

Keywords
Japanese Candlestick, Trading Strategies, Candlestick Trading Strategies, Candlestick Strategies, Technical Analysis

***Corresponding Author**
Email: pgkulkarni139[at]gmail.com

ABSTRACT

The purpose of this study is to review the evidence on the performance of Japanese candlestick trading strategies. To achieve this, the study comprehensively reviews survey, theoretical and empirical studies on the subject of candlestick trading strategies and discusses the consistency and reliability of candlestick trading across markets and over time. The majority of the studies were collected from academic journals published from 1998 to the present and recent working papers, books and magazines. The reviews are arranged under two sections, first section contains review of studies that state candlestick trading rules are not profitable and second section contains review of studies that state candlestick trading rules are profitable.

1. Introduction

> *'To investor willing to buy and hold common stocks for the long-term, the stock market has offered excellent rewards over the years in term of both dividend growth and capital appreciation. The market is even more challenging, fulfilling and rewarding to resourceful investors willing to learn the art of market timing through a study of technical analysis.' (p.1)*
>
> Martin Pring (2002)

Technical Analysis is the study of market action1, primarily through the use of charts, for the purpose of forecasting future price trend (John Murphy, 1999). Technical analysts believe that price trends are determined by the interaction between buyer and seller. They are repetitive and reflect information pertaining to the market. Therefore studying the price movement in the form of price chart is all that required to forecast the future possible price movement of an asset.

On the contrary, the academics were skeptical about prediction of the future price using the historical data (technical analysis).They tend to believe that successive price changes were independent (Malkiel, 1996) and price prediction is not possible since all available information is *fully* reflected in prices (Fama, 1970). Further, the efficient market exists in three forms viz., weak, semi strong and strong. In any of this form technical analysis should not provide significant positive returns (Jensen, 1978). Therefore in efficient markets any attempt to predict future price movement using historical data is futile. Samuelson (1965) argues that:

> *"…there is no way of making an expected profit by extrapolating past changes in the futures price, by chart or any other esoteric devices of magic or mathematics. The market quotation already contains in itself all that can be known about the future and in that sense has discounted future contingencies as much as is humanly possible." (p. 44)*

The attitude of academic towards technical analysis or predicting the future price using historical data is well described by Burton Malkiel (1996) in his book A Random Walk Down Wall Street:

> *"Obviously, I'm biased against the chartist. This is not only a personal predilection but a professional one as well. Technical analysis is anathema to the academic world. We love to pick on it. Our bullying tactics are prompted by two considerations: (1) after paying transactions costs, the method does not do better than a buy-and-hold strategy for investors, and (2) it's easy to pick on. And while it may seem a bit unfair to pick on such a sorry target, just remember: It's your money we are trying to save." (p.140)*

Never-the-less, since the introduction of Dow Theory by Charles H Dow in late 1800s technical analysis, as an investment decision making tool, has been widely used by the practitioner like fund managers, brokers, dealers, investment advisors, investor, trader, and speculator in the financial markets. Taylor and Allen (1992) surveyed foreign exchange dealers in the London market and concluded that 90% of the respondents use technical analysis for trading short-term horizon. The wide acceptance & usage of technical analysis by practitioners is mainly because of ease of use, can be applied to any asset class which has past price data, can be studied on any time frame and most importantly it depicts the market psychology through its price charts, especially candlestick charts.

Price charts are the prime and most crucial component of technical analysis. A price chart is the pictorial representation of the trading activity of an issue / asset with respect to time. There are different types of price charts viz., bar chart,

[1] The term market action includes the three principal source of information available to technician – price, volume and open interest.

candlestick chart, line chart, point and figure chart, kagi chart etc. Among the available charting techniques, the most widely used charting technique by almost all the technical analysts around the world is candlestick charting technique. Gregory Morris (1995, p. 3 & 213) mentioned that the wide usage of candlestick charts is generally accredited for its visual attraction, clearly depiction of mass market psychology and its short-term predictive power for one to ten days.

