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Analysıs of Market Risk in Stock Investment Using Value at Risk Method (Study on Manufacturing Companıes in Lq-45 Lısted on Indonesıa Stock Exchange)

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Abstract

Capital flows as one part of this economic growth is sourced from the capital markets namely Indonesia stock exchange. The capital markets have a function of economics because capital markets provide a facility or vehicle which brings together two interests, namely those who have excess funds and those who need funds. Before investing, investors should set a goal of investing and the magnitude of the funds invested. Any investment decisions taken have the risks borne by the investor, either investment in bonds or stocks. Stocks with known characteristics of high risk-high return, which means the stock provides an opportunity to earn high profits but also potentially high loss risk. Value at Risk (VaR) models has been extensively used not only in the banking sector but also in calculating in many sectors. The aim of this paper is to outline Value at Risk methodology by giving more emphasis on variance-covariance method, historical simulation, and Monte Carlo model. The model used to investigate the applicability and usefulness of VaR in stock investment in Indonesia Manufacturing companies. Using the methodologies as described, the maximum potential loss on each stock and its portfolio of nine stocks calculated at 95% confidence level. The models were validated using backtesting and Kupiec test. The research found that there are different results of VaR calculated using variance-covariance, historical simulation, and Monte Carlo models. However, the variance-covariance model is the valid one to measure the maximum potential loss of stocks.

Keywords

Value at risk; Indonesia manufacturing companies; Indonesia stock exchange (idx); Variance-covariance; Historical; Monte Carlo; Back testing

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Introduction

Indonesia has so many problems in the economy. The last few years, the Government of Indonesia to try to find a variety of solutions to address the economic problems in Indonesia. The improvement of economic growth by the Government of the last few years seemed to be giving a positive result. According to Kemenperin, quarter III in 2013, Indonesia's economic growth slows. Indonesia's economy is measured based on the magnitudes of the gross domestic product (GDP) on the basis of the price applicable, quarter III in 2015 reached Rp 2.982 .6 trillion.

Indonesia economic quarter III in 2015 against quarter III in 2014 growing 4.73 % increase compared to quarter II-2015 growing 4.67%, but slowed down compared to close to quarter III in 2014 growing 4.92 %. Indonesia economic quarterly III in 2015 against the previous quarter grow 3.21 %. The economy of Indonesia up to quarter III in 2015 grows 4.71 % (Kemenperin, 2015). These economic growth efforts have a goal encourages an influx of foreign and domestic capital into productive sectors to open employment and boosts economic growth. This capital can be a source of development financing. This capital flow is very important so that the Government does not depend on foreign loans.

Capital flows as one part of this economic growth are sourced from the capital markets namely Indonesia stock exchange. The capital markets have a function of economics because capital markets provide a facility or vehicle bring together two interests, namely those who have excess funds and those who need funds. Before investing, investors should set a goal of investing and the magnitude of the funds invested. Any investment decisions taken have the risks borne by the investor, either investment in bonds or stocks. Stocks with known characteristics of high risk-high return, which means the stock provides an opportunity to earn high profits but also potentially high loss risk. Stock price fluctuations resulted in investors can receive a profit, Nora loss. Not only are investors who have the risk of its investments, but the company will also have risks that exist within the company after investors make an investment. This risk is called risk speculative. Speculative risk arguably includes a larger class of risk Speculative risk is the uncertainty of events that may give rise to profits or loss. According to Aparna Gupta (2013, 9), the speculative risk can be categorized as market risk, credit risk, strategic, business, and reputational. The company shall manage those risks properly so as not to impact on the earnings of the company and also the profits will be given to investors.

Companies in the industrial sector in Indonesia have a major influence on economic growth Indonesia is a country with the greatest potential land for the development of the industrial sector. This is related to a large number of existing resources, which are raw materials and labors in Indonesia. According to the World Investment Report 2010-2011 release by the United Nation Conference on Trade and Development, Indonesia is 9thlargest investment appeal in the world (UNCTAD, 2010).

