Contrarian and Momentum Investment Strategies in Pakistan Stock Exchange

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This study examines several aspects of the momentum strategies, such as profitability, risk-based explanation, and decomposition of the momentum profits. For this purpose, we use weekly and monthly data of 581 firms listed at the Pakistan Stock Exchange (PSX) for the period 2004-2014. We found the presence of momentum profits over short and long-horizons, while majority of the contrarian profits were observed only in the presence of penny stocks that have share prices of PKR 10 or less. As a robustness check, we computed returns through the weighted relative strength scheme (WRSS) procedure and average cumulative abnormal returns (ACARs). Interestingly, the results reported through WRSS have shown a similar pattern to that obtained through average cumulative abnormal returns (ACARs). Further, to know which factor contributes more to momentum and contrarian profits, we used the model proposed by Lo and MacKinlay (1990). Our findings show that the overreaction effect is the largest contributing factor of contrarian profits in PSX, while cross-sectional risk is the second largest factor and negatively affects the contrarian profits. Moreover, the lead-lag effect contributes positively to the contrarian profits. Similarly, the largest contributing factor for momentum profits is the underreaction effect, whereas cross-sectional risk is the second largest factor that positively affects momentum profits. Unlike contrarian profits, lead-lag effect reduces the momentum profits in the PSX.

1. INTRODUCTION

There is an extensive body of financial literature, which empirically documents the predictability of stock returns from their past data. DeBondt and Thaler (1985) and Jegadeesh and Titman (1993) were the pioneers who for the first time provided evidence about the profitability of momentum and contrarian strategies. The predictability of stock returns from the past data poses serious question about the validity of efficient market hypothesis. DeBondt and Thaler (1985) provided evidence that investors can capitalise on the stock return opportunities in market by predicting the mean reversion in the stock returns through contrarian strategy. Contrarian strategy involves selling winners stock and buying losers stock. After eight years of DeBondt and Thaler study, Jegadeesh and Titman (1993) proved empirically that there exists trends in the market through which investor can earn returns on the stock in short-term. Such strategy is called as momentum strategy which involves buying of winner stocks and selling of loser stocks i.e. opposite of contrarian strategy. Momentum strategy is relatively a short-term strategy which assumes that stocks that perform well in the past will continue to perform well in the

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future. On the other hand, contrarian strategy is a relatively long-term strategy and is based on the hypothesis that stock returns have mean-reversion. It assumes that stocks which have performed well in the past might have an element of investors' overreaction. Once the wave of investors' overreaction ends, prices will gradually adjust to their intrinsic values, leaving behind a pattern of negative returns. So, based on this, contrarian investors generally buy loser stocks (poor performers of market) and sell winner stocks (good performers of the market).

In this study, we attempt to examine several aspects of the momentum investment strategies in the Pakistan Stock Exchange, such as profitability of different momentum strategies, risk-based explanation of the momentum profits (if any), and decomposition of the momentum profits. There are several factors that motivate us to conduct this study. First, in the last fifteen years, Pakistan Stock Exchange received considerable amount of foreign portfolio investment[1] and delivered remarkable stock returns. The Wall Street Journal termed Pakistan Stock Exchange as one of the top performers in the year 2013.[2] Despite this focus, PSX remains relatively less known to international community in terms of research and empirical findings. Therefore, our study is relevant not only to local investors and managers, but also to international portfolio managers and investors, who are attracted to PSX not just because of higher equity returns but also because of the potential diversification advantages.

More specifically, despite rich empirical literature on this topic elsewhere, studies that investigate the profitability of momentum and contrarian strategies are limited in Pakistan. One reason may be the issue of non-availability of rich data sets i.e. a large sample of firms and for a longer period of time. Another reason might be the extensive labour work involved in developing portfolios on weekly or monthly frequency in overlapping fashion, using conventional software such as MS Excel. Nevertheless, we developed customised Stata program that can flexibly develop momentum portfolios under several constraints [Shah (2015)].[3]

Further, this study contributes to the existing literature by showing how momentum and contrarian profits can change when we construct the sample under a variety of different criteria. Our empirical results show mixed findings under different constraints. For example, using the full sample without any constraint, momentum strategy yields significant returns both in short and intermediate horizons in Pakistan Stock Exchange, while contrarian strategies result in significant returns in short and long horizon (i.e. both in weekly and monthly strategies). However, contrarian profits completely disappear when we exclude penny stocks (with price below PKR 5 and PKR 10) from the sample in weekly strategies, yielding exclusively momentum profits. Therefore, penny stocks, which are mostly illiquid, is the most key factor causing contrarian profits. In the monthly strategies, contrarian profits exist only in long run when we drop penny stocks from the sample. Similarly, we use other constraints to identify the existence of momentum profits. For example, we found that there is a positive relation

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[1]The foreign portfolio investors injected around $404 million in the KSE in the year 2013, according to National Clearing Company of Pakistan (NCCPL).

[2]*Wall Street Journal*, "Daring Investors Brave Pakistan Market" Jan. 3, 2014

[3]The programmme is called asm.ado. It can be accessed from the author's website: www.OpenDoors.Pk

between share trading volume and returns of the momentum profits. Higher the trading volume of a stock, higher will be the momentum profits and vice versa. This analysis helps in understanding the key features of Pakistan market while testing momentum strategies.

Rest of the paper is organised as follows. In the next section, we will discuss the theoretical framework and related literature, followed by the methodology section. Section 4 presents and discusses the empirical results and Section 5 concludes the paper.

2. RELATED LITERATURE

In the last decades of 20th century, most of the financial research focused on the stock market anomalies resulting from market inefficiencies. Most of the topics which have been researched in this area come under the predictability of stock prices on the basis of historical data. Investors employ different investment strategies to earn abnormal profits on the basis of past prices. The two well-known strategies are momentum and contrarian investment strategies. Momentum strategy is a short-term strategy and gives abnormal profits when investors buy winners and sell losers stocks. On the other hand, contrarian strategies are relatively long-term strategies and result in the abnormal returns when investors buy past losers and sell winners stocks in their portfolios.

There are various explanations for the existence of momentum phenomenon in asset prices. For example, accelerating revenues and/or increasing profit margins, resulting from increasing sales, cost improvements or overall market expansion (sector momentum) might lead to momentum in stock prices. Similarly, business cycle over an extended period of time might cause continuation in the stock prices in the direction they are already going into. Another explanation for momentum phenomenon comes from the behavioural factors. Due to limited cognitive abilities and attention, investors might not fully incorporate the available information in stock prices in a timely manner. When an economic event occurs, investors might adjust the prices only partially. However, in the subsequent periods when investors have understood the event more clearly, they would adjust the prices further. Such an adjustment process will cause the stock prices to form a pattern, thereby giving rise to momentum effect. And finally, momentum can also occur due to investors' overreaction to news. When investors overact, they would move the prices away from the optimal/fair values. With the passage of time when the overreaction effect diminishes, prices will gradually adjust back to their fair values (price reversals).

The literature review part is divided into four subsections, which shows its systematic way of doing it. The first section generally provides evidence of the previous studies regarding the significance of contrarian and momentum strategies in different stock markets. The second subsection then provides a discussion on explaining the profitability of these strategies. The third subsection discusses that how different researchers have decomposed the contrarian and momentum profits. The last section provides a critical review of the size-based explanation of both contrarian and momentum profits.

2.1. Significance of Contrarian and Momentum Profits

Researches have reported profits on the basis of momentum and contrarian strategies in different stock markets. DeBondt and Thaler (1985) conducted the very first research in which they presented evidence in support of contrarian profits in US market.

Similarly, for the first time, Jegadeesh and Titman (1993) reported momentum profits in US market and stated that a winner portfolio gives positive returns up to 12 months and then lose its momentum in the next 24 months. This shows return continuation in short horizon and return reversal in long-term. Rouwenhorst (1998) also provides evidence of momentum profits in international markets. Schiereck, *et al.* (1999) found excess returns in 5-year ranking period for contrarian portfolios and similar profits were observed for short-term momentum portfolios.

Kang, Liu and Ni (2002) found statistically significant profit for portfolio formed, based on contrarian and momentum strategies in China Stock market. They used Lo and MacKinlay (1990) and Jegadeesh and Titman (1995) methods to test the profitability of both contrarian and momentum strategies in the China Stock market using type "A" shares. Eight different horizons were taken both for the formation and holding periods. So, a total of 64 different investment strategies were formed. Among them, they observed significant profit for 14 contrarian and 10 momentum strategies. Nevertheless, Kang et al. (2002) did not find evidence that whether profits under these strategies will survive after their adjustment for risk and size of the firm. Forner and Marhuenda (2003) also provide evidence for the presence of long-term contrarian and short-term momentum profits in the Spanish stock market. However, they showed that these profits are not due to data snooping. They concluded that profits obtained from both contrarian and momentum strategies are robust both to portfolio size and the formation date choice.

Moreover, McInish, *et al.* (2008) tested the profitability of contrarian and momentum strategies in seven Pacific countries. They reported significant contrarian profits from winner portfolios in Japan, while momentum profits from loser portfolios in both Hong Kong and Japan. This was a new finding in the investment literature that momentum profits came from the loser stocks in the portfolio in these countries. However, it is open to test that whether such findings hold in other stock markets. Similarly, Bildik and Gulay (2007) showed compelling evidence of long and short-horizon contrarian profits in Istanbul Stock Exchange (ISE). However, they have not checked it whether such profits hold in intermediate horizon. There is a chance that the behaviour of such profits might completely change or one can say that such profits may not be robust to time horizon. But Demir, Muthuswamy, and Walter (2003) used data of Australian equity market and found that short and intermediate horizon momentum strategies are profitable. They further observed that the magnitude of momentum profits found in Australian market is greater than other international markets. Moreover, his findings make it evident that these returns are robust to risk adjustment and prevail different time horizon.

2.2. Behavioural Aspect of Contrarian and Momentum Profits

Research studies provide different explanations for the profitability of momentum and contrarian strategies. They provide alternative explanations for these profits. Among them, DeBondt and Thaler (1985) proposed that investors' irrational behaviour is responsible for such profits. They suggest that when investors change their prospect, they are likely to give more weight to recent information and underestimate past (historical) information, which obviously results in more optimism towards good news and pessimism towards bad news. This behaviour of investors causes the stock prices to

deviate for a short-period of time from their actual values. This violation of efficient market hypothesis is known as overreaction effect. The observed that asset prices cannot stay away for long from their intrinsic values, thus price movements are followed by price reversals in the long run, thereby making room for contrarian profits. Similarly, momentum profits can be explained from the psychological perspective, which suggests that underreaction of prices to latest information is responsible for this behaviour. It means that the effect of news may be incorporated gradually into the prices, so that it is likely to have positive autocorrelations during such periods.

