COMPARISON OF THREE TECHNICAL TRADING METHODS VS. BUY-AND-HOLD FOR THE S&P 500 MARKET

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ABSTRACT

This paper compares three common technical trading indicators against the buy-and-hold strategy for the American S&P 500 index. Data across 17 years and 5 years will be examined to determine trading method efficiency over long and short terms, with both time periods ending in the spring of 2009. An additional study will demonstrate the ability of the technical trading methods to correctly position a trader for days when the S&P 500 market moves greater than 2% in either direction. The results demonstrate that some, but not all, of the technical indicators can be used as a predictive indicator of upcoming market direction when used in accordance with the methods demonstrated in this report.

I. Introduction

Technical analysis attempts to predict the price of a futures contract or stock index based solely on historical prices and volumes. Pring defines Technical Analysis as follow (Pring 1991, page 3):

"Technical analysis is based on the idea that prices move in trends, which are determined by the changing attitudes of traders towards various economic, political and psychological forces". As Pring points out "the art of technical analysis is to identify trend changes at an early stage and to maintain an investment posture until the weight of evidence indicates that the trend has reversed."

In other words, we define Technical analysis as an approach to forecasting stock and financial futures prices which examines patterns of price change, rates of change, and changes in volume of trading and open interest, irrespective of underlying fundamental market factors. We can also say that Technical analysis is a method of evaluating commodities by analyzing statistics generated by market activity, volume, open interest, past prices, and various indicators based on prices and volumes. Technical analysts do not attempt to measure a commodity's intrinsic value; instead they look for patterns and indicators on the charts that will determine a whether you should go long or short or stay neutral for any futures contract.

Conversly, Fama (1970) defined an efficient financial market as one in which security prices always fully reflect the available information; any new information will be quickly and instantaneously reflected in prices. Furthermore, since news on any company, by definition, is unpredictable (arrives randomly), price changes will be unpredictable or follow a random walk. The "weak-form" Efficient Market Hypothesis (EMH) asserts that stock prices already reflect all information that can be derived by investigating market trading data such as the history of past prices or trading volume. Advocates of the weak-form market efficiency hypothesized that investors could not drive profits above a buy-and-hold strategy using any trading rule that depended solely on past market information such as price or volume, implying that technical trading rules are useless.

After more than three decades of research and literally thousands of journal articles, financial economists and practitioners have not yet reached a consensus whether technical trading rules could discern recurring-price patterns for profitable trading. The overwhelming majority of financial economists support the "weak-form" efficient market hypothesis. This is because much of earlier research supported the random walk hypothesis. The following studies have long supported the weak-form market efficiency: Larson, (1960); Osborne, (1962); Alexander, (1964); Granger and Morgenstern, (1963); Mandelbrot, (1963); Fama and Blume, (1966); Fama (1965) finds that stock prices indeed follow random walks and he finds no systematic evidence of profitability of technical trading strategies. Van Horn and Parker (1967) using a simple technical trading rule for 30 NYSE securities confirm the random walk hypothesis. Jensen and Benington (1970) conclude that technical trading rules are not useful. By the end of 1970s, the attitude of academics towards technical trading is described by Shleifer (2000, p. 9): "as matters stood at the end of the 1970s, the EMH was indeed one of the great triumphs of twentieth-century economics."

However since the early1990s, technical trading has been enjoying a renaissance both on Wall Street and in academic circles. Several papers have presented evidence that some simple trading rules are useful for predicting stock market returns. The cornerstone of this new research on technical analysis is an article by Brock, Lankonishok and LeBaron (1992), BLL analyzed moving averages and trading range breaks on the Dow Jones Industrial Index from 1897 to 1985. They used various short and long moving averages of prices to generate buy and sell signals. They tested long moving averages of 50, 150 and 200 days with short averages of 1, 2 and 5 days. They point out that "all buy-sell differences are positive and the t-tests for these differences are highly significant…" and they go on to conclude that their "results are consistent with technical rules having predictive power".

