The Profitability of Technical Trading Rules: Evidence from Emerging Market of Pakistan

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Abstract

This study examines the validity of technical trading rules namely Variable Moving Average (VMA), Fixed Moving Average (FMA), and Trading Range Breakout (TRB). The study assumes that on a buy signal, traders take a long position and add stock to their investment portfolio. Similarly, on sell signals, stocks are excluded from the portfolio. Moreover, to test the profitability of technical trading rules, returns of these technical trading rules generated portfolios are compared with simple buy and hold portfolio returns. The results reveal that both VMA as well as TRB rules provide significant abnormal returns. Yet, we show that only one out of a total of eight FMA rules provides significant excess returns. Our results indicate that the Pakistan Stock Exchange (PSX) is weak form inefficient.

JEL Classification: G12; G14; D53

Keywords: Moving Average; Trading Range Breakout; Fixed Moving Average; Variable Moving Average; Trading Rules

1. Introduction

Technical Analysis has always been an area of interest for researchers, academicians, and practitioners because it raises a question on the validity of the Efficient Market Hypothesis (EMH). Accurate prediction of future movements of stock prices provides an opportunity for investors to earn lucrative profits. Excess returns motivate stock traders to develop trading strategies. The technical trading strategy is defined as an infinite ad-hoc rule that generates buys and sells signals. These signals are generated based on historic trends and patterns of the past stock prices and volume. In the past, academicians and researchers show a reluctant attitude towards the theoretical acceptance of trading rules as they directly raise several questions regarding the validity of EMH. However, a review of recent literature indicates that several studies have successfully documented several stock market anomalies.

The existence of anomalies in stock markets weakens our belief in the concept of efficient markets. According to the random walk theory, stock prices exhibit a random walk in an informationally efficient market. Thus, it is almost impossible for someone to identify the trend or hidden pattern in historical stock prices. Moreover, proponents of random walk theory openly discourse against technical trading rules. The EMH clearly states that investors cannot forecast future prices using historical market data, exploring trends or patterns, and, even based on

insider information (Fama, 1970). However, profits earned based on technical analysis are a challenge to EMH.

According to behavioural doctrine, stock prices are predictable. One can easily identify the hidden patterns in historical market-generated statistics by using technical and fundamental analysis (Yu *et al*., 2012). The more provocative claim of technicians is that once you identify the trend in historical data, it will lead you to earn abnormal/excess returns on your investment (Teele, 2010). Therefore, stock returns predictability is possible by exploiting various phenomenon like momentum, reversal, high frequency, filters, algorithms, and, other technical trading strategies (Wang *et al*., 2000; Neely, 2003; Chang *et al*., 2004; Namet *et al*., 2005).

Technical trading systems are sets of trading strategies that govern the buy or sell position of an asset. Technical analysts employ different tools and trading rules e.g. Moving Average (MA), momentums, resistance/support level and, charting techniques to forecast future prices (Kwon & Kish, 2002). Technical trading strategies were developed around the 1700 century when Chinese rice traders used candlestick charts. This phenomenon got theoretical support in the late 18th century when Charles Dow presented his famous Dow Theory. Peter Hamilton further supports his work by forecasting bull and bearish trend for US markets.

Technical strategies are actively employed by brokerage houses, investors, and currency dealers all over the world. Brokerage houses update technical commentaries on daily basis and even many of their advisory services are mainly based on these technical rules (Park & Irwin, 2007). The recent empirical evidence suggests remarkable achievements in the profitability of technical trading strategies (Hsu & Kuan, 2010; Young *et al*., 2009).

To examine the profitability of the trading rules, the recent studies have largely focused on developed countries like the USA, the UK, Japan, Australia, Canada, New Zealand, Germany, Spain, and other European countries (Brock *et al*., 1992; Kim & Lee, 2004; Teele, 2010). However, over time, empirical research on technical trading analysis has shifted to emerging stock markets. This is because emerging markets are a potential source of opportunities for investors (Harvey, 2002; Yu *et al*., 2012).

Gunasekarage and Power (2001) analyze the effectiveness of trading rules in South Asian stock markets including the Pakistan Stock Exchange (PSX). They found statistically significant results for all 18 trading rules applied to the Pakistan Stock Exchange (PSX). Previous studies have mainly focused on unadjusted abnormal gains. Moreover, opponents of trading rules argue that trading rules are just the proxies of already known risk factors. They further argue that technicians help investors in gaining excess returns by simply selecting the stocks, which already possess certain risk characteristics (Jensen & Benington, 1970).