The theoretical explanation of DeBondt and Thaler (1985) has shortcoming of not explaining why some markets yield abnormal return under these strategies and others do not, though similar investors' cognitions are involved. These explanations have been further confirmed by Barberis, Shleifer, and Vishny (1998), Hong and Stein (1999). They suggested that short-term momentum in stock prices is attributed to the slow reaction or underreaction of investors to the news. On the other hand, contrarian profits are exploited when investor's overreaction is corrected in the long run. It should be noted that both underreaction and overreaction hypothesis are not contradictory. They confirm that short-term momentum and long-term contrarian reversals in stock returns can coexist which is largely attributed to the irrational behaviour of investors.

Daniel, Hirshleifer, and Subrahmayam (1998) presented a continuous overreaction model which was based on two psychological aspects. The first aspect proposed by them is investors' overconfidence which states that investors underestimate their forecast error variance because they believe themselves to be more able to value securities than they (investors) actually are. Biased self-attribution is the second aspect of their model. They argue that the investors' confidence grows when public information is in agreement with their information, but the reverse situation is different. Their confidence does not fall equally when public information opposes the investors' private information. Psychologically, this becomes evident that individuals tend to credit themselves for past success but for failure they blame external factors. Consequently, due to this behaviour investor's overconfidence increases, when it is followed by confirming news and as a result investors overestimate the accuracy of their information. This investors' overconfidence increases the prices of winner stocks over their actual values. In this model, momentum profits are reported to result from the delayed overreaction, which is eventually reversed as prices revert to reflect their fundamentals.

In another study, Barberis, *et al.* (1998) presented a model, which combines conservatism bias and representative heuristic. Conservatism bias states that when people observe new evidence they are slow in updating their belief. But conservative individuals may ignore the full information content regarding stock earnings or some other public announcement and at least partially they are still persistent on their prior estimates of earnings. On the other hand, representative heuristic is a cognitive bias, which states that when making judgment about the probability of an uncertain event or sample, individuals observe it as similar in essential characteristics to its population and it reflects the important features of the process by which it is generated. Representativeness leads to wrong judgments. This is because something that is more representative does not make it more likely to be the best always. In the same way, investors may wrongly estimate the price of a firm which has consistent growth in earnings while in fact this may not always

be the case. As a result, investors using the representativeness heuristic may ignore the fact that past high earnings growth is unlikely to repeat itself, so they overvalue the company. Conservatism bias is responsible for underreaction of stocks to firm specific information which causes momentum effect, while on the other hand representative heuristic bias leads investors to predict future expected returns from the past performance. Reversal effect is reported to have been resulted from the combination of both these effects.

Hong and Stein (1999) proposed a behavioural model that was based on the underreaction of stocks to information and their consequent overreaction. This model was based on the classification of investors in two groups which they named as momentum traders and Newswatchers. These two types of investors are different in the way they process the information. Newswatchers use signals about stock's future fundamental to predict its prices and momentum traders on the other hand based its analysis on the information about past prices trends. Adjustment of prices in response to new information occurs slowly, which is because of the gradual diffusion of private information among the newswatcher population that results in underreaction in short run. Underreaction of stock prices portrays that momentum traders could be profitable by following the price trends, which ultimately lead to overreaction. This effect has also been documented by Lehmann (1990), Dechow and Sloan (1996) and Hong and Stien (1999). The consequent overreaction in long run results in price reversals.

Vlad (2008) investigated the asset pricing process and found that the effect of investors' misconceptions is a long run effect. He found that the effect of good and bad news on share pricing is not the same. Bad news tends to create more fluctuation and volatilities than good news of the same magnitude and this is called as disposition or loss aversion effect. The disposition effect is a negative feedback strategy, which is caused because of the investors' tendency to realise profits but not losses and this ultimately results in price reversals. However, Lehman (1990), Park (1995) and Conrad, *et al.* (1997) argued that using bid-ask spread to calculate profits based on short-term contrarian strategy may be spurious. It is due to the use of bid and ask prices that lead to wrong appearance of winners and losers' stocks.

2.3. Components of Contrarian and Momentum Profits

Researchers have tried to split both contrarian and momentum profits into components to find their contributing factors. Conrad and Kaul (1993) have shown that momentum profits are caused by the cross-sectional risk, which is induced due to the portfolio formation procedure. While on the other hand, Chan (1988) explained contrarian and momentum profits as being caused by the time varying market risk. He observed relatively small contrarian profits which he attributed to the fact that losers are more likely to be riskier than winners in the holding period, in the light of time varying common factors.

Chan (1988) was a bit critical in his view and argued that selecting high risk stocks as the winners and relatively low risk stocks as the losers is the correct strategy to earn momentum profits. As a general rule in finance, higher the risk, higher will be the returns, and under momentum strategies, higher returns tend to continue in the next period. Moreover, Lo and MacKinlay (1990) argued that contrarian profits are caused due

to the size related lead lag effect rather than the phenomena described by Chan (1988) i.e. time series pattern exhibit the extreme performers or the Daniel, *et al.* (1988) overreaction effect explanation. They further argued that stocks of large companies' show quick reactions to information than the small companies' stocks which implies that large stocks tend to lead the returns of small stocks. Lo and MacKinlay (1990) called this as the lead lag effect. Moreover, they found that the current returns of the small stocks have large positive cross serial correlation with the lag returns of the large stocks, though this relation is not true in the reverse order.

One of the conspicuous contradictions came from the study of Jegadeesh and Titman (1995) study. They proposed that lead-lag structure is not an important source of contrarian profits in the US stock market. They argue that the tool which Lo and MacKinlay (1990) used to identify the lead- lag structure i.e. the average auto covariance, mislead the results and cannot be used to find the lead-lag contribution to contrarian profits. They further explained it by stating that cross autocovariance work is used as an indicator of lead-lag structure, only when some stocks exhibit instantaneous reaction to common factors and some stocks on the other hand react with lag and do not show contemporaneous reaction. They found that less than 5 percent of contrarian profits are contributed by lead-lag structure while the majority of the profits are attributed to the overreaction of stock returns to firm-specific information. These findings are consistent with DeBondt (1985) and Daniel, *et al.* (1998). Daniel, *et al.* (1998) argued that momentum profits are not due to the lead lag effect and is caused by the stocks' delayed reaction to firm specific information.

2.4. Risk and Size Based Explanation of Contrarian and Momentum Profits

The literature provides enormous evidences about the profitability of the contrarian and momentum investment strategies and their behaviour. Nevertheless, there is much less evidence that whether these abnormal profits could be explained from the risk perspective. De Bondt and Thaler (1985) have used risk-adjusted returns instead of market adjusted returns to account for the riskiness of these strategies. However, they applied the traditional methodology of computing the beta and considered it as stable over a time (i.e. 60 months before the formation period). This has been criticised by Chan (1988) who argued that changes in beta in the formation period would bias the results. Chan (1988) proposed that risk of the portfolios i.e. both winners and losers are not constant over time. Moreover, the risk of the strategy seemingly has correlation with the level of market risk premium. So, the abnormal returns estimation might be sensitive to the way risks are estimated. Chan (1988) adopted the standard Sharpe-Linter Capital Asset Pricing Model (CAPM).

Moreover, Chopra, *et al.* (1992) showed that overreaction effect weakens but does not disappear completely, when we control for size or beta. They showed that small firms exhibit more overreaction effect than larger ones. They hypothesise from these results that the dominant holder of stocks i.e. institutional investors of smaller firms may overreact while that of larger stocks do not. In another study, Baytas and Cakici (1999) showed that higher return results for long-term investment strategies which are based on price and size than those based on past performance. They put forward the argument that as loser tends to be low in price and market value and vice versa for winner, so they argue that most of the long-term price reversals might be due to price and size effect.

The review of the literature provides ample evidences of the contrarian and momentum profits. From the perspective of Pakistan, there is only limited research on the given topic. As mentioned before, there are only two notable studies [Shah and Sha (2015); Rehman and Mohsin (2012)] that investigate momentum strategies. Although, researchers have paid attention to study other anomalies in the Pakistan Stock Exchange in recent years.[4] Therefore, our study will provide a more convincing evidence of profitability of both strategies which in turn will provide evidence against the efficient market hypothesis too that states that investors cannot beat the market. Moreover, overreaction of stock prices to firm specific information may be a factor that generates contrarian profit while for momentum profit it might be the underreaction of stock prices to firm specific information. Thus, there is need of exploring possible behavioural explanation of contrarian and momentum profits in Pakistan Stock Exchange.

2.5. Research Hypotheses

Based on the arguments and evidences in the literature review section, following hypotheses could be derived.

(1) H_1: Momentum strategies generate significant returns in short horizon.
(2) H_1: Contrarian strategies generate significant returns in long horizon.
(3) H_1: Contrarian and momentum return are explained from systematic risk perspective.
(4) H_1: Lead lag effect, cross sectional risk and time series pattern contribute to contrarian and momentum profits.

3. METHODOLOGY

This section discusses the research strategy, research choice and sample of the study, the data used and the time span considered in this study. Moreover, it presents the models that have been used for analysis.

3.1. Data Sources and Sample Size

The study uses share prices of all the companies listed on the PSX. Most recent data of stock prices for all the companies listed on PSX used in this study is from the period 2004 to 2014. Data of closing prices of all the stocks has been taken from www.opendoors.pk. KSE-100 value weighted index is used as market index.

3.2. Portfolio Construction

3.2.1. *Average Cumulative Returns Model*

To test the hypothesis that whether contrarian and momentum strategies result in significant profits in PSX, the study employs the method used by DeBondt and Thaler (1985) which is widely used in this area. Profitability of the two strategies is

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[4]For example, researchers have studied day of the week effect [Shah and Abdullah (2015)], cross-autocorrelations in portfolio returns [Ishtiaq and Abdullah (2015)], market efficiency [Khan and Khan (2016)] and capital structure and abnormal stock returns [Ullah and Shah (2014)].

analysed, using two periods called as formation period, also called as ranking period (R-period) and testing period, which is also known by holding period (H-period). First, simple returns on stocks are computed through log return formula which is given below:

$$R_{j,t} = LN\left(\frac{P_f}{P_i}\right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Where LN is the natural logarithm, P_f is the closing price and P_i is the initial price. In ranking period, returns of the stocks included in the sample are determined. To compute cumulative market adjusted excess return, following equation is used:

$$CU_j = \sum\nolimits_{t=-12}^{0} \left(R_{j,t} - R_{M,t}\right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where CU_j is the cumulative market adjusted return, R_j is the return of the stock j for the month t and R_M is the market index return at time t. Equation 2 is used to sort the stocks in the ranking period. In R-period, then 10 equal size portfolios are formed from the sorted stocks. The portfolio with the highest cumulative returns is the winner portfolio and the one with the lowest stock returns is the loser portfolio. The top three portfolios are taken as winner portfolio and the bottom three are taken as loser portfolio, so that each winner and loser portfolio comprises of thirty percent of all the stocks. After this, equal weighted average return for winner and loser portfolios are computed in holding period (H-period), then the difference between the returns of winners and losers is calculated. If the difference between the average returns of winners and losers is positive then return continuation (momentum profits) is declared, on contrary if it gives negative returns then it will show return reversal (contrarian profits).

