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Should Individual Investors Use Technical Trading Rules to Attempt to Beat the Market?

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Abstract: Problem statement: Despite widespread academic acceptance of the Efficient Markets Hypothesis, some stock traders still use technical trading rules in an attempt to beat the market. **Approach:** This study looked at four trading rules, namely, the arithmetic moving average, the relative strength index, a stochastic oscillator and its moving average. These trading rules compare the relationship of current prices to past price patterns to generate a signal when to buy and sell stocks. The trading rules were tested over the years 2000-2009, a period of time that exhibited bull and bear markets, to determine if traders could actively trade a stock and beat a passive investment strategy. **Results:** We tested the four trading rules against the 576 stocks that comprise the S&P 100, the NASDAQ 100 and the S&P Midcap 400. The results proved discouraging to that strategy, in that no one trading rule consistently beat the market. **Conclusion/Recommendations:** Since technical trading rules cannot be used to consistently beat a long-term buy and hold strategy, we recommend that investors first use fundamental analysis to select stocks and then apply a technical trading rule to enhance potential trading gains.

Key words: Efficient market hypothesis, moving average, relative strength index, stochastic oscillators

INTRODUCTION

In traditional tests of the weak-form of the Efficient Markets Hypothesis, price return differences are found to be insufficient to develop trading rules to take advantages of historical price patterns (Elton and Gruber, 1995). Yet, traders continue to use technical analysis to establish buy and sell decisions for various assets across markets. This study sets out to determine if there are consistently profitable techniques that can be applied for use in equities markets and compare the techniques for market-beating returns to traders who use them. Traders, in this sense, represent individuals who actively manage their positions by holding short-term positions. These activities contrast to investors who have a longer-term investment horizon and are deemed more passive investors, using what is deemed a naïve "buy and hold" strategy. The primary difference in perspective is whether taking advantage of short-term price movements is more beneficial than long-term price movements.

Technical analysis, in contrast to fundamental analysis of assets, looks at the current price and relates this to past price history to determine the timing of buying and selling of stocks. The weak-form of the Efficient Markets Hypothesis states that stock prices contain all current information towards valuing the company (Blume *et al*., 1994, show that volume statistics also are significant in conveying information). Changes in prices result from changes in the supply and demand for the stock. There are numerous trading techniques available and with the increased usage of personal computers and on-line data services, the number and complexity of these techniques will surely increase to keep pace with their proponents. However, in the end, most trading techniques are based on taking advantage of simple mathematical rules based on the tendency toward mean reversion. Simply stated, 'what goes up must come down' (and in most cases the reverse occurs as well).

Prior literature: Of the academic work studying the effectiveness of the various trading techniques

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available, most focus on applying technical analysis and time-series tools to broad indices and not on individual equities. Brock *et al*. (1992); Gencay (1996); Bessembinder and Chan (1998) and Kwon and Kish (2002) examine the returns on US stock market indices and find that technical trading provides positive predictive power, in direct conflict with the weak form of the Efficient Market Hypothesis. More recently, Wong *et al*. (2003); Ben-Zion *et al*. (2003) and Papathanasiou and Samitas (2010) find that traders can exploit potential inefficiencies that arise from smaller and thinner international markets by using technical trading rules. Seiler (2001) finds that an optimal filter of the Relative Strength Index (RSI) rule provides for positive returns; however, his study only shows results for the RSI rule and for only illustrates its use on one stock.

Another line of literature, Momentum Strategy, focuses on the psychological aspect of trading. This strategy assumes the pattern of trading based on events or economic data will continue for a period of time. If patterns of reaction occur, then stock prices do not follow a random pattern, as has been statistically shown in the past. Chan *et al*. (1996) and Hong and Stein (1998) find evidence of momentum trading with regards to analysts' earnings predictions and the subsequent earnings announcements by firms. While momentum trading is similar in essence to technical trading, it relies on announcements and economic events, while technical trading strictly abides by mathematical rules.

