

“KSE: a look at sub-variants of price momentum strategy”

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KSE: a look at sub-variants of price momentum strategy

Abstract

The objective of this paper is to examine the impacts and profitability in great detail of sub-variants of price momentum strategies on Karachi Stock Exchange (KSE) which is an emerging stock market. The sub-variants are price momentum strategies, trading volume based momentum strategies and weekly momentum strategies. It is found out that KSE is an emerging stock market which is fully integrated with existing financial global system and offers positive returns. It is also found out that price momentum strategies give positive above average statistically significant returns. Trading volume based momentum strategies and weekly momentum strategies with shorter time period give average or below average return. Though most of weekly and trading volume momentum strategies are profitable but they should be used in combination with price momentum strategies and should have shortest formation period. Future research should focus on intraday trading volume and emerging stock markets.

Keywords: Karachi Stock Exchange, KSE-100 index, w-1 portfolios, price momentum investment strategy, trading volume based momentum strategies, weekly price momentum strategies.

JEL Classification: G15.

Introduction

Although short-term momentum effect has been found in almost all the developed stock markets of the world yet its very existence and magnitude of profits are questionable and debatable for emerging markets. There are authors who claim that short-term momentum effect has been found in emerging market but it is very weak. For instance Swinkles, De Groot and Pang (2010) investigated frontier markets for momentum strategies and found that country momentum was positive but it was weaker too. Similarly Griffin, Ji and Martin (2005) also claimed that short-term momentum effect was weak in Asian stock markets. It is of prime importance to investigate short-term effect in great detail for an emerging market to remove the confusion about the issues mentioned above. Because, momentum investment strategies have many variants or version and each variant gives astonishing results which need to be carefully understood, analyzed and interpreted. The important short-term momentum strategies are price momentum strategies, value momentum strategies and style momentum strategies and there are different set of strategies within these strategies. In this part, price momentum strategies and their variant strategies will be implemented, analyzed and interpreted in detail to examine short-term momentum effect for an emerging stock market. According to Jegadeesh and Titman (1993), short-term momentum effect lasts for 3 to 12 months. Historical prices contain useful information and proponents of short-term momentum effect have used historical prices' data to develop and implement price momentum strategies. It is clear from the previous studies that many authors have tried different combination of price momentum strategies to analyze the returns

and found that, with different formation or holding periods, several price momentum strategies give different returns. It means that it is of extreme importance to implement price momentum strategies with different time periods because different rolling portfolios will perform differently and give different returns. Therefore, it is important to examine which strategy results in positive return in order to have the idea of which strategy should be used at what time to maximize the value of the investor's portfolio. Just like historical prices of stocks, past data of trading volume also contains useful and important information and it has been used previously in combination with momentum strategies to predict future returns. This activity falls under the category of technical analysis because it uses previous information to forecast future returns. There is a very strong support which can be found among the relationship of momentum effect, stock prices and trading volume. But very few authors in financial literature have used trading volume and momentum strategies to determine future returns. For instance Lee and Swaminathan (2000) examined the relationship between short-term momentum effect and trading volume using stock market of US. Nagel (2000) has also mentioned that trading volume has not enough roles to predict future returns for longer time period. Similarly Chui, Titman and Wei (2000) claimed that momentum profits were higher where turnover ratios were higher whereas countries with low turnover ratios results were failed to display momentum profits (Hameed and Yuanto, 2000). Chui, Titman and Wei (2000) and Hameed and Yuanto (2000) examined eight and six Asian stock markets respectively. Chan, Hameed and Tong (2000) found an increase in trading volume followed by an increase momentum profits. Zuchel (2001) came up with a theoretical model in which similar investors were linked to momentum and

trading volume. Glaser and Weber (2001) have also studied the relationship of stock prices and trading volume in the context of short-term momentum effect for German stock market. Many research authors believe that past trading volume contains valuable information but a few papers have been found in this regard. Therefore it is of utmost importance to examine the relationship of short-term momentum effect and trading volume for an emerging stock market using price momentum strategies based on trading volume to analyze the momentum phenomenon in detail. Weekly momentum investment strategies are also one of the variants of price momentum strategies. It is also essential to see how short-term momentum effect will result in shortest possible run. Weekly momentum strategies are attractive to investors yet very little work has been done in this regard. Recently Pang, Tang and Xu (2013) used weekly momentum strategies for Asian stock markets including Chinese stock market and found that weekly momentum existed for a year and weekly momentum strategies were profitable in first few weeks. The price momentum strategies have three important sub-variants. They are stock price momentum strategies, momentum strategies based on trading volume and weekly momentum strategies. All these strategies have never been implemented and analyzed in detail for an emerging stock market. Many authors are of the view that short-term momentum effect is weak in emerging stock markets particularly in Asian stock markets (Rouwenhorst, 1999; Griffin et al., 2003; Chui et al., 2010). Short-term momentum effect is an established phenomenon for developed stock markets but it keeps giving different statements when it comes to emerging stock market. Therefore an out of sample data is required to thoroughly and comprehensively examine the short-term momentum effect. An insight into short-term momentum effect for emerging markets will help to understand momentum phenomenon and bring uniformity and harmony in the gap that exists between developed and developing stock markets. Therefore the aim of this study is to implement, analyze and interpret the variants of price momentum strategies for an emerging stock market to examine if there is a gap in developed and emerging stock markets on the characteristics of momentum effect. The emerging stock market which has been chosen in this regard is "Karachi Stock Market" and the index is "KSE-100" index. Though little work is done on this stock market in the context of momentum phenomenon but short-term momentum effect has been found in Karachi Stock Exchange by many authors, for instance, Griffin, Ji and Martine (2005) and Ejaz and Polak (2013). But this stock market has always been under examination with other

developed and emerging markets. Griffin, Ji and Martin (2005) and Ejaz and Polak (2013) have examined Karachi stock market with 38 and 13 stock markets respectively. Therefore it presents out of sample and untapped data because price momentum strategies and its variants have never been implemented fully on this stock market. Since, each variant results in different profits, so it will be interesting to examine this emerging financial market under different variants. It will also be significant and important to analyze and interpret the results from different variants of price momentum strategies.

