

ANALYSIS OF VALUE AT RISK MEASUREMENT USING THE VARIANCE-COVARIANCE METHOD IN THE SECURITIES PORTFOLIO

Rezza Gustantya Pratiwi^{1*}, Rahmat Setiawan²

Universitas Airlangga Surabaya, Indonesia

Email : rezza.gustantya.pratiwi-2022@feb.unair.ac.id^{1*},
rahmatsetiawan@feb.unair.ac.id²

*Correspondence

ABSTRACT

Keywords: Obligasi; Return; Value at Risk; Varian-ovarian.

Bonds are one of the investment instruments with fixed income. One of the most popular bonds is government bonds, which are considered safer than corporate bonds or other investment instruments. Every financial investment instrument that provides a rate of return (return) will have risks. Choosing bonds with the smallest loss rate is one of the priorities of an investor. One of the steps that investors can take is to determine the value of Value at Risk (VaR) first to determine the maximum loss obtained when investing. This study will discuss the risks in Bank Jatim's FVTOCI portfolio by measuring the Value at Risk value of each selected bond sample and several portfolio combinations of these bonds. The bonds used as samples in this research are FR0068, FR0080, FR0096 and FR0098. The measurement of this VaR value uses the Varian-Covariance method, where the assumption of the data used is data with a normal distribution. The resulting VaR value can be used as a consideration for the company to choose bonds for its investment portfolio.



Introduction

Bonds are one of the investment instruments of Fixed Income Securities (SPT) issued by the government and companies as debt securities. Investors get returns in the form of coupons every certain period and can get capital gains when selling these bonds (Herdiyan, Septiawati, Faturahman, & Djuanda, 2023). Every financial investment instrument that provides a rate of return (return) will have risks. Bonds have various risks that accompany them, including interest rate, Call, Default, Liquidity, and Volatility (Tu & Chen, 2018). These risks are caused by uncertainty factors surrounding these bonds' process and structure. Therefore, investors should always view that trading a bond always has risks.

Choosing bonds with the smallest loss rate is one of the priorities of an investor. Investors can determine the value of Value at Risk (VaR) in advance to determine the maximum loss obtained when investing (Adibrata, Hartati, & Asih, 2021). The VaR estimation process is integral to the risk management framework applied to banks and non-bank companies (Deni Sunaryo, 2021). The estimation process requires several precise risk calculations and modelling techniques to produce the best estimate that determines the magnitude of VaR for a certain period and the confidence level of a specific interval (Anam, Di Asih, & Kartikasari, 2020). In companies/institutions in the form of banks, the VaR calculation results can be used to determine how much minimum capital banks need to meet Basel regulations.

One application of VaR measurement is the variant-covariant method known as the Delta Normal Method. The variance-covariance method was chosen because it produces a lower estimate of the potential future volatility of an asset or portfolio compared to Monte-Carlo simulation methods and historical simulations (Aritonang & Nasution, 2023). The lower the estimated volatility, the lower the level of risk. Low volatility estimates are caused because the variance-covariance method assumes that returns are typically distributed, and portfolio returns are linear to the return of a single asset (Rachmatin, 2015).

Bank Jatim is one of the BPDs that has been conducting treasury transactions for quite a long time to increase the company's fee-based income (Thariq, 2020). One of the transactions carried out is the sale and purchase transaction of securities, which will later be separated into 3 (three) portfolio groups, namely Amortised Cost (AC), Fair Value Through Other Comprehensive Income (FVTOCI), and Fair Value Through Profit and Loss (FVTPL). In AC portfolios, securities cannot be traded and can only be liquidated at maturity. In FVTOCI portfolios, securities can be traded if there is a need for liquidity, while in FVTPL portfolios, securities must be traded in specific time intervals (Nainggolan, Juliana, & Alantina, 2020). Because the bonds purchased by Bank Jatim in the FVTOCI portfolio can be a choice of assets that are relatively liquid when there is a need for liquidity, Bank Jatim must consider the potential risk and return on each bond so that an optimal portfolio can be formed, both in terms of return and risk (Ma'ula, Handayani, & Zahroh, 2018). One that can be used to measure the level of risk in investment is the calculation of Value at Risk (VaR).