Other researchers have used some variants of BLL's moving averages to investigate whether stock market indices can be predicted by some simple form of technical analysis. Bessembinder and Chan (1995) conclude that the BBL's rules are successful in predicting stock price movement in Japan, Hong Kong, South Korea, Malaysia, Thailand and Taiwan, with the predictability strongest in the last three markets. Raj and Thurston(1996) using both the moving average rules and trading range break-out for Hang Seng Futures Index conclude that the moving average strategy does not produce significant excess return, but trading range break-out rules produced significant positive returns for the buy signal. Ergul , Holmes and Priestley (1997), using daily closing prices of 63 stocks traded on the Istanbul Stock Exchange, conclude that technical analysis on volume can aid the prediction of returns which cannot be predicted by the analysis of past returns in isolation. Pruitt and White (1998), using the University of Chicago's CRSP daily data tapes over the 1976-1985 period, conclude that technical trading rules are capable of outperforming a simple buy-and-hold strategy even adjusting for transaction costs. Bessembinder and Chan (1998) confirm the basic BLL results; however, they argue that the BLL results can coexist with the notion of market efficiency when considering transaction costs. Fong and Ho (2001) use technical trading rules for internet stock and conclude that average buy-sell spread is large and significant even after accounting for transaction costs. Gencay, (1998a, 1998b); Ratner and Leal, (1999) also support the predictive power of technical trading rules. Kwon and Kish (2002), applying three popular technical trading rules to NYSE index over the period 1962-1996, conclude that the technical trading rules have the potential to capture profit opportunities over various models when compared to the buy and hold strategy.

However, there are studies that do not support technical strategies. Hudson, Dempsey and Keasey (1996) apply BLL 's technical trading rules in the United Kingdom stock market return over the 1935- 1994 period and conclude that technical trading rules did not generate excess returns after taking transaction costs of 1 percent per round trip. Szakmary, Davidson, and Schwarz (1999) find that trading rules on individual stock perform poorly but trading rules for the overall Nasdaq index tend to earn statistically significant abnormal return; however, they believe since there is a high level of transaction costs associated with Nasdaq trading, these abnormal returns are generally not economically significant for them. Coutts and Cheung (2000) analyze the Hang Seng returns from 1985 to 1997 and they conclude that both the moving average and trading break-out rules fail to provide positive abnormal returns, net of transaction

costs. Ready (2002) points out that the apparent success of the BLL moving average rules is a spurious result of data snooping and need not persist in the future.

Technical trading rules have also been applied to foreign exchange markets. For a survey of technical trading on foreign exchange markets see Taylor and Allen, (1992); Maillet and Michel, (2000). Hsu and Kuan (2005) find that technical trading rules are profitable for newer indexes such as the NASDAQ Composite or the Russell 2000. Chang et al (2006) applied moving average trading rules for Taiwan stock market and conclude that for Taiwan stock index moving average rules beats the buy-and-hold stategy. Metghalchi et al. (2008) allied few moving average rules with different strategies to Swedish stock market and show that some moving average rules could beat the buy-and-hold strategy even accounting for transaction costs. Menkohh and Taylor (2007, p.949) survey technical trading rules for currencies and conclude that " on balance, however, the literature of profitability of technical trading rules tends to support the existence of significant profits to be had by employing these rules in the foreign exchange markets".

This paper concentrates upon the S&P 500 Index because that index is a primary indicator of the movement of all stocks in the US market, and thus and important indicator for stocks in the global market. Additionally, because the S&P 500 is a highly liquid index, a trader can easily use various S&P 500 ETFs available in the market. In this paper we use three technical trading methods and compare them with the "buy-and-hold" strategy commonly recommended by efficient market theorists. In the first case, 9-day, 18 day, and 40 day SMA (Simple Moving Averages) were compared to show that the 9-day SMA relative to an 18-day SMA provided the best results. In the second method, the PSAR (Parabolic Stop-and-Reversal) was used to indicate market entry and exit points. Finally, a method based on the RSI (Relative Strength Index) was compared to determine the best trading strategy for the data set. In addition, these strategies were compared for the period from September 1992 through April 2009, and the shorter term period of May 2004 through April 2009, to determine if the strategies produced similar results over the more volatile recent 5 years.

Finally, because "big move days" of moves greater than +/-2% are important to capture and/or miss, special consideration is given to the ability of each method to correctly place a trader on "big move days." This 2% aspect is considered important because a few days of large movements can cause large gains or large losses. So all of the strategies were evaluated for which strategy most effectively captures the positive moves of greater than 2%, while avoiding the negative market move of over -2%.

