

# Profitability of Iranian Stock Market Based on Technical Analysis Trading Rules

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## Abstract

In this study, we focused on Tehran stock exchange market analysis based on applying moving average rules. The Tehran stock exchange in the Middle East has evolved into an exciting and growing marketplace where individual and institutional investor trade securities of over 420 companies. In an attempt to examine the ability to earn excess return by exploiting moving average rules, the average annual return on exponential moving average and simple moving average strategies were compared with annual return generated by naive buy and hold strategy. The finding based on the paired t-confidence interval hypothetical test procedures indicates that the moving average rule has more capability in predicting Tehran market and employment of the proposed technique generates excess returns for investors. Based on the findings, it is concluded that the Tehran capital market has great opportunities to apply such technique for yield enhancement and portfolio diversification.

*Key Words:* Technical trading rules; Stock Exchange, Technical Analysis (TA); Portfolio analysis; Simple Moving Average (SMA); Exponential Moving Average (EMA).

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## 1. Introduction

Technical Analysis is the term used in the financial world for a diverse set of methods unified by one basic conviction: The behavior of markets is not random but occurs in accordance with patterns that repeat over time. TA as a tool of investment for the average investor thrived in the late nineteenth century when Charles Dow, then editor of the Wall Street Journal, proposed the Dow Theory (refer to Gunasekarage et al., 2001). He recognized that movement is caused by the action/reaction of the people dealing in stocks rather than the news in itself.

Both researchers and technical analysts agree that the moving averages are one of the most popular and widely used technical indicators. Reference to the use of MAs goes back to almost 80 years ago. Gartley (1930) was one of the pioneers. The two most popular types of moving averages are the Simple Moving Average, SMA and the Exponential Moving Average, EMA. A SMA is formed by computing the average or mean price of a security over a specified number of periods. While it is possible to create moving averages from the Open, the High, and the

Low data points, most moving averages are created using the closing price. In order to reduce the lag in simple moving averages, technicians often use EMA (also called exponentially weighted moving averages). EMA's reduce the lag by applying more weight to recent prices relative to older prices. The weighting applied to the most recent price depends on the specified period of the moving average.

The early investigations of the MA were carried out by Van Horne et al. (1960). They proved that none of the rules tested were successful when compared to a buy-and-hold strategy. Nevertheless, several researchers in the 1990s changed this view and indicated that MA crossovers do actually have predictive abilities and are, therefore, worthy of being investigated. A very influential research is that of Brock et al. (1992) who investigated the predictive ability of MA rules given daily United States Dow Jones Industrial Average Index (DIIA), over 90 years from 1897 to 1986. The MA rules they applied included, (Length of the short/long periods), (1, 50), (1,150), (5,150), (1,200) and (2,200) with zero percent

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and one percent bands. Their findings revealed that the busy signals generated higher returns than sell signals, which were in turn higher/lower, respectively, than the returns generated from a buy-and-hold strategy. Hence, the MA rules have predictive ability especially if sufficiently long series of data are considered. Similar findings were also obtained by Hudson et al. (1996) who applied the same rules that Brock had already applied, but to the daily United Kingdom Financial Times Industrial Ordinary Index (FTI), for the period from July 1935 to January 1994.

Bessembinder and Chan (1995) applied a few rules from those presented by Brock to six daily equity market indices in Asia, namely Hong Kong, Japan, Korea, Malaysia, Thailand and Taiwan over the period of 1975 to 1991. They found very strong forecasting capabilities for the Malaysian, Thai and Taiwanese stock markets. Ratner and Leal (1998) applied the 10 Variable Moving Average (VMA) rules from Brock to ten emerging markets in Latin America and Asia, from 1982 through 1995. The authors concluded that substantial profits could be achieved for Thailand and Taiwan, as well as Mexico. The same was obtained when these rules were used to analyze their performance with respect to four emerging south Asian markets (Bangladesh, India, Pakistan and Sri Lanka) over a 10-year period from 1990 to 2000 (refer to Gunasekarage et al., 2001). Their findings indicate that technical trading rules have predictive ability in these markets and reject the null hypothesis predicting that the returns to be earned from studying moving average values are equal to those achieved from a naive buy and hold strategy. Furthermore, Ihab A. El-Khodary (2009) show that the MA crossover technique can predict the Egyptian stock market index and its securities and could be great opportunities from applying this technique to the Egyptian market for yield enhancement and portfolio diversification.