The bulk of the technical analysis literature bases itself on the apparent visual verification on an ex post basis of the gain potential of technical trading (Elder, 1987; Stein, 1989; Arnold, 1994; Etzkhorn, 1995). Our study broadens the literature by looking at individual stock issues, expanding the sample to that of stocks of various size and the overall performance of strictly following technical trading strategies on an ex ante basis.

Data: The sample of data used in this study includes daily high, low and closing prices from the equities that comprised the S&P 100, the NASDAQ 100 and the S&P Midcap 400 indices as of July 1, 2009. The time period studied spanned a period of 9½ years; from January 3, 2000 through June 30, 2009. The data allows for a broad range of stocks over a relatively long period of time so that prices will not be entirely subject to specific events or market conditions. The beginning of this sample period saw the boom and bust of the technology stocks; the effects surrounding September 11, 2001; the general market expansion as well as the steep declines and recovery from the financial crisis and global economic recession. We included the three indices in our sample to compare the trading performances of broadly-traded, high-volume listings as well as those that have less depth and trading activity. There were 576 unique stocks in our sample; twenty-four of the listings were listed within both the S&P 100 and the NASDAQ 100.

The time period of this study can be generally described as mixed between a bear market, as measured by the S&P 500 Index, which lost 36.8% of its value and a flat market, as seen with an average price appreciation of only $4.47 per share over this time period. The broader market began the decade at 1455.22 and ended at 919.32.

MATERIALS AND METHODS

The trading techniques we employ are the arithmetic Moving Average (MA), the Relative Strength Index (RSI) and a Stochastic Oscillator (K). These are among the more popular, general techniques used by technical traders and the basis for many trading programs. The performance from using these trading tools will be contrasted against a naive buy-and-hold strategy over the same period.

Arithmetic moving average: The arithmetic Moving Average is the arithmetic average of prices of a stock over the most recent period of n days:

$$MA_t = \frac{\sum_{i=0}^{n-1} P_{t-i}}{n}$$

The Moving Average generates a forecast from the past prices of a security. A Moving average that is increasing indicates that, on average over time, prices are trending higher. The degree of sensitivity for the technique is determined by the value of n, the number of days in the period. If n is too small, there is too much sensitivity to changes in daily prices; if n is too large, the Moving Average will not be sensitive enough.

The trading signal generated by the moving average is determined when the current price crosses the Moving Average line. If the current day's closing price crosses to trade above the Moving Average line, that generates a "buy" signal to traders -- demand is currently stronger than in the past. If the closing price crosses to trade below the Moving Average line, demand is currently weaker than in the past and that event generates a "sell" signal to traders.

Anticipated trend performance of the moving average indicator: The effectiveness of using the Moving Average for generating a correct "buy" or "sell" decision can be anticipated by looking at the dynamics of the Moving Average model itself:

$$\frac{dMA_t}{dP_t} > 0$$

One would expect, during a bull market when equities generally show higher prices, that the Moving Average of prices would move accordingly higher, but remain lower than the higher-trending current price. This is due to the Moving Average retaining prices from earlier in the time period. Without any crossing of price lines and Moving Average lines, there would be no "buy" signals or "sell" signals that the investor could act upon (throughout our methodology, we assume that traders can only act on each change of signal. This avoids over-accumulating or over-borrowing shares in long or short positions. Similar rules hold for the Relative Strength Index and the Stochastic Oscillator techniques). A similar, but opposite, analysis would be observed during a bear market. Thus, without periodic price changes, traders would not be able to take advantage of the potential long-term gains that less active buy-and-hold investors could enjoy during a sustained trend.