2. Candlestick Defined

In 1700s Munehisa Homma used past price information to predict the future price of rice in Japan. The methodology of Homma later evolved as Candlestick Charting, which is practiced by all the technical analysts around the world (Nison, 2004). A candlestick is a graphical representation of an asset day's price activity i.e., opens, high, low and close. Each day's candlestick is called as single line and usually it is made-up of two components viz., body (*jittal*) and shadows (*kage*).

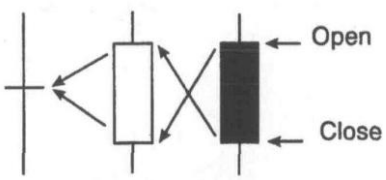

Figure 1: Candlesticks

The body of the candle, represented by rectangular box, is an area between open and close. The height of the body depends on the range between open and close. The body will be white or empty, if the day's close is above the open i.e., bullish candle or up-closing days. The bullish candle is also called as yang line. On the other hand the body will be black or filled, if the day's open is above the close i.e., bearish candle or down-closing days. The bearish candle is also called as yin line. Shadows are the extensions above and below the body. The upper shadow (*uwakage*) represents the high of the day and the lower shadow (*shitakage*) represents the low for the day.

Candlestick as a technical charting tool doesn't only portray the relationship between open, high, low and close. It also facilitates the chartist with a quick insight of the mass trading psychology. Thus candlesticks are said to have a short-term predictive power for one to ten days (Gregory Morris, p 213). In Sum, Candlestick trading strategies uses one to three days past price data or candle lines to generate trading signals. Candlestick trading strategies can be used as standalone basis or in combination with some technical tools / indicators for making short-term investment decisions.

3. Review of Candlestick Literature

Since from the study of Brock, Lakonishok and LeBaron (1992), there has been a surge of academic interest in the claims of technical analysis (Park and Irwin, 2004) (refer figure 5). From 1988-2004, 92 modern studies were done on profitability of technical trading strategies out of which 58 studies showed positive results, 24 studies showed negative results and 10 studies showed mixed results. Further, from 1998-2014, 19 studies were done on performance of candlestick trading strategies out of which 12 studies showed positive results, 07 studies showed negative results.

This paper reviews the literature of these nineteen papers on candlestick. The review of literature is arranged into two sections; the first section review the studies which claims that candlestick trading rules are not profitable and the second section review the studies which claims that candlestick trading rules are profitable.

Figure 2: Number of Technical Trading Studies (1960-2004)

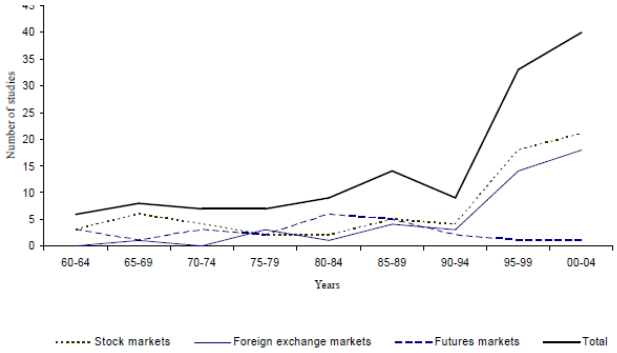

Figure courtesy: Park and Irwin (2004)

3.1 Candlestick Trading Rules are Not Profitable

Fock, Klein and Zwergel (2005) [Equity and Bond Futures, Germany] researched on predictive power of candlestick patterns on intra-day futures data of DAX and Bund Futures for 2002-2003 periods. The study examined 19 candlestick patterns on standalone as well as with different technical analysis tools like Moving Average, Momentum indicator, Relative Strength Indicator and Moving Average Convergence & Divergence indicators. The study was first of its kind to define the candlestick patterns mathematically to form a basis for scientific analysis. The study used t-test and Bootstrap Methodology for the statistical analysis. They concluded that that the results were poor even without taking transaction costs into account. The study suggest for further research in the area with volume for strength confirmation of the pattern.