1. Literature review

Glaser and Weber (2002) conducted a study on German stock market to study the relationship between short-term momentum effect and trading volume. This relationship came out as relationship between momentum investment strategies and turnover. Turnover in terms of trading volume has been defined by the authors as number of shares traded to total number of shares outstanding. They also want to use the results to explain momentum phenomenon. They were of the view that in recent time, interaction of momentum phenomenon and trading volume has become a great interest to many researchers. They also believed that much work has been on momentum and it has been documented by many researchers that momentum investment strategy results in significant returns almost in every stock market of the globe. They argue that technical analysts believe that historical prices and trading volume contain too much information for future price predictions and therefore they utilize them quite often and there is ample amount of literature written in this regard. They did a study on one of the largest stock market of Europe, where the functioning of the institutions was totally different, to examine the relationship of between the two. They wrote that they took the analysis of Lee and Swaminathan (2000) to a different level by giving evidence on book-to-market ratio, size, and returns altered for industry and other verification on the results. They argued that above factors are useful to seek authentic explanation over the momentum and differentiate the useless information because, in their opinion, presence of momentum effect is established but there is great disagreement over the understanding of it. They further wrote that Conrad and Kaul (1998) found that momentum investors buy high average stocks and sell low average stocks and future returns are constant over a time period. The authors associated such difference of variations across stocks with risk. But authors argued that all such research papers have not included trading volume or turnover but recently this topic has been touched by many researchers and ample amount of

work has been in this regard both empirically and theoretically. They wrote that Lee and Swaminathan (2000) included stock turnover in their study on US stock market and found that momentum results are powerful for the stocks which have large turnover and, over longer time period, trading volume can be used to forecast the enormity and perseverance of returns earned by momentum investment strategy. But they also presented the contrary view of Nagel (2001) who found through his paper that trading volume turnover does not play any essential role in forecasting future returns of momentum investment strategy and he argued that turnover is more useful with book-to-market ratio. The authors argue that Chui, Titman and Wei (2000) conducted a study on eight stock markets of Asia and found that in five stock markets stock which has huge trading volume resulted in high momentum profits. When Country impartial strategy was implemented, it was found that lower trading volume stocks returns were five time lower than higher trading volume stocks returns. Hameed and Yuanto (2001) also conducted a study on six Asian countries and found that low trading volume stocks' have not shown momentum and only two stock markets in total showed momentum investment profits resulted after pursuing momentum investment strategy of stock with higher trading volume. They also argued that Chan, Hameed and Tong (2000) found that higher trading volume resulted in powerful momentum effect. The authors used Frankfurt stock exchange for the study and used 446 firms listed on the stock market. They found that their results were in line with the existing empirical and theoretical findings. They also found that huge turnover stocks resulted in powerful momentum returns. And, trading volume momentum strategy can be associated with winners and this finding went against the finding of Lee and Swaminathan (2000), as claimed by the authors. They claimed that their research paper is the first study that studied the relationship between trading volume and share prices in the context of German stock market. August, Schiereck, and Weber (2000) and Schiereck, De Bondt, and Weber (1999) also did their studies on German stock market but the time period was not latest and the sample was small. Their study was different because their time period was more present and they studied relatively large sample. They wrote, up to some degree, book to market ratio and industry factors are responsible for profits of momentum investment strategy.

Agathe (2012) studied short-term momentum effect in the context of Mauritius stock market by writing a paper "Momentum Strategies on the Stock Exchange of Mauritius". The purpose of the paper is to examine the existence of momentum effect in the stock market of Mauritius and how it affects the

investors at the stock market. Fama and French (1988) showed in their paper that future returns can be predicted in the long run whereas the research paper of Conrad and Kaul (1989) exhibited the future predictions of stocks for the short run. Author argued that momentum phenomenon is the one that puts question on EMH. Author viewed momentum strategy as the simple trading strategy and wrote that in momentum strategy investor buys winners and sells loser and by doing this they earn positive abnormal returns. The author further wrote that many research papers have been written to examine the momentum effect and its source of profitability. According to author, there are three main explanations that have come to define the source of momentum. First momentum is associated with the psychology of investors, second is the under reaction of investors to the new information and third is the variation of average returns of a single stock across stocks. Muga and Santamaria (2007) wrote that profits derived from momentum investment strategy in the stock markets of Latin America were found to be stronger than that of developed market. Cleary and Inglis (1998) examined the momentum strategy of Canadian stock market and found that momentum strategy is profitable in the stock market of Canada and it can be simply associated with the risk. It was found that momentum investment strategies were not persistent in the Mauritius stock market and they attributed this finding in line with the finding of Rouwenhorst (1999) and Mauritius stock market was classified as the emerging stock market by the author. The results derived by momentum strategies in Mauritius stock exchange were different than the results of momentum strategies conducted in stock markets of Europe and USA. The author argued that it is possible as the stock market of Mauritius is relatively less connected and integrated to the developed and established stock markets. As put by Harvey (1995), this low level of integration is due to the restriction on foreign investor to do investment in the local stock market of a country. The author concluded that momentum strategies were not able to earn significant returns in the Mauritius stock market and after controlling the various market factors. It was found that efficient market hypothesis existed for the stock market in Mauritius and momentum returns cannot be implemented consistently to beat the market.

2. Data and methodology

The stock market which has been chosen for the construction of price momentum strategies is Karachi Stock Exchange and the index is KSE 100. To construct price momentum strategies, monthly historical data of KSE 100 index have been downloaded from the DataStream for the period

starting from 1st February, 2009 and ending on 1st June, 2014. It is the data for the past 65 months. Those companies are selected which have the monthly price for the full sample period. Therefore there are total 88 companies included in the sample and 12 companies dropped due to low number of observations or no observations at all.