The manufacturing industry is the most attractive sector to an investor to invest,

especially after the international trade and economic crisis in Europe and America getting better. The Ministry of the industry has been optimistic about the growth of the manufacturing industry, although there are various obstacles including limited availability of infrastructure etc. (Kemenperin, 2015). According to Central Bureau Of Statistics Indonesia, the growth of production of large and medium manufacturing industry 2015 annual ride 4.57% compared to 2014. The increase was mainly due to the rise in production of the pharmaceutical industry, Chemical drug products, and traditional medicines, up 12.53%, Industrial Goods of metal, not machines and equipment, up 9.47%, Nonmetallic Minerals Industry Goods, and food, respectively rising 7.37% (Central Bureau of Statistics, 2015).

The growth of industrial production in large and medium manufacturing quarter IV 2015 rose by 4.02% against quarter IV by 2014. The types of industries that are experiencing the rise mainly due to the rise in production of the pharmaceutical industry, Chemical drug products, and traditional medicine rise 15.27%, industrial computer, Electronic and optical Goods rose 11.36% and industrial rubber, Rubber and plastic goods from rising 8.15%. While the types of industries that experienced a decrease in the production of Apparel Industry is the largest down 14.63%, industrial electric equipment down 10.93%, and industrial chemicals and Chemical goods from 8.93% down.The growth of industrial production in large and medium manufacturing quarter IV 2015 rose by 1.69% against quarter III by 2015 (Central Bureau Of Statistics, 2015).

The number of companies goes public in Indonesia also has an impact on a large number of an investor in and outside the country who want to invest. There are three runways that are the basis of the decision of the investors, namely the expected return, the level of risk, and the relationship between return and risk. Investors can reduce risk by diversifying investments. The diversified investment will give optimum benefits in return for investments in a portfolio correlated negatively. Markowitz (1952) has proven that the risk of investing reduced by combining some assets in a portfolio. Markowitz method indicates if the financial assets in a portfolio have a correlation of return of less than one, then the overall portfolio risk lowered.

According to the traditional methods of risk measurement, risk quantification is done by measuring the sensitivity i.e. by observing changes in one of the risk factors and their impact on profit or loss of a portfolio. The measurement results are traditionally in the form of the amount of the loss is experienced, but these measurements do not give an idea of the potential amount of probability or loss that may be experienced. Besides measurement traditionally used on the assets individually, so each has assets of different risk measurement methods (Sartono, 2006). According to Sartono (2006), If each of these assets is combined into one portfolio, risk measurement becomes difficult because of the many methods that are used for each of the assets even though the need for diversification in investing in one or more product groups so that the risk be reduced.

In 1994, JP Morgan developed the methods of VaR, which then its use is

very widespread for measuring the various types of risk. According to the Best (1999) method of Value at Risk (VaR) is a method of measuring the risk statistically estimate the maximum loss that may occur over a certain level of confidence in the portfolio. There are several models in the VaR measurement i.e. Variance-Covariance models, Historical Simulation models, and Monte Carlo models. Previous research found that the VaR calculation by using the Variance-Covariance models produce undiversified VaR larger compared to a calculation model of Historical. In this research, will be used different objects and different analysis tools from previous research.

Theorıtıcal and Conceptual Background

Understanding Investments

Investment related to a wide range of activities that is able to invest some funds in the asset, such as land Rikk, gold, machinery, buildings, or investments in financial assets such as bank deposits, shares or bonds. According to Tandelilin (2010), investment is the commitment to a number of funds or other resources are done at this time, with the aim of acquiring a number of advantages in the future. The purpose of affecting the investment because it does because of a necessity or a need where the investment occurs automatically in accordance with the development needs of the living, as well as an investment due to due to an expectation of where these investments are included in investment due to the deliberate because there is hope of benefit or profit. In addition to his motivation there are also aspects that can be inflicted in the penginvestasian sacrifice aspects contained therein, namely an investor must answer resource, the aspect of hope against the investment that he did in order to create welfare society, aspects of risk where everyone doing business investment to always expect profits but in reality not everyone who could do business profitably, but there's a turnover or even a loss, the aspect of time in which to invest in needed patience to wait for the expected results as well as aspects of the type where every investment like to do differently in shape and the risks there of.