Relative strength index: The Relative Strength Index for any trading day, RSI_t, was developed by J. Welles Wilder. This index value measures the strength of prices for the most recent period of n days, using the following formula:

$$RSI_t = \left(\frac{U_t^{n-1}}{D_t^{n-1} + U_t^{n-1}}\right) * 100$$

U_t is the average of the closing prices for those days in which the price increases from the previous trading day during the period; D_t is the average of the closing prices for those days in which the price declines from the previous trading day; t ranges from 0-n-1. The index is on a 0-100 scale. An upward-trending stock would have a value approaching 100 and a downward trending contract would have a value approaching zero. The perceived usefulness of the RSI is that it shows trends or breakouts sooner and/or more clearly than simple price charting-when the RSI is at a high level, the stock can be considered overbought and this would provide a signal for a trader to sell the stock (a "sell" signal), while a low RSI value would be considered an oversold condition and this provide a signal for a trader to buy the stock (a "buy" signal).

Anticipated trend performance of the relative strength index: The effectiveness of the RSI during a trending market can be anticipated by looking at the effect of rising and falling prices have on the Index:

$$\frac{\partial RSI_t}{\partial U_t} > 0, \quad \frac{\partial RSI_t}{\partial D_t} < 0$$

In a bull market, with upward-trending prices, U would have dominance over D. The RSI of the stock would increase correspondingly, signaling more "sells" than "buys". Acting upon this technique would limit the gain in a trending equity by selling too soon. In a bear market, D would have dominance over U. The RSI of the stock would decrease, signaling "buys" to a greater degree than "sells". Under that setting, traders would tend to buy before a stock bottoms out. If the trader believes that the RSI does signal the beginning of a new trend, then the trading signals generated by the Relative Strength Index would be appropriate. This corresponds to evidence of longer-term mean reversion.

Stochastic oscillators: A Stochastic Oscillator (the Oscillator) compares the value of current prices with the range of prices during the n day trading period. The Oscillator further compares two indices of price movements to generate buy and sell signals; K, the index itself and Z, a moving average of the index:

$$K_t = \left(\frac{P_t - L_t^{n-1}}{H_t^{n-1} - L_t^{n-1}}\right) * 100, \quad Z_t = \frac{\sum_{i=0}^{n-1} K_{t-i}}{n}$$

In this index, H_t is the highest high and L_t is the lowest low for intraday prices during the period. From this, we observe a difference among the three trading rules; the Stochastic Oscillator takes into account the intraday price movements along with the closing prices. A low value for K_t generates a "buy" signal (an oversold condition) and a high value for K_t generates a "sell" signal (overbought). This is similar in nature to the RSI. Just as with the arithmetic Moving Average, K_t crossing Z_t signals a "buy" or a "sell".

Anticipated trend performance of the stochastic oscillator: The performance of the Stochastic Oscillator with respect to price movements differs from the Relative Strength Index by including the price variable into the formula. The range of prices is also important in determining the value of K_t and Z_t:

$$\frac{\partial K_t}{\partial P_t} > 0, \frac{\partial K_t}{\partial H_t} < 0, \frac{\partial K_t}{\partial L_t} < 0, \frac{\partial Z_t}{\partial K_t} > 0$$

Within a bull-trend, as more recent prices increase relative to the range of trading, there is a stronger "sell" signal. However, as prices increase overall, there is some downward pressure in K_t. This is shown by the negative influence of H_t. During a bear market, the more recent prices generate a "buy" signal, but this is countered by the influence of L_t. The Oscillator also is sensitive to the magnitude of the price range during the period. Price changes within a period of low volatility are magnified. This creates more trading signals than recent price stability during a period of high volatility.

Testing: The tests for this study will compare gains from the trading signals generated by the Arithmetic Moving Average, the Relative Strength Index and the Stochastic Oscillators. The gains from these rules are then compared with a simple buy-and-hold strategy for each of the 576 stocks in the sample. In contrast, the passive investor buys one share of each stock on January 3, 2000 (or, whenever trading began for the stock) and holds this investment until June 30, 2009.

