Research Journal of Applied Sciences, Engineering and Technology 5(6): 2147-2155, 2013
DOI:10.19026/rjaset.5. 4765
ISSN: 2040-7459; e-ISSN: 2040-7467

Submitted: May 30, 2012 Accepted: July 28, 2012 Published: February 21, 2013

Research Article

Investigation and Analyzing Efficiency of Risk-adjusted Ratios in Portfolio Selection

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Abstract: The aim of this study is to analyze the efficiency of Risk-adjusted Ratios in portfolio selection in Tehran Stock Exchange. This study was performed on the companies that were active from 2006 until 2010. The winner and loser portfolio of 50 Top companies selected based on Risk-adjusted Ratios in Tehran Stock Exchange and then their performances were compared by the "mean difference" test "one-way Analysis of Variance" (ANOVA) and Tukey test. Results showed that there is a possibility of selecting an appropriate portfolio using of the Risk-adjusted Ratios. However M3 measure has better than the other two criteria and the market.

Keywords: Portfolio management, portfolio selection, post-modern portfolio theory, risk-adjusted ratios

INTRODUCTION

Internationally, an active and prosperous equity market has always been considered as a sign of development of a country. In the developed countries, the most investments are made through financial markets. The active participation of society members in exchange capital market, ensures the continuing of equity market and sustainable development of the country. The major issue for investors in these markets is taking a good decision for selecting appropriate portfolio for investing.

We witness vast efforts for improving the methods for studying and analyzing stocks in financial markets of the world. These efforts resulted to presenting some new methods. Both new and old methods are trying to find a response for the desire of maximizing the dividend in financial markets.

A huge number of information and other effective factors cause decision making as a hard job for the investor to select an appropriate portfolio. The criterion of the majority of people at the time of decision for selecting stock are the number of sellers and purchasers gossips and other unimportant similar issues. This research proposes a model to analyze the information related to different companies and as a result to help investors to find a model for maximization their dividends.

Investor usually considers conflicting goals such as return, risk and liquidity in the portfolio selection simultaneously. Some researchers introduce the liquidity of assets as one of the main criteria in the optimization portfolio mean-variance framework (Andrew and Constantin, 2003). However logical investors are looking for an acceptable level of risk in order to maximize their return in the capital markets.

This research is going to review the performance of Risk-adjusted Ratios in Tehran Stock Exchange. Therefore we used these measures that had previously been used by many researchers such as Usta and Kantar (2011) in Turkey Stock Exchange, Nathaphan and Chunhachinda (2010), Anagnostopoulos and Mamanis (2010), Zakamouline and Koekebakker (2009), Pesaran and Zaffaroni (2008) and Chordia and Shivakumar (2002) in USA Stock Exchange Ping-Chen and Po-Chang (2009) in Taiwan faineance and market (Li *et al*., 2010; Simanjuntak *et al*., 2006; Liu *et al*., 2003; Werner, 2006; Huang, 2008).

LITERATURE REVIEW

The aim of this study is to present a comprehensive assessment of efficient standards and models in selecting portfolio in Tehran Securities and Stock Exchange. Aiming to this the efficiency and power of different criterion are studies. Also the previous studies are mentioned in detail. During the recent years along with scientific research the concept of risk is changed. If the stock exchanges are risky the major issue of any investor is specifying the portfolio with the maximum utility and this is equal to select appropriate portfolio.