This study examines whether technical trading rules help investors to gain abnormal returns. The findings of the study would be quite helpful to identify whether a certain trading strategy contains inherent superior capabilities across periods or it gained superior capabilities by chance. If trading rules provide significant abnormal returns, then technical rules provide some additional/unique information to investors. Therefore, this study has significant implications for investors in devising their trading strategies.

The rest of the article is structured as follows. Section 2 presents data and methodology. Section 3 presents the results and discussions. Section 4 provides conclusions.

2. Data and Methodology

The main purpose of this study is to validate technical trading rules profitability. A technical trading strategy helps to identify the buying and selling position; whichever is more profitable at particular point in time. Previously, these strategies are found a significant prediction tool for stock indices, future market trends, foreign exchange movements, and individual securities as well. Technical analysis contains large number of mechanical techniques to predict future prices. When one has such large set of tools, the most critical point is the selection of most appropriate set of rules as it directly influences the empirical results (Hsu *et al*., 2010). For example, if you choose very few rules it may cause statistical inference biasness. Therefore, in this study, we try to maintain a balance and select two most popular trading strategies. Specially, we use the most popular technical trading rules that are generally applicable in all the stock markets i.e. moving average technique and trading range breakout (TRB hereafter). Furthermore, we apply both variable and fixed moving average techniques.

2.1 Data

Sweeney (1986) suggests that data on individual stocks should be applied for testing the validity of technical trading rules. He further recommended that individual stocks should be preferred over indices to ensure the true capability of trading strategies. Therefore, the sample of this study consists of 100 individual stocks listed at PSE from January 2004 to December 2013. Daily stock prices are collected from websites of PSE and Business Recorder.

2.2 Moving Average

Moving average is considered the most popular trading rule to gauge the trend among asset prices. There are many types of moving average e.g. exponential moving average. For the study, we use only a simple moving average, which we calculate by taking the summation of a set of stock closing prices for a specific period and dividing this sum by the total number of days of that period. Mathematically, it is express as follows:

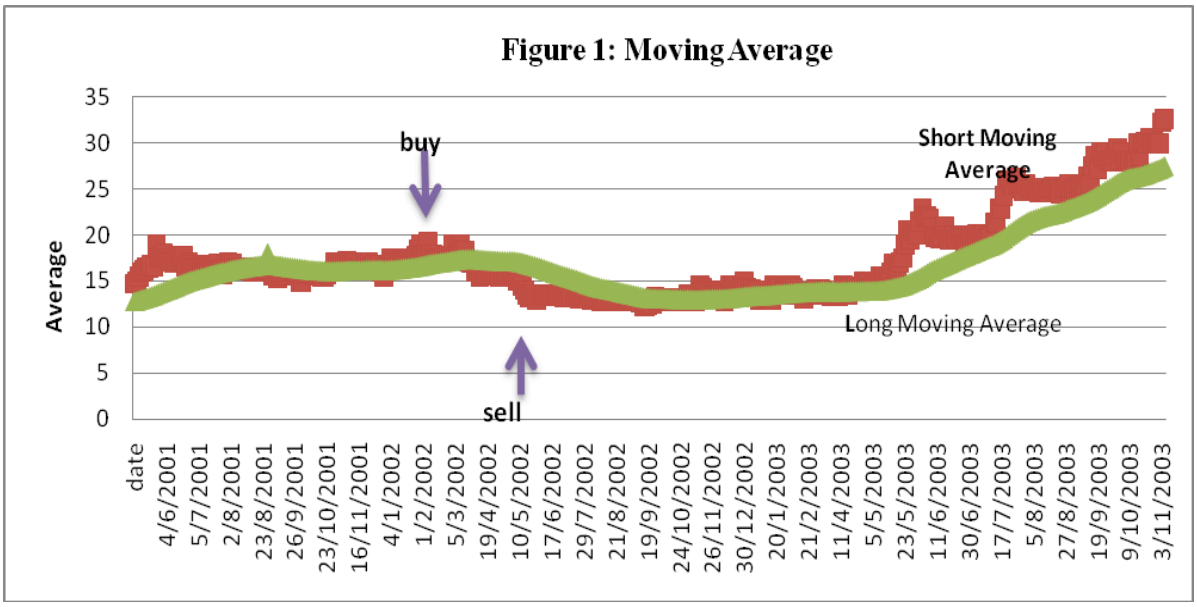
Moving Average $= \sum closing\ stock\ price\ /n$

where, n is the total number of observations.

