



Volatility of Market Portfolio and Volatility of Stock Returns

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ABSTRACT

One of the basic criteria for making decisions on the exchange is stock returns. Stock returns has, in itself, information content. Most of actual and potential investors use stock returns in financial analysis and forecasts. Today, investment includes the bulk of economic activities. One of the requirements of development in any society is investment. Any investor to invest, pays attention to several factors, most notably of which is the return on investment, and prediction of the return obtained from that investment. In different cases of investment (assuming constant risk), the investor usually chooses the case, which has higher return.

Keywords: Volatility, Market Portfolio, Stock Returns

INTRODUCTION

If there is no benchmark for determining the price of more risk admission in Tehran Stock Exchange, and the stock of firms with higher risk is priced like stock of firms with low risk, the returns realized by investors would not be commensurate with the level of risk taking. Moreover, in estimating the rate of expected return and explaining the CAPM model, the systematic risk factor of the market is applied and to calculate the correlation coefficient, the positive and negative returns on assets and market indicators compared to the average period is used. As a result of the positive part of differences compared to the average, modifies the negative differences (Rostami Noroozabad, Shojaei, Khezri, & Rahmani Noorozabad, 2015). Therefore, systematic risk, which is the essential factor in estimation of expected return rate is not calculated properly. Consequently, many investors are not able to gain returns commensurate with risk and the realized return will be different from investors' expectations. In these circumstances, the firm's shares are always priced more or less than their actual value. Therefore, those who are aware of the relationship between risk and return on equity of firms listed in the Tehran Stock Exchange, will benefit from the opportunities available in the market (Bortoluzzo, Minardi, & Passos, 2014).

Lack of attention to the relationship between risk and investors' expected return will help market inefficiency and Iran's capital market, whose main symbol is Tehran Stock Exchange,

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always will be inefficient and out of balance. This nonconformity leads to outflow of capital from this young market or to prevent the inflow of new capital to it. Therefore, the presence of a model that can cover the risk and return criteria in determining the value of the stock, and help to move Tehran Stock Exchange towards more efficiency, seems to be necessary (Chen, Roll, & Ross, 1986; Shanken & Weinstein, 2006).

In addition, we know that the purpose of investment is foremost to increase or at least protect financial wealth. Therefore, it seems that evaluating portfolio performance is important for investors. If the results are not satisfactory, the reason should be clear to make the necessary changes. However, it is important to evaluate the portfolio, whether an individual investigates his own portfolio individually or he has invested indirectly in investment firm (Fernández & Gómez, 2007; Song, Liu, & Yang, 2017).

METHODOLOGY

The independent and dependent variables of the study are measured as follows:

Research Variables:

The research independent variable is volatility of market portfolios returns and the dependent variable is expected returns volatility of stock portfolios individual stock. Beta as unchangeable risk of an asset, relative to the stock market, defines the CAPM of needed return for investment in the form of equation (1):

Equation (1)

$$E(R_i) = r_f + \beta_i E(R_m - r_f)$$

$E(R_i)$: Expected returns volatility of asset i .

r_f : Risk-free interest rate.

$E(R_m)$: Expected returns volatility of stock market.

β_i : Risk of asset i .

CAPM can be divided into two parts of risk-free rate of return (r_f), and the risk premium. Stock risk premium is the investors' returns demand in excess of risk-free interest rate, to offset the irreversible risk of investment, which is calculated in the form of beta, in equation (2):

Equation (2)

$$\beta_i = \frac{\text{cov}(R_i; R_m)}{\text{var}(R_m)}$$

Market risk premium is considered as return ($E(R_m) - r_f$). Return more than the risk-free interest rate for investors, is to keep the stock market. As individual assets risk premium is equal to the product of the market risk premium.

Equation (1) can be rewritten in the form of equation (3):

Equation (3)

$$E(R_i) - r_f = \beta_i [E(R_m) - r_f]$$

Beta allows proper analysis of the variance of an asset, especially R_i variance as the equation (4):

Equation (4)

$$+ \hat{\sigma}_i = \beta_i \hat{\sigma}_m$$

Therefore, $\hat{\sigma}_i$ can be decomposed into two parts. The first part is the systematic risk of the firm ($\beta_i \hat{\sigma}_m$), which shows a part of the attributable asset variance to the market volatility. The second part is the firm's unsystematic risk ($\hat{\sigma}$) and relates to certain volatilities of the firm.

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If all assets prices are related to the market movement, the error term (ϵ) is always zero, $0 = \epsilon$.