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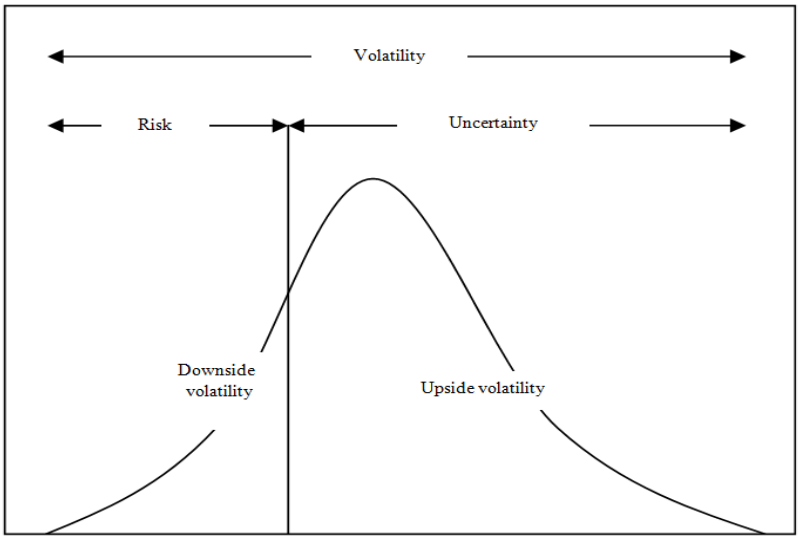

Fig. 1: The separation between upside volatility, downside volatility, risk and uncertainty in PMPT

The investors are trying to select portfolio with the least risk and the most return so it is necessary to use models and criterion which are in compliance with the current condition of market.

As explained the aim of forming portfolio is maximization of return by compositing different stock exchange. In the early (Markowitz, 1952) quantitatively defined the expected return as the mean of return variable and risk as its variance. In the model developed by him the investors can for a certain return decrease the risk of their stock and select a portfolio with the least risk and/or specified the level of desired risk level to obtain the expected return. Since then mathematical analysis on portfolio management has developed greatly and variance has become the most popular mathematical definition of risk for portfolio selection. Scholars developed a variety of models using variance to quantify risk in various situations for example variance models proposed by Gram and Schyns (2003), Deng (2005) and Huang (2007).

When return distributions securities are asymmetric the selected portfolio based on variance may have a potential danger to sacrifice too much expected return in both high return extremes and low return extremes. For this purpose in great deal number of models semi-variance model was proposed and lots of models were built to minimize semi-variance in different cases for example Grootveld and Hallerbach (1999) and Rom and Ferguson (1994).

One of the tools that are used by post modern portfolio theory is the downside risk. It is measured by target semi-deviation and is termed downside deviation. Moreover it is expressed in percentages and therefore allows rankings in the same way as standard deviation (Rom and Ferguson, 2001; Rom, 2002).

Roy (1952) defines the investment risk level as assessment of probability of stock market crash of investment value in lower disastrous level. The criterion of Rosy is to minimization of loss probability. In financial resources this criterion is considered as the most famous criterion for measuring the undesired risk (Huang, 2008).

Post-Modern Portfolio Theory (PMPT) based on the relationship between return-adjusted risks explains the behavior of the investor and optimal portfolio selection criteria. So based on the new model of adjusted risk and resulting improvements Post-Modern portfolio theory has been established (Estrada, 2000, 2006). PMPT is an appropriate criterion to evaluate the portfolio performance. This theory presents the more accurate criterion by making use of an adjusted risk indicator. In post-modern theory only returns lower than the target is considered as a risk (Wiesinger, 2010). Figure 1 illustrates the separation between upside volatility downside volatility risk and uncertainty in post-modern portfolio theories (Brian and Ferguson, 1993).

Many studies have been done based upon this theory. In a research entitled "a Mean-Variance portfolio optimal under utility pricing" (Werner, 2006) studied optimal expected asset model. Result of the research indicated efficient of mean-variance model in the classical case. Li *et al*. (2010) introduced Mean-Variance-Skewness model for portfolio selection with fuzzy returns. They proposed a skewness concept for fuzzy variables. Result demonstrated the effectiveness of the proposed algorithm. It is used in an uncertain environment. Another study by Anagnostopoulos and Mamanis (2010) was performed to solve the discrete mean-variance portfolio selection. Result indicated efficient of Multi-objective algorithms. Whereas that the Non-dominated Sorting Genetic Algorithm II has better performance than Pareto Archived Evolution Strategy. Usta and Kantar (2011) introduced a Mean-

Variance-Skewness-Entropy Model (MVSEM) for portfolio selection. Result showed that MVSEM has better performance than traditional portfolio selection models. Moreover MVSEM able to provide a smaller portfolio turnover compared with other models.

