An Examination of the Relationship between Values at Risk and Expected Stock Return in Tehran's Stock Exchange

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Abstract

The main objective of this study was to examine the relationship between Value at Risk (VaR) and expected returns from 2002 to 2013 in Tehran's Stock Exchange. In this study parametric value at risk, which considers the distribution of returns as normal and the historical value at risk as abnormal, was used to test the presence of the volatility anomaly in the companies listed in Tehran's Stock Exchange. Also, this study controlled the impact of the variables (Firm size, Book value to Market value) and the relationship between Value at Risk and expected return.

The results of the analysis of the panel data showed a significant positive relationship between the parametric VaR , historical VaR and expected returns during the period under review .The results showed that the control variables didn't have an effect on the relationship between Value at Risk and expected returns.

Keywords: Value at Risk, Expected Return, Volatility Anomaly

1. Introduction

Pricing of assets is one of the most serious and basic challenges in the financial knowledge. The main focus is risk factors that can explain the changes in expected returns. The empirical studies in this category have so far failed to reduce the challenges facing it. Empirical evidence has attempted to identify important risk factors. However, it is obvious that in the classic financial framework, higher volatility is respective to higher expected return. Despite the fundamental support for a positive relationship between the risk and return in numerous empirical evidences, some empirical evidences, such as Anget et al. (2006,2009) found that there was a reverse relationship between these two variables and that the stocks with lower volatility created the higher expected return compared to the stocks with higher volatility. These findings brought

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about many studies to support and confirm the results of study conducted by Anget et al. For this reason, some researchers have tried to find a reverse relationship. One of the things that led to the clarification of the relationship between risk and return was an attention to the distribution of asset returns. In classic asset pricing models such as the CAPM, it is assumed that the distribution of returns is normal. However, evidence shows that the distribution of returns is not normal. Since the distribution of return is normal, the standard deviation measures the risk. As soon as the distribution of stock returns get away from the normal distribution, standard deviation loses its efficiency. While the distribution of return is not normal, VaR will measures the risk. The use of a Value at Risk can help to overcome the above parody. Therefore, this study examined the relationship between VaR and expected return.

2. Review of Literatures

There are lots of researches in the course of investigating the relationship between the effective driving factors and return of financial securities. In some of these researches the effect of one factor was considered while in other researches the effect of more than one factor has been investigated. Here it will be discussed about these researches briefly.

Mean-variance portfolio theory is one of the assumptions and theoretical models of asset pricing. Statistical results of the experimental tests of asset pricing model and the efficient market hypothesis are conditional on the assumptions of the distribution of returns. In most financial theories and empirical methods, the distribution of stock returns rates are considered normal. However, in the real world returns aren't normally distributed and have been Skewness and Kurtosis(kon,1984).

Normal Hypothesis testing on daily returns of the Dow Jones Industrial stocks was performed by Fama, He showed that the distribution of daily stock returns had greater elongation (tails wider) in comparison to the normal distribution (Fama,1976).

In an article entitled" High idiosyncratic volatility and low returns," Ang et al. (2009) investigated the low volatility anomalies from 1980 to 2003.They examined stock market of the United States and the G7 countries (Canada, France, Germany, Italy, Japan, England and America). Their first survey was conducted in 2006 and then it was continued in 2008 and 2009. That portfolio was based on the ratio of Book value to Market value and Firms size. General Volatility was based on daily returns and standard deviation errors which were calculated based on Fama and French model, which is considered as a measurement tool of idiosyncratic risk. Finally, the research group announced that there would be a negative relationship between the idiosyncratic risk and average stock returns in the future. This research group investigated the 23 stock markets of other countries and found that a similar relationship would occur between the idiosyncratic risk and average stock returns of these seven countries in the future (Ang et al .,2009).

Huang et al. (2007) and Fu (2009) showed that through the use of monthly data the results of study conducted by Ang et al. could be reversed and a positive relationship would exist between idiosyncratic risk and expected return (Huang et al. ,2007; Fu,2009).