Based on the formulation of the problem above, the objectives of this study are as follows:

1. Analyze the difference in maximum potential loss on each bond in PT—East Java Regional Development Bank, Tbk with Value at Risk (VaR) calculation.
2. Shows a significant difference in the Value at Risk VaR calculation in a diversified portfolio compared to a single asset.

Research Methods

Types of Research

The type of research used is quantitative research with content analysis. Research is carried out systematically to examine risk estimates in investments in the form of bonds by collecting data that will be measured using statistics.

Operational Definition and Variable Measurement

In this study, the operational definition of the variables is as follows:

1. Value at Risk (VaR)

Value at Risk (VaR) is an attempt to quantify the maximum potential loss that may occur in an asset or portfolio position with a certain probability over a certain period.

The variable measurement used in this study is a ratio, where the final result to be obtained is a Value at Risk (VaR) value (Rahmadhani, Zulfahridar, & Hariadi, 2016). The smaller the percentage of VaR, the smaller the estimated loss received. The VaR

value will be used to determine the level of risk and estimated loss of each bond or portfolio.

2. Data Types and Sources

This study used primary and secondary data types. The type of secondary data to be used is bond yield data that has been determined as a sample. The data is taken from the IBPA website, namely www.phei.co.id. The data is from February 20 to May 19, 2023 (55 working days).

Population and Research Sample

The population of this study is bonds in Banka Jatim's FVTOCI portfolio. The bonds sampled in this study were selected based on specific criteria (purposive sampling): government bonds with a remaining duration of more than 8 (eight) years and have fixed return characteristics. The bonds used as research objects are FR68, FR80, FR96 and FR98.

Data Collection Methods

The data collection method used in this study so that the data obtained is relevant so that it can be used as a foundation in the analysis process; then, the data collection technique is a documentation method by collecting, studying, and analysing primary and secondary data. The documentation method used in this study is to take predetermined bond market price data to be sampled.

Data Analysis Techniques

In this study, the data analysis technique used is Parametric Statistics, where assumptions are made during research. An example is the assumption that the data used is usually distributed. This assumption is used because this study uses the Variant-Covariance method, where one of the criteria is the assumption that the data used is usually distributed.

In the analysis with the Varian-Covarian method, the calculation of the return value of bond prices and the normality test of market return data using Kolmogorov-Smirnov. The normality test of portfolio return data with Kolmogorov-Smirnov and the correlation value of the bond portfolio have conditions of $-1 \leq \text{correlation} < +1$. Next, measurement of single asset VaR value and portfolio VaR value and verification test of VaR results using Log-likelihood Ratio Test.

Hypothesis Testing Criteria

The criteria for testing both hypotheses will be based on the VaR value generated by each bond and portfolio. If FR80 bonds have the smallest VaR value compared to other bonds, then FR80 bonds are concluded to have the least estimated risk so that the first hypothesis is proven. Furthermore, suppose the bond portfolio produces a smaller VaR value than each bond. In that case, it is concluded that the bond portfolio has a more negligible estimated risk than bonds that are a single asset, so the second hypothesis is proven.

Results and Discussion

VaR value on a single asset's valuable letter

1. Data Normality Test with Kolmogorov Smirnov Test Method

Value at Risk (VaR) values can be calculated using the Variance-Covariance method when the data is usually distributed. In this study, the data used yielded data from each security within 55 working days (Wijayanti & Diyanti, 2017). The effect of profit volatility, profit smoothing and corporate governance on the profit quality of Islamic and conventional banks. Therefore, the data will first be tested for normality using the Kolmogorov-Smirnov Test Method, and the following hypothesis is formed:

H_0 = Normally distributed securities yield data

H_1 = Abnormally distributed securities yield data

Kriteria ujiif calf then accessed, and if $D_{hitung} > D_{tabel}$ then

rejected H_0 .

