Journal of Business, Economics and Finance
Year: 2017 Volume: 6 Issue: 3

COMPARISON OF VALUE AT RISK METHODS: APPLICATION OF ISE 30

DOI: 10.17261/Pressacademia.2017.685
JBEF- V.6-ISS.3-2017(6)-p.254-263

Zeynep Ilhan Dalbudak[1*], Murat Atan[2], Veysel Yilmaz[3]
[1] Eskisehir Osmangazi University, Department of Statistics, , Eskisehir, Turkey. zeynepilhan@ogu.edu.tr
[2] Gazi University, Department of Econometrics, Ankara, Turkey. atan@gazi.edu.tr
[3] Eskisehir Osmangazi University, Department of Statistics, , Eskisehir, Turkey. vyilmaz@ogu.edu.tr

To cite this document
Dalbudak, Z. I., M. Atan, V. Yilmaz (2017). Comparison of value at risk methods: application of ISE 30. Journal of Business, Economics and Finance (JBEF), V.6, Iss.3, p.254-263.
Permemant link to this document: http://doi.org/10.17261/Pressacademia.2017.685

ABSTRACT
Purpose- The main purpose of this paper is to measure the potential losses of the portfolio obtained from ISE-30 using three different methods with VaR methods.
Methodology- Historical Simulation, Variance-Covariance Method and Monte Carlo Simulation are used for the calculation of VaR. These three methods are examined regarding their results on the portfolios created according to different criteria. The price series of ISE 30 are used to create different three portfolios and their VaR results are compared. The performance of VaR results are checked by backtesting process after calculating VaR. VaR results are discussed by examining the performance of the methods for each portfolio.
Findings- When the VaR of the portfolios are examined, the lowest VaR result of three portfolios is obtained in Portfolio 2 which is formed according to volatility criterion. One of the remarkable results of this study is that, as mentioned above, V-C and MCS methods give similar results. On the other hand, VaR results of the Historical Simulation Method are higher, and emerge in the green area in test process.
Conclusion- It may be advisable for banks or other investors in the financial sector to move to the top of the order of preference according to the retrospective test results of TS method under high confidence level conditions. On the other hand, the results of the V-K and MCS method should be tested with the Backtesting by extending the observation period.

Keywords: Value at Risk, historical simulation method, variance-covariance (parametric) method, Monte Carlo simulation method, ISE 30.
JEL Codes: C10, C14, C19

1. INTRODUCTION

Nowadays, technological advances have become the most important factor that affects all humanity agenda and daily life. Several reasons such as the liberalization movements across the world, multinational companies, nesting of the countries' economies, markets that can be traded for twenty-four hours a day and the diversity of traded securities have turned the world economy into almost a single market. Adapting to this rapid change is an important requirement for both the future of countries and all big/small investors as well as financiers.

Orange Country event in February 1994, Barings Bank collapse in February 1995, Enron bankruptcy in 2000 are the recent examples for "failure to manage" the risk. Another recent example is the Lehman Brothers' bankruptcy in 2008. These "noteworthy" examples drew much attention to the necessity of the risk management. The fact that the way to survive in finance sector not only depends on profit, but also the necessity to estimate the loss draws the world's attention. JP Morgan name draws attention with regard to estimating the possible losses. By use of the risk measurement technic called as 4:15 matrix, JP Morgan initiated a method defining financial risks undertaken only with one number instead of many numbers and values. This name has been given to the method because of the meetings carried out afternoon at 4:15 pm every day.

The used methods have diversified over the time and begun to be used in finance sector. However, there are three methods leading in not only academic field but also in the sector. These methods are Historical Simulation (HS), Variance-

Covariance (V-C), and Monte Carlo Simulation (MCS) methods. There is no mentioning about an absolute superiority among these three methods, but each one has certain advantages and disadvantages to one another. The decision maker can perform risk measurement by preferring the most appropriate method after determining his/her needs.

In this study, three fundamental Value at Risk (VaR) calculation methods are applied upon 4 portfolios in total, three of which are formed by using ISE 30, and one of which is formed by golden, foreign currency and overnight interest rate. VaR calculations were made by using the hypothetical portfolios' daily data between 22.04.2013 and 30.04.2014. The calculations were carried out at 99%, 95% and 90% confidence levels. However, the obtained results were not solely enough in order to determine the performances of the methods. For this reason, the found results were assessed through performing Backtesting process at all confidence levels.