Prices have been converted to returns because prices are not unit free where returns are. Returns are good to use in constructing price momentum strategy because it brings uniformity in the data and provides an ease in the analysis while comparing momentum strategies of different periods. Following formula has been used to determine returns.

$$\text{Returns} = \frac{\text{Price}_t - \text{Price}_{t-1}}{\text{Price}_{t-1}} \times 100,$$

whereas Price_t = closing price; Price_{t-1} = opening price.

For the construction of price momentum strategies, the methodology of Jegadeesh and Titman (1993) has been adopted in this part. In this methodology, winners' and losers' rolling portfolios have been constructed after going through formation (j) and holding (k) period. It is important to mention that j equals to 3, 6, 9 and 12 months. Similarly holding period also equals to 3, 6, 9 and 12 months. To construct the rolling portfolios, all stocks listed on KSE-100 index are ranked in descending order based on their previous J month return. Therefore, each month will show four different individual portfolios depending on formation period j. Top 10 performing stocks will be chosen based on their returns' rankings and given the name of winner's portfolios or "winner" (w). To the contrary, bottom 10 performing stocks based on their returns' ranking will be selected and given the name of loser's portfolios or "loser" (l). Then, these portfolios are held for k months. Rolling portfolios have been constructed to increase the power of significance test and permit the use of simple t-statistics for monthly returns. So for a j3k3 strategy, for instance, a portfolio on 1st August 2009 will show the performance from May, 2009 to July, 2009 and it will be held till 31st of October 2009. Subsequently, next portfolio will be formed on 1st September, 2009 and will be held until 31st of December, 2009. So the portfolio's return will be the average monthly return of liquidation month and k-1 month. In a one single price momentum strategy, there will be winner portfolios, loser portfolios and winner minus loser portfolios (w-l hereafter) or momentum portfolios. "w-l" portfolios are formed by selling winner portfolios and buying loser portfolios or by going long in winner portfolios and selling short in loser portfolios. The returns of winner and loser portfolios

are used to get w-l returns in order to analyze the short-term momentum effect in KSE 100 index. Jegadeesh and Titman (1993), Griffin, Ji and Martin (2005) and Zoghalmi (2013) have also formed w-l portfolios to analyze the momentum phenomenon in stock markets in their respective papers. Total of 16 price momentum strategies will be calculated ($4j \times 4k$).

Winner portfolios, loser portfolios and w-l portfolios are also constructed based on trading volume. These strategies are known as momentum strategies based on trading volume. To examine the impact of trading volume based momentum strategies, trading volume for each stock and each formation period have been calculated. It is important to mention that trading volume is average daily turnover during the several formation periods whereas turnover is number of shares traded divided by total number of shares outstanding. Therefore, at the beginning of each month, all stocks, listed on KSE 100 index, are sorted based on their trading volume over the preceding jth month formation period. The stocks are further categorized into three different and distinct trading volume groups' i.e. high trading volume (Vh), medium trading volume (Vm) and low trading volume (Vl). It provides a good opportunity to analyze the impact of momentum on different sizes of trading volume across the several holding periods. Each group will have 16 price momentum trading volume based strategies. There will be total 48 price momentum strategies based on trading volume i.e. 16×3 volume groups (Vh, Vm and Vl). These strategies will expand the horizon of analysis and will enable to inspect the momentum effect from the trading volume perspective.

Weekly price momentum strategies have also been applied to examine the impact of momentum strategies on weekly prices of stocks. Winner portfolios, loser portfolios and w-l portfolios have been constructed based on weekly prices of stocks instead of monthly prices of stocks. The methodology for the construction of weekly portfolios is the same as the methodology for the construction of monthly portfolios. For instance, weekly prices are converted into returns then they are sorted in a descending order after the formation period (j). Winners and losers portfolios have been selected and held for k months. However, the formation and the holding periods are different than that of monthly returns. The formation and holding period are 3, 4, 5 and 10 and 3, 4, 5 and 10 respectively. It is important to mention that numbers written above show number of weeks for instance a j3k3 strategy will show that a portfolio has been formed on the basis of returns of 3 weeks and then it will be held for next three weeks. There will be 16 weekly price momentum strategies i.e. ($4j \times 4k$). And each price momentum strategy will have winner portfolios, loser portfolios and w-l portfolios.

In a nutshell, there are three different variants of price momentum strategies used to construct their respective portfolios to see the impact of momentum effect. These variants are price momentum strategies (monthly), momentum strategies based on trading volume and week price momentum strategies. There will be total 80 price momentum strategies: 16 for price momentum strategies (monthly), 48 for momentum strategies based on trading volume and 16 for weekly price momentum strategies.

3. Analysis

In this part of analysis, price momentum strategies will be analyzed. There are several things in price momentum strategies which are of utmost importance and need to be critically analyzed and interpreted. For instance it is important to observe that whether price momentum strategies are giving above average or abnormal positive returns, if yes, then are these returns statistically significant or not?

Similarly it will be seen if price momentum strategies behave traditionally or the given returns come in a non-traditional way. It is important to define the term “traditionally”. A traditional momentum strategy is the one in which an investor profits by taking long position in winner portfolio and going short in loser portfolio which will lead to the observation that KSE 100 index operates just like any developed stock market on the globe. If price momentum strategy behaves in a traditional way then it means that it is in line with the findings of previous authors. One major concern which may halt the foreign investor to invest in emerging stock markets like KSE is that whether KSE 100 index functions like any other stock market or simply put KSE fully integrated with the developed financial stock markets? Price momentum strategies can remove this concern if they behave in traditional way in KSE 100 index. Through the price momentum strategy the consistency, durability and longevity of profitability of KSE will be examined.