Chang et al. (2004) attempted a prediction comparative study using five Brock's VMA rules (those with zero percent band) between eleven emerging stock markets indices and two developed country indices (USA and Japan). These countries included Argentina, Brazil, Chile, Mexico, the Philippines, India, Indonesia, Malaysia, South Korea, Taiwan and Thailand. The data series for all thirteen markets included daily closing prices from 1991 through 2004. Employing the VMA showed that there is some evidence of forecasting power for the emerging markets studied. The Malaysia and Philippines market indices produced high abnormal returns as a result of employing the technical trading rules. Nevertheless, for the USA the VMA rule suggested in the study by [Brock] lost its forecasting power when employed to the recent data set. Another recent study by Ming and Siok-Hwa (2006) examined the profitability of 10 VMA rules and 10 FMA rules on 9 Asian markets indices during the period from 1988 to 2003. The rules employed were different

from those examined by Brock; they were (1, 20), (1, 60), (1,120), (1,180) and (1,240) with zero percent and one percent bands for the VMA and 10 holding days after generation of signal for the FMA. The authors concluded that the VMA and the FMA have economic significance in eight of the nine markets; China, the Philippines, Singapore, Indonesia, Malaysia, Korea, Taiwan and Thailand. The 9<sup>th</sup> market left out was Japan.

Some authors such as A.M. Rawani (1993), Levich et al. (1993), Zhang (1994), Green et. Al. (1994), Yao et. Al. (1996), Yao and Tan (2000) applied technical trading rules to predict foreign exchange rates. Schulmeister (2008) in the United States showed that some of the technical trading rules actually have the ability to predict stock price movements. However, relatively new emerging stock markets in the Asia-Pacific region have not been widely studied and tested yet. Hence, the main research question of the present research is whether we can efficiently ease technical analysis methods in Tehran Stock Exchange or not. Moreover, whether such methods can deliver more returns than buy-and-hold strategy for shareholders than was expected was the other concern of this research. This study employs moving average rule to examine whether a simple trading rule based on a comparison of average returns over a short and long period can outperform a naive strategy whereby the investor buys a broadly based portfolio of securities and holds this portfolio until the end of the period. MA rules depends on El-Khodary(2009) identify the lengths of short and long periods, type of MA model and type of price data. Here commend that users could fine-tune these parameters according to what they find suitable for their strategy.

In the Tehran financial markets, now more than ever, timing is everything. When should investors get into the market and when should they get out? Every trader would like to know what the market is going to do before it actually does it.

Tehran Stock Exchange opened in February 1967. This market is currently considered as one of the most important executive mechanisms for national economy optimization in order to facilitate the equipment and active contribution of the private sector in the productive activities through transferring some of the state duties to the private sector, gathering and errant savings, all to be directed toward investment. Price data for this stock exchange has only fairly recently become available; so little or no research has been conducted on asset pricing in this market. The tests performed in the present paper replicate those conducted on developed stock market data. The findings in this investigation may help authorities to resolve some of the debates that persist in the different developed market studies on the profitability of such rules.

The remainder of the paper is organized as follows. Section 2 describes the data used in the study and

Empirical results. Section 3 analyses the results from these rules and offers some conclusions.

## 2. Empirical Results

Technical Analysis is done by identifying the trend from past movements and then using it as a tool to predict future price movements of the stock. It can be done by using any of the following methods:

a) Moving Averages: This method is used to predict the trend and specify various support and resistance levels in the short and long-term period.

b) Charts and Patterns: Some analysts use charts and patterns to decide on the trend and then judge the future movement. The tool used by such analyst is converting the chart in one of the many form of many shapes commonly formed by stocks.

In this study, in order to find the best Technical Analysis method that generates the highest significant returns with respect to Tehran Exchange Stock market, we used moving averages method. The main advantages of moving averages is that they smooth the data and thus provide a clearer visual picture of the current trend and, second, MA signals can give a precise answer as to what the trend is. The MA rule focuses on the crossing-over of the long-run moving average by the short-run moving average. A buy (sell) signal is generated when the short moving average cuts the long moving average from below (above). The main disadvantage is that they are lagging rather than leading indicators but this should not be a problem to long-term investors.