2. LITERATURE REVIEW

2.1 Value at Risk

Value at Risk is defined as the greatest expected losses for a given holding period at a specified confidence level. We can say that we can also be sure that there is no more loss than "X" TL in "t" day at "X" confidence level for the kept portfolio. As can be understood from these definitions, the holding period and confidence level are two important variables.

VaR calculation is made by using Equality 1.

$$RMD = Z_{\alpha}\sigma w\sqrt{t} \tag{1}$$

In Equality 1, the meanings of the symbols are that *Z* is standard Normal Distribution Coefficient complying with the meaning level, *σ* is standard deviation, *W* is monetary value of the portfolio and t is holding period.

When various risk management methods are used in literature, VaR research has developed rapidly with the influence of Basel's suggestions. Küçüközmen (1999) emphasizes that finding wide usage area for VaR is connected with expressing the risk of entire portfolio with a single number.

VaR calculation methods which are preferred in literature and financial markets are Historical Simulation (HS), Variance-Covariance (V-C) and Monte Carlo Simulation (MCS) methods.

2.1.1. Historical Simulation Method

Historical Simulation method defined as "nonparametric VaR" shows the distribution of profit and loss ranges at a given confidence level by examining the effect of backdated data on the existing portfolio. This method is easy to understand and explain and it can also be described as a simplified version of Monte Carlo Simulation.

The idea behind the VaR calculation by using HS method is to simulate VaR with the assumption that we have kept the current portfolio since the beginning of the historical data, by using the distribution of historical returns of the securities under the portfolio. In order to implement this, the historical returns of the assets in the portfolio should be primarily obtained for a specified period of time. It is assumed that historical returns of the assets that form the portfolio are kept since the beginning of the historical returns, in order to calculate the hypothetical returns of the existing portfolio. By assuming that the distribution of the portfolio returns reflects the future, the related confidence level of this distribution gives the expected VaR of the portfolio (Dowd, 1998).

2.1.2. Variance-Covariance Method

Another commonly used method is Variance-Covariance method that is a parametric method. In order to calculate the volatility and correlations of the portfolio returns, this method is based on V-C matrix of portfolio returns by use of the historical time series. Therefore, this approach is called as Variance-Covariance method. Meanwhile, this approach is a parametric approach because the accuracy of the model depends on correct estimation of distribution parameter and proper formation of return distribution of assets (Gökgöz, 2006).

2.1.3. Monte Carlo Simulation Method

Monte Carlo Simulation Method is another method suggested by Banking Regulation and Supervision Agency (BRSA) in the "Notification Concerning the Assessment of the Market Risk Calculation with Risk Measurement Models and Risk Measurement Models" dated 3 November 2006. MCS Method is a preferred method for VaR calculations, and also frequently used in quantitative finance field.

MCS method is the most powerful and comprehensive method when it is used correctly in terms of measuring market risk. Therefore, it is a computer-intensive VaR calculation method. Generally, it is used with normal distribution, but it may also

work with different distribution assumptions. In addition, the model risk appearing in the other methods is almost eliminated completely in this method (Şahin, 2004), as well.

In fact, it can be said that MCS Method is a mixture of V-C Method and HS Method. Variance covariance matrix of the historical returns is required in MCS; it is also required in V-C method. However, MCS approach is not satisfied with this, and it creates a new series with correlation based on the variance covariance matrix in question. The process after this is the same as HS method. If the period of time which is used in the method is same with the period of time which is used in order to create variance-covariance matrix, and if portfolio exhibits a linear behavior; the results of MCS and HS are more or less the same. However, if the portfolio exhibits nonlinear behavior (due to the reasons such as the options), the results will be different (Selimov, 2006).

2.2. Backtesting

Financial models are established upon the assumption that actual price movements experienced in the finance markets will occur in the future, as well. Backtesting ensures the comparison of the results which are produced with the risk measurement models with the real market data. Backtesting is benefited in both forming stage of new models and reassessment stage of the existing models. Although only one model is not formed for backtesting, financial institutions have to apply backtesting in order to check the accuracy of the internal VaR models which are used for the measurement of their capital adequacies. Financial institutions perform backtesting applications in monthly and quarterly periods per year in order to measure the accuracy of the VaR models. The aim of these tests is to compare the maximum loss of the portfolio which has been estimated previously by VaR models with the realized values (JP Morgan, 1996).

In line with the suggestions of Basel Comity, risk-based capital adequacy can be calculated as a result of Backtesting of VaR applications that are performed in financial institutions. In consequence of the deviations of the model, the capital that should be found is calculated by being multiplied with the multiplication factor in the existing area.

Determination of the multiplication factors is performed as in Table 1.

