Technical Analysis Strategies: Development of Heiken Ashi Stochastic

Roy Trivedi, Smita

18 October 2018

Technical Analysis Strategies: Development of Heiken Ashi Stochastic

Dr. Smita Roy Trivedi *

Assistant Professor, National Institute** of **Bank Management, NIBM Campus, NIBM PO, Kondhwe Khurd, Pune-411048

Corresponding author: Dr. Smita Roy Trivedi, National Institute of Bank Management, NIBM Campus, NIBM PO, Kondhwe Khurd, Pune-411048.
Email:smita@nibmindia.org; akshmita@gmail.com

Introduction:

The profitability of technical analysis is supported by empirical studies and anecdotal evidence from traders. A host of empirical studies have shown that technical analysis generates excess returns, eschewing the academic distrust of it (Pinches, 1970, Menkoff & Taylor, 2007, Surajaras and Sweeney 1992; Menkhoff and Schlumberger 1995; Neely 1997; LeBaron 1999; Saacke, 2002). This paper develops a new technical analysis strategy using the Heiken Ashi (HA) Candlesticks. Heiken Ashi is variant of the Japanese candlestick and tries to understand the trend generation in the market. If we change a regular candlestick chart to HA, we find a series of red or blue candles emerging which clearly demonstrates the trend. Using the trend reversal signals given by HA, I develop an indicator, the HASTOC, or HA stochastic which can be used to give buy and sell signals to the trader. The indicator is then back tested with an entry-exit strategy using the HASTOC on intraday hourly USD/INR data from May, 2018 to September, 2018 to confirm its profitability.

What do we know about TA profitability?

Technical analysis is the ability to forecast price movements based on qualitative and quantitative study of historical price data. Strategies developed either from visual analysis of graphs or statistical analyses of price patterns are used to forecast with reasonable accuracy future prices to generate profits. This contradicts random walk hypothesis. If random walk holds, consequential changes in prices are random, implying forecasting of prices cannot be done "in any meaningful way" (Fama & Blume 1966).

Economic literature concedes that technical analysis serves as an important tool in the hands of market practitioners as they took their trading decisions (Pinches, 1970, Menkoff & Taylor, 2007, Surajaras and Sweeney 1992; Menkhoff and Schlumberger 1995; Pilbeam 1995; Neely 1997; LeBaron 1999; Saacke, 2002). The earliest empirical studies on profitability of technical analysis indicators centered on questioning the success of technical analysis strategies in the presence of random walk. Brock et al (1992) showed, using technical analysis based on filter techniques, that profit can be generated substantially in excess of buy and hold returns. Fama (1970) points out that efficient markets should eliminate the presence of excess returns, and in this context, many of the empirical studies have focused closely on whether technical analysis leads to generation of excess reruns as opposed to positive returns in general.

With random walk holding in the financial markets, any technical analysis strategy cannot outperform a buy and hold strategy. If markets are efficient, prices at any given point of time correctly estimate its intrinsic value based on all information available till that point in time. If with new information coming the changes in prices behave in a random manner or is distributed independently as a random variable (Pinches 1970), the forecasting of future prices is ruled out.

In its narrow variant, random walk theory postulates that future price movements cannot be predicted on the basis of past price data alone. In the broader sense, random walk theory contends that present prices already reflect all past public information and hence the future cannot be predicted on the basis of history (Pinches, Ibid). Following the seminal work of Messe and Rogoff (1983), it is strongly held that random walk exists in forex markets and fundamental forecasting has largely failed to beat random walks (Neely et al., 2000). If technical analysis success comes from under reaction or overreaction to information as sentiment sways the market, it may not in fact be violating market efficiency. For example, Fama & Blume (1998) points out that if overreaction to market is matched by under reaction in some of the time, it would suggest efficiency exists over longer run.

Is technicals then self-fulfilling (Murphy, 1999)? If traders are confident on the ability of technical analysis indicators in interpreting psychological biases, logical reasoning suggests the technical analysis will be self-fulfilling. This suggests same kind of signals will elicit the similar responses from traders so that herd behaviour ensues. However the wide variety of technical analysis rules often leads to non- uniform signals, rejecting the possibility of herd behaviour.