Investment and Stock Return

One of the goals of investors investing is to get a return. In the absence of the profit levels enjoyed from an investment, surely investors will not invest. So, all investments have the main purpose of getting a return. The understanding Return according to Jogiyanto Shares (2009:199), the return is the result of the investment. Meanwhile, according to Brigham and Houston (2006:215), return or the rate of return is differences between the amount received and the amount invested, divided by the amount invested. According to Tandelilin (2010), the expected profits from the portfolio are the weighted average of the rate of profit expected of each individual assets that make up the portfolio. The presentation of the value of the portfolio is invested in each individual asset in the portfolio are known as weighing a portfolio. If the entire portfolio weights added, would amount to a total of 100% or 1.0. This means that all funds have been invested with the expected portfolio return (Tandelilin, 2010).

Understanding the Risk

According to Bank Indonesia Regulation's definition (PBI), No. 5/8/ PBI/2003 on the implementation of the management (2003) the risk is the potential for the occurrence of an event (events) that may give rise to a loss. According to the risk management Certification Body (BSMR) and the Global Association of Risk Professionals (GARP) (A:4, 2007), the risk is defined as the chance of the occurrence of the results (outcomes). According to Hanafi (2006), the risk is the magnitude of the deviation between the rate of expected return (ER) and the actual rate of return. According to Arthur j. Keown (2000), the risk is the prospect of an outcome that is not preferred (operates as a standard deviation). Of the various definitions above, it concluded that the definition of risk is a condition arising due to the uncertainty with the completely unfortunate consequences that may occur.

Value at Risk

Research results are known as Risk Metric associated with the measurement of risk. One of the results of research, which are quite widely used, is the use of holding period 1 today with a 95% confidence level in calculating VaR. Besides the determination of the value of the decay factor in applying the method, Exponentially Weighted Moving Average (EWMA) is also widely used, namely about 0.94 to daily volatility and volatility to 0.97 monthly.

Jorion (2007) States that the VaR is the number of maximum predicted losses will occur in the time (horizon) with a certain level of trust. So, the calculation of quantitative factors needed in calculating the value of VaR on a specified time horizon and at a certain level of trust that has been established before.

Method

This research uses quantitative research type. Quantitative research is a type of research that focuses on testing using measured data. Types of data used in this research are quantitative to calculate return and VaR. The source of the data used in this research is a secondary data source.

Sampling

In this study, the population used is companies in Indonesia enrolled in LQ-45. The sample is representative of the population partially or researched. Sampling technique in the quantitative research is the nonprobability sampling. Part of nonprobability sampling purposive sampling was used. The criteria used based on specific reasoning or rations. This study the criteria used is with certain considerations, i.e.:

1. Companies in Indonesia are enrolled in LQ-45.
2. Companies in Indonesia are listed on the Indonesia stock exchange and present financial reports and a complete ratio with variables will be examined based on the sources used.
3. Companies in Indonesia are listed on the Indonesia stock exchange IPO before doing years of research (before 2013).
4. Companies with stocks that active and liquid that meets the criteria 45 stocks most active within 30 days of the last stock exchange or active for the last 3 years.

5. Companies have a market capitalization of over Rp 1 trillion so that it can represent the values of daily market trading, even capable of being index mover in the formation of the JCI in the Indonesia stock exchange.
6. Companies that during the period of research become a member remains on the LQ-45 (not coming-out)
7. Manufacturing companies in Indonesia who published a financial report in full and detailed.

After specifying the type and number of shares that will use as the basis for research. The amount of data selected stocks as the investment portfolio as much as 9 stocks. Daily data collection nine selected stocks since 1 February 2013 up to 28 February 2016. The data collected for each stock as many as 780 daily share price data.