Table 1. Returns of price momentum strategy

| Formation period (j) | | Holding period (k) | | | | |
|----------------------|----|--------------------|-----------------|-----------------|-----------------|----------|
| | | 3 | 6 | 9 | 12 | |
| Winner | 3 | 15.37139 | 15.07141 | 14.81073 | 14.61831 | |
| Loser | | -6.68575 | -6.73746 | -6.83267 | -6.87516 | |
| Winner-Loser | | 22.05714 | 21.80887 | 21.64341 | 21.49346 | 21.75072 |
| (t-stat) | | 31.86004 | 39.19623 | 43.3667 | 41.99713 | |
| Winner | 6 | 11.71166 | 11.48437 | 11.26166 | 11.09714 | |
| Loser | | -4.13332 | -4.25629 | -4.33968 | -4.39236 | |
| Winner-Loser | | 15.84498 | 15.74066 | 15.60135 | 15.4895 | 15.66912 |
| (t-stat) | | 34.25736 | 36.54394 | 40.28691 | 45.23122 | |
| Winner | 9 | 10.05659 | 9.865997 | 9.703382 | 9.627738 | |
| Loser | | -3.26262 | -3.35645 | -3.4342 | -3.463 | |
| Winner-Loser | | 13.3192 | 13.22244 | 13.13759 | 13.09073 | 13.19249 |
| (t-stat) | | 38.10119 | 39.98394 | 42.76402 | 46.94101 | |
| Winner | 12 | 8.923217 | 8.76999 | 8.680649 | 8.553316 | |
| Loser | | -2.76556 | -2.85927 | -2.91065 | -2.93627 | |
| Winner-Loser | | 11.68877 | 11.62926 | 11.5913 | 11.48958 | 11.59973 |
| (t-stat) | | 41.02779 | 42.01307 | 43.74029 | 40.27054 | |

Table 1 shows the returns of price momentum strategies. Horizontally, there is holding period (k) exhibited by 3, 6, 9 and 12 months whereas, vertically, there is formation period (j) denoted by 3, 6, 9 and 12 months. It exhibits the monthly average returns of 16 price momentum strategies for the period starting from 1st of February, 2009 and ending on 1st of June, 2014. There are 16 price momentum strategies comprising of combination of months mentioned above. A traditional price momentum strategy is a combination of a winner portfolio, loser portfolio and momentum or “w-l” portfolio. It is important to define “w-l” portfolio. A “w-l” portfolio is basically that portfolio or that same momentum strategy in which an investor goes long in winner portfolio and takes short position in loser portfolio or investor’s returns are increased by

selling the loser portfolio short. It is the corner stone of momentum strategy. A “w-l” portfolio is also known as “zero cost momentum portfolio” or “momentum portfolio”. Therefore, each price momentum strategy in the “Table 1: Returns of price momentum strategy” has winner portfolio, loser portfolio and “w-l” portfolio. For instance a j3k3 price momentum strategy has a winner, loser and w-l portfolios and same goes for the rest of 15 price momentum strategies.

It is mentioned earlier in this study that though short-term momentum effect has been found in KSE by Griffin, Ji and Martin (2005) but the objective of this study is to examine the profit results of 16 price momentum investment strategies and their capacity

to produce above average positive returns or abnormal returns in integration with KSE 100 index for the investors. All price momentum strategies are behaving just like any other traditional momentum strategy. All winner portfolios are giving positive returns whereas all loser portfolios are resulting in negative returns. All w-1 portfolios are giving positive returns too. It is quite evident from the Table 1 that all 16 momentum strategies are giving positive abnormal returns. All returns are statistically significant. These findings are in line with the findings of previous authors for instance Jegadeesh and Titman (1993) and Swinkles, De Groot and Pang (2010) who documented momentum profits in US stock market and frontier markets respectively. Above findings lead to an interpretation that all 16 price momentum strategies are profitable under different lengths in terms of months. The results are in line with the existing literature which means that investors' attitude towards investing decision is the same as any investor's attitude in any other developed or emerging market, similarly, the findings also suggest that KSE in general and KSE 100 index in particular operate in a way in which other global stock markets work. It is an encouraging finding for foreign investors who want to earn above average return. In a momentum investment strategy value of a portfolio is maximized by going short in loser portfolio. It is very clear from the results that an investor can take long position in a winner portfolio and selling stocks short in loser portfolio to earn above average return in order to maximize the wealth of portfolio. This is a hopeful and fruitful finding for investors who want to invest in emerging markets in general and in KSE in particular. The average return of all price momentum strategies is little over 15% which is quite high. One reason may be that KSE is an emerging market and all emerging markets are known to give abnormal returns and due to this reason foreign investors invest in bulk in thriving emerging stock markets. There may be several other reasons but one important reason might be the "catch-up effect". The chances of rapid growth in developed stock markets in US or in Europe are rare because they have already grown rapidly in the past and now in maturity phase. These stock markets are saturated and they have achieved the level of standardization, therefore, they can only offer average returns. Whereas, emerging stock markets like KSE are still in growth phase and there is an unprecedented room for growth, development and improvement which leads to tons of investment in such stock markets and due to such heavy investments these stock markets give abnormal returns. Offering abnormal return is the main characteristic of every emerging market and it is reaffirmed by the authors. For instance Swinkles, De Groot and Pang (2010) found abnormal returns