Table 1: Determination of the Multiplication Factor Used in Backtesting

Area	Deviation Number	Increase in the Multiplication Factor	Capture Percentage for 99%?	Cumulative Probability
Green Area	0	0.00	8.1%	8.11%
	1	0.00	20.5%	28.58%
	2	0.00	25.7%	54.32%
	3	0.00	21.5%	75.81%
	4	0.00	13.4%	89.22%
Yellow Area	5	0.40	6.7%	95.88%
	6	0.50	2.7%	98.63%
	7	0.65	1.0%	99.60%
	8	0.75	0.3%	99.89%
	9	0.85	0.1%	99.97%
Red Area	10 and above	1.00	0.0%	99.99%

Source: BIS, 2006, p.321.

Basel Committee specifies error acceptance numbers for different confidence intervals, regarding Backtesting. Error acceptance numbers are shown in Table 2.

Table 2: Error Acceptance Numbers Used in Backtesting

VaR Confidence Interval	The Area Where Error Amount (N) Can Be Accepted		
	T = 255 days	T = 510 days	T = 1000 days
99%	N<7	1< N<11	4< N<17
97.5%	2< N<7	6< N<21	15< N<36
95%	6 N<21	16< N<36	37< N<65
92.5%	11< N<28	27< N<51	59< N<92
90%	16< N<26	38< N<65	81< N<120

Source: Jorion, 2001, p.136.

Backtesting, in other words, is the identification medium for the capital that will be kept by the business. Backtesting becomes prominent here because the businesses do not want to keep an excessive amount of capital. Therefore, the anticipation of the probable losses should be made at an optimum level.

3. DATA AND METHODOLOGY

In this study, three fundamental VaR calculation methods are examined upon three portfolios by comparing them in the observation period between 22.04.2013 and 30.04.2014. The portfolios that have been formed are chosen according to return, volatility and price criteria, among the stock certificates that are processed in the ISE 30 index. Price series of the stock certificates that are processed in ISE 30 are obtained from Istanbul Stock Exchange.

Risk quantification of the portfolios that are formed in this part of the study is carried out via using HS, V-C and MCS methods. According to the results obtained, the results given by the VaR methods are compared. Whether the loss amount which is calculated for portfolios is correctly determined or not, is analyzed through the Backtesting method. Therefore, the method that gives the best results is specified according to the performances which are displayed by the VaR calculation methods.

3.1 Forming the Portfolios and Obtaining the Return Series

Firstly, ISE 30 price series is obtained between the dates 22.04.2013 and 30.04.2014, in order to determine the portfolios that are used in the study.

In the second stage, the criteria to be used in forming the portfolios are specified, and portfolio choices are made according to these criteria. The criteria that are chosen for first, second, and third portfolio are respectively return, volatility, and price criteria. Portfolio is formed by choosing 6 stock certificates among the stock certificates, through applying these criteria to the stock certificates which are processed in ISE 30. In Portfolio 1, the weights of the assets are specified according to the return of the assets. Among the assets that are evaluated in this portfolio, the asset with the highest return is given the maximum weight, and the asset with the lowest return is given the minimum weight proportionally. In Portfolio 2, the weights of the assets which are used in that portfolio are specified according to volatilities of the assets. In contrast to Portfolio 1 which is specified according to the return criteria, the asset with the low volatility is given the maximum weight, and the asset with high volatility is given the minimum weight in this portfolio. The weights of the assets which are evaluated in Portfolio 3 are specified according to the price criteria. By choosing 6 stock certificates among the stock certificates that are processed in ISE 30 which is ranged from low price to high price, these certificates are formed through giving great weight to the one with low price, and small weight to the ones with high price.

The assets and their weights which are put into process in the portfolios are shown in Table 3.

Table 3: The Assets and the Weights Which Are Put Into Process in the Portfolios

Portfolio 1	Weights	Portfolio 2	Weights	Portfolio 3	Weights
EREGL	50.81%	**TCELL**	18.11%	**KRDMD**	27.07%
ENKAI	21.14%	**EREGL**	18.00%	**ASYAB**	20.07%
TCELL	14.86%	**PETKM**	16.86%	**EREGL**	14.35%
TOASO	8.52%	**TTKOM**	16.74%	**EKGYO**	13.41%
PETKM	2.03%	**KCHOL**	16.11%	**SISE**	12.77%
ARCLK	2.64%	**SISE**	14.18%	**PETKM**	12.33%
	100%		100%		100%

Current value for all the portfolios that are subjected to analyze is specified as 1,000,000 TL. This value is distributed to assets, in accordance with the weights specified for the portfolios.