Stage of Calculation

Translation of research methodology in measuring the risk of stock market investment policy on Manufacturing companies by using the model of Value at Risk (VaR) generally fall into the following stages: Specify the type and number of shares that will use as the basis for research, Calculate expected return by using a geometric return, Calculate return portfolio using the formula, Measure the variance of portfolio assets, Determine the Variance of each stock and the portfolio Variance-Covariance model, Specifically for doing calculations with VaR Historical Simulation model, Calculate the magnitude of the value of the maximum loss (VaR) for each stock and portfolio VaR model Variance Covariance.

Testing of the Validity

The data used to calculate the value of VaR is the value of return, therefore, the results of the decision depend on the possibilities and statistical theory. A possibility of giving the size of his little big trust will be the decision makers within the scope of a given result. Before the deployment of the data return to measure the validity of testing needs to be done VaR data, which includes distribution patterns, testing normality, heteroscedasticity, and volatility was followed by backtesting. To determine the validity of the model than to do Back Testing with the Kupiec Tests use data for 252 days or one year of data. On the research of Back Testing done with a Test where the trust level Kupiec/confidence level used is 95% done with 252 data transactions during 1 year. If failure rate (N) numbering between $6<N<21$ then the VaR model is considered valid for measuring potential losses. But if $N < 6$ then the model was considered too conservative, whereas if $N > 21$ then the model was considered too moderate (Jorion, 2007).

Results Fındıngs and Discussion

In this research, a Fund of Rp. 1,522,866,780,000 (based on exposure of 29 January 2016) have been invested by nine companies manufacturing Indonesia which is the sample in this research form of investment shares on the capital market. The reason the election on 29 January 2016 as the exposure is due on the date of this research will be assumed as the current situation (current situation in the research period). In general, the reason the selection of shares by the management of the company manufacturing Indonesia

is based on the consideration of the diversification of investments in various kinds of stock. If the return of an asset class is going through a downturn, then return the other asset classes is expected to increase, so that an overall portfolio return is relatively stable. The composition of the portfolio of stocks that are used as research data as shown in Table 1 as follows:

Model Evaluation: Calculation Results

Table 1. Stocks Exposure of the Indonesia Manufacturing Companies

Shares	Lot	Shares Volume	Closing Price	Value of portfolio	Weight
ASII	932,481	93,248,100	6,450	601,450,245,000	39.49%
CPIN	154,889	15,488,900	3,345	51,810,370,500	3.40%
GGRM	14,341	1,434,100	58,350	83,679,735,000	5.49%
ICBP	45,212	4,521,200	14,450	65,331,340,000	4.29%
INDF	179,966	17,996,600	6,200	111,578,920,000	7.33%
INTP	54,173	5,417,300	19,700	106,720,810,000	7.01%
KLBF	1,027,517	102,751,700	1,335	137,173,519,500	9.01%
SMGR	166,838	16,683,800	11,050	184,355,990,000	12.11%
UNVR	49,255	4,925,500	36,700	180,765,850,000	11.87%
Total		262,467,200		1,522,866,780,000	100%

Based on the exposure of the stock investment made by Companies manufacturing Indonesia it appears that the selection of issuers still dominated by the automotive sector sub (39.49%) i.e. to stock ASII (Astra), this can be understood given the very development of automotive companies in Indonesia due to the large number of market demand for motor vehicles.

Model Evaluation: Calculation of Data Return

Investment return data stock is continual and time series data, so to find out the results of the daily return can be calculated using geometric methods return, which is a logarithmic function of the price ratio. The use of the geometric return to avoid biased results.

Related to the magnitude of the influence on divided as common elements in the calculation using the arithmetic return.

Based approach with the geometric return, can then be calculated return on his daily respectively for nine selected stocks. After the return of each stock daily known throughout the period specified, and then calculated the daily portfolio return anyway from the stocks. Return is then assigned a proportion of (weighted) the magnitude of the value of each of the stocks that make up the portfolio weighting as portfolios. If the whole weight of the overall aggregated portfolio does it, weigh is 100%.