from momentum strategies in frontier and emerging markets. Most emerging economies are vulnerable to political situation or any crisis so are their stock markets. There is always an element of uncertainty or risk involved in emerging stock markets. There is also a saying in finance that "greater the risk, greater will be the return". Many investors might believe that one of main reasons of such huge abnormal returns is risk. But the element of risk behind abnormal returns from momentum strategies in emerging market has largely been rejected in many research studies. For instance Fama and French (1996) and Zoghalmi (2013) claimed that risk based model like Fama-French three-factor model and CAPM were not found behind the momentum profits. There are several authors who tried to explain reasons behind abnormal returns but there is no consensus and unanimity over the results. Therefore there may be several other reasons in the background of abnormal returns. This is the area which needs to be explored for emerging stock markets in general and KSE in particular and future research should focus on the reasons behind the abnormal and excessive momentum returns found emerging stock markets like KSE. It is pretty evident from the result of 16 momentum strategies that all price momentum strategies are statistically significant and giving positive abnormal and above average returns. However the highest abnormal returns are posted by j3 price momentum strategies. Among j3 price momentum strategies, the highest return is posted by j3k3 price momentum strategy which is 22% whereas returns for j6, j9 and j12 price momentum strategies went down relatively and drastically. For instance a j3k6 price momentum strategy is posting a 22% return but a j6k3 price momentum strategy is posting a return of 15.74% or 16% which is 6% lower than the return of j3k6 price momentum strategy. Similarly a j9k3 and j12k3 momentum strategies are documenting returns of 13.31% and 11.68% respectively. It is important to note the there is sharp decline of almost 6% in momentum profits from j3 momentum strategies to j6 momentum strategies but there is a gradual decrease of 2% and 2% from j6 to j9 price momentum strategies and j9 to j12 price momentum strategies. It leads to an important finding that short-term momentum effect lasts for 3 to 12 months and it reaffirms the findings of Jegadeesh and Titman (1993, 2001) who also documented the same about momentum but it is of utmost importance to note that in j12k12 price momentum strategy, the profits is the lowest which means that as the formation period and holding period get longer, momentum profits start to reduce. In other words one can write that the shorter the momentum period, the bigger will be the momentum profits and greater the

momentum period, the smaller the momentum profits. By looking at the results, it can be interpreted that momentum profits are abnormal in the start (j3 period), get normal and stabilized in the middle (j6 and j9 periods), tend to get low in the end (j12 period) but they may disappear after 12 months. In other words, momentum effect is strong initially in the stocks but as time period gets longer it tends to get weaker and disappear ultimately. This is exactly in line with the definition of short-term momentum effect which states that in short run, recent past losers remain the losers and recent past winners remain the winners (Jegadeesh and Titman, 1993). This short run period lasts from 3 to 12 months. But, within this short run period, j3 price momentum strategies are posting abnormal returns. So an investor should choose shorter period price momentum strategies to earn abnormal returns. It is quite evident now that price momentum strategies with shorter period are profitable than price momentum strategies of longer period. The lowest return posted by the longest period price momentum strategy. The longest time period price momentum strategy is j12k12 and its return is 11.48% which is the lowest return in the entire Table 1. Similarly all the returns posted by j12 price momentum strategies are lowest. Shortest time period is j3k3 and it is posting the highest return which is 22% whereas j3k12 strategy is also posting 4th highest return among 16 price momentum strategies which is 21.50%. So key to maximize the wealth of portfolio is to adopt the shortest momentum strategy in price momentum strategy family.

Though other price momentum strategies are also profitable and registering good above average returns but it depends on the trading priorities of the investors. For instance, young investors can take more risk because of their age, they may go for j3k3 price momentum strategy but middle age investors may like stable returns so they may go for j6k6 or j12k12 price momentum strategies. This is not at all a final observation about the investors. There are several other things other than age factor which can be accounted for when it comes to investing decision. From profitability view point, j3k3, j3k6, j3k9 and j3k12 are the most profitable price momentum strategies which are found in Table 1. An investor can earn positive abnormal returns of more than 20% by going long in winner portfolios and taking short position in loser portfolios. J6 price momentum strategies are also posting above average returns where as j9 and j12 price momentum strategies are posting 13% and 11.5% returns respectively. It is important to know that horizontally and vertically profits are decreasing. For instance, if one moves from j6k3 to j6k12, it will be found that price momentum strategies' profits are decreasing at a very slow rate. Similar

trend can be observed for j3, j9 and j12 price momentum strategies. It is important to know that rate of reduction in momentum profit is very slow horizontally. Vertically the trend of momentum profits is different. For Instance, from top to bottom the returns are decreasing drastically. At the top there is j3k3 and at the bottom there is j12k3 strategy and both are posting returns of 22% and 11.68% respectively. There is a sharp decline of almost 11% from top to down journey. The rate of reduction is huge vertically whereas it is negligible horizontally. So it is advisable to go for horizontal price momentum strategies i.e. j3k3, j3k6, j3k9 and j3k12 to earn huge return instead of going vertically i.e. j3k3 to j12k3 to earn stream of inconsistent and incoherent returns.

3.1. Trading volume momentum strategies. The Table 2 (please see in Appendix) shows the results of momentum strategies based on trading volume. As it is also mentioned in data and methodology section that trading volume momentum strategies have three categories i.e. high trading volume (Vh), medium trading volume (Vm) and low trading volume (Vl). Vh presents the momentum profits of winner portfolios, loser portfolios and w-l portfolios which have high trading volume whereas Vl tenders the results of winner portfolios, loser portfolios and w-l portfolios which have low trading volume and Vm presents the profits of momentum portfolios with medium trading volume. However Vh-Vl shows the difference between high trading volume and low trading volume portfolios. This "Table 2: Trading volume momentum strategies" gives 48 trading volume based momentum strategies. It is important to mention that each trading volume group has 16 momentum strategies. The "Table 2: Trading volume momentum strategies" shows that, out of 48 trading volume based momentum strategies, 41 momentum strategies based on trading volume are statistically significant. Out of 7 not statistically significant strategies, 4 belong to low trading volume group and 3 belong to medium volume group. The returns offered by trading volume momentum strategies are statistically significant but they are low. For instance the highest return is offered by j3k3Vm momentum strategy which is 2.28%. From the results, it is clear that Vh momentum strategies are posting high returns relatively to Vm and Vl momentum strategies. For example, j3k6Vh momentum strategy is posting a return of 2.106% where as j3k6Vm and j3k6Vl are posting returns of 2.07% and 0.07% respectively. This gives rise to the finding that in trading volume based momentum strategies higher return are directly related to higher trading volume. In other words, portfolios which are traded heavily on stock market will post higher returns.

