International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Optimal Portfolio Construction Using Bitcoin, Gold, LQ45 Index, and Indonesia Bond Index

Wildan Syahid Nugraha[1], Subiakto Soekarno[2]
[1,2] School of Business and Management, Institute Technology of Bandung, Indonesia

ABSTRACT: Cryptocurrencies are significant improvements in the digital age that have changed the way we think about money. The first cryptocurrency was Bitcoin, introduced in 2009 and was created by Nakamoto. Due to their potential ups and downs, many people now think that cryptocurrencies are appropriate for use as an investment instrument, especially millennials who are attracted to higher-risk investment alternatives. A number of different investing options such as cryptocurrencies, gold, and other conventional assets like equities and bonds have unique characteristics and advantages. It's essential for investors to understand the similarities and differences between cryptocurrencies and other assets in order to create diversified portfolios.

In this study, the optimum portfolio will be constructed using Bitcoin, Gold, LQ45 Index, and ABF IBI as the representative of Indonesia Bond Index. Mean-Variance Optimization will be used as an asset allocation method, and will be compared to the other methods such as Risk Parity, 60/40 Portfolio, and Equally Weighted to find a better risk-adjusted return. The Sharpe ratio analysis is used to evaluate the portfolio performance resulting from every method. The investment strategy will be simulated to know which strategy will result the best total return in the end of simulation period.

According to risk, return, and the Sharpe ratio, Bitcoin could perform better than gold, LQ45, and ABF IBI. Furthermore, the Mean-Variance Optimization resulted the highest Sharpe ratio compared to the other methods. The optimal weight from the portfolio construction using Mean-Variance Optimization allocated 53% to ABFI index, 40% to Bitcoin, and 7% to gold, which resulted 48.2% portfolio return, 40.44% portfolio risk, and 1077.8% Sharpe ratio. From the investment strategy simulation, the quarterly rebalancing strategy was found to be the best strategy with the total return 223.36%.

KEYWORDS: Cryptocurrency, Investment strategies, mean-variance optimization, Portfolio construction, Sharpe ratio.

INTRODUCTION

One of the most important concepts lately in finance is portfolio optimization, which tries to build investment portfolios with the best possible balance of expected returns and risk. In the process, assets are combined to enhance returns while lowering total portfolio risk. Investors can reduce risk and possibly improve their investment performance by diversifying their investments across different asset classes. In order to maximize asset returns for a given amount of volatility, it is critical to take into account the distributions and classes of various assets in investor portfolio. Most investments usually concentrate on traditional assets like stocks, bonds, and precious metals such as gold. Cryptocurrency, a new kind of commodity asset that has emerged in recent years and caught the interest of investors, has, however, gained popularity [1].

A major innovation in the digital age, cryptocurrencies have transformed the idea of money. The simplest definition of a cryptocurrency is a form of exchange that is independent of national boundaries and central banks, unlike traditional currencies **[2].** The first cryptocurrency was Bitcoin, which was created by Nakamoto and presented in 2009. Since then, many more cryptocurrencies have been developed, each with its own special features and applications. Many individuals now believe that cryptocurrencies are suitable for use as an investing tool due to their potential ups and downs, particularly members of the millennial age who are drawn to higher-risk investment opportunities **[3].**

Cryptocurrencies, gold and other traditional assets like stocks and bonds are all different investment possibilities with their own special traits and qualities. For investors looking to build diversified portfolios, it's important to comprehend the similarities and differences between cryptocurrencies and other assets. The extreme volatility of cryptocurrencies, like Bitcoin, is well known. The cryptocurrency market's price changes can be huge in a short amount of time, which attracts traders but also increases risk for investors. Although gold's price might fluctuate, it is typically thought to be less volatile than cryptocurrencies. The volatility of

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

stocks can also be influenced by market circumstances, corporate performance, and developments in the industry. The fixed income characteristic of bonds, on the other hand, tends to make them less volatile.