The remainder of this paper is structured as follows: Section II discusses data and methodology, Section III presents empirical results on technical trading rules, Section IV demonstrates statistical results, and Section V includes conclusions, followed by references.

II. Data and Methodology

Datastream's daily open, high, low, and close for the S&P 500 index over the period of 7/15/1992, to 4/15/2009 are used to compute daily returns as changes in logarithms of the index. The start date for the data is determined because the open-high-low-close metric for the S&P 500 in Datastream is 7/15/1992. Before 7/15/1992, only the closing prices are available. Although changes in stock price index do not include daily dividend yields, we do not expect this omission to alter the results of our analysis, as Miles and Coutts (1995) review the literatures regarding dividends and conclude that any bias in the results due to dividend exclusion will be minimal.

In this study, Moving Average rules, Relative Strength Index method, and PSAR technique are compared with the buy-and-hold strategy. One of the most important trend-determining techniques is based on the crossing of two moving averages (*MA*) of daily closing prices. According to this rule, buy (sell) signals are emitted when the short-term moving average exceeds (is less than) the long-term moving average. In this study we use long moving averages of 18 days and the short moving average of 9 days; many technicians use these two moving averages to go long or short in their daily trading. For example, if the SMA(9) line is above the SMA(18) line, we are in the market. If the opposite is true and the SMA(18) is greater than the SMA(9), we are out of the market and in cash.

The second technique that we apply in this paper is to use the very well known Relative Strength index (RSI) indicator to get in and out of the market. Specifically, we will be in the market as long as RSI is greater than 50, and will be out of the market as long as the RSI is equal or below 50. The RSI indicator, one of the most popular indicators was invented by Welles Wilder, it measures the velocity of directional movement. RSI is a ratio of the upward price movement to the total price movement over a given period of days (Wells Wilder suggested using 14). Suppose the number of days is N. The calculation of RSI is described below. RSI ranges from 0 to 100.

AU = Average of x days' up closes

AD = Average of x days' down closes

$$RS = \frac{AU}{AD}$$

Then, $RSI = 100 - \frac{100}{1 + RS}$

Actually, RSI equals to $\frac{AU}{AU + AD} \times 100$, so it is a number between 0 and 100.

The third method of technical analysis used in this paper is the Parabolic SAR (Stop and Reversal) Technical Indicator. The Parabolic SAR, developed by Welles Wilder, is generally used to set trailing price stops; thus it is a stop-loss system. The stop is continuously moved in the direction of the position. The indicator is below the prices on the bull market (Up Trend), when it's bearish (Down Trend), it is above the prices. When the index is above the PSAR value, we will be in the market and when the index is below the PSAR value, we will be out of the market. PSAR values are calculated as follow:

EP = Highest high for a long trend, and lowest low for a short trend, updated each time a new EP is reached.

AF = Default of 0.02 (2%), increasing by 0.02 (2%) each time a new EP is reached, with a maximum of 0.20 (20%)

PSAR = PSARn+1 = PSARn + (AF * (EP - PSARn))

Exceptions: If PSARn+1 (the next PSAR) is within or beyond today's or yesterday's price range, PSARn+1 is set to the closest price. For example, in a long trend, PSARn+1 would be set to the closest low, and in a short trend, PSARn+1 would be set to the closest high.

For calculation of RSI and PSAR in the spreadsheet used for analysis of the raw price data, an Excel Add –In provided by TA-Lib: Technical Analysis Library at http://ta-lib.org , is used extensively. This powerful, open source MS Excel add-in allowed comparison of the returns provided when trading rules were set up using the PSAR and the RSI, as well as vary the input variables to determine the point at which a trader would enter or short the market.

Within the 17 year timeframe encompassed by this market data are wars, the tech bubble, the Sept. 11 attacks, and the housing market bubble, as well as other important events which affected the market. And although significant booms, significant busts, and many unforeseen events are included in the 17 years of data provided, it was also considered important to analyze the data and models over the more recent 5 year period of the data set. The 5 year data study was performed to determine which system was relevant to the most recent times, including the significant and prolonged downturn in the market.

Two additional aspects of trading the markets were not considered. The first; when the system employed keeps the money in cash, no calculation was made for interest accrued on that cash position as in a sweep account. Interest accrual could easily be calculated but is not the primary concern of our study. The second: Trading costs were not considered in this study. The reason for this lack of consideration is due to the liquidity of the S&P index as well as the low trading costs of internet-based trading platforms. The results of the study have shown significant differences in the performance of the varied methods, as well as few enough trades to make up for the difference had trading costs been considered.