Selecting formation and holding period is purely subjective [Ismail (2012)]. Nevertheless, this study has used two types of data, i.e. weekly and monthly to check the robustness of the profitability of these strategies. The study used eight different horizons in weeks (1, 2, 3... 8 weeks) and forty-eight (48) different horizons in months (1, 2, 3....48 months) both for formation and holding period. We have developed methodology for 12 months. The same methodology will be applied to other time horizons as well. Cumulative abnormal return (CAR) for each of the nine, 1 year overlapping periods for winner and loser portfolio is calculated through:

$$CAR_{p,i,t} = \sum\nolimits_{T=1}^{t} AR_{p,i,t} = \Sigma_{T=1}^{t} \Sigma_{j=1}^{n} \frac{1}{n} \left(R_{j,i,t} - R_{M,i,t}\right) \quad \ldots \quad \ldots \quad (3)$$
$$t{:}1, 2, 3 \ldots 12 \text{ months, p: L, W}$$

Where n denotes the number of stocks that are included in each portfolio, 'i' is the period under consideration and AR_p is the abnormal return on a portfolio. In case when return of a stock is not present in any given month after the' formation of stocks the portfolio, then the study computes average of the available stocks returns. This is because that in time when a stock stopped trading, there is an implicit readjustment in the stock returns by liquidating those stock which disappeared and investing the money in the remaining stocks of the portfolio so that it is equally weighted. After this, average of the CAR across different holding periods is computed for each portfolio and for each month of the holding period:

$$ACAR_{p,t} = \frac{1}{N} \sum_{i=1}^{N} CAR_{p,i,t} \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (4)$$

Here N represents the number of test periods, i.e. 10 in our case. When an overreaction exists, the following result in holding period will be obtained.

$$ACAR_{C,t} = ACAR_{L,t} - ACAR_{W,t} > 0, \qquad t=1, 2, 3 \dots 12 \qquad \dots \qquad \dots \quad (5)$$

The above equation shows the average cumulative abnormal return of the zero investment portfolios (Portfolio having net value zero because it's achieved by simultaneously purchasing the loser securities and selling equivalent winner securities) for contrarian strategy and vice versa for momentum strategy. So, when the above condition is observed, it will show the overreaction of the stock returns and when the opposite of it is obtained then that will be the underreaction of the stock returns. Consequently, this paves the way for the testing of hypothesis of underreaction and overreaction.

As mentioned above, the study has used two types of data with respect to time. One is weekly data that computes returns of the stocks' weekly cumulative and second is monthly data that computes monthly cumulative stock returns. Time periods of 1 to 8 weeks and 1 to 48 months have been used both for formation and holding. Using 8 different periods in weekly data and 48 periods in monthly data for each formation and holding period, strategies of corresponding time periods will be obtained. Here, it should be noted that the study is not following the procedure of Jegadeesh and Titman (1990) that have considered different time horizons for formation and holding period. In this study, an equal time is considered for formation and holding period. The reason is that similar results are observed for each formation period under different holding periods. Moreover, both long and short-time periods are covered to account for momentum and contrarian strategies, so there is no need to calculate different holding periods' cumulative returns for the same formation period. For example, if formation is of 1 week, so holding period is also 1 week, if formation period is 2 weeks, holding period is also 2 weeks and so on for other time periods. Similar procedure has been applied in the monthly data as well.

To avoid bias that arise from bid ask spread, price pressure due to illiquid markets and non-synchronous data, the study also provide a case in which one trading period is being skipped between portfolio formation and holding periods for all investments strategies [Chan, et al. (1999); Lehman (1990)].

Buy-and-hold method is used to calculate the long-term return. DeBondt and Thaler (1985) methodology is applied again, however, we substitute Equation 2 and 3 by:

$$CU_j^{B\&H} = \left[\prod_{t=-12}^{0}(1 + R_{j,t}) - 1\right] - \left[\prod_{t=-12}^{0}(1 + R_{M,t}) - 1\right] \dots \qquad \dots \quad (6)$$

$$CAR_{P,i,t}^{B\&H} = \frac{1}{n}\sum_{j=1}^{n}\left[\prod_{T=1}^{t}(1 + R_{j,T}) - 1\right] - \left[\prod_{T=1}^{t}(1 + R_{M,T}) - 1\right] \qquad \dots \quad (7)$$

t: 1, 2, 3…12. i: 1, 2, 3…. 9. p: L, W

$CU_j^{B\&H}$ is the buy-and-hold cumulative return of stock j, $CAR_{P,i,t}^{B\&H}$ is buy-and-hold cumulative abnormal return of portfolio 'p' for the period 't' and ranking-holding period 'i', while ∏ is the sign of product.

Previously, most of the researchers have preferred to use non-overlapping time periods to ensure independence in calculating different statistics. Nevertheless, this restriction greatly reduces the number of holding periods and consequently the reliability of statistics obtained is also reduced. To avoid this problem, Ball and Kothari (1989) proposed a method that allows an overlapping among ranking and holding periods. According to their proposed method, at the beginning of each calendar year from 2004 to 2014 (we have a total of 10 ranking periods) the stocks are ranked on the basis of their buy-and-hold cumulative returns (Equation 6) of previous 12 months in descending order and portfolios are constructed as described previously. Then the significance of returns obtained in the holding period has been checked through simple t-test. Whenever a stock is missing in the holding period i.e. following the portfolio formation period then that stock is permanently dropped from the portfolio and the cumulative abnormal return is calculated by taking average of the available stocks with same procedure as used before.

3.3. Risk Adjusted Abnormal Returns Model

Chan (1988) presented a method that could analyse the abnormal risk adjusted returns of the momentum and contrarian strategy without the issue of beta instability. Doing so, he proposed to run the following regression in each of the formation-holding periods:

$$R_{p,t} - R_{f,t} = \alpha_{p,F} (1 - D_t) + \alpha_{p,T} D + \beta_{p,F} (R_{m,t} - R_{f,t}) + \beta_{p,D} (R_{m,t} - R_{f,t}) D_t + \varepsilon_{p,t}$$
$$t: -12....0....12, \quad p: L, W \qquad ... \qquad ... \qquad ... \qquad ... \quad (8.1)$$

R_p is the returns on either losers' or winners' portfolio during the month t, $R_{m,t}$ and $R_{f,t}$ are returns of the market index and risk free rate respectively in the month t, D_t is a dummy variable whose value is 0 during the formation period ($t \leq 0$) and 1 in the testing period ($t > 0$),which allows to estimate different intercepts and betas during both the periods; $\alpha_{p,F}$ and $\alpha_{p,T}$, representing risk adjusted abnormal returns or the Jensen's alpha during the formation and test period respectively; systematic risk of the portfolio p is estimated by $\beta_{p,F}$ during the formation period; $\beta_{p,D}$ shows the change observed in the systematic risk between formation and test period of portfolio p, therefore the test period beta will be ($\beta_{p,F} + \beta_{p,D}$); $\varepsilon_{p,t}$ is the error term and is assumed to have normal distribution with variance of $\sigma^2_{p,F}$ and $\sigma^2_{p,T}$ during the formation and testing period respectively.

The null hypothesis $\alpha_{p,T} = 0$ will show the absence of overreaction or underreaction from the investors. A significant $\alpha_{p,T} > 0$ or $\alpha_{p,T} < 0$ for any strategy will show continuation (momentum profit) or change (contrarian profits) respectively. Furthermore, the returns of only momentum strategies have been regressed in the following manner:

$$R_{W,t} - R_{L,t} = \alpha_{WL,F} (1 - D_t) + \alpha_{WL,T} D_t + \beta_{WL,F} (R_{m,t} - R_{f,t}) + \beta_{WL,D}$$
$$(R_{m,t} - R_{f,t}) D_t + \varepsilon_{p,t} \quad ... \qquad ... \qquad ... \qquad ... \qquad ... \qquad ... \quad (8.2)$$

3.3.1. *Weighted Relative Strength Scheme (WRSS) Methodology*

The study employs the methodology developed by Lo and MacKinlay (1990) for the formation of contrarian and momentum portfolios. As the name implies, WRSS is the investment strategy that buys stocks in proportion to their returns over the formation period. In case of momentum strategy, investor would take long position in stocks that

yields positive returns, with higher weight being assigned to top performers. Similarly, investors take short positions in stocks that yield negative returns with higher weight on bottom performers. The winner stocks are the stocks that outperform the market ($R_{i,\,t\text{-}1}$ − $R_{m,\,t\text{-}1}$ > 0), where $R_{i,\,t\text{-}1}$ is the returns of the stocks and $R_{m,\,t\text{-}1}$ is the returns on the market index during the formation period t-1. On the other hand, loser stocks are those that underperform the market i.e. $R_{i,\,t\text{-}1}$ − $R_{m,\,t\text{-}1}$ < 0. During each formation period t-1, the weight $w_{i,\,t}$ assigned to each stock is:

$$w_{i,\,t} = 1/N \,(R_{i,\,t\text{-}1} - R_{m,\,t\text{-}1}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

Where N is the number of stocks in the sample in each time period. The profit denoted by π_t in the testing period is computed through the following equation:

$$\pi_t = \frac{1}{N}\sum_{i=1}^{N} R_{i,t} * w_{i,t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

$w_{i,\,t}$ is the weight assigned to each stock in the formation period and $R_{i,\,t}$ is the returns of each stock during the testing period. The profit for the momentum portfolio in each period is the average of weighted returns of all stocks in the sample. So, the positive value of Equation 10 will show momentum profits while the negative value will indicate contrarian profits.

4. ANALYTICAL MODELS

4.1. *t*-tests

To check whether the contrarian and momentum profits in holding period are significantly different from zero, the study employs simple *t*-test. By running the test, when the average return of the holding periods on winner-loser portfolio is significantly positive (negative), different from zero, the evidence of momentum (contrarian) profit would be obtained, assuming that the transaction cost does not affect winner-loser returns.