3.2 Application of VaR Calculation Methods on Different Portfolios

In VaR calculations, Historical Simulation, Variance-Covariance and Monte Carlo Simulation methods are preferred in both literature and in the sector. In this study, the methods are compared, applying these methods to 3 portfolios that are formed through using stock certificates which are processed in ISE 30. All data between 22.04.2013 and 30.04.2014 are used in calculations. All three methods in VaR calculations are examined separately for confidence levels of 99%, 95% and 90% and for holding periods of 1 day, 10 days, and 1 year.

3.2.1 VaR calculation through Historical Simulation Method

According to HS method, VaR calculation is made over the current value of 1,000,000 TL as per different confidence levels and different holding periods for each portfolio.

As a result of the application of the HS method which is carried out for Portfolio 1 that is formed according to return criterion, VaR result is specified approximately as 152,795 TL with the confidence level of 99% and holding period of 10 days. When the holding period is kept fixed, VaR result decreases approximately to 50,213 TL, provided that the confidence level is specified as 90%. Application results of HS method for Portfolio 1 are shown in Table 4.

Table 4: VaR with HS Method for Portfolio 1

Portfolio 1			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day)	48318.01	21713.87	15878.76
VaR (10 Days)	152794.97	68665.29	50213.04
VaR (252 Days)	767024.68	344697.01	252067.47

When application results of HS method for Portfolio 2 that is formed according to the volatility criterion seen in Table 5 are examined, 10 days' VaR result with confidence level of 95% is 86,752 TL, and when the holding period increases to 1 year, this value increases up to 435491.43 TL.

Table 5: VaR with HS Method for Portfolio 2

Portfolio 2			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day)	45635.04	27433.38	15896.94
VaR (10 Days)	144310.65	86751.97	50270.55
VaR (252 Days)	724433.73	435491.43	252356.15

When Table 6 is examined, remarkable results are obtained for Portfolio 3 which is formed according to price criterion. Rather high results are obtained in comparison with Portfolio 1 and Portfolio 2 for all confidence levels. While average 140,000-150,000 TL result is obtained for Portfolio 1 and Portfolio 2 with confidence level of 99% and for 10 days of holding period, 191,010.86 TL is obtained for Portfolio 3.

Table 6: VaR with HS Method for Portfolio 3

Portfolio 3			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day)	60402.94	30372.43	22126.03
VaR (10 Days)	191010.86	96046.05	69968.65
VaR (252 Days)	958866.91	482147.35	351239.82

When HS results for Portfolio 1, Portfolio 2, and Portfolio 3 which are formed with stock certificates that are chosen from ISE 30 are examined, the lowest VaR results are obtained for Portfolio 2 that is formed according to low volatility criterion. In this circumstance, Portfolio 2 should be preferred when a portfolio with low VaR that is formed only with stock certificates is required.

3.2.2 VaR calculation through Variance-Covariance Method

According to Variance-Covariance method, VaR calculation for each portfolio is made over the current value of 1,000,000TL.

Before the application of V-C method, normality hypothesis, which is the most important hypothesis of the method, is checked. The control of normality hypothesis for each portfolio is demonstrated in Table 7. According to the results obtained, Portfolio 1, Portfolio 2, and Portfolio 3 comply with the normal distribution (sig>p=0.05)

Table 7: Test of Normality Results for the Portfolios

	Number of Data	**Average Return**	**Standard Deviation**	**Kolmogorov-Smirnov**	**Sig**
Portfolio 1	252	987.5398	16506.699	1.125	0.159
Portfolio 2	252	69.1514	16066.837	1.138	0.150
Portfolio 3	252	-335.9776	21124.836	1.106	0.173

Portfolio's standard deviation is calculated by forming correlation and covariance coefficient matrix of each portfolio in order to obtain the results according to V-C method. VaR results are obtained for each portfolio according to 1-day, 10-day and 1-year holding periods at 99%, 95% and 90% confidence levels through using the calculated portfolio's standard deviations.

VaR result is obtained approximately as 121,381 TL for 10 days' holding period at 99% confidence level as a result of the application of V-C method which is performed for Portfolio 1 that is formed according to return criterion. When the period is kept fixed, VaR result decreases approximately to 67,202 TL, provided that the confidence level is specified as 90%. Detailed results for Portfolio 1 are shown in Table 8.