There are two main forms of moving averages. The SMA calculates the average price over a specified moving period. For example, a 20-day simple moving average will calculate the average mean price from the last twenty day's closing prices and so on. All moving averages are lagging indicators and will always be "behind" the price. If the price were rising, the SMA would most likely be below. Because moving averages are lagging indicators, they fit in the category of trend following indicators. When prices are trending, moving averages work well. However, when prices are not trending, moving averages can give misleading signals

The EMA also averages the last  $x$  day's closes but assigns a greater weight to the more recent prices making it more sensitive to current price action and thus reducing the lag effect. EMA's reduce the lag by applying more weight to recent prices relative to older prices. The weighting applied to the most recent price depends on the specified period of the moving average. The shorter the EMA's period, the more weight will be applied to the most recent price

In this study, we analyzed data for the largest 20 companies in the Tehran Exchange Stock market for a period of 9 years and 3 months from 21 March 2001 to 21

June 2010. We examined sixteen strategies on the lengths of (1,25,0), (1,50,0), (1,100,0), (1,150,0), (2,25,0), (2,50,0), (2,100,0) and (2,150,0) with the closing price in the two main forms of moving averages, SMA and EMA. In the mentioned parentheses, the arguments show Length of the short period, Length of the long period and Size of the band, respectively. The rules differ from each other with respect to the length of the short and long period and by the type of MA model.

Tehran Stock Exchange (TSE) opened in February 1967. During its first year of operation, only six companies were listed there. In 1989, economic authorities' attention to restarting of TSE activities increased the number of listed companies from 56 in 1988 to 422 in 2006. Furthermore, in 1988 the annual value of shares traded in the TSE, was the internal rate of return (IRR) 9.9, which increased to IRRs 44.8b in 2006. During these years, return of TSE investments grown up considerably and in 2003 reached to 131.4%, which on that year was the highest return between WFE's members. Today TSE has evolved into an exciting and growing marketplace where individuals and institutional investors trade securities of over 420 companies.

In fact, TSE was considered as one of the most important executive mechanisms for national economy optimization in order to facilitate the equipment and active contribution of the private sector in the productive activities through transferring some of the state duties to the private sector, gathering and errant savings, all to be directed toward investment.

In this exercise, to examine whether a simple trading rule based on a comparison of average returns over a short and long period can outperform a naive strategy to the Tehran market, the authors applied the SMA and EMA technique. The SMA is the sum of the prices over a certain number of periods ( $n$ ) divided by the number of periods to get an average price of the security as shown by Eq. 1.

$$SMA_n = \frac{1}{n} \sum_{k=n+1}^k p_t \quad (1)$$

Where  $k$  is the relative position of the period currently being considered within the total number of periods and  $P_t$  is the price of the security at time  $t$ . The SMA has been criticized for the fact that each price in the data series being averaged is equally weighted; thus assuming that old prices are equally as relevant as the ones that are recent. Those critics have argued that the most recent prices are more significant than older ones and therefore should have a greater influence on the final average results. Accordingly, analysts and traders thought of different methods through which more weight is given to the most recent prices and this has led to the development of various types of new MAs, the most popular of which is the EMA. The EMA is calculated by adding a percentage of yesterday's MA to a percentage of today's price value, according to the following:

$$EMA_t = (1 - ESF) * EMA_{t-1} + ESF * P_t \quad (2)$$

Where  $P_t$  as mentioned above and ESF is an exponential smoothing factor calculated by  $\frac{2}{(1+n)}$  and is a number between 0 and 1. Thus, the EMA applies the weighting factors which decrease exponentially, where the weighting for each older price decreases exponentially, giving much more importance to recent observations without discarding older observations entirely.

In this exercise, we applied the SMA technique and EMA technique, along with a number of different combinations of short and long length of periods. The buy and sell signals obtained from these different combinations is provided in Table 1.

Based on the numbers of buy and sell signals in Table 1, one can notice that by increasing either the short period length or the long period length, the number of buy/sell signals decrease. As an interesting observation, one can notice that opposite conflicting signals were generated on the same day for different rules. It should be kept in mind that these signals are supposed to provide guidance to the investor/trader. The important question that needs to be probed is which of the above strategies provides the highest return for the Tehran Exchange Stock market.

