A hybrid strategy using Mean Reverting Indictor PSAR and EMA

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Abstract— *The mean reversion phenomenonis very useful in the financial markets. There are many technical Analysis tools that follow the mean reversion process. These tools are known as Technical Indicators. In this paper, we take the moving average known as Exponential Moving Average (EMA) which follows the mean reversion process and is called mean reverting indicator. To reduce the layback of EMA, we try to combine it with Parabolic Stop and Reversal Indicator (PSAR). In this paper we attempt to construct a Hybrid Strategy of EMA and PSAR. We apply this strategy on stock which is sampled using some important fundamental factors.*
Keywords—*Mean Reversion, Technical Analysis, Fundamental Factors, PSAR, EMA*

I.   Introduction

Mathematical Study of the financial markets is an ongoing process and lot of economic and financial theories rely on mathematical models of risk to accomplish such studies.There are many tools and techniques available in financial mathematics. Some tools and techniques are simple while others are a bit complex.

One of the oldest techniques wasused by Thales mentioned in the book of Aristotle. According to the story, Thales had very good knowledge about the movement of the stars, so he made predictions about the olive crop based on the intensity of the winter cold. He forecast to place orders for olives before its harvest season. And then during the harvest season when the demand for olives increased, he could buy them cheaply as per his agreement.Nowadays, in modern finance this technique isknown as speculating on call option. [1]

There are two types of Stock Market Analysis: 1) Fundamental Analysis and 2) Technical Analysis. The fundamental analysis compares 'Fair Value' with 'Traded Value' of stock and measures whether the stock is undervalued or overvalued. The technical analysis is based on the chart and identifies the dynamic changes of the stock along the direction.

In this paper we mainly focus on mean reversion. The mean reversion theory is one of the important theory of financial mathematics which is directly applied to financial market. If we talk about Technical Analysis of financial market through indicators, then there are many types of indicators. Among all the indicators, mean reverting indicators areused commonly in the financial market. Mean Reversion is a phenomenon in which asset price eventually returnsto its long-term mean. But according tofinancial theory not only theasset price but historical return also reverts to the long-run mean. [2]

In simple words, mean reversion is nothing but regression towards mean. Statistician Francis Galton was the first person in history who observed this phenomenon. He explained "How extreme events are usually followed by more normal events." [3] In this paper, we mainly focus on technical analysis.But this includes technical analysis as well as a small part of fundamental analysis.The most common Mean Reverting indicator is Moving Average. In financial market, there are many types of moving averages like Simple Moving Average (SMA), Exponential Moving Average (EMA), Weighted Moving Average (WMA), etc. The period of themoving average is depending on thetime-frame of investment. Generally, investors use 3, 5, 8, 20, 50, 100, 200 period and closing price as base price. In this paper, we use Exponential Moving Average (EMA) and Parabolic Stop and Reversal (PSAR) indicator for stock market analysis. We construct a combined strategy by using EMA and PSAR and apply this combined strategy on some scripts which are selected by fundamental factors namely Return on Equity (ROE), Total Profit Growth (TPG) and Liabilities.PSAR contains extreme high and low price as base price and contains a constant namedAccelerationFactor with range 0.02 to 0.2. So, with the help of EMA and PSAR we are able to check the effect of high price, low price and closing price on upcoming price. In simple words with the help of high, low and closing price we try to gauge the upcoming market trend.

- **Fundamental Factors**

 Fundamental analysis is a method of defining asset valuation based on company's reasonable economic factors. Fundamental analysis determines reliable and consistent fair value of the company. With the help of a fundamental factor, it is very easy to identify whether the position of the company in the current market is reliable/trust worthy for investment or not. Also, it is helpful to check profitability. The fundamental factors used in this study are Total Profit Growth%, Return on Equity (ROE) % and total liabilities to select profitable stock of shortlisted companies from Nifty50 index.

 Return on Equity (ROE)[7][9]: Return on equity is a financial term which is calculated by dividing net profit by shareholder's total equity, where shareholder's total equity is company's total stocks subtracted by liabilities (debt). Using ROE we can predict how efficiently company will grow in future and how much profit is created by company's assets. If ROE of company is high then company is growing and making good profits by company's assets. The formula for calculating ROE is as below.

$$ROE \ = \frac{Net\ Profit}{Shareholder's\ Total\ Equity}$$

Total Profit Growth (TPG) [7]: Total profit growth is a growth measurement of company. It shows how the company is growing in last financial years. If company's TPG is continuously growing then the company is good to invest. If company's TPG is continuously falling or fluctuating highly then investing in that company increases the risk.

Liabilities [7][9]: Liabilities are a dynamic aspect of a company to finance operations and pay for large expansions. Liabilities are a debt part which the company owes. Liabilities are paid as decided percentage between decided terms. If liabilities of company are low then company is good to invest and vice-versa. Also, there are chances to default or bankrupt of the company. The formula for calculating liabilities is as below.

$$Liabilities = Total\ Assets - Shareholder's\ Total\ Equity$$

- **Parabolic Stop and Reversal (PSAR)** [6][13]

 PSAR is a time and price technical analysis tool. Parabolic SAR (PSAR) was first introduced in 1978 by Welles Wilder, Jr. in his book, "New Concepts in Technical Trading Systems". The book was published in 1978 and also featured several of his now classic indicators such as The Relative Strength Index, Average True Range and the Directional Movement Index. The parabolic SAR is a technical analysis indicator that sets trailing price stops for long or short positions. PSAR helps traders to decide entry and exit points. PSAR is mainly used to identify trend and points of potential reversal in the price movement of traded asset. PSAR is widely used to set trailing stop loss. The Parabolic SAR mainly works in trending markets. In neutral market PSAR fails to catch the trend. Wilder recommends traders should first establish the direction of the trend using the parabolic SAR and then use alternative indicators to measure the strength of the trend. PSAR appears on a chart as series of dots. If dot appears above the closing price PSAR indicates it as a down trend. When dot appears below the closing price PSAR indicates it as up trend. The signals are used to set stop losses and profit targets.

