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Research Article

Comparison of Markowitz Model and Sharpe Model to Cryptocurrency Investment Measurement

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Abstract. Analyzes focuses om the differences between Markowitz and Sharpe models in optimizing cryptocurrency investment portfolios. Data consists of monthly prices from ten major cryptocurrencies collected between January 2022 and December 2024. Markowitz and Sharpe models construct optimal portfolios, which are then evaluated using Sharpe Ratio, Treynor Ratio, and Jensen's Alpha to measure portfolio performance based on risk and return. Sharpe Portfolio has a higher Sharpe Ratio than Markowitz Portfolio because expected return is higher even though standard deviation is also higher. In Treynor Ratio, both portfolios have similar values because beta is the same, making expected return the key factor in the difference. In Jensen's Alpha, both portfolios generate returns above market expectations after adjusting for risk, with Sharpe Portfolio achieving a higher value than Markowitz Portfolio. Different portfolio optimization methods result in different risk and return characteristics. Investors can choose a portfolio based on risk preferences. If return-to-total-risk ratio is the main priority, Sharpe Portfolio can be selected due to a higher Sharpe Ratio. However, if risk stability and diversification are more important, Markowitz Portfolio can be an alternative, as it focuses on minimizing risk through a balanced asset combination.

Keywords: Markowitz Model, Sharpe Model, Portfolio Optimization, Investment Performance

1. Introduction

Cryptocurrencies have risen rapidly in market capitalization over the past few years. Despite its striking volatility, its high average return and low correlation have established it as an alternative investment asset for portfolios and risk management (Petukhina et al., 2021). The popularity of these digital assets continues to grow, mainly due to their ease of access and potential in portfolio diversification. However, high volatility is a big challenge. The Commodity Futures Trading Supervisory Agency (Bappebti, 2024) revealed that the country's crypto industry experienced significant growth throughout 2024. The transaction value from January to April 2024 reached IDR 211 trillion, surpassing the total transaction value of IDR 149 trillion throughout 2023. In addition, the number of registered investors increased from 16.7 million in December 2022 to 19.75 million in May 2024, with 893,541 active users.

Figure 1. Purpose of Buying Cryptocurrency, Indonesia Crypto Network

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Figure 1 shows the purpose of buying cryptocurrency based on a survey by the Indonesia Crypto Network in 2023–2024. Enthusiasm for cryptocurrency in Indonesia is not solely driven by speculation. Most respondents view cryptocurrency as a viable long-term investment asset. Around 71.9% of crypto users in Indonesia chose long-term investment as their primary reason for engaging with cryptocurrencies.

The increasing confidence in cryptocurrency as a long-term investment highlights the need for a structured and strategic approach to portfolio management. Investors must optimize asset allocation and balance risk and return to manage digital asset volatility effectively. Markowitz (1952) introduced an optimization model that allocates assets by considering the relationship between returns and risk, making it relevant for managing cryptocurrency investments. The main goal of the Markowitz Model is to reduce overall portfolio risk by diversifying investments among various assets, allowing investors to choose an optimal portfolio at different risk levels (Yi, 2024). The concept of efficient limits helps investors find portfolios that offer maximum returns at a certain risk level or minimum risks at a certain return level. Sharpe (1966) improved this model by introducing the Sharpe ratio, which measures portfolio performance by dividing the portfolio's risk premium by its standard deviation. This method helps identify portfolios with optimal returns per unit of risk (Wulandari & Susandini, 2021). Investors with higher risk tolerance often diversify into broader financial assets such as warrants, futures, and international equities. The Markowitz and Sharpe methods help overcome the limitations of random diversification and provide a more systematic way to measure and manage portfolio risk. Previous studies have applied these models to traditional assets such as stocks and bonds, but their application to cryptocurrency portfolios is still limited (Cao, 2023). This study aims to fill this gap by providing a framework for constructing an optimal cryptocurrency portfolio.