The Moving Average rule will use 20, 100 and 200 day periods, to determine if the length of n affects the performance of the rule. The Relative Strength Index and the Stochastic Oscillator will have two separate "sell" levels, at 70 and at 80 and two separate "buy" levels, at 30 and at 20. These will help determine if the stricter filtering of price movements improves the results of these rules. In addition, n for the Relative Strength Index will vary; using 3, 9, 14 and 30 day periods; that for the Stochastic Oscillator (K_t), 9, 20, 100 and 200 day periods; for the Stochastic Oscillator Moving Average (Z_t), 20, 100 and 200 day periods, for consistency to the Arithmetic Moving Average Rule. By abiding by the trading rules, we hope to determine if a trader can invest in a mechanical, non-emotional fashion and outperform the market. If traders can use trading rules to outperform a naive buy and hold investment strategy, then these results provided some evidence that contradicts the weak-form of the efficient market hypothesis. The implications on information costs and time should be apparent.

We translate the overall gains from each of the individual stocks as being generally equivalent to buying one share in each stock at either the start of the sample period, as in the case of the buy-and-hold strategy; or going long one share of stock on an initial "buy" signal, or selling short by borrowing one share of stock on an initial "sell" signal. The average gains across each of the trading strategies are equivalent to having a price-weighted portfolio with one share traded in each stock upon the appropriate signal. Individual stock prices were adjusted for splits. Gains do not include dividends or commissions.

RESULTS AND DISCUSSION

During the January 2000-June 2009 period that we studied, the passive strategy of buying and holding stock resulted in an average gain of $4.47 per share across the sample of 576 issues. The median gain was $4.30 per share. Results of individual stocks did, obviously, vary. The maximum gain for any given stock was $321.26 (GOOG), whereas the maximum loss was $324.26 (PALM). The standard deviation of gains from our sample was $37.34.

The overall performances of trading using the four technical trading rules described in this study are illustrated in Table 1-4. Of the thirty-two variations to these rules, only nine resulted in overall average gains

Table 1: Comparison of trading results for 20, 100 and 200 day moving average rule with passive buy and hold strategy

	Buy and hold	MA 20	Round trips	MA 100	Round trips	MA 200	Round trips
Overall sample	$4.47	-$10.18	134.77	-$5.62	57.40	-$3.21	38.17
S&P 100	-$1.45	-$20.94	145.06	-$10.23	64.48	-$6.06	43.31
NASDAQ 100	$9.76	-$2.57	132.03	$0.22	55.28	$3.20	34.93
S&P Midcap 400	$4.45	-$9.70	133.15	-$6.08	56.34	-$4.21	37.84

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

Table 2a: Comparison of trading results for 3, 9, 14 and 30 day relative strength index (using a 70-30 filter) rule with passive buy and hold strategy

	Buy and hold	RSI 3	Round trips	RSI 9	Round trips	RSI 14	Round trips	RSI 30	Round trips
Overall sample	$4.47	$13.96	109.81	$2.80	18.26	$4.19	7.65	$4.97	1.14
S&P 100	-$1.45	$23.54	117.66	$5.78	18.90	$9.37	7.41	$10.08	0.92
NASDAQ 100	$9.76	$14.25	107.71	$0.98	17.37	$1.48	6.90	$3.04	0.75
S&P Midcap 400	$4.45	$11.72	108.57	$2.59	18.35	$3.71	7.90	$4.30	1.29

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

Table 2b: Comparison of trading results for 3, 9, 14 and 30 day relative strength index (using an 80-20 filter) rule with passive buy and hold strategy

	Buy and hold	RSI 3	Round trips	RSI 9	Round trips	RSI 14	Round trips	RSI 30	Round trips
Overall sample	$4.47	$9.56	62.13	$2.85	5.12	$5.21	1.26	$0.22	0.13
S&P 100	-$1.45	$15.58	65.20	$3.74	4.60	$6.30	0.95	$0.00	0.00
NASDAQ 100	$9.76	$15.93	61.48	-$2.39	4.35	$3.59	0.88	$0.00	0.00
S&P Midcap 400	$4.45	$6.55	61.60	$4.00	5.44	$5.38	1.42	$0.14	0.19