 In the calculation of PSAR, the first point in each Initial PSAR will be high or low value of current price. Rising and falling SAR are calculated according to the aforesaid factors differently as given in below equations I and II.

(I) Rising PSAR:

$$Current\ PSAR\ =\ Previous\ PSAR + \ Previous\ AF\ (Previous\ EP - Previous\ PSAR)$$

(II) Falling PSAR:

$$Current\ PSAR\ =\ Previous\ PSAR - \ Previous\ AF\ (Previous\ PSAR - Previous\ EP)$$

where,
- Previous PSAR = The PSAR value of previous period.
- Extreme point (EP) = The highest high of current uptrend and lowest low of the current downtrend.
- Acceleration Factor (AF) = Determines the sensitivity of the SAR. Basically, it starts from 0.02 and isincreased by 0.02 every time new EPisrecorded and maximum it goes up to 0.2. Each time new trend is recorded, it is back on its basic value 0.02.

- **Exponential Moving Average (EMA)** [5]

 An exponential moving average (EMA) is a type of moving average (MA). EMA is technique of smoothing highly fluctuated data. Simple Moving Average (SMA) gives equal weight to smoothen data whereasEMA gives exponentially diminishing weights to all past prices. This moving average is very well known and used.Like all moving averages, this technical indicator is used to produce buy and sell signals based

on the historical average. EMA is a trend indicator which helps to determine direction of the trend. When the market is in a strong and sustained uptrend, the EMA indicator line will also show an uptrend and vice-versa for a down trend. We consider buying signals when the price is rising above the EMA line and consider selling signals when the price falls below the EMA line. A rising EMA tends to support the price action, while a falling EMA tends to provide resistance to price action. EMAs are commonly used in conjunction with other indicators to confirm significant market moves and to gauge their validity.

EMA is easy to Calculate. The equation for calculating EMA is as follows.

$$EMA = (C \times K) + (EMA\,(y) \times (1 - K))$$

Where,

C = Current closing Price

K = Exponential smoothing constant = $\left(\frac{2}{N+1}\right)$

N = Numbers of days in EMA

$EMA(y)$ = Previous periods EMA which is simply SMA of last n-days closing price.

II.   Literature review

Praekhaow (2010) focused on the development of moving average trading rules. These rules were applied to the stock samples takenfrom Thailand Stock Exchange selected by simple random sampling method. He observed that the rules of moving average trading create a better opportunity to buy and sell profitable stocks at any time. [4]

Mitra (2011) analyzed the advantages of the moving average based on the rules of trade in India from December 2000 to November 2010 over a period of ten years. The analysis of the study found a profit from technical analysis when the price of the trade was ignored or kept at a low level but found that trading costs were an important factor in determining the profitability of the trade. [5]

Yazdi&Lashkari (2012) developed Virtual Historical Trading Software (VHTS) for the purpose of calculating the Parabolic SAR (P-SAR) indicator based on its original formulas and interpretations. Also, it generated buy and sell signals. They examined the effectiveness of the P-SAR indicator for four pairs of currencies; Euro-US Dollar, British Pound- US Dollar, US Dollar-Swiss Franc, US Dollar-Japanese Yenwere evaluated based on the profit of buy and sell signals. He saw that P-SAR performed well with EURUSD. [6]

Pandya (2013) studied the technical and fundamental analysis on selected stocks of five IT companies to assist in investment decisions in this sector and concluded that both analysis guided investors.[7]

Shah (2013) studied indicators namely Moving Average Convergent and Divergent(MACD) with EMA and Stochastic Oscillator in technical analysis. The researcher investigated that MACD with EMA generated best profit, maximum number of buying and selling signals, best Average return.[8]

Heikal et. al (2014) analyzed the effect of independent variables such as return on assets, return on equity, net profit margin, debt to equity ratio, current ratio and theeffect of dependent variable of growth income on the Indonesian stock exchange. They analyzed the relation between independent variable and dependent variable. [9]

Raudys and Pabarškaitė (2015) introduced the optimized custom moving average as the most suitable method for smoothing the stock time series and concluded that the optimized custom moving average was useful to find out the trends and the profitability of the investment. [10]

Dhole (2017) worked on literature review on Fundamental and Technical Analysis.[11]

Nti et. al (2019) attempted to systematically and critically review approximately one hundred and twenty-two (122) corresponding research works reported in academic journals over 11 years (2007–2018) in the field of stock market forecasting using machine learning. And the various techniques identified from these reports were clustered into three categories called technical, fundamental and composite analysis. They also found that Support vector machine and artificial neural network were found to be the most used machine learning algorithms for stock market prediction. [12]

Madhu et. al (2019) investigated algorithmic trading of three mean reversion indicators. And further improvised either by adding a new mean reversion indicator to the existing algorithm or by using a new combination of indicators. [14]

Singh and Gor (2020) developed a solution for derivative pricing a European put option under the assumption that the distribution returns follows Gumbel distributed at maturity and also checked its relevancy to the actual market. [17]

Vaghela and Gor (2020) worked on the combination of Elliott Wave theory and sentiment indicator to identify future market direction. They tried to reduce the complexity of Elliott Wave theory by using sentiment indicator.[16]

Panchal and Gor (2020) converted chart pattern of technical indicators which followed mean reversion into numeric form and determined buy and sell signal of investment without having to test the chart pattern. They tried to describe the hold phenomenon in the stock market. [15]

In this paper, the EMA indicator is applied to stocksthat are selected by fundamental factors.PSAR indicator has been combined with EMA indicator to reduce the drawback of EMA indicators. Thus, a new hybrid strategy has been proposedto find long and short positions.

III. Modeling the Hybrid Strategy of PSAR and EMA

Exponential Moving Average is calculated using number of periods and closing price of security while PSAR is calculated on extreme high and low price of security. Exponential Moving Average is helpful for eliminating fluctuation in security prices. Also, it can determine whether price of security is in buy zone or sell zone. PSAR is leading and lagging indicator. It is helpful to identify reversal market. PSAR is mainly useful to set trailing stop-loss of a security. The signals generated by the EMA are delayed in the financial markets which is the biggest layback of EMA. It cannot measure sudden rise and fall. Many times, PSAR generates falsiereversal signal due to small correction in strong trend.

