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PROFITABILITY OF THE MOVING AVERAGES TECHNICAL TRADING RULES IN AN EMERGING STOCK MARKET: A STUDY OF STOCKS LISTED IN PAKISTAN STOCK EXCHANGE

Muhammad Arif, Abdul Rauf Laghari, and Avinash Advani

ABSTRACT

This study examines the profitability of Moving Averages (MA) timing strategy over the buy and hold strategy for individual stocks listed at Pakistan Stock Exchange (PSX). We applied Han, Yang, and Zhou (2013), methodology to individual stock returns and found inconclusive evidence of MA timing strategy's predictive ability to earn higher returns over buy and hold strategy. We also report market risk-adjusted returns to remove any market movement effects and apply alternative moving averages lag lengths to check the robustness of our results. We observe individual stock returns are noisier than portfolio returns and the simple technical trading rule of moving average lack the ability to predict individual stock returns. We propose the use of more complex trading rules in future studies to ascertain the profitability of technical trading rules in individual stocks.

Keywords. *Technical Analysis; Individual Stocks; Moving Average (MA); Buy and Hold Strategy; Pakistan Stock Exchange (PSX).*

INTRODUCTION

Technical analysis literature provides plentiful research on the profitability of technical trading rules for stock market indices and portfolios (de Souza et al., 2018; Yu, Nartea, Gan, & Yao, 2013; Gunasekarage & Power, 2001), but there are very few studies focusing on the applicability of technical trading rules on individual stocks trading. In this study we apply the technical trading rule of moving averages on individual stocks listed in Pakistan Stock Exchange (PSX); we find positive MAP returns for low volatility stocks while positive results disappear for high volatility stocks. These results are consistent with previous studies including a study by Eljelly (2004), who found a

significant negative relationship between the firm's profitability and its liquidity level, as measured by the current ratio. Chang, Chan, and Chiang (2014), conducted a study of individual stocks in an emerging market, and found a tradeoff between liquidity and profitability of variable moving average stock returns; correspondingly we report a parabolic relationship between volatility and stock returns. Difference between moving average and buy and hold returns (MAPs) show positive returns for first three quintiles ranging from 4.53% to 6.73%, whereas last two quintiles show an extreme decrease in MAP returns ranging between -8.18% to -163.33%. Average success ratios of 39.4% for MAPs provide considerable evidence to conclude that MA timing strategy is not applicable to individual stock trading. Risk-adjusted returns also show comparable results as of raw returns with high R-Square values of 44% on average across quintiles implying the strength of the model and the accuracy of results.

We also report MAP return for alternate lag lengths and end up getting the same result pattern across quintiles as of 10-day moving averages. MAP returns diminish till MA 50-day lag length as compared to 20-day lag returns then returns show an increasing pattern for MA 100 and 200-day lag lengths. We report positive BETCs for first three quintiles and negative BETCs for last two quintiles across all lag lengths. Thus, the negative BETC values for higher volatility stocks support our claim of MA timing strategy being unsuccessful in predicting market prices for individual stocks listed at PSX.

The rest of the paper is organized as follows: next section summarizes the literature of technical analysis mainly in currency market, proceeding section provides outline of methodology used in the study, empirical analysis of results, robustness of results for MA timing strategy and conclusion to the discussion on MA timing strategy results are given in the subsequent sections.

LITERATURE REVIEW

Technical analysis literature provides very in-depth analysis on a stock index and portfolio profitability but the profitability of technical trading rules for individual stocks have not been studied at length in technical analysis literature. Chang et al. (2014), studied the profitability of simple technical trading rule of variable moving averages (VMA) using individual stock data from the Taiwan Stock Exchange (TWSE). This study used trading volume as a proxy for stock liquidity and observed that by and large

VMAs do better than buy and hold strategy; additionally, they found out a decreasing trend in profits of VMAs with increasing trading volume for shares showing a tradeoff between stock liquidity and profitability of VMAs.