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

Table 3a: Comparison of trading results for 9, 20, 100 and 200 day stochastic oscillator (using a 70-30 filter) rule with passive buy and hold strategy

	Buy and hold	K 9	Round trips	K 20	Round trips	K 100	Round trips	K 200	Round trips
Overall sample	$4.47	$13.84	103.03	$6.07	51.77	$0.95	11.60	$5.75	5.70
S&P 100	-$1.45	$21.98	110.81	$12.46	55.80	$3.17	12.30	$5.24	6.06
NASDAQ 100	$9.76	$17.28	100.43	$3.18	50.58	-$2.32	10.79	$6.31	5.37
S&P Midcap 400	$4.45	$11.10	101.94	$5.37	51.17	$1.29	11.65	$5.72	5.71

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

Table 3b: Comparison of trading results for 9, 20, 100 and 200 day stochastic oscillator (using an 80-20 filter) rule with passive buy and hold strategy

	Buy and Hold	K 9	Round trips	K 20	Round trips	K 100	Round trips	K 200	Round trips
Overall sample	$4.47	$14.91	80.22	$6.03	40.43	$0.70	8.97	$3.02	4.17
S&P 100	-$1.45	$22.79	86.45	$10.17	43.64	$0.64	9.33	$3.08	4.45
NASDAQ 100	$9.76	$22.62	78.40	$5.39	39.54	-$2.55	8.27	$0.90	3.87
S&P Midcap 400	$4.45	$11.13	79.27	$5.26	39.94	$1.55	9.07	$3.55	4.18

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

Table 4a: Comparison of trading results for 20 day moving average using the 9, 20, 100 and 200 day stochastic oscillator rule with passive buy and hold strategy

	Buy and hold	K 9	Round trips	K 20	Round trips	K 100	Round trips	K 200	Round trips
Overall sample	$4.47	-$22.07	227.34	-$19.66	181.56	-$15.16	151.48	-$8.70	138.50
S&P 100	-$1.45	-$31.47	241.98	-$27.59	192.15	-$22.32	161.06	-$17.84	148.72
NASDAQ 100	$9.76	-$25.31	220.40	-$32.71	178.95	-$23.88	148.96	-$7.95	135.53
S&P Midcap 400	$4.45	-$19.10	225.81	-$14.50	179.83	-$11.29	149.96	-$6.81	136.95

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing.

Table 4b: Comparison of trading results for 100 day moving average using the 9, 20, 100 and 200 day stochastic oscillator rule with passive buy and hold strategy

	Buy and hold	K 9	Round trips	K 20	Round trips	K 100	Round trips	K 200	Round trips
Overall sample	$4.47	-$19.81	194.35	-$15.28	130.90	-$6.67	73.07	-$6.78	65.60
S&P 100	-$1.45	-$29.28	208.03	-$24.00	140.67	-$14.34	80.15	-$12.83	72.36
NASDAQ 100	$9.76	-$22.40	188.49	-$21.70	127.59	-$2.29	71.89	-$7.38	64.39
S&P Midcap 400	$4.45	-$17.00	192.76	-$11.64	129.54	-$6.07	71.77	-$5.25	64.38

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

Table 4c: Comparison of trading results for 200 day moving average using the 9, 20, 100 and 200 day stochastic oscillator rule with passive buy and hold strategy

	Buy and hold	K 9	Round trips	K 20	Round trips	K 100	Round trips	K 200	Round trips
Overall sample	$4.47	-$15.92	182.29	-$8.27	119.84	-$5.72	57.94	-$6.30	48.82
S&P 100	-$1.45	-$25.71	196.10	-$20.35	130.09	-$13.13	65.44	-$10.98	55.63
NASDAQ 100	$9.76	-$15.77	175.83	-$4.21	115.70	-$5.27	56.37	-$2.70	47.24
S&P Midcap 400	$4.45	-$13.73	180.82	-$6.58	118.58	-$4.15	56.64	-$6.17	47.68

The gains (losses) are averages, per share, for the individual stocks listed in each index. The number of round trips represents the average number of combinations of buys and sells (or sells and buys) over the entire 9 year period, per listing

that exceeded the $4.47 average per share from buying and holding any stock from our sample. By definition, active trading strategies result in far more trades than does the passive strategy; however, this it itself doesn't prove to necessarily provide a proper path toward generating gains-from our results, we generally find that for each additional trade, gains decline by $0.11, regardless of the type of active strategy employed.