Due to these types of pros and cons we formulated a strategy to combine both indicators. The EMA can eliminate price fluctuations and the PSAR can recognize the reverse trend. Therefore, combining these two indicators can be a profitable and effective strategy for investing in the financial market. In this paper, the combined strategy used is named as Hybrid strategy of PSAR and EMA. This Hybrid strategy works better than single indicator strategy. We applythis Hybrid Strategy on selected stock which is selected by fundamental factors namely ROE, TPG and Liabilities.

Stepwise Procedure followed:
* Select some stocks using fundamental factors.
* Identify whether the price of security is in buy zone or sell zone through EMA.
* Check whether price of security is near or far to EMA.
* Identify the trend of security by PSAR.
* Check whether current market is normal volatile or highly volatile.
* To take position in market either long or short through Hybrid Strategy's signal.
* Identify reversal market by Hybrid Strategy to book profit on previous position.

IV. Research Methodology

o   Data Collection:
The data from 01-01-2018 to 01-01-2020 was collected from the National Stock Exchange website.
o   Computation:
* Fundamental factors:

We used Fundamental factors for selection of companies. We selected10 companies from NIFTY 50 index by using fundamental factors namely ROE, TPG and total Liabilities. The companies and its fundamentals are given in table 1.

Table: 1: Stock Selection			
Company name	**ROE (%)**	**Total liabilities (cr.)**	**Total Profit growth %**
Adani Ports and Special Economic Zone Ltd.(L)	17.52%	62,382	32.95%
Bajaj Finance Ltd.(L)	21.98%	123,506	45.00%
Bharti Infratel Ltd.(L)	14.31%	19,034	29.74%
Dr. Reddy's Laboratories Ltd.(L)	13.61%	23,314	-3.76%
Hindustan Unilever Ltd.(L)	**81.95%**	20,656	18.67%
Nestle India Ltd.(L)	**45.30%**	**7,058**	**22.57%**
Sun Pharmaceutical Industries Ltd.(L)	9.19%	65,580	-7.31%
Tata Consultancy Services Ltd.(L)	35.98%	127,335	7.16%
Ultratech Cement Ltd.(L)	8.58 %	79,944	79.77%

In table 1, there are two companies Hindustan Unilever Ltd. and Nestle India Ltd. that have high Return on Equity (ROE). From these two companies, we selected Nestle India Ltd. because it had low liability and high profit growth as compared to Hindustan Unilever Ltd.
* Exponential Moving Average:
$$EMA = (C \times K) + (EMA\,(y) \times (1-K)) \dots (1)$$
Where, $EMA\,(y)$ = Previous periods EMA which is simply SMA of last n-days closing price.
➢   Calculations of 5-period EMAusing excel:
▪   Step 1: Use previous periods EMA which is simply SMA of last 5-days closing price.

- ▪ Step 2: Calculate smoothing constant (K) by formula (2/ (N+1)). Here N=5 so K = 0.3333.
- ▪ Step 3: Calculate 5-period EMA by equation (1).
- ▪ Step 4: If 5-period EMA < closing price, consider it as "UP" trend and if 5-period EMA > closing price, considerit as "DOWN" trend.
- ▪ Step 5: If we get uptrend then we go for "LONG" position and if we get downtrend then we go for "SHORT" position.

For Table 2	
3rd column	EMA of 5 days. Calculated by given formula.
4th column	Trend determined by 5-period EMA. When 5-period EMA< closing price we consider up trend and vice versa.
5th column	Outcomes. When 5-period EMA provides uptrend, we go for Long position and vice versa.

Table 2: Observation table of EMA 5(Year 2019)				
Date	Close	5-period EMA	Trend 5-period EMA	Outcomes
18 Jan	11248.4	11198.43	**UP**	**LONG**
21 Jan	11255.2	11217.34	**UP**	**LONG**
22 Jan	11236.5	11223.72	**UP**	**LONG**
23 Jan	11315.9	11254.41	**UP**	**LONG**
24 Jan	11433.4	11314.02	**UP**	**LONG**
25 Jan	11365.6	11331.19	**UP**	**LONG**
28 Jan	11360.6	11340.99	**UP**	**LONG**
29 Jan	11399.1	11360.34	**UP**	**LONG**
30 Jan	11396.7	11372.45	**UP**	**LONG**
31 Jan	11497.8	11414.19	**UP**	**LONG**
01 Feb	11556.5	11461.58	**UP**	**LONG**
08 Feb	11242.7	11487.4	**DOWN**	**SHORT**
11 Feb	10843.5	11272.98	**DOWN**	**SHORT**
12 Feb	10783.8	11110.08	**DOWN**	**SHORT**
14 Feb	10628.8	10949.82	**DOWN**	**SHORT**
15 Feb	10535.5	10811.85	**DOWN**	**SHORT**
18 Feb	10349.5	10657.89	**DOWN**	**SHORT**
19 Feb	10515.4	10610.44	**DOWN**	**SHORT**
20 Feb	10521.8	10580.92	**DOWN**	**SHORT**
21 Feb	10622	10594.601	**UP**	**LONG**
22 Feb	10685.5	10624.87	**UP**	**LONG**
25 Feb	10831.7	10693.745	**UP**	**LONG**
26 Feb	10804.4	10730.593	**UP**	**LONG**
27 Feb	10713.7	10724.968	**DOWN**	**SHORT**
28 Feb	10639.8	10696.607	**DOWN**	**SHORT**
01 Mar	10451.8	10615.086	**DOWN**	**SHORT**
05 Mar	10506	10578.76	**DOWN**	**SHORT**