Due to the fact that currency market literature considers the profitability of technical trading rules for individual currencies; we use currency market technical analysis literature for individual stocks. McKenzie (2007), using simple technical rules variable length moving averages, fixed length moving averages and trade range breakout, studied seventeen emerging markets for the profitability of technical trading rules and found market conditions and trading volume information can be used to earn higher returns than the market. Currency investments in emerging economies provide up to 20% annual return in the presence of 5% annual cost and trading rules are consistent over time (Chong & Ip, 2009). Many researchers, (Chang et al., 2014; Fernández-Pérez, Fernández-Rodríguez, & Sosvilla-Rivero, 2012), found a higher return for technical trading rules over buy and hold strategy for 25 currencies out of 39 in the presence of transaction cost, and they conclude market inefficiency as being the reason for the success of technical trading rules in predicting the market. Tajaddini and Crack (2012), report profitability of long and short momentum strategies to be 1 and 3 % after considering the real transaction cost; they also indicate the decrease in profit for the last 5 years in the sample period. Coakley, Marzano, and Nankervis (2016), studied 22 currencies quoted in US dollar over a period of 1996 to 2015. They found simple trading rules including moving averages and complex trading rules like Bollinger bands and relative strength index as profitable. However, after robustness test for data snooping bias, only complex trading rules like relative strength index and Bollinger band were found profitable, especially in last decade of the sample period from 2006-2015, indicating an increase in the market efficiency. Similarly, Fernández-Rodríguez, Sosvilla-Rivero, and Andrada-Felix (2003), compared the returns transformed by using nearest neighbor non-linear predictors with moving average and found that later provide less profitable results in the presence of transaction cost and interest rate.

From the technical trading rules literature of currency market, it is pertinent to conclude that foreign exchange markets have become more efficient over time making it difficult to do better than market using simple trading rules (Arthur, 2018; Katusiime, Shamsuddin, & Agbola, 2015). However, it is found that complex and more advanced trading rules still

provide substantial profits. Relating stock market performance in the emerging economies and stock trading, strong reliability on the Pakistan stock market has been seen recently. According to Khan, Khan, and Ahmed (2017), as the local and international investors are now coming back to Pakistan, the Pakistan Stock Exchange will thrive and soon protrude in the emerging stock markets. Thus, this study signifies an important topic for understanding the stock market behavior and predictability trends.

RESEARCH QUESTION

Through the extensive review of the available literature on the moving average technical trading rules and a thorough study of the trends and behavior of the Pakistan Stock Exchange, this research study intends to inquire upon the following research question:

- How does the application of Moving Average technical trading rules provide better analysis and insight for the Pakistan Stock Exchange?

DATA AND RESEARCH METHODOLOGY

This study is an extension of our previous study, 'Profitability of the Moving Averages Technical Trading Rules in an Emerging Stock Market: A Study of Pakistan Stock Exchange'**.** We take data for the period starting from 30th Dec 2005 to 31st Dec 2015 using DataStream; data consists of four data series namely; i) individual stock prices of 271 stocks for sample period, ii) market index prices of 2,610 trading days, iii) 30-day Treasury bill rates for sample period, and iv) daily dates for sample period. Furthermore, R program's statistical computing module is use for data analysis.

Moving Average (MA) timing strategy is applied to find individual stock returns and examine whether MA timing strategy is successful in producing a higher return than buy and hold strategy for individual stock returns. First, we calculated the daily returns and annualized standard deviation for each individual stock. There we put a filter for a stock return greater than 300% and a standard deviation of 0%. We calculated 10-day MA returns for each stock applying a filter for infinite values. Now we calculated MAP returns for individual stocks using 10-day MA returns and buy and hold returns based on the buy signals. After calculating the MAP returns, five quintiles based on individual stock standard deviation were created. After portfolios were formed, three different returns namely i) buy and hold strategy returns, ii) MA timing strategy returns and iii) MAP returns for each portfolio formed in the previous step, were calculated.