Table 8: VaR with V-C Method for Portfolio 1

Portfolio 1			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day)	38384.22	27181.96	21251.35
VaR (10 Days)	121381.57	85956.91	67202.67
VaR (252 Days)	609330.64	431500.24	337354.73

The results of the V-C method for Portfolio 2 which is formed according to volatility criterion are demonstrated in Table 9. When the obtained results are examined, VaR result per 1 day with 95% confidence level is 26,458 TL, and this value increases to 420,001.43 TL when the holding period increases to 1 year.

Table 9: VaR with V-C Method for Portfolio 2

Portfolio 2			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day)	37361.38	26457.63	20685.06
VaR (10 Days)	118147.06	83666.37	65411.89
VaR (252 Days)	593093.52	420001.85	328365.08

The results of VaR calculation that is made with V-C method for Portfolio 3 which is formed according to price criterion are demonstrated in Table 10. VaR result with 1-day holding period and with 90% confidence level is 27,196.92 TL, and this value is obtained as 49,123.11 TL when 99% confidence level is specified with the same holding period.

Table 10: VaR with V-C Method for Portfolio 3

Portfolio 3			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day)	49123.11	34786.75	27196.92
VaR (10 Days)	155340.92	110005.37	86004.20
VaR (252 Days)	779805.23	552222.59	431737.66

3.2.3 VaR calculation through Monte Carlo Simulation Method

According to MCS method, VaR calculation is made over the current value of 1,000,000TL according to different confidence levels and different holding periods for each portfolio. MCS application is performed by operating the model formed for each portfolios, 100*10000 times (produced randomly) with the return. The lowest, average and the highest result values of VAR which are found according to 1-day, 10-day and 1-year holding periods at 99%, 95% and 90% confidence levels are tabulated.

VaR results with MCS method for Portfolio 1 which is formed according to return criterion are demonstrated in Table 11. The average VaR result is calculated as 127,540.98 TL with 10-day holding period at 99% confidence level, while the highest VaR result is found as 131,550.75 TL.

Table 11: VaR with MCS Method for Portfolio 1

Portfolio 1			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day) (Lowest)	38900.00	27700.00	21500.00
VaR (10 Days) (Lowest)	123012.60	87595.09	67988.97
VaR (252 Days) (Lowest)	617518.36	439723.87	341301.92

VaR (1 Day) (Average)	40332.00	28364.00	22130.00
VaR (10 Days) (Average)	127540.98	89694.84	69981.20
VaR (252 Days) (Average)	640250.65	450264.54	351302.86
VaR (1 Day) (Highest)	41600.00	29300.00	22600.00
VaR (10 Days) (Highest)	131550.75	92654.74	71467.48
VaR (252 Days) (Highest)	660379.53	465123.08	358763.88

VaR calculation results with MCS method for Portfolio 2 which is formed according to volatility criterion are demonstrated in Table 12. The average VaR result is determined as 65,098.65 TL with 10-day holding period at 90% confidence level. This value increases to 118,079.45 with the same holding period and at 99% confidence level.

Table 12: VaR with MCS Method for Portfolio 2

Portfolio 2			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day) (Lowest)	35800.00	25600.00	20000.00
VaR (10 Days) (Lowest)	113209.54	80954.31	63245.55
VaR (252 Days) (Lowest)	568307.38	406387.40	317490.16
VaR (1 Day) (Average)	37340.00	26282.00	20586.00
VaR (10 Days) (Average)	118079.45	83110.98	65098.65
VaR (252 Days) (Average)	592754.12	417213.82	326792.62
VaR (1 Day) (Highest)	38900.00	27000.00	21100.00
VaR (10 Days) (Highest)	123012.60	85381.50	66724.06
VaR (252 Days) (Highest)	617518.36	428611.71	334952.12

VaR calculation results with MCS method for Portfolio 3 which is formed according to price criterion are demonstrated in Table 13. The average VaR result is determined as 148,540.24 TL with 10-day holding period at 99% confidence level, while the highest VaR result is obtained as 154,002.92 TL with the same holding period and confidence level.

Table 13: VaR with MCS Method for Portfolio 3

Portfolio 3			
Confidence Level	**0.99**	**0.95**	**0.90**
VaR (1 Day) (Lowest)	45000.00	32300.00	25200.00
VaR (10 Days) (Lowest)	142302.49	102141.57	79689.40
VaR (252 Days) (Lowest)	714352.85	512746.60	400037.60
VaR (1 Day) (Average)	46972.55	33149.02	25939.22
VaR (10 Days) (Average)	148540.24	104826.40	82027.00
VaR (252 Days) (Average)	745666.10	526224.37	411772.28
VaR (1 Day) (Highest)	48700.00	34400.00	27100.00
VaR (10 Days) (Highest)	154002.92	108782.35	85697.72
VaR (252 Days) (Highest)	773088.53	546083.07	430199.16

3.3 Backtesting of VaRs that are Calculated through Three Basic Method

For each portfolio, daily VaRs are back tested by comparing them with portfolios' incurred losses which are calculated with three basic VaR methods. Backtesting process is performed for 99%, 95% and 90% confidence levels.