Figure 1 (5-period EMA)
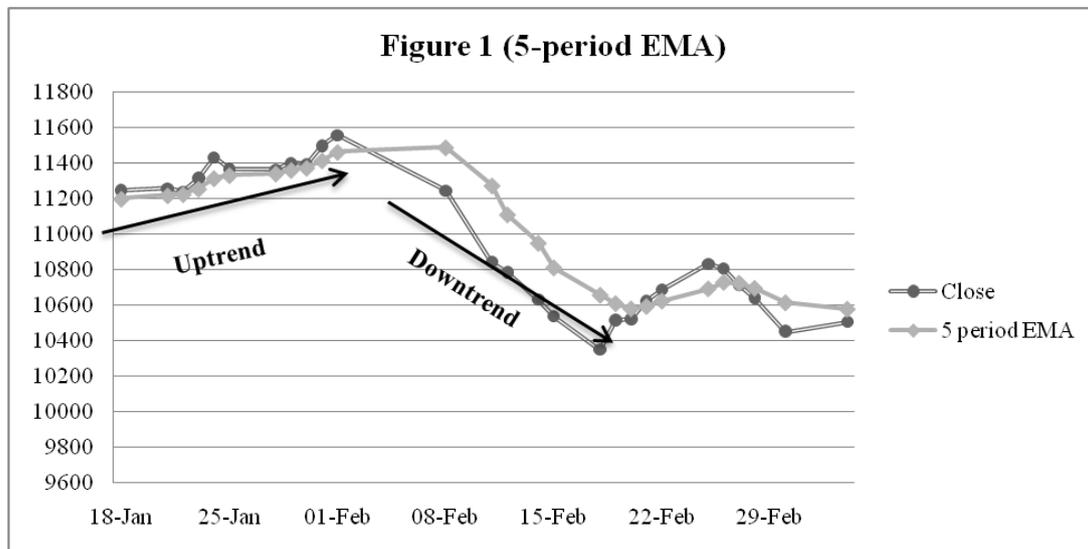
The above figure is representation of 5-period moving average of the selected company of NSE from 18th January 2019 to 5th March 2019. In the above figure, black line with circle indicates current day closing price and grey line with square indicates current day 5-period EMA. Whenever line of closing price and 5-period EMA cross each other,it indicates potential change in current market trend. In above figure, line of closing price crosses line of 5- period EMAin the direction from up to downsideon 3[rd]February 2019 which indicates starting of downtrend of market and on 21st February 2019 line closing price crosses line of EMA in the direction from down to upside which indicates starting of uptrend of market.

- Parabolic Stop and Reversal (PSAR):

(I)　　Rising PSAR:

$$Current\ PSAR\ =\ Previous\ PSAR\ +\ Previous\ AF\ (Previous\ EP - Previous\ PSAR) \quad .....(2)$$

(II)　　Falling PSAR:

$$Current\ PSAR\ =\ Previous\ PSAR\ -\ Previous\ AF\ (Previous\ PSAR - Previous\ EP) \quad .....(3)$$

➢　　Calculations of PSAR using excel.

▪　　Step 1: Use current day high or low price as initial PSAR value.

▪　　Step 2: If PSAR < closing price,considerit as "UP" trend and if PSAR > closing price, consider it as "DOWN" trend.

▪　　Step 3: If we get up trend then Extreme Point (EP) is highest high of current uptrend. If we get down trend, then EP is lowest low of current downtrend.

▪　　Step 4: Acceleration factor has basic value 0.02 and it increases with each time new EP is recorded. Its maximum value is 0.2. Each time new trend is recorded it comes to initial value 0.02. We can change the initial values as per convenience.

▪　　Step 5: after computing all values we put each value in equation (2) or (3) and we get next PSAR value.

For Table 3	
2nd column	The high price of current day
3rd column	The low price of current day
4th column	The closing price of current day
5th column	PSAR value which calculated by formula of PSAR
6th column	Trend of current day. When PSAR < Closing price it considered as "UP" trend and when PSAR > Closing price it considered as "Down" trend.
7th column	The Extreme Point. For "UP" trend it is highest high of high price and for "DOWN" trend it is lowest low of low price.
8th column	The Acceleration factor. It basically starts from 0.02 and increased by 0.02 as new "EP" recorded and maximum goes to 0.2.
10th column	Outcomes. When Trend determined by PSAR is an uptrend we go for "LONG" position and when trend determined by PSAR is downtrend we go for "SHORT" position.

Table 3: Observation table of PSAR(Year 2019)									
Date	High	Low	Close	PSAR	Trend	EP	Acc.	Acc.*(PSAR-EP)	Outcomes
18 Jan	11326.5	11181	11248.4	10732.6	**UP**	11458	0.02	-14.51	**LONG**
21 Jan	11309	11150.1	11255.2	10747.11	**UP**	11458	0.02	-14.22	**LONG**
22 Jan	11350	11200	11236.5	10761.33	**UP**	11458	0.02	-13.93	**LONG**
23 Jan	11348	11240	11315.9	10775.26	**UP**	11458	0.02	-13.65	**LONG**
24 Jan	11460	11306	11433.4	10788.92	**UP**	11460	0.04	-26.84	**LONG**
25 Jan	11517	11300	11365.6	10815.76	**UP**	11517	0.06	-42.07	**LONG**
28 Jan	11420	11155	11360.6	10857.84	**UP**	11517	0.06	-39.55	**LONG**
29 Jan	11440	11293.9	11399.1	10897.38	**UP**	11517	0.06	-37.18	**LONG**
30 Jan	11439.8	11280	11396.7	10934.56	**UP**	11517	0.06	-34.95	**LONG**
31 Jan	11539	11373	11497.8	10969.51	**UP**	11539	0.08	-45.56	**LONG**
01 Feb	11622	11430.2	11556.5	11015.07	**UP**	11622	0.1	-60.69	**LONG**
08 Feb	11751	11111	11242.7	11749	**DOWN**	11111	0.02	12.76	**SHORT**
11 Feb	11300	10765.5	10843.5	11751	**DOWN**	10765.5	0.04	39.42	**SHORT**
12 Feb	10850	10615.7	10783.8	11751	**DOWN**	10615.7	0.06	68.12	**SHORT**
14 Feb	10779	10310	10628.8	11682.88	**DOWN**	10310	0.08	109.83	**SHORT**
15 Feb	10740.2	10251	10535.5	11573.05	**DOWN**	10251	0.1	132.21	**SHORT**
18 Feb	10580	10176.2	10349.5	11440.85	**DOWN**	10176.2	0.12	151.76	**SHORT**
19 Feb	10729	10350	10515.4	11289.09	**DOWN**	10176.2	0.12	133.55	**SHORT**
20 Feb	10638.8	10399.2	10521.8	11155.54	**DOWN**	10176.2	0.12	117.52	**SHORT**
21 Feb	10671.5	10450	10622	11038.02	**DOWN**	10176.2	0.12	103.41851	**SHORT**
22 Feb	10709	10561.7	10685.5	10934.6	**DOWN**	10176.2	0.12	91.008289	**SHORT**
25 Feb	10870	10680	10831.7	10176.2	**UP**	10870	0.02	-13.875996	**LONG**