The Markowitz theoretical model was applied to data from four main cryptocurrency assets—Bitcoin, Tether, Ethereum, and BNB—over the past year. Investors with low-risk tolerance can short sell Tether, Ethereum, and BNB in the short term, while those focusing on returns can short sell Tether and Ethereum (Li, 2024). Research on 16 cryptocurrencies shows that the optimal portfolio using the Markowitz approach consists of Cardano, Binance Coin, and Bitcoin. Correlation analysis indicates that most cryptocurrencies have a moderate correlation, except for Tether, which behaves differently (Mazanec, 2021). The Sharpe method proves that Bitcoin performs better than IDX 30 and gold (Febriansyah & Saryadi, 2022). This method also provides the best results when evaluating the performance of the JII 70 stock portfolio compared to the Treynor and Jensen methods in the Indonesian market (Sa'diyah et al., 2023). Both the Jensen and Treynor methods use the securities market line to measure portfolio performance but differ in their calculations. The Treynor method calculates performance based on the slope of the line connecting the portfolio position to the risk-free return, while the Jensen method measures the difference between the actual portfolio return and the expected market return (Muchlisina, 2023).

In investing, indices are important tools for measuring the performance of a market or market segment. An investment index represents a collection of assets, such as stocks, bonds, or other assets, and tracks changes in their value or performance, as explained by (Rahman, 2023). One example is S&P (Standard & Poor's), a global financial company that provides market data and creates indices to monitor the performance of various markets. One part of S&P's indices is the S&P Cryptocurrency Broad Digital Market Index, a tool designed to track the performance of digital assets listed on open digital exchanges that meet minimum criteria for liquidity and market capitalization. The index reflects a broad range of investments and is calculated based on the market capitalization of each digital asset by multiplying the total supply of coins by their price. The index is calculated quarterly and aims to give a comprehensive overview of the investable cryptocurrency market.

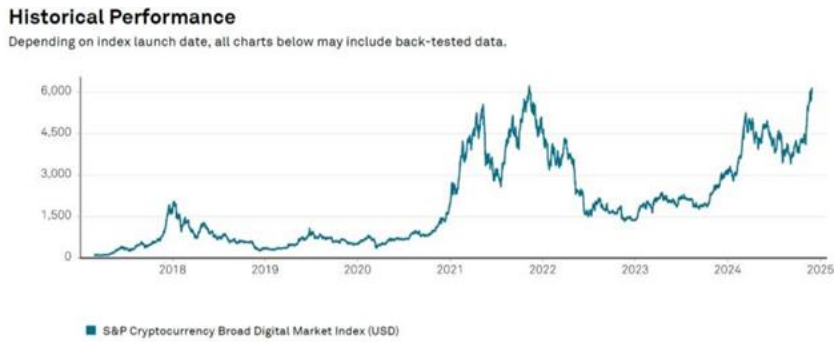

Figure 2. Historical Performance Indeks S&P Cryptocurrency Broad Digital Market S&P Global

Figure 2 shows the historical performance of the S&P Cryptocurrency Broad Digital Market Index (USD) from 2018 to 2025. The index started at around 1,500 in early 2018 and remained relatively stable until mid-2020. It then surged significantly, reaching its first peak at approximately 5,000 in late 2021, driven by growing investor interest in cryptocurrencies. However, in 2022, the index dropped sharply to around 3,000 due to market corrections and increased volatility. By the end of 2024 and early 2025, the index rebounded strongly, surpassing 6,000, indicating a market recovery and renewed investor confidence. This performance underscores the highly volatile nature of the cryptocurrency market and emphasizes the need for a well-planned investment strategy.

Based on previous studies on crypto assets for investment and the importance of portfolio diversification, this study aims to examine the application of the Markowitz and Sharpe methods in determining a combination of cryptocurrency assets that produces an optimal portfolio. The application of the Markowitz and Sharpe methods considers market volatility and the unique characteristics of cryptocurrencies, such as high liquidity in assets like Bitcoin, Tether, and certain altcoins.