Marshal, Young and Rose (2005) [Equity, USA] tested the profitability of candlestick using daily price data of Dow Jones Industrial Average (DJIA) components for the period 1990 - 2002. Twenty eight candlestick patterns both continuation and reversal pattern were used for the study. The 10-day exponential moving average was used to define the trend and trades were entered at the opening of the next day of the signal and the positions were held for 10-days. The study used bootstrap methodology for statistical analysis and found that the studied candlestick pattern do not have the forecasting power.

Marshal, Young and Cahan (2007) [Equity, Japan] conducted study to test the profitability of candlestick charts. The study used price data of 59 stocks of TOPIX Large-70 index and 41 stocks of TOPIX Mid-400 index. The study tested the profitability of 14 single line and 14 reversal patterns. 10-day Exponential Moving Average was used to define trend. Trades are entered at the close of the signal day, opening on the next day of the signal and close on the next day of the signal.

Positions were held for 10-days duration. Applying bootstrap methodology they found no evidence that candlestick technical analysis is profitable when applied to the largest 100 stocks listed on the Tokyo stock exchange over 1975-2004.

Marshal Horton (2007) [Equity, USA] examined the Japanese Candlestick charting method for 349 stocks with alternative tests. The 349 stocks were selected randomly representing all major industry groups. The study examined profitability for eight three-line reversal patterns, four bullish reversal and four bearish reversal and in-addition the study also examined the predictive power of bear signal Doji. 3-day moving average was used to define the trend. Hit ratio - Total no of successful signals for bull signals was divided by total number of bull signals to obtain the frequency distribution for "good' bull signals. The distribution was then sorted and normalized to obtain the CDF used in the nonparametric tests. The study used Kolmogorov Smirnov (KS) test, Cramer-von Mises test (CVM) & Birnbaum-Hall Test (BH) and concluded that the candlestick charting technique don't create any value in trading individual stocks.

Raymonds Lieksins (2007) [Equity, Europe (Latvia, Lithuania, Estonia)] to analyse the applicability of candlestick technique to Baltic Stock Market studied 69 stocks that are listed on OMX Riga, Vilnius and Tallinn from 2005 – 2007. The eight three line patterns 4 – bullish and 4 – bearish reversals were studied and 3-day moving average was used to define trend. Using Hit ratio as a measure of profit the study concluded that candlestick trading technique doesn't create profit opportunities in Baltic Stock Market.

Duvinage, Mazza and Petitjean (2012) [Equity, USA] conducted a study to test the predictive power of Japanese candlesticks on intraday basis. The study used minute data from Apr 1, 2010 to Apr 12, 2011 for the 30 components of the DJIA index. The study used around 83 candlestick rules defined in TA-lib MATLAB toolbox. Using Bootstrap Methodology and Superior Predictive Ability (SPA) test and its stepwise version (SSPA) the study concluded that though Candlestick can predict intraday returns, but such predictive power is not useful for active portfolio management.

Marshal, Young & Rose (2007) [Equity, USA] conducted a study to test the profitability of quantitative market timing technique of Candlestick technical analysis for the US market. The study used daily price data of stocks included in the Dow Jones Industrial Index (DJIA) during 1992 - 2002. Fourteen single line and fourteen reversal patterns for holding period of 2, 5 & 10 days were studied. Using bootstrap methodology and t-test the study concluded that basing ones trading decisions solely on these techniques does not seem sensible but we cannot rule out the possibility that they compliment some other market timing technique. Thus the study concluded the outcome as not - favorable to Mixed.