Additionally, standard deviation, T-stat, Skewness, and Sharp ratio for each portfolio across different returns isalso calculated. The results produced Table 1 that is used for analyzing the excess returns of MA timing strategy over buy and hold strategy. After analyzing the profitability of MAP raw returns, CAPM to MAPs returns is applied to calculate risk-adjusted returns and the profitability of MAP risk-adjusted returns is thus analyzed in Table 2.

For analyzing the robustness of our results, two methods are used; i) Alternate lag Lengths and ii) Break Even Transaction Cost (BETC). We calculated alternate lag lengths of 20, 50,100 and 200 days to analyze the effect of lag length on the profitability of MA timing strategy returns; this effect is analyzed in Table 3; with an added analysis of random switching strategy. Finally, in Table 4, holding periods, trading frequency and BETC are calculated to analyze the efficiency of MA timing strategy in the presence of transaction cost.

EMPIRICAL ANALYSIS AND RESULTS

The raw and risk-adjusted return of MA timing portfolios in Table 1 and 2 are reported respectively. All the tables are given in the Appendix. Table 1 presents the average returns on individual stocks, returns on MA (10) strategy and the parallel MAPs categorized into five groups by an increasing function of individual stock volatility. The analysis is performed on individual stocks and grouped on the basis of individual stock volatility. Skewness and Sharpe ratio are used to compare and interpret the results.

Panel A in Table 1 shows the average returns and basic characteristics of the buy-and-hold strategy for the quintile individual stock. The annual average returns vary from the lowest, 14.45% to the highest, 92.69%. There is a significant increase in return from the fourth quintile to the highest volatility quintile. For the buy-and-hold strategy, the difference between the highest and the lowest quintile is average 78.24% per year which is highly significant. The skewness in panel A displays negative numbers except for the highest volatility portfolio. The range of skewness is from -0.33 to 0.28. Furthermore, the Sharpe ratio states the average return in excess of the risk-free rate per unit of total risk. Panel A clearly show that all Sharpe ratios are significant especially the highest quintile with a Sharpe ratio of 2.71. There is no significant difference between the results of the portfolio approach and individual stock approach.

Parallel to panel A, panel B represents the results of 10 days MA strategy on the individual stock basis. Differ to the results in panel A and 10-day MA strategy of the portfolio approach, the returns on MA timing strategy of individual stocks increase through the first 3 quintiles and decrease through the last 2 quintiles. Compared to the portfolio approach, the MA returns on first 3 quintiles are still higher than the returns in panel A but lower than the MA returns of portfolio approach. For example, for the lowest quintile, the return is 18.98% which is higher than 14.45% in panel A and lower than the MA return on portfolio approach which is 18.98% versus 21.75%. The decrease from the third quintile to the highest quintile is significant. Especially the MA return of the highest quintile highly differ to the MA return of portfolio approach, -70.64% versus 86.66%. Hence, the MA timing strategy is not working well on an individual stock basis for highly volatile stocks. Furthermore, the MA timing quintiles display a similar scale but all positive skewness across the volatility quintile. The results of Sharpe ratio for MA timing quintiles are much higher than for the buy-and-hold quintiles except the highest quintile with a Sharpe ratio of -4.44%.

Panel C reports the results for MAPs which explains the profitability of MA timing strategy over buy and hold strategy. Differ to the portfolio approach, the results in panel C are not significant across 1 to 4 quintiles, ranging from -8.18% to 6.73%. The MAP returns on the fourth quintile and the highest quintile are both negative. MAP return of -167.86% for the highest quintile again shows the MA strategy is not working well on high volatile individual stocks. Similarly, to portfolio approach, the skewness in panel C is large and positive except the highest volatility quintile. The success ratios are all below 50% and with average 39% across the quintiles. Thus, the MA strategy is unlikely to be successful in individual stock estimation.

Overall, the MA strategy is not successful in producing consistently high returns to beat buy and hold strategy for individual stocks. For low volatility level, the MA timing strategy still slightly outperforms the buy-and-hold strategy. However, for high volatility level, the MA strategy underperforms then buy-and-hold strategy. Moreover, high t-statistic values of all returns in Table 1 show the results are highly statistically significant. Low success ratios expose MA strategy is not likely to success across all quintiles.