2. Literature Review

2.1. Investment Portfolio

A portfolio is a collection of assets owned by individuals or institutions to maximize returns and manage risks through diversification (Hakim & Waluyo, 2023). Diversification is a key investment strategy that allocates funds across various asset types to reduce overall portfolio risk (Asniwati et al., 2024). Investors must understand different investment instruments, such as gold, stocks, mutual funds, bonds, property, and cryptocurrencies, each with unique risk and return characteristics. Gold is more stable and low risk (Christianti et al., 2022), while stocks offer higher potential returns but are riskier (Puspita et al., 2023) Mutual funds provide flexible fund management through investment managers (Adhianto, 2020), and bonds are a conservative option with moderate risk (Jubaidi, 2020). Property offers long-term benefits from rental income and value appreciation (Andika et al., 2023), while cryptocurrencies have high profit potential but significant volatility and risk (Purba & Siregar, 2022). Among investment options, cryptocurrencies stand out as a unique and fast-growing asset that is worth learning more about. Cryptocurrency is a digital currency used for secure transactions, supported by blockchain technology (Ahamad et al., 2022). Unlike conventional currencies regulated by central authorities, cryptocurrency operates on a decentralized network, allowing global access and providing opportunities for individuals without access to traditional banking services (Nabilou & Prum, 2019). Blockchain securely records transaction data in interconnected blocks verified by nodes, while cryptography protects transactions using public and private keys (Moin et al., 2019). Since Bitcoin was introduced in 2009 by Satoshi Nakamoto, cryptocurrency has rapidly evolved from early concepts like ecash, B-Money, and Bit Gold into a market with over 10.881 digital currencies and a market capitalization of $3.22 trillion (Investing.com, 2025). With features such as decentralization, security, and transparency, cryptocurrency has significantly impacted the financial system and become an essential part of investment portfolio. Because cryptocurrency is complex and has many types, it's important to understand each type and its role in the financial system. Cryptocurrency is divided into 8 types based on their specific functions (Institute, 2025).

Payment cryptocurrency works as a digital currency, such as Bitcoin and Litecoin, with a limited supply, making it deflationary. Utility tokens, like Ethereum, are used to pay for transactions and run decentralized applications. Service tokens, such as Storj, allow access to certain services, like data storage. Finance tokens, like Binance Coin (BNB), offer discounts on transaction fees on specific platforms. Governance tokens give holders voting rights for network decisions. Media tokens are used for content and gaming, like Basic Attention Token (BAT). Stablecoins, like USDT, maintain a stable value by being pegged to fiat currencies. CBDC is issued by central banks to improve payment efficiency with government oversight. While understanding the different types of cryptocurrency is crucial, investors must also evaluate the risks and potential returns associated with these assets. Effective risk management is key to achieving long-term success in any investment strategy.

Investments are always faced with the risk of losses or returns that are not in line with expectations. Investment returns can be in the form of realization of returns calculated from historical data, or expectations of expected future returns (Bustami et al., 2021). High rates of return are often associated with great risks, so investors need to be careful in making decisions to minimize risks, especially regarding the impact of inflation and interest rate changes (Putri, 2024).

2.2 Portfolio Method

Optimal portfolio methods use various approaches, such as traditional methods, Markowitz methods, Sharpe methods, new efficient sets, single-index models, and post-modern methods. Markowitz calculates an optimal stock portfolio through multi-objective optimization and focuses on portfolio optimization for conventional investors by considering a single factor that affects portfolio returns (Balqis et al., 2021). Research shows that Markowitz is more effective in building an optimal portfolio for the cryptocurrency market than the single-index model (Nurhakim, 2024). Sharpe selects the portfolio with the highest Sharpe ratio by subtracting the risk-free return from the expected portfolio return and dividing it by the portfolio's total risk. Sharpe identifies how efficiently the portfolio generates returns compared to the total risk taken. The optimal portfolio reaches the maximum point on the Capital Market Line (CML), which represents the best combination of risk and return for investors.

Research confirms that diversification improves investment performance, especially for younger investors with higher risk tolerance (Liestyowati et al., 2023). Indonesia's Financial Services Authority (OJK) Regulation Number 3 of 2024 supports responsible FinTech innovation through consumer protection rules and sandbox mechanisms for testing. Regulation prioritizes personal data protection and transparency to enhance consumer protection (Ekawati et al., 2024). Bitcoin outperforms gold and stocks in terms of returns, volatility, and Sharpe ratios (Widiawira & Akbar, 2023).