Stocks, bonds, gold, and cryptocurrencies provide distinct investment options with distinct characteristics and risk profiles. Although cryptocurrencies come with higher risks and regulatory consideration, they also have the benefits of decentralization, high volatility, and possible significant returns. Due to these concerns, there is much discussion over whether or not crypto assets are appropriate to be used as investment instruments. Therefore, further research is required to determine whether investing in crypto assets is worthwhile or not.

Cryptocurrency assets are compared to traditional assets like gold, equities, and bonds to conduct analysis. The representative for crypto assets will be Bitcoin. Since gold is a common financial tool, it will be used in the real estate sector. Bond mutual fund Bahana ABF Indonesia Bond Index Fund (ABFI) will be utilized for bonds. LQ45 Index will be used as a proxy for stocks. In the end, Sharpe Ratio will be used to calculate investment performance measurements from those assets, measuring asset portfolio performance by taking total risk or standard deviation into account. The main objective of this research is to help investors in selecting the best possible decisions regarding investments.

BUSINESS ISSUE

Maximizing return while minimizing risks is the main objective of investing in order to earn and protect money over time. In addition to maintaining their wealth from depreciation due to inflation and unanticipated market risks, investors seek to increase their capital by generating returns on their investments. Investors use a variety of approaches and assets for investing in order to achieve investment growth and management. They could allocate their money among a variety of asset classes, such as equities, bonds, real estate, and others, in order to diversify their investment portfolio and maximize potential profits. Diversification distributes risk and minimizes the impact of losses from a single investment.

Cryptocurrency, as an investment asset, has gained significant attention since it gives bigger return then the other asset classes for recent years. Despite receiving a lot of attention as a kind of investment, cryptocurrencies are not without disadvantages. Greater returns come with greater risks. Cryptocurrency values can quickly experience the extreme volatility that is characteristic of them. The high levels of volatility seen in the cryptocurrency market can be caused by a variety of factors, including market sentiment, technology breakthroughs, regulatory announcements, and macroeconomic situations **[4]**.

One of the approaches in investing is portfolio optimization. In order to maximize returns while lowering risks, portfolio optimization is a critical component of investment management. Effectively optimizing portfolios that contain several different asset classes, however, is a challenge. Because of these issues, author want to analyse and compare the performance of cryptocurrency, as an investment asset, to other assets such as stocks, gold, and bonds and find the optimal portfolio to be constructed between them, so that investor knows what investment should be chosen to get the optimal return with adjusted risk.

RESEARCH QUESTIONS

In order to determine the research findings, following research questions will be addressed: (1) How does Bitcoin's performance compare to traditional investment instruments like gold, stocks, and bonds? (2) What is an optimal investment portfolio that can be constructed using Bitcoin, gold, LQ45, and ABF IBI? (3) What is the effective investment strategy for the optimum portfolio using the buy and hold and rebalancing strategy?

RESEARCH OBJECTIVES

According to the research question, the objectives of this research are: (1) To evaluate the performance of Bitcoin in relation to traditional investment assets such as gold, stocks, and bonds. (2) To create an optimal investment portfolio which is constructed using Bitcoin, gold, LQ45, and ABF IBI. (3) To provide the effective investment strategy for the optimum portfolio using the buy and hold strategy and rebalancing strategy.

THEORETICAL FOUNDATION

Mean-Variance Optimization

A common approach in portfolio management named as Mean-Variance Optimization attempts to construct the optimal portfolio

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

by balancing the trade-off between expected returns and portfolio risk. The core concept of Mean-Variance Optimization is the calculation of expected return, variances (or standard deviations), and covariances (or correlations) of the assets. In order to do that, periodic return data should be calculated first using formula as follow:

$$r_t = \frac{EV_t - BV_t}{BV_t}$$

The expected return can then be determined after the calculation of periodic returns. There are two ways of calculating expected return. The first one is the arithmetic average of the sample rates of return:

$$E(r) = \frac{1}{n}\sum_{s=1}^{n} r(s)$$

The second one is the geometric (Time-Weighted) average return.