As it is clear from the name, the moving average is kept on rolling to ensure that the most recent data is being used to identify the trend. Thus, in each moving average oldest data point is dropped out and is replaced with a new data point. This technique generates buy and sell signals by simply comparing a short-term moving average (SMA) with a long-term moving average (LMA).

A buy signal is generated when SMA is greater than LMA and a sell signal is generated when SMA falls below then LMA. LMA characterizes as the elongated trend of the stock prices. In this study, the one-day short moving average is used for all strategies and four long moving average periods are used. In a time frame of 50, 100,150, and 200 days, the moving average is considered as LMA.

Figure 1 presents an example of the moving average's graphical representation. When SMA crosses from above, a buy signal is generated and similarly, when SMA falls below the LMA a sell signal is generated.



SMA> LMA = Buy signal
SMA< LMA = Sell signal

By following the moving average rule, each day is classified either as a buy or a sell day. There is a possibility that it may generate a false signal regarding trend because of the swift variation among stock prices. A counterfeit signal may also be generated because the two moving averages might be very adjacent and cross each other repeatedly. Brock *et al*.(1992) suggest adding a filter in conjunction with these trading rules to minimize these false signals.

To further refine the technique, a predefined bandwidth is used. Following the footsteps of Brock *et al*. (1992), we used a 1% bandwidth to whiplash the effect of smaller differences. In the case of moving average, this 1% band is placed above and below LMA. The Variable moving average (VMA) rules imply buy and sell signals with a 1% band as follows:

SMA>1.01*LMA = Buy signal
SMA<0.99* LMA = Sell signal
Otherwise no signal.

After adding the constraint of 1% bandwidth, few signals would be generated as compared to the simple moving average because those days in which the short moving average crosses the long moving average with a very trifling amount would not be considered. This study assumes that stocks enter (exit) from the portfolio on the receipt of buy (sell) signal said differently, once a trading signal is generated, an investor will take a short or long position accordingly to gain the abnormal returns. The closing prices are recorded for all the bought and sold stocks. Moreover, daily equal-weighted portfolios are formed and each day number of stocks in the

portfolio can vary. For sake of simplicity, transaction costs for all stocks are assumed to be negligible. Once signals are generated then the returns associated with the signals are calculated.

This study implies both fixed and variable-length moving average. The fixed moving average (FMA) differs from VMA as signals are emitted at the start of an upward or downward trend and once a buy/sell signal is generated in the FMA the desired position need to be held for a fixed period and all other signals are ignored during this period. In equation form, it is defined as

Buy signal= SMA>LMA and $SMA_{t-1}<LMA_{t-1}$
Sell signal= SMA<LMA and $SMA_{t-1}>LMA_{t-1}$
Otherwise no signal.

where, t_{-1} represents a previous day.

Ten days holding period is set for the FMA. Therefore, when a signal is received that position is held for 10 days and all other signals during this period are ignored. The FMA rules also produce fewer signals as compared to the VMA. The same four time periods are used for FMA as well and 1% filter rule is also used to further refine the signal of FMA strategy. A buy signal is only generated when the short moving average is above the long moving average by 1% and the short moving average of the previous day is less than the long moving average.

Buy signal= SMA>1.01 LMA and $SMA_{t-1}<LMA_{t-1}$
Sell signal= SMA<0.99 LMA and $SMA_{t-1}>LMA_{t-1}$
No signal otherwise

We use the most popular moving average period, that is (1, 50)(1,100), (1,150) (1,200); where the short period is one day and the long period is 50, 100, 150, and 200 days respectively. Further, 0 and 1% bands are used to eliminate the effects of "whipsawing". For emerging markets,1% trading is considered as an effective tool for investors in the eradication of false signals (Bessembinder & Chan, 1998). Total 16 moving average rules are examined in this study; eight with 1% bandwidth and eight with 0% filter.

2.3 Trading Range Breakout (TRB)

Another technical rule used in this study is the trading range breakout. The TRB provides a buy and sells signal with reference to a local maximum and minimum price level. The local maximum level is known as a resistance level. An analyst believes that most investors are willing to sell their stocks when the price touches its peak. This creates a blockage to the price incremental trend. This selling pressure will cause resistance to a price rise above the previous peak. If the price rises above the previous peak, it has broken through the resistance area. Such a breakout is considered to be a buy signal. Under this rule, a sell signal is generated when the price penetrates the support level, which is the local minimum price. The underlying rationale is that the price penetrating the support level. In any case, for stocks, whose current price manages to cross this resistance level, a sell position is recommended because it infiltrates a downward trend. The TRB is considered as the starting point of any major change in prices. Local maximum and minimum prices indicate the future larger swings of prices

The literature suggests that traders should take a long position when prices go above the previous peak (maximum) and take a short position when prices go below the support level. The following equation is the mathematical expression for TRB.