There are several ratios that can be used to measure the performance of a cryptocurrency portfolio. The Sharpe Ratio is a primary tool for comparing portfolio models in investment management (Barillas et al., 2020). This ratio was created by Nobel laureate William F. Sharpe in 1966 to help investors evaluate an asset's volatility. With the Sharpe Ratio, investors can identify investments that offer the best potential returns based on their risk tolerance. In addition, the Treynor Ratio measures the returns earned above the risk-free return, compared to the level of market risk taken. This ratio uses systematic risk as the main risk measure instead of total risk. The higher the Treynor Ratio, the better the portfolio's performance (Tajdini et al., 2021). Meanwhile, Jensen's Alpha measures the average portfolio returns that exceed or fall short of the returns predicted by the Capital Asset Pricing Model (CAPM) (Hoque et al., 2020).

The data analysis method related to the author criteria that has been collected will be processed using Microsoft Excel. The optimal analysis of the crypto portfolio will be carried out by applying the Markowitz model, namely with the following formula (Hartono, 2024).

$$\sigma p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} W_i \,.\, W_j \,.\, \sigma_{ij}$$

$$E\,(Rp) = \sum_{i=1}^{n} W_i \,.\, E(Ri)$$

$$\sum_{i=1}^{n} W_i =$$

The Markowitz use the Lagrange Multiplier which consists of ten steps as bellow.

1. Collection of historical price data
   The initial stage of this study involves collecting monthly historical price data from a number of crypto assets Bitcoin (BTC), Ethereum (ETH), Binance Coin (BNB), Solana (SOL), Cardano (ADA), Tron (TRX), Avalanche (AVA), Ton Coin (TON), Shiba INU (SHIB), and ChainLink (LINK). The observation period is set from January 2022 to December 2024.
2. Calculating the monthly coin return of each crypto

$$\boldsymbol{Return} = \frac{\boldsymbol{P_t - P_{t-1}}}{\boldsymbol{P_{t-1}}}$$

3. Calculate the expected return of each crypto

$$\boldsymbol{E(R_i)} = \frac{\boldsymbol{\sum_{t=1}^{n} R_{it}}}{\boldsymbol{n}}$$

4. Calculate the standard deviation of each crypto sample that has a positive expected return

$$\boldsymbol{\sigma} = \frac{\boldsymbol{\sum_{t=1}^{n}[R_{it} - E(R_i)]^2}}{\boldsymbol{n-1}}$$

5. Calculating the Coefficient of Variation

$$\boldsymbol{CV_i} = \frac{\boldsymbol{Risk}}{\boldsymbol{Return\ Expectation}}$$

6. Calculating covariance between crypto coins
   A variant is a covariant with itself, if elaborated it would be as follows

$$\sigma = \frac{\sum_{t=1}^{n}\left[\left(R_{it} - E(R_i)\right).\left(R_{jt} - E\left(R_j\right)\right)\right]}{n-1}$$

7. Calculating the correlation between crypto coins
   The concept of correlation is the same as variance, so the correlation value can be obtained from the covariant value.

$$r_{ij} = \rho_{ij} = \frac{Cov(R_i, R_j)}{\sigma_i \,.\, \sigma_j}$$

8. The expected portfolio return is the weighted average return of each crypto flowing into the portfolio in percentage units. It is calculated by collecting the product from the individual's expected return in proportion. The determination of the proportion of funds from the portfolio candidate coins is done using the solver application program in Microsoft Excel. This application will provide the best proportion of funds to generate maximum returns.
9. Calculating the expected portfolio return

$$\boldsymbol{E\ (Rp)} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{W_i\ .E(Ri)}$$

10. Calculate the standard deviation of the portfolio

$$\boldsymbol{\sigma p} = \left[\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}}\sum_{\boldsymbol{j=1}}^{\boldsymbol{n}} \boldsymbol{W_i\,.W_j.\sigma_{ij}}\right]^{\boldsymbol{0,5}}$$

The Sharpe method, a data analysis method related to the author's criteria that has been collected which will be processed using Microsoft Excel. Optimal crypto portfolio analysis will be carried out by applying the Sharpe model, namely with the following

formula (Hartono, 2024). The Sharpe Method formula uses a Lagrange Multiplier which consists of explane steps as bellow.