3.2 Candlestick Trading Rules are Profitable

G Caginalp and H Laurent (1998) [Equity, USA] study on candlestick is one of the earliest study on candlestick charting. The study was conducted on equity market in United States of America. The study focused on eight three-day's candlestick reversal patterns that were tested for their predictability of change in direction of trend. The study defined the direction of the trend by using three-day moving average. The study used daily price data of all S&P 500 components between 1992 and 1996 to perform statistical test and assess the predictive ability of candlestick patterns for a holding period of two days. The study used z-test and standard deviation for statistical analysis and concluded that the three-day patterns have high predictive power in candlestick analysis.

Yatrakis & Williams (2005) [Equity, USA] conducted a study to examine whether shooting star candlestick pattern do in fact contain information about the emotional behavior of traders, which can be shown to influence the subsequent price of a security in violation of the weak form of the EMH. The study used daily price data of 2000 stocks traded on NYSE from March 01 - April 30, 2005. Only Shooting star was studied for a holding period of t+20. The study used t-test, Mean Return and Median Return and showed that a small but statistically significant excess return over the five days following the appearance of the candlestick pattern and suggest the existence of a short-lived anomaly in the weak form of the EMH.

Goo, Chen and Chang (2007) [Equity, Taiwan] conducted a study to test the profitability of candlestick and compare the same with holding days. The study used 25 stocks from both Taiwan Top 50 Tracker Fund and Taiwan Top 100 Tracker Fund. Twenty six single and multiple line continuation and reversal patterns were studied using 5-day moving average to define the trend. Trades were entered on the next day of the signal and the positions were held up-to 10days. Using t-test and ANOVA (Duncan's Multiple Range Test) the study provided strong evidence that some of the candlestick trading strategies do have value for investors and different candlesticks needs different holding period. The performance of the most candlesticks has been improved with stop loss strategy.

Shiu & Lu (2011) [Equity, Taiwan] conducted study with the objective to assess the predictive power of the two-day candlestick patterns and also to determine the key factors to improve the performance. The study used 10-years, 1998 - 2007, daily price and volume data of 69 electronics securities of Taiwan stock exchange. The study used three bullish candlestick reversal patterns viz., Piercing Line, Bullish Engulfing & Bullish Harami. Three bearish candlestick reversal patterns viz., Dark cloud Cover, Bearish Engulfing & Bearish Harami. The study used five-day Moving Average as per Caginalp & Laurent (1998) to define the trend. They measure the return by considering the difference between Close & open for each day up to five days. Applying Quantile Regression model the study concluded that Harami pattern is more profitable among the six patterns studied.

Shiu & Lu (2012) [Equity, Taiwan] conducted study to test the profitability of candlestick patterns in the emerging markets of Taiwan. The study used daily Price data of 50 components from Taiwan 50 from 2002-2009. The study tested the profitability of twenty-four two day candlestick pattern and used five – day moving average to define the trend. The returns were calculated for one, five and ten days. Using skewness-adjusted

t-statistics and binomial test the study conclude that candlestick patterns create value to investors.

Xie, Zhao & Wang (2012) [Equity, Europe & Asia] conducted a study to test the forecasting ability of the Japanese candlestick in a predictive regression framework. The study made an attempt to answer the question that whether or not the Japanese candlestick charts provide valuable information for forecasting the equity returns by taking a comprehensive look at the main global financial markets. The study collected the monthly index data from the main open global financial markets in Europe (FTSE 100, DAX, and CAC 40) and in Asia (NIKKEI 225, HANGSENG and STRAIT TIMES) and performed in-sample and out-of sample forecasts. The in-sample forecasts span the whole sample observation. When performing out-of-sample forecasts, the whole data was divided into two portions. The Jan 2001 - Aug 2008 was used as out-of-sample forecasting tests and the prior observations are employed to estimate the coefficients. The study concluded that both in-sample and out-of-sample forecasts indicate informative of the Japanese candlestick in forecasting stock returns.