Blitz et al. (2007) examined the decile weighted portfolio of the stocks based on the volatility of the past 3 years and classified the ratio of book value to market value. The results showed that an increase of risk (Standard Deviation and beta CAPM) would result in the reduction of portfolio return. Results of this study were also confirmed by the studies conducted in the markets of America, Europe and Japan. All these studies confirmed the low volatility anomalies in these markets (Blitz et al. ,2007).

Verchenco (2002) tested the relationship between stock returns and risk through the use of exponential GARCH model. He investigated this relationship considering asymmetric risk, systematic and idiosyncratic risk. According to the results of his study, in half of the markets there was a positive relationship between the systematic risk and stock return while in other markets the idiosyncratic risk had a significant negative impact on the return on equity shares (Verchenco,2002).

Baker et al. (2011) investigated the volatility anomalies in 21 developed countries and in 12 emerging markets. They formed decile and quintile portfolios by using the volatility of monthly returns and finally confirmed the existence of low volatility anomaly (Baker,2011).

Bali et al. (2004) classified Monthly decile portfolio of 10% , 5% and 1% value-at-risk. In their study, they find a positive relationship between the risk and average return (Bali,2004).

To examine the cross-sectional relationship between the expected return and risk, Kang (2011) used the ICC used as an indicator of expected returns. His findings indicated that there was a positive relationship between the idiosyncratic risk and expected return (Kang, 2011).

3. Methodology

This study aimed at investigating the relationship between value at risk and expected return in Tehran's Stock Exchange. The research data included daily returns and audited financial statements of the companies listed in Tehran's Stock Exchange from 2002 to 2013. Adjusted daily prices of the companies were collected by Tseclient and the daily return and other variables were calculated using Excel. Also to examine the relationship between VaR and expected returns and to examine the effects of control variables such as firm size, and book value to market value, Eviews 8 was used. The study sample consists of all firms listed in Tehran's Stock Exchange. The sample includes all firms except for firms that were considered as financial intermediaries.

To examine the relationship between VaR and expected return the following model was taken into account:

$$R_{it} = \alpha_{it} + \gamma_{it}(\text{Risk Measure}_{it-1}) + \varepsilon_{it} \qquad (1)$$

Where R_{it} is firm i's day t expected return and $\text{Risk Measure}_{it-1}$ is firm i's risk measure, observed at day t-1, and calculated return observations over the previous 100 trading days.

These measures are calculated by parametric and historical VaRs which are as follows:

1) There are two primary ways to calculate VaR: parametric and historical. We include both methods in our initial investigation. Parametric VaR is defined by a distribution and its parameters. We assume a normal distribution, which is defined by its mean and standard deviation. A confidence level is required to determine the degree of certainty that the VaR provides. Parametric VaR is defined as:

$$\text{VaR}_{it} = \bar{R}_{it} - S_{it}Z$$

Where $\bar{R}_{it}$ is the average return for firm i over the previous 100 days, S_{it} is the standard deviation firm i's on day t, and Z is the corresponding Z-score, representing the confidence level. For example, to be 95% confident that the value for VaR is the maximum expected loss, given that the distribution conforms to a normal distribution, the Z-score would be 1.65.

2) A potential problem of parametric VaR, which has been suggested in the related literature, is that that stock returns are not normally distributed. Historical VaR is a non-parametric measure which is estimated by historical observations. As such,e stimation of the historical VaR is not dependent on a return distribution assumption. For example, if an investor wishes to be 95% confident of the size of maximum loss, he can rank the last 100 days of trading from the highest to lowest. The 95% VaR is on the fifth lowest return, representing the maximum loss that is to be expected 95% of the time during the next period. Because the VaR is most likely negative, we follow the Bali and Cakici (2004) methodology of multiplying VaR by negative one, which allows for easier interpretation of the sign of the coefficients (i.e., a positive co coefficient on VaR indicating a positive risk–return relation).