Why should technical analysis be profitable? Menkoff & Taylor (2007) points to the belief among traders that technical analysis can represent changes in market psychology. If fundamental factors cannot reflect changes or swings in sentiment, prices may not be reflecting all information. The reaction of prices to new information coming from random events is likely to generate new movement in the market. At the same time, as these prices do not reflect new information, the fundamental analysis may not help to predict prices. Technical analysis strategies do better in interpreting both the reaction to newer information and consequent generation of new trends.
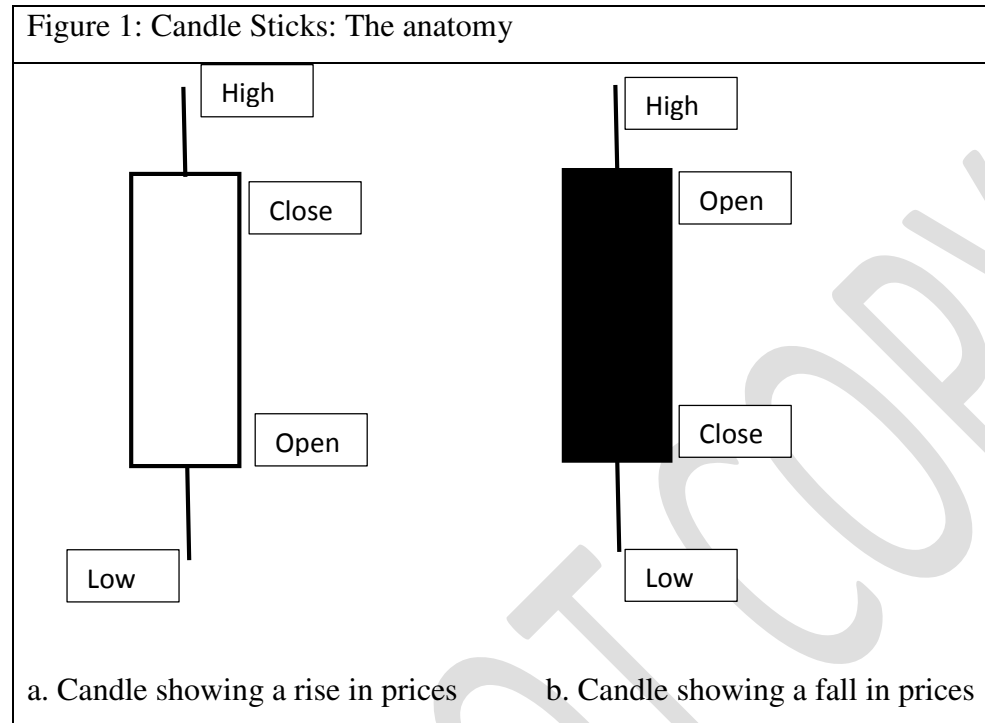
What are these random events? Silber (1994), Andrew C. Szakmary and Mathur (1997), Neely (1998) show the presence of intervention is strongly associated with profits from technical analysis indicators. Le Baron (1999) points out that central bank intervention would introduce noticeable trends into the evolution of exchange rates making it possible for market participants to gain from trading.

The success of technical analysis indicators in the presence of any market event comes from the ability to recognize trend creation. The basic premise of technical analysis is that market move in trends which can be recognized through suitable indicators (Murphy, 1999). Technical analysis indicators are largely trend following trying to recognize trend creation or turn in the market. Indicators based on moving averages try to understand the start of a new trend by comparing the present price movement to longer term averages. Indication of divergence from the longer term averages suggest the existence of trends in the market. Momentum technical indicators by seeing the rate of price change give early indications of trend generation. If random market events leads to trend generation, it is contended that technical analysis indicators would be able to recognize the same and generate profits through use of suitable strategies.

Development of HA based indicator: HASTOC

Heiken Ashi is a variant of the very popular Japanese candlestick technique. Candlesticks reflect the Japanese bar charting technique and similar to a bar construct, it also records the four important information that technical analysis traders are seeking namely, open, high, close, low. On the candlestick chart the open and close is reflected in the broad portion of the bar or the candle. The high and close for the day is reflected in the shadows or the wicks of the candle. Let us look at figure 1 to understand the candlestick technique. The wide portion shows the body of the candle, with the upper and lower lines reflecting either the open or close for the day. If the close is on the

higher side as compared to the open, the shaded area is shown in blue or white. If the close is on the lower side as compared to the open, the shaded area or the candle is shown as red or black. The wicks of the candle show the high and low as shown in the figure 1.