26 Feb	10855	10666.5	10804.4	10190.08	**UP**	10870	0.02	-13.598476	**LONG**
27 Feb	10820.7	10651.8	10713.7	10203.67	**UP**	10870	0.02	-13.326507	**LONG**
28 Feb	10763.5	10555.1	10639.8	10217	**UP**	10870	0.02	-13.059977	**LONG**
01 Mar	10675	10406	10451.8	10230.06	**UP**	10870	0.02	-12.798777	**LONG**
05 Mar	10566.7	10281.5	10506	10242.86	**UP**	10870	0.02	-12.542801	**LONG**

Figure 2 (PSAR)
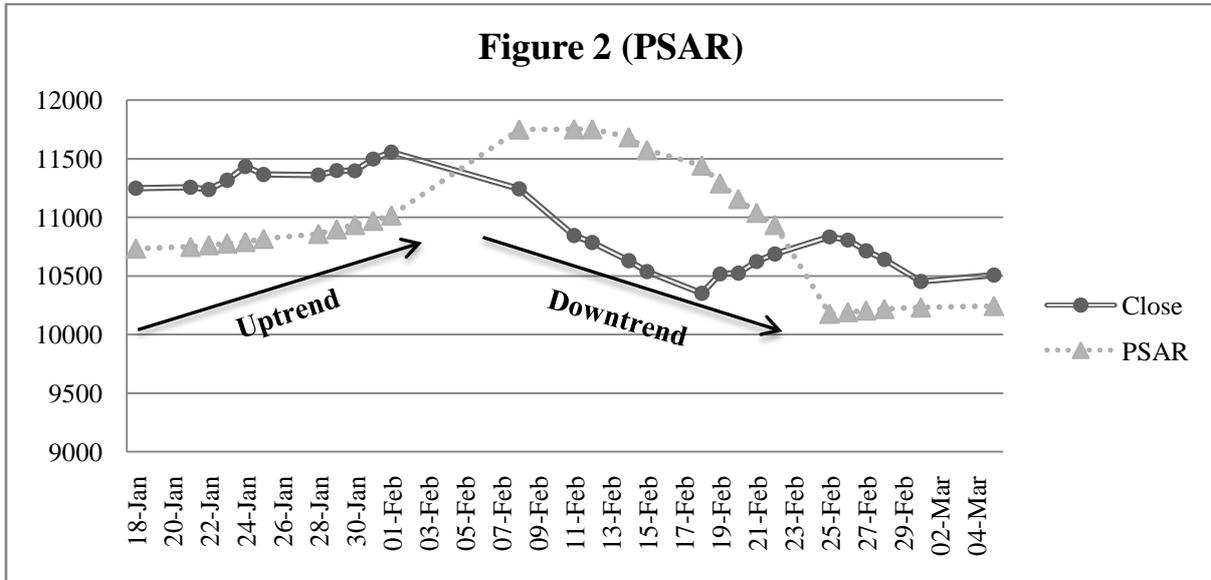
The above figure is representation about PSAR of the selected company from 18th January 2019 to 5th March 2019. In above figure black line with circle indicates current day closing price and gray line with triangle indicates current PSAR. Whenever PSAR points are above the line of closing price then current market trend is downtrend and vise-versa. As in above figure, from 18th January 2019 to 5th February 2019 PSAR points are below the closing price that indicates uptrend and 9th February 2019 to 21st February 2019 PSAR points are above the closing price.

o Observation

In above individual calculations of PSAR we get lot of uptrend and downtrend signals. From that signals we decide which position we have to take for trading. In calculation table 2 we see that there is uptrend between 18-01-2019 to01-02-2019 which is a profitable signal. Also, from 07-02-2019to 22-02-2019 it shows downtrend which is again profitable signal for trading. But from 25-02-2019 to 05-03-2019 PSAR shows up trend and on the other hand market is on the downtrend. So, these are misleading signals for trading. Now we introduce EMA indicator. EMA is a lagging indicator. It contains errors although it is an average of past data. So,in a combined strategy, we confirm the trend provided by PSAR using EMA indicator. Here we take EMA of 5 days to minimize the lag of indicator.

- Step 1: Calculate PSAR for the considered period.
- Step 2: Calculate EMA 5 for the considered period.
- Step 3: Consider "LONG" position when both PSAR and EMA indicators shows uptrend.
- Step 4: Consider "SHORT SELL" position when both indicators show down trend.
- Step 5: We go for long position investment when we get continuous three "LONG" outcomes from combined outcomes and we go for short position investment when we get continuous three "SHORT SELL" outcomes from combined outcomes.
- Step 6: We will wind up our position whenever both indicators contradicts trend of each other and shows "HOLD" signal.

For Table 4	
3rd column	The trend determined by PSAR
4th column	The trend determined by 5-period EMA
5th column	Combined Outcomes. When both PSAR and 5-period EMA gives UP trend we considered LONG position and vice versa. When both contradict each other's trend we wind up our position or HOLD for investing.