$$E(r) = [(1 + r_1) \times (1 + r_2) \times \cdots \times (1 + r_n)]^{1/n} - 1$$

The standard deviation is used to measure risk in the next step's calculation. The standard deviation is defined as follow:

$$\hat{\sigma} = \sqrt{\frac{1}{n-1}\sum_{s=1}^{n}[r(s) - \bar{r}]^2}$$

Since the historical data which will be collected is a weekly data, the formula of risk and return will result weekly risk and return. To annualize both weekly risk and return, the follow formulas will be defined:

$$\overline{r_a} = (1 + \bar{r})^{52} - 1$$

$$\sigma_a = \sigma \times \sqrt{52}$$

Covariance and correlation of two assets will be calculated to measure the relationship between the returns of multiple assets.

$$Cov(r_i, r_j) = \frac{\sum_{t=1}^{n}(r_i - \bar{r_i})(r_j - \bar{r_j})}{n}$$

Meanwhile, the formula of correlation is defined as follow:

$$\rho(r_i, r_j) = \frac{Cov(r_i, r_j)}{\sigma_i \times \sigma_j}$$

Portfolio return and risk will be the calculation in Mean-Variance Optimization after defining the weight of each asset. Portfolio return and risk will be defined as follow:

$$E(r_p) = \sum_{i=1}^{n} x_i E(r_i)$$

$$\sigma(r_p) = \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n} x_i\, x_j Cov(r_i, r_j)}$$

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Benchmark Asset Allocation Methods

1. 60/40 Portfolio

The 60/40 allocation method, also known as the "60/40 portfolio," is a traditional investment strategy that involves allocating 60% of a portfolio to equities (stocks) and 40% to fixed-income assets (bonds). This allocation is based on the principle of balancing risk and return by combining the potentially higher returns of stocks with the relative stability and income generation of bonds.

2. Equally Weighted

The equally weighted allocation method is a type of investment strategy that gives each asset or security in a portfolio an equal amount of weight. With this strategy, the performance and risk of the portfolio as a whole are equally contributed by each asset. The equally weighted allocation approach is easy to understand and put into practice because it calls for distributing funds equally among all assets. The weights of individual assets are determined using this method without reference to any specific criterion, such as market capitalization or fundamental analysis **[5].**

3. Risk Parity

Risk parity is an asset allocation method that seeks to balance the risk contributions of various assets or asset classes while allocating portfolio weights **[6]**. Instead of just using traditional allocation based on market capitalization or equal weights, it focuses on balancing the risk exposure of each asset in the portfolio. To implement risk parity, the weight of each asset is multiplied by the risk measure for that asset, such as volatility or standard deviation, to determine the risk contribution of each asset **[7].** The weights are changed to ensure that the total risk contributions from all assets or asset classes are equal. To compute the risk contribution, the standard deviation is defined:

$$\sigma(x) = \sqrt{x_1^2\sigma_1^2 + 2x_1x_2\rho\sigma_1\sigma_2 + x_2^2\sigma_2^2}$$

It follows the marginal risk of the first asset is:

$$MR = \frac{\partial\sigma(x)}{\partial x_i} = \frac{x_1\sigma_1^2 + x_2\rho\sigma_1\sigma_2}{\sqrt{x_1^2\sigma_1^2 + 2x_1x_2\rho\sigma_1\sigma_2 + x_2^2\sigma_2^2}}$$

Then, the risk contribution of the first asset is:

$$RC_1 = x_1\frac{\partial\sigma(x)}{\partial x_i} = \frac{x_1^2\sigma_1^2 + x_1x_2\rho\sigma_1\sigma_2}{\sqrt{x_1^2\sigma_1^2 + 2x_1x_2\rho\sigma_1\sigma_2 + x_2^2\sigma_2^2}}$$