Table 1  
Number of buy and sell signals

Strategy	Number of signals	
	Buy	Sell
(1,25,0) Simple	31	30
(1,50,0) Simple	20	20
(1,100,0) Simple	14	13
(1,150,0) Simple	10	10
(2,25,0) Simple	32	32
(2,50,0) Simple	22	21
(2,100,0) Simple	13	13
(2,150,0) Simple	11	10
(1,25,0) Exponential	34	32
(1,50,0) Exponential	23	23
(1,100,0) Exponential	16	15
(1,150,0) Exponential	12	12
(2,25,0) Exponential	33	32
(2,50,0) Exponential	22	21
(2,100,0) Exponential	16	15
(2,150,0) Exponential	11	10

In the present work, in order to figure out the best alternative, we compared mean daily buy and sell capital gain yield for sixteen strategies as presented in Table 2. Column 1 highlights the strategy while columns 2 and 3 report the mean daily buy and sell capital gain yield, respectively. The capital gain yield on day  $t$  is calculated by deducting the log value of the index on day  $t - 1$  ( $P_{t-1}$ ) from its log value on day  $t$  ( $P_t$ ).

$$C_{it} = \log_e[P_t] - \log_e[P_{t-1}] \quad (3)$$

According to Table 1, the buy returns are positive for all the markets while every one of the sell returns is negative. The majority of these buy and sell returns are statistically significantly different from those available to investors who follow a passive buy and hold strategy. In fact, for TSE, all the gain returns are greater than the passive strategy returns.

Table 2  
Mean daily buy and sell capital gain yield

Strategy	Mean daily capital gain (%)		
	Buy	Sell	Gain=Buy-Sell
(1,25,0) Simple	0,355	-0,242	0,597
(1,50,0) Simple	0,267	-0,180	0,447
(1,100,0) Simple	0,216	-0,154	0,370
(1,150,0) Simple	0,182	-0,130	0,312
(2,25,0) Simple	0,296	-0,182	0,478
(2,50,0) Simple	0,211	-0,130	0,341
(2,100,0) Simple	0,162	-0,094	0,256
(2,150,0) Simple	0,138	-0,082	0,220
(1,25,0) Exponential	0,362	-0,254	0,616
(1,50,0) Exponential	0,291	-0,210	0,501
(1,100,0) Exponential	0,224	-0,174	0,398
(1,150,0) Exponential	0,193	-0,145	0,338
(2,25,0) Exponential	0,284	-0,184	0,467
(2,50,0) Exponential	0,229	-0,152	0,381
(2,100,0) Exponential	0,172	-0,110	0,281
(2,150,0) Exponential	0,175	-0,079	0,254

The paired t-confidence interval and test procedures are used to analyze the differences between the simple and exponential moving average twice. The 1<sup>st</sup> hypothetical test was examined based on the gain derived from the period of one day and the 2<sup>nd</sup> one tested for the period of two days. The procedures are used to determine if the mean difference for the two types of strategies is likely to be different from value of zero. By using Minitab statistical package, the two mentioned tests were carried out based on a given confidence interval, which quantifies the uncertainty associated with estimating the difference from sample data. Hence, we can be 90% confident that the true difference of two moving average types is between 0.013715 and 0.049785 for all strategies defined based on one-day period. The calculated p-value of the test is 0.013, which is rather lower than the desired type one error; say 0.05. Accordingly, the exponential moving average strategy works better than the simple moving average type for the periods of one day. The consequences of such hypothetical evaluation also support such deduction for the periods of two days. Therefore, we can conclude that the mean of the exponential moving average is greater than the mean of the simple moving average at the 0.05 level of significance.

Table 3 reports summary statistics for mean annual capital gain yield and standard deviation for all strategies. The findings of this study indicate that with a naive strategy, whereby the investor buys a broadly-based portfolio of securities and holds this portfolio until the end of the period, return of TSE investments was 19.47% mean annual capital gain yield and 7.81% mean annual

dividend yield which defined as dividend per share per price of share. Therefore, the mean annual return is 27.28%, which expresses an investor has actually earned during a certain period in the past. It includes interest, dividends and capital gain such as an increase in the share price generated in the Tehran Exchange Stock market for a period of 9 years and 3 months from 21 March 2001 to 21 June 2010 on the naive buy and hold strategy. Through considering 15.5% risk free rate in Iran, risk premium would be 11.78%. Table 3 compares mean annual capital gain of sixteen strategies using the naive strategy. Most profitable MA rule is exponential of length 1-25 using the close price that generated 123.87% mean annual capital

gain yield. The excess return that can be earned from this strategy is 104.4%.

Table 3 also reveals high volatility in the market represented through the standard deviation of the annual returns. Investors use the standard deviation of historical performance to try to predict the range of returns that is most likely for a given investment. When a stock or portfolio has a high standard deviation, the predicted range of performance is wide, implying greater volatility. Figure 1 shows the mean annual capital gain yield % in all strategies.