The Moving Average rules, on average, all lost money for traders, as did all the Moving Averages of the Stochastic Oscillators. The RSI strategy generally was, on average, profitable; however, only four of the eight rules provided gains above those of the passive buy and hold strategy. Likewise, the Stochastic Oscillator strategy was also, on average, profitable for traders; but, again, only five of the eight rules beat the passive strategy.

Moving average: The use of the 20 day Moving Average rule had an average overall loss of $10.18. The maximum gain was $383.13 (GOOG) and the maximum loss was $257.01 (NVR). From these results, if an investor had bought GOOG when it was first issued and traded using the 20 day Moving Average rule, the passive gain of $321.26 could have been improved by $61.87. Likewise, the loss from the investment in PALM (the worst-performing passive investment) could have been turned into a gain of $9.79. The standard deviation of the gains was $37.23. The 100 day Moving average rule had an average loss of $5.62. The range between the maximum gain, $215.66 and the maximum loss, $220.99, narrowed to $436.65. The standard deviation of the gains also decreased to $30.66. The 200 day Moving Average rule had an average loss of $3.21. The range between the maximum gain, $179.11 and the maximum loss, $144.10, was $323.21. The standard deviation of the gains further decreased, to $27.84.

A contributing factor to the performance of the Moving Average rule could be the number of trades made. On average, there were 135 round trips on each stock over the sample period using the 20 day Moving Average, 57 round trips for the 100 day Moving Average and 38 round trips for the 200 day Moving Average. The large number of trades, often referred to as "whip-sawing", is a result of prices moving around the Moving Average frequently, limiting upward or downward movements. The 20 day Moving Average displayed more sensitivity between any closing price and its Moving Average than did the 100 day or the 200 day Moving Averages; hence, more frequent trading. These results could be expected of the performance across a generally flat market.

Relative strength index: The performance resulting from the use of the Relative Strength Index varied. In contrast to the Moving Average rule, each of the RSI variations averaged positive gains. However, no reliable "rule-of-thumb" appeared across the eight variations. The 3 day RSI, RSI_3, using a 70-30 trading range had an average overall gain of $13.96. The maximum gain was $187.22 (AKAM) and the maximum loss was $406.19 (GOOG). In contrast, AKAM's buy-and-hold loss was $308.45, a difference of $495.67. The range of RSI_3 gains was $593.41. The standard deviation of the RSI_3 gains was $38.52. RSI_3, using an 80-20 trading range had had an average overall gain of $9.56. The maximum gain was $202.55 (PALM) and the maximum loss was $388.41 (GOOG). The range of RSI_3 gains was $590.95. The standard deviation of the RSI_3 gains was $34.53. The 9 day RSI, RSI_9, using a 70-30 trading range had had an average overall gain of only $2.80. The maximum gain was $134.01 (PALM) and the maximum loss was $258.32 (PCLN). The range of RSI_9 gains was $392.33. The standard deviation of the RSI_9 gains was $30.00. RSI_9, using an 80-20 trading range had had an average overall gain of just $2.85. The maximum gain was $297.84 (PALM) and the maximum loss was $275.44 (GOOG). The range of RSI_9 gains was $573.27. The standard deviation of the RSI_9 gains was $32.97. The 14 day RSI, RSI_{14}, using a 70-30 trading range had had an average overall gain of just $4.19. The maximum gain was $291.98 (PALM) and the maximum loss was $272.03 (GOOG). The range of RSI_{14} gains was $564.00. The standard deviation of the RSI_{14} gains was $30.66. RSI_{14}, using an 80-20 trading range had had an average overall gain of $5.21. The maximum gain was $499.94 (PCLN) and the maximum loss was $126.80 (ISRG). The range of RSI_{14} gains was $626.74. The standard deviation of the RSI_{14} gains was $29.33. The 30 day RSI, RSI_{30}, using a 70-30 trading range had had an average overall gain of $4.97. The maximum gain was $217.81 (PALM) and the maximum loss was $313.29 (GOOG). The range of RSI_{30} gains was $531.09. The standard deviation of the RSI_{30} gains was $28.98. RSI_{30}, using an 80-20 trading range had had an average overall gain of only $0.22. The maximum gain was $75.74 (CEPH) and the maximum loss was $38.82 (ADS). The range of RSI_{30} gains was $114.56. The standard deviation of the RSI_{30} gains was $4.69. Only 11 stocks had trading activity using this rule. Our general results are consistent with those found by Seiler (2001).

