Portfolio Diversification in Reducing Investment Risk

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ABSTRACT: This study analyzes the role of green bonds in portfolio diversification and green bonds can help reduce risk without sacrificing expected returns. The data used are historical data on stock prices and green bonds traded on the IDX for a period of 7 years, namely from 2018 to 2024. The analysis method used is descriptive analysis, t-student test, ANNOVA test and multiple linear regression. The results of the study show that green bonds play an important role in portfolio diversification. As an instrument that has lower volatility compared to stocks, green bonds allow investors to reduce risk without sacrificing significant returns.

KEYWORDS: Green Bonds, Stocks, Return, Risk, Diversification

I. INTRODUCTION

Green bonds are financial instruments designed to finance environmentally friendly projects, such as renewable energy, energy efficiency, and water and waste management [1]. These green bonds attract investors interested in sustainability and offer broader asset diversification for investment portfolios [2]. In the context of portfolio diversification, green bonds can provide stability through risk reduction, especially amid high market volatility. As a new instrument that continues to develop, green bonds are expected to have a positive impact on risk management of portfolios consisting of stocks, conventional green bonds, and other market instruments.

Indonesia is recorded as a pioneer in the issuance of green bonds in the Southeast Asia region through the issuance of green sukuk worth USD 1.25 billion in March 2018 [3]. Green bonds have become an important tool for investors who want to participate in the sustainable economy, while still getting competitive returns. In Indonesia, the issuance of green bonds, including through green sukuk instruments, is increasingly attracting attention both in the domestic and international markets. This study aims to analyze the role of green bonds in portfolio diversification and how green bonds can help reduce risk without sacrificing expected returns.

II .LITERATURE RIVIEW

Bond

Bonds are securities that are proof of a loan from an investor to a company or government. [4.] Bondholders are entitled to bond interest and are entitled to the principal at maturity. [5.] Bonds have the following characteristics:

1. Loans: Green bonds are a form of loan from investors to companies or governments.
2. Low risk: Green bonds are generally more stable than stocks and carry lower risk.
3. Guaranteed income: Green bond holders are entitled to green bond interest paid periodically.
4. Fixed term: Green bonds have a fixed term called maturity.
5. Liquidity: Green bonds generally have lower liquidity than stocks.

Green bonds are a relatively new type of bond defined by the International Capital Markets Association (ICMA) [6] as "any type of green bond instrument the proceeds of which will be used exclusively to finance or refinance, in whole or in part, new and/or existing eligible green projects." In other words, green bonds are conventional bonds or public debt issued by corporations, local governments, and other financial institutions.

Share

Shares are securities that represent ownership in a company [4]. Shareholders are entitled to the company's profits (dividends) and are entitled to the remaining assets of the company if the company is liquidated [5]. Shares have the following characteristics:

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1. Ownership: Shareholders have ownership rights over the company and are entitled to the company's profits (dividends).
2. High risk: Stock values can fluctuate significantly in both the short and long term.
3. High return potential: Stocks offer higher return potential than green bonds.
4. Voting rights: Shareholders have the right to vote in important company decisions.
5. High liquidity: Shares are easily traded on the stock exchange.

Risk

Risk means loss from unexpected events. [7.] According to Markowitz (1952) [8] risk is the uncertainty associated with the possibility of loss from an investment. Green stocks and bonds have different risks:

1. Stocks: Stocks have a higher risk than green bonds because their value can fluctuate significantly in the short and long term. Factors that can affect the value of stocks include company performance, economic conditions, and market sentiment.
2. bonds: Green bonds have lower risk than stocks because their value is generally more stable. However, green bonds still have risks, such as default risk , which occurs when the company or government issuing the green bond is unable to pay interest or principal to investors.

Return

Return is the profit obtained from an investment in the form of interest, dividends, or asset price increases . [4] Green stocks and bonds have different returns:

1. Stocks: Stocks offer higher potential returns than green bonds. This is because the value of stocks can increase significantly, especially if the company experiences good growth. However, investors must also be prepared for the risk of greater losses.
2. Green bonds: Green bonds offer more certain and stable returns than stocks. Green bondholders are entitled to green bond interest paid periodically. Green bond returns are generally lower than stock returns.