4.2 Lo and MacKinlay Model

Contrarian and momentum profits are also explained from behavioural point of view. The psychological explanation to the behaviour of contrarian and momentum profit gives a deep insight into these investment strategies. Researchers suggest that the behaviour may be attributed to underreaction or overreaction of the prices to the latest information. They tend to have autocorrelation during these periods. In the literature, stock market overreaction implies that individual security returns are negatively autocorrelated over some holding period which means that if a stock performs well in one period will be a bad performer in the next. The negativity in auto correlation will show the stock market overreaction for individual stocks. Jegadeesh and Titman (1993) developed a frame work for the regression to analyse the component of contrarian and momentum profits. The model they developed is:

$$r_{i,t} = \mu_i + b_{0,i}^t f_t + b_{1,i}^t f_{t-1} + e_{i,t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

μ_i denotes the expected returns of the stock i, b^t_0 and b^t_1 show the sensitivities of stock i to contemporaneous and lagged factor realisations at time 't', while f_t represents the unexpected factor realisation which is proxied by the demeaned market returns (in this

case KSE100 index demeaned returns for the period t and t-1), $e_{i,t}$ is the idiosyncratic or firm specific component of return of stock i at time t, generally called the error term. Jegadeesh and Titman (1993) modified the Lo and MacKinlay Model and decomposed contrarian profits into the above three components. Moreover, the profits reported are obtained through WRSS, so for a contrarian strategy:

$$E(\pi^c) = E\left(\frac{1}{N}\sum_{i=1}^{N} R_{i,t} * w_{i,t}\right) = -\sigma_\mu^2 - \Omega - \delta\sigma_f^2 \qquad \dots \qquad \dots \qquad \dots \quad (12)$$

Expected contrarian and momentum profit is decomposed into three components, according to the Equation 12. The first term $-\sigma_\mu^2$, which is also present in Lo and MacKinlay (1990) model, shows the cross-sectional dispersion in expected returns. A stock having higher expected return will tend to exhibit higher than average returns during both the formation and holding periods and will reduce contrarian profit. $-\Omega$ is the second component of the Equation 12, which represents the negative of average auto covariance of the firm specific or idiosyncratic component of returns. This is determined by reactions of stock prices to firm specific information. Jegadeesh and Titman called it as the overreaction component of the contrarian profit. This component contributes to contrarian profit when Ω is negative, in the case when stock prices tend to overreact to firm specific information. The last component $\delta\sigma_f^2$ represents the lead lag effect in the stock prices, rises from the difference in the timeliness of stock price reactions to common factors. In case $\delta\sigma_f^2 < 0$, this component will contribute positively to contrarian profit and vice versa for $\delta\sigma_f^2 > 0$. Each of the three factors is further defined by the formulas given below:

Cross Sectional Risk

$$\sigma_\mu^2 = -\frac{1}{N}\sum_{i=1}^{N}(\mu_i - \bar{\mu})^2 \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (13)$$

Lead Lag Effect

$$\delta = \frac{1}{N}\sum_{i=1}^{N}(b_{0,i} - \overline{b_0})(b_{1,i} - \overline{b_1}) \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (14)$$

Auto Covariance

$$\Omega = \frac{1}{N}\sum Cov(\varepsilon_{i,t} - \varepsilon_{i,t-1}) \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (15)$$

Where μ_i is the regression intercept of stock i, b_0 and b_1 are the variables which need to be estimated with the help of regression and $\overline{b_0}$ and $\overline{b_1}$ are the averages of b_0 and b_1 respectively. $\varepsilon_{i,t}$ and $\varepsilon_{i,t-1}$ are the error terms of stock i, at time t and t-1 respectively. Running the regression (Equation 11), the above three Equations 13, 14 and 15 are then computed to find the relative contribution of each component in contrarian and momentum profits.

5. RESULTS AND DISCUSSION

This section presents the result of momentum and contrarian portfolios. In the methodology section, we discussed two methods to compute the returns of momentum and contrarian strategies i.e. ACAR and WRSS. Results of each method are shown separately. After this, risk adjusted returns have been computed on the basis of ACARs.

While WRSS returns are used to decompose the profits of momentum and contrarian strategies. Moreover, the study has used six different scenarios for ACARs to examine the effect of these cases on returns of momentum and contrarian strategies.

5.1. Scenarios

The study has used six different scenarios to check the robustness of these strategies.

(i) **Raw data:** We start the analysis using data in its raw form. No treatment has been made to it.

(ii) **Dropping stocks with zero returns:** Stocks that yield zero returns are dropped from the sample to check whether it influences the profitability of the investment strategies or not. Zero returns result from no trading in each stock.

(iii) **Dropping stocks having returns less than –100 percent or greater than +100 percent:** This is done to reduce the influence of extreme values.

(iv) **Dropping stocks having trading volume less than a certain level:** Stocks with trading volume less than 500, 1000 and 5000 shares have been analysed separately, to check whether trading volume of stocks have an effect on the profitability of contrarian and momentum strategies.

(v) **Dropping penny stocks:** Penny stock i.e. stocks having price less than Rs 5 and Rs 10 have been dropped and analysed separately.

(vi) **Skipping a period:** Due to the bias that results from the bid-ask spread, price pressure due to illiquid markets and non-synchronous trading, the study skips one period between formation and testing period for all the investment strategies [Chan, *et al*. (1999); Lehmann (1990)].

5.2. Average Cumulative Abnormal Returns

All the tables in this study were constructed using asdoc package of Shah (2018). Due to limitation of space, we report the results of tests based on monthly data. Tables based on weekly data can be provided by the authors on request. The results obtained on the basis of raw weekly data in the testing period show that the returns of the winner-loser (momentum) portfolio in the first five formation holding periods are significantly negative, showing the presences of contrarian profits. Nevertheless, significant momentum profits are reported in the seventh and eighth week's formation-holding periods. All the returns show significance at 1 percent level. These results are quite strange because momentum in stock returns are expected in the near future and reversion takes relatively longer time. The reason for such results might be the presence of penny stocks that do not trade quite frequently. Even a smaller increase in their prices result in a bigger percentage increase. However, due to illiquidity, they do not trade in the coming period, resulting in the contrarian profits. To control this, such stocks were dropped in the next test.

Similar procedure has been carried out to compute the monthly average cumulative abnormal returns (ACAR), as shown in Table 4.1. The study has taken time period from 1 month to 48 months both for formation and holding periods. Unlike the pattern shown in weekly returns, monthly ACAR show opposite patterns. The first strategy of one-formation

Table 4.1

Monthly ACARs

Average cumulative abnormal (market adjusted) returns (ACAR) are calculated with buy and hold procedure for portfolio. A portfolio with the lowest ACARs during the previous 1, 2, 3, ... 48 months ranking period is the *loser* portfolio and the one with the highest ACARs in the same period is called as a *winner* portfolio. Each *winner* and *loser* portfolio consists of 30 percent of the sorted stocks. Stocks in each portfolio are held for the respective 1, 2, 3... 48 months. KSE-100 Index is a value weighted index and is used as a proxy for the market portfolio. T-statistics is depicted with ***, ** and *, showing 1 percent, 5 percent and 10 percent level of significance, respectively.

Strategy	Obs.	Raw data ACAR	Drop if ri=0 ACAR	Drop if ri<-1 and ri>1 ACAR	Drop if Volume<500 ACAR	Drop if Volume<1000 ACAR
1 Formation-Holding	117	-0.00685	-0.00871**	-0.00578	0.00161	0.00812*
2 Formation-Holding	115	0.0232***	0.0217***	0.0246***	0.0313***	0.0328***
3 Formation-Holding	113	0.0443***	0.0401***	0.048***	0.054***	0.0528***
4 Formation-Holding	111	0.0739***	0.0686***	0.0773***	0.0849***	0.081***
5 Formation-Holding	109	0.0852***	0.0798***	0.0905***	0.0999***	0.103***
6 Formation-Holding	107	0.0963***	0.0999***	0.108***	0.113***	0.12***
7 Formation-Holding	105	0.107***	0.115***	0.125***	0.126***	0.138***
8 Formation-Holding	103	0.124***	0.131***	0.143***	0.147***	0.151***
9 Formation-Holding	101	0.141***	0.151***	0.162***	0.164***	0.162***
10 Formation-Holding	99	0.158***	0.17***	0.178***	0.181***	0.171***
11 Formation-Holding	97	0.169***	0.184***	0.19***	0.193***	0.181***
12 Formation-Holding	95	0.182***	0.198***	0.199***	0.214***	0.202***
13 Formation-Holding	93	0.198***	0.222***	0.212***	0.234***	0.218***
14 Formation-Holding	91	0.221***	0.242***	0.227***	0.262***	0.241***
15 Formation-Holding	89	0.24***	0.263***	0.243***	0.28***	0.264***
16 Formation-Holding	87	0.252***	0.276***	0.253***	0.296***	0.284***
17 Formation-Holding	85	0.259***	0.29***	0.256***	0.302***	0.306***
18 Formation-Holding	83	0.267***	0.303***	0.267***	0.317***	0.321***
19 Formation-Holding	81	0.281***	0.314***	0.28***	0.329***	0.338***
20 Formation-Holding	79	0.293***	0.328***	0.292***	0.345***	0.357***
21 Formation-Holding	77	0.303***	0.338***	0.305***	0.358***	0.373***
22 Formation-Holding	75	0.303***	0.335***	0.31***	0.366***	0.379***
23 Formation-Holding	73	0.29***	0.322***	0.302***	0.363***	0.381***
24 Formation-Holding	71	0.274***	0.3***	0.296***	0.361***	0.378***
25 Formation-Holding	69	0.255***	0.273***	0.287***	0.354***	0.376***
26 Formation-Holding	67	0.223***	0.242***	0.265***	0.344***	0.368***
27 Formation-Holding	65	0.198***	0.222***	0.254***	0.333***	0.365***
28 Formation-Holding	63	0.179***	0.203***	0.245***	0.31***	0.363***
29 Formation-Holding	61	0.15***	0.176***	0.233***	0.292***	0.343***
30 Formation-Holding	59	0.146***	0.155***	0.218***	0.287***	0.331***
31 Formation-Holding	57	0.139***	0.143***	0.204***	0.279***	0.318***
32 Formation-Holding	55	0.139***	0.133***	0.189***	0.279***	0.314***
33 Formation-Holding	53	0.131***	0.126***	0.178***	0.27***	0.315***
34 Formation-Holding	51	0.121***	0.116***	0.16***	0.252***	0.328***
35 Formation-Holding	49	0.101***	0.105***	0.143***	0.23***	0.331***
36 Formation-Holding	47	0.0851***	0.0939***	0.13***	0.224***	0.326***
37 Formation-Holding	45	0.0743***	0.0774***	0.115***	0.214***	0.321***
38 Formation-Holding	43	0.0556**	0.0547*	0.0993***	0.212***	0.324***
39 Formation-Holding	41	0.0348	0.0311	0.0774***	0.212***	0.319***
40 Formation-Holding	39	0.0081	-0.00758	0.0495	0.21***	0.31***
41 Formation-Holding	37	-0.0376	-0.0443	0.00277	0.193***	0.295***
42 Formation-Holding	35	-0.0655	-0.0875	-0.0252	0.19***	0.292***
43 Formation-Holding	33	-0.111	-0.12	-0.0725	0.21***	0.302***
44 Formation-Holding	31	-0.131	-0.143	-0.0999	0.245***	0.332***
45 Formation-Holding	29	-0.125	-0.139	-0.106	0.28***	0.36***
46 Formation-Holding	27	-0.11	-0.0863	-0.11	0.311***	0.389***
47 Formation-Holding	25	-0.107	-0.0505	-0.106	0.298***	0.393***
48 Formation-Holding	23	-0.052	-0.0299	-0.051	0.297***	0.405***