Figure 1: Candle Sticks: The anatomy

a. Candle showing a rise in prices   b. Candle showing a fall in prices

Heiken Ashi candlesticks have become very popular in recent years. Heinken Ashi uses a form of averaging to smooth out the movement in the market. As with the traditional candlestick pattern, Heinken Ashi also uses the open, high, low, close prices. However, in the Heinken Ashi candlesticks, this information is reflected in a different way. The calculation formula[i] to smooth out the movement in the market is as follows (StockCharts, 2018):

Close = (Open Price + High + Low +Close) / 4
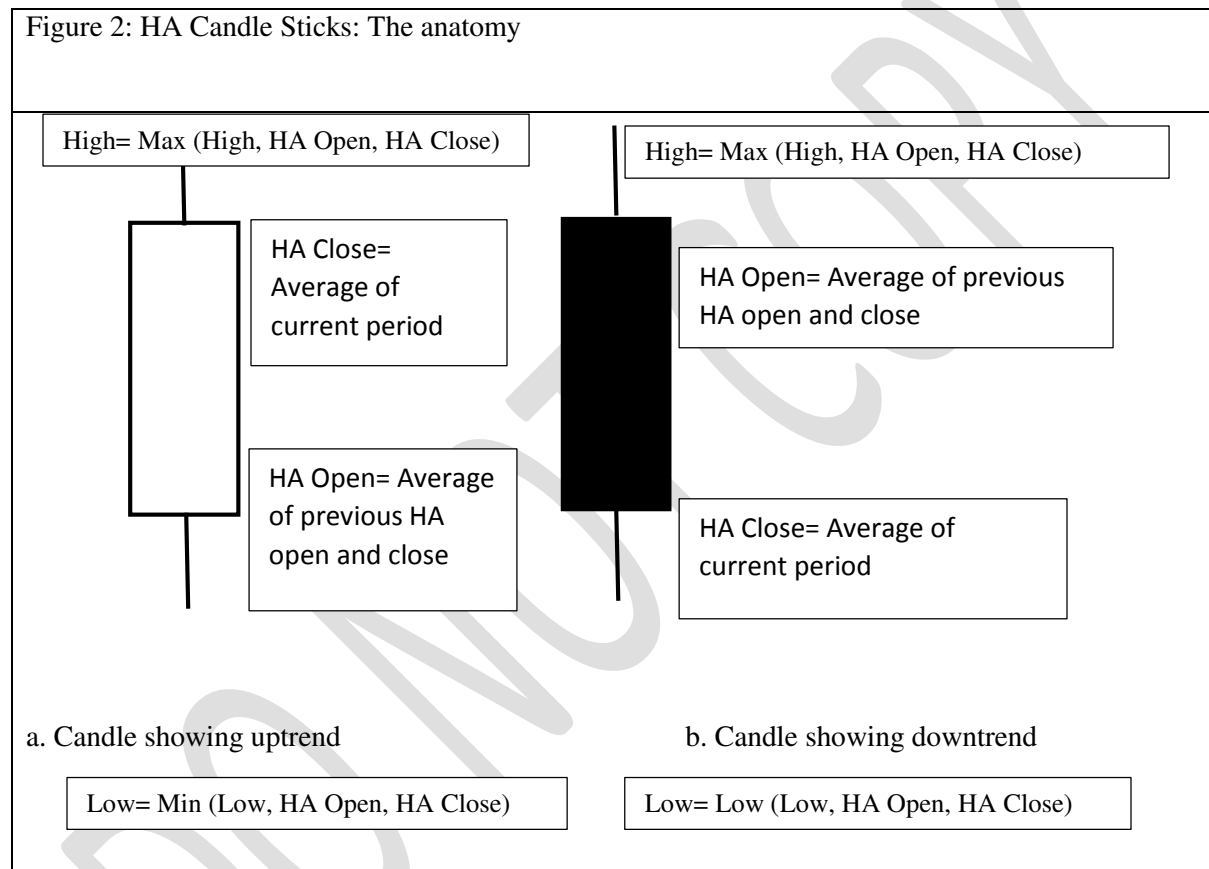
Open = Average of Open Price and Close Price of the previous HA candle

High = Maximum value of the (High of the Day, Open of HA, Close of HA)

Low = Minimum value of the (Low of the Day, Open of HA, Close of HA)

The formula above tells us that each price in the Heinken Ashi candlestick is a derived one. The open of the Heinken Ashi candlestick is the average of the open price and close price of the previous HA candle, meaning it reflects the average range that the price has taken priorly. The close of the Heinken Ashi is average of the entire price movement during the day.