Table 2 presents the results of alphas, betas and adjusted R-square by computing CAPM regression based on 10-day MAPs. The changes of alpha by

increasing volatility follow the same pattern as returns on 10-day MA strategy through all quintiles. The alphas increase across the first three quintiles and decrease after. Compared to portfolio approach, the alphas are positive and relatively small across the first three quintiles, ranging from 5.62 to 8.82; the alphas of the fourth quintile and the highest quintile are negative and significantly less than that for portfolio approach, -5.44 versus 20.30 and -160.69 versus -10.33 respectively. The negative alphas are due to underperformed MA strategy for high volatile category individual stocks. As the result, the alpha between the highest and lowest quintile is considered negative. Most t-statistic values are either greater than 2 or less than -2 except the fourth quintile (-1.67) which shows that most values are statistically significant.

Compared to the portfolio approach, the individual stock approach has substantially similar and slightly larger market betas. There is a downward trend through the first 4 quintiles which from -0.22 to -0.55 and a slight rise for the highest quintile (-0.53). Negative betas present that increase in the market risk premium gives a negative impact on the MAPs and investors are likely to invest in risk-free rather than invest in the stock market.

The results of adjusted R-squares show the confidence that the performance of the model can be explained by the variables. Compared with the portfolio approach, adjusted R-squares for the individual stock are substantially similar or larger. This presents the CAMP model can explain more of the result under individual stock approach than that under the portfolio approach. An average 43.39% adjusted R-square across quintiles shows that 43.39% of the results can be explained by the risk exposure as measured by beta. As same as portfolio approach, the adjusted r square of the highest volatility quintile is also low (18.26%).

Robustness of the Results

The robustness of the MA timing strategy's profitability for the individual stocks listed on PSX is discussed in the following segment, considering alternative lag lengths, with the objective of scrutinizing MA timing strategy and BETC estimation.

Alternate Moving Averages Lag Lengths

Table 3 shows the profitability of individual stock quintiles applying 20-, 50-, 100- and 200- day moving averages. It is clear that the results are like the 10-day moving average timing strategy i.e.; the average returns, as well as the CAPM alphas, are negative. Table 3 reports decrease in average returns and CAPM alphas of individual stocks with an increase in lag lengths. For example, the average

individual return for the lowest quintile for the 20-day lag is 6.59% while it is 5.02% for the same quintile for 200-day lag. Random switching strategy results are shown in the last column of Table 3. This strategy switches, by random chance between the buy and hold and risk-free T-bills. It generates negative results along the quintiles with -3.40% being the lowest quintile's annualized average return while -42.65% is the annualized average return of the highest quintile.

Predominantly, it can be summarized that the Buy and Hold strategy outperforms the Moving Average timing strategy of quintile individual stock for high volatile portfolios. This is one the striking feature of individual stock analysis. This feature is mainly due to the presence of higher noise in individual stocks in comparison with that of the portfolio.

Average Holding Period, Trading Frequency and Break-Even Transaction Cost (BETC)

The result in Table 4 reports average holding periods, trading frequency and break-even trading cost (BETC) across different lag lengths of moving average strategy based on individual stocks. It is clearly shown that for same level volatility, the holding days increase as the lag length increase. For instance, the holding days of the lowest quintile are 37.88, 50.37, 77.85, 98.33 and 154.39 respectively from 10-day MA to 200-day MA clearly showing an increasing trend. In contrast to portfolio approach, individual stock approach mostly has longer holding period each corresponding lag length and volatility. The only outlier 121.81 for portfolio approach is less than 165.30 positions in 2nd volatility with a lag length of 200 which is ignorable.

The trading frequency results can be directly reflected on the lengths of holding days. For the same lag length, the more days the stocks are held, the less frequent the stocks are traded. The trading frequency of 10-day MA is about 5% of the total days and 200-days MA is about 0.9% of the total days. The reason is that there is an increasing function of holding days by increase the lag length, so on average, the results for trading frequency are smaller as the lag length increase. For the same reason, the results of trading frequency are less for the corresponding volatility level and lag length compared to the portfolio approach.