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4. Calculate the standard deviation of each crypto sample that has a positive expected return

$$\boldsymbol{\sigma} = \frac{\sum_{t=1}^{n} [\boldsymbol{R_{it} - E(R_i)}]^2}{\boldsymbol{n-1}}$$

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$$\sigma = \frac{\sum_{t=1}^{n} \left[\left(R_{it} - E(R_i) \right) . \left(R_{jt} - E\left(R_j \right) \right) \right]}{n-1}$$

7. Calculating the correlation between crypto coins
   The concept of correlation is the same as variance, so the correlation value can be obtained from the covariant value.

$$r_{ij} = \rho_{ij} = \frac{Cov(R_i, R_j)}{\sigma_i \, . \, \sigma_j}$$

8. Calculate the optimal portfolio using the RBR value for the Sharpe M
9. ethod Monthly risk-free returns can be formulated as follows

$$RBR = \frac{5.37\%}{12}$$

10. The expected portfolio return is the weighted average return of each crypto flowing into the portfolio in percentage units. It is calculated by collecting the product from the individual's expected return in proportion. The determination of the proportion of funds from the portfolio candidate coins is done using the solver application program in Microsoft Excel. This application will provide the best proportion of funds to generate maximum returns.
11. Calculating the expected portfolio return

$$\boldsymbol{E\ (Rp) - R_{BR}} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{W_i} \, . \, [\, \boldsymbol{E(Ri) - R_{BR}}]$$

12. Calculating the expected portfolio return

$$\sigma p = \left[\sum_{i=1}^{n}\sum_{j=1}^{n} W_i . W_j . \sigma_{ij}\right]^{0,5}$$

After calculating the expected return and standard deviation of the optimal portfolio using the Markowitz and Sharpe methods, the portfolio performance is then measured using the Sharpe, Treynor, and Jensen's Alpha ratios.

1. Sharpe Ratio

   The Sharpe Ratio measures performance relative to total risk, calculated as excess return per unit of standard deviation. This ratio is very useful for comparing funds with similar investment strategies. It evaluates risk-adjusted returns, providing a simple way to assess performance based on risk. The Sharpe Ratio also helps compare funds with different risk profiles (Brinza et al., 2023).

$$S = \frac{E(R_p) - R_f}{\sigma_p}$$

2. Treynor Ratio

   The Treynor method is a way to measure portfolio performance, developed by Jack Treynor. This index is often called the reward-to-volatility ratio. Like the Sharpe index, the Treynor method measures portfolio performance by calculating portfolio returns based on the level of portfolio risk. Treynor assumes that the portfolio is well-diversified, so the relevant risk is systematic risk (Nuzula & Darmawan, 2019).

$$\boldsymbol{T = \frac{E(R_p) - R_f}{\beta_p}}$$

3. Jensen's Alpha

   The Jensen method considers the average past return and the minimum rate of return, which is calculated using the Capital Asset Pricing Model (CAPM). The difference between the average return and the minimum rate of return is called alpha. Jensen's Alpha is an absolute measure that estimates a constant return over the investment period, achieving a return above or below the buy-hold strategy with the same systematic risk. A higher and significant Jensen Alpha value indicates the best portfolio. If the alpha value is positive, the portfolio performs better than the market index. Conversely, if the alpha value is negative, the portfolio performs worse than the market index (Nurlaeli, 2021).

$$\sigma p = R_p - \left[R_f + \beta_p(R_m - R_f)\right]$$

3. Method

The population in this study consists of 10,881 cryptocurrencies listed in the market. The sample is taken from the S&P Cryptocurrency Broad Digital Market Index, focusing on 10 major coins: Bitcoin (BTC), Ethereum (ETH), Binance Coin (BNB), Solana (SOL), Cardano (ADA), Tron (TRX), Avalanche (AVA), Ton Coin (TON), Shiba INU (SHIB), and ChainLink (LINK). These ten coins are selected because they are part of the S&P Index and have significant market capitalization. The monthly closing price data from January 2022 to December 2024 is collected from CoinMarketCap.com and serves as the basis for identifying the optimal portfolio.