The Heinken Ashi open would be greater than the Heinken Ashi close (resulting in a HA blue candle) only when yesterday's, HA open and HA close average exceeds the daily average for the day, or if prices on the average have been rising. Since yesterday's HA open is again the average of previous period HA open and close, it necessarily requires that for a blue candle to form the prices must be on the rise, or an upward trend must be in motion. Similarly, a HA red candle shows prices on the average is falling. Thus the HA candle sticks can help to identify the general market movement and aid in trend analysis.

Figure 2: HA Candle Sticks: The anatomy

High= Max (High, HA Open, HA Close)

High= Max (High, HA Open, HA Close)

HA Close= Average of current period

HA Open= Average of previous HA open and close

HA Open= Average of previous HA open and close

HA Close= Average of current period

a. Candle showing uptrend

b. Candle showing downtrend

Low= Min (Low, HA Open, HA Close)

Low= Low (Low, HA Open, HA Close)

The HA candles would show bull candles with no lower shadow if the momentum is high in the market. No upper shadow means the open of the HA is also the lowest the prices have reached in that period, which in HA parlance implies that the low of the period has exceeded the average of HA open and close of the previous period. Similarly a big bear with no upper shadow represents that the open of the period is also the highest of the period, which in HA parlance would mean that the high of the day is lower than the average of the previous HA open and close.

HA STOC: Conception, construct and use

As discussed earlier, technical analysis works in understanding the present trend in the market and in identifying the trend reversal. The trader who identifies reversal earliest in the market through use of technical analysis will be able to get the maximum advantage out of the positions. Looking at the HA charts, the following patterns for reversal emerge:

1. Trend reversal is marked by small body candles (sometimes doji, i.e. open and close as the same level).

2. The shadows tend to be smaller just prior to a reversal

3. The candles are big and shadows long in a strong uptrend or downtrend.

We see that a clear pattern of small body candles with smaller wicks emerging for reversals.

This means that HA candle length as well as the wick sizes can be a good indicator of reversal. We use the difference between the candle open and closed predict the reversal pattern. Similarly the reduced length of the shadow is an excellent indicator of indecision in the market before the change. We note that the difference between the candles can be good as indicator for the chartists in the market and reversal can be predicted and trades taken accordingly on the basis of the difference between the candles narrowing down.

Mathematically this means trend reversal is given by the Difference between open and close of HA candle attaining minimum value.

Let the Difference of HA open and lose be denoted as Δ,

$\Delta = HAC_t - HAO_t$…………………….(1)

Where, HAC= HA close for the period t

HAO= HA open for the period t,

Let HAC_t= (Open Price + High + Low +Close) / 4= X_t,

So we write equation 1 as,

$\Delta = X_t - HAO_t = 0$……………………(2)

$X_t = HAO_t$, or

$X_t = (HAO_{t-1} + X_{t-1})/2$, or,

$X_t = (HAO_{t-2} + X_{t-2})/4 + X_{t-1}/2$, or

$X_t = \frac{(HAO_{t-3} + X_{t-3})}{8} + \frac{X_{t-1}}{2} + \frac{X_{t-2}}{4} + \cdots$ (3) ,

Generalising for t=n,

$$X_n = \frac{O_1}{2^{n-1}} + \sum_{t=1}^{n-1} \frac{X_t}{2^{t-n}} \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

This implies if the difference between HAO and Close is to be minimum, the average price today sum of open of the first period, exponentially reduced and average of previous period, again exponentially reduced.

However the problem with using the difference between the HA candle open and close as an indicator for chart analysis is that are the absolute values tend to differ across securities and markets. In this case we have to have a standardised indicator with a range of values definite to get clear-cut quantitative signals out of the tool.

To address this issue we develop a Heiken Ashi stochastic, or the HASTOC which will take the values between 0 to 100%. Any value on the upper side of 70% is taken to be trend momentum while any value on the downside of 30% would be taken to be trend reversal. The stochastic tries to put the difference in the context of the average difference over a period of ten days.

$$HASTOC_t = \frac{D_t - Min(D_t)}{Max(D_t) - Min(D_t)},$$

Where D_t= Difference between HA Open and HA Close

We also calculate the wick length of HA candles and use it to derive a stochastic HASTOC (W), The wick length (WL) is given by the difference between the high and close (open) added to the difference between the low and open (close) for a blue (red) candle. HASTOC (W) is given by

$$HASTOC(W)_t = \frac{WL_t - Min(WL_t)}{Max(WL_t) - Min(WL_t)}$$

The following strategies are developed and back tested:

1. If difference (D_t) is negative and HASTOC value falls below 5 %, "buy" decision is taken and if difference is positive and HASTOC value falls below 5%, "sell" decision is taken. The fall of HASTOC below 5% is taken to represent a trend reversal (Strategy 1 a)

2. For the second strategy, we consider an exit strategy to the above and liquidate the position when HASTOC is above 50% representing a momentum. (Strategy 1b)

3. The combination of HASTOC and HASTOC (W) is taken here. For the strategy taken above in (1), we impose an additional condition that that HASTOC (W) should also be less than 5%. The exit strategy remains the same. (Strategy 2 a & b)

The profitability of the strategies is back tested on the USD/INR data. The calculations of HASTOC and HASTOC (W) for a sample data and profits of different strategies is given in Table 1 & 2.

Table 1: Calculation of HASTOC and HASTOC (W) for sample USD/INR data

Timestamp	Open	High	Low	Close	HA open	HA close	HA high	HA low	HADIFF STOCHASTIC	WL STOCHASTIC
5/1/2018 0:30	66.48	66.48	66.42	66.42	66.4500	66.4500	66.48	66.42		
5/1/2018 2:30	66.44	66.45	66.44	66.45	66.45	66.445	66.45	66.44		
5/1/2018 10:30	66.45	66.45	66.45	66.45	66.4475	66.45	66.45	66.4475		
5/1/2018 12:30	66.44	66.44	66.44	66.44	66.44875	66.44	66.448	66.44		
5/1/2018 15:30	66.5	66.5	66.5	66.5	66.44438	66.5	66.5	66.44438		
5/1/2018 19:30	66.51	66.51	66.51	66.51	66.47219	66.51	66.51	66.47219		
5/1/2018 21:30	66.5	66.52	66.5	66.52	66.49109	66.51	66.52	66.49109		
5/1/2018 22:30	66.76	66.8	66.76	66.8	66.50055	66.78	66.8	66.50055		
5/1/2018 23:30	66.79	66.79	66.79	66.79	66.64027	66.79	66.79	66.64027		
5/2/2018 9:30	66.75	66.75	66.635	66.6775	66.71514	66.70313	66.75	66.635	100.000%	100.000%
5/2/2018 10:30	66.68	66.745	66.6775	66.7125	66.70913	66.70375	66.745	66.6775	97.725%	60.317%
5/2/2018 11:30	66.715	66.7725	66.715	66.7275	66.70644	66.7325	66.7725	66.70644	86.938%	38.839%
5/2/2018 12:30	66.725	66.75	66.635	66.6525	66.71947	66.69063	66.75	66.635	100.000%	83.655%
5/2/2018 13:30	66.655	66.685	66.64	66.66	66.70505	66.66	66.70505	66.64	100.000%	19.420%
5/2/2018 14:30	66.66	66.7	66.63	66.68	66.68252	66.6675	66.7	66.63	90.748%	53.381%
5/2/2018 15:30	66.6775	66.705	66.67	66.675	66.67501	66.68188	66.705	66.67	84.003%	27.320%
5/2/2018 16:30	66.6775	66.705	66.64	66.67	66.67844	66.67313	66.705	66.64	87.757%	57.950%

Table 2: Signals generated and profits from different strategies

Strategy	No of signals	Average profits	St Dev profits
1a	211	0.0306%	0.0630%
1b	1318 (exit: 480)	0.00305%	0.06440%
2a	1212 (exit: 480)	0.00305%	0.06440%

REFERENCES

1. Bhattacharya, Utpal and Paul A. Weller, 1997, "The Advantage to Hiding One's Hand:

2. Brock, W., J. Lakonishok, and B. LeBaron, 1992, "Simple Technical Trading Rules and the Stochastic Properties of Stock Returns," Journal of Finance, 47, 1731

3. Dooley, Michael P. and Jeffrey R. Shafer, 1984, "Analysis of short-run exchange rate behavior: Economics, Princeton University.

4. Edison, Hali J., 1993, "The Effectiveness of Central-Bank Intervention: A Survey of the

5. Fama, E., and M. Blume, 1966, "Filter Rules and Stock Market Trading," Journal of Business, 39, 226-241.

   Finance, 12, 451-74.

6. Fleming M and Remolona E, (1999). Price Formation and Liquidity in the U.S. Treasury Market: The Response to Public Information. The Journal of Finance 54, (5):1901-1915.