There are two factors that influence the result of BETC, the return on MA and the number of trading days. As the number of trading days cannot be negative, negative MAs cause the negative BETCs. BETC shows the breakeven point that the profit can cover the transaction cost. In Table 4, most results of BETCs are negative and negative values present the MA strategy is not profitable taking transaction costs into account compared

to buy and hold strategy. Roughly saying that the scale of BETCs increase as the lag length increase and the volatility increase. For positive BETCs, most of them are exceedingly small and the meaningful results for 200-day MAI are due to less trading frequency. Hence, there is no incentive to use the MA strategy for investing in groups of individual stocks.

CONCLUSION

In this study, MA timing strategy is applied on individual stock returns of stock listed in PSX. We found inconclusive evidence to report profitability of MA timing strategy. As compared to its predictive ability for volatility sorted portfolios, MA timing strategy shows a weak predictive ability for individual stocks and consequently fails to earn consistent higher returns over buy and hold strategy. Results of our study are consistent with (Chang, Jong, & Wang, 2017; Coakley et al., 2016; Fernández-Rodríguez et al., 2003), findings of moving averages' predictive ability in currency markets.

Based on our finding we can conclude that; the individual stock returns are noisier than portfolio stock returns. Our finding can be used to further investigate the efficiency of more complex technical trading rules in predicting stock returns.

Appendix

Table 1. Profitability of Individual Stocks

	Panel A. *Volatility Quintile individual stocks*				***Panel B.*** *MA (10) Timing individual stocks*				***Panel C.*** *MAPi*			
Rank	Avg Ret	Std Dev	Skew	S. Ratio	Avg Ret	Std Dev	Skew	S. Ratio	Avg Ret	Std Dev	Skew	Success
Low	14.45 (4.28)	10.12	-0.33	0.68	18.98 (11.37)	5.01	0.32	2.29	4.53 (1.84)	7.38	0.42	0.43
2	15.22 (3.35)	13.64	-0.48	0.56	21.95 (9.83)	6.70	0.27	2.15	6.73 (2.10)	9.59	0.60	0.42
3	23.07 (4.29)	16.14	-0.49	0.96	29.65 (11.25)	7.91	0.30	2.80	6.58 (1.76)	11.21	0.78	0.40
4	25.32 (3.69)	20.56	-0.37	0.87	17.14 (4.99)	10.29	0.58	0.93	-8.18 (-1.71)	14.35	0.75	0.41
High	92.69 (8.84)	31.46	0.28	2.71	-70.64 (-12.02)	17.62	0.79	-4.44	-163.33 (-20.7)	23.68	-0.27	0.31
High-Low	78.24 (8.06)	29.11	0.67	2.43	-89.63 (-15.86)	16.96	0.80	-5.73	-167.86 (-22.50)	22.37	5.24	0.27

Note: Table 1 describes the essential qualities of the returns on the decile individual stocks, the returns on the MA timing (10) portfolios, and the returns on the comparing MAPs, MAP jt10. Panel A and B show buy-and-hold strategy and MA timing individual stocks respectively, covering the five volatility quintiles that include the average return, the standard deviation, the skewness, and the sharp ratios. Moreover, Panel C presents the difference between MA timing individual stock returns and buy and hold individuals stock returns and Success Rates of the MAPs.

Table 2. CAPM

Rank	Panel A. CAPM		
	A	βMKT	Adj.R2 (%)
Low	5.62 (2.77)	-0.22 (-33.30)	32.15
2	8.57 (3.96)	-0.37 (-52.72)	54.30
3	8.82 (3.67)	-0.45 (-57.50)	58.57
4	-5.44 (-1.67)	-0.55 (-52.06)	53.68
High	-160.69 (-22.51)	-0.53 (-22.88)	18.26
High - Low	-166.31 (-23.12)	-0.31 (-13.31)	7.01

Note: Table 2 explains the annual alphas, the market betas, and adjusted r squares across the volatility quintiles based on the daily CAPM regressions of 10-day MAPS. The alphas are annualized and in percentage.