III. Empirical Results

1. S&P 500 Returns

The data was used to calculate the S&P 500 returns using a buy and hold method for the 17-Year and 5-Year terms of the study. To garner similar returns an investor could simply buy an S&P ETF or index fund, and never withdraw that money. The results are shown in the table below:

Strategy:	Buy and Hold
17 Year Return:	71.44%
5 Year Return:	-25.42%

2. Simple Moving Average Method Returns

Initially, Simple Moving Averages for 9 days, 18 days, and 40 days were calculated, and then used to determine when to be in or out of the market as the value of the shorter-term moving average became greater than the longer-term moving average. It was determined that the SMA(9) and SMA(18) would yield the most attractive returns for both the longer and shorter periods of the study than using either the SMA(9)/ SMA(40) or the SMA(18)/ SMA(40) as per the tables below, and thus the SMA(9)/ SMA(18) method was therefore singled out for the remainder of this study. To garner the results highlighted below, a trader would be in the market whenever the SMA(9) was greater than the SMA(18), and short the market whenever the SMA(18) was less than the SMA(9). Using this method, a trader would have switched between Bullish or Bearish postures 248 times during the 17 Year study, and 65 times during the 5-Year study. In the chart below, the "(Bullish)" return is the return collected when the SMA Method positions the trader long in the market, and the "(Bearish)" return is the return as the method has positioned the trader short.

For the 17-Year Study:

Strategy:	Simple Moving Averages
Term of Study:	17 Year
SMA(9) > SMA(18) Return (Bullish):	138.66%
SMA(9) < SMA(18) Return (Bearish):	67.22%
SMA(9) > SMA(40) Return (Bullish):	96.59%
SMA(9) < SMA(40) Return (Bearish):	25.16%
SMA(18) > SMA(40) Return (Bullish):	61.58%
SMA(18) < SMA(40) Return (Bearish):	-9.85%

For the 5-Year Study:

Strategy:	Simple Moving Averages
Term of Study:	5 Year
SMA(9) > SMA(18) Return (Bullish):	19.65%
SMA(9) < SMA(18) Return (Bearish):	45.07%
SMA(9) > SMA(40) Return (Bullish):	8.03%
SMA(9) < SMA(40) Return (Bearish):	36.75%
SMA(18) > SMA(40) Return (Bullish):	0.76%
SMA(18) < SMA(40) Return (Bearish):	26.18%

To calculate the total return, simply add the absolute values of the Bullish and Bearish returns together for a total return of 205.88% for the 17-Year study and 64.72% for the 5-Year study for the SMA Long-and-Short Method.

3. PSAR Method

The PSAR and RSI values were calculated using a Microsoft Excel Add–In provided by TA-Lib: Technical Analysis Library at http://ta-lib.org . This powerful add-in allowed comparisons in the returns provided when trading rules were set up using the PSAR and the RSI, as well as variation in the input variables to determine the point at which a trader should be long or short the market.

Typically the PSAR is used as a stop-loss system, not necessarily as a buy-and-sell indicator. For this study, settings for the PSAR were the default 0.02 Step Period and 0.20 Max Step Period. Using this method, a trader would have switched between long or short postures 401 times during the 17 Year study, and 123 times during the 5-Year study. PSAR returns for when our model was long and short the market for the 17-Year and 5-Year terms are shown in the table below:

Strategy:	PSAR
Term of Study:	17 year
PSAR Bullish Return:	375.25%
PSAR Bearish Return:	303.81%

Strategy:	PSAR
Term of Study:	5 year
PSAR Bullish Return:	80.78%
PSAR Bearish Return:	108.91%

In this case, the PSAR Long-and-Short Method returned 679.06% in the 17-Year study and 189.91% in the 5-Year study.