Importance of research: The promotion of efficiency level of companies and economic firms in this competitive world is the most factors for their running and continuation. In contemporary economic system financial system play the most role in economic development of the countries but without having a dynamic and efficient financial system accessing to development is not possible.

Today at the most valid stock exchange of the world the importance of selection appropriate portfolio by using new criteria as a strategy has been studied. Even though some researchers are done in this respect but the majority of those researches focused on portfolio modern theory and considered risk as symmetric. In order to application of framework of portfolio postmodern theory in equity market of Iran it is necessary to do research regarding new strategies and studying their profitability. According to Lohre *et al*. (2008) indicated that if investors employ adverse risk to optimize the portfolio it would lead to a portfolio creation that coincides with their perception of risk. Another study (Leela *et al*., 2008) based on an adverse risk and normal risk model could prove role of adverse risk in portfolio selection and showed that most investors are willing to gain maximum of return with control of risk negative. Another research done by Tarja and Paul (2006) introduces a measure for portfolio performance in mean-variance-skewness framework. They extend the mean-variance efficiency analysis by adding a new dimension i.e., skewness. As this method is to open up a new paradigm in portfolio performance measurement which is based on mean-variance-skewness framework and can thus overcome the difficulties of the existing CAPM-based performance measures. They suggest that portfolio efficiency based on mean-variance-skewness is more desirable than the one based on mean-variance. Alexandra (Wiesinger, 2010; Aragon and Ferson, 2006; Farinelli *et al*., 2008) referred to this point. They suggested new ratios because they were agreeing that modern theories can't represent real performance of investment companies. The new ratios could manage investment funds well. They showed that financial institutions are interested to invest not only based on return but based on risk that is expected for companies. Banks incline to act based on performance ratios of adjusted risk when assessing the business.

Research objectives: Different dangers are always threat the economic activities. Changes in prices rules and regulations and other elements effective on supply and demand are the most reasons for instability and risk in equity market. Financial markets developed internationally and rapid changes have effect on economic behavior of individuals and the concepts of investors of market status (Fan and Xu, 2004). Along with development of economic activities and increasing the bankruptcy of different financial institutions and firms the subject of risk management and using appropriate tools for measuring and controlling market risks are very important (Yiu, 2004).
The goals of this research are:

- Present an efficient and effective strategy for helping specialists and researchers to select appropriate portfolio and assess the degree of efficiency and potentiality of each Risk-adjusted strategies and their comparison with each other and market.
- Assist with a specialized active institution in the market and the possibility of taking decision for investment encourage investors for more participation in equity market by using effective strategies and more stability for the economy of Iran. Other ambitions of the study are followed as: help to increase the efficiency of the market help to increase intellectual decision creation of better opportunity for operational and financial investment.
- Using the criteria based on adjusted risk for making winner-loser portfolio. It is revealed that we can select appropriate portfolio via those criteria. Further the criteria can present a new approach in this regard for investors as well as managers and directors.

RESEARCH METHOD AND DATA

Research method is according to survey method and a correlation type which its main goal is to define the relationship among some quantitative variables. This is an empirical research in the field of comparative studies or the difference between 2 independent samples. For testing the hypothesis we use relevant statistic test including Independent Samples Test and ANOVA with Tukey test. A long research between 2006 and 2010 were considered. Convenient sampling was the sampling method of choice in this study thus we just selected the company that during the period their stock was actively traded on the Stock Exchange and their relevant financial information was available. The 50 Top companies were active in Tehran Stock Exchange and research sample represents. Data were collected from different research methods. In order to analyze data we used daily and monthly return of companies that issued by Tehran Stock Exchange. All in all to portfolio selection the blow hypotheses are supposed.