Strategy	Obs.	Drop if Volume<5000 ACAR	Drop if Price<5 ACAR	Drop if Price<10 ACAR	Skip 1 Month ACAR
1 Formation-Holding	117	0.0112***	0.00176	0.00321	0.0172***
2 Formation-Holding	115	0.0309***	0.0126***	0.00887***	0.0346***
3 Formation-Holding	113	0.0448***	0.0254***	0.0172***	0.0543***
4 Formation-Holding	111	0.065***	0.0379***	0.0214***	0.0785***
5 Formation-Holding	109	0.0832***	0.04***	0.0177***	0.0873***
6 Formation-Holding	107	0.0986***	0.0409***	0.0186***	0.0954***
7 Formation-Holding	105	0.117***	0.0462***	0.0197***	0.11***
8 Formation-Holding	103	0.131***	0.0553***	0.0256***	0.13***
9 Formation-Holding	101	0.148***	0.0657***	0.0303***	0.149***
10 Formation-Holding	99	0.159***	0.0663***	0.0314***	0.162***
11 Formation-Holding	97	0.17***	0.0804***	0.0348***	0.174***
12 Formation-Holding	95	0.188***	0.0843***	0.0299***	0.187***
13 Formation-Holding	93	0.206***	0.085***	0.0251***	0.204***
14 Formation-Holding	91	0.218***	0.0972***	0.0251**	0.228***
15 Formation-Holding	89	0.234***	0.106***	0.0224*	0.244***
16 Formation-Holding	87	0.228***	0.11***	0.0198	0.253***
17 Formation-Holding	85	0.216***	0.114***	0.0232*	0.257***
18 Formation-Holding	83	0.218***	0.126***	0.029**	0.268***
19 Formation-Holding	81	0.224***	0.14***	0.0292**	0.282***
20 Formation-Holding	79	0.24***	0.151***	0.0363***	0.293***
21 Formation-Holding	77	0.263***	0.169***	0.0549***	0.299***
22 Formation-Holding	75	0.28***	0.181***	0.0587***	0.292***
23 Formation-Holding	73	0.304***	0.178***	0.0659***	0.284***
24 Formation-Holding	71	0.315***	0.183***	0.074***	0.26***
25 Formation-Holding	69	0.311***	0.182***	0.0782***	0.238***
26 Formation-Holding	67	0.314***	0.184***	0.0738***	0.208***
27 Formation-Holding	65	0.307***	0.187***	0.0745***	0.185***
28 Formation-Holding	63	0.32***	0.191***	0.071***	0.161***
29 Formation-Holding	61	0.335***	0.19***	0.0667***	0.141***
30 Formation-Holding	59	0.339***	0.195***	0.0611***	0.138***
31 Formation-Holding	57	0.34***	0.194***	0.0602***	0.133***
32 Formation-Holding	55	0.356***	0.197***	0.0545***	0.128***
33 Formation-Holding	53	0.38***	0.196***	0.0518***	0.128***
34 Formation-Holding	51	0.389***	0.196***	0.047***	0.111***
35 Formation-Holding	49	0.418***	0.199***	0.048***	0.0932***
36 Formation-Holding	47	0.423***	0.214***	0.0454***	0.081***
37 Formation-Holding	45	0.454***	0.21***	0.0457***	0.0682***
38 Formation-Holding	43	0.468***	0.207***	0.0359**	0.0578**
39 Formation-Holding	41	0.467***	0.206***	0.0178	0.0332
40 Formation-Holding	39	0.466***	0.195***	0.00583	-0.00078
41 Formation-Holding	37	0.47***	0.193***	-0.00387	-0.0505
42 Formation-Holding	35	0.481***	0.206***	-0.00045	-0.0762
43 Formation-Holding	33	0.492***	0.217***	-0.00061	-0.116
44 Formation-Holding	31	0.51***	0.228***	-0.0114	-0.128
45 Formation-Holding	29	0.539***	0.236***	-0.00812	-0.112
46 Formation-Holding	27	0.59***	0.272***	-0.0274*	-0.114
47 Formation-Holding	25	0.645***	0.292***	-0.0421***	-0.101
48 Formation-Holding	23	0.666***	0.338***	-0.0555***	-0.0292

and one-holding results in the contrarian profit but is insignificant. However, returns of other strategies (from month 2 till month 38) are positive and significant, which means that momentum strategy yields significant profits, in relatively medium horizon and long horizon. Nevertheless, strategies after 41 months and onwards till 48 months yield contrarian profits but all of them are insignificant. In PSX, the data in its raw form has shown that contrarian strategy yields insignificant profits in relatively longer time horizon.

Moreover, considering the second scenario, we dropped those stocks from the sample that have zero returns, to check whether the elimination of such stocks effects the performance of portfolios in the testing period. The patterns of returns for strategies in weekly ACARs are similar to the raw data. However, there is a slight difference in the amounts of the returns. In the first five weeks, returns that result in the contrarian profits are slightly less than that of the raw data. However, the last two strategies, based on 7 and 8 weeks of formation and holding, result in the momentum profits and are slightly greater than the similar strategies of the raw data.

On the other hand, monthly returns also show the same patterns of returns as were observed in the raw data in the second scenario. However, the first strategy has shown significant contrarian profits unlike the first strategy in raw data that yielded insignificant profit. Moreover, significant momentum profits have been reported for 2 months formation-holding strategy and beyond that till 38 months. However, the momentum profits reported are greater than those reported for the raw data for the similar strategies. Moreover, insignificant contrarian profits result in the strategies of 40 months till 48 months formation-holding.

In the next scenario, stocks having returns less than −100 percent or greater than +100 percent have been dropped from the dataset. Computing the ACARs of momentum strategies have been shown in Table 4.1 in the third column. Interestingly, the patterns of ACARs remain the same as was observed previously in the case of raw data and dropping the zero returns. Similarly, monthly ACARs of strategies are also similar to the previously observed patterns. However, the contrarian profits of the 1-1 formation-holding strategy are insignificant like those obtained for the raw data. Moreover, momentum is also observed for the month 39 formation-holding as well, unlike the previous two cases which yielded momentum profits till 38 months formation-holding.

Furthermore, the effect of trading volume on the performance of momentum and contrarian strategies has also been observed. To this end, the study has used three different thresholds of trading volume to include those stocks that have decent traded volume in the stock market. First, stocks that have trading volume less than 500 are dropped from the sample. The results are shown in Table 4.1. The ACARs reported are somehow different from the previous cases. Contrarian profits are observed for 1, 2 and 3 weeks formation-holding strategies while momentum profits exist for the weeks 6, 7 and 8 formation-holding strategies.

Second, stocks that have trading volume less than 1000 are dropped from the sample and ACARs of the rest of the stocks are calculated. Now, only first two strategies result in the contrarian profits while the strategies from 4 weeks to 8 weeks formation-holding yield significant momentum profits. Third, stocks with trading volume less than 5000 have been dropped to get the frequently traded stocks on the PSX. ACARs of the

stocks have been computed. Interestingly, just one portfolio yields contrarian profits, which is for the first strategy i.e. one-week formation-holding, and the rest of the strategies from 2 weeks to 8 weeks formation-holdings result in significant momentum profits. It shows that investing in the frequently traded stocks will yield significant momentum returns in a relatively short horizon.

Similar procedure is adopted for the monthly data to compute the ACARs, after dropping three different trading volumes. When we drop stocks having trading volume less than 500 shares, it results in momentum profits for all the strategies starting from 2 months to 48 months formation-holding strategies. The first strategy i.e. one-month formation-holding result in insignificant momentum profits. Applying the second condition of dropping stocks, having trading volume less than 1000 shares, all the strategies exclusively result in significant momentum profits. Similarly, significant momentum profits are observed for all strategies in case of dropping stocks having trading volume less than 5000 shares.

It has been observed that the returns for respective strategies in the second case (dropping stocks having trading volume less than 1000 shares) have greater returns than the first case (dropping stocks having trading volume less than 500 shares). Moreover, the returns for the respective strategies in the third case (dropping stocks having trading volume less than 5000) are greater than those of the second case. Therefore, it can be inferred from the results (trading volume scenarios) in Tables 4.1 and 4.2 that there is a positive relation between trading volume of stocks and the profits of the momentum strategy. So, higher the trading volume, higher will be the momentum profits.

Moreover, the study attempted to see the effect of penny stocks on the strategies performance in the testing period. Penny stocks are common stocks of small companies that trade at lower price per share in the market. It is relatively risky and volatile and is subject to manipulation by stock promoters. In the first case, stocks having prices less than Rs 5 have been removed and ACARs of the remaining stocks have been computed. The results are shown in Table 4. For the weekly data, all the strategies yield momentum profits. However, momentum profits for the strategies 6, 7 and 8 weeks formation-holding periods are significant. Moreover, in case of removing stocks having prices less than Rs 10 yielded significant momentum profits for all the strategies exclusively. It should be noted that without penny stocks removed, most of the strategies yielded significant contrarian profits. Therefore, it was the presence of penny stocks that caused those contrarian profits, which disappear once these stocks are dropped.

For the monthly returns, when stocks having prices less than Rs 5 are dropped, significant momentum profits are reported for all the strategies except the first one 1-month formation-holding which is insignificant. However, the pattern of returns is different in case of removing the stocks having prices less than Rs 10. Profits of the 1-month formation-holding strategy are positive and insignificant. Strategies after that, from 2 to 15 months formation-holding and from 17 to 38 months formation-holding result in significant momentum returns. Furthermore, significant contrarian profits are reported for the last three strategies 46, 47 and 48 months formation-holding period, which gives support to the notion that contrarian strategies yield significant returns in long term.

Lehman (1990) controls for bias due to bid-ask spread, by skipping one trading period between portfolio formation and holding periods. The results obtained are shown in Table 4.1. Contrarian profits result for the first three strategies 1, 2 and 3 weeks formation-holding periods but are insignificant. While momentum profits are reported for the last four strategies 5, 6, 7 and 8 weeks formation-holding periods. For the monthly data, the study skipped one month between formation and holding period. The results obtained are similar to the previous cases. It yields significant momentum profits for most of the strategies from 1-month formation-holding period till 38-month formation-holding periods. Insignificant contrarian profits are reported for the last eight strategies from 40 months to 48 months formation-holding periods.

It can be concluded from these results that in the PSX, the most successful investment strategy is momentum that can generate significant returns in short, intermediate and long horizons. Nevertheless, contrarian profits are reported mostly for weekly strategies and few of the contrarian strategies that yield significant profits were reported in long-term (46, 47 and 48th months formation-holding), only in the case when penny stocks having prices less than Rs 10 have been dropped. So, contrarian strategies yield significant profits in short-term and slightly in long-term.

In view of these results, it is evident that the hypothesis that contrarian and momentum strategies do not generate statistically significant returns can safely be rejected. Evidence for different short-term and long-term contrarian and momentum strategies has been reported. The study provided evidence that strategies based on the previous returns could generate statistically significant returns in PSX both in short-term and long-term. Furthermore, it has been observed that the average cumulative abnormal returns exist for both the contrarian and momentum strategies in different time horizons, so the profits could be attributed to the overreaction and underreaction of stock prices. Furthermore, the profits reported for these strategies vary with the reconstruction of sample and the time period considered. For example, contrarian profits disappear for the strategies once we drop penny stocks from the sample.

5.3. Trading Strategies based on Non-Cumulative Returns

The returns of portfolios in Table 4.2 are different from the cumulative returns depicted in Table 4.1. The procedure for computing the ranking/formation period returns is same in this case as used for cumulative returns (ACARs), however, returns in holding/testing period is computed for the last designated month only and not cumulative of all the inclusive months. This is a more pragmatic method of calculation of returns for momentum and contrarian strategies as it can pinpoint marginal returns of each holding period returns.

The results of the weekly strategies (available on request) show that all the strategies yield momentum profits. Most of the strategies are significant. However, strategies of 9 weeks formation with 3 and 6-weeks holding result in the insignificant returns. We also check the results by skipping one week in formation and holding period to control for bid-ask spread or non-synchronous trading. The results show that few strategies yield insignificant returns e.g. 6 weeks formation with 3 and 6 weeks holding and 12 weeks formation with 3 weeks holding strategies yield insignificant returns. Moreover, the strategy yielding the highest significant returns is 9 weeks formation and 12 weeks holding strategy.

Comparing these results with average cumulative abnormal returns, it is evident that ACARs are larger in percentage than the above average returns, which is obviously due to the cumulative factor. The pattern of returns by investment strategies is different in ACARs. Most of the strategies in weekly ACARs yield contrarian strategies, even when one week is skipped in between formation and holding periods. The reason diagnosed was the presence of penny stocks in the winner and loser portfolios, whose smaller change in prices result in significant reversals in returns.

Table 4.2

Non-Cumulative Holding Period Returns—Monthly Data

The portfolios are formed on the basis of *J*-months lagged returns and then held for *K*-months. The values of J and K for different strategies are indicated in the first column and row, respectively. The stocks are ranked in ascending order on the basis of *J*-months lagged returns. The equally weighted portfolio comprising 30 percent of the lowest past return stocks is the loser portfolio while the equally weighted portfolio comprising 30 percent of the highest past return stocks is the winner portfolio. The average monthly returns of these portfolios are presented in this table. The returns shown in the Panel A are formed immediately after the lagged return are computed for formation/ranking of stocks while the portfolios shown in Panel B are formed one (01) month after the computation of lagged returns for formation/ranking of stocks. The t-statistics are reported in parentheses for *winner-loser* portfolios with 1, 2 and 3 stars, showing significance at 10 percent, 5 percent and 1 percent level respectively. The sample period is June 2004 to March 2014.

Months J(F) K(H)	Panel A				Panel B			
	6	12	24	36	6	12	24	36
6 *loser*	-0.02512	-0.02618	-0.025	-0.02418	-0.0260	-0.0258	-0.02284	-0.02422
6 *winner*	-0.0141	-0.01516	-0.01826	-0.01666	-0.0226	-0.02103	-0.01969	-0.02171
6 *winner-loser*	0.011	0.011	0.00674	0.00752	0.003428	0.004836	0.00315	0.002507
	(4.06)***	(3.28)***	(2.08)**	(1.88)*	(2.25)**	(3.42)***	(1.96)*	(1.23)
12 *loser*	-0.02809	-0.02419	-0.02749	-0.02052	-0.02832	-0.02639	-0.02791	-0.01701
12 *winner*	-0.01259	-0.01444	-0.01875	-0.00879	-0.02261	-0.02039	-0.02247	-0.01271
12 *winner-loser*	0.0155	0.00975	0.00874	0.0117	0.005704	0.005998	0.005438	0.004301
	(5.28)***	(2.95)***	(2.04)**	(3.1)***	(3.52)***	(3.61)***	(2.39)**	(1.58)
24 *loser*	-0.0291	-0.03117	-0.01866	0.01143	-0.02981	-0.03	-0.01537	0.008236
24 *winner*	-0.01489	-0.02057	-0.00767	0.010014	-0.02437	-0.02534	-0.01014	0.01135
24 *winner-loser*	0.0142	0.0106	0.011	-0.00142	0.005437	0.004656	0.005224	0.003114
	(3.53)***	(2.31)**	(1.94)*	(-0.227)	(2.79)***	(2.12)**	(1.89)*	(0.89)
36 *loser*	-0.03091	-0.01986	0.00704	0.011287	-0.02764	-0.01817	0.010318	-0.00331
36 *winner*	-0.01521	-0.00962	0.01276	0.011381	-0.02219	-0.01277	0.01473	0.00404
36 *winner-loser*	0.0157	0.01024	0.00572	9.39E-05	0.005457	0.005402	0.004413	0.007346
	(2.79)***	(1.7)*	(0.71)	(0.00751)	(2.18)**	(1.93)*	(1.03)	(1.05)

Similarly, all the monthly strategies generate momentum profits except one strategy i.e. 36 months formation, 24 months holding strategy, which yields contrarian profit, however insignificant. The largest significant momentum profit resulted from 6 months formation and 36 months holding strategy. In Panel B, all the strategies for 36 months formation yield insignificant returns. The most profitable strategy in Panel B is 12 months formation and 12 months holding strategy, which generates 0.599 percent returns. It is also observed that in case of controlling for the bid-ask spread/non-synchronous trading, returns for most of the strategies are being reduced.

5.4. Risk Adjusted Abnormal Returns

After analysing the behaviour of average cumulative returns, resulting from momentum and contrarian strategies for different time horizons, there is now a need to

explain whether the positive returns reported for momentum and contrarian strategies are due to their levels of risks or not. To accomplish this task, we use the method proposed by Chan (1988). The results of the regression of excess returns of the *winner-loser* portfolios are shown in Table 4.3. As shown in the table, risk-adjusted abnormal returns $\alpha_{p, F}$ of zero-investment portfolio (*winner-loser*) are significant and positive, regardless of the length of the formation period and weekly or monthly frequencies.

Table 4.3

Monthly Risk Adjusted Abnormal Returns

Risk-adjusted abnormal weekly returns for the zero investment portfolios formed with the highest Cumulative Risk Adjusted Returns ACARs during the previous 1, 2, 3....36 months. Risk-adjusted abnormal returns in each of the formation (F) and test (T) periods, for the winner (loser) portfolio with the 30 percent sorted stocks that have had the highest (lowest) ACARs in the formation periods of 1, 2, 3...36 months as well as for the zero-investment portfolio. Period analysed: 2004-2014. KSE-100 index, a value weighted index is used as a proxy of the market portfolio. ***, ** and * shows 1 percent, 5 percent and 10 percent level of significance respectively. The risk adjustment is made with the following regression:

$$R_{p,t} - R_{f,t} = \alpha_{p, F} (1 - D_t) + \alpha_{p, T} D_t + \beta_{p, F} (R_{m, t} - R_{f, t}) + \beta_{p, D} (R_{m, t} - R_{f, t}) D_t + \varepsilon_{p, t}$$