It is quite clear from the Table 2 that all momentum strategies based on trading volume belong to Vh are statistically significant. J3Vh group are offering returns in between 2% to 2.1%. All j9Vh momentum strategies are giving less than 1% return whereas the group of j12Vh is giving returns which stay in the range of 1% to 1.70%. J6Vh group is offering a maximum return of 1.77%. But j3Vh momentum strategies are giving returns higher than j6Vh, j9Vh and j12Vh momentum strategies. The lowest returns are offered by j9Vh momentum strategies. For instance the highest return is posted by j3k12Vh momentum strategy which is 2.21% whereas the lowest return is posted by j9k12Vh momentum strategy which is 0.88%. It leads to an interpretation that as the period of the momentum strategy increases, the return offered by high trading volume group decreases at a slighter rate. It is quite evident from the returns of j3k3Vh and j12k12Vh momentum strategies. Because, j3k3Vh is giving a statistically significant return of 2.17% whereas j12k12Vh is posting a return of 1.07%. There is a smaller but sharp decline in the rate of return as time period increases. This finding suggests that time period should be considered while going for trading volume momentum strategies.

It is quite evident from Table 2 that trading volume momentum based strategies of Vm group are statistically significant except three strategies. J3Vh group is posting a return of 2% more or less and all returns are statistically significant. Although, returns of j6Vm group are also statistically significant, they are just under 1.40%. The trading volume momentum based strategies belong to j6 Vm group and offering returns of less than 0.70% but three of them are statistically significant. J12Vh group is also offering low returns which are just under 0.33% but two out of four strategies are not statistically significant. It is clear from the profits of Vm group that trading volume based momentum strategies are also sensitive to time period or they respond to time period. For instance, j3k3Vm momentum strategy is posting a return of 2.28% which is statistically significant whereas j12k12Vm momentum strategy is giving a return of 0.33% which is also significant statistically but the returns decline sharply. Although there is decline of approximately 2% in the returns which is relatively small but the time period of trading volume momentum based strategy should be given great attention. It is important to observe that returns of trading volume momentum strategies increases as time period decreases.

It is pretty obvious from the Table 2 that all trading volume based momentum strategies are statistically significant of low trading volume except 4 strategies.

Vl trading volume group represents the portfolios which have low trading volume or they are traded in smaller quantity in the stock market. It is quite obvious from the Table 2 that trading volume based momentum strategies of j6Vl group are statistically significant but they are posting returns of 0.50% which is relatively very low. Trading volume momentum based strategies belong to j9Vl group are posting returns little under 0.87% but all returns are statistically significant. J12Vl group strategies are giving returns of just under 0.82% and they all are statistically significant. It is quite clear from the Table 2 that trading volume based momentum strategies of j12 group are giving more returns than any other group of low trading volume i.e. Vl. For instance j12k6Vl momentum based trading volume strategy gives a return just under 0.70% whereas j6k12 gives a return of 0.48% and both returns are statistically significant. There is a small increase in return as time period increases. This gives way to the interpretation that, in low trading volume portfolios, profits of trading volume based momentum strategies increase as the time period increases and vice versa.

The results are quite interesting and surface some important findings. It is obvious from the Table 2 that though trading volume momentum strategies are profitable but they are not as profitable as price momentum strategies. They should be used beside price momentum strategies. They should be used as a mean of maximizing the overall value of the portfolio. Another interesting finding is time period. Time period is very important in trading volume based momentum strategies. It is quite clear from the Table 2 (Trading volume momentum strategies) that there is an opposite relationship between time period and high and medium trading volume portfolios. It means return of trading based momentum strategy increases as time period of same momentum strategy decreases but time period has direct relationship with low trading volume portfolios. Momentum profits tend to get low, weak and disappear as time period gets longer. Therefore, investor using momentum investment strategies based on trading volume should pay great attention to time period because trading volume based momentum strategies offer relatively lower returns than price momentum strategies and returns become fragile as time period of investment strategies tend to get longer.

3.2. Weekly momentum investment strategies.

As mentioned earlier, the third variant of momentum investment strategies is weekly price momentum strategies. In this variant of momentum investment strategy, time period tends to get shorter.

Table 3. Weekly momentum strategy

| Formation period (J) | | Holding period (k) | | | | |
|----------------------|----|--------------------|----------------|----------------|----------------|---------|
| | | 3 | 4 | 5 | 10 | |
| Winner | 3 | 6.57083 | 6.57535 | 6.57453 | 6.54618 | |
| Loser | | -3.9483 | -3.9287 | -3.9138 | -3.8742 | |
| Winner-Loser | | 10.5191 | 10.5041 | 10.4883 | 10.4204 | 10.483 |
| (t-stat) | | 51.8291 | 53.6894 | 55.4095 | 62.1467 | |
| Winner | 4 | 5.86881 | 5.87262 | 5.86929 | 5.84414 | |
| Loser | | -3.3387 | -3.324 | -3.3145 | -3.2866 | |
| Winner-Loser | | 9.20747 | 9.19661 | 9.18382 | 9.13078 | 9.17967 |
| (t-stat) | | 51.8569 | 53.2161 | 54.73 | 60.8074 | |
| Winner | 5 | 5.34605 | 5.34719 | 5.34433 | 5.31886 | |
| Loser | | -2.9178 | -2.9005 | -2.9013 | -2.8796 | |
| Winner-Loser | | 8.26388 | 8.24766 | 8.24559 | 8.19848 | 8.2389 |
| (t-stat) | | 51.063 | 51.4508 | 53.3679 | 59.0496 | |
| Winner | 10 | 3.96411 | 3.96074 | 3.95433 | 3.91523 | |
| Loser | | -1.1622 | -1.8687 | -1.8651 | -1.8536 | |
| Winner-Loser | | 5.12628 | 5.82941 | 5.81939 | 5.76886 | 5.63599 |
| (t-stat) | | 43.291 | 47.7688 | 48.6177 | 54.2257 | |