Table 1: The EROV, sortino and M3 ratios

Ratio	Formula	Explanation
Excess Return on Value-at-risk (EROV)	$\mathbf{EROV} = \{\mathbf{r} - \mathbf{r_f}\}/\mathbf{VaR}$	r : Portfolio returns $\mathbf{r_f}$: Risk free rate VaR : Portfolio VaR
Sortino	$SOR = (\bar{r_p} - \bar{r}_f)/\sigma_{down}$	$\bar{r_p}$: Asset or portfolio return $\bar{r_f}$: Risk free rate σ_{down} : Downside deviation
M3	M3 $= a \times avr\ (Portfolio) + b$ $\times avr\ (benchmark) + (1 - a$ $- b) \times rf$	$a = v\frac{(benchmark)}{v}\ (Portfolio)\ sqrt\ [\{1 - tc^2\}\ /\{1 - c^2\}]$ $b = tc - c\ \times sqrt\ [\{1 - tc^2\}\ /\{1 - c^2\}]$ $tc = 1 - tTE^2/\ \{2 \times v\ (benchmark)^2\}$ avr (.) : Average returns rf : Risk free rate v (.) : Volatilities tc : Target correlation between portfolio and benchmark c : Actual correlation between portfolio and benchmark tTE : Target tracking error

First hypothesis: There are possible of appropriate portfolio selection by Risk-adjusted Ratios.

Second hypothesis: Risk-adjusted Ratios have better performance than market in portfolio selection.

This research is done according to Bacon (2004, 2008) and the Post-Modern portfolio theory definition of EROV Sortino and M3 ratios as they are shown in (Table 1). The risk free rate is defined as the geometric mean of the ratio that central bank of the Islamic Republic of Iran is published during study period of this survey.

Excess Return on Value-at-risk (EROV): Excess Return on VaR is basically a Sharpe Ratio using Value-At-Risk instead of Volatility as the risk measure (Bacon, 2004). Assuming normally distributed returns the VaR of a long-position is calculated as a quantile of the standard normal distribution at a certain confidence level α using the expected value (i.e., the mean) and the standard deviation (Jorion, 2006):

$$VaR = -(r + Z_\alpha * \sigma)$$

α : Confidence level
Zα : Quantile of the standard normal distribution

When VaR is used to assess risk-adjusted performance the measure Excess return on VaR (EVaR) emerges. It compares the excess return of an asset to the VaR of the asset (Wiesinger, 2010).

Sortino ratio: Sortino ratio is the actual rate of return in excess of the investor's target rate of return per unit of downside risk. A measure of excess return per unit of risk based on downside semi-variance instead of total risk (the standard deviation of the portfolio) used by the Sharpe ratio. Since the Sortino ratio takes into account only the downside size and frequency of returns it measures the reward to negative volatility trade-off. For the case where the target return is equal to the mean of the distribution the LPM of order 2 corresponds to the semi-variance (Burkler and Hunziker, 2008). In all other cases it is referred to as downside variance (Bacon, 2008). The second LPM-based performance measure is the Sortino Ratio which was first introduced by Sortino and Van Der Meer (1991). It is defined as the ratio of the excess return over a minimum threshold τ and the downside deviation δ^2. Originally the Sortino Ratio (SOR) and δ^2 were calculated by the following expressions (Sortino, 2001):

$$SOR_i(\tau) = \frac{r_i^d - \tau}{\delta^2}$$

The Sortino Ratio can be regarded as a modification of the Sharpe Ratio as it replaces the standard deviation by downside deviation which only considers the negative deviations from the mean or a minimum return threshold. Similar to Omega downside deviation can be interpreted as the square root of the LPM of order 2 which finally leads to the version of the Sortino Ratio below in which an LPM is used as a risk measure (Kaplan and Knowles, 2004):

$$SOR_i(\tau) = \frac{r_i^d - \tau}{\sqrt[2]{LPM_2(\tau)}}$$

where,
r_i : Single return realization
τ : Minimum return threshold
LPM_2 : Lower-partial moment of degree 2

Negative deviations from the return threshold are more strongly weighted due to the LPM of order 2 and thus express a higher risk-aversion of the investor (Poddig *et al*., 2003).