To study the impact of the control variables such as liquidity, firm size, and book value to market value of equity on the relationship between VaR and expected the following test was used:

$$R_{it} = \alpha_t + \gamma_t(\text{Risk Measure}_{it-1}) + \delta_t \ln(\text{size})_{it-1} + \lambda_t \ln(B/M)_{it-1} + \varepsilon_{it} \quad (2)$$

where R_{it} and $\text{Risk Measure}_{it-1}$ are defined as in Eq. (1), and $\ln(\text{size})_{it-1}$, $\ln(B/M)_{it-1}$ are the previous daily values of natural log of size, natural log of book value to market value equity for firm i, respectively.

4. Empirical Results

Table 1. Descriptive statistics for risk measures and control variables.

variable	Return	Parametric VaR	Historical VaR	B/M	Size
Mean	-0/027	-4/80	-3/14	0/60415	11/99
Median	0/00	-4/6	-3/49	0/500782	11/89
Maximum	3/99	-1/48	-0/87	1/55	13/17
Minimum	-3/98	-9/65	-4/83	0/073	11/31
Std. Dev.	2/37	2/15	1/12	0/412779	0/58
Skewness	0/061	-0/53	0/58	0/801447	0/51
Kurtosis	2/25	2/73	2/18	2/728993	2/1

In Table 1 the descriptive statistics for the return, VaR and control variables used in this study are provided.

Table 2. Unit Root Test

variable	Levin,Lin&Chu	Probability	Im,Pesaran	Probability
Expected return	-12/7526	(0/0001)	-16/7292	(0/0001)
Parametric VaR	-29/6649	(0/0001)	-31/3812	(0/0001)
Historical VaR	-37/2109	(0/0001)	-38/2119	(0/0001)
Size	-46/5502	(0/0001)	-46/6336	(0/0001)

B/M	-50/3365	(0/0001)	-49/9687	(0/0001)

In Table 2 unit root test has been done and all variables were stable.

Table3. F Limer Test

	F-statistic	**Probability**
Model 1	0/98288	0/7392
Model 2	0/9897	0/6476
Model 3	0/9793	0/7806
Model 4	0/9768	0/6895

In table 3 the F statistic is greater than the 5 % significance level, so all models are data pool.

Table 4. The Result of Model Estimation (1)

Model	$\mathbf{R_{it} = \alpha_t + \gamma_t(VaR_{it-1}) + \varepsilon_{it}}$			
Variables	**Coefficient**	**Std-error**	**t-Statistic**	**Prob**
Intercept	0/047	0/023	2/012	0/044
Parametric VaR	0/015	0/004	3/477	0/0005
AR(1)	0/5164	0/002	249/001	0/000
DW	2/052	**Adjusted R-squared (R^2)**		0/267

In table 4 t-statistic Parametric VaR is equal to 10.952 and significance level is less than 5%.Therefore, there is a significant and positive relationship between the Parametric VaR and

expected return. In this model Durbin Watson statistic is 2.051, which is indicative of the lack of relationship between errors. Also adjusted R-Squared is equal to0.267. Therefore it can be concluded that the regression equation is only about 26.77% of the variation expected return that is explained by this variable.

Table 5.The Result of Model Estimation (1)

Model	$\mathbf{R}_{it} = \alpha_t + \gamma_t(Historical\ VaR_{it-1}) + \varepsilon_{it}$			
Variables	**Coefficient**	**Std-error**	**t-Statistic**	**Prob**
Intercept	-0/188	0/022	-8/208	0/000١
Historical VaR	0/0355	0/0045	7/823	0/000١
AR(1)	0/516	0/002	248/9	0/000١
DW	2/051	**Adjusted R-squared (R^2)**		0/267

In table 5 t-statistic Historical VaR is equal to 7.823 and significance level is less than 5%.Therefore, there is a significant and positive relationship between the Parametric VaR and expected return. In this model Durbin Watson statistic is 2.051, which is indicative of the lack of relationship between the errors. Also adjusted R-Squared is equal to 0.267. Therefore it can be concluded that the regression equation is only about 26.77% of the variation expected return that is explained by this variable.