Chootong and Sornil (2012) [Equity, Thailand] conducted a study to predict the future trend and construct a decision support system using a combination of chart pattern, candlestick patterns and technical indicators. The study used price data of 5-individual stocks from different industries of stock exchange of Thailand from 2002 - 2011. The candlestick patterns used were segregated based on the type of reversals (bullish, bearish & neutral) and the reliability (high, low & medium). Further the study used technical indicators namely, Moving Average, Exponential Moving Average, Relative Strength Indicator, Bollinger Band, On Balance Volume, Moving Average Convergence and Divergence & Stochastic Oscillator. Using Neural Network the study concluded that Combining Chart pattern and indicators generally outperforms the use of traditional trading methods based on indicators, across multiple stocks and time periods

Bennoit and Mazza (2013) [Equity, Europe] conducted study to check Whether Japanese Candlesticks can influence the transaction costs of sequence of orders and whether they can help traders with their decision of timing or not. The study used 15 min data for 61 trading days from Feb 01,2006 - Apr 30, 2006 for 81 stocks belonging to 3 national indices BEL20, AEX & CAC40. The study used two categories of candlestick structures. Doji (Doji; Bullish Doji; Bearish Doji; Dragonfly Doji; Bullish Dragonfly Doji; Bearish Dragonfly Doji; Gravestone Doji; Bullish Gravestone Doji and Bearish Gravestone Doji). Hammer (Hammer; Inverted Hammer; Shooting Star and Hanging Man). Sequence of Trades try to capture ex-post the market timing intention of traders, that is their strategy of breaking up large orders into smaller ones in order to avoid large market impact costs and/or to avoid revealing too much information to the market. Transaction Cost Measure the market impact of an order i is computed as the signed difference between the average execution price (AEP) and the beginning of the sequence (BOQ). The study used panel regression and found that Candlestick provide a partial response to the traders dilemma as they help detect time window where transaction costs are lower and therefore are suitable for the submission of very aggressive orders.

Lu and Chen (2013) [Equity, Europe] conducted a study to examine the performance of candlestick trading strategies within the context of European stock markets. The study used daily price data of component stocks in the FTSE 100 (UK), DAX 40 (Germany) and CAC 30 (France) from 2003 – 2012 periods. Transaction cost was also considered to test the performance. Twenty-four two-day patterns both reversal & continuation were studied using a 1*4 vector i.e., coding pattern by 1234, 1324 ... (ref.- Levy 1971 & Lu & Shiu 2012). 5-day Moving Average as per Caginalp & Laurent (1998) was used to identify the trend. The trades were initiated on the immediate day after the signal and closed on the 10th day. Following Brock et. al raw return was examined rather than abnormal returns. Using Johnson t-test, Bootstrap Methodology & Bonferroni-adjusted significance levelsthe study provided some support for Candlestick charting. One reversal pattern is profitable for stocks in the FTSE – 100; one continuation pattern is profitable for the DAC 30 and other in CAC 40

Prado, Ferneda, Morais, Luiz, Matsura (2013) [Equity, Brazil] Conduct a study similar to morris for the Brazilian stock market and compare results of both the studies. The study analyses statistically the predictive ability of candlesticks for the Brazilian market, considering a set of 10 stocks contribute 40% in Ibovespa index (Sao Paula stock exchange) for the period 2005-2009. the stocks were selected on three criteria. First, large amount of daily negotiation; second, greatest participation in Ibovespa calculation and third, representativeness of given business segment. Sixteen candlestick patterns were studied; the pattern selection was based on their appearance in most literature and also those patterns studied by morris. The analysis of each pattern originated the following information-- First, pattern type and kind of reversal; second, total number of occurrence; third, hit ratio for each day (d-1 to d-7) and lastly, the percentage of mean loss or mean gain for each occurrence of the pattern under analysis. Using Binomial Distribution the study found statistically significant evidence of the predictive ability of some patterns, which may indicate the technique must be adapted to the market where it is intended to be used.