Table 4: Observation table of combined strategy(Year 2019)				
Date	**Closing price**	**PSAR Trend**	**5-period EMA Trend**	**Combined outcomes**
18 Jan	11248.4	**UP**	**UP**	**LONG**
21 Jan	11255.2	**UP**	**UP**	**LONG**
22 Jan	11236.5	**UP**	**UP**	**LONG**
23 Jan	11315.9	**UP**	**UP**	**LONG**
24 Jan	11433.4	**UP**	**UP**	**LONG**
25 Jan	11365.6	**UP**	**UP**	**LONG**
28 Jan	11360.6	**UP**	**UP**	**LONG**
29 Jan	11399.1	**UP**	**UP**	**LONG**
30 Jan	11396.7	**UP**	**UP**	**LONG**
31 Jan	11497.8	**UP**	**UP**	**LONG**
01 Feb	11556.5	**UP**	**UP**	**LONG**
08 Feb	11242.7	**DOWN**	**DOWN**	**SHORT**
11 Feb	10843.5	**DOWN**	**DOWN**	**SHORT**
12 Feb	10783.8	**DOWN**	**DOWN**	**SHORT**
14 Feb	10628.8	**DOWN**	**DOWN**	**SHORT**
15 Feb	10535.5	**DOWN**	**DOWN**	**SHORT**
18 Feb	10349.5	**DOWN**	**DOWN**	**SHORT**
19 Feb	10515.4	**DOWN**	**DOWN**	**SHORT**
20 Feb	10521.8	**DOWN**	**DOWN**	**SHORT**
21 Feb	10622	**DOWN**	**UP**	**HOLD**
22 Feb	10685.5	**DOWN**	**UP**	**HOLD**
25 Feb	10831.7	**UP**	**UP**	**LONG**
26 Feb	10804.4	**UP**	**UP**	**LONG**
27 Feb	10713.7	**UP**	**DOWN**	**HOLD**
28 Feb	10639.8	**UP**	**DOWN**	**HOLD**
01 Mar	10451.8	**UP**	**DOWN**	**HOLD**
05 Mar	10506	**UP**	**DOWN**	**HOLD**

Figure 3 (PSAR & 5-period EMA strategy)
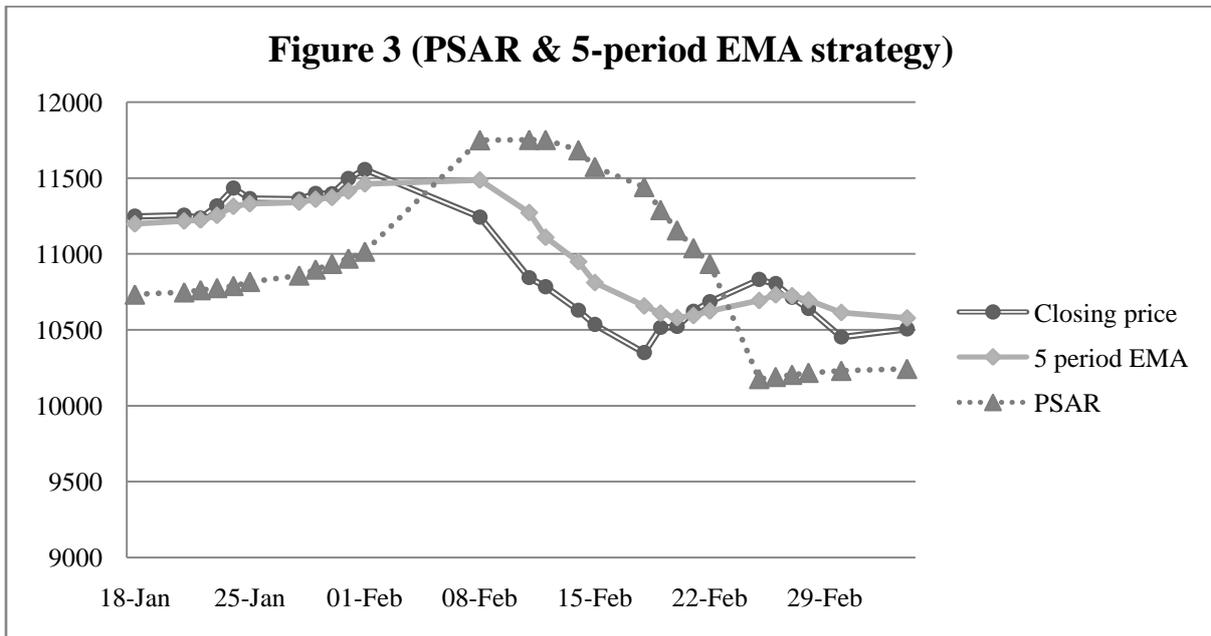
The above figure represents the Hybrid Strategy of PSAR and EMA of the selected company of NSE from 18th January 2019 to 5th March 2019. In figure 3,black line with circle indicates closing prices, dotted line with triangle indicates values of PSAR and grey line with square indicates values of 5-period EMA. With the help of Hybrid Strategy, we can clearly identify potential change in the market. In the above figure on 9 February 2019, EMA generated late reversal signal but PSAR caught that single to overcome the drawback of EMA.

o   Result Sample snapshot of the data on the hybrid strategy of Nestle India.

Table 5: Hybrid Strategy of EMA and PSAR(Year:2019)			
Duration	**PSAR outcomes**	**5-Period EMA outcomes**	**combined outcomes**
01 to 05 Jan	DOWN	UP	HOLD
08 Jan	UP	UP	LONG
09 to 10 Jan	UP	DOWN	HOLD
11 to 16 Jan	UP	UP	LONG
17 Jan to 09 Feb	DOWN	DOWN	SHORT
12 Feb to 01 Mar	UP	UP	LONG
05 to 08 Mar	UP	DOWN	HOLD
09 to 12Mar	DOWN	DOWN	SHORT
13 Mar	DOWN	UP	HOLD
14 Mar	DOWN	DOWN	SHORT
15 to 16 Mar	DOWN	UP	HOLD
19 Mar	DOWN	DOWN	SHORT
20 to 22 Mar	UP	UP	LONG
23 Mar	UP	DOWN	HOLD
26 Mar to 20 April	UP	UP	LONG
23 to 25 April	DOWN	DOWN	SHORT
26to 27 April	DOWN	UP	HOLD
30 April to 02 May	UP	UP	LONG
03to 07 May	UP	DOWN	HOLD
08 to 09 May	UP	UP	LONG
10 May	UP	DOWN	HOLD
11 to 18 May	UP	UP	LONG
21 May	UP	DOWN	HOLD
22 to 25 May	UP	UP	LONG
28 May	UP	DOWN	HOLD
29 to 30 May	DOWN	DOWN	SHORT
31 May	DOWN	UP	HOLD
01 to 04 June	UP	UP	LONG
05 June	DOWN	DOWN	SHORT
06 to 08 June	DOWN	UP	HOLD
11 to 13 June	UP	UP	LONG
14to 18 June	UP	DOWN	HOLD
19 June	DOWN	DOWN	SHORT
20 to 25 June	DOWN	UP	HOLD
26 to 27 June	UP	UP	LONG