4. RSI Method

Finally, the RSI was considered. Typically, the RSI is viewed as an oscillator with upper and lower reversal zones to determine when an index is overbought or oversold. Traders also look at the centerline of the RSI oscillator as an indicator, wherein crossing the midpoint (RSI value of 50) to the positive is a signal that average gains are higher than average losses. For this study and with the benefit of perfect hindsight, the crossover point could be selected to find the maximum possible return for this method for both the 17-Year and 5-Year Studies. Under normal circumstances this idealized return would not be possible because the ideal RSI value would not be known, but for the benefit of the study the best possible results for the method were found. As expected during the recent bear market, the idealized RSI score which determines whether we are in or short the market is greater than 50. By increasing the RSI score required to be in the market, a bearish market posture is predisposed. For example at RSI scores less than 56 for the most recent term, the RSI method generates negative results for return. In our study the difference in return based on RSI levels with differences of only 1 point could be significant. Because the RSI Method returns were significantly lower than those of the other methods, the number of posture switches was not considered. The idealized RSI levels are highlighted in yellow in the tables below with surrounding values to show differences in return:

Strategy:	RSI
Term of Study:	17 year
RSI at 50 Bullish Return:	56.55%
RSI at 51 Bullish Return:	58.29%
RSI at 51 Bearish Return:	13.14%
RSI at 52 Bullish Return:	48.33%

Strategy:	RSI
Term of Study:	5 year
RSI at 50 Bullish Return:	-26.71%
RSI at 56 Bullish Return:	4.82%
RSI at 56 Bearish Return:	32.13%
RSI at 57 Bullish Return:	1.72%

Thus at the idealized RSI cross-over level for each term, return for the 17-year study would be 71.73% and for the 5-Year study would be 36.95%, numbers which significantly lag the other two active trading methods.

5. Two Percent Movement Comparison

To further explore the efficiency of the technical trading methods, an additional study was performed on the ability of each method to correctly position a trader to capture gains in the market of greater than or less than 2%. Because returns on those days in which the market moves greater than 2% are relatively large in comparison to normal movement over days and weeks, the most effective method of capturing those large movements would generate significant value for a trader. Additional studies were performed for 3% and 4% days, but will not be reported. By concentrating on the 2% and greater movements, more potential "big days" are captured. For this comparison, the RSI Crossover Method was neglected due to that method's poor results relative to the SMA9/SMA18 and PSAR methods. The number of greater than and less than 2% daily movements and those days' corresponding returns are shown in the tables below for the 17-Year and 5-Year studies:

2% 17-year Term Results										
	Days with +2% move	+2% days captured	Return on +2% days captured	+2% days missed	Return on +2% days missed	Days with -2% move	-2% days captured	Return on -2% loss captured	-2% days missed	Return on -2% loss missed
SMA Method	149	60	167%	89	305%	171	56	-151%	115	-384%
PSAR Method	149	87	259%	62	212%	171	52	-154%	119	-381%

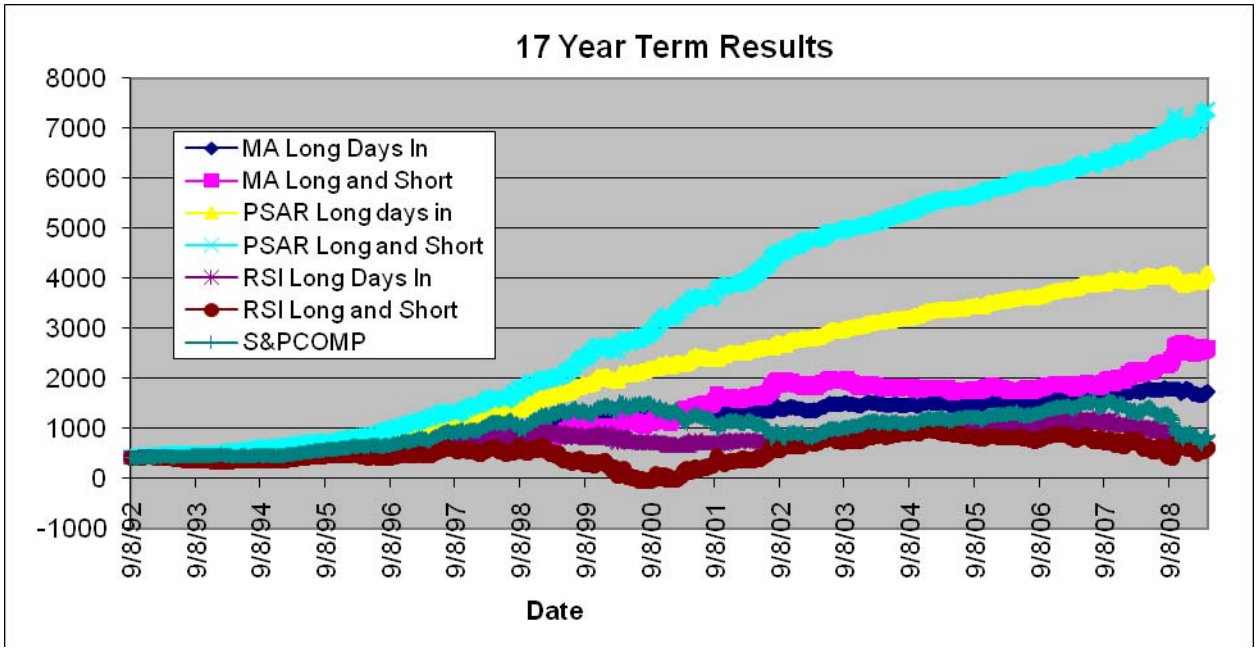
2% 5-year Term Results										
	Days with +2% move	+2% days captured	Return on +2% days captured	+2% days missed	Return on +2% days missed	Days with -2% move	-2% days captured	Return on -2% loss captured	-2% days missed	Return on -2% loss missed
SMA Method	53	19	63%	34	134%	71	23	-66%	48	-192%
PSAR Method	53	30	100%	23	97%	71	27	-90%	44	-168%