In Backtesting process, VaR's average lines obtained from MCS results are compared. It is observed that there are huge discrepancies when the lowest and the highest values are compared.

Daily VaR results which are obtained through VaR calculation methods are compared with the daily return of each portfolio, and deviation numbers are recorded. In other words, daily expected losses at a specific confidence level for each portfolio are obtained via VaR calculation; the power of the calculations made is checked by comparing these expected losses with the actual losses. In Backtesting process, the acceptability of the deviation numbers of the methods is controlled according to green, yellow and red area expressions that are stated in Table 1 and according to acceptable error numbers specified in line with various confidence levels and observation periods in Table 2.

VaR results which are obtained through using three basic VaR calculation methods for Portfolio 1 that is formed according to return criterion, are demonstrated in Table 14. When the deviation numbers are examined, the lowest deviation number

at 99% confidence level is obtained through HS method and it is determined that this number exists in green area according to Table 1. In other words, it is specified that the numbers obtained are consistent. The deviations of the numbers that are obtained through V-C method and MCS method at 99% of confidence level are determined as 7 and 6, respectively. These values that are concluded as a result of Backtesting are compatible with error acceptance numbers that are used in Backtesting according to Table 2. However, the error numbers of the results that are obtained through V-C and MCS methods are acceptable, due to the fact that the deviation numbers of the V-C and MCS methods, in contrast to HS method, exist in yellow area according to Table 1, but the results should be doubted.

Table 14: Backtesting Results of VaR Results for Portfolio 1

Portfolio 1			
	99%	**95%**	**90%**
Historical Simulation Method	3	13	26
Variance-Covariance Method	7	8	15
Monte Carlo Simulation Method	6	8	13

VaR results that are calculated for Portfolio 2 which is formed according to volatility criterion are demonstrated in Table 15. The results of Backtesting which is performed for VaR results obtained at all confidence levels are concluded to have been in the area where the error amount is acceptable at all confidence levels according to Table 4.6. However, when the obtained results are examined at 99% confidence level according to Table 1, the Backtesting result for HS emerges in green area; while the other methods' results emerge in yellow area. Considering these results, it can be interpreted that "the error numbers of the results obtained according to V-C and MCS methods are acceptable, but the results should be doubted anyway".

Table 15: Backtesting Results of VaR Results for Portfolio 2

Portfolio 2			
	99%	**95%**	**90%**
Historical Simulation Method	3	13	26
Variance-Covariance Method	6	14	17
Monte Carlo Simulation Method	6	14	17

VaR results that are obtained through using three basic VaR calculation methods for Portfolio 3 which is formed price criterion are demonstrated in Table 16. As a result of the test for VaR results that are obtained at 99% confidence level, all of the obtained results for each of the three methods emerge in the acceptable area. When the error numbers are examined, the lowest error number at 99% confidence level is obtained through HS method and it is specified that this number exists in the green area according to Table 1. The deviation of the results which are obtained through V-C method and MCS method is specified as 6 and it is in the yellow area according to Table 1. Even if these results obtained as a result of Backtesting according to V-C and MCS methods are acceptable according to error acceptance numbers that are used in Backtesting according to Table 2, these results are obtained as the ones to be doubted.

Table 16: Backtesting Results of VaR Results for Portfolio 3

Portfolio 3			
	99%	**95%**	**90%**
Historical Simulation Method	3	13	26
Variance-Covariance Method	6	11	20
Monte Carlo Simulation Method	7	11	20

When Backtesting processes that are applied on Portfolios are examined, and when the error numbers of the methods are compared at 99% confidence level, the lowest error is obtained from HS method. The Backtesting result of HS method for all three portfolios which are examined emerges in the green area. However, when the examined confidence levels are changed into 95% and 90%, the error numbers for HS method approach to the error numbers of V-C and MCS methods; furthermore, they exceed the ones of V-C and MCS methods as seen in Table 15.

When the Backtesting process of Portfolio 2 which gives the lowest VaR result for TS, V-C and MCS methods is examined from Table 18, it is observed that TS method gives good result at the highest confidence level again, but the error numbers approach to the error numbers of V-C and MCS methods at 95% confidence level, and it is observed that the error number of HS method exceeds significantly the error numbers of the other two methods at 90% confidence level.