V. Conclusion

Using Fundamental factors,we can select superior stocks in market for long term trading strategies. The combination of PSAR and EMA indicators provide better long and short positions in the market and provide good strength of trend. This combination gives the better signals for trading rather than single indicator strategy. By applying technical indicator results on selected stock we get profitable long and shot-sell positions. Combination of Fundamental Analysis and Technical Analysis provides gainful strategy in market to book profits and helps to protect from losses. Also, this strategy helps to prevent wrong reserves in sideways market and generate many options for profitable position.

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Appendix

➢ The hybrid strategy PSAR-EMA strategy between the data range 01 January 2018 to 31 December 2019 is as below.

Duration	PSAR outcomes	5-period EMA outcomes	combined outcomes
01to 05 Jan 2018	**DOWN**	**UP**	**HOLD**
08 Jan	**UP**	**UP**	**LONG**
09to 10 Jan 2018	**UP**	**DOWN**	**HOLD**
11to 16 Jan 2018	**UP**	**UP**	**LONG**
17 Jan to 09 Feb 2018	**DOWN**	**DOWN**	**SHORT**
12 Feb to 01 Mar 2018	**UP**	**UP**	**LONG**
05to 08 Mar 2018	**UP**	**DOWN**	**HOLD**
09to 12 Mar 2018	**DOWN**	**DOWN**	**SHORT**
13 Mar 2018	**DOWN**	**UP**	**HOLD**
14 Mar 2018	**DOWN**	**DOWN**	**SHORT**
15 to 16 Mar 2018	**DOWN**	**UP**	**HOLD**
19 Mar 2018	**DOWN**	**DOWN**	**SHORT**
20to 22 Mar 2018	**UP**	**UP**	**LONG**
23 Mar 2018	**UP**	**DOWN**	**HOLD**
26 Mar to 20 April 2018	**UP**	**UP**	**LONG**
23 to 25 April 2018	**DOWN**	**DOWN**	**SHORT**
26to 27 April 2018	**DOWN**	**UP**	**HOLD**
30 April to 02 May 2018	**UP**	**UP**	**LONG**
03 to 07 May 2018	**UP**	**DOWN**	**HOLD**
08 to 09 May 2018	**UP**	**UP**	**LONG**
10 May 2018	**UP**	**DOWN**	**HOLD**
11 to 18 May 2018	**UP**	**UP**	**LONG**
21 May 2018	**UP**	**DOWN**	**HOLD**
22 to 25 May 2018	**UP**	**UP**	**LONG**
28 May 2018	**UP**	**DOWN**	**HOLD**
29to 30 May 2018	**DOWN**	**DOWN**	**SHORT**
31 May 2018	**DOWN**	**UP**	**HOLD**
01 to 04 June 2018	**UP**	**UP**	**LONG**
05 June18	**DOWN**	**DOWN**	**SHORT**
06 to 08 June 2018	**DOWN**	**UP**	**HOLD**
11 to 13 June 2018	**UP**	**UP**	**LONG**
14 to 18 June 2018	**UP**	**DOWN**	**HOLD**
19 June 2018	**DOWN**	**DOWN**	**SHORT**
20 to 25 June 2018	**DOWN**	**UP**	**HOLD**
26 to 27 June 2018	**UP**	**UP**	**LONG**
28 June to 03 July 2018	**UP**	**DOWN**	**HOLD**
04 to 18 July 2018	**UP**	**UP**	**LONG**
19 July2018	**UP**	**DOWN**	**HOLD**
20 to 23 July 2018	**UP**	**UP**	**LONG**
24 to 25 July 2018	**UP**	**DOWN**	**HOLD**
26 July2018	**UP**	**UP**	**LONG**
27 to 30 July 2018	**DOWN**	**DOWN**	**SHORT**
31 July to 02 Aug 2018	**UP**	**UP**	**LONG**
03 Aug 2018	**UP**	**DOWN**	**HOLD**
06 to 09 Aug 2018	**UP**	**UP**	**LONG**
10 Aug 2018	**UP**	**DOWN**	**HOLD**
13to 31 Aug 2018	**UP**	**UP**	**LONG**
03 Sep 2018	**UP**	**DOWN**	**HOLD**
04 Sep to 08 Oct 2018	**DOWN**	**DOWN**	**SHORT**
09to 10 Oct 2018	**DOWN**	**UP**	**HOLD**
11 Oct 2018	**DOWN**	**DOWN**	**SHORT**