It is clear from the Table 3 that there are 16 weekly momentum investment strategies. Holding period (k) starts horizontally and denoted by 3, 4, 5 and 10 whereas formation period (j) goes from top to bottom and also presented by 3, 4, 5 and 10. It must be remembered that above mentioned numbers present number of weeks. First column of the Table 3 shows the portfolios name and columns 3 to 6 show the returns of the portfolio. It is obvious from the Table 3 that profits or returns from all 16 weekly momentum investment strategies are giving returns which are statistically significant. J3k3 weekly momentum investment strategy is posting a return of 10.51% which is statistically significant. The point of mentioning the return of this strategy is that j3 group is posting higher return than to its rival groups in general and j3k3 in particular. The total duration of j3k3 weekly momentum strategy is 6 weeks and the return is 10.51% whereas the duration of j10k3 strategy is 13 weeks and the return is 5.12%. The leads to a finding that time period plays an important role in weekly investment momentum strategy. Weekly momentum investment strategy with shorter time period is more profitable than weekly momentum investment strategy with longer time period. But j3k10 strategy is offering a return of 10.42% which is statistically significant. This gives an interesting insight. It is clearly evident from the Table 3 that j3k10 and j10k3 have same time period but the winner, loser and w-l portfolios of j3k10 strategy are giving 50% higher return than the winner, loser and w-l portfolios' of j10k3 weekly momentum strategy. It gives rise to the interpretation that, within the time period, formation period also plays its role in determining returns of a weekly momentum investment strategy. It gives further understanding that the shorter the formation

period, the higher the momentum profits and the higher the formation period, the lower the returns. It is clear from the Table 3 that returns of w-l portfolios tend to get low from top to bottom. The above findings or interpretations are also applicable for the rest of the strategies. For instance, j4k5 is offering a return of 9.18% whereas the j5k4 weekly strategy is giving a return of 8.24% and both returns are statistically significant. The common thing between the two strategies is the time period. Both strategies have 9 weeks duration still the return of j4k5 weekly momentum investment strategy is greater than the return of j5k4 weekly momentum investment strategy. One of the reasons is the duration of time period. The time period of forming portfolios of j4k5 momentum investment strategy is shorter than the formation period of j5k4 strategy. One important thing to observe is the length of the formation period can make return decline slowly or sharply. For instance, there is difference of less than 1% between the returns of j4k5 and j5k4 strategies which means that if the formation period increases by 1 week then the rate of decline in momentum return is very low. Now it is important to notice that the return of j10k4 strategy is 5.18%. There is a drop of exactly 4% between the returns of j4k5 and j10k4 weekly momentum investment strategies. This surfaces the finding that the length of formation period can catalyze the rate of decline in return. This trend is also observable throughout the Table 3. It is quite evident from the results of other strategies. For instance there is approximately a drop of 2.40% between the returns of j5k10 and j10k10 momentum strategies. Weekly momentum investment strategies are profitable and their returns are statistically significant. An investor can earn positive average return up to 10% by going long in

winner portfolios and taking short position in loser portfolios. But apart from the other factors, the time period should be given greater attention because weekly momentum investment strategies with shorter time period can give good positive return whereas weekly momentum strategies with longer time period can result in positive yet low returns. Therefore, investors should be vigilant about the time period. Apart from time period, they should also give more importance to formation period. Weekly momentum strategies with longer formation periods result in good positive returns. In general weekly momentum strategies are profitable and they post significant average return. Weekly momentum investment strategies provide an excellent opportunity to investors to maximize the wealth of their portfolios and to earn positive return by going long in winner portfolios and taking short position in loser portfolios.

Conclusion

There are many papers written in financial literature on short-term momentum effect. Several authors have implemented different momentum strategies for their papers to investigate this phenomenon. For instance, Jegadeesh and Titman (1993) used price momentum strategies to inspect short-term momentum effect. Over the period of two decades, various variants of momentum investment strategies have come up to the surface. Some of important variants are price momentum strategies, intraday trading momentum investment strategies, style momentum strategies, industry momentum strategies etc. There are also sub-variants of variant of each momentum strategy. For example, price momentum strategy has three variants i.e. price momentum investment strategies, trading volume based price momentum strategies and weekly momentum strategies. The motivation behind the paper is to bring the variants or sub-variants together in one study in order to understand or examine the performance of momentum investment strategies in detail. For this purpose, sub-variants of price momentum strategies have been chosen in this regard. The objective of this paper is to examine the impact of several sub-variants of price momentum

strategies on stock market. In previous papers, very few authors have come up with this type of idea. Most of the previous studies were focused on price momentum strategies or industry momentum strategies. This is the first paper of its kind that is bringing at least all the sub-variants of one type of momentum investment strategy under one roof to examine the impact on the stock market. The stock market which is chosen in this regard is Karachi Stock Exchange which is also known as emerging stock market among financial fraternity. The findings are interesting. First variant of momentum investment strategy is price momentum strategy. There are total 16 momentum investment strategies under this variant. All strategies are giving 15% of monthly average return. The results suggest that KSE-100 index is not an isolated stock market and it is very much integrated to existing global financial system. Short-term momentum strategy shows the same characteristics in KSE as it has shown in any other developed stock market. The results of sub-variant, which is price momentum investment strategies, suggest that KSE is growing at a staggering rate but it has not achieved its full potential yet. The trading based momentum strategies also offer decent return. There are total 48 trading volume based momentum investment strategies but 7 of them are not statistically significant. Other strategies do offer positive returns and can be used to maximize the value of the portfolio but they should be used with price momentum strategies. Weekly momentum strategies are also profitable and offer good average returns but formation period should be given more importance while implementing weekly momentum strategies. Weekly price momentum investment strategies with shorter time period are more profitable than weekly momentum investment strategies with longer time period. Karachi Stock Exchange is an emerging market and offers good returns for sub-variants of price momentum strategy. But there are several other variants and their sub-variants which are needed to be addressed. The focus of future research may shift to other variants particularly to intraday trading momentum strategy and emerging stock market.