Table 3  
Mean annually capital gain yield and standard deviation for all strategies

	Naive			
Mean annually capital gain yield%	19,47			
Standard Deviation	10,20			
	(1,25,0) (simple)	(1,50,0) (simple)	(1,100,0) (simple)	(1,150,0) (simple)
Mean annually capital gain yield%	121,22	91,87	75,89	63,73
Standard Deviation	28,90	26,51	29,61	28,68
	(2,25,0) (simple)	(2,50,0) (simple)	(2,100,0) (simple)	(2,150,0) (simple)
Mean annually capital gain yield%	99,29	71,73	55,8	47,85
Standard Deviation	21,03	18,11	20,79	20,67
	(1,25,0) (exponential)	(1,50,0) (exponential)	(1,100,0) (exponential)	(1,150,0) (exponential)
Mean annually capital gain yield%	123,87	100,5	77,91	67,33
Standard Deviation	39,32	33,97	32,89	32,12
	(2,25,0) (exponential)	(2,50,0) (exponential)	(2,100,0) (exponential)	(2,150,0) (exponential)
Mean annually capital gain yield%	95,45	78,19	58,85	59,47
Standard Deviation	31,52	20,99	19,89	43,78

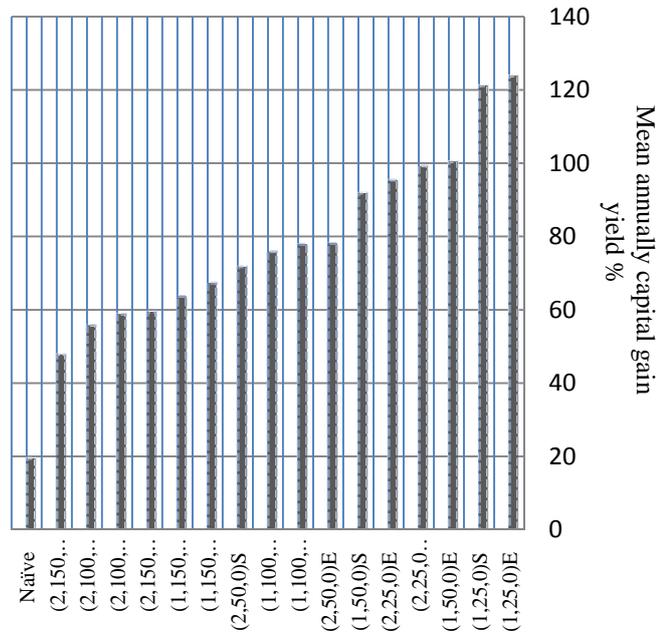


Fig. 1. Comparison on annually mean capital gain

### 3. Conclusion

In this study, we examined the performance of one of the simplest and most popular classes of technical trading rules; moving average, for one of the emerging capital markets in the Middle East. Moving averages rules depends on identifying the lengths of short and long periods, type of model, and type of price data on which the analysis is to be based.

In an attempt to find the optimal moving average rules that generates the highest significant returns with respect to Tehran Exchange Stock market, we analyzed data for the largest 20 companies in the exchange for a period of 111 months from 21 March 2001 up to 21 June 2010. We examined sixteen strategies; the lengths of (1,25,0),(1,50,0),(1,100,0),(1,150,0),(2,25,0),(2,50,0),(2,100,0) and (2,150,0) based on the closing price in two most popular types of moving averages of the SMA and EMA.

The findings of this study indicate that with a naive strategy whereby investor buys a broadly-based portfolio of securities and holds this portfolio until the end of the period, return of TSE investments is 19.47% mean annual capital gain yield and 7.81% mean annually dividend yield. Therefore, the mean annual return generated in Tehran Exchange Stock market during the long evaluated period based on the naive buy and hold strategy is 27.28%. Considering 15.5% risk free rate in Iran, risk premium would be 11.78%. Most profitable MA rule is exponential of length 1-25 using the close price which generated 123.87% mean annual capital gain yield. The excess return that can be earned from this strategy is 104.4%.

Clear evidence was detected confirming that the moving average rule has predictive ability in this market and the employment of these techniques generates excess returns to investors in this market. Based on these findings, it can be concluded that Tehran capital market is not weak form efficiency point of view. Therefore, there could be great opportunities from applying this technique to Tehran Exchange Stock market in order to yield enhancement and portfolio diversification.

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