Buy signal= P_t> Max (Pt_{-1}……P_{n-1}) and P_{t-1}<Max (P_{t-1}……P_{n-1})
Sell signal= P_t<Min (Pt_{-1}……P_{n-1}) and P_{t-1}>Min (P_{t-1}……P_{n-1})
Otherwise no signal

To implement the TRB strategy, periods for calculation of local maximum and minimum levels are designed following the moving average rules. Resistance and support levels are calculated using past prices of 50, 100,150, and 200 days time frame. A 10-day holding period is also used. Besides, the rule is implemented with a 0 and 1% band. Eight TRB rules are applied in this study, four with 0% bandwidth and the other four with 1% bandwidth.

Following equations represent the calculation of buy/sell signal pertaining 1% filter. Signal is only generated when current price cuts above/below the resistance/support level by a 1% amount. If the price lies in between the bracket of 1%, no signal is generated.

Buy signal= P_t>1.01 Max (Pt_{-1}……P_{n-1}) and P_{t-1}<Max (P_{t-1}……P_{n-1})
Sell signal= P_t<0.99 Min (Pt_{-1}……P_{n-1}) and P_{t-1}>Min (P_{t-1}……P_{n-1})
Otherwise no signal.

3. Results and Discussion

The core purpose of a technician is to identify the hidden pattern in historical data and then suggest an investment strategy accordingly to get excess returns. In this study following Brock *et al*. (1992), we used two most popular trading techniques i.e. moving average and trading range breakout. To test the significance of these rules, t-test statistics is used. Daily portfolio return is calculated by using logarithm difference of closing prices of current day and previous day. Mean daily portfolio return of buy and hold strategy is 0.0427%.

The difference of mean daily buy and hold portfolio return and mean daily portfolio return of VMA portfolio is positive. In other words, technical trading portfolio returns are higher than of simple buy and hold portfolio returns. For example, the VMA(1,50,0) portfolio daily mean return is 0.783%, which is 20 times higher than simple buy and hold mean daily return i.e. only 0.04%. Annual mean daily returns are also calculated for trading rules portfolios. VMA rule portfolio gives very high annual percentage returns. For instance, VMA (1, 50, and 0) trading portfolio exhibits 6.13% annual returns. Similarly, VMA (1, 50, and 1%) trading portfolio also generates 6% annual returns. It is also observed that when LMA time frame increases, the size of annual return of portfolio starts shrinking. Likewise, when VMA calculated with 200 days LMA i.e. VMA (1, 200, 0) the annual return figure is 1.75%, which is almost 70% less than the annual return of VMA (1, 50, 0) rules. On average, VMA (1, 50, 0) are more profitable and by adding filter of 1 % no major incongruity is notice among mean daily return and annual returns.

All eight VMA trading rules provide positive and significant excess returns as compared to the simple buy-hold portfolio for stocks used in this study. Moreover, since the p-value for all VMA rules are also less than 0.05, the excess returns are statistically different from zero. The results of the study are consistent with Gunasekarage & Power (2001) and Chang *et al*. (2004).

It is also observed that comparatively variable moving average rules provide higher average annual return. Brock et al. (1992) suggest that the most useful trading rules is a 50 day variable moving average rule. It is pertinent to mention here that these annual returns are neither market adjusted and nor risk adjusted.