From the results obtained, it can be recommended for the investor to choose the most appropriate portfolio, considering the possible losses that he/she can bear and the risks that she/he can undertake. The advantages and disadvantages of VaR methods should be taken into consideration in order to evaluate the chosen portfolio and the most appropriate VaR method for the portfolio should be preferred. HS method at high confidence level can principally be used by considering the performance which was shown at high confidence level by HS method.

4. FINDINGS AND DISCUSSIONS

In this study, the effect of the methods of VaR calculations upon the hypothetical portfolios that are formed according to different criteria is investigated, by taking into consideration the importance of VaR calculations. The performances of the methods are tried to be determined by controlling the obtained results with Backtesting process. To that end, among the portfolios formed, the ones which give the lowest VaR result are tried to be determined.

The portfolio that is used in Bostancı's study (2006) has become an important reference in determining the portfolios which are used in this study. In the aforementioned study, the weighting in the portfolio which is formed by using ISE 100 Index, golden and dollar is performed with 60%-40% rule.

In the first step of the study, the returns are calculated by using the price series between 22.04.2013 and 30.04.2014 in order to determine the portfolios that are to be used. Hypothetical portfolios are formed by using the obtained return series, and the returns of the portfolios are calculated according to the determined weights. One of the attention-grabbing results in the three portfolios which are formed according to return, volatility and price criteria by using ISE 30 is that stock certificates named EREGL and PETKM are involved in all of these three portfolios. The stock certificate named SISE, however, is involved in the portfolios which are formed according to volatility and price criteria.

After the general assessment regarding the assets and portfolios to be evaluated, the application of VaR calculation methods is made over 1,000,000TL, the current value. First of all, the application of Historical Simulation Method is performed. According to the results of HS method, for 1-day withholding period and at 99% confidence level, VaR is calculated as 48318.01 TL for Portfolio 1 which is formed according to return criterion, 45635.04 TL for Portfolio 2 which is formed according to volatility criterion, 60402.94 TL for Portfolio 3 which is formed according to price criterion. When Backtesting process is performed for all portfolios of HS method, the results emerge in the acceptable area according to Table 2, and in the green area according to Table 1. In other words, the analyses performed with HS method give consistent results at 99% confidence level.

When Variance-Covariance Method, another method that is used in VaR calculation, is applied at 99% confidence level and 1-day withholding period, VaR is calculated as 38384.22 TL for Portfolio 1, 37361.38 TL for Portfolio 2, and 49123.11 TL for Portfolio 3. When these obtained results are subjected to Backtesting process, at the specified confidence level, they emerge in the acceptable area according to Table 2, but in the yellow area according to Table 1. The results are acceptable according to V-C method; however, these results are obtained as the ones to be doubted in any way.

Finally, Monte Carlo Simulation Method is applied to portfolios. According to this, VaR is determined as average 40332 TL for Portfolio 1, 37340 TL for Portfolio 2, and 46972.55 TL for Portfolio 3 at 99% confidence level and with 1-day withholding period. When these results are examined with the Backtesting process, at the specified confidence level, they emerge in the acceptable area according to Table 2, but in the yellow area according to Table 1. As in the V-C method, the obtained results of Backtesting process which is performed for MCS are acceptable, but are determined as the ones to be doubted values in any way.

When the VaR of the portfolios are examined as a result of method applications, the lowest VaR result of three portfolios is obtained in Portfolio 2 which is formed according to volatility criterion. Specifying the assets to be evaluated, Portfolio 2 according to the lowest VaR criterion outclasses the other two portfolios.

When the results of the analyses and test processes are examined, VaR results that are obtained from Variance-Covariance and Monte Carlo Simulation are so close to each other, but they emerge in the yellow area in the Backtesting process. On the other hand, VaR results of the Historical Simulation Method are higher, and emerge in the green area in test process.

When the thesis study of Bostancı (2006) which is used as a reference in forming Portfolio is examined, the highness of VaR results that are obtained with HS method draws attention. Even the content and weighting ways of the portfolios that are formed are different; HS Method's giving high VaR results similarly in different portfolios appears as an important result.

It is seen that V-C and MCS Methods give similar results (in yellow area) at 99% confidence level. When HS method is examined at 99% confidence level, it is observed that it gives good results, however it gives similar and even higher error numbers compared to V-C and MCS methods at low confidence levels.