   Foreign Exchange Market: A Bootstrap Approach," Journal of International Money and

7. Frieden, R. (2001), Probability, Statistical Optics, and Data Testing: A Problem Solving Approach, Springer: New York.

8. Humpage, Owen, 1998, "U.S. Intervention: Assessing the Probability of Success," Federal Journal of International Economics, (49)1, pp. 125-143.

9. Klein, Michael W., 1993, "The Accuracy of Reports of Foreign Exchange Intervention," Journal of International Money and Finance, 12, 644-53.

10. Kuepper, J (nd). Heikin-Ashi: A Better Candlestick. Retrieved July 5 from http://www.investopedia.com

11. LeBaron, Blake, 1999, Technical trading rule profitability and foreign exchange intervention,

12. Levich R., and L. Thomas, 1993, "The Significance of Technical Trading Rule Profits in The Literature after 1982," Special Papers in International Economics No. 18, Department of March 1973 to November 1981," in D. Bigman and T. Taya (eds.), *Floating Exchange*

13. Meese, Richard, and Kenneth Rogoff. 1983. "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?." Journal of International Economics 14: 3-24.

14. Menkhoff, Lukas and Taylor, Mark P.(2007), The Obstinate Passion of Foreign Exchange Professionals: Technical Analysis, Journal of Economic Literature, 45(4): 936-972 Monetary Economics, 39, 251-77.

15. Murphy, J. (1999). Technical analysis of financial markets. New York: penguin Group

16. Neely, C., 2002, The Temporal Pattern of Trading Rule Returns and Central Bank Intervention: Intervention Does Not Generate Technical Trading Rule Profits, Journal of International Economics, pp. 211-32

Neely, Christopher J. and Paul A. Weller, 1999, "Technical Trading Rules in the European Monetary System," Journal of International Money and Finance, 18 (3), 429-58.

17. Neely, Christopher J., 1998, "Technical Analysis and the Profitability of U.S. Foreign Exchange Intervention," Federal Reserve Bank of St. Louis *Review*, 80(4), 3-17

18.   Neely, Christopher J., Paul A. Weller and Robert Dittmar, 1997, "Is Technical Analysis in the Foreign Exchange Market Profitable? A Genetic Programming Approach," Journal of Financial and Quantitative Analysis, 32, 405-26.

19. Obstfeld, M., and K. Rogoff, 1996, Foundations of International Macroeconomics, Massachusetts: MIT Press.

20. Peiers, Bettina, 1997, "Informed Traders, Intervention and Price Leadership: A Deeper View of Profits in Foreign Exchange Markets," Journal of International Money and Finance, 16, 513-35.

21. Pilbeam, K. *International Finance*, 3rd edition, Palgrave, New York, 2009.

22. Pinches, G E. (1970), The Random Walk Hypothesis and Technical Analysis, *Financial Analysts Journal,* 26 (2) : 104-110

23. Ramaswamy, R. and H. Samiei, 2000, The Yen-Dollar Rate, Have Interventions Mattered?, International Monetary Fund, Working Paper No. 00/95.
Rates and *the State* of *World Trade Payments*, Ballinger: Cambridge, Mass., 43-69.
Reserve Bank of Cleveland Working Paper 9608.

24. Saacke, P. 2002. Technical analysis and the effectiveness of central bank intervention, Journal of International Money and Finance, 21 , 459–479
Speculation and Central Bank Intervention in the Foreign Exchange Market," Journal of

25. Stein, J. C. 1989, Cheap talk and the Fed: A theory of imprecise policy announcements. American Economic Review, 79(1): 32-42.

26. Stock   Charts   (2018),   Heikin-Ashi   ,
https://stockcharts.com/school/doku.php?id=chart_school:chart_analysis:heikin_ashi

27. Surajaras, P. and Sweeney, R.J. 1992, Profit-Making Speculation in Foreign Exchange Markets. Boulder: Westview Press.

28. Sweeney, Richard J., 1986, "Beating the foreign exchange market," Journal of Finance, 41, 163-82.

29. Szakmary, Andrew C. and Ike Mathur, 1997, "Central Bank Intervention and Trading Rule the Microstructure of the Foreign Exchange Market," Journal of Finance, 52, 1589-1614.

---

[i] Kuepper, J (nd). Heikin-Ashi: A Better Candlestick. Retrieved July 5 from http://www.investopedia.com