International Journal of Finance and Managerial Accounting, Vol.2, No.6, Summer 2017

# Overreaction & Under reaction: Evaluating performance and Speed of Adjustment Investment Strategies in Tehran Stock Exchange (TSE)

**Mahdi Madanchi Zaj**
Ph.D. Candidate, Department of Financial Management, Science and Research Branch, Islamic Azad University, Tehran, Iran
madanchi@iauec.ac.ir

**Hashem Nikoomaram**
Faculty Member, Department of Financial Management, Science and Research Branch, Islamic Azad University, Tehran, Iran
(Corresponding author)

**Ali Saeedi**
Faculty Member, Department of Management, North-Tehran Branch, Islamic Azad University, Tehran, Iran

## ABSTRACT

In this research, overreaction and underreaction have been studied by assessing profitability and excess returns of investment strategies and evaluating price adjustment speed in short and long terms. The results showed that the momentum investment strategies had higher annual returns in comparison to contrarian strategies in all short and long periods which led to confirmation of underreaction phenomenon and rejection of overreaction. The small size and value portfolios had higher significant returns. The highest current price to 52-week high ratio portfolios had higher returns than the lowest portfolios in short and long term periods, which is an evidence of momentum and underreaction phenomenon in the market. In addition, the speed of investment strategies adjustment to market-wide information was assessed using Dimson Beta regression and some evidences of the underreaction in short term and overreaction in long term were confirmed. The influence of winner and loser portfolio formation and holding months was observed.

## Keywords:

Overreaction, Underreaction, Speed of Adjustment Price, Market Efficiently.

## 1. Introduction

According to the efficient market hypothesis (EMH) of Fama (1970) investors' response to new information, plays the main role in degrees of the securities market efficiency. If the investors' response is quick, the market moves toward the efficiency and in case of any delay or disruption in the investors' response, the efficient market efficiency degrees get less. If information diffuses gradually across the population, prices underreact in the short run. Continuation of price movements in short term due to the momentum result in overreaction in long-term. So reversal returns in long term, indicate correcting on false move that ultimately leads to correcting overreaction (Hong and Stein, 1998). One of the methods of overreaction and underreaction assessment, is testing the profitability of investment strategies. De Bondt and Thaler (1985), found that the annual returns of loser portfolios were more than winner portfolios returns. They inferred that their findings are caused by investors' overreaction.

Jegadeesh and Titman (1993), observed stocks price momentum in short term and proposed momentum strategy. They found out that selling loser and buying winner stocks for the short term holding periods have had excess returns, which was interpreted as the underreaction. In some researches both underreaction and overreaction were studied at the same time. There are three well-known behavioral finance models including Daniel, Hirshleifer & Subrahmanyam (1998), Barberis, Shleifer & Vishny (1998) and Hong & Stein (1998) models. In this study, underreaction and overreaction in Tehran Stock Exchange have been examinned simultaneously.

The main question in this paper is whether the investors in the Tehran Stock Exchange have underreaction in short term and overreaction in long term? Therefore, the research hypotheses are as follows:

**Hypothesis 1:** The returns of winner portfolios are higher than loser portfolios in short term.

**Hypothesis 2:** The returns of loser portfolios are higher than winner portfolios in long term.

**Hypothesis 3:** The returns of portfolios based on highest and lowest quartiles of variables including value, size and 52-week high (momentum) in short term and long term are different.

In addition, we studied simultaneous underreaction and overreaction by assessing the speed of investment strategies returns adjustment to market-wide information using Dimson beta regression and the following hypothesis was resulted:

**Hypothesis 4:** Portfolio adjustment speed of winner portfolios and the highest quartiles of firm-specific variables to market-wide information is different with adjustment speed of loser portfolios and the lowest quartiles of variables.

Finally, to examine the impact of calendar effects on winner and loser portfolios' (momentum effects) we tested month effects of portfolios` formation and holding and the hypothesis is as follows:

**Hypothesis 5:** The average returns of different months of (12 months) formation and holding of each investment strategy are different.

In this study, our population consists of all stocks listed on the TSE in Iran included in all companies for a period of 15 years from March 21, 2002 to February 19, 2016. To test overreaction and underreaction following the Jegadeesh & Titman (1993) and De Bondt and Thaler (1985), winner and loser portfolios were constructed weekly and held at various short term to long-term periods, then their average returns were compared with each other. In addition the firm-specific variables portfolios including P/E, the size and the 52-week high, were formed weekly and their performances were evaluated. Further in order to assess the impact of momentum, value and size factors on underreaction and overreaction, the adjustment speed of investment strategies returns to market-wide information was evaluated and the lead, and lagged coefficients of Dimson beta regression were used, in compliance with Brennan et al (1993) and Chorida and Swaminatan (2000). At the end according to Zarowin (1985 and 1990) and Wang (2008) we evaluated month effects of winner and loser portfolios formation and holding.

The results showed that annual returns of winner portfolios were more excess than loser portfolios in all short and long holding periods and under reaction was approved and overreaction phenomenon was rejected. The efficiency of momentum strategies in the short term, was consistent with Jegadeesh and Titman (1993), Chan et al. (2000), Wong (2008), Rastgoi (2009) respectively. Non-efficiency of the contrarian strategies was contrary to Conrad and Kaul (1998), Grinblatt and Keloharju (1998), Dahlquist and Broussard (2000), Daniel et al. (2000), Soares and Serra (2005) and Wu (2004), but research result were

in agreement with Foster and Kharazi. Higher returns of value and small size portfolios were observed and higher return of portfolios based on higher current price to 52-week high ratios in short and long term periods was found which consistent with the underreaction. Furthermore, the adjustment speed of investment strategies returns to market-wide information was assessed by Dimson beta regression and evidences of underreaction in short term and overreaction in long term were verified. In addition, the month effects of winner and loser in portfolios formation and holding month were observed, and evidences suggested differences in 11th, 4th, 12th and 5th months in portfolios.

This paper proceeds as follows: In the next section, the literature and some related studies on investment strategies, overreaction and underreaction and speed of price adjustment were introduced. Then data and methodology were described. After that the results of investment strategies, price adjustment speed and examinations of month effects were presented and explained. Consequently, the conclusions were drawn.

## 2. Literature Review

### 2.1. Overreaction

De Bondt and Thaler (BT) (1985), studied investors overreaction by momentum and contrarian strategies on the NYSE for the period between 1926 to1982. They showed that the average of loser portfolios` annual returns were 8% more than winner portfolios. They interpreted that their findings were derived from investors overreaction. Despite some criticisms, the BT results, were confirmed for other country markets (Soares and Serra, 2005).

Zarowin (1990) argued that, the size effect and January effect can influence on BT results and studied January effect along with momentum effect. He found that the loser portfolios in future 36- month periods have higher performances. Also, he compared the all months returns with the returns of January and February – December, by which the January effect has been a major factor in better performance over previous loser portfolios. In addition, Wang (2008) evaluated the efficiency of momentum strategies in UK, Germany, Japan, and China and didn't observe January effect in these markets.

Moskowitz and Grinblatt (1999), discovered a strong momentum effect in the industries. They showed buying the last winner industries and selling the last loser industries led to excess returns. Kubota and Takehara (2010) added liquidity and momentum factors to Fama and French (1993) 3-factor unconditional model and presented five-factor model. They evidenced the five-factor model was better than Fama and French three-factor model.

### 2.2.Underreaction

Jegadeesh and Titman (JT) (1993), observed movement of share's prices in short term and introduced momentum investment strategy. They showed that a strategy that buys stocks with the highest positive return in J months (winners), and sells them with the lowest returns in the same period (losers), yielded significant abnormal returns during the following K months (here J and K are in multiples of 3 to12), that is consistent with underreaction to firm-specific news. Further they found that winner stocks had a better performance than loser stocks, around the quarter earnings announcement dates, in the first 6 months. In 2001, they again updated research data and confirmed the previous findings and explained that profitability of momentum strategies could be entirely due to cross-sectional variation in expected returns rather than to any predictable time-series variations in stock returns.

The JT, were confirmed in other studies; Grinblatt et al. (1994) Chan et al. (1996), Han and Tonks (2001) in UK, Rastgoi et al. (2009) in India, Wang (2008), in UK, Germany and China, Wang and Wu (2011) and Moskowitz at al. (2012). Sources of momentum profitability have been examined in several studies which explored momentum profitability with growth, value and volume of transactions. Lee and Swaminathan (2000) found that momentum premium for stocks with higher transaction volume is more for winner and loser portfolios. Chan *et al*. (2000) showed that higher profits for momentum portfolios were implemented on markets with higher volume in the previous period, indicating that return continuation is stronger following an increase in trading volume.

Tziogkidis and Zachouris (2009) compared the performance of simple momentum and variable-oriented momentum strategies based on 20 firm-specific variables. They found that top analysts' EPS estimate revisions followed by low P/E and high ROE contribute the most in producing momentum portfolios

of superior performance, compared to a simple price momentum strategy that indirectly inferred market underreaction to various announcement EPS. George and Hwang (2004) found that return of the 52 -week high strategies are about twice as large as those associated with size and bid-ask bounce strategies.

Also Liu et al. studied (2011) momentum strategy of 52-week high on international markets (including 16 countries; Austria, Russia, Belgium, Denmark, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, Taiwan and UK) and showed that this strategy has been profitable in ten countries.

## 2.3. Simultaneous Overreaction and Underreaction

In some researches overreaction and underreaction have been studied at the same time. Evidences of simultaneous overreaction and underreaction are found in De Bondt and Thaler (1985). Cutler et al. (1991), found positive short-lag autocorrelations and negative autocorrelations at horizons of a few years for 13 stock markets. Also results of momentum and later reversal were confirmed in some studies (Kaestner, 2006).

Lehmann (1990), forming the loser and winner portfolios found that the loser portfolios in the next week, had abnormal positive returns and winner portfolios, had abnormal negative returns. Abarbanell and Bernard (1992) studied overreaction and underreaction of analysts to previous earning information as an explanation for the abnormal behavior of stock prices. They found evidences of analysts' predictions underreaction to recent earning and the post earnings announcement drift (PEAD). Conrad and Kaul (1998) found that momentum strategy was profitable for medium-term period of three to twelve-months. Contrarian strategy was appropriate in short weekly or monthly periods and long-term horizons of three to five years. Grinblatt and Keloharju (1998) showed that momentum strategies performances were significant in Finland stock exchange and individual investors used contrarian strategies based on the past returns of 3 to 6 months ranking periods and institutional investors tended to use the contrarian strategy. Dahlquist and Broussard (2000) examined the contrarian strategy and found that returns of holding periods were not significant, but the sale of winners was significant.

In simultaneous overreaction and underreaction studies, there are three behavioral finance models including Daniel, Hirshleifer & Subrahmanyam (DHS) (1998), Barberis, Shleifer and Vishny (BSV) (1998) and Hong and Stein (HS) (1991). While interpreting the overreaction, DHS addresses two biases, overconfidence and self-attribution of investors when making investment decisions. DHS believes that investors are overconfident on their own information and only adjust them slightly when signals are contrary to them. Underreaction is the result of an initial overreaction and later correction of this pricing is not authentic. On the contrary, if signals confirm investors' ideas, then overreaction will continue and price will move more than reasonable evaluation. BSV proposed a model based on representativeness and conservatism regime concepts with combining two normal modes which are mean reversion and trending regime which lead to overreaction in some situations and underreaction in others. When investors think they are reversing to mean and expect that signal (profit) will be reversed in the next period, underreaction will occur. HS modeled overreaction and underreaction phenomena with a focus on heterogeneous combination of two types of investors in the market; news watcher investors who trade based on private information and momentum traders. He assumed that private information gradually spreads among the news watcher traders. His model predicts stocks prices which have underreaction over the short term to medium term periods and overreaction during long term periods.

Hill and Eggins (2000) proposed a new category of investment strategies, allocated high weight to the stocks that had high performance recently while the reverse indices allocated lower weights to these stocks. They found that the short term momentum and long term reverse indices, have had higher performances than the benchmark indices.

Gutierrez et al. (2004) investigated momentum strategies in short term and contrarian strategies in long term by using cross-sectional returns of stocks. They considered state of the market as a proxy of investors' tendency to risk aversion. They found that momentum return occur only when the market is in growth state that agrees with overreaction hypothesis. The findings of Soares and Serra (2005) in Portuguese

Stock Market supported overreaction hypothesis and value strategies had superior performance. Further they found weak evidences weak evidence in support of momentum effects that persisted after controlling for risk.

Patro and Wu (200٦) showed that the mean-reversion and momentum can occur jointly and considering the interactions between them is important. Using data for 18 indices of developed equity markets, they found that the mean-reversion and momentum were negatively related to each other. Kaestner (2006) found that investors had underreaction to earning announcement in short term and simultaneous had overreaction to the past earnings surprise in long time. Zhu (2007) examined Hong Kong stock market behavior for abnormal price movements in a trading day using Hang Seng data indices. The results indicate that investors tend to have underreaction to the good news and overreaction to the bad news.

Foster and Kharazi (2008) examined Return of momentum and contrarian investment strategies in the 2002-1997 period using the weekly and daily top 50 Indexes in Tehran Stock Exchange. They found that only momentum strategy had above-average returns over an intermediate (3–12 month) horizon but contrarian strategies didn't so.

Lin *et al.* (2016) found that the earnings momentum generated remarkably high profits in Taiwan, but found no momentum premium for conventional momentum strategies. Their finding support for the underreaction hypothesis and rejects the overreaction hypothesis in explaining the profitability of the earnings momentum.

*Mehrani et al. (2016)* studied contrarian and momentum strategies in periods associated with optimism, pessimism and normal market sentiment condition. They showed that combining normal market sentiment with behavioral finance strategies increases performances, additionally results seen using contrarian strategies compared to momentum strategies.

## 2.4. Speed of price adjustment

The price adjustment is the process of reflecting information into stock price. This process causes, the stock trading price get closer to its true value and eventually it gets equal to that (Amihud & Mendelson, 1987). Market efficiency is in relation with rapid and complete information reflection, hence, faster and more complete price adjustment result in more efficient market degree (Damodaran, 1993). Speed of stock prices adjustment is, the period of time it takes to reflect information into the stock price and the stock trading price gets to its real value. Speed of assets price adjustment to their intrinsic values, presents the direct criteria of underreaction and overreaction degrees in financial markets (Theobald & Yallup, 2004).

The approaches of studying price adjustment speed are classified in three different categories; approach of security speeds of price adjustment towards the intrinsic values, speed of price adjustment to firm specific information, speed of price adjustment to market wide information. In approach of speeds of price adjustment towards the intrinsic values of securities different models have developed based on autocorrelation functions that evaluate reflection speed of new information in each share or portfolio. These studies are derived from overreaction and underreaction behavioral models such as DHS, BSV and HS which are inferred from returns series particular autocorrelation patterns.

Price adjustment speed to firm specific information approaches are based on event study methodology that is primary tool for assessing the speed of stock price adjustment to various kinds of information, such as stock splits, merger and acquisitions, the sale of initial public offerings, exchange listings, spinoffs, and proxy contests (Lim, 2009).

## 2.5. Price adjustment speed to market-wide information approach

Since Lo and Mackinlay (1990) found, return on large stocks, leads to small stocks (not vice versa), the lead-lag effects sources have been the subject of many studies. Hence it is inferred that some stocks react to market-wide information with more delay than other stocks. Brennan *et al.* (1993) using Dimson regression found that firm size, liquidity and number of investment analysts following a firm are all significantly related to price adjustment speed. Many analyst firms also tend to respond more rapidly to market returns than do few analyst firms, adjusting for firm size.

Jegadeesh and Titman (1995) proposing a multi-variable model examined the contribution of stock

price overreaction and delayed reaction to the profitability of contrarian strategies. They showed that stock price reacted to common factors with a delay but it overreacted to firm-specific information. Delayed reactions to common factors gave rise to size-related lead-lag effects in stock returns and most of the contrarian profit was due to stock price overreaction. Du *et al*. (2011), following JT, and focusing on two groups of portfolios based on industry and size, found significant reaction pattern to common information and size was proxy of delayed reaction to common information.

Chorida and Swaminatan (2000) found that returns on high transaction volume portfolios lead to returns on low volume portfolios significantly. They used Dimson beta regression, for zero investment portfolios including equal sizes of high transaction volume portfolios and low volume portfolios to test cross-autocorrelations sources. They found that lead-lag effects react more slowly to market-wide information for the low volume than high volume stocks.

Chiao *et* al. (2004) investigated the price adjustment and lead-lag relations between returns on five size-based portfolios in the Taiwan stock market. They found that the price adjustment of small-stock portfolios is not slower than that of large-stock portfolios. Further, they found evidences that supported a positive leading role of large-stock portfolio returns over small-stock portfolio returns.

Marshall and Walker (2002) studied daily stock price reaction to new information of grouped portfolios by size quintiles of shares traded in the Santiago de Chile Stock Exchange. Using cross-correlation, autocorrelation and Dimson beta regression, they found that large company stock prices react to both good and bad news sooner than smaller ones. Chiang *et al.* (2008) examined speed of stock price adjustment in the Chinese stock markets and showed that tradable shares for domestic individual investors react to market wide information faster than the tradable shares for foreign institutional investors. Additionally using Dimson beta regression they examined that the stocks with higher information flow and more prominent situation in the stock market are adjusted to information faster.

Lim (2009) developed a model similar to Hou and Moskowitz (2005), for assessing stock price adjustment to market-wide information with the market returns for weekly stocks returns at the same time and four week lags. Prasanna and Menon (2012) found that in India, large firms and firms with high turnover and trading volume, assimilated the market wide news faster, when compared with others. In addition, Stocks with high firm value and share price volatility were found to adjust to market information faster and firms with higher financial leverage took a longer time for price adjustments.

# 3. Methodology

## 3.1. Portfolio construction methods

In this study, the overreaction and underreaction is evaluated by assessing investment strategies profitability. Therefore, two groups of stock portfolios were formed: the momentum and contrarian strategies and the firm-specific variables based strategies. The winner and loser portfolios were formed following the Jegadeesh and Titman (1993) and De Bondt and Thaler (1985). First of all, returns of all stocks have been calculated in the 11 past periods as ranking periods including J = 1, 2, 3, 4, 12, 24, 48, 72, 96, 144 weeks. Then they were sorted all stock returns during ranking periods and selected 25% of the highest returns stocks as winner portfolios and 25% of the lowest return stocks as loser portfolios. In order to form the firm-specific variables based portfolios including P/E, size and current price to 52-week high ratio, these variables were sorted weekly for all stocks and then selected 25% of the highest and 25% of the lowest variables as higher and lower quartiles` portfolios. Portfolios were formed with equal weight and held in 8 periods as a period of holding including K =1, 2, 3, 12, 24, 48, 96, 144 weeks. The portfolios rebalanced weekly and assumed no trading costs. To assess underreaction and overreaction a wide spectrum of ranking and holding periods in the short term to long term were implemented.

Thus, 88 momentum strategies and 88 contrarian strategies are constructed using all combinations among the 11 ranking periods and 8 holding periods (8×11). Further, 48 firm-specific variables strategies are constructed considering 3 variables and the high and low quartiles portfolios of each variable and 8 holding periods (3×2×8).

To minimize small-sample biases in estimators of the profits` components of the investment strategies and to increase the power of the research tests following Conrad and Kaul (1998), investment

strategies were implemented for overlapping holding periods on a weekly frequency. Therefore, there was 777 observations for all of the strategies. The portfolio formation and back testing procedure has been programed in MATLAB program.

## 3.2.Data

The population consisted of all stocks listed on the TSE in Iran included in 417 companies for a 15 year period from March 21, 2002 to February 19, 2016 and the whole population is examined. The data of Tehran Stock Exchange are extracted from Rahavard Novin software.

## 3.3.Variables

- Return of any stocks over a ranking period ($RPR_{i,n}$), using daily stocks adjusted returns on dividends and increase in capital ($r_{it}$), is calculated according to equation (1 ):

$$RPR_{i,n} = \prod_{i=1}^{n}(1 + r_{i.t}) - 1 \quad (1)$$

- Returns of equal weighted portfolios for holding periods, is calculated according to equation (2):

$$PHPR_t = \frac{\sum_{i=1}^{n} HPR_{i,t}}{N} \quad (2)$$

- To evaluate the strategies returns over the various holding periods, their average returns (R Hold Period), are formed as the annual return (RAnnualized) through equation (3):

$$R_{Annualized} = \left[(1 + R_{Hold\ Period})^{1/n}\right] - 1 \quad (3)$$

- We used the information ratio to compare different strategies. Its higher value indicates to higher excess returns relative to the risk incurred. This ratio is calculated as equation (4):

$$Information\ Ratio\ (IR) = \frac{The\ annual\ excess\ return}{The\ annual\ tracking\ error} \quad (4)$$

where:

$$Tracking\ Error = \sqrt{\frac{\left(\sum_{i=1}^{n}(excess\ return)\right)^2}{n}} \quad (5)$$

- Tracking error of the strategies during holding periods is made annual through equation (3).
- The current price to the 52-weeks high ratio (P / 52-Week high)

this ratio is obtained through division of the current stock price to the 52- week high at any date, according to Equation (6):

$$(52\text{WH})P/52 - Week\ high = \frac{P_t}{52-Week\ high} \quad (6)$$

The higher values of 52WH indicate that the current price of a stock is closer to its 52-week high price. The highest possible value of 52WH is 1, which occurs when the current price is the 52-week high price (Hao *et al*., 2014). In addition to the 52WH measure, we also consider alternative strategies based on Jegadeesh and Titman's (1993) price momentum. Therefore, if the highest possible value of 52WH is closer to 1 it is proxy of momentum and if its closer to 0 it would be proxy of contrarian.

- P/E ratio (forward P/E)

The forward P/E ratio is reported in website of TSE daily.

- The market value:

This variable is proxy of the firm size and is calculated by market-cap logarithms.

- For measuring the speed of price adjustment of investment strategies to market-wide information, according to Brennan et.al (1993) and Chorida et.al (2000), we applied Dimson beta regression for each investment strategy. This method the first was introduced by Dimson in 1979. To do so, weekly returns of TSE dividend and Price Index (TEDPIX) were used as market return proxy, hence we consider a net zero investment portfolio returns 0 that is long in portfolio B and short in portfolio A. So a regression of the return on the net zero investment portfolio returns on the market return is:

$$r_{O,t} = \alpha_O + \sum_{k=-K}^{K} \beta_{O,k}\, r_{m,t-k} + u_{O,t} \quad (7)$$

Where:

$\sum_{k=1}^{k} \beta_{o,k} = 0$ Sum of adjustment factors with portfolio delays

$\sum_{k=-k}^{1} \beta_{o,k} = 0$ Sum of portfolio lead adjustment factors

a. If $\sum_{k=1}^{K} \beta_{O,k} < 0$ and $\beta_{O,0} > 0$, the Portfolio B is adjusted more rapidly to common information than portfolio A. In other words, evaluation of the adjustment speed (relative to the market portfolio) is a function of both contemporary beta and the lagged betas and vice versa.
b. For Dimson beta regression five lead periods (weeks), and five lag periods are used.
c. Higher speed of a strategy than another strategy represents its overreaction to the market-wide information. In other words, its underreaction is less in that strategy.

### 3.4. Methods

We used t-student test to test the comparison between investment strategies in similar holding periods. Due to the volatility and risk of different investment strategies, the information ratio as a measure of risk-adjusted returns was used for better comparison between the strategies. If winner portfolios returns more than the loser portfolios is underreaction exists and on the other hand more returns of loser portfolios than winners indicate to the overreaction phenomenon.

In addition to assess the impact of momentum, value and size factors in investors' reaction and following Brennan *et al.* (1993) and Chorida *et al.* (2000), the speed of investment strategies adjustment to market-wide information was evaluated and the Dimson beta regression lead- lag variables coefficients were used. One of the irregularities of efficient market hypothesis (EMH), is calendar effects. Calendar effect refers to the stock tendency to different performances in different time periods. Finally following Zarowin (1985 and 1990) and Wang (2008) we surveyed the influence of calendar effects on winner and loser portfolios returns (momentum effect) therefor, the differences between winner and loser portfolios returns in different months of the year were examined by ANOVA and LSD and Tukey Post hoc tests.

## 4. Results

### 4.1. Testing Hypothesis of difference between winner and loser portfolios returns

The average annual returns of winner and loser portfolios in terms of all ranking and holding periods and the t-student test results, the differences between the average returns of 88 winner and 88 loser portfolios in the corresponding ranking and holding periods are provided in Table 1. The first hypothesis test results showed that the research hypothesis has been confirmed in 77 Winner and loser portfolios and in 11 winner and loser portfolios with (J=Ranking period, K= Holding period) the hypothesis is rejected because significance level was more than 5 percent and there was no significant difference between winner and loser portfolios returns, including periods: (J=144, K=1, 2, 4, 12), (J = 96, K = 24, 48), (J = 72, K = 48), (J = 48, K=96), (J = 36, K = 96,144) and (J = 24, K = 144).

The average annual returns of winner and loser portfolios in terms of holding and ranking periods are shown in figures 1 and 2. Although the average return of winner is more than loser portfolios of all holding periods, the annual returns with increased length holding and ranking periods was descending in relation to the momentum strategies and ascending in regard to the contrarian strategies. The most annual returns belonged to momentum strategies (J=1, K=1) by 148% and the lowest return was for the contrarian strategy (J=1, K=1) by -5%.

**Table 1: The average of annual returns of winner and loser portfolios (percent)**

| Holding Periods (Weeks) | | | 1 | 2 | 4 | 12 | 24 | 48 | 96 | 144 | Grand Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ranking Periods | The Loser Portfolios | Average | 15.5 | 20.4 | 25.5 | 29.6 | 30.7 | 33.7 | 36.9 | 37.7 | 28.8 |
| | | 1 | -5.2 | 4.4 | 15.0 | 27.1 | 29.9 | 34.2 | 36.0 | 35.9 | 22.2 |
| | | 2 | -0.2 | 8.0 | 18.0 | 27.9 | 29.8 | 33.6 | 35.9 | 36.2 | 23.6 |
| | | 3 | 3.6 | 11.7 | 20.4 | 28.3 | 30.1 | 33.4 | 35.8 | 36.2 | 24.9 |
| | | 4 | 7.6 | 15.5 | 22.6 | 28.7 | 30.2 | 33.1 | 35.6 | 36.2 | 26.2 |
| | | 12 | 18.4 | 22.3 | 25.8 | 29.1 | 29.0 | 31.3 | 35.4 | 36.5 | 28.5 |
| | | 24 | 21.2 | 23.5 | 26.6 | 28.6 | 28.5 | 31.2 | 35.9 | *37.2 | 29.1 |
| | | 36 | 22.1 | 25.0 | 27.7 | 28.3 | 28.5 | 31.8 | *36.5 | *38.2 | 29.8 |
| | | 48 | 22.3 | 24.9 | 27.4 | 28.1 | 29.3 | 32.5 | *36.6 | 38.8 | 30.0 |
| | | 72 | 25.0 | 27.4 | 29.7 | 31.1 | 31.8 | *33.7 | 38.9 | 39.6 | 32.2 |
| | | 96 | 25.4 | 27.9 | 30.6 | 31.4 | *32.7 | *36.9 | 40.3 | 39.7 | 33.1 |
| | | 144 | *30.9 | *33.6 | *36.3 | *37.3 | 38.2 | 38.9 | 39.4 | 39.8 | 36.8 |
| | The Winner Portfolios | Average | 70.3 | 61.7 | 55.0 | 47.8 | 43.4 | 41.5 | 38.0 | 37.6 | 49.4 |
| | | 1 | 147.7 | 112.0 | 84.2 | 61.4 | 51.2 | 46.4 | 41.7 | 40.0 | 73.1 |
| | | 2 | 115.4 | 93.8 | 75.6 | 58.7 | 50.3 | 45.9 | 41.1 | 39.8 | 65.1 |
| | | 3 | 98.8 | 81.9 | 69.7 | 56.7 | 49.5 | 45.7 | 40.8 | 39.7 | 60.4 |
| | | 4 | 86.3 | 75.2 | 64.8 | 54.8 | 48.3 | 45.0 | 40.6 | 39.6 | 56.8 |
| | | 12 | 63.5 | 59.0 | 55.7 | 49.4 | 44.6 | 44.4 | 39.9 | 38.7 | 49.4 |
| | | 24 | 53.9 | 51.3 | 49.4 | 45.3 | 43.3 | 43.2 | 38.6 | *37.9 | 45.4 |
| | | 36 | 47.4 | 45.9 | 45.6 | 44.7 | 43.9 | 41.8 | *37.3 | *37.3 | 43.0 |
| | | 48 | 47.5 | 46.7 | 47.1 | 45.7 | 42.6 | 40.0 | *35.9 | 36.3 | 42.7 |
| | | 72 | 41.1 | 40.5 | 40.2 | 39.4 | 37.5 | *36.7 | 34.5 | 35.2 | 38.1 |
| | | 96 | 38.6 | 38.8 | 39.0 | 37.7 | *35.4 | *35.0 | 33.9 | 34.7 | 36.7 |
| | | 144 | *33.2 | *33.3 | *33.5 | *32.2 | 31.0 | 32.6 | 33.3 | 34.5 | 33.0 |
| **Grand Average** | | | 42.9 | 41.0 | 40.2 | 38.7 | 37.1 | 37.6 | 37.4 | 37.6 | 39.1 |

* The P-Value of t-student test was more than significance level 5% so there was no significant difference between winner and loser portfolios returns in the corresponding ranking and holding periods.

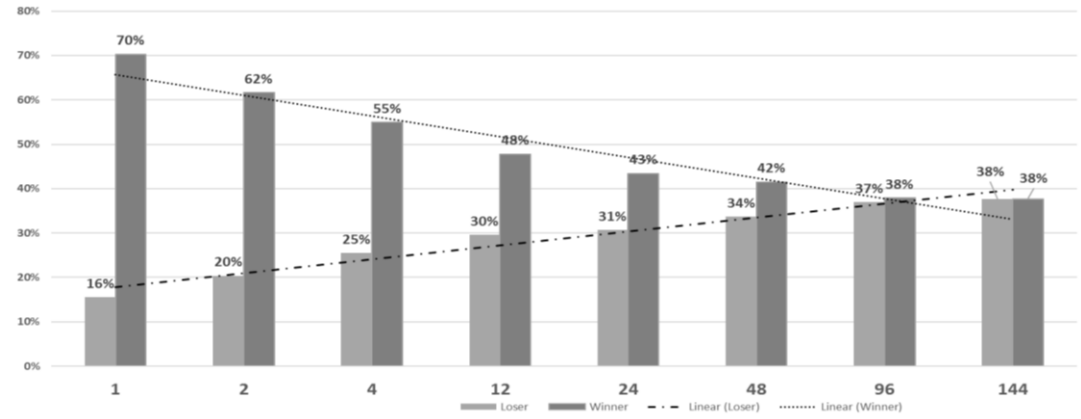


**Figure 1: The average of annual returns of winner and loser portfolios in terms of holding Periods**

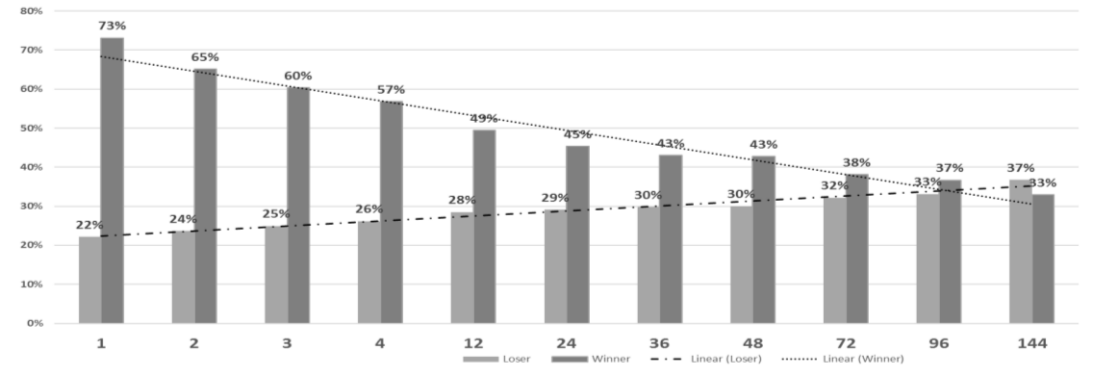


**Figure 2: The average of annual returns of winner and loser portfolios in terms of ranking Periods**

## 4.2. Winner and Loser Portfolios Excess Returns

In this section, the excess annual returns of winner and loser portfolios relative to market returns have been calculated from 2002 to 2016 and provided in Table 2. To calculate the market returns, the market index returns in 8 holding periods are used. Excess returns of 54 portfolios including 11 loser portfolios including of (J = 24 to 144, K = 12 to 144) and 43 winner portfolios including of (J = 1 to 144, K= 2 to 144) has been positive. The average of portfolios excess returns in holding periods are provided in figure 3. Increasing the holding periods, the excess return was ascending, in other words the returns of investment strategies was more than market returns. The most excess annual returns of winner portfolios (J=1, K=4, 12), were 19.1 % and 19.9 % respectively, and loser portfolios (J =144, K=48) and (J=96, K =96) were 2.9%.

In the years 2013 and 2014, after the increase in the intensification of economic and financial sanctions, Tehran Stock Exchange experienced high growth. The average of excess returns trend over 11 years from 2002 to 2012 is shown in Figure 4. Thus, in these years, the excess return of winner portfolios was positive and for loser portfolios it was negative. By increasing holding periods winner portfolios excess return was descending and loser portfolios excess return has been ascending.

Since winner portfolios returns (momentum strategy) was more than loser portfolios returns (contrarian strategy) in all periods, it is inferred that hypothesis of overreaction phenomenon in medium-term and long-term in TSE has been rejected and hypothesis of underreaction phenomenon in short-term, medium-term and long-term in TSE has been confirmed. However, because of positive excess returns in holding periods of 48, 96 and 144 weeks, weak evidences of long-term and medium-term overreaction in TSE has been observed. Inefficiency of contrarian strategy in long-term and higher returns of momentum strategy even in long-term periods were contrary to the research results of Conrad and Kaul (1998), Grinblatt and Keloharju (1998), Dahlquist and Broussard (2000), Daniel *et al.* (2000), Soares and Serra (2005), Wu (2004), Mehrani *et al.* (2016) respectively. On the other hand, the inefficiency of contrarian strategy was in compliance with the results of and Foster and Kharazi (2008) studies. The efficiency of momentum strategy in the short term, was consistent with the research results of Jegadeesh and Titman (1993), Chan et al (2000), Wang (2008), Rastgoi (2009) respectively.

**Table 2: The average of annual excess returns of winner and loser portfolios (percent)**

| Holding Periods (Weeks) | | | 1 | 2 | 4 | 12 | 24 | 48 | 96 | 144 | Grand Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ranking Periods | The Loser Portfolios | **Average** | -231.0 | -91.4 | -39.7 | -11.9 | -5.8 | -2.2 | -0.5 | 0.4 | -47.8 |
| | | 1 | -251.8 | -107.3 | -50.2 | -14.5 | -6.7 | -1.7 | -1.5 | -1.3 | -54.4 |
| | | 2 | -246.7 | -103.8 | -47.2 | -13.7 | -6.8 | -2.3 | -1.6 | -1.1 | -52.9 |
| | | 3 | -243.0 | -100.0 | -44.8 | -13.3 | -6.4 | -2.5 | -1.6 | -1.0 | -51.6 |
| | | 4 | -239.0 | -96.2 | -42.6 | -12.8 | -6.4 | -2.8 | -1.8 | -1.1 | -50.3 |
| | | 12 | -228.2 | -89.5 | -39.3 | -12.4 | -7.5 | -4.6 | -2.0 | -0.8 | -48.1 |
| | | 24 | -225.4 | -88.2 | -38.6 | -13.0 | -8.1 | -4.7 | -1.5 | 0.0 | -47.4 |
| | | 36 | -224.4 | -86.7 | -37.5 | -13.2 | -8.1 | -4.1 | -0.9 | 1.0 | -46.7 |
| | | 48 | -224.2 | -86.8 | -37.8 | -13.5 | -7.3 | -3.4 | -0.8 | 1.5 | -46.5 |
| | | 72 | -221.6 | -84.3 | -35.4 | -10.5 | -4.8 | -2.2 | 1.5 | 2.4 | -44.4 |
| | | 96 | -221.2 | -83.8 | -34.6 | -10.2 | -3.8 | 0.9 | 2.9 | 2.5 | -43.4 |
| | | 144 | -215.7 | -78.1 | -28.9 | -4.3 | 1.6 | 2.9 | 2.0 | 2.5 | -39.8 |
| | The Winner Portfolios | **Average** | -176.2 | -50.1 | -10.2 | 6.3 | 6.9 | 5.6 | 0.5 | 0.4 | -27.1 |
| | | 1 | -98.8 | 0.2 | 19.1 | 19.9 | 14.6 | 10.5 | 4.2 | 2.7 | -3.4 |
| | | 2 | -131.2 | -17.9 | 10.4 | 17.1 | 13.8 | 10.0 | 3.7 | 2.6 | -11.4 |
| | | 3 | -147.8 | -29.9 | 4.5 | 15.2 | 12.9 | 9.8 | 3.4 | 2.4 | -16.2 |
| | | 4 | -160.2 | -36.5 | -0.4 | 13.2 | 11.7 | 9.1 | 3.1 | 2.4 | -19.7 |
| | | 12 | -183.1 | -52.7 | -9.5 | 7.8 | 8.0 | 8.5 | 2.4 | 1.4 | -27.1 |
| | | 24 | -192.7 | -60.4 | -15.8 | 3.8 | 6.7 | 7.3 | 1.2 | 0.7 | -31.2 |
| | | 36 | -199.2 | -65.8 | -19.6 | 3.1 | 7.4 | 5.9 | -0.1 | 0.1 | -33.5 |
| | | 48 | -199.0 | -65.0 | -18.1 | 4.1 | 6.1 | 4.1 | -1.6 | -1.0 | -33.8 |
| | | 72 | -205.5 | -71.3 | -25.0 | -2.2 | 1.0 | 0.8 | -2.9 | -2.0 | -38.4 |
| | | 96 | -207.9 | -72.9 | -26.2 | -3.9 | -1.1 | -0.9 | -3.5 | -2.5 | -39.9 |
| | | 144 | -213.3 | -78.5 | -31.7 | -9.3 | -5.6 | -3.3 | -4.1 | -2.7 | -43.6 |
| **Grand Average** | | | -203.6 | -70.7 | -25.0 | -2.8 | 0.5 | 1.7 | 0.0 | 0.4 | -37.4 |

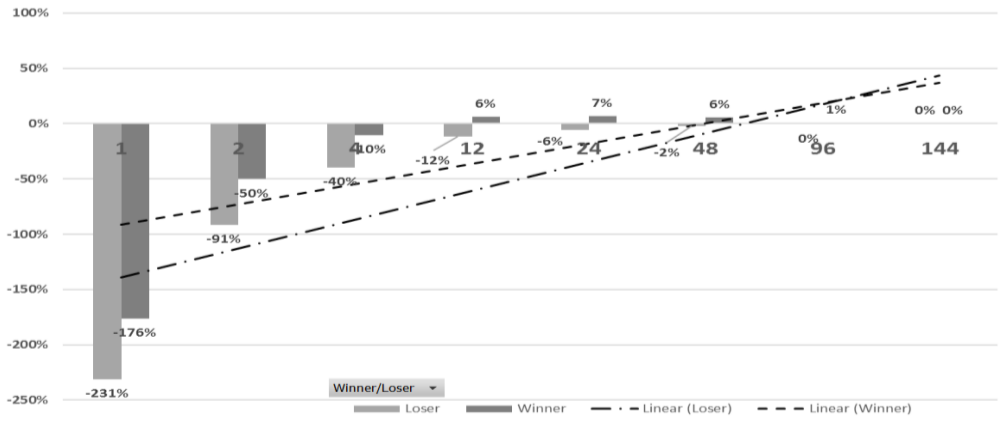


**Figure 3: The average of annual excess returns of winner and loser portfolios (From 2002 to 2016)**

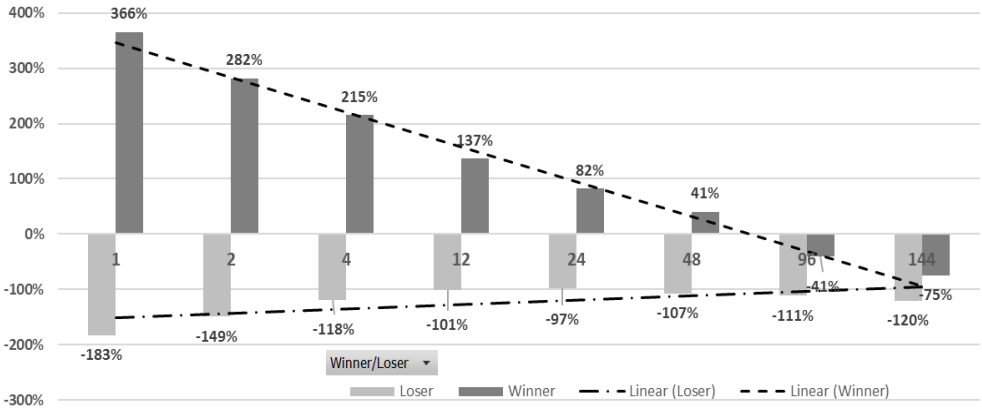


**Figure 4: The average of annual excess returns of winner and loser portfolios (From 2002 to 2012)**

## 4.3. The Risk Adjusted Return Winner and Loser strategies

Average of excess returns and information ratio are shown in terms of winner and loser portfolios in holding periods in Figure (5). By increasing length of holding period to 48 weeks for winner portfolios, excess returns of the strategies and information ratio have ascended and they have descended in holding periods of 96 and 144 weeks. The most information ratio of winner portfolios in periods (J=1, K=48) and (J=2, K=48) were with 20.7 and 20 percent respectively. Because of more negative excess return of loser portfolios their information ratio has also been negative and in this strategy by increasing holding period, information ratio had a descending trend up to holding period of 24 weeks and after 48 weeks holding period it was ascending and it was positive in 144 weeks holding period. The highest information ratio of loser portfolios was (J = 144, K =144) with 8.5%.

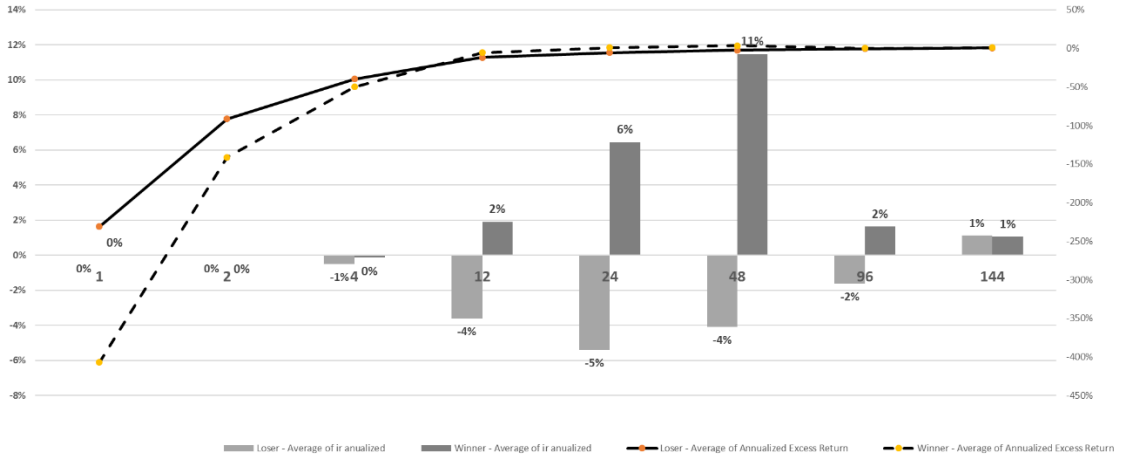


**Figure 5: The average of annual excess returns and Information Ratios of winner and loser portfolios**

## 4.4. Testing Hypothesis of Firm-specific Variables Investment Strategies Returns

In this section, profitability of three firm-specific variables based strategies include the P/E, market-cap and current price to 52-week high ratio in the highest and lowest classes (first and fourth quartile) of each variable in 8 holding periods are compared and tested. In Table (3) average annual returns of strategies have been shown. Test results indicate that according to P-Value all three strategies were smaller than the significance level of 5 percent in 8 holding periods, so research hypothesis has been confirmed so the difference between returns of the high and low class variables were significant.

Return of the lowest class of P/E and market-cap based strategies in all holding periods has been more than its highest classes. Which indicates that the return of value stocks is more than growth stocks in both short term and long term periods. Also, the returns of strategies based on small firms are more than returns of big firms. Increasing the length of the holding periods, return trend of value strategies for small firms, was descending. The highest annual returns of the value strategy, with 4 weeks holding and small firms with one week holding were with 42.7 and 59.1 percent respectively.

Investment strategy based on the highest class of the current price to 52-week high ratio in all holding periods has been more than its lowest class. The highest class of this ratio, indicates momentum returns. By increasing holding periods the highest class return trend was descending and the highest return belonged to one holding period equal with 77.3 %. These results were consistent with returns of winner portfolios in the previous section and indicated that there is strong evidence of underreaction in short-term, medium-term and long-term. Additionally, the results are consistent with the studies of George and Hwang (2004), Liu *et al.* (2011) and Hao *et al*. (2014).

**Table 3: The average of annual returns of firm-specific variables Strategies (percent)**

| Strategy | Holding Periods | 1 | 2 | 4 | 12 | 24 | 48 | 96 | 144 | Grand Average |
|---|---|---|---|---|---|---|---|---|---|---|
| **P/E** | The Highest Class | 28.8 | 28.5 | 28.2 | 28.5 | 27.3 | 28.5 | 28.8 | 28.7 | 28.4 |
| | The Lowest Class | 41.1 | 41.7 | 42.7 | 41.2 | 38.3 | 37.4 | 37.2 | 37.2 | 39.6 |
| **Market-Cap** | The Highest Class | 27.0 | 27.9 | 29.8 | 32.2 | 31.7 | 32.8 | 34.1 | 34.1 | 31.2 |
| | The Lowest Class | 59.1 | 58.5 | 56.1 | 52.5 | 48.0 | 47.2 | 44.3 | 41.0 | 50.8 |
| **P/52 Week High** | The Highest Class | 77.3 | 69.4 | 63.3 | 55.0 | 48.1 | 43.7 | 37.0 | 36.3 | 53.7 |
| | The Lowest Class | 22.7 | 23.2 | 24.7 | 24.6 | 23.1 | 27.3 | 33.4 | 33.5 | 26.6 |

* The all P-Value of t-student test was less than significance level 5% so there was significant difference between the highest and lowest portfolios returns in the corresponding holding periods.

## 4.5. The Excess Returns Firm-specific Variables Investment Strategies

The average of excess returns of Firm-specific variables based investment strategies are provided in Table 4. Excess returns was positive only in the lowest class of P/E in 24 and 48 weeks holding periods, the lowest class of market-cap in 12, 24, 48, 96 and 144 weeks holding periods and the highest class of current price to 52-week high ratio that is specified in table 4.

Confirmation of positive excess returns on market in the strategies based on the lowest class of ratio P/E represents profitability of the value stocks that is consistent with Basu (1983) and Fama and French (1993) respectively. Further Confirmation of positive excess return in the strategy based on lowest class of market-cap, is consistent with Banz (1981), Fama and French (1993) and lakonishok et al. (1994); and it indicated size effect and existence of extra profits phenomenon in small firms.

**Table 4: The average of annual excess returns of firm-specific variables Strategies (percent)**

| Strategy | Holding Periods | 1 | 2 | 4 | 12 | 24 | 48 | 96 | 144 | Grand Average |
|---|---|---|---|---|---|---|---|---|---|---|
| **P/E** | **The Highest Class** | -217.7 | -83.3 | -37.0 | -13.0 | -9.3 | -7.4 | -8.6 | -8.6 | -48.1 |
| | **The Lowest Class** | -205.4 | -70.1 | -22.5 | -0.3 | 1.8 | 1.5 | -0.3 | -0.1 | -36.9 |
| **Market-Cap** | **The Highest Class** | -219.5 | -83.8 | -35.4 | -9.4 | -4.9 | -3.1 | -3.3 | -3.2 | -45.3 |
| | **The Lowest Class** | -187.5 | -53.2 | -9.1 | 11.0 | 11.4 | 11.3 | 6.9 | 3.7 | -25.7 |
| **P/52 Week High** | **The Highest Class** | -169.3 | -42.3 | -1.9 | 13.4 | 11.6 | 7.8 | -0.4 | -1.0 | -22.8 |
| | **The Lowest Class** | -223.9 | -88.5 | -40.5 | -17.0 | -13.5 | -8.7 | -4.0 | -3.8 | -50.0 |

## 4.6. Speed of Investment strategies price adjustment

In this section adjustment speed of different investment strategies portfolios to market-wide information are examined using Dimson Beta regression. First of all, the returns of zero portfolios is calculated by the subtracting of winner and loser portfolios returns in similar ranking and holding periods and subtracting of high and low class portfolio`s returns of firm-specific variables. Then Dimson Beta regression is regressed with 5 lead-lag weekly periods. Results of the Dimson regression application are summarized in Table 5. The all estimated regressions P-Value of F statistic, was less than of 5%, so the overall regression models were validated.

If the contemporaneous beta of zero portfolios is positive and the sum of the lagged betas of zero portfolios are negative it shows that the adjustment speed of winner portfolios is greater than loser and also adjustment speed of high classes is greater than low classes and vice versa. When both of them are positive it shows that winner portfolios and higher classes of variables are more sensitive to common information and if both coefficients are negative it shows that loser portfolios and lower classes of variables are more sensitive to common information. Among 88 regressed models in zero portfolios in 15 cases adjustment speed of winner portfolios was more than loser ones for which 13 cases were (J=1 to 36, K=1, 2, 4) and 2 cases were (J=1, K=24, 144). It suggested that winner portfolios adjust themselves to market-wide information faster in short term and correct their short-term movement with higher speed. It represented underreaction phenomenon in short time. In addition, in two cases of (J=4, 8, K=144) adjustment speed of loser portfolios was higher than winner ones that showed overreaction in long term.

For the portfolios based on P/E and market-cap no evidences of greater adjustment speed of high classes than low classes and vice versa were observed. Although were found more sensitivity to market information of high classes of P/E (growth stocks) and low classes of market-cap (small stocks) portfolios.

For the strategies based on P/52-Week High ratio in 2 and 4 week holding periods its higher classes (proxy of momentum effect) adjustment speed was more than its lower classes and in 144 week holding periods its lower classes (proxy of reverse effect) adjustment speed was more than its higher classes. These evidences show underreaction in short terms and overreaction in long terms.

## 4.7. The month effects in winner and loser portfolios

In this section hypothesis 5, difference between the average returns of different months of each winner and loser portfolios in the holding periods (176 strategy) have been tested. Test results are summarized in Table (6).

Of the176 tests carried out in the 81 strategies including 28 contrarian strategies (loser portfolios) and 53 momentum strategies (winner portfolios), the research hypothesis confirmed and indicated different with average return of different months in the year in 1 to 24 weeks holding periods. But in 95 strategies the research hypothesis is rejected and difference of average return of different months in the year in 1 to 24 weeks holding periods has not been significant. Statistical results of winner portfolios were stronger than loser portfolios.

Sources of differences were assessed by using Tukey and LSD Post hoc tests. The greatest source of difference (in 81 confirmed hypothesis) is provided in the table (7). Hence, in the loser portfolios the greatest difference is observed between returns of months 11, 4

and in the next priority it is observed between months 5, 12. In winner portfolios in the first priority, the

greatest difference is observed between returns of months 1 and 11 and in the next priority it is observed between months 12, 5, 6 and 7. Furthermore, the average returns of different months of the winner and loser portfolios is calculated in 81 confirmed hypothesizes for 1 to 24 weeks period, and its results are presented in table 8. The results indicate that in winner portfolios the most returns of months 6 and 5 were 18.5 and 17.7 percent respectively and the lowest returns of months 12, 1 and 2 were 10.2, 11.8 and 11.8 percent respectively.

**Table 5: The contemporaneous and lagged betas of Dimson Beta regression on the zero portfolios**

| Strategy Type | Holding Periods | 1 | | 2 | | 4 | | 12 | | 24 | | 48 | | 96 | | 144 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ranking Periods | B0 | ∑LagB | B0 | ∑LagB | B0 | ∑LagB | B0 | ∑LagB | B0 | ∑LagB | B0 | ∑LagB | B0 | ∑LagB | B0 | ∑LagB |
| Momentum/Contrarian | 1 | 0.001* | 0.000* | 0.002* | -0.008* | -0.003 | -0.014 | -0.010 | -0.027 | 0.004* | -0.003* | -0.013 | -0.050 | -0.010 | -0.184 | 0.034* | -0.280* |
| | 2 | 0.002* | -0.004* | 0.003* | -0.010* | -0.006 | -0.010 | -0.017 | -0.023 | -0.001 | -0.023 | -0.072 | -0.145 | -0.011 | -0.250 | -0.048 | -0.078 |
| | 3 | 0.002* | -0.008* | 0.001* | -0.015* | -0.002 | -0.006 | -0.028 | -0.026 | -0.006 | -0.067 | -0.047 | -0.173 | -0.022 | -0.235 | -0.086 | -0.156 |
| | 4 | 0.002* | -0.008* | 0.001* | -0.010* | 0.001* | -0.005* | -0.025 | -0.036 | -0.015 | -0.090 | -0.057 | -0.158 | -0.008 | -0.198 | -0.113** | 0.013** |
| | 12 | 0.003* | -0.002* | 0.002* | -0.003* | 0.000 | -0.023 | -0.024 | -0.060 | -0.028 | -0.087 | -0.110 | -0.247 | -0.093 | -0.279 | -0.061 | -0.555 |
| | 24 | 0.001*** | 0.001*** | 0.003*** | 0.001*** | 0.001* | -0.004* | -0.004 | -0.053 | -0.025 | -0.062 | -0.107 | -0.449 | -0.045 | -0.329 | -0.081 | -0.327 |
| | 36 | 0.000*** | 0.001*** | 0.001* | -0.002* | -0.002 | -0.007 | -0.015 | -0.080 | -0.037 | -0.129 | -0.110 | -0.455 | -0.056 | -0.172 | -0.115 | -0.114 |
| | 48 | -0.002 | -0.003 | -0.003 | -0.008 | -0.007 | -0.022 | -0.022 | -0.094 | -0.040 | -0.211 | -0.119 | -0.484 | -0.093 | -0.194 | -0.045** | 0.057** |
| | 72 | -0.002 | -0.008 | -0.004 | -0.020 | -0.008 | -0.051 | -0.035 | -0.123 | -0.042 | -0.247 | -0.115 | -0.554 | -0.071 | -0.307 | 0.022*** | 0.255*** |
| | 96 | -0.003 | -0.007 | -0.005 | -0.016 | -0.008 | -0.046 | -0.036 | -0.125 | -0.048 | -0.252 | -0.116 | -0.492 | -0.031 | -0.051 | 0.000*** | 0.252*** |
| | 144 | -0.004 | -0.010 | -0.006 | -0.024 | -0.009 | -0.063 | -0.034 | -0.121 | -0.056 | -0.279 | -0.121 | -0.458 | -0.043 | -0.090 | 0.039*** | 0.403*** |
| Variables | P/E | 0.0008*** | 0.0041*** | 0.0014*** | 0.0079*** | 0.0031*** | 0.0186*** | 0.0088*** | 0.0064*** | 0.0061*** | 0.0745*** | -0.0437 | -0.1504 | 0.0527*** | 0.0722*** | -0.0366 | -0.2267 |
| | Market Capital | -0.0007 | -0.0064 | -0.0015 | -0.0138 | -0.0066 | -0.0311 | -0.0228 | -0.0254 | -0.0386 | -0.1575 | -0.1710 | -0.6875 | -0.2518 | -0.9644 | -0.2387 | -1.3410 |
| | P/52 Week High | 0.0029*** | 0.0002*** | 0.0036* | -0.0018* | 0.0012* | -0.0115* | 0.0048*** | 0.0174*** | 0.0217*** | 0.0567*** | -0.0901 | -0.3950 | -0.0338 | -0.3795 | -0.0176** | 0.0271** |

Note: The Dimson Beta regression is regressed for zero portfolios with 5 lead-lag weekly periods as follows:

$$r_{O,t} = \alpha_O + \sum_{k=-5}^{5} \beta_{O,k}\, r_{m,t-k} + u_{O,t}$$

The returns of zero portfolios is calculated by the subtracting of winner and loser portfolios returns in similar ranking and holding periods and subtracting of high and low class portfolio`s returns of firm-specific variables.

* The adjustment speed of winner portfolios and high class variables portfolios are greater than loser and low class variables portfolios.

** The adjustment speed of loser and low class variables portfolios are greater than winner portfolios and high class variables portfolios.

***The winner portfolios and higher classes of variable portfolios are more sensitive to common information.

[The blank cells] The loser portfolios and lower classes of variable portfolios are more sensitive to common information.

**Table 6: The ANOVA test result of difference between the winner and loser portfolios of the different months**

| Holding Periods | | 1 | 2 | 4 | 12 | 24 | 48 | 96 | 144 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Loser Portfolios | **Total** | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | **88** |
| | Reject Research Hypothesis | 11 | 6 | 5 | 4 | 1 | 11 | 11 | 11 | **60** |
| | Accept Research Hypothesis | | 5 | 6 | 7 | 10 | | | | **28** |
| Winner Portfolios | Total | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | **88** |
| | Reject Research Hypothesis | 4 | | | | | 11 | 11 | 9 | **35** |
| | Accept Research Hypothesis | 7 | 11 | 11 | 11 | 11 | | | 2 | **53** |
| **Grand Total** | | **22** | **22** | **22** | **22** | **22** | **22** | **22** | **22** | **176** |

**Table 7: The Months that differ between the winner and loser portfolios using LSD and Tukey post hoc tests**

| Holding Periods | | 1 | 2 | 4 | 12 | 24 |
|---|---|---|---|---|---|---|
| **Loser Portfolios** | First Priority | 11,4 | 11,4 | 11,4 | 12,4 | 12,6 |
| | Second Priority | 12,5 | 12,5 | 11,4 | 11,4 | 2,7 |
| **Winner Portfolios** | First Priority | | 11,1 | 11,1 | 6,1 | 5,2 |
| | Second Priority | | | 11,5 | 7,1 | 12,6 |

**Table8: The average returns of different months of the winner and loser portfolios in 81 accepted research Hypothesis**

| Months | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loser Portfolios | 5.0 | 3.7 | 8.3 | 1.6 | 3.1 | 1.7 | 6.2 | 12.0 | 6.3 | 15.2 | 19.3 | 2.6 |
| Winner Portfolios | 11.8 | 12.0 | 11.8 | 13.7 | 18.5 | 17.7 | 15.2 | 15.3 | 15.4 | 14.0 | 12.2 | 10.2 |
| **Grand Average** | 9.5 | 9.1 | 10.6 | 9.5 | 13.2 | 12.2 | 12.1 | 14.2 | 12.2 | 14.4 | 14.7 | 7.5 |

Note: This table is based on weekly average returns

In loser portfolios, the highest return was for month 11 with 19.3% and the lowest return for months 4 and 6 were 1.6 and 1.7 percent respectively. These results are consistent with LSD and Tukey post hoc test results.

## 5. Discussions and Conclusion

Investors are faced with different behavioral biases that are in contrast to the efficient market hypothesis (EMH). Investors' underreaction and overreaction are some of behavioral phenomena in financial markets. In this article, simultaneous underreaction and overreaction of investors in the short term and long term in Tehran Stock Exchange were evaluated. We implemented investment strategies based on winner and loser portfolios in various short term and long term holding periods. The returns of winner portfolios in short term and long term were more than loser portfolios so underreaction phenomenon was confirmed in short term and long term and overreaction was not confirmed. Then we applied the firm-specific variables based strategies, including value, size and the 52-week high. The results indicated that higher returns of value and small stocks and higher returns of portfolios based on higher value of the current price to 52-week high ratio in short and long term periods were confirmed which showed momentum and underreaction phenomenon in the market. In addition, the speed of investment strategies information adjustment to market-wide information was assessed using Dimson Beta regression and some evidences of underreaction in short term and overreaction in long term were confirmed. Finally the formation and holding month effect of winner and loser portfolios was either examined and evidences showed differences in months 11, 4, 12 and 5 portfolios. As a result, investors are advised to apply momentum investment strategy in TSE. More studies can be done in relation to combined investment strategies and the speed of price adjustment to market-wide information in TSE and the other markets.

## References

1) Abarbanell, J. S., & Bernard, V. L. (1992). Tests of analysts' overreaction/underreaction to earnings information as an explanation for anomalous stock price behavior. The Journal of Finance, 47(3), 1181-1207.
2) Amihud, Y., & Mendelson, H. (1987). Trading mechanisms and stock returns: An empirical investigation. The Journal of Finance, 42(3), 533-553.
3) Banz, R. W. (1981). The relationship between return and market value of common stocks. Journal of financial economics, 9(1), 3-18.
4) Barberis, N., Shleifer, A., & Vishny, R. (1998). A model of investor sentiment. Journal of financial economics, 49(3), 307-343.
5) Basu, S. (1983). The relationship between earnings' yield, market value and return for NYSE common stocks: Further evidence. Journal of financial economics, 12(1), 129-156.
6) Bernard, V. L. (1992). Stock price reactions to earnings announcements: A summary of recent anomalous evidence and possible explanations.

7) Brennan, M. J., Jegadeesh, N., & Swaminathan, B. (1993). Investment analysis and the adjustment of stock prices to common information. Review of Financial Studies, 6(4), 799-824.
8) Chan, K., Hameed, A., & Tong, W. (2000). Profitability of momentum stragegies in the international equity markets. Journal of financial and quantitative analysis, 35(02), 153-172.
9) Chiang, T. C., Nelling, E., & Tan, L. (2008). The speed of adjustment to information: Evidence from the Chinese stock market. International Review of Economics & Finance, 17(2), 216-229.
10) Chiao, C., Hung, K., & Lee, C. F. (2004). The price adjustment and lead-lag relations between stock returns: microstructure evidence from the Taiwan stock market. Journal of Empirical Finance, 11(5), 709-731.
11) Chordia, T., & Swaminathan, B. (2000). Trading volume and cross-autocorrelations in stock returns. The Journal of Finance, 55(2), 913-935.
12) Conrad, J., & Kaul, G. (1998). An anatomy of trading strategies. Review of Financial studies, 11(3), 489-519.
13) Cutler, D. M., Poterba, J. M., & Summers, L. H. (1991). Speculative dynamics. The Review of Economic Studies, 58(3), 529-546.
14) Dahlquist, J. R., & Broussard, J. P. (2000). Testing the contrarian investment strategy using holding period returns. Managerial Finance, 26(6), 16-22.
15) Damodaran, A. (1993). A simple measure of price adjustment coefficients. the Journal of Finance, 48(1), 387-400.
16) Daniel, K., Hirshleifer, D., & Subrahmanyam, A. (1998). Investor psychology and security market under-and overreactions. the Journal of Finance, 53(6), 1839-1885.
17) De Bondt, W. F., & Thaler, R. (1985). Does the stock market overreact? The Journal of finance, 40(3), 793-805.
18) Dimson, E. (1979). Risk measurement when shares are subject to infrequent trading. Journal of Financial Economics, 7(2), 197-226.
19) Du, D., Denning, K., & Zhao, X. (2011). Evidence on stock reaction to market-wide information. Review of Pacific Basin Financial Markets and Policies, 14(02), 297-325.
20) Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. The journal of Finance, 25(2), 383-417.
21) Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. Journal of financial economics, 33(1), 3-56.
22) Foster, K. R., & Kharazi, A. (2008). Contrarian and momentum returns on Iran's Tehran Stock Exchange. Journal of International Financial Markets, Institutions and Money, 18(1), 16-30.
23) George, T. J., & Hwang, C. Y. (2004). The 52-week high and momentum investing. The Journal of Finance, 59(5), 2145-2176.
24) Grinblatt, M., & Keloharju, M. (1998). Momentum investing and performance using Finland's unique data set. Anderson School at UCLA.
25) Grinblatt, M., Titman, S., & Wermers, R. (1994). Momentum Investment Strategies, Portfolio Performance, and Herding: A Study of Mutual Fund Behavior.
26) Gutierrez, R. C., Cooper, M. J. & Hameed, A. (2004). Market states and momentum. The Journal of Finance, 59(3), 1345-1365.
27) Hao, Y., Chou, R. K., & Ko, K. C. (2014). The 52-Week High, Momentum, and Investor Sentiment. Working paper.
28) Hill, R. J., & Eggins, J. (2008). Momentum and Contrarian Stock-Market Indices.
29) Hong, H., & Stein, J. C. (1999). A unified theory of underreaction, momentum trading, and overreaction in asset markets. The Journal of finance, 54(6), 2143-2184.
30) Hou, K., & Moskowitz, T. J. (2005). Market frictions, price delay, and the cross-section of expected returns. Review of Financial Studies, 18(3), 981-1020.
31) Jegadeesh, N., & Titman, S. (1995). Overreaction, delayed reaction, and contrarian profits. Review of Financial Studies, 8(4), 973-993.
32) Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. The Journal of finance, 48(1), 65-91.
33) Jegadeesh, N., & Titman, S. (2001). Profitability of momentum strategies: An evaluation of alternative explanations. The Journal of finance, 56(2), 699-720.
34) Kaestner, M. (2006). Investors' Misreaction to Unexpected Earnings: Evidence of Simultaneous Overreaction and Underreaction.
35) Kubota, K., & Takehara, H. (2010). Expected return, liquidity risk, and contrarian strategy:

evidence from the Tokyo Stock Exchange. Managerial Finance, 36(8), 655-679.

36) Lakonishok, J., Shleifer, A., & Vishny, R. W. (1994). Contrarian investment, extrapolation, and risk. The journal of finance, 49(5), 1541-1578.

37) Lee, C., & Swaminathan, B. (2000). Price momentum and trading volume. the Journal of Finance, 55(5), 2017-2069.

38) Lehmann, B. N. (1990). Fads, martingales, and market efficiency. The Quarterly Journal of Economics, 105(1), 1-28.

39) Lim, K. P. (2009). The speed of stock price adjustment to market-wide information.

40) Lin, C., Ko, K. C., Chen, Y. L., & Chu, H. H. (2016). Information discreteness, price limits and earnings momentum. Pacific-Basin Finance Journal, 37, 1-22.

41) Liu, M., Liu, Q., & Ma, T. (2011). The 52-week high momentum strategy in international stock markets. Journal of International Money and Finance, 30(1), 180-204.

42) Lo, A. W., & MacKinlay, A. C. (1990). When are contrarian profits due to stock market overreaction?. Review of Financial studies, 3(2), 175-205.

43) Marshall, P., & Walker, E. (2002). Asymmetric reaction to information and serial dependence of short-run returns. Journal of Applied Economics, 5(2), 273-292.

44) Mehrani, K., Rahnamay Roodposhti, F., Nekomaram, H., & Saeedi, A. (2016). Behavioral trading strategies and investor sentiment: Empirical research in Tehran Stock Exchange (TSE). Indonesian Capital Market Review, 94-109.

45) Moskowitz, T. J., & Grinblatt, M. (1999). Do industries explain momentum?. The Journal of Finance, 54(4), 1249-1290.

46) Moskowitz, T. J., Ooi, Y. H., & Pedersen, L. H. (2012). Time series momentum. Journal of Financial Economics, 104(2), 228-250.

47) Patro, D. K., & Wu, Y. (2004). Predictability of short-horizon returns in international equity markets. Journal of Empirical Finance, 11(4), 553-584.

48) Prasanna, K., & Menon, A. (2012). The speed of stock price adjustments to market wide information in India. Asia-Pacific Journal of Financial Studies, 41(5), 541-562.

49) Rastogi, N., Chaturvedula, C., & Bang, N. P. (2009). Momentum and overreaction in Indian capital markets. International Research Journal of Finance and Economics, 32, 83-92.

50) Soares, J. V., & Serra, A. P. (2005). "Overreaction" and "Underreaction":-Evidence for the Portuguese Stock Market. Faculdade de Economia da Universidadedo Porto.–November.

51) Theobald, M., & Yallup, P. (2004). Determining security speed of adjustment coefficients. Journal of Financial Markets, 7(1), 75-96.

52) Tziogkidis, P., & Zachouris, P. (2009). Momentum equity strategies: Are certain firm-specific variables crucial in achieving superior performance in short term holding periods?. International Research Journal of Finance and Economics, 1, 7-27.

53) Wang, D. (2008). Are anomalies still anomalous? An examination of momentum strategies in four financial markets.

54) Wang, J., & Wu, Y. (2011). Risk adjustment and momentum sources. Journal of Banking & Finance, 35(6), 1427-1435.

55) Wu, Y. (2004). Momentum trading, mean reversal and overreaction in Chinese stock market.

56) Zarowin, P. (1990). Size, seasonality, and stock market overreaction. Journal of Financial and Quantitative analysis, 25(01), 113-125.

57) Zhu, J. (2007). Do investors over-or under-react? Evidence from Hong Kong Stock Market. Journal of American Academy of Business, 11(2), 58