Tsung - Hsun Lu (2014) [Equity, Taiwan] conducted study to examine the predictive power of candlestick charting technique. To avoid the issue of non-synchronous trading the study used daily price data of individual stocks in Taiwan from Jan 4, 1992 to Dec 31, 2009. Further, the study used 12 single line candlestick patterns and it was the first paper which creates a four-price-level approach to categorizing and analysing one day pattern. 3-day Moving Average is used to define trend. Profits are measured by stock prices as the natural logarithm of the closing price divided by opening price on day following the signal (t+1). This is to check profitability on intraday basis since it's a short term tool. Further it also tested the profitability of pattern for 10 holding days. The study used Johnson t-test, Binomial test and Bootstrap Methodology and found that that four patterns are profitable for the Taiwan stock markets. The result also suggests that the candlestick approach perform better with smaller firms and lower priced stock.

LU, Huang & Hsu (2014) [Equity, USA] conducted a study to assess the predictive power of three-day candlestick patterns. Improve performance by adopting a variable holding period approach and to identify two behavioral factors to explain the source of profitability when using candlesticks. The study used Taiwan component stocks daily data from 1992 – 2012. Three line four bullish and four bearish patterns were studied. Trend was identified by using 5-day moving average and a position was entered on t+4 and held till t+6 i.e., 3–day holding period. Using Johnson t-test and Conventional binomial test is used to examine that the winning rate is 50 percent the study concluded that Morning Star & Evening Star yield significantly positive return after considering transaction cost and fixed holding period, Moving Average of three period defined better trend than Moving Average of ten period and Volume per trade and turnover rates affects the profits of candlestick patterns.

4. Conclusion

This report revived empirical work regarding candlestick trading strategies for period 1998-2014. Nineteen studies were done on performance of candlestick trading strategies out of which twelve studies showed positive results, seven studies showed negative results. The difference in results can be attribute to the candlestick patterns used for study, definition of trend and candlestick patterns, trading strategy i.e., entry and exit points and last but not the least the statistical test used to test the statistical significance.

To conclude, forecasting the future doesn't make one successful instead it reduced the chance of failure.