Note that in this table, any time a day is "captured," the method has place the trader in the correct position to realize those gains, whereas the term "missed" indicates that the trader was improperly positioned, and thus would be positioned against the market direction. The SMA and PSAR method correctly position a trader for "big days" as per the following table:

Market Position Correctness		
	17 Year Term	5 Year Term
Total 2% days	320	124
Percent SMA correct	36.25%	33.87%
Percent PSAR correct	43.44%	45.97%

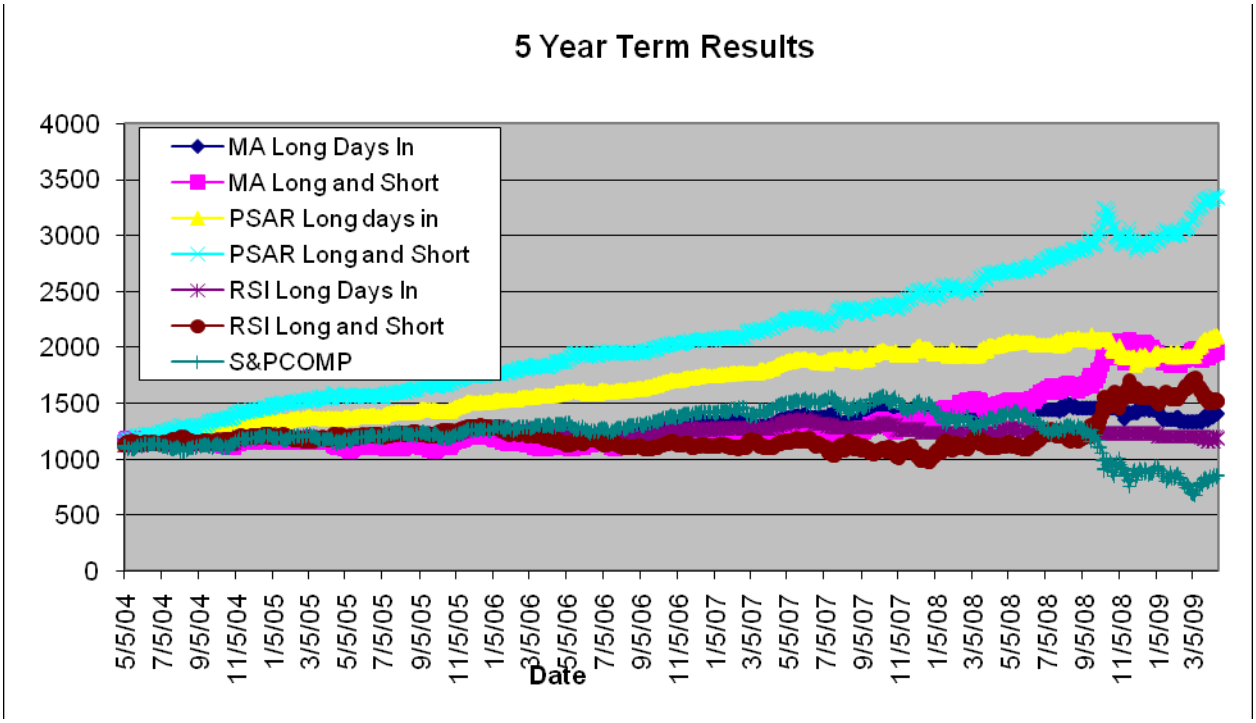
6. Summary of Empirical Results

The charts below provide graphic evidence of the results for all of the methods discussed in this report. For this study, the PSAR indicator is far more adept at positioning a trader long or short on the S&P500. Results over the long and short terms show that by using the PSAR as the buy and sell signal, a trader will significantly outperform the market, and thereby the "buy and hold" method, as well as the other strategies discussed in this report.



To provide some perspective the the chart above monetarily, had a trader followed the methods charted above over the 17-Year term, using $10,000 as the starting figure, that investor would have realized gains in the following amounts:

S&P Buy-and-Hold Method:	$ 7,144
SMA 9 / SMA 18 Long-and-Short Method:	$20,588
PSAR Long-and-Short Method:	$67,906



Monetarily, had a trader followed the methods charted above over the 5-Year term, again using $10,000 as the starting figure, that investor would have realized gains in the following amounts:

S&P Buy-and-Hold Method:	($ 2,542)
SMA 9 / SMA 18 Long-and-Short Method:	$ 6,472
PSAR Long-and-Short Method:	$18,991

IV. Statistical Results

In addition to the empirical results, a statistical t-test was performed to demonstrate statistical significance in the results for the 17 year study. The T-test is performed using data from the chart below. Required inputs include the average daily return, annual return, standard deviation, and number of days in which the various strategies were implemented.

	Market Return	SMA(9)-SMA(18) is Bullish	SMA(9)-SMA(18) is Bearish	PSAR is Bullish	PSAR is Bearish
Average Daily	0.000171	0.000562	-0.00039	0.001539	-0.00174