The sum of the two risk contributions is equal to standard deviation:

$$RC_1 + RC_2 = \sigma(x)$$

For more than two assets, the vector of marginal risk is defined:

$$\frac{\partial\sigma(x)}{\partial x_i} = \frac{\Sigma x}{\sqrt{x^T\Sigma x}}$$

The risk contribution of the i^{th} asset is defined as follow:

$$RC_i = x_i\frac{(\Sigma x)_i}{\sqrt{x^T\Sigma x}}$$

The sum of the full contributions is also equal to standard deviation:

$$\sum_{i=1}^{n} RC_i = \sigma(x)$$

As mentioned above, the concept of risk parity allocation method is to balance the risk contribution of all assets. The weights are adjusted to ensure that the risk contributions from all assets are equal. After calculating the risk contribution of each asset, the adjusting process could be conducted using an iteration process or an optimization tool such as Microsoft Excel's Solver.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Investment Strategy

In order to determine which investment strategy would result in the highest portfolio return, this research will compare some investment strategies such as buy and hold and rebalancing strategy.

1. Buy and Hold Strategy

The buy and hold investment strategy is a long-term strategy in which investors buy securities and hold them for a long time, despite slight volatility in the markets. This approach is predicated on the idea that the market's long-term upward trend will result in profitable returns for investors who remain persistent.

2. Rebalancing Strategy

A rebalancing strategy is an approach used to rebalance a portfolio back to its desired asset allocation. It includes frequently monitoring the weights in the portfolio and making changes to put them back in line with the planned allocation. Rebalancing has multiple benefits for portfolio management. Mainly, it helps in maintaining the portfolio's targeted risk profile over time. Investors can realign their portfolios using a number of different rebalancing strategies. In this research, the time-based rebalancing strategy will be used. This approach describes rebalancing the portfolio on a regular basis, such as quarterly, semi-annually, or annually, regardless of the particular asset class weights.

Portfolio Performance Evaluation

1. Sharpe Ratio

In order to obtain understanding of the portfolio's risk, return, diversity, and other important characteristics, it uses a variety of quantitative and qualitative indicators and approaches. The Sharpe ratio is one of many metrics used in portfolio measurement to evaluate a portfolio's risk-adjusted performance. The Sharpe ratio assesses a portfolio's excess return for each unit of risk taken. The Sharpe ratio is deducting the risk-free rate of return from the portfolio's average return and dividing the result by the portfolio's volatility or standard deviation.

$$Sharpe\ Ratio = \frac{\boldsymbol{E(r_p)} - R_f}{\sigma(r_p)}$$

2. Risk-free Rate

One of the main concepts in finance is the risk-free rate, also known as the riskless rate or risk-free interest rate. The yields of government bonds or Treasury bills, which are thought to be the most accurate representations of a risk-free investment, are frequently used to calculate the risk-free rate. According **[8]**, there are two requirements for an investment to be riskfree, (1) There can be no default risk, (2) There can be no reinvestment risk. If one of those two requirements are not fulfilled, the investment cannot then be defined as a risk-free asset.

CONCEPTUAL FRAMEWORK

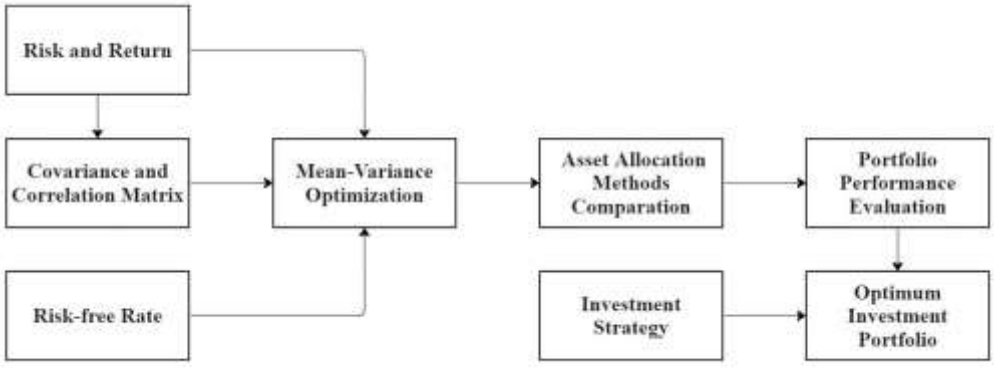

Figure 1. Conceptual Framework

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

The conceptual framework gives the image how this research will be conducted. The objective of this research is to construct the optimum investment portfolio and give the best investment strategy to be implemented. In order to achieve that, the first step to do is the calculation process by calculating risk dan average return from the historical data of each investment asset. The next step is to construct a covariance matrix that contains covariance between investment assets. The correlation matrix is then constructed from that covariance matrix and standard deviation of each asset. By adding a risk-free rate, the optimization process can be computed. The mean-variance optimization will be conducted first, following by comparing the result with other asset allocation methods.