Table 3. Alternate Moving Averages Lag Lengths

Rank	MAPi (20)		MAPi (50)		MAPi (100)		MAPi (200)		Random Switching	
	Avg Ret	CAPM α	Avg Ret	CAPM α	Avg Ret	CAPM α	Avg Ret	CAPM α	Avg Ret	CAPM α
Low	6.59 (2.72)	7.50 (3.75)	4.83 (2.08)	5.65 (2.94)	5.04 (2.32)	5.70 (3.13)	5.02 (2.55)	5.42 (3.28)	-3.40 (-2.02)	-2.50 (-2.03)
2	6.68 (2.09)	8.25 (3.81)	5.35 (2.71)	6.79 (3.23)	5.71 (1.88)	6.90 (3.34)	6.64 (2.21)	7.46 (3.69)	-3.75 (-1.65)	-2.30 (-1.73)
3	6.75 (1.80)	8.65 (3.58)	4.11 (1.11)	5.86 (2.43)	2.56 (0.70)	4.05 (1.70)	4.83 (1.27)	5.92 (2.45)	-7.67 (-2.85)	-5.93 (-3.91)
4	-7.30 (-1.50)	-4.93 (-1.50)	-5.48 (-1.12)	-3.26 (-0.97)	-4.50 (-0.90)	-2.58 (-0.74)	-4.55 (-0.87)	-3.15 (-0.87)	-8.91 (-2.60)	-6.84 (-3.12)
High	-158.03 (-19.83)	-155.77 (-21.61)	-143.36 (-17.64)	-141.17 (-19.25)	-130.78 (-15.64)	-128.92 (-16.98)	-116.46 (-13.26)	-115.06 (-14.49)	-42.65 (-8.14)	-40.68 (-8.85)
High-Low	-164.62 (-21.76)	-163.27 (-22.40)	-148.19 (-19.17)	-146.82 (-19.80)	-135.84 (-16.86)	-134.61 (-17.44)	-121.48 (-14.35)	-120.48 (-15.00)	-39.25 (-8.09)	-38.18 (-8.19)

Note: Table 3 shows the average returns (Avg Ret) and the CAPM alphas (CAPM □) of Moving Average Individual stocks (MAIs) with alternate lag length 20-, 50-, 100- and 200-days. We also provide the average returns of the Random switching. The results are annualized and in percentages.

Table 4. Trading Frequency and BETC

Rank	MAI (10)			MAI (20)			MAI (50)			MAI (100)			MAI (200)		
	Hold Per	Trad Freq	BETC	Hold	Trad Freq	BETC	Hold Per	Trad Freq	BETC	Hold Per	Trad Freq	BETC	Hold Per	Trad Freq	BETC
Low	37.88	4.87	3.49	50.57	3.23	30.38	77.85	1.83	52.15	98.33	1.29	59.40	154.39	0.83	108.98
2	18.50	5.66	27.18	27.58	3.83	41.19	46.11	2.27	58.12	73.66	1.43	19.19	121.81	0.88	56.70
3	27.31	5.07	9.35	39.88	3.30	2.38	74.34	1.92	25.95	101.56	1.33	42.47	152.81	0.89	143.91
4	39.38	5.03	-0.30	56.06	3.47	-6.76	78.64	2.12	-28.36	124.42	1.37	-67	153.40	0.99	-41.12
High	24.59	5.43	-659.86	34.37	3.90	-857.00	58.47	2.46	-1163.10	77.10	1.83	-1467.14	111.46	1.31	-1820.40

Note: Table 4 reports the evaluated average holding period (Hold: Per), the trading frequency calculated as the trading fraction of trading days (Trading) and the break-even transaction costs (BETX) in basis points of MAIs with alternate lag lengths 10, 20, 50,100 and 200 respectively.

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