References

1. Benoit, D., & Mazza, P. (2012). Do Japanese Candlesticks Help Solving the Trader's Dilemma? 25th Australasian Finance and Banking Conference 2012. Available at SSRN: https://ssrn.com/abstract=2139304 or http://dx.doi.org/10.2139/ssrn.2139304.
2. Brock, W., Lakonishok, J., & LeBaron, B. (1992). Simple technical trading rules and the stochastic properties of stock returns. *The Journal of finance*, *47*(5), 1731-1764.
3. Caginalp, G., & Laurent, H. (1998). The predictive power of price patterns. *Applied Mathematical Finance*, *5*(3-4), 181-205.
4. Chootong, C., & Sornil, O. (2012). Trading Signal Generation Using A Combination of Chart Patterns and Indicators. *International Journal of Computer Science Issues (IJCSI)*, *9*(6), 202.
5. Duvinage, M., Mazza, P., & Petitjean, M. (2013). The intra-day performance of market timing strategies and trading systems based on Japanese candlesticks. *Quantitative Finance*, *13*(7), 1059-1070.
6. Fock, J. H., Klein, C., & Zwergel, B. (2005). Performance of candlestick analysis on intraday futures data. *The Journal of Derivatives*, *13*(1), 28-40.
7. Goo, Y. J., Chen, D. H., & Chang, Y. (2007). The application of Japanese candlestick trading strategies in Taiwan. *Investment Management and Financial Innovations*, *4*(4), 49-79.
8. Horton, M. J. (2009). Stars, crows, and doji: The use of candlesticks in stock selection. *The Quarterly Review of Economics and Finance*, *49*(2), 283-294.
9. Jensen, M. C. Some Anomalous Evidence Regarding Market Efficiency. *Journal of Financial Economics*, 6(1978):95-101.
10. Lieksnis, R. (2008). THE PREDICTIVE POWER OF CANDLESTICK PRICE PATTERNS IN THE BALTIC STOCK MARKET. *Economics & Business*, *17*.
11. Lu, T. H. (2014). The profitability of candlestick charting in the Taiwan stock market. *Pacific-Basin Finance Journal*, *26*, 65-78.
12. Lu, T. H., & Chen, J. (2013). Candlestick charting in European stock markets. *Jassa*, (2), 20.
13. Lu, T. H., & Shiu, Y. M. (2011). Pinpoint and synergistic trading strategies of candlesticks. *International Journal of Economics and Finance*, *3*(1), 234.
14. Lu, T. H., & Shiu, Y. M. (2012). Tests for two-day candlestick patterns in the emerging equity market of Taiwan. *Emerging markets finance and trade*, *48*(sup1), 41-57.
15. Lu, T., Huang, Y., & Hsu, C. (2014). Can price anomalies been obtained by using candlestick patterns. In *Meeting of World Finance Conference, Venice, Italy. Available from: http://www. mx. nthu. edu. tw/~ ylihuang/pdf/Candle. pdf*.
16. Malkiel, B. G. (1999). A Random Walk Down Wall Street: Including a Life-Cycle Guide to Personal Investing, Norton, New York.
17. Malkiel, B. G., & Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, *25*(2), 383-417.
18. Marshall, B. R., Young, M. R., & Cahan, R. (2008). Are candlestick technical trading strategies profitable in the Japanese equity market?. *Review of Quantitative Finance and Accounting*, *31*(2), 191-207.
19. Marshall, B. R., Young, M. R., & Rose, L. C. (2006). Candlestick technical trading strategies: Can they create value for investors?. *Journal of Banking & Finance*, *30*(8), 2303-2323.
20. Marshall, B. R., Young, M. R., & Rose, L. C. (2007). Market timing with candlestick technical analysis. (April 16, 2007) available at SSRN https://ssrn.com/abstract=980583 or http://dx.doi.org/10.2139/ssrn.980583.
21. Morris, G. L. (1995). *Candlestick Charting Explained: Timeless Techniques for Trading Stocks and Futures,* McGraw-Hill, New York.
22. Murphy, J. J. (1999). *Technical analysis of the financial markets: A comprehensive guide to trading methods and applications*, New York Institute of Finance.
23. Nison, S. (2003). *The Candlestick Course*. John Wiley & Sons.
24. Nison, S. (2004). Candlestick trading principles. *Technical Analysis of Stocks and Commodities, Nov*, 22-27.
25. Park, C. H., & Irwin, S. H. (2004). The profitability of technical analysis: A review.
26. Park, C. H., & Irwin, S. H. (2007). What do we know about the profitability of technical analysis?. *Journal of Economic Surveys*, *21*(4), 786-826.
27. Prado, H. A., Ferneda, E., Morais, L. C., Luiz, A. J., & Matsura, E. (2013). On the effectiveness of candlestick chart analysis for the Brazilian stock market. *Procedia Computer Science*, *22*, 1136-1145.

28. Pring, M., 2002, *Technical Analysis Explained*, McGraw-Hill, New York.
29. Samuelson, P. A. (1965). Proof that properly anticipated prices fluctuate randomly. *Industrial management review*, *6*(2).
30. Taylor, M. P., & Allen, H. (1992). The use of technical analysis in the foreign exchange market. *Journal of international Money and Finance*, *11*(3), 304-314.
31. Xie, H., Zhao, X., & Wang, S. (2012). A comprehensive look at the predictive information in Japanese candlestick. *Procedia Computer Science*, *9*, 1219-1227.
32. Yatrakis, P. G., & Williams, A. A. (2008). Information Conveyed By Japanese Candlestick Chart Patterns: An Apparent Anomaly In The Weak Form Of The Efficient Market Hypothesis. *Richards College of Business, University of West Georgia*, 1-19.