12to 17 Oct 2018	**UP**	**UP**	**LONG**
19to 25 Oct 2018	**UP**	**DOWN**	**HOLD**
26 Oct to 09 Nov 2018	**UP**	**UP**	**LONG**
12to 13 Nov 2018	**UP**	**DOWN**	**HOLD**
14to 16 Nov 2018	**UP**	**UP**	**LONG**
19to 22 Nov 2018	**DOWN**	**DOWN**	**SHORT**
26to 28 Nov 2018	**DOWN**	**UP**	**HOLD**
29 Nov to 03 Dec 2018	**UP**	**UP**	**LONG**
04 to 05 Dec 2018	**UP**	**DOWN**	**HOLD**
06 to 10 Dec 2018	**DOWN**	**DOWN**	**SHORT**
11 Dec 2018	**DOWN**	**UP**	**HOLD**
12to 20 Dec 2018	**UP**	**UP**	**LONG**
21to 26 Dec 2018	**UP**	**DOWN**	**HOLD**
27to 31 Dec 2018	**UP**	**UP**	**LONG**
01 to 02 Jan 2019	**UP**	**DOWN**	**HOLD**
03 Jan 2019	**UP**	**UP**	**LONG**
04to 07 Jan 2019	**DOWN**	**DOWN**	**SHORT**
08 to 10 Jan 2019	**DOWN**	**UP**	**HOLD**
11to 15 Jan 2019	**UP**	**UP**	**LONG**
16 to 17 Jan 2019	**UP**	**DOWN**	**HOLD**
18 Jan to 07 Feb 2019	**UP**	**UP**	**LONG**
08 Feb to 20 Feb 2019	**DOWN**	**DOWN**	**SHORT**
21to 22 Feb 2019	**DOWN**	**UP**	**HOLD**
25to 26 Feb 2019	**UP**	**UP**	**LONG**
27 Feb to 05 Mar 2019	**UP**	**DOWN**	**HOLD**
06to 11 Mar 2019	**DOWN**	**DOWN**	**SHORT**
12 Mar 2019	**DOWN**	**UP**	**HOLD**
13 to 14 Mar 2019	**UP**	**UP**	**LONG**
15 to 18 Mar 2019	**UP**	**DOWN**	**HOLD**
19 Mar 2019	**UP**	**UP**	**LONG**
20 Mar 2019	**UP**	**DOWN**	**HOLD**
22 Mar 2019	**UP**	**UP**	**LONG**
25 Mar 2019	**UP**	**DOWN**	**HOLD**
26 Mar to 01 April 2019	**UP**	**UP**	**LONG**
02 April 2019	**UP**	**DOWN**	**HOLD**
03 to 05 April 2019	**UP**	**UP**	**LONG**
08 April 2019	**UP**	**DOWN**	**HOLD**
09 to 11 April 2019	**DOWN**	**DOWN**	**SHORT**
12 April 2019	**DOWN**	**UP**	**HOLD**
15to 16 April 2019	**UP**	**UP**	**LONG**
18to 23 April 2019	**UP**	**DOWN**	**HOLD**
24to 25 April 2019	**DOWN**	**DOWN**	**SHORT**
26 April 19	**DOWN**	**UP**	**HOLD**
30 April to 16 May 2019	**DOWN**	**DOWN**	**SHORT**
17 May to 12 June 2019	**UP**	**UP**	**LONG**
13 June 19	**UP**	**DOWN**	**HOLD**
14 to 18 June 2019	**DOWN**	**DOWN**	**SHORT**
19 June 2019	**DOWN**	**UP**	**HOLD**
20 June 2019	**UP**	**UP**	**LONG**
21 June 2019	**UP**	**DOWN**	**HOLD**
24 June to 02 July 2019	**UP**	**UP**	**LONG**
03 July 2019	**UP**	**DOWN**	**HOLD**
04 to 05 July 2019	**UP**	**UP**	**LONG**
08 July 19	**UP**	**DOWN**	**HOLD**
09 to 11 July 2019	**DOWN**	**DOWN**	**SHORT**
12 July 2019	**DOWN**	**UP**	**HOLD**
15 July 2019	**DOWN**	**DOWN**	**SHORT**
16 to 17 July 2019	**DOWN**	**UP**	**HOLD**
18 to 24 July 2019	**DOWN**	**DOWN**	**SHORT**
25 July 19	**DOWN**	**UP**	**HOLD**
26to 29 July 2019	**UP**	**UP**	**LONG**
30 July 2019	**UP**	**DOWN**	**HOLD**
31 July 2019	**UP**	**UP**	**LONG**
01 Aug 2019	**UP**	**DOWN**	**HOLD**
02 Aug 2019	**DOWN**	**DOWN**	**SHORT**
05 to 19 Aug 2019	**UP**	**UP**	**LONG**
20 Aug 19	**UP**	**DOWN**	**HOLD**

21 Aug to 03 Sep 2019	**UP**	**UP**	**LONG**
04 Sep 19	**DOWN**	**DOWN**	**SHORT**
05 to 11 Sep 2019	**DOWN**	**UP**	**HOLD**
12 Sep 19	**DOWN**	**DOWN**	**SHORT**
13to 17 Sep 2019	**DOWN**	**UP**	**HOLD**
18 Sep 2019	**UP**	**UP**	**LONG**
19 Sep 2019	**UP**	**DOWN**	**HOLD**
20 to 30 Sep 2019	**UP**	**UP**	**LONG**
01 Oct 2019	**UP**	**DOWN**	**HOLD**
03 Oct 2019	**UP**	**UP**	**LONG**
04to 07 Oct 2019	**UP**	**DOWN**	**HOLD**
09to 23 Oct 2019	**UP**	**UP**	**LONG**
24 Oct 2019	**UP**	**DOWN**	**HOLD**
25 Oct 2019	**DOWN**	**UP**	**HOLD**
29 Oct 2019	**DOWN**	**DOWN**	**SHORT**
30 Oct 2019	**DOWN**	**UP**	**HOLD**
31 Oct to 01 Nov 2019	**UP**	**UP**	**LONG**
04 to 07 Nov 2019	**UP**	**DOWN**	**HOLD**
08to 19 Nov 2019	**DOWN**	**DOWN**	**SHORT**
20 Nov 2019	**DOWN**	**UP**	**HOLD**
21to 22 Nov 2019	**DOWN**	**DOWN**	**SHORT**
25to 26 Nov 2019	**DOWN**	**UP**	**HOLD**
27to 28 Nov 2019	**UP**	**UP**	**LONG**
29 Nov 2019	**UP**	**DOWN**	**HOLD**
02 Dec 2019	**UP**	**UP**	**LONG**
03 to 06 Dec 2019	**UP**	**DOWN**	**HOLD**
09to 12 Dec 2019	**DOWN**	**DOWN**	**SHORT**
13 Dec 2019	**DOWN**	**UP**	**HOLD**
16to 17 Dec 2019	**DOWN**	**DOWN**	**SHORT**
18 to 19 Dec 2019	**DOWN**	**UP**	**HOLD**
20 to 31 Dec 2019	**UP**	**UP**	**LONG**