Measurement and evaluation will be next conducted using Jakarta Composite Index as a benchmark. The best portfolio construction will be used as the optimum investment portfolio and be simulated with several investment strategies.

METHODOLOGY

In this research, various investment asset classes, including cryptocurrency, commodities, equities, and fixed-income assets, are being considered to construct an optimal portfolio. Historical data from the past ten years is collected for Bitcoin (as a proxy for cryptocurrencies), gold (as a proxy for commodities), the LQ45 index (as a proxy for equities), and the ABF IBI index (as a proxy for fixed-income assets). The data is analyzed using Microsoft Excel, and the portfolio optimization process is conducted using the Solver add-in. The mean-variance optimization technique is employed to maximize the Sharpe ratio and evaluate the portfolio's performance against the benchmark, which is the IHSG index.

The asset allocation methods utilized in this study include mean-variance optimization, a 60/40 portfolio allocation (with 60% allocated to the LQ45 index and 40% to ABF IBI), an equally weighted allocation (25% allocation to each asset), and a risk parity allocation that balances the risk contribution of each asset. The risk-free rate is determined using the 10-year government bond rate adjusted for the default spread to account for reinvestment risk. The portfolio performance is evaluated based on the Sharpe ratio, and investment strategy simulations are conducted, including a buy and hold strategy, as well as rebalancing strategies with different frequencies (annual, semi-annual, and quarterly). Overall, this research aims to identify the optimal portfolio allocation using various asset classes, evaluate its performance against the benchmark, and simulate different investment strategies to determine the most effective approach.

RESULT AND ANALYSIS

As a result, this study found that the relationship between each investment asset has a low correlation. The best asset allocation method to be implemented is the mean-variance optimization that has beaten other methods in terms of maximizing the value of Sharpe ratio. The simulation's findings show that the quarterly rebalancing approach is the best investment strategy to incorporate into an already-optimal portfolio that was produced by mean-variance optimization. This method generates 223.34% as the highest return at the end of the simulation period compare to other investment strategies.

Risk and Return

Table 1. Weekly (above) and Annual (below) Return and Risk

	Bitcoin	Gold	LQ45	ABFI
Arithmetic Average Retrun	2.36%	0.13%	0.09%	0.12%
Geometric Average Return	1.46%	0.11%	0.04%	0.11%
Standard Deviation	14.06%	2.05%	2.94%	1.52%
	Bitcoin	Gold	LQ45	ABFI
Arithmetic Average Retrun	235.56%	7.05%	4.61%	6.46%
Geometric Average Return	112.54%	5.89%	2.26%	5.83%
Standard Deviation	101.40%	14.81%	21.21%	10.98%

Table 1 provides an analysis of the weekly and annual risk and return for each investment asset. Bitcoin exhibits the highest average return, both arithmetically and geometrically, but also carries the highest risk. Its volatility is reflected in the 101.40% standard deviation. Gold, on the other hand, offers a moderate return with lower volatility, making it a relatively less risky investment. The LQ45 index shows moderate returns and a relatively high risk, while the ABF index offers the lowest risk among the assets and a decent return.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Based on the risk-return trade off, Bitcoin is considered an aggressive investment choice with the potential for higher returns but also higher risk. Gold and bonds are classified as conservative investments, providing a safer option with predictable returns. The LQ45 index represents a moderate asset choice, where investors are willing to take on higher risks for potentially greater rewards. These categorizations assist investors in aligning their risk profiles with the suitable investment assets. Overall, this analysis highlights the risk and return characteristics of each investment asset, allowing investors to make informed decisions based on their risk tolerance and desired outcomes.

Correlation Matrix

Correlation defines the relationship between two variables, giving it a more understandable measurement **[9]**. The correlation coefficient runs from -1 to +1, with -1 representing a perfect negative linear connection. +1 represents a perfect positive linear connection, and 0 represents no linear connection. By comparing relationships between various assets, correlation enables investors to construct diversified portfolios by identifying those with low correlation **[10]**.

Table 2. Correlation Matrix

	Bitcoin	Gold	LQ45	ABFI
Bitcoin	**1**	0.049	0.035	-0.052
Gold	0.049	**1**	-0.083	-0.009
LQ45	0.035	-0.083	**1**	-0.033
ABFI	-0.052	-0.009	-0.033	**1**

Table 2 shows the correlation matrix between investment assets. The positive correlation indicates a positive linear relationship between the return of two assets where both assets experience positive returns. On the contrary, the negative correlation indicates a negative linear relationship where one asset experiences a positive return and the other one experiences a negative return.

All investment assets have a low correlation. Gold and LQ45 have the lowest correlation (-0.083), whereas Bitcoin and gold have the highest correlation (0.049). In order to reduce risk or diversify the portfolio, Gold and LQ45 is a good combination to be chosen in investing. The correlation between gold and ABFI is almost 0, it indicates that their returns don't follow a reliable linear trend so combining them is not a good option.

As a result, while a low correlation might show that there is not a linear relationship between assets, it does not necessarily indicate that the combination is good for a portfolio. More complete insights for portfolio construction can be obtained by doing a detailed investigation and applying portfolio optimization methods.

Mean-Variance Optimization

A common approach in portfolio management named as Mean-Variance Optimization attempts to construct the optimal portfolio by balancing the trade-off between expected returns and portfolio risk. The calculation of expected returns, variances (or standard deviations), and covariances (or correlations) of the assets in the portfolio form the core concept of Mean-Variance Optimization. Creating a mathematical model that maximizes the portfolio's expected return for a given level of risk or minimizes the portfolio's risk for a given level of expected return is part of the optimization process. The optimization algorithm chooses the optimal asset allocation to achieve the desired risk-return profile by taking into account the trade-off between expected returns and portfolio risk **[11]**.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Table 3. Mean-Variance Optimization Result

Investment Assets	Weight		
	Max. Return	Min. Risk	Max. SR
Bitcoin	100%	0.56%	39.70%
Gold	0%	30.25%	6.99%
LQ45	0%	16.30%	0.00%
ABF IBI	0%	52.89%	53.31%
Total	100%	100%	100%
	Max. Return	Min. Risk	Max. SR
Portfolio Return	112.54%	5.87%	48.20%
Portfolio Risk	101.40%	7.86%	40.44%
Sharpe Ratio	106.32%	14.43%	107.48%

Table 3 shows the result from mean-variance optimization process. The outcome of maximizing return will be a 100% allocation to Bitcoin. Although it will provide the highest return for the portfolio, the risk will also be higher. By minimizing risk, 52.89% of the allocation will go into ABF IBI and 30.25% allocation to gold. It is obvious that to get minimum risk, conservative investments are the options. The portfolio return that comes by minimizing risk is 5.87%. If investing using an approach that minimizes risk is chosen, relatively little return on the portfolio will be obtained.

By maximizing Sharpe ratio, the highest allocation will go to ABF IBI as 53.31%, 39.7% will go to Bitcoin and 6.99% to gold. LQ45 index has 0% allocation since, in this study, it has the lowest return but also the second highest risk. The portfolio return and risk by using this approach will be 48.2% and 40.44% respectively. It also should be noted that while the Sharpe ratio for employing the maximum Sharpe ratio and maximum return is near, the portfolio risk has a significant difference. It illustrates the portfolio's risk-adjusted return.

Benchmark Asset Allocation Methods

1. Equally Weighted

Table 4. Comparison Between Equally Weighted and MVO

Investment Assets	Weight	
	Equally Weighted	MVO
Bitcoin	25%	39.70%
Gold	25%	6.99%
LQ45	25%	0.00%
ABF IBI	25%	53.31%
Total	100%	100%
	Equally Weighted	MVO
Portfolio Return	31.63%	48.20%
Portfolio Risk	26.44%	40.44%
Sharpe Ratio	101.75%	107.48%
	Benchmark Index	
JCI Sharpe Ratio	-0.98%	

In this process, the weight of each investment asset will be all the same (1/N). By using the same tool (Solver), Table 4 above shows the result of equally weighted asset allocation method. The portfolio return and risk are 31.63% and 26.44% respectively. Compared to the optimal portfolio from the mean-variance, the portfolio return of this method will not give a higher result. The portfolio risk is lower due to the small portion in Bitcoin. The Sharpe ratio of this method is 101.75% which is lower compared to the mean-

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

variance approach but it is still bigger than the benchmark index's Sharpe ratio which is a negative value. The equally weighted has weaknesses such as overexposure to underperforming assets and lack of diversification where it does not consider the correlation between assets. The result also shows that the optimal portfolio for mean-variance optimization still gives the better values by giving a higher Sharpe ratio and portfolio return.

2. 60/40 Portfolio

The 60/40 portfolio is a traditional asset allocation method that put 60% allocation to the equity asset and 40% allocation to the fixed-income asset. In this method, the 60% allocation will go to LQ45 index and 40% to ABF IBI. Table 5 below shows the result of calculation. The comparation gives a clear idea that this method will not give the best result since the Sharpe ratio is negative. Its Sharpe ratio is even lower than the benchmark index's Sharpe ratio which also has a negative value. It means that the portfolio return is lower than the risk-free rate, and that increasing the allocation to an underperforming asset will result in a lower portfolio return than expected. There is a possibility that this portfolio construction will give negative returns in the future.

Table 5. Comparison Between 60/40 Portfolio and MVO

Investment Assets	Weight	
	60/40 Portfolio	MVO
Bitcoin	0%	39.70%
Gold	0%	6.99%
LQ45	60%	0.00%
ABF IBI	40%	53.31%
Total	100%	100%
	60/40 Portfolio	MVO
Portfolio Return	3.69%	48.20%
Portfolio Risk	13.32%	40.44%
Sharpe Ratio	-7.84%	107.48%
	Benchmark Index	
JCI Sharpe Ratio	-0.98%	

3. Risk Parity

To do the portfolio construction using the risk parity asset allocation method, the data of annual average return and risk of each investment asset will be used. The covariance and correlation matrices will also be utilized. The risk parity asset allocation strategy seeks to build a portfolio with an evenly distributed amount of risk among investment assets. Table 6 below shows the result of portfolio construction using risk parity asset allocation method. The weight allocation from that value of risk contribution will go to ABFI at 42.71%, gold at 30.94%, the LQ45 index at 22.01%, and bitcoin at 4.34%. This portfolio's return and risk are 9.69% and 8.94% respectively, and its Sharpe ratio is 55.47%.

The portfolio comparison between risk parity and mean-variance optimization is shown in the Table 7 below. In this study, by equally distributing the risk contribution to all investment assets, the risk parity method will result a small return due to less allocation in Bitcoin which has the biggest risk among the investment assets. Its small return is also due to overexposure to the underperformance asset (LQ45). As a result, both the portfolio returns and the Sharpe ratio using this method are far below the portfolio return and the Sharpe ratio of mean-variance optimization method.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Table 6. Risk Parity Asset Allocation Method

Investment Assets	Bitcoin	Gold	LQ45	ABFI
Expected Return	112.54%	5.89%	2.26%	5.83%
Standard Deviation	132.97%	14.89%	21.45%	11.01%
Weight	4.34%	30.94%	22.01%	42.71%
Risk Contribution	2.24%	2.24%	2.24%	2.24%
Portfolio Risk	8.94%			
Portfolio Return	9.69%			
Sharpe Ratio	55.47%			

Table 7. