

Analysis of Mean-Reversion Tendency of Stock Prices for Companies Listed in Tehran Stock Exchange¹

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ABSTRACT

In securities exchange markets, different anomalies usually occur that can make the market quite inefficient. One of these abnormalities is mean-reversion tendency. The present study aims to determine mean-reversion tendency of the main indices of Tehran stock exchange (TSE).

This was a descriptive analytical study with the statistical population of all companies listed in Tehran Stock Exchange Market (TSEM) during Jun 1997 to April 2012. The census sampling was done. The sample size was equal to the statistical population. Data collection instruments included the custom stock exchange tools of Rah-Avard Novin (version 3, Mabna Co., Iran) and Eviews (Version 7, HIS Inc., USA). Furthermore, Internet resources were used to gather related data as well as accessing the above-mentioned instruments. In order to analyze data, Augmented Dickey-Fuller (ADF) test was used to prove persistent or mean-reversion tendency of time series.

Findings showed that the cash return- stock price index has significantly returned to the mean during 2003-2004 ($p = 0.040$) and 2011-2012 ($p = 0.002$). In 50 top companies, mean-reversion tendency was also significant during 2004-2003 ($p = 0.036$) and 2012-2011 ($p = 0.013$). In addition, general index of TSE has returned to the mean value during 2003-2004 ($P = 0.023$). Results of this study show that TSEM has lacked the required efficiency in some time periods. Instabilities of exchange can be because of market-influencing factors such as inflation, fluctuations of world oil price, base currency, and economic sanctions.

KEYWORDS: mean-reversion, random walk, efficient market, cash return-stock price.

INTRODUCTION

According to the efficient market hypothesis, stock prices of the exchange follow the process of random walk. If prices follow the random walk theory, price changes will be random (independent) over time. However, sometimes some movements and abnormalities occur in the stock exchange markets, which make the market inefficient. One of the most important abnormalities is mean-reversion tendency (Fama, 1970). In an efficient market, stock prices respond quickly and accurately to the relevant information. Efficient market follows the process of random walk theory. In such a market, the stock return cannot be predicted based on the previous variations in price (Osborne, 1959). Nevertheless, mean reversion test is a method to evaluate the market's efficiency. Mean reversion shows whether shocks have permanent effect on the system or temporary effect. If stock has the property of mean-reversion, i.e. the processes are persistent, the effects of price shocks will be unstable and temporary, and prices will return to their trend path over time. From the enterprise viewpoint, this means that prices are predictable based on the previous behavior, otherwise shocks effects will be permanent and prices will gain a new balance and will not be predictable based on the historical movements (Narayan & Perasad, 2007). Mean-reversion is the sign of insecurity and irrational process in the capital market arising from various economic factors such as inflation, recession, inflation recession, devaluation of national currency, interest rate etc, as well as political reasons, including international relations, political instability, government decisions, prohibition and... . Each of these reasons may lead to the inefficiency of capital market. Many studies are performed on the phenomena of mean-reversion and market efficiency and inefficiency and have shown different results. Giving one clear definition of "mean-reversion" is difficult since there is no existing consensus on a comprehensive and impediment definition of mean-reversion. Definition 1: An asset model is mean reverting if asset prices tend to fall (rise) after hitting a maximum (minimum) (CECCHETTI, S.G., P.S. LAM and N.C. MARK, 1990). Definition 2: An asset model is mean reverting if returns are negatively auto-correlated. In such a

¹ . The post graduate thesis approved by Kermanshah Branch, Islamic Azad University

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model, less output of the mean in a period will be compensated with higher “compensative” output of the mean in the next period. This definition has some problems with some experimental evidence since it can be true or false by the change of study course, so selecting study course can affect the results of the model goodness of fit (DANIEL, K., 2001). Definition 3: A pricing model is mean-reversion when its output series is persistent. Outside the pricing models and in econometric world and other modeling of time series, persistence is a clear and generally listed definition of mean-reversion (Narayan. P and Perasad. A, 2007), which is the desired definition of mean-reversion according to the purpose of this study. For example, in a study titled mean-reversion in 17 European countries, Narayan and Perasad (2007) found that stock price indices of 17 surveyed European countries indicate the existence of a unit root for the period of 2003-1988 and are consistent with the Efficient Market Hypothesis. Kim, M.J., Nelson, C.R. (1998) examined a sample of New York stock exchange during 1936-1995. They confirmed the phenomenon of mean-reversion, but attributed this phenomenon to the period before World War II. In a study titled efficient market in the weak form using nonlinear models and examining stock markets in the Middle East and Africa, Lim, K. (2009) concluded that the efficient market hypothesis is inefficient for the Middle East and African countries including predictable elements. In a study titled reviewing stock returns in the stock markets of African countries including Egypt, Kenya, Morocco, Nigeria, South Africa, Tunisia and Zimbabwe, Alagidede, P. and T. Panagiotidis (2009) examined random walk behavior in the market’s efficiency and concluded to reject null hypothesis and also concluded that stock market returns for the mentioned states follow random walk. So far, many researches have been done on mean-reversion. In separate articles in different countries, De Bondt, W. and Thaler, R (1985), French, K. R. and Roll, R (1986), Rosenberg, B., K. Reid, and R. Lanstein (1985), Howe, J.S (1986), O’Brien, J. (1987), Lo, A. W. and MacKinlay (1989), Fama, E.F. and French (1988), Poterba, J. M. and Summers (1988), Cochrane, J. H. and Sbordone (1988), Mills, T. C (1994), Fraser (1995), Lee, B-S (1995), Richards, A. J (1997), Balvers, R., Wu, Y. and Gilliland, E. (2000), Lewellen (2001), GROPP, J. (2004), Grieb, T.A. and Reyes (1999), *Lim, K (2009)* reached evidence on mean-reversion in stock exchange. In contrast, researchers such as Granger, C. W. J. and Morgenstern (1963), Fama (1970), LeRoy, S. F (1982), Kim, M. J., Nelson, C. R. and Startz, R (1991), Richardson, M. and Stock (1989), Huber, P. (1997), Narayan & Perasad (2007), Zhu, Z (1998), Richardson, M. (1993) found evidence on the unpredictable nature of the stock and concluded that stock prices follow the random walk. In a study titled reviewing the weak form of capital market’s efficiency in TSE, Allahyari (2008) concluded that the review of TSE efficiency in the weak form is used to answer the question of whether successive changes of stock price are independent of each other or not? Therefore, statistical methods of correlation serial analysis were used. Data used in this study include daily stock prices of ninety-five companies listed in TSE from 1999 to August 2005. The results of this study indicate that there is correlation between successive changes of stock prices at the confidence level of 95%, and certain investors can gain abnormal profits knowing specific and private information. In general, lack of informational efficiency of TSE has been proved. Foster and Kharrazi examined the return of inverse investment strategies and price continuity during 1977-2002 (September 1997 to October 2002). They evaluated weekly and daily returns of fifty top companies in TSE. They concluded that only price continuity strategy has created additional efficiencies in mid-term. However, reverse investment strategies were not like this. In other words, they did not confirm the existence of mean-reversion in TSE. In a study titled reviewing the existence of mean-reversion phenomenon in TSE using the variance ratio test and weekly data in different time periods, Tehrani, Ansari, and Sarenj (2008) concluded that mean-reversion is confirmable in both indices of price and cash return in most time periods. However, the index of fifty top companies has followed random walk process during 2008-2005. In other words, the efficiency of this index can be listed in the mentioned period. It can be said that high volume of transactions and high liquidity of more active companies in exchange may have affected the efficiency of this index in the mentioned period.

However, if the trend of movement in the stock exchange market follows mean-reversion in certain periods, this will indicate market inefficiency in these periods. Considering the crucial role of mean-reversion tendency determination on the efficiency assessment of stock exchange as well as adopting appropriate trading strategies in stock market, conducting a detailed study on Iran stock market is necessary. Therefore, the present study aims to determine mean-reversion tendency of three main indices of TSE, including price, cash return-price, and index of fifty top companies.

RESEARCH METHODOLOGY

The study was a descriptive-analytic study. The statistical population included all companies listed in TSE Market, i.e. companies the stock of which is traded through the stock market. The sample size is equal to the statistical population. In order to do this study, data were collected during 16 years since 2011:4-1997:1, and this

sixteen-year-old period was divided into 8 two-year periods and then the parameters' trends were compared during these periods. Instruments of collecting statistics and information included computer and internet and data analysis instrument was Eviews software. Data were collected from data achieves of official websites of TSE and affiliated instruments in which two principles of accuracy and precision were completely met. Descriptive statistics, including mean, standard deviation and variance were used for data analysis. For this purpose, the Eviews software was used. In addition, ADF unit root test was used for mean-reversion tendency determination. In general, results obtained from this study are important and valid for several reasons. First, investigation of the stock exchange market not only is not limited to a specific time, but also is related to long time to provide a more accurate image of the TSE. Second, the analyzed data are 9925 to give more importance to the obtained results. Third, the evaluation of the stock exchange persistence is performed using ADF test possessing greater credibility, compared to other tests such as the ratio of variance and negative auto-correlation coefficient.

RESULTS

Findings showed that the minimum and the maximum fluctuations of total index during 2011-2012 (N = 295) had belonged to the years of 2009-2010 (N = 487). In addition, the maximum and the minimum mean of total index belonged to 2011-2012 (SD = 878, X = 25677) and 1997-1998 (X = 1583, SD = 49), respectively. These data are presented in Table (1).

These findings were calculated by statistical ADF. The results showed that the total index of TSE has significantly returned to the mean during 2003-2004 (p=0.0230). In other periods, mean-reversion was not considered significant. These results are presented in Table (1).

Table (1)

Statistical index and results of ADF for determining mean-reversion of total index in TSE

P	t	SD	M	N	Period of time
0.7265	-1.1	49	1583	390	1997-1998
-0.989	0.57	438	2212	483	1999-2000
0.903	-0.42	687	4054	478	2001-2002
0.023	-3.2	2527	10796	483	2003-2004
0.514	-1.5	1074	10430	419	2005-2006
0.902	-0.42	1115	10079	477	2007-2008
0.999	1.57	3981	14024	487	2009-2010
0.094	-2.6	878	25677	295	2011 - 2012
0.725	-0.38	4648	9397	3482	1997-2012

Findings showed that the minimum and the maximum fluctuations of cash return-price index had belonged to 2011-2012 (N = 289) and 2003-2004 (N = 483), respectively. In addition, the maximum and the minimum mean of total index belonged to 2011-2012 (SD = 20787, X = 99667) and 1999-2000 (SD = 49, X = 1583), respectively. These data are presented in Table (2).

These findings were analyzed using ADF test. The results showed that the variation trend of cash return-price index of TSE has significantly returned to the mean valued during 2003-2004 and 2011-2012 (p=0.0404) and (p=0.0230). In other periods, mean-reversion was not considered significant. These results are presented in Table (2).

Table (2)

Statistical indices and ADF test for determining mean-reversion of cash return- stock price index in Tehran Stock Exchange

p	t	SD	M	N	Time period of
-	-	-	-	-	1997-1998
0.992	0.7	901	3645	404	1999-2000
0.944	-0.13	1984	8288	478	2001-2002
0.0404	-2.95	6942	26154	483	2003-2004
0.731	-1.1	1584	29648	419	2005-2006
0.752	-1	5995	36750	478	2007-2008
0.999	1.44	16480	56859	482	2009-2010
0.0018	-3.98	20787	99667	289	2011-2012
0.461	-0.22	28736	34269	3028	1997-2012

Findings showed that fifty top companies index had the lowest and the highest fluctuations during 2011-2012 (N=294) and 2007-2008 (N=492), respectively. Furthermore, the maximum and the minimum mean of fifty top companies index belonged to 2011-2012 (SD = 43, X = 1249) and 1997-1998 (SD = 3, X = 99), respectively. These data are presented in Table (3).

These findings were calculated by statistical Dickey-Fuller test. The results showed that the variation trend of fifty top companies of TSE has significantly returned to the mean during 2003-2004 and 2011-2012 ($p=0.036$) and ($p=0.0127$). In other periods, mean-reversion was not considered significant. These results are presented in Table (3).

Table (3)

Statistical indices and results of Dickey-Fuller test for determining mean-reversion of fifty top companies' index in TSE.

p	t	SD	M	N	Time period of
-	-	-	-	-	1997-1998
0.992	0.7	901	3645	404	1999-2000
0.944	-0.13	1984	8288	478	2001-2002
0.0404	-2.95	6942	26154	483	2003-2004
0.731	-1.1	1584	29648	419	2005-2006
0.752	-1	5995	36750	478	2007-2008
0.999	1.44	16480	56859	482	2009-2010
0.0018	-3.98	20787	99667	289	2011-2012
0.461	-0.22	28736	34269	3028	1997-2012

DISCUSSION AND CONCLUSION

Findings of this study showed that the trend of total index variations only during 2003-2004 has been persistent following a mean-reversion tendency, whereas in other periods has followed a random walk trend. The variation trend of cash return-stock price has been persistent during 2003-2004 and 2011-2012, so that followed mean-reversion tendency and has been non-persistent in other periods. Regarding fifty top companies index in TSE, the obtained results show that the variation of this parameter has also followed mean-reversion tendency during 2003-2004 and 2011-2012, while has followed a random walk in other

In other words, investigation of TSE during 1997 to July 2012 showed that the variation trend of three parameters has been persistent so that followed a mean-reversion tendency in TSE only during 2003-2004. Mean-reversion tendency for both parameters of cash return- stock price and fifty top companies has been persistent during 2011-2012 and the parameters have had no mean-reversion tendency in other periods and have followed random walk. Generally, we can conclude that stock market of Iran has followed mean-reversion tendency during 2003-2004 and 2011-2012 and has lost its efficiency, and has been weakly efficient in other periods of Tehran Stock Exchange. According to the results of this research based on market inefficiency during two periods of 2003-2004 and 2011-2012 and poor performance during 1997-2002 and 2005-2010 and its comparison with other researches in different countries such as the articles of Lim (2009), Narayan and Perasad (2007), Zhu (1998), Kim and Nelson (1998), we conclude that the crisis or the political or economic problems created in other countries has caused mean-reversion. Like wars and economic sanctions or fundamental and cross weakness in countries' economy, these problems can cause mean-reversion even in developed economic countries such as America and Europe. In addition, TSE was considered ineffective according to the results of this study during 2003-2004 and 2011-2012. This can be due to political issues such as economic sanctions, high inflation and recession in the country causing inefficiency of Tehran stock exchange. TSE has had weak efficiency during 1997-2002 and 2005-2010 indicating the reasonable process of TSE in these periods.

According to the results of this research, its comparison with the results of Allahyari's research (2008) and its results on the informational inefficiency of TSE during 2005 to August 1999, These two researches differ due to presenting a single definition of mean-reversion, using statistical methods and different sample sizes of two studies. In addition, the results of this study are consistent with the researches of Foster and Kharrazi. They examined the return of inverse investment strategies and price continuity during 1977-2002 (September 1997 to October 2002) and concluded that only price continuity strategy has created additional efficiencies in medium term. However, reverse investment strategies were not like this. In other words, they did not confirm the existence of mean-reversion in Tehran stock exchange. The results of the researches of Tehrani, Ansari, and Sarenj (2008) showed that mean-reversion is confirmable in both indices of price and cash return-price in most time periods. However, the index of fifty top companies has followed random walk process during 2008-2005. In

other words, the efficiency of this index can be listed in the mentioned period. It can be concluded that the difference is due to presenting no single definition of mean-reversion, statistical methods and different sample sizes of two studies.

Results of this study, compared with previous similar studies conducted on TSE, possess more generalization and credibility. Previous studies have covered a particular period, for example one or more years, and have used fewer data sources, while this study has examined the variation trend of TSE for 16 years and has also considered 9925 datum. Furthermore, the present study evaluated the consistency of TSE using the Augmented Dickey – Fuller (ADF) test has more credibility than the other tests.

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