Annual	0.045402	0.157214	-0.09694	0.492101	-0.36408
SD (Std Dev)	0.012103	0.009347	0.015206	0.010207	0.014121
N (No. days)	4183	2469	1714	2438	1745
SQRT(N)	64.67612	49.68903	41.40048	49.37611	41.7732
SD/SQRT(N)	0.000187	0.000188	0.000367	0.000207	0.000338
Mean/[SD/SQRT(N)]= t-stat	0.912558	2.985479	-1.06779	7.44544	-5.15029
Var/N	3.502E-08	3.53853E-08	1.34902E-07	4.273E-08	1.143E-07
Var/N comparison	7.004E-08	7.04039E-08	1.69921E-07	7.775E-08	1.493E-07
T Test Result	N/A	1.47359593	-1.360941947	4.906048	-4.94591

For the 17-year study the daily average of buy-and-hold strategy is .000171 (.017percent per day) with a standard deviation of .00121. Thus the t-value for the buy and hold strategy for the entire period (4183 observations) is equal to 0.9126 (.000171 divided by .00121/4183). The annual average over the entire period is 4.54 %. In this paper, we compare all t-statistics with 1.96, the critical t-value at 95% confidence level for a large numbers of observations.

V. Conclusions

To conclude, the mechanical trading systems based on the SMA and PSAR indicators have been back-tested to show empirical results when compared to the buy and hold strategy. Statistically, the Moving Average method does not generate confidence greater than the 95% confidence level of results which vary from the Buy-and-Hold method. However the PSAR method results demonstrate statistical significance at a 95% confidence level. These findings are true over both the long term and short term studies evaluated by this research. However, improvements could be made to both methods in an attempt to correctly position a trader for "big days" as indicated by the 2% Study results. The RSI, typically acknowledged to be a robust indicator, was apparently not applied in a manner that produced positive gains in this report. A future study of the RSI might concentrate more heavily in on entering the market as the RSI score crosses the midpoint, and then exiting or shorting the market as the RSI reaches the upper reversal zone and begins to decline. Overall, this report and study would seem to counter the beliefs of Efficient Market Theorists and those who preach the "Buy-and-Hold" method for the small investor.

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