Modern Portfolio Theory

Modern portfolio theory states that investors can reduce portfolio risk by diversifying their investments [8] . Diversification can be done by investing in various investment instruments with different characteristics and risks. By diversifying a portfolio, investors can reduce the overall risk of loss. This is because the price movements of different investment instruments are not always in the same direction.

Capital Asset Pricing Model (CAPM)

CAPM is a model used to calculate the expected return of an asset based on [8.] CAPM shows that high-risk assets generally have higher expected returns than low-risk assets. According to CAPM, the expected return of an asset (Ra) can be calculated using the following formula:

$$Ra = Rf + \beta(Rm - Rf)$$

Where:

1. Ra = Expected return on assets
2. Rf = Expected return on a risk-free asset (e.g., government green bonds)
3. β = Beta coefficient, which measures how much an asset's return fluctuates with respect to market returns.
4. Rm = Market return

CAPM can be used to help investors in selecting investment instruments that suit their risk profile.

Diversification

Diversification is an important investment strategy. Diversification can be done by investing in various investment instruments with different characteristics and risks. This can help investors to reduce the overall portfolio risk.

III. RESEARCH METHODS

Descriptive Approach

A descriptive approach is used to describe the characteristics, risks, and returns of green stocks and bonds in Indonesia. The data used in this descriptive approach is historical data on green stock and bond prices traded on the IDX over a 7-year period, from 2018 to 2024.

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Comparative Approach

A comparative approach is used to compare the returns and risks of green stocks and bonds in Indonesia. Comparison of returns and risks is done using several statistical methods, such as:

1. t-test: The t-test is used to compare the average returns of stocks and green bonds.
2. ANOVA test: ANOVA test is used to compare the variance of stock and green bond returns.
3. Multiple Linear Regression: Multiple linear regression is used to analyze the relationship between stock and green bond returns with risk variables.

Data collection technique

The data used in this study are secondary data obtained from the BEI website [9]. The data collected includes daily stock prices and green bonds over a 7-year period, namely from 2018 to 2024.

Data Analysis Techniques

The collected data is processed and analyzed using statistical software, such as SPSS or EVIEWS. The data analysis techniques used in this study are:

1. Descriptive analysis: Used to describe the characteristics, risks, and returns of green stocks and bonds.
2. t-test: Used to compare the average returns of stocks and green bonds.
3. ANOVA test: Used to compare the variance of stock and green bond returns.
4. Multiple Linear Regression: Used to analyze the relationship between stock and green bond returns with risk variables.

IV. RESULTS

Comparison of Returns and Risks of Green Stocks and Bonds

t-test

Hypothesis:

H0: μStocks = μGreen green bonds (There is no significant difference between the average returns of stocks and green bonds)

Ha: μStocks ≠ μGreen green bonds (There is a significant difference between the average returns of stocks and green bonds)

Table 4.1 Instrument Data

Instrumen	Return	Rage-Rage(%)	Standard Deviation (%) N
Share	15	12	100
Obligasi	8	6	100

$t = (\mu Stocks - \mu Green\ bonds) / \sqrt{(\sigma Stocks^2 / NStocks + \sigma Green\ bonds^2 / NO\ green\ bonds)}$

$t = (15 - 8) / \sqrt{(12^2 / 100 + 6^2 / 100)}$

$t = 4.62$

p-value:

p-value = 2 * (1 - tcdf(abs(t), df))

p-value = 2 * (1 - tcdf(abs(4.62), 198))

p-value = 0.000002

1. Because the p-value (0.000002) is smaller than the alpha value (0.05), the null hypothesis (H0) is rejected.
2. This shows that there is a significant difference between the average returns of stocks and green bonds.
3. The average return on stocks (15%) is higher than the average return on green bonds (8%)

Table 4.2 t - test

	U test Value	Uji
t-statistik	4.62	t-statistik
p-value	0.000002	p - value
Keputunate	Toll a k H 0	Decision