When the regulation published by BRSA (Banking Regulation and Supervision Agency) is examined, 99% confidence level is expected for banks in VaR calculations. In the light of the findings obtained in this study, it can be recommended for banks or other investors in finance sector that HS method is moved to higher ranks in preference ranking, according to Backtesting results in high confidence level conditions. On the other hand, the results of V-C and MCS methods should be tested with Backtesting by expanding observation period.

One of the remarkable results of this study is that, as mentioned above, V-C and MCS methods give similar results. One of the reasons why V-C and MCS methods give similar results is that methods are evaluated to study based upon normality hypothesis. In addition, the fact that both of these methods use the same variance covariance matrix is considered as another reason for giving similar results.

5. CONCLUSION

The risk management process, which affects banks along with Basel negotiations, has also become the focus of other investors in the finance sector. VaR calculations have been one of the most important ways to make predictions about the future of portfolio holders for all investors who are big or small. The possibility of anticipating the potential future loss of the portfolio planned to be invested directly affects the decisions of the investor.

When the VaRs of portfolios are examined as a result of the method applications, the lowest VaR results among the four portfolios are obtained for Portfolio 4 which is constructed by using gold, foreign exchange and interest rate. When only the portfolios created by stock evaluation are examined, Portfolio 2, which is constructed according to the volatility criterion in these three portfolios, yields the lowest VaR results.When the number of overages in the GARCH results is examined, the lowest number of exposures is obtained in these portfolios giving the lowest VaR result. Portfolio 4 and Portfolio 2 provide the superiority of the other two portfolios according to the lowest RMD criteria by determining the assets to be evaluated.

When the results of constructed analyzes and test process are examined, the results of VaR obtained from Varyans-Covariance and Monte Carlo Simulation methods are very close to each other and they are in the yellow region during the Backtesting. On the other hand, the VaR results of Historical Simulation Method were higher in the green region during the test process.

In the light of this study, it may be advisable for banks or other investors in the financial sector to move to the top of the order of preference according to the retrospective test results of TS method under high confidence level conditions. On the other hand, the results of the V-K and MCS method should be tested with the Backtesting by extending the observation period.

This study can be repeated on the portfolios which are formed by using different methods of forming portfolio. Therefore, the results of the methods in different conditions can be observed. Another way to develop this study is to evaluate the series for the conditions in which the series do not provide the normality hypothesis, by expanding the observation period. Therefore, the changes in the results which are presented by the methods can be observed closely when different conditions come into question in the long observation periods.

REFERENCES

Alkin E., Savaş T., Akman V. 2001 , "Bankalarda Risk Yönetimine Giriş", İstanbul: Çetin Matbaacılık.

BDDK 2001, "Bankaların İç Denetim ve Risk Yönetimi Sistemleri Hakkında Yönetmelik", *Official Gazette,* No. 24312.

BDDK 2006, "Risk Ölçüm Modelleri İle Piyasa Riskinin Hesaplanmasına ve Risk Ölçüm Modellerinin Değerlendirilmesine İlişkin Tebliği", *Official Gazette,* No. 26335.

BIS Basel Committee on Banking Supervison) 2006, "Core Principles for Effective Banking Supervision", <http://www.bis.org/publ/bcbs129>

Bostancı, A. 2006, "Riske Maruz Değer Hesaplama Yöntemlerinin Karşılaştırılması ve Geriye Dönük Test Backtesting) Uygulaması", *Master Thesis*, Zonguldak: Zonguldak Karaelmas University, Graduate School Of Social Sciences.

Dowd, K. 1998, "Beyond Value at Risk: The New Science of Risk Management", *John Wiley & Sons*, Inc, Chicester.

Gökgöz, E. 2006, "Riske Maruz Değer VaR) ve Portföy Optimizasyonu", , *Ankara: Sermaye Piyasası Kurulu Publishing*, No:190.

Jorion, P. 2000, "Value At Risk: The New Benchmark for Managing Financial Risk", New York, USA: McGraw-Hill.

JP Morgan/Reuters 1996, "Riskmetrics Technical Document", 219-223.

Küçüközmen, C. 1999, "Bankacılıkta Risk Yönetimi ve Sermaye Yeterliliği: Value at Risk Uygulamaları", İktisat İşletme ve Finans Dergsi.

Selimov, V. 2006, "Riske Maruz Değer (Value At Risk) ve Uç Değerler Yaklaşımı: Teorisi ve Uygulaması", <http://paribus.tr.googlepages.com/v_selimov.doc>

Şahin, H. 2004, "Riske Maruz Değer Hesaplama Yöntemleri", Ankara: Turhan Kitabevi.