Table 5a: Comparison of results of the 10 best performing stocks, using the Passive "Buy and Hold" strategy to trading performance from technical trading rules

Company	Buy and hold	Best trading results	Worst trading results
GOOG	$321.26	$383.14	-$522.25
STRA	$198.56	$238.63	-$209.77
BIDU	$178.55	$193.75	-$339.01
ISRG	$145.60	$260.08	-$204.55
FSLR	$137.38	$132.75	-$241.54
MA	$121.31	$94.31	-$159.62
AAPL	$116.73	$157.46	-$158.60
ESI	$92.94	$81.60	-$84.17
UTHR	$83.33	$85.85	-$83.52
EQIX	$67.04	$64.07	-$52.55

Table 5b: Comparison of results of the 10-worst performing stocks, using the passive "Buy and Hold" strategy to trading performance from technical trading rules

Company	Buy and hold	Best trading results	Worst trading results
BTH	-$65.46	$95.94	-$131.14
BRCM	-$66.00	$133.23	-$67.66
AFFX	-$78.91	$165.16	-$107.81
YHOO	-$92.51	$95.25	-$73.31
ADCT	-$119.02	$127.48	-$401.51
TWX	-$142.00	$121.81	-$124.24
VRSN	-$172.46	$217.35	-$238.75
PCLN	-$172.70	$499.94	-$288.27
AKAM	-$308.45	$187.22	-$188.28
PALM	-$324.26	$297.84	-$180.29

Trading activity was also lower, in general, for the RSI rule compared to that from the Moving Average rule. Using RSI_3 resulted in an average number of 110 round trips for the 70-30 range and 62 round-trips for the 80-20 range. Using RSI_9 resulted in 18 and 5 round-trips, on average, for the 70-30 and 80-20 ranges, respectively. Using RSI_{14} resulted in 8 and 1 round-trip, on average, for the 70-30 and 80-20 ranges, respectively. Using RSI_{30} resulted in 1 and 0.13 round-trips, on average, for the 70-30 and 80-20 ranges, respectively.