| Strategy | Obs. | Raw data | | | | |
		$\alpha_{p, F}$	$\alpha_{p, T}$	$\beta_{p, F}$	$\beta_{p, D}$	R-squared
1 Formation-Holding	232	0.343***	-0.0135*	0.274***	-0.521***	0.915
2 Formation-Holding	226	0.473***	0.0108	0.0884	-0.220*	0.922
3 Formation-Holding	220	0.576***	0.0250**	0.0592	-0.181*	0.929
4 Formation-Holding	214	0.657***	0.0464***	0.0154	-0.142	0.938
5 Formation-Holding	208	0.725***	0.0452***	-0.0172	-0.0435	0.942
6 Formation-Holding	202	0.783***	0.0447***	-0.033	0.0272	0.948
7 Formation-Holding	196	0.830***	0.0458***	-0.0815	0.0883	0.952
8 Formation-Holding	190	0.870***	0.0505***	-0.133**	0.161**	0.954
9 Formation-Holding	184	0.898***	0.0520***	-0.185***	0.212***	0.957
10 Formation-Holding	178	0.921***	0.0620***	-0.241***	0.302***	0.962
11 Formation-Holding	172	0.943***	0.0709***	-0.277***	0.326***	0.965
12 Formation-Holding	166	0.964***	0.0829***	-0.299***	0.341***	0.967
13 Formation-Holding	160	0.991***	0.0930***	-0.306***	0.338***	0.969
14 Formation-Holding	154	1.012***	0.108***	-0.328***	0.375***	0.974
15 Formation-Holding	148	1.029***	0.116***	-0.337***	0.360***	0.973
16 Formation-Holding	142	1.042***	0.117***	-0.349***	0.351***	0.972
17 Formation-Holding	136	1.057***	0.109***	-0.354***	0.354***	0.971
18 Formation-Holding	130	1.070***	0.108***	-0.354***	0.378***	0.97
19 Formation-Holding	124	1.083***	0.103***	-0.360***	0.373***	0.968
20 Formation-Holding	118	1.092***	0.0928***	-0.358***	0.358***	0.964
21 Formation-Holding	112	1.097***	0.0779***	-0.348***	0.349***	0.961
22 Formation-Holding	106	1.114***	0.0559**	-0.346***	0.341***	0.962
23 Formation-Holding	100	1.137***	0.0305	-0.352***	0.365***	0.964
24 Formation-Holding	94	1.159***	-0.00192	-0.385***	0.358***	0.972
25 Formation-Holding	88	1.186***	-0.0266	-0.421***	0.376***	0.976
26 Formation-Holding	82	1.211***	-0.0585**	-0.455***	0.408***	0.979
27 Formation-Holding	76	1.235***	-0.103***	-0.482***	0.420***	0.982
28 Formation-Holding	70	1.257***	-0.139***	-0.494***	0.448***	0.986
29 Formation-Holding	64	1.263***	-0.175***	-0.460***	0.453***	0.987
30 Formation-Holding	58	1.245***	-0.192***	-0.388***	0.354***	0.988
31 Formation-Holding	52	1.261***	-0.216***	-0.379***	0.319***	0.988
32 Formation-Holding	46	1.299***	-0.255***	-0.413***	0.296***	0.99
33 Formation-Holding	40	1.321***	-0.290***	-0.420***	0.291**	0.988
34 Formation-Holding	34	1.406***	-0.311**	-0.512***	0.377*	0.989
35 Formation-Holding	28	1.342***	-0.377*	-0.415***	0.238	0.991
36 Formation-Holding	22	1.259***	-0.39	-0.317***	0.134	0.994

The abnormal returns in the testing period $\alpha_{p,T}$ are negative and significant for the first six weeks (1 to 6 weeks) formation-holding strategies for the raw data. The abnormal returns of the 8 weeks formation-holding are positive but insignificant. These results are consistent with the simple ACARs computed on weekly basis. Nevertheless, risk-adjusted abnormal returns for the monthly data are somewhat similar. The abnormal returns of the 1-week formation-holding strategies are negative and significant at 10 percent level.

This regression uses the returns for the zero-investment portfolio obtained previously i.e. ACARs. However, in the monthly data, observations have been significantly reduced for long-time periods, which affect the results of the estimates. Therefore, we limit the regression to 36 months formation-holding period instead of 48 months which has been used in ACARs. For the raw data case, the returns for strategies from 3 months to 22 months formation-holding has positive and significant returns, while strategies from 26 to 35 months formation-holdings are negative and significant.

The negative returns shown for the strategies 26 to 35 months formation-holding was previously positive in simple ACARs. However, when the risk is considered, it results in the negative returns. The results show contrarian profits in the short horizon (1 to 6 weeks) as well as in the long-term (26 to 35 months), however, this time more strategies yield significant contrarian profits in the long-term as compared in the case of simple ACAR. Strangely, this effect is even more pronounced in case of dropping the penny stocks from the sample. When penny stocks are dropped, all the strategies yield negative risk adjusted returns and most of the returns are significant in case of dropping the stocks having prices less than Rs 10. So the negative returns might be due to the presence of penny stocks which are mostly illiquid.

On the other hand, momentum profits are reported in the short and intermediate (3 to 22 months) horizon, while in the simple ACAR, momentum profits were observed till 38 months formation-holding.

Furthermore, the $\beta_{p,F}$ reported for all the strategies in the weekly data is insignificant, implying that the systematic risk for momentum portfolios in the formation period is not larger enough to be considered. However, $\beta_{p,D}$ reported is significant and on the other hand most of the strategies yield significant profits. So even when the risk is considered, these strategies result in significant profits except for few strategies. For example, in the monthly data, the abnormal returns for the strategies 23, 24 and 25 months formation-holding are insignificant, which is however significant in ACARs reported in Table 4.1. Moreover, the values of beta for these strategies are significant. So once the risk is considered, the behaviour of these three strategies can be significantly explained. Furthermore, if we look at the returns in the testing period, they have decreased from that in the formation period but generally the values of beta are not big enough to explain the profits fully, to a greater extent. It can be inferred that risk of portfolios could partially explain the returns under these strategies.

The difference in the systematic risk $\beta_{p,D}$ between formation period and testing period is highest for the one-month formation-holding strategy that yields significant contrarian profits. Therefore, it can be stated that the reversion observed in the returns of loser-winner portfolio (contrarian strategy) is due to the difference in risk of the portfolio in the formation and testing period. The $\beta_{p,F}$ of the ranking period is negative on average i.e. 29 out of 36 strategies have shown negative beta which are

reliably different from zero. The beta in the testing period has been increased from that in the formation period with an average gain of 0.243(mean value of $\beta_{p,D}$). Although, the beta can explain the returns to the momentum and contrarian strategies, however, the values of beta of these strategies is very small when compared to their returns to be explained. So $\beta_{p,\,D}$ is still not large enough to account for the profitability of the momentum and contrarian strategies.

Similar summary can be developed for other scenarios both in the monthly and weekly data. The $\beta_{p,\,F}$ in the weekly data has become significant when stocks with trading volume is less than 1000 and 5000, and in the case of dropping the stock having price less than Rs 5 and Rs 10. Moreover, the abnormal returns in the testing period of the 3, 4 and 5 weeks formation-holding strategies (in case of dropping stocks having trading volume less than 1000 shares) become insignificant, which is otherwise significant previously in computation of simple ACARs. So, risk can have a role in explaining the returns of these strategies. It is also evident from the betas in the testing period, which on average are high compared to those in the formation period. Similar results are observed in the case of dropping stocks of trading volume, less than 5000 shares are dropped.

Considering the results, it can be concluded that both short and long horizon contrarian strategies and short and intermediate horizon momentum strategies yield significant profits even after their adjustments for risk. So, one can speak of an overreaction effect in short and long horizon and underreaction effect in short and intermediate horizon. Moreover, explanation of these profits on the basis of risk is limited to very few strategies both in the monthly and weekly data, which is in line with the previous studies [Forner and Marhuenda (2003)]. Even after adjusting for the risk, most of the strategies yield significant positive and negative returns though the magnitude of these returns in the testing period has been reduced than that of the formation period. So, risk partially explains the return of these strategies.

Moreover, in unreported results, we found that the pattern of risk adjusted abnormal returns, observed in the testing period $\alpha_{p,\,T}$ is similar to that obtained for ACARs.

5.5. Weight Relative Strength Scheme (WRSS)

Weighted relative strength scheme (WRSS) is another method of computing returns, proposed by Lo and MacKinlay (1990). WRSS is the investment strategy of buying stocks in proportion to their returns in the formation period. Moreover, stocks that outperform the market are designated as winners and those that underperform the market in the formation period are the loser stocks. The weighted relative profits of these winner and loser stocks are observed in the testing period, which are reported in Table 4.6. This method has been employed to check whether the profits of the investment strategies, reported previously through other procedures, are robust to the method used to compute their returns. Results in Table 4.4 show that the patterns of returns for the different formation-holding strategies are surprisingly similar to those obtained through ACARs in Table 4.2. Nevertheless, it is different from the risk-adjusted abnormal returns reported earlier.

The profits reported for the 1-month formation-holding, just like the ACARs, are negative, which means that they result in contrarian profits but are insignificant.

Nevertheless, McInish, *et al.* (2008) reported that results of the strategy, immediately following the formation period, should be interpreted with caution because it might depict the price patterns resulted from the non-synchronous trading. All other strategies, from 2 months to 36 months formation-holding periods result in momentum profits i.e. they yield positive returns. Furthermore, when all the returns are annualised, both the methods WRSS and ACARs show that the 4 and 5 months formation-holding strategies yield highest significant momentum returns. 4 and 5 months formation-holding strategies yield 38.4 percent and 36.24 percent annual returns through WRSS procedure while 22.17 percent and 20.44 percent annualised returns are reported through ACARs procedure. The next highest returns strategies are different for both the strategies. The annualised returns computed through WRSS and ACARs are shown in Table 4.5.

Table 4.5

Comparison of Annualised ACARs and WRSS Returns

The table provides the annualised returns of the strategies reported in Tables 4.2 and 4.6 for ACARs and WRSS. The returns are sorted, based on the absolute values, irrespective of the signs of the profits reported.

Strategy	WRSS	Annualised WRSS Returns	Strategy	ACARs	Annualised ACARs
4 Formation-Holding	0.128	38.40%	4 Formation-Holding	0.0739	22.17%
5 Formation-Holding	0.151	36.24%	5 Formation-Holding	0.0852	20.45%
3 Formation-Holding	0.084	33.60%	6 Formation-Holding	0.0963	19.26%
7 Formation-Holding	0.188	32.23%	15 Formation-Holding	0.24	19.20%
8 Formation-Holding	0.212	31.80%	10 Formation-Holding	0.158	18.96%
6 Formation-Holding	0.158	31.60%	14 Formation-Holding	0.221	18.94%
9 Formation-Holding	0.232	30.93%	16 Formation-Holding	0.252	18.90%
10 Formation-Holding	0.249	29.88%	9 Formation-Holding	0.141	18.80%
11 Formation-Holding	0.258	28.15%	8 Formation-Holding	0.124	18.60%
12 Formation-Holding	0.278	27.80%	11 Formation-Holding	0.169	18.44%
13 Formation-Holding	0.297	27.42%	7 Formation-Holding	0.107	18.34%
14 Formation-Holding	0.317	27.17%	17 Formation-Holding	0.259	18.28%
15 Formation-Holding	0.336	26.88%	13 Formation-Holding	0.198	18.28%
16 Formation-Holding	0.354	26.55%	12 Formation-Holding	0.182	18.20%
17 Formation-Holding	0.371	26.19%	18 Formation-Holding	0.267	17.80%
18 Formation-Holding	0.385	25.67%	19 Formation-Holding	0.281	17.75%
19 Formation-Holding	0.397	25.07%	3 Formation-Holding	0.0443	17.72%
20 Formation-Holding	0.411	24.66%	20 Formation-Holding	0.293	17.58%
21 Formation-Holding	0.426	24.34%	21 Formation-Holding	0.303	17.31%
22 Formation-Holding	0.443	24.16%	22 Formation-Holding	0.303	16.53%
23 Formation-Holding	0.459	23.95%	23 Formation-Holding	0.29	15.13%
2 Formation-Holding	0.0399	23.94%	2 Formation-Holding	0.0232	13.92%
24 Formation-Holding	0.476	23.80%	24 Formation-Holding	0.274	13.70%
25 Formation-Holding	0.492	23.62%	25 Formation-Holding	0.255	12.24%
26 Formation-Holding	0.507	23.40%	26 Formation-Holding	0.223	10.29%
27 Formation-Holding	0.522	23.20%	27 Formation-Holding	0.198	8.80%
28 Formation-Holding	0.535	22.93%	1 Formation-Holding	-0.0069	-8.22%
29 Formation-Holding	0.546	22.59%	28 Formation-Holding	0.179	7.67%
30 Formation-Holding	0.556	22.24%	29 Formation-Holding	0.15	6.21%
31 Formation-Holding	0.565	21.87%	30 Formation-Holding	0.146	5.84%
32 Formation-Holding	0.574	21.53%	31 Formation-Holding	0.139	5.38%
33 Formation-Holding	0.578	21.02%	32 Formation-Holding	0.139	5.21%
34 Formation-Holding	0.581	20.51%	33 Formation-Holding	0.131	4.76%
35 Formation-Holding	0.576	19.75%	34 Formation-Holding	0.121	4.27%
36 Formation-Holding	0.569	18.97%	35 Formation-Holding	0.101	3.46%
1 Formation-Holding	-0.0009	-1.13%	36 Formation-Holding	0.0851	2.84%