With a significance level of 0.05 and n (number of data) = 55, Kolmogorov Smirnov's critical test table determined $D_{tabel} = 0.180$. The results of data processing using Mc. Excel obtained the following results:

Table 1
Kolmogorov Smirnov Normality Test Calculation Table

Bond	Max D_{hitung}	D_{tabel}	Result
FR0068	0,126478652	0,180	$D_{hitung} < D_{tabel}$
FR0080	0,084725869	0,180	$D_{hitung} < D_{tabel}$
FR0096	0,105050931	0,180	$D_{hitung} < D_{tabel}$
FR0098	0,071747555	0,180	$D_{hitung} < D_{tabel}$

From the data above, all maximum numbers D_{hitung} each bond has a smaller value than D_{tabel} , so they H_0 accepted. So, the yield data for each bond above is data with a normal distribution.

1. Results and Analysis of VaR value measurement

VaR is a quantitative measurement of risk that estimates the maximum potential loss that may occur in the future that an investor will face if holding a portfolio at a specific holding period and confidence level, assuming that market conditions are expected. The formula used in calculating VaR for a single asset is:

$$VaR = Z(\alpha)\sigma P\sqrt{t}$$

With:

$Z(\alpha)$: The z value for the normal distribution at the 95% level is 1.645;

σ : volatility or standard deviation of return of an asset (according to the table);
 P: The market value of an asset/investment value is Rp 1.000.000.000,00;
 t: The holding period is 250 (assuming the number of working days in 1 year).

With calculations using the formula above, the results of the VaR value are obtained as follows:

Table 2
The VaR value of each bond

Bond	Nilai VaR (Rp)	Percentage
FR0068	40.867.796	4,09%
FR0080	34.210.227	3,42%
FR0096	49.816.305	4,98%
FR0098	39.180.150	3,92%

Table 2 shows that bonds with the code FR0080 have the smallest VaR value compared to other bonds, IDR 34,210,227.00 per year or 3.42% of the total investment value. The VaR value can be interpreted that at a % confidence level of 95%, FR0080 bonds have a maximum potential loss of IDR 34,210,227.00 or 3.42% of the total investment value for the following year. Bonds with the code FR0096 have the most considerable VaR value compared to other bonds, amounting to Rp 49,816,305.00 per year or 4.98% of the total investment value. The VaR value can be interpreted that at a % confidence level of 95%, FR0096 bonds have a maximum potential loss of IDR 49,816,305.00 or 4.98% of the total investment value for the following year.

VaR value in the securities portfolio

Covariance is a term that indicates how much change two independent variables have changed together. A positive covariance means that the asset is moving in the same direction, while if the covariance is negative, it means the asset is moving in the opposite direction (Santoso, 2018). The selection of securities for portfolio formation can use covariate value as one of the indicators. Optimising returns by minimising risk is done by including assets in the portfolio with negative covariance. Here are the covariance values of each bond pair:

Table 3
The covariance value of each bond combination

	FR0068	FR0080	FR0096	FR0098
FR0068		2,04%	2,93%	2,24%
FR0080	2,04%		2,46%	1,91%
FR0096	2,93%	2,46%		2,79%
FR0098	2,24%	1,91%	2,79%	

It can be seen that all covariance values are positive, meaning that each bond has a positive relationship, and returns move in the same direction. However, because there is no negative covariance value, the portfolio formation uses a combination of two assets so that six portfolios are formed, namely FR0068 and FR0080, FR0068 and FR0096,

FR0068 and FR0098, FR0080 and FR0096, FR0080 and FR0098, and FR0098 bond portfolios.