Stochastic oscillators: Using the 9 day Stochastic Oscillator (K_9) with both the 70-30 and the 80-20 trading filter resulted in the best overall performances of the technical strategies. K_9, using a 70-30 trading range had an average overall gain of $13.84. The maximum gain was $238.63 (STRA) and the maximum loss was $179.41 (PALM). In contrast, STRA's buy-and-hold gain was $198.58, a difference of $40.05. The standard deviation of the K_9 gains was $33.83. K_9, using an 80-20 trading range had had an average overall gain of $14.91. The maximum gain was $212.59 (PCLN) and the maximum loss was $180.29 (PALM). The standard deviation of the K_9 gains was $32.83. The 20 day Stochastic Oscillator, K_{20}, using a 70-30 trading range had had an average overall gain of $6.07. The maximum gain was $145.29 (STRA) and the maximum loss was $522.25 (GOOG). The standard deviation of the K_{20} gains was $39.58. K_{20}, using an 80-20 trading range had had an average overall gain of $6.03. The maximum gain was $134.52 (STRA) and the maximum loss was $418.92 (GOOG). The standard deviation of the K_{20} gains was $36.76. The 100 day Stochastic Oscillator, K_{100}, using a 70-30 trading range had had an average overall gain of only $0.95. The maximum gain was $143.64 (STRA) and the maximum loss was $228.57 (PCLN). The standard deviation of the K_{100} gains was $27.37. K_{100}, using an 80-20 trading range had had an average overall gain of only $0.70. The maximum gain was $164.99 (STRA) and the maximum loss was $235.17 (PCLN). The standard deviation of the K_{100} gains was $27.80. The 200 day Stochastic Oscillator, K_{200}, using a 70-30 trading range had had an average overall gain of $5.75. The maximum gain was $188.03 (STRA) and the maximum loss was $157.87 (PALM). The standard deviation of the K_{200} gains was $27.92. K_{200}, using an 80-20 trading range had had an average overall gain of just $3.02. The maximum gain was $112.80 (JNPR) and the maximum loss was $215.15 (GOOG). The standard deviation of the K_{200} gains was $27.56. These general results are inconsistent with those found by Seiler (2001).

The trading results, on average, from employing all the various Moving Averages of the Stochastic Oscillator lost money for traders. A general observation from the different combinations of period length for the Moving Average; i.e.; 20, 100 and 200 day; was that there were smaller average losses and less deviations amongst the trading results as the length of the periods increased.

Does technical trading boost "winners" and salvage "losers"?: Finally, we simulate the results of outstanding and dismal investing by comparing the performance of the ten best (as shown in Table 5a) and the ten worst (Table 5b) performing stocks for this period to the best and worst trading performances, using any technical trading rule, for each of those stocks. The average gain for the best investments over the 9-year period was $146.27 per share. On average, combining the best results from all of the possible trading rules improved this performance by an additional $22.89 per share. However, even these good investments could have lost money had the investor traded mechanically using the wrong rule over this

period. The average loss was $205.56 per share for such a "worst case" situation, which would have been an overall difference in results of $351.83. Similarly, the worst performing stocks for this period had an average loss of $154.18 per share from the beginning to the end of the period. The best traders of these dismal stocks would have improved the overall performance by $348.30. The average gain from the best trading for these stocks was $194.12. However, even the worst trader of these worst stocks would have done only $25.96 more in damage. The difficulty in evaluating the performance of the various technical trading techniques is that no individual trading rule consistently outperformed or underperformed the other rules or the passive "buy-and-hold" strategy.

CONCLUSION

This study describes several popular technical trading strategies. These strategies, which include the Arithmetic Moving Average, the Relative Strength Index and a Stochastic Oscillator, differ in their perspective and their sophistication toward determining trading effects to the supply and demand for equities. We tested these strategies for each of the 576 US equities that comprised the S&P 100, the NASDAQ 100 and the S&P Midcap 400 over the 9-year period from January 2000 through June 2009. Our results found an average loss of $2.40 per share across all active strategies we employed. This contrasts to an average gain of $4.47 per share using the passive "buy-and-hold" investing strategy. Some strategies, specifically the Relative Strength Index and the 9 day Stochastic Oscillator, did out-perform the passive strategy. However, our findings do not consider commissions or fees. By design, with active trading come multiple trades that would erode potential profits.

When considering the overall effectiveness of technical trading rules, the benefit may not come from determining which stocks to buy based on a mechanic rule and observed signal, but when to buy stocks that provide benefits from sound fundamental analysis. The evidence of this study infers that performing fundamental analysis is still a strong prerequisite for improved investment performance and that a combination of fundamental and technical analysis may provide opportunities for enhancing investment results.

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