Related to the purpose of the research will measure the potential value of a loss of 9 types of auctions that have been set out in the investment decision, then it should be calculated the return

of each stock by using historical data. Historical data used in the research starting from the date of February 1, 2013, at up to 29 January 2016 or equal to 780 daily data. This research period selected based on the newest research and concluded on January 29, 2016, due to the determination of stock assignment LQ-45 is done twice in a year is the month of February to July and August to January. The results of the calculation of the return made against results mean of return, minimum and maximum return, standard deviation, and skewness calculation with the results as presented in Table 2 as follows:

Table 2. The Calculation of the Average, Minimum and Maximum Return Standard Deviation, and Skewness Nine Types of Stocks.

Code	Minimum	Maximum	Average	Standard Deviation	Skewness
ASII	-0.08973	0.10697	0.00018	0.02148	0.16000
CPIN	-0.16814	0.14698	0.00016	0.03082	-0.28400
GGRM	-0.08521	0.07947	0.00014	0.02093	-0.05900
ICBP	-0.07333	0.08923	0.00074	0.02037	0.24600
INDF	-0.10228	0.11980	0.00005	0.02140	0.22600
INTP	-0.10827	0.10935	0.00011	0.02434	0.12900
KLBF	-0.09685	0.10368	0.00026	0.02128	0.13200
SMGR	-0.12201	0.11922	0.00047	0.02332	0.04900
UNVR	-0.07015	0.13217	0.00066	0.02087	0.77700

In the table above, calculation of the Average return of nine stocks was analyzed during the period February 1, 2013, until 29 January 2016, the INDF stock is stock with the lowest return i.e. 0.00005 and the highest average return achieved by ICBP of 0.0074. The highest value of the returned Results in that period reached by the shares of the CPIN, which reached 0.1469. While the minimum value in the calculation of the value of the biggest losses in the period is CPIN reached by 0.1681.

Classic Assumption Test

Test of normality was done with the aim to find out whether the distribution of the data return nine stocks has a normal distribution or not/skewed. Based on normality testing table, can be inferred that the return of the overall nine stocks is not normal/skewed because of the value of Asymp. SIG (2-tailed) smaller than 0.05. Therefore, to do the calculation of the Variance-Covariance is need to calculate z score using Cornish-Fisher Expansion formula to determine the value of Z correction. After a test of normality return known data that the data was not Normal, then the adjustment must be performed against the value of α.

On a normal distribution of α that is used comes from the normal use the value of the Z-score. If the distribution is not normal then α that is used is the result of an adjustment by using the Z correction. Customization of the form α was conducted on the skewness

Normality data by using the equation of Cornish-Fisher Expansion.

Heteroscedasticity test is carried out with the aim to find out whether the data returned are homoscedasticity or heteroscedasticity. Based on the result of data return is Homoscedasticity because significant-t more than 0.05, so to do the calculation of volatility of return by using the EWMA approach does not need.

The Calculation of the Variance-Coє variance VaR Each Stock

The value of the VaR indicates the maximum potential loss financial assets or portfolios owned in a period of utilization with a certain level of trust. Further calculation of the Variance-Covariance VaR done for each stock is present in Table 3 below:

Table 3. Calculation of VaR with a Time Horizon 1 day, 5 days, 10 days, and 20 days ahead

Code	Price Exposure	St. Deviation	Z correction	VAR 1 day	VAR 5 Days	VAR 10 Days	Var 20 Days
ASII	6,450	0.02148	2.47909216	343.38947	767.84220	1,085.892853	1,535.6844
CPIN	3,345	0.03082	2.646182746	272.80133	610.002308	862.6735373	1,220.00462
GGRM	58,350	0.02093	2.327553661	2,842.41023	6,355.8225	8,988.490381	12,711.645
ICBP	14,450	0.02037	2.577873584	758.63385	1,696.35686	2,399.010879	3,392.71372
INDF	6,200	0.02140	3.109308725	412.46173	922.292466	1,304.318513	1,844.58493
INTP	19,700	0.02434	2.65294	1,272.01305	2,844.30765	4,022.458452	5,688.6153
KLBF	1,335	0.02128	2.491867898	70.79996	158.31352	223.8891277	316.627041
SMGR	11,050	0.02332	2.844247963	732.80188	1,638.59482	2,317.323011	3,277.18963
UNVR	36,700	0.02087	1.804364288	1,381.75932	3,089.70778	4,369.506645	6,179.41556

In the table above, it is seen that the highest VaR for a period of 1 day per sheet to the stock occurred at GGRM shares amounting to Rp 2,842.41023, while VaR lowest occurred on stock KLBF Rp. 70.79. VaR for a period of 5 days next to per shares happens to shares GGRM amounting to Rp. 6,355.8225 whereas the lowest VaR occurred on stock KLBF Rp. 158.31352. Var for a period of 10 days to the fore for per shares happen to GGRM shares amounting to Rp. 8,988.490381 while VaR lowest occurred on stock KLBF Rp. 223.889. Var for a period of 20 days to the fore for per shares happen to GGRM shares amounting to Rp. 12,711.645 while VaR lowest occurred on stock KLBF Rp. 316.627041.

Calculation of VaR by Historical Simulation

One of the methods that can be used to calculate VaR using historical data upon the return of shares or stock portfolio is to use a model of Historical Simulation. The way that must be taken in calculating the value of the VaR by Historical Simulation, first done with the sort of stock return data. Sorting starts from the value of the largest losses up to the amount of profit the largest. After it made the list with percentile confidence level assigned. In this study, the number of stock return data used as many as 780 data coherently time (time series) with a 95% confidence level, so 5% of that data is data number 39 with data return

number- 39 are used as a percentile value calculated VaR Historical Simulation. Calculation of maximum losses to top nine stocks is carried out using the same return data used in the calculation of the Variance-Covariance VaR exposure.

Table 4. VaR Historical Simulation Calculation

Code	Price	Percentile data-39	Var 1 day	Var 5 days	Var 10 days	Var 20 Days
ASII	6,450	-0.03718	-239.805	-536.2193	-758.32864	-1072.4386
CPIN	3,345	-0.05380	-179.97	-402.4253	-569.11527	-804.85054
GGRM	58,350	-0.03440	-2007.32	-4488.511	-6347.7135	-8977.0225
ICBP	14,450	-0.03348	-483.727	-1081.647	-1529.6796	-2163.2937
INDF	6,200	-0.03031	-187.893	-420.1419	-594.17036	-840.28379
INTP	19,700	-0.03792	-747.009	-1670.363	-2362.2496	-3340.7255
KLBF	1,335	-0.03534	-47.1781	-105.4933	-149.19011	-210.98667
SMGR	11,050	-0.04032	-445.547	-996.2729	-1408.9426	-1992.5457
UNVR	36,700	-0.03237	-1187.81	-2656.015	-3756.1722	-5312.0297

On 1 day VaR, value at risk of the greatest experienced by GGRM Rp-2,007.32 and the smallest Value at risk experienced by KLBF is Rp.-47.1781. On 5 days VaR, value at risk of the greatest experienced by GGRM Rp-4,488.511 and the smallest Value at risk experienced by KLBF is Rp-105.4933. On 10 days VaR, value at risk of the greatest experienced by GGRM Rp-6,347.7135 and the smallest Value at risk experienced by KLBF is Rp-149.19011. On 20 days VaR, value at risk of the greatest experienced by GGRM Rp-8,977.0225 and the smallest Value at risk experienced by KLBF is Rp. -210.98667.

Calculation of VaR by Monte Carlo Simulation

One of the methods that can be used to calculate VaR using Monte Carlo data random the return of shares or stock portfolio is to use a model of Monte Carlo Simulation.

The results of calculation of VaR Monte Carlo Simulation over ten stocks are present in table 5:

Table 5. VaR Monte Carlo Simulation Calculation

Code	Drift	Future Price	Percentile 5%	Var 1 day	Var 5 days	Var 10 days	Var 20 Days
ASII	-0.00042	6447.48537	-0.000754	-4.86	-10.87042974	-15.37310917	-21.74085948
CPIN	-0.00064	3343.35985	-0.000754	-2.520893325	-5.636888839	-7.971764646	-11.27377768
GGRM	-0.00008	58325.47691	-0.000728	-42.46094719	-94.94556431	-134.2733047	-189.8911286
ICBP	0.00053	14444.76891	-0.000761	-10.99246914	-24.57990825	-34.7612396	-49.15981649
INDF	-0.00018	6197.32719	-0.000704	-4.362918344	-9.755781998	-13.79675921	-19.511564
INTP	-0.00041	19695.36633	-0.000698	-13.7473657	-30.74004421	-43.47298742	-61.48008841
KLBF	0.00003	1334.31812	-0.000701	-0.935357002	-2.09152184	-2.957858552	-4.18304368
SMGR	-0.00074	11041.01894	-0.000744	-8.214518091	-18.36822085	-25.97658705	-36.73644171
UNVR	0.00044	36689.69895	-0.000767	-28.1409991	-62.92518694	-88.98965278	-125.8503739

The VaR Model Testing

To test whether the model calculation of VaR is accurate/valid or not, then the required testing is Backtesting (Jorion, 2007). One of backtesting model is done with Test Kupiec (Kupiec, 1995) that is by comparing the test results between actual return data value prediction VaR. Results comparison is done to calculate the rate of failure (failure rate) of each model. In testing, the backtesting committed against the Variance-Covariance model, Historical Simulation, and Monte Carlo Simulation to find out the validity of the magnitude of the potential loss of nine stocks that are examined. The models used are the Kupiec Tests by using the test data as much as 255 data 1 year final since March 1, 2015, up to 29 January 2016. If it is known that the rate of failure (failure rate) is in the range of N<21 when T = 255, then the VaR model is said to be valid enough to measure the maximum potential loss (Jorion, 2007).

The results of the testing done either using the Variance-Covariance model as well as using the model of Historical Simulation shows the results turned out to be a different validation to measure the potential loss of a maximum of 9 stocks individually as presented in table 6 below:

Table 6. VaR Back Testing Result

Code	Variance-Covariance	Validity (<21)	Historical Simulation	Validity (<21)	Monte Carlo Simulation	Validity (<21)
ASII	4	Valid	242	Not Valid	141	Not Valid
CPIN	4	Valid	237	Not Valid	143	Not Valid
GGRM	5	Valid	241	Not Valid	134	Not Valid
ICBP	3	Valid	247	Not Valid	134	Not Valid
INDF	2	Valid	239	Not Valid	136	Not Valid
INTP	8	Valid	242	Not Valid	129	Not Valid
KLBF	5	Valid	239	Not Valid	141	Not Valid
SMGR	2	Valid	243	Not Valid	135	Not Valid
UNVR	12	Valid	244	Not Valid	136	Not Valid

Based on the results of testing the validity of the VaR model on top turns the failure rate generated by Variance-Covariance model entirely is greater compared with Historical Simulation and also Monte Carlo Simulation. Jorion (2007) said that if the value of N>21, then the model was considered too moderate. From the results of the above research States that the calculation of the Variance-Covariance Model is a model that is valid and can be used to measure the value at risk compared with the method of Historical as well as Monte Carlo Simulation. It because Historical and Monte Carlo using 5% percentile, which means it uses 5% data as the comparison.

Conclusion

Measurement of market risk on investment stock either individually or

in the portfolio Variance-Covariance VaR model turns out to produce greater value compared to using a model of Historical Simulation and Monte Carlo Simulation.

Whereas, in the calculation of an undiversified VaR Variance-Covariance indicates the result is smaller compared with the calculation of diversified VaR. This has proved that the value of the stock on an individual basis risk cannot be reduced through diversification by portfolio.

Notes on Contributors

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