Markowitz and Sharpe models determine the optimal portfolio using mathematical formulas and Microsoft Excel. The steps include collecting monthly historical price data for each coin, calculating returns, expected returns, standard deviation, covariance, and correlation between coins, and applying portfolio optimization formulas. Markowitz calculates portfolio proportions without risk-free returns, while Sharpe uses the risk-free return and Sharpe ratio to find the optimal portfolio. Optimization is done with Microsoft Excel's Solver to get the best proportion of each crypto asset in the portfolio.

4. Results and Discussion

This study examines the optimization of crypto portfolios in the S&P Cryptocurrency Broad Digital Market Index, along with expected returns and risks. The optimization process follows these stages.

Expected crypto returns

Monthly returns are calculated by comparing each coin's price in the current month with the previous month. This is calculated using the logarithmic return formula to ensure accuracy. These returns help assess coin performance before selecting the optimal portfolio. Coins with positive returns are more likely to be included in an optimal portfolio as they boost profits and lower risk (Salim & Rizal, 2021).

Table 1. Expected returns of each coin

No	Crypto Code	E (r)
1	BTC	0.0428
2	ETH	0.0300
3	BNB	0.0340
4	SOL	0.0838
5	ADA	0.0465
6	TRX	0.0534
7	AVAX	0.0364
8	TON	0.0548
9	SHIB	0.0400
10	LINK	0.0324

[1] Source: Data processed, 2025

Covariance between cryptos

Covariance is a measure used to display the relationship between two random assets. This shows whether these two assets are changing together and whether they are strongly correlated. It is commonly used to measure portfolio diversification. Table 2 of cryptocurrencies with positive returns shows variations in their risk and return levels. Bitcoin (BTC) has a moderate return (0.0428) with relatively low volatility (STDEV 0.1670), making it one of the more stable investment options. In contrast, Solana (SOL) recorded the highest return (0.0838) but accompanied by very high volatility (STDEV 0.3816), reflecting a huge risk. Cardano (ADA) and Ethereum (ETH) offer decent returns but with higher volatility than Bitcoin, while Tron (TRX) has a medium return (0.0534) with the lowest risk (STDEV 0.1223).

Table 2. Risk any crypto

No	Crypto Code	E (r)	STDEV	VAR
1	BTC	0.0428	0.1670	3.9007
2	ETH	0.0300	0.2052	6.8455
3	BNB	0.0340	0.1637	4.8146
4	SOL	0.0838	0.3816	4.5519
5	ADA	0.0465	0.4190	9.0087
6	TRX	0.0534	0.1223	2.2889
7	AVAX	0.0364	0.3440	9.4603
8	TON	0.0548	0.2794	5.1033
9	SHIB	0.0400	0.3191	7.9793
10	LINK	0.0324	0.2292	7.0666

[2] Source: Data processed, 2025

Expected Returns and Optimal Portfolio Risk Markowitz Method

A portfolio with optimal weight compared to a portfolio with the same weight. The optimal weight portfolio is calculated using the solver program in the Microsoft Excel application. This program is implemented to determine the proportion of cryptos that can produce an optimal portfolio by minimizing its risk. The results show that 3 weights were selected for each crypto BNB 15.20%, TRX 69.10%, and TON 15.70%. The portfolio yields an expected return of 5.07% and a standard deviation of 9.72%.

Table 3. Expected Returns and Optimal Portfolio Risk Markowitz Method

No	Crypto Code	Weight	E (r)
1	BTC	0.00%	0.0428
2	ETH	0.00%	0.0300
3	BNB	15.20%	0.0340
4	SOL	0.00%	0.0838
5	ADA	0.00%	0.0465
6	TRX	69.10%	0.0534
7	AVAX	0.00%	0.0364
8	TON	15.70%	0.0548
9	SHIB	0.00%	0.0400
10	LINK	0.00%	0.0324
	Total	100%	
	Expected Return of Portfolio		5.07%
	Deviation Standard of Portfolio		9.72%

[3] Source: Data processed, 2025

Expected Returns and Sharpe Method Optimal Portfolio Risk

The optimal weight portfolio of the sharpe method is calculated using the solver program in the Microsoft Excel application by adding the RBR. This program is applied to knowing the proportion of cryptos that can generate an optimal portfolio by minimizing their risk. The results show that 3 weights were selected for each crypto: SOL 4.74%, TRX 75.36%, and TON 19.91%. The portfolio yields an expected return of 5.51% and a standard deviation of 10.10%.