Table 1: Descriptive statistic of trading rule portfolio

Trading Strategy	Mean	SD	T-value of portfolio return	P-Value	Average annual return in
VMA					
VMA (1, 50, 0%)	0.7830	0.04712	51.3282	0.00	6.13895
VMA (1, 50, 1%)	0.7811	0.0464	51.5277	0.00	6.10463
VMA (1, 100, 0%)	0.5736	0.0466	36.1718	0.00	3.22678
VMA (1, 100, 1%)	0.5703	0.04606	36.1061	0.00	3.19203
VMA (1, 150, 0%)	0.4628	0.04613	28.5358	0.00	2.20208
VMA (1, 150, 1%)	0.4645	0.04566	28.6092	0.00	2.21511
VMA (1, 200, 0%)	0.4036	0.04549	24.2646	0.00	1.75986
VMA (1, 200, 1%)	0.4027	0.04506	24.2982	0.00	1.75378
FMA					
FMA (1, 50, 0%)	0.0777	0.01478	3.20682	0.00	0.21612
FMA (1, 50, 1%)	0.0516	0.01477	0.70603	0.24	0.13872
FMA (1, 100, 0%)	0.0516	0.01413	0.70226	0.24	0.13864
FMA (1, 100, 1%)	0.0340	0.01410	0.98512	0.16	0.1087
FMA (1, 150, 0%)	0.0410	0.01314	0.30626	0.38	0.10892
FMA (1, 150, 1%)	0.0252	0.01307	1.83279	0.03	0.06562
FMA (1, 200, 0%)	0.0345	0.01198	0.9331	0.18	0.09099
FMA (1, 200, 1%)	0.0254	0.0119	1.81292	0.03	0.06623
TRB					
TRB (1, 50, 0%)	0.0612	0.01487	2.68896	0.00	0.16669
TRB (1, 50, 1%)	0.0160	0.01486	2.71239	0.00	0.04118
TRB (1, 100, 0%)	0.00691	0.01420	3.58286	0.00	0.01756
TRB (1, 100, 1%)	0.005125	0.01417	3.76294	0.00	0.01756
TRB (1, 150, 0%)	0.006292	0.01308	3.65682	0.00	0.01299
TRB (1, 150, 1%)	0.005058	0.01299	3.77853	0.00	0.01598
TRB (1, 200, 0%)	0.006793	0.01196	3.62539	0.00	0.01282
TRB (1, 200, 1%)	0.005921	0.01182	3.71117	0.00	0.01726

Note: Table 1 represents summary of the results for the 24 trading rules portfolio constructed in this study. The first column from the left shows the **name** of trading strategies. The values in brackets are symbolic depictions of days of SMA, LMA and filter are calculated i.e. first figure in brackets is showing the total number of days used for SMA, then 2nd figure represents number of days used for LMA and last figure represent filter amount. For example, a 50 day variable moving average with 0% band symbolizes as VMA (1,50,0) where 1 is SMA time period, 50days is used for LMA and 0 presents band width. Similarly, a 50-dayvariable moving average with 1% bandwidth is written as VMA (1,50,1).

On the flip side, all the FMA values are insignificant except of FMA (1, 50, 0). This suggests that the FMA rules do not help investors to outperform the market. For fixed moving average a buy or sell position is held for a fixed period of time and any other signal in between the time frame is ignored. For consistency purpose, same four time frames like VMA are used and 1% filters are also applied. This study uses a 10 days holding period, a trading signal position is held for 10-day and all other signals are ignored. After 10 days, new signal is incorporated and process goes on. Only 1 FMA rule out of total 8 FMA rules provides significant excess daily return. While for other 7 trading rules, differences of returns are statistically insignificant. These results are consistent with Lam *et al*.(2007).They report that FMA rules are small and statistically insignificant for Hong Kong Stock Market. The results of the study are inconsistent with Bassminder and Chan (1998), who claim that the FMA rules are more profitable than the VMA rules.

Total eight TRB rules are applied in this study and it is observed that all of the TRB rules provide significant abnormal returns. Although, these returns are very small as compared to VMA rules, they are statistically significant. TRB rules are also held for 10 days. Therefore, this study infers that when signals have to hold for a fixed period of time it is better to use TRB strategy than the FMA rule. The results also suggest that by adding 1% filter no dramatic change come in the average daily and annual return. In other words, filters do not help to improve the performance of trading strategy in this context.

4. Conclusions

This study investigates technical trading rules' profitability for emerging market of Pakistan. To measure the profitability of trading rules, two most common groups of trading strategies i.e. moving average and trading range breakout are studied. Within moving average both variable length and fixed length moving averages are used. All of the VMA and TRB rules provide significant returns. The findings indicate that both of these rules provide larger returns as compared to simple buy and hold returns. Only 1 FMA rules out of total eight rules provides significant positive returns. In the FMA rule, signal positions are supposed to be held for 10 days. The findings also reveal that for Pakistani equity market, trading rules signals become extraneous after few days. That is, they are only profitable for short period.

On average, the VMA rules provide more accurate signals and average annual return generated through VMA is far better than FMA and TRB rules. Brock *et al*. (1992) state that if trading rules are engaging to provide significant excess returns, it will indicate market inefficiency. The eight variable moving average rules and eight TRB rules provide significant abnormal returns. Therefore, this study provides clear evidence of market inefficiency. On average trading rules help investors to earn abnormal return and these trading rules provide these profits by exploiting the hidden pattern. Therefore, Pakistani equity market is weak form inefficient in this context. One of the major implications of this study is to provide better knowledge to investors about technical trading rules. Trading rules are not mere proxies of already known impact factors rather they provide additional benefits to the investors by looking into past trends.

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