M3 measure: This measure evaluated effect of adjusted-correlation between factors contained in portfolio without regard to the portfolio of investment is

Table 2: Characteristics in EROV, SORTINO and M3

Title	EROV	SORTINO	M3
Risk measure	Value-at-risk	Downside deviation	Portfolio and benchmark risk
Type of distribution	All of distributions	For asymmetrical distribution	All of distributions
Focus of attention	Extreme of expected loss	Deviations of return adverse	Factors of effective on the benchmark risk
Type of stock for evaluation	Species of financial tools	Species of investment portfolio	Species of portfolio
Application	Determination of asset sufficiency	Calculate excess return on total volatilities	Forecast events ahead of investment

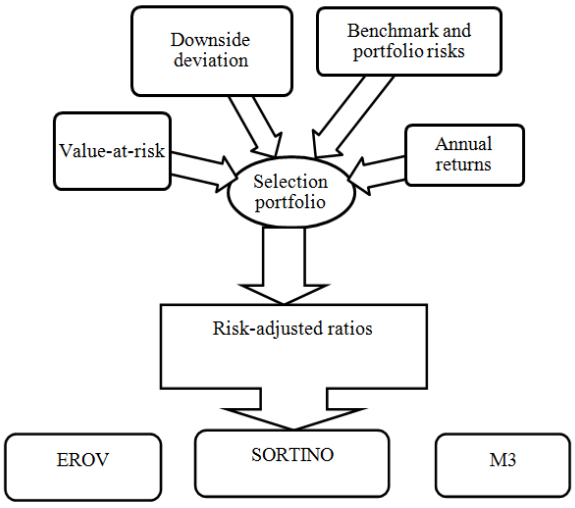

Fig. 2: The research scheme

an active inactive or invest in securities without risk. With the M3 measures returns are correlation-adjusted by leveraging the fund with active passive and risk-free funds so that the resulting volatility equals benchmark volatility and the TE equals the Target TE. M3 adjusts for absolute as well as relative risks (Muralidhar, 2000; Cogneau and Hubner, 2009).

Measure of M3 surveys factors of effectiveness based on the benchmark risk. For insisting of this criterion to a number of factors this model describes correlation-adjusted of factors in investment funds with regard to the active portfolio management style. This measure could be a suitable measure for the portfolio structure establishment. If no systematic risk exist then the results of M3 is equal to the M2 measure (Aragon and Ferson, 2006).

M3 is preferred to all other measures of risk-adjusted performance as:

- It includes investments in all assets including cash and the passive benchmark to produce the highest risk-adjusted return for a tracking error target.
- It is the only measure that ranks portfolios (measured over the same time period) identical to rankings based on the confidence.

Two investment opportunities will typically have different variances and correlations to the benchmark in turn leading to different tracking errors relative to the benchmark. This is a difficult comparison with too many moving parts. In order to compare the 2 it is recommended that the investor needs to invest in the active strategy the risk-less asset and benchmark to ensure:

- The volatility of this composite is equal to that of the benchmark (Modigliani and Modigliani, 1997).
- The tracking error of this composite is equal to the target tracking error (Muralidhar, 2000).

The second is achieved by ensuring that the newly created composite portfolio has a correlation equal to a target correlation (derived from the fact that there is a target tracking error and that the volatility of the benchmark and that of the composite are equal). The M3 measure extends Modigliani and Modigliani (1997) by recognizing that the investor has to consider basis points of risk-adjusted performance after ensuring that correlations of various funds versus the benchmark are also equal thereby ensuring that the tracking errors are equal (Muralidhar, 2001).

M3 is 'volatility-risk-and-correlation-risk'-adjusted-performance.

M3 rankings differ from M2 and rankings.

If no target tracking error exists a = 0 and M3 will equal M2.

M3 can be used in a forward-looking sense: It can provide ex ante guidance how to structure portfolios with TE restrictions (Andreas, 2001; Muralidhar, 2003).

In this study analysis M3 SORTINO EROV measures and in Table 2 compares their characteristics together.

In this study VaR variability of reduction return benchmark and portfolio risks and efficiency compound annual returns are considered as independent variables and M3 SORTINO and EROV measures are considered as dependent variables. Each of the variables has 16 and 8 times of observation during a year. Figure 2 indicates our research scheme.