Table 4. Expected Returns and Optimal Portfolio Risk Sharpe Method

No	Crypto Code	Weight	E (r)
1	BTC	0.00%	0.0428
2	ETH	0.00%	0.0300
3	BNB	0.00%	0.0340
4	SOL	4.74%	0.0838
5	ADA	0.00%	0.0465
6	TRX	75.36%	0.0534
7	AVAX	0.00%	0.0364
8	TON	19.91%	0.0548
9	SHIB	0.00%	0.0400
10	LINK	0.00%	0.0324
	Total	100%	
	Expected Return of Portfolio		5.51%
	Deviation Standard of Portfolio		10.10%

[4] Source: Data processed, 2025

The performance measurement of the optimal portfolio using the Markowitz and Sharpe methods.

The portfolio with the highest Sharpe Ratio demonstrates a higher return-to-risk ratio. The Markowitz Portfolio has an expected return of 5.07% with a standard deviation of 9.72%, resulting in a Sharpe Ratio of -0.0308. Meanwhile, the Sharpe Portfolio has an expected return

of 5.51% with a standard deviation of 10.10%, resulting in the highest Sharpe Ratio of 0.0144. Based on this value, the Sharpe Portfolio offers a better return-to-risk ratio than the Markowitz Portfolio.

Table 5. Portfolio Comparison

Metode	Sharpe Ratio	Treynor Ratio	Jensen's Alpha
Markowitz Portfolio	-0.0308	-0.0030	0.0053
Sharpe Portfolio	0.0144	0.0015	0.0097

[5] Source: Data processed, 2025

Based on Table 5, the performance of both portfolio types is evaluated using Sharpe Ratio, Treynor Ratio, and Jensen's Alpha. The Sharpe Portfolio has the highest Sharpe Ratio (0.0144) because it has a higher expected return (5.51%) than the Markowitz Portfolio (5.07%), although it comes with a slightly higher standard deviation. The Markowitz Portfolio has a Sharpe Ratio of -0.0308, indicating that its return is lower relative to its total risk.

In Treynor Ratio, which measures return against systematic risk (beta), the Sharpe Portfolio has a higher value (0.0015) than the Markowitz Portfolio (-0.0030), suggesting that the Sharpe Portfolio provides better compensation for systematic risk.

In Jensen's Alpha, which evaluates whether a portfolio generates a return exceeding market expectations after adjusting for risk, both portfolios show positive values, with the Sharpe Portfolio at 0.0097 and the Markowitz Portfolio at 0.0053. This indicates that both portfolios outperform market expectations, with the Sharpe Portfolio generating a higher excess return.

5. Conclusions

The Markowitz Portfolio and Sharpe Portfolio have different risk and return characteristics based on the applied optimization method. The Sharpe Portfolio has a higher Sharpe Ratio than the Markowitz Portfolio because expected return is higher even though standard deviation is also higher. In Treynor Ratio, the values of the Markowitz Portfolio and Sharpe Portfolio are not significantly different because both portfolios have the same beta. The difference in Treynor Ratio is influenced by the difference in expected return for each portfolio. In Jensen's Alpha, both portfolios show positive values, which indicates that returns exceed market expectations after adjusting for risk. The difference in Jensen's Alpha is caused by the difference in expected return after considering market return and the same level of systematic risk.

Investors can choose a portfolio based on their risk preferences. If the main priority is the return-to-total-risk ratio, then the Sharpe Portfolio can be selected, because it has a higher Sharpe Ratio. However, if risk stability and diversification are more important, then the Markowitz Portfolio can be an alternative, because it focuses on minimizing risk through a more balanced asset combination.

Further research can explore portfolio optimization under different market conditions because cryptocurrency asset volatility changes due to global market dynamics. Other asset classes, such as bonds or technology stocks, can be included to analyze how cross-asset diversification affects risk and return ratios. Additional performance evaluation methods, such as Sortino Ratio or Omega Ratio, can provide a more detailed analysis of downside risk in cryptocurrency investments.

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