The difference from the single-asset VaR calculation is that portfolio VaR uses portfolio volatility (σ_p). For a portfolio consisting of 2 assets, σ_p can be obtained by the formula from Jorion (2007).

$$\sigma_p = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{12} \sigma_1 \sigma_2}$$

with:

w_1 dan w_2 : Weight of the first asset and the second asset in the portfolio;

σ_1 dan σ_2 : Variants of the return of the first asset and the second asset;

ρ_{12} : Correlation between Return of First Asset and Second Asset.

The correlation value is between -1 and 1; if the value is 1, then the two assets have a full correlation relationship. Whereas if it is worth zero, the two assets are not related. So, the portfolio VaR can be found with the following equation:

$$VaR_p = \sqrt{w_1^2 VaR_1^2 + w_2^2 VaR_2^2 + 2 w_1 w_2 VaR_1 VaR_2 \rho_{12}}$$

With:

w_1 dan w_2 : Weight of the first asset and the second asset in the portfolio;

VaR_1 dan VaR_2 : VaR the first asset and VaR the second asset;

ρ_{12} : Correlation of Return of First Asset and Second Asset.

The VaR of a portfolio depends mainly on the weight or amount of exposure of the bonds contained in a portfolio and on the VaR that has been generated in measurement. With the basic assumption that in this study, the weight/proportion of investment is averaged to simplify calculations, the amount of portfolio VaR can be calculated according to the correlation between each bond in a portfolio expressed by the correlation coefficient. The results of calculating the portfolio's correlation value and Value at Risk value are shown in the table below.

Table 4
Table of correlation coefficient and VaR values of each portfolio

Portfolio	Bond	Korelasi	Nilai VaR (Rp)	Percentage
1	FR0068 & FR0080	0,98556	37.404.346	3,74%
2	FR0068 & FR0096	0,97415	45.050.949	4,51%
3	FR0068 & FR0098	0,94701	39.490.479	3,95%
4	FR0080 & FR0096	0,97737	41.783.152	4,18%
5	FR0080 & FR0098	0,94701	36.208.105	3,62%
6	FR0096 & FR0098	0,96855	44.152.005	4,42%

Table 4 shows that the correlation value between bonds is almost close to 1, which means a positive linear relationship. The table also concludes that portfolio 5, consisting of FR0080 and FR0098 bonds, has the smallest VaR value compared to other portfolios, amounting to Rp. 36,208,105.00 or 3.62% of the total investment value. This can be interpreted that at a confidence level of 95%, a portfolio with a combination of FR0080 and FR0098 bonds has a maximum potential loss of IDR 36,208,105.00 or 3.62% of the total investment value for the following year.

Portfolio 2, consisting of FR0068 and FR0096 bonds, has the largest VaR value compared to other portfolios, which is Rp.45,050,949.00 or 4.51% of the total investment value. This can be interpreted that at a confidence level of 95%, a portfolio with a combination of FR0068 and FR0096 bonds has a maximum potential loss of IDR 45,050,949.00 or 4.51% of the total investment value for the following year.

The VaR value of the portfolio shows a lower yield than the VaR of a single asset. The lower value indicates a diversification effect. Diversification can occur due to the mutually compressing effect between bonds. If one asset suffers a loss while another asset experiences a profit, then the profit of the other asset can be used to cover the loss of other assets. So, it can be said that investing by forming a portfolio can reduce the value of risk in investing.

Conclusion

The best bond to invest in is FR0080 because it has a smaller risk value of IDR 34,210,227.00 or 3.42% of the total investment value at a confidence level of 95% for the next one-year period. The best portfolios to invest in are the FR0080 and FR0098 bond portfolios because they have a smaller risk value of IDR 36,208,105.00 or 3.62% of the total investment value at a confidence level of 95% for the next one-year period.

A bond portfolio's VaR is lower than individual bonds' VaR. This is due to the diversification effect, where there is a compressing effect between bonds so that it can reduce the value of risk. The diversification effect will be of more excellent value if the correlation between bonds is lower.

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