Comparing the WRSS returns to that obtained through ACARs procedure, it observed that the patterns of returns are similar, however, in absolute terms the WRSS returns are much higher than the ACARs. The reason is the difference in mathematical procedure of WRSS and ACARs. ACARs use the geometric mean of the returns of all the stocks in each winner and loser portfolio, while WRSS takes the simple arithmetic mean. The difference is also due to the use of weights computed in the ranking period. However, both use the market adjusted returns in their procedures.

5.6. Decomposition of Momentum and Contrarian Profits

The profits presented in Table 4.4 through WRSS procedure has been decomposed through Lo and MacKinlay (1990) model with the help of model developed by Jegadeesh and Titman (1995). The three components in the Lo and MacKinlay model are denoted by σ^2_μ (cross-sectional risk among stocks), Ω (correlation or time pattern of stocks that exhibit market inefficiency exploitable by trading strategies i.e. momentum or contrarian strategies) and $\sigma^2_f \delta$ (lead-lag effect as analysed by Lo and MacKinlay (1990)). The components of 1 to 5 months formation-holding strategies are shown in Table 4.8.

Results reported in Table 4.5 show that the variance of expected stock returns σ^2_μ is positive and results in the decrease in contrarian profits. Moreover, those stocks which have higher expected returns experience higher than average returns both in formation and holding periods. So, it is the reason that this component reduces contrarian profits and increases momentum profits. The second term is Ω, which is the cross-sectional average of serial covariance of the idiosyncratic component of individual stock returns (error terms) and is taken as proxy for the overreaction effect. This component is determined by the overreaction of stock prices to firm specific information or due to the investors' sentiment on a specific stock. If there is overreaction of stock prices to firm specific information and the overreaction corrects in the following period, the value of own-serial covariance will be negative. Thus, it will increase contrarian profits but will decrease the momentum profits.

Table 4.6

Decomposition of Contrarian and Momentum Profits

Profits of the strategies from 1 to 5 months formation periods are decomposed according to Lo and MacKinlay Model. The percentages in the parenthesis show the relative contribution of each factor to the contrarian and momentum profits.

Strategy	σ^2_μ	Ω	$\delta \sigma^2_f$
Expected profit of the contrarian strategy = $- \sigma^2_\mu - \Omega - \sigma^2_f \delta$			
1 Formation-Holding	0.00211	-0.00278	-0.00018
(Contrarian)	(-42%)	(55%)	(4%)
Expected profit of the momentum strategy = $\sigma^2_\mu + \Omega + \sigma^2_f \delta$			
2 Formation-Holding (Momentum)	0.00722	0.03829	-0.0019
	(15%)	(81%)	(-4%)
3 Formation-Holding (Momentum)	0.01579	0.08584	-0.01119
	(14%)	(76%)	(-10%)
4 Formation-Holding (Momentum)	0.03039	0.13942	-0.02506
	(16%)	(72%)	(-13%)
5 Formation-Holding (Momentum)	0.04434	0.17012	-0.01632
	(19%)	(74%)	(-7%)

Moreover, if there is underreaction of stock prices to firm-specific information or if noise trading cancels each other and there is no creation of sentiments, the own-serial covariance will be positive. In this scenario, it will contribute to the momentum profits. Their values for one-month formation-holding strategy are negative, which will increase the contrarian profits. The positive impact is also evident when its value is being put in the equation given in the table.

The last term $\sigma^2_f\delta$ is the proxy for lead-lag structure of returns proposed by Jegadeesh and Titman (1995). It is the cross-sectional variance of common factors' unexpected realisation times the cross-sectional average of individual stocks cross-serial covariance of contemporaneous and lagged sensitivities to common factor realisation. If $\sigma^2_f\delta$ is negative (i.e. if cross-serial covariance between contemporaneous and lagged betas is negative), it means that case lead-lag structure contributes positively to contrarian profits and negatively to momentum profits and vice versa if $\sigma^2_f\delta$ is positive. For example, it is negative for one-month formation-holding, so it means it contributes positively to the contrarian profits.

Relative contribution of each component is also given in Table 4.6 in percentages. However, the first component, which instead of contributing to the contrarian profits, decreases it by 42 percent. So, the cross-sectional risk among stocks is one of the most important key factors, according to Lo and MacKinlay model that accounts for the decrease in contrarian profits in PSX. The second term which is proxy for the overreaction effect is the biggest contributing factor (55 percent) to the contrarian profits. It shows that stock prices reaction to information in the stock market is significant factor that yields contrarian profits in the one-month formation-holding strategy. Moreover, it also accounts for the market inefficiency. The third component which is proxy for the lead-lag effect contributes positively but in relatively very less amount (4 percent).

Similarly, four momentum strategies are decomposed, given in Table 4.6. The first factor, i.e. cross-sectional risk reported for all the momentum profits is positive and so is contributing positively to the momentum profits. The second term which is the own-serial covariance of error term is positive for all the four momentum strategies. It means that stock prices underreact to firm specific information. Surprisingly, it is negative for all the momentum profits in PSX and so is causing it to reduce.

The relative contribution of each factor is highest for the underreaction effect. In PSX, investors do not seem to associate sentiments with the stock prices and it becomes consistent over a period of time, giving rise to momentum profits. The first component, i.e. variance of expected returns is the second highest contributing factor to momentum profits. The lead lag structure is the only factor that reduces the momentum profits in PSX. However, the percentage by which it reduces the momentum profits is relatively less than the percentage of the other two factors that contribute positively to the momentum profits.

6. CONCLUSION

In this paper, we sought (i) to check the presence of contrarian and momentum investment strategies in the PSX, (ii) to provide risk-based explanation for momentum and contrarian profits obtained, and (iii) to split contrarian and momentum profits into its components on the basis of Lo and MacKinlay model. We accomplished these objectives

by analysing the data of 581 firms listed at the PSX, for 11 years' time period from 2004-2014. We analysed the significance of contrarian and momentum strategies through three different methods i.e. Average cumulative abnormal returns, risk-adjusted abnormal returns and weighted relative strength scheme returns. In computing average cumulative abnormal returns, we used six different cases for weekly and monthly formation-holding periods separately, to examine whether the profits obtained through the investments strategies differ with the changes in the data or not. The pattern of returns in these different scenarios is generally the same with minor difference. For example, dropping stocks, having trading volume less than 500, 100 and 5000 (highly traded stocks) in the monthly data, all the strategies yield significant momentum profits. The most significant variable that changed the results from momentum to contrarian camp is the presence of small or penny stocks. When we drop penny stocks in the monthly data (stocks having prices less than Rs. 10), three significant contrarian profits are reported (46, 47 and 48 months formation-holding periods). Moreover, dropping penny stocks in the weekly data yielded significant momentum profits which were previously contrarian. Our tests indicate that if investors use raw data, without removing penny stocks, they will observe significant contrarian profits in short-run. One reason for this finding might be that penny stocks are usually illiquid. When they show profit or loss in one period, they remain inactive in the next.

Generally, the patterns of returns obtained for weekly and monthly formation-holding strategies are different. Comparing the results of the weekly raw data, we get significant contrarian profits (1 to 5 weeks formation-holding strategies) and significant momentum profits (7 and 8 weeks formation-holding strategies). So interestingly, contrarian and momentum strategy yield significant returns in short-term. The result of contrarian profits in such a short term is due to the penny stocks that do not trade quite frequently. For the monthly data, significant momentum profits are reported for 2 to 38 formation-holding strategies. Although contrarian profits also exist in long-term for 41 to 48 months formation-holding strategies but they are insignificant. However, variation in these patterns has been observed in different scenarios both for weekly and monthly formation-holding strategies, as discussed in the above paragraph. Therefore, the significance of momentum and contrarian profits is the evidence that stock prices show underreaction and overreaction in PSX.

Moreover, the profits reported through ACARs have been used to examine that whether such profits could be explained on the basis of risk. However, we fail to provide much evidence for explaining these profits, based on systematic risk. Furthermore, the pattern of the returns of the strategies obtained through WRSS is interestingly similar to those obtained for ACARs (compared with the ACARs of only raw data). All the strategies (2 to 36 months formation-holding strategies) yield significant momentum profits. Although the pattern observed in WRSS is similar to that of ACARs, nevertheless, the returns obtained through WRSS are much higher than computed through ACARs. Moreover, we also converted the portfolios' returns to annualised form. Both WRSS and ACARs have shown that the 4 and 5 months formation-holding strategy will yield highest significant momentum profits. Nevertheless, after that, the ranking of portfolios in WRSS and ACARs, based on annualised returns, differs. Further, our results indicate that cross-sectional risk decreases the contrarian profits. While the time series

pattern (overreaction effect) and lead-lag structure contribute positively to the contrarian profits. Relatively, the overreaction effect is the largest contributing factor of the one-month contrarian profits in PSX.

Our findings show that penny stocks significantly impact the performance (i.e. reverses especially in case of weekly strategies) of momentum portfolios. Future researches might enquire about the reasons and channels through which penny stocks exert influence on momentum portfolios. Furthermore, we found that share trading volume has positive relation with the momentum profits in the weekly data. So, there is a need to find that whether such relation exists in other stock markets or not?

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