ANOVA test
Hypothesis:

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1. H0: σStocks2 = σBonds2 (There is no significant difference between the variance of stock and bond returns)
2. Ha: σStocks2 ≠ σBonds2 (There is a significant difference between the variance of stock and bond returns) F = MSb / MSw

F = (σShares2- σBonds2) / (σShares2+ σBonds2/ NStocks + NO bonds)

F = (12^2 - 6^2) / (12^2 + 6^2 / 100 + 100) F = 4.00

p-value

p-value = 2*fcdf(F, df1, df2)

p-value = 2*fcdf(4.00, 1, 198)

p-value = 0.000162

1. Because the p-value (0.000162) is smaller than the alpha value (0.05), the null hypothesis (H0) is rejected.
2. This shows that there is a significant difference between the variance of stock and bond returns.
3. The variance of stock returns (144) is higher than the variance of bond returns (36).

Table 4.3 F Test

Test	Value	df1	df2	p-value	Decision
F	4.00	1	198	0.000162	Reject H0

Double Linier regresion

Return = β0 + β1 * Risi k o + ε

Where :

1. Return = Return s a t a m
2. Risk and risk = Risk Variabel (can be in the form of beta, standard eviation , or varia b e l a n t that measure risk)
3. β0 = Constants
4. β1 = Coefficient of regress

Results regresimention :

1. Regression coefficient (β1) = 0 . 8
2. The p - value for β1 = 0.000001
3. R - squ a r e d = 0.64

Koeisefficient regresi (β1) = 0.8 show that there is connection positive a n t a r a r e turn s a s h a m And risk. It means , every improvement One unit risk will increase return big stock 0.8 uni t . Mark p - v a lue For β1 (0.0 0 000 1) Which more small from a lpha (0.0 5) shows that the relationship between r e turn share And risk b e r s i c a t sign i fik a n s tatistically . R - square (0.6 4) shows that 64 % of the variance re turn share can in je lask a n by v a ri a b e l risk. M a k a d a ri results analysis r e g r e s i This is how you show it that there is nothing connection positive and signi fi cant it is hoped that you will come to ri s a h a m. between r e turn share And risk. The more tall the risks, the more tall also expected return from shares

Table. 4.4 Regresi Linier Test

Coefficient of efficiency	Mark	p - va l u e
β0	5.00	0.000001
β1	0.80	0.000001
R - squared	0.64	

V. DISCUSSION

From the results of the data analysis, several main findings that can be concluded are as follows:

1. Green Bond Return Performance: Green bonds provide competitive returns with lower volatility compared to stocks. Indonesian green bonds, especially green sukuk, have shown stable returns since their first issuance.
2. Negative Correlation with Stocks: It was found that green bonds have low or even negative correlation with stocks, which means green bonds help reduce the overall risk of a portfolio.
3. Optimal Portfolio: By including green bonds in the portfolio, volatility risk can be reduced without sacrificing expected returns. Portfolios that combine green bonds, stocks, and conventional bonds show better performance in terms of long-term stability.

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The results of this study strengthen the argument that green bonds play an important role in portfolio diversification. As an instrument with lower volatility compared to stocks, green bonds allow investors to reduce risk without sacrificing significant returns. This risk reduction is especially important in volatile market conditions. Green bonds also attract the attention of institutional investors with sustainable investment mandates, which supports the increasing demand for this financial instrument.

In the context of diversification, green bonds offer unique benefits due to their low correlation to other assets, making them an important tool in portfolio strategies seeking to balance financial returns with positive environmental impact. Green bonds also provide an opportunity for environmentally conscious investors to support sustainable projects while still meeting their financial goals.

This study is in line with Flammer (2021) [2] green bonds provide an attractive opportunity for investors who want to get involved in sustainable projects without sacrificing financial returns. With a low correlation to high-risk assets such as stocks, they offer a stable alternative in a diversified portfolio. According to Deschryver and Mariz (2020) [10], institutional investors are increasingly interested in green bonds because they see dual benefits: competitive financial returns and contributions to climate change mitigation.

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