K_j rate of expected return using the D-CAPM, is as the following:

Equation (5)

$$K_j = R_f + \beta_d(R_m - R_f)$$

Decreasing beta (Adjusted Beta) is calculated by the following equation:

Equation (6)

$$\beta = \frac{S_{cov R_i, R_m}}{S_{var R_m}}$$

k_i : Expected return rate

R_f : Risk-free interest rate

R_i is calculated through the following equation.

Equation (7)

$$R_i = \frac{(1 + \alpha)P_1 + DPS - P_0}{P_0}$$

α : Percentage of capital increase

P_0 : Price of the beginning of the period

P_1 : Price of the end of the period

DPS: Dividends paid to the shareholders

In order to calculate R_f , using the information on central bank site, on account interest rate of long-term investment deposits is considered.

The following equations are applied to calculate the rate of return on the market.

Equation (8)

$$R_m = \frac{I_2 - I_1}{I_1} * 100$$

I_2 : Price of month end of the market index.

I_1 : Price of month beginning of the market index.

R_M : Rate of return on the market.

In this study, in order to calculate beta coefficient of wavelet, six time scales are used. The first scale is associated with time movements of 2-4 days, the second scale is associated with time movements of 4-8 days, the third scale is associated with time movements of 8-16 days, the fourth scale is associated with time movements of 16-32 days, the fifth scale is associated with time movements of 32-64 days, the sixth scale, as the highest scale, is associated with time movements of 64-128 days. The reason for considering the sixth scale as the highest scale is that the seventh scale is associated with time movements of 128-256 days that is nearly 1 year, and its calculation is far away from the main goal of the study.

The study population involves all firms of three industries of pharmaceutical, food and vehicles listed in the Tehran Stock Exchange, whose financial reports are applied for the six year period from 2006 to 2011. The statistical sample of the study consists of the firms, which have all the following conditions:

1. The firm is listed on the Tehran Stock Exchange until 2006.
2. The firm's fiscal year end is March 19.
3. During the period of investigation, the firm's stock has not faced transaction interruption more than 6 months.
4. The research needed information of the firm is accessible.

5. The firm is not among the firms of the industries of investment, financial intermediaries and holding.

According to the defined sampling conditions, 58 firms have been selected.

The reason for imposing the third condition is that if a firm's trading symbol has been closed for a long time and its share are not traded, first, the parameters relating to that share are not comparable with the share, which has constantly been traded. Secondly, its estimation parameters such as systematic risk criteria will not be statistically very significant. This means that, as systematic risk index is obtained on the basis of time regression between the returns of studied firms' securities and the market return, the presence of transaction interruption longer than usual leads to not be able to measure the firm's expected return with reasonable accuracy. Furthermore, the period less than 6 months may lead to the removal of a large number of firms in the statistical sample.

In order to test the research hypotheses, the beta of studied firms is calculated in annual separation and in different time scales through Downside Capital Asset Pricing Model (DCAPM).

Then, using wavelet tools different time series return and beta of studied firms are evaluated, based on which the optimum period will be introduced.

T-test is used to test the hypotheses. During this test, reaching the significance of the independent variable coefficient, at the confidence level of 95%, we can deduce that there is a linear relationship between the dependent and independent variables. In addition, F-statistic and ANOVA are used in order to determine estimation goodness. Hypotheses acceptance criterion is the significance of the correlation between the variables at 95% confidence level.

RESULTS

The experimental results are studied in two parts of descriptive and inferential analyses. In descriptive analysis the statistics of mean, median, standard deviation, minimum and maximum are investigated.

Table 1. Descriptive Statistics of Research Variables

| Variable | Mean | Std. Deviation | Min. | Max. |
|---|---------|----------------|-------|------|
| First scale market portfolio return (2-4 days) | 0.035 | 0.076 | -0.09 | 0.26 |
| Second scale market portfolio return (4-8 days) | 0.009 | 0.032 | -0.08 | 0.07 |
| Third scale market portfolio return (8-16 days) | 0.01 | 0.031 | -0.08 | 0.14 |
| Fourth scale market portfolio return (16-32 days) | 0.003 | 0.009 | -0.02 | 0.02 |
| Fifth scale market portfolio return (32-64 days) | -0.0007 | 0.003 | -0.01 | 0.01 |
| Sixth scale market portfolio return (64-128 days) | -0.024 | 0.005 | 0.02 | 0.01 |
| First scale expected return rate (2-4 days) | 0.39 | 0.85 | -1.04 | 2.92 |
| Second scale expected return rate (4-8 days) | 0.36 | 1.16 | -2.87 | 2.73 |
| Third scale expected return rate (8-16 days) | 0.55 | 1.52 | -3.95 | 6.88 |
| Fourth scale expected return rate (16-32 days) | 0.32 | 0.81 | -1.93 | 1.84 |
| Fifth scale expected return rate (32-64 days) | 0.32 | 0.8 | -1.4 | 3.4 |
| Sixth scale expected return rate (64-128 days) | 0.26 | 0.64 | -1.42 | 1.95 |

In order to test the research hypotheses, the beta of studied firms is calculated in annual separation and in different time scales through Downside Capital Asset Pricing Model (DCAPM). In each test, first Pearson coefficient of cross-correlation of the variables is analyzed. In addition, using t-test and regression analysis, the significance of models variables coefficients is examined. The research hypotheses are as follows, therefore, the null hypothesis and the alternative hypothesis are proposed as the following:

According to the results the following table, F value is equal to 44.1, which is significant at the confidence level of 95%. This means that the estimation is good. In addition, the

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determination coefficient and adjusted determination coefficient of the model are respectively, equal to 0.44 and 0.43.

Regard to the following table results, the parameter value between independent variable of the market portfolio return and the dependent variable of expected return rate of first scale is equal to -0.149 that is significant at 95% confidence level.

Table 2. First Hypothesis (Short-Term Period of 2-4 Days)

| Dependent Variable: ER1 | | Method: Panel Least Squares | | |
|------------------------------------|-------------|--|--------------|-------------------------|
| Includes: 6 Periods | | Sample Scope: 2006-2011 | | |
| Number of Firms: 158 | | Total Observations: 58 | | |
| Variables | Coefficient | SD | T Statistics | T Statistics Likelihood |
| C | 0.071284* | 0.009346 | 7.627282 | 0.000 |
| B1STDRM | -0.149063* | 0.000739 | -6.641353 | 0.000 |
| Determination Coefficient | 0.440 | Dependent Variable Mean | | 0.035 |
| Adjusted Determination Coefficient | 0.430 | Standard Deviation of Dependent Variable | | 0.076 |
| SD Regression | 0.057 | Akaike's Criterion | | -2.831 |
| Unexplained Error Sum of Squares | 0.186 | Schwarz's Criterion | | -2.760 |
| Log Likelihood | 84.115 | Hannan Quinn Criterion | | -2.803 |
| Durbin Watson Statistics | 1.729 | F Statistic | | 44.107 |
| | | F statistic Likelihood | | 0.001 |

According to the results the following table, F value is equal to 31.68, which is significant at the confidence level of 95%. This means that the estimation is good. In addition, the determination coefficient and adjusted determination coefficient of the model are respectively, equal to 0.36 and 0.34.

Regard to the following table results, the parameter value between independent variable of the market portfolio return and the dependent variable of expected return rate of second scale is equal to -0.01 that is significant at 95% confidence level.

Table 3. Second Hypothesis (Short-Term Period of 4-8 Days)

| Dependent Variable: ER1 | | Method: Panel Least Squares | | |
|------------------------------------|-------------|--|--------------|-------------------------|
| Includes: 6 Periods | | Sample Scope: 2006-2011 | | |
| Number of Firms: 158 | | Total Observations: 58 | | |
| Variables | Coefficient | SD | T Statistics | T Statistics Likelihood |
| C | 0.019067* | 0.003805 | 5.011099 | 0.001 |
| B1STDRM | -0.015643* | 0.000278 | -5.628883 | 0.001 |
| Determination Coefficient | 0.361 | Dependent Variable Mean | | 0.0049 |
| Adjusted Determination Coefficient | 0.349 | Standard Deviation of Dependent Variable | | 0.032 |
| SD Regression | 0.025 | Akaike's Criterion | | -4.434 |
| Unexplained Error Sum of Squares | 0.037 | Schwarz's Criterion | | -4.363 |
| Log Likelihood | 130.590 | Hannan Quinn Criterion | | -4.406 |
| Durbin Watson Statistics | 1.881 | F Statistic | | 31.684 |
| | | F statistic Likelihood | | 0.001 |

With regard to the significance of the relations of the first and second hypotheses at 95% confidence level, it can be concluded that in short term, there is a significant relationship between market portfolio return and the expected return rate and the first and second hypotheses are confirmed.

According to the results the following table, F value is equal to 37.25, which is significant at the confidence level of 95%. This means that the estimation is good. In addition, the determination coefficient and adjusted determination coefficient of the model are respectively, equal to 0.39 and 0.38.

Regard to the following table results, the parameter value between independent variable of the market portfolio return and the dependent variable of expected return rate of third scale is equal to -0.039 that is significant at 95% confidence level.

Table 4. Third Hypothesis (Mid-Term Period of 8-16 Days)

| Dependent Variable: ER1 | | Method: Panel Least Squares | | |
|------------------------------------|-------------|--|--------------|-------------------------|
| Includes: 6 Periods | | Sample Scope: 2006-2011 | | |
| Number of Firms: 158 | | Total Observations: 58 | | |
| Variables | Coefficient | SD | T Statistics | T Statistics Likelihood |
| C | 0.014256* | 0.003250 | 4.387031 | 0.0001 |
| B1STD RM | -0.039904* | 0.000229 | -6.103636 | 0.001 |
| Determination Coefficient | 0.399 | Dependent Variable Mean | | 0.0105 |
| Adjusted Determination Coefficient | 0.388 | Standard Deviation of Dependent Variable | | 0.031 |
| SD Regression | 0.024 | Akaike's Criterion | | -4.562 |
| Unexplained Error Sum of Squares | 0.033 | Schwarz's Criterion | | -4.491 |
| Log Likelihood | 134.311 | Hannan Quinn Criterion | | -4.534 |
| Durbin Watson Statistics | 1.798 | F Statistic | | 37.254 |
| | | F statistic Likelihood | | 0.001 |

According to the results the following table, F value is equal to 61.44, which is significant at the confidence level of 95%. This means that the estimation is good. In addition, the determination coefficient and adjusted determination coefficient of the model are respectively, equal to 0.52 and 0.51.

Regard to the following table results, the parameter value between independent variable of the market portfolio return and the dependent variable of expected return rate of fourth scale is equal to -0.25 that is significant at 95% confidence level.

Table 5. Fourth Hypothesis (Mid-Term Period of 16-32 Days)

| Dependent Variable: ER1 | | Method: Panel Least Squares | | |
|------------------------------------|-------------|--|--------------|-------------------------|
| Includes: 6 Periods | | Sample Scope: 2006-2011 | | |
| Number of Firms: 158 | | Total Observations: 58 | | |
| Variables | Coefficient | SD | T Statistics | T Statistics Likelihood |
| C | 0.008692* | 0.001079 | 8.056237 | 0.0001 |
| B1STD RM | -0.259216* | 7.55E-05 | -7.838885 | 0.0001 |
| Determination Coefficient | 0.523 | Dependent Variable Mean | | 0.0032 |
| Adjusted Determination Coefficient | 0.514 | Standard Deviation of Dependent Variable | | 0.0090 |
| SD Regression | 0.006 | Akaike's Criterion | | -7.259 |
| Unexplained Error Sum of Squares | 0.002 | Schwarz's Criterion | | -7.188 |
| Log Likelihood | 212.517 | Hannan Quinn Criterion | | -7.231 |
| Durbin Watson Statistics | 1.815 | F Statistic | | 61.448 |
| | | F statistic Likelihood | | 0.001 |

With regard to the significance of the relations of the third and fourth hypotheses at 95% confidence level, it can be concluded that in mid-term, there is a significant relationship between market portfolio return and the expected return rate and the third and fourth hypotheses are confirmed.

According to the results the following table, F value is equal to 10.7, which is significant at the confidence level of 95%. This means that the estimation is good. In addition, the determination coefficient and adjusted determination coefficient of the model are respectively, equal to 0.16 and 0.14.

Regard to the following table results, the parameter value between independent variable of the market portfolio return and the dependent variable of expected return rate of fifth scale is equal to -0.01 that is significant at 95% confidence level.

Table 6. Fifth Hypothesis (Long Term Period of 32-64 Days)

| Dependent Variable: ER1 | | Method: Panel Least Squares | | |
|-------------------------|-------------|-----------------------------|--------------|-------------------------|
| Includes: 6 Periods | | Sample Scope: 2006-2011 | | |
| Number of Firms: 158 | | Total Observations: 58 | | |
| Variables | Coefficient | SD | T Statistics | T Statistics Likelihood |
| C | -0.002014* | 0.000559 | -3.606682 | 0.0007 |
| B1STD RM | -0.016148* | 4.94E-05 | -3.271403 | 0.0018 |

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| | | | |
|------------------------------------|---------|--|---------|
| Determination Coefficient | 0.160 | Dependent Variable Mean | -0.0006 |
| Adjusted Determination Coefficient | 0.145 | Standard Deviation of Dependent Variable | 0.0031 |
| SD Regression | 0.002 | Akaike's Criterion | -8.794 |
| Unexplained Error Sum of Squares | 0.0004 | Schwarz's Criterion | -8.723 |
| Log Likelihood | 257.029 | Hannan Quinn Criterion | -8.766 |
| Durbin Watson Statistics | 1.932 | F Statistic | 10.702 |
| | | F statistic Likelihood | 0.001 |

According to the results the following table, F value is equal to 18.21, which is significant at the confidence level of 95%. This means that the estimation is good. In addition, the determination coefficient and adjusted determination coefficient of the model are respectively, equal to 0.24 and 0.23.

Regard to the following table results, the parameter value between independent variable of the market portfolio return and the dependent variable of expected return rate of sixth scale is equal to -0.033 that is significant at 95% confidence level.

Table 7. Sixth Hypothesis (Long Term Period of 64-128 Days)

| | | | | |
|------------------------------------|-------------|--|--------------|-------------------------|
| Dependent Variable: ERI | | Method: Panel Least Squares | | |
| Includes: 6 Periods | | Sample Scope: 2006-2011 | | |
| Number of Firms: 158 | | Total Observations: 58 | | |
| Variables | Coefficient | SD | T Statistics | T Statistics Likelihood |
| C | -0.005482* | 0.000974 | -5.626428 | 0.001 |
| B1STDRM | -0.033795* | 7.92E-05 | -4.268227 | 0.001 |
| Determination Coefficient | 0.245 | Dependent Variable Mean | | -0.002 |
| Adjusted Determination Coefficient | 0.231 | Standard Deviation of Dependent Variable | | 0.005 |
| SD Regression | 0.005 | Akaike's Criterion | | -7.721 |
| Unexplained Error Sum of Squares | 0.001 | Schwarz's Criterion | | -7.650 |
| Log Likelihood | 225.918 | Hannan Quinn Criterion | | -7.693 |
| Durbin Watson Statistics | 1.931 | F Statistic | | 18.217 |
| | | F statistic Likelihood | | 0.007 |

With regard to the significance of the relations of the fifth and sixth hypotheses at 95% confidence level, it can be concluded that in long term, there is a significant relationship between market portfolio return and the expected return rate and the fifth and sixth hypotheses are confirmed.

CONCLUSION

In the first and second hypotheses, the coefficients of market portfolio return became significant at 95% confidence level with the values of -0.149 and -0.01, respectively. With regard to the significance of the relations of the first and second hypotheses at 95% confidence level, it can be concluded that in short term, there is a significant relationship between market portfolio return and the expected return rate and the first and second hypotheses are confirmed. In addition, in the short term the impact of market portfolio return in the first scale is greater than the second scale.

Studies show that in short term, the effect of market returns on stock returns is higher. This is due to the lack of analysts' consensus on the share and behavioral reasons such as the skewness of the return (Nejad, Jahantigh, & Rahbari, 2016). However, the positive relationship between stock returns and market portfolio return is confirmed in some studies (Aloui, Jammazi, & Hamida, 2018) and in some others the positive linear relationship is rejected (Vakilifard & Heirany, 2013).

In the third and fourth hypotheses, the coefficients of market portfolio return became significant at 95% confidence level with the values of -0.25 and -0.039, respectively. With regard to the significance of the relations of the third and fourth hypotheses at 95% confidence level, it can be concluded that in mid-term, there is a significant relationship between market

portfolio return and the expected return rate and the third and fourth hypotheses are confirmed. In addition, in the short term the impact of market portfolio return in the third scale is greater than the fourth scale.

In the fifth and sixth hypotheses, the coefficients of market portfolio return became significant at 95% confidence level with the values of -0.01 and -0.03, respectively. With regard to the significance of the relations of the fifth and sixth hypotheses at 95% confidence level, it can be concluded that in long term, there is a significant relationship between market portfolio return and the expected return rate and the fifth and sixth hypotheses are confirmed. In addition, in the long term the impact of market portfolio return in the sixth scale is greater than the fifth scale.

The above result is consistent with the research results of Rhaiem, Ben, and Mabrouk (2007), and shows that the relationship between stock returns and the level of market portfolio return in the short-term and long-term scales is more intense, so that stock market is more efficient in the short term and long term.

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