Table 6. The Result of Model Estimation (2)

Model	$\mathbf{R}_{it} = \alpha_t + \gamma_t(VaR_{it-1}) + \delta_t \ln(\mathbf{size})_{it-1} + \lambda_t \ln(B/M)_{it-1} + \varepsilon_{it}$			
Variables	**Coefficient**	**Std-error**	**t-Statistic**	**Prob**
Intercept	0/640	0/2167	2/956	0/0031
Parametric VaR	0/080	0/014	5/367	0/0000
Size	-0/0442	0/0177	-2/495	0/0126

B/M	0/225	0/0246	9/140	0/0000
AR(1)	0/515	0/002	248/23	0/0000
DW	2/047	**Adjusted R-squared (R^2)**		0/265

Table 6 shows whether the control variables have an effect on the relationship between Parametric VaR and expected return. The relationship between the control variables and the expected return were investigated in the previous studies, so the results of these previous studies can be used in this study. In this study, a significant negative relationship was found between the firm size and expected return which was in line with the results of studies conducted by Barber & Lyon (1997), Fama& French (1981),and Haffman Moll (2012). Also a significant positive relationship was found between the B/M and expected return which was in line with the results of the studies conducted by Barber & Lyon(1997), Fama& French (1981),and Haffman Moll (2012). Also a significant positive relationship was found between the expected return and Parametric VaR by adding the control variables. This positive relationship indicates that the control variables have not an impact on the relationship between the VaR and expected return. It should be mentioned that the addition of the control variables increases the explanatory power of the model (the adjusted R-Squared measure).

Table 7. The Result of Model Estimation (2)

Model	$\mathbf{R}_{it} = \alpha_t + \gamma_t(\boldsymbol{Historical\ VaR}_{it-1}) + \delta_t \ln(\mathbf{size})_{it-1} + \lambda_t \ln(\boldsymbol{B/M})_{it-1} + \varepsilon_{it}$			
Variables	**Coefficient**	**Std-error**	**t-Statistic**	**Prob**
Intercept	0/807	0/218	3/702	0/0002
Historical VaR	0/049	0/008	5/506	0/0000
Size	-0/0456	0/017	-2/578	0/0099
B/M	0/220	0/024	8/946	0/000۱
AR(1)	0/514	0/0246	8/946	0/000۱
DW	2/047	**Adjusted R-squared (R^2)**		0/265

Table 7 shows whether the control variables have an effect on the relationship between Historical VaR and expected return. The relationship between the control variables and the

expected return was investigated in the previous studies. In this study, a significant negative relationship was found between the firm size and the expected return which was in line with the results of the studies conducted by Barber & Lyon (1997), Fama& French (1981), and Haffman Moll (2012). Also, a significant positive relationship was found between the B/M and expected return which was in line with the studies conducted by Barber & Lyon(1997), Fama& French (1981),and Haffman Moll (2012). Also, in this study a significant positive relationship was shown between the expected return and Historical VaR by adding the control variables. This positive relationship indicates that the control variables have not an impact on the relationship between VaR and expected return. It should be mentioned that the addition of the control variables increases the explanatory power of the model (the adjusted R-Squared measures).

5. Conclusions

Capital asset pricing model explains the relationship between the volatility and returns .One of the assumptions of the pricing models is that the distribution of return is normal while the distribution of stock returns in the real situations is not normal. Therefore ,in this study, to test the presence of volatility anomaly, parametric value at risk, considering the distribution of the returns as normal, and historical value at risk , not considering the distribution of the returns as normal, were used. Furthermore, the effect of the variables such as firm size and B/M on the relationship between the VaR and expected return was controlled. The results showed the existence of a significant positive relationship between the parametric value at risk, historical value at risk and expected returns. Also, there was a significant negative relationship between the firm size and the expected returns and there was a significant positive relationship between the B/M and expected returns.

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