RESULTS OF HYPOTHESIS TESTING

First hypothesis: There are possible of appropriate portfolio selection by Risk-adjusted Ratios. To test this

Table 3: The results of first hypothesis testing by independent samples test

					Levene's test for equality of variances		t-test for equality of means			
Position	Variable	Population	Winner mean	Loser mean	F	p	t	df	p	Means difference
3 month	EROV	Win-loss	0.4530	-0.1467	5.390	0.027	13.943	30	0.000	0.19203
data	SOR	Win-loss	-0.7194	-0.9224	5.820	0.022	7.880	30	0.000	0.20307
	M3	Win-loss	-0.3581	-1.8684	12.965	0.001	4.612	30	0.000	1.51030
6 month	EROV	Win-loss	0.1800	-0.1055	1.608	0.225	5.513	14	0.000	0.12352
data	SOR	Win-loss	-0.7568	-0.8961	0.734	0.406	4.588	14	0.000	0.13926
	M3	Win-loss	-0.5607	-1.7115	9.334	0.009	2.154	14	0.049	1.15076

Table 4: The results of second hypothesis testing by ANOVA

Variable	Group	S.S.	df	M.S.	F	Sig.
The results of second hypothesis based on 3 month data						
Difference mean of	Between group	22.735	3	7.578	27.158	0.000
winner and loser	Within group	16.743	60	0.279		
portfolio	Total	39.478	63			
The results of second hypothesis based on 6 month data						
Difference mean of	Between group	6.529	3	2.176	5.405	0.005
winner and loser	Within group	11.273	28	0.403		
portfolio	Total	17.802	31			

hypothesis the average of winner and loser portfolios return is compared in 3 indicators on holding periods 3 and 6 months:

$$\begin{cases} H0: MEAN_{win} \le MEAN_{loss} \\ H1: MEAN_{win} > MEAN_{loss} \end{cases}$$

$$\text{model } erov: \ t_{(df:30)} = 13.943 \quad p = .000 \quad p_{ob} < p_{CR}$$

$$\text{model } sor: \ t_{(df:30)} = 7.880 \quad p = .000 \quad p_{ob} < p_{CR}$$

$$\text{model } m3: \ t_{(df:30)} = 4.612 \quad p = .000 \quad p_{ob} < p_{CR}$$

Based on data collected from the sample group and t test calculated t statistics is larger than the critical table of statistics and in other words the calculated error is smaller than 0.05. Consequently zero hypotheses are rejected at 95% confidence and the research hypothesis is accepted as a safe assumption. According to a meaningful difference exists between calculated mean of winner and loser portfolio in 3 indicators. Therefore, there is possibility of portfolio selection by EROV SORTINO and M3 criteria in sample companies. The Table 3 showed the result of test.

Second hypothesis: Risk-adjusted Ratios have better performance than market in portfolio selection. To test this hypothesis the difference average of winner and loser portfolio is compared in three indicators and market:

$$\begin{cases} H0: MEAN_{erov,w-l} = MEAN_{sor,w-l} = MEAN_{m3,w-l} = MEAN_{market} \\ H1: ALL\ MEANS\ NOT \text{ EQUAL} \end{cases}$$

Table 5: Comparisons of three indicators with market by tukey HSD

Variable	Number	Ranking at the 0.05 error level (3 month data)	
Market	16	0.0329	
EROV	16	0.1920	
SOR	16	0.2031	
M3	16		1.5103
Error level		0.7990	1.0000
Variable	Number	Ranking at the 0.05 error level (6 month data)	
Market	8	0.0658	
EROV	8	0.1235	
SOR	8	0.1393	
M3	8		1.1508
Error level		0.9960	1.0000

Based on 3 month data:

$$F_{(df:3,60)} = 27.158 \quad p = .000 \quad p_{ob} < p_{CR}$$

Based on 6 month data:

$$F_{(df:3,60)} = 5.405 \quad p = .005 \quad p_{ob} < p_{CR}$$

Based on 3 and 6 months data collected from the sample group and one-way ANOVA test calculated F statistics is larger than the critical table of statistics and in other words the calculated error is smaller than 0.05. Consequently zero hypotheses are rejected at 95% confidence and the research hypothesis is accepted as a safe assumption. And for compare each of the indicators with market indicator Tukey test is used. Based on Tukey test the portfolio selection doesn't show a meaningful difference with the market indicator by using of EROV and SORTINO. But the portfolio selection by using of M3 measure show a meaningful difference with the market indicator and it is larger than market. The Table 4 and 5 represent the result of tests.

CONCLUSION

Since the selection of appropriate portfolio is important for investors and may lead them to a better

performance in the capital market. The knowledge of the efficient and accurate criteria for investment seems to be necessary. So we must seek mechanisms that help us to achieve our objectives in the current economic and market conditions.

The result of research indicated that the possibility of portfolio selection exists by using of Risk-adjusted Ratios. According to the research of Aragon and Ferson (2006) and Zakamouline and Koekebakker (2009) ratios related to post-modern portfolio theory would better define the performance of the companies. And the portfolio selection criteria based on post-modern portfolio theory (1987) counsel the professional management of portfolio performance. In this regard M3 measure showed better performance in comparison with EROV SORTINO and the market. This finding showed that investors are risk-averse. In other words risk isn't symmetrical and it has highly skewness toward adjustment. The researches of Usta and Kantar (2011), Li *et al*. (2010) and Janal *et al*. (2007) emphasize to use of skewness in mean- variance model. So that it could prove role of risk-adjusted in portfolio selection. Because investors notice more on the fluctuation lower than target return rate.

Researchers such as Lohre *et al*. (2008) and Leela *et al*. (2008) that emphasized the use of an adverse risk and normal risk model could prove role of adverse risk in portfolio selection and showed that most investors can gain maximum of return with control of negative risk. As a result averagely these companies can avoid from unwanted adverse risk of their portfolio and gain a good performance.

Result showed that M3 measure has more ability than other criteria in clarification of market conditions. Of course the researches of Muralidhar (2000) and Farinelli *et al*. (2008) approve the use risk-adjusted performance evaluation measures because these measures have more robustness in comparison with traditional measures and they aren't consider normality in return distribution and are compatible with market term.

Interpreting of the result based on previous studies: This study indicated that M3 measure is a suitable measure for portfolio selection. In contrary to other researches such as Zakamouline and Koekebakker (2009) that recommended generalized Sharpe ratio for portfolio selection. Also Sortino ratio is achieved middle position among 3 ratios of portfolio selection.

Current thriving markets are looking for fluctuations and fluctuations can only be ignored in the stagnant market. So based on Janal *et al*. (2007), Liu *et al*. (2003) and Pesaran and Zaffaroni (2008) the model that is presented in this study to select the appropriate portfolio is good. In this regard Gozal (2012) as well as Cooper *et al*. (2004) suggested investment companies to use a more optimized structure in their portfolio.

According to the result of research portfolio returns mean in short-term is larger than portfolio returns mean in long-term and in regard to the researches of Griffin *et al*. (2003), Richards (1997) and Horst (1998) manager's focus on short-horizon than long-horizon.

Restrictions of research:

- We didn't consider changes in macroeconomic conditions political and social changes over the years of study.
- Due to limited statistical community of top 50 companies listed in Tehran Stock Exchange generalization of results to other economic units should be done with caution.

RECOMMENDATIONS FOR FUTURE RESEARCH

- It is suggested to researchers that test Portfolio selection by other ratios such as Omega Upside Potential Omega-Sharpe & Prospect ratios.
- It is also suggested that test Portfolio selection on other statistic sample group by these Ratios.

ACKNOWLEDGMENT

We would like to acknowledge Dr. George O. Aragon W.P. Carey School of Business Arizona State University Dr. Wayne E. Ferson at Marshall School of Business University of Southern California Los Angeles California Dr. Arun S. Muralidhar Managing Director FX Concepts Inc and Chairman Mcube Investment Technologies LLC and Dr. Andreas Steiner University of Osnabrück Department of Economics Osnabrück Germany.

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