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Appendix

Table 2. Trading volume momentum strategies

| | | k = 3 | | | | k = 6 | | | | k = 9 | | | | k = 12 | | | |
|-----|-----------|--------------|---------------|---------------|---------------|---------------|---------------|--------------|--------------|--------------|--------------|---------------|---------------|----------------|--------------|---------------|--------------|
| | | Vh | Vm | VI | Vh-VI | Vh | Vm | VI | Vh-VI | Vh | Vm | VI | Vh-VI | Vh | Vm | VI | Vh-VI |
| j3 | W | 4.6009 | 3.46553 | 1.87463 | 2.72626 | 4.39459 | 3.20842 | 1.7719 | 2.6227 | 4.2772 | 3.0038 | 1.6473 | 2.62987 | 4.236522 | 2.8592 | 1.5604 | 2.6761 |
| | L | 2.4212 | 1.18302 | 1.81544 | 0.60572 | 2.28834 | 1.12846 | 1.7014 | 0.587 | 2.1185 | 1.0283 | 1.59473 | 0.52376 | 2.016945 | 0.9463 | 1.50365 | 0.5133 |
| | W-L | 2.1797 | 2.28251 | 0.0592 | 2.12054 | 2.10625 | 2.07996 | 0.0705 | 2.0357 | 2.1587 | 1.9755 | 0.05257 | 2.10611 | 2.219577 | 1.9129 | 0.05674 | 2.1628 |
| | (t-stats) | 6.026 | 7.8235 | 0.3061 | 4.7175 | 8.356 | 10.2 | 0.47 | 6.103 | 10.15 | 12.98 | 0.4269 | 7.1147 | 11.6421 | 15.46 | 0.4963 | 7.071 |
| j6 | W | 3.9543 | 1.46717 | 2.29547 | 1.65884 | 3.82201 | 2.7301 | 2.1524 | 1.6696 | 3.7559 | 2.6573 | 2.01345 | 1.74243 | 3.703439 | 2.56 | 1.8913 | 1.8121 |
| | L | 2.3929 | 2.8596 | 1.78901 | 0.6039 | 2.20004 | 1.42071 | 1.6732 | 0.5269 | 2.0464 | 1.3741 | 1.58383 | 0.46256 | 1.926382 | 1.3029 | 1.50611 | 0.4203 |
| | W-L | 1.5614 | 1.39243 | 0.50646 | 1.05494 | 1.62197 | 1.30939 | 0.4792 | 1.1427 | 1.7095 | 1.2832 | 0.42962 | 1.27987 | 1.777057 | 1.2572 | 0.38519 | 1.3919 |
| | (t-stats) | 5.833 | 8.7685 | 3.0035 | 2.7342 | 7.4564 | 10.782 | 3.284 | 3.387 | 5.877 | 13.9 | 3.2881 | 3.2309 | 11.8149 | 10.28 | 3.1255 | 5.193 |
| j9 | W | 3.166 | 2.24993 | 2.46689 | 0.69908 | 3.09976 | 2.17147 | 2.2842 | 0.8156 | 3.0262 | 2.2842 | 2.11852 | 0.90766 | 2.990193 | 2.0918 | 2.01103 | 0.9792 |
| | L | 2.4403 | 1.97076 | 1.58736 | 0.85296 | 2.29028 | 1.89563 | 1.5258 | 0.7645 | 2.1592 | 1.5505 | 1.45512 | 0.70409 | 2.106536 | 1.777 | 1.41598 | 0.6906 |
| | W-L | 0.7256 | 0.27917 | 0.87953 | -0.1539 | 0.80948 | 0.27584 | 0.7584 | 0.0511 | 0.867 | 0.7336 | 0.6634 | 0.20357 | 0.883657 | 0.3148 | 0.59505 | 0.2886 |
| | (t-stats) | 3.973 | 1.8891 | 4.7468 | -0.508 | 5.8723 | 7.0711 | 4.907 | 0.212 | 7.915 | 2.081 | 5.2264 | 1.0421 | 9.34546 | 6.633 | 5.4859 | 1.708 |
| j12 | W | 3.371 | 2.12355 | 2.31385 | 1.05719 | 2.70883 | 2.0504 | 2.1476 | 0.5613 | 3.2096 | 2.0205 | 2.01783 | 1.19178 | 3.165458 | 2.0091 | 1.92994 | 1.2355 |
| | L | 2.323 | 1.84236 | 1.49915 | 0.82381 | 0.99693 | 1.76327 | 1.4484 | -0.451 | 2.1005 | 1.7092 | 1.41715 | 0.68339 | 2.091718 | 1.6757 | 1.4027 | 0.689 |
| | W-L | 1.0481 | 0.28119 | 0.81471 | 0.23337 | 1.71191 | 0.28713 | 0.6992 | 1.0127 | 1.1091 | 0.3113 | 0.60068 | 0.5084 | 1.07374 | 0.3335 | 0.52724 | 0.5465 |
| | (t-stats) | 6.517 | 1.052 | 4.4087 | 0.8978 | 6.736 | 1.7291 | 4.37 | 5.044 | 9.897 | 1.948 | 4.3275 | 3.2616 | 10.2238 | 2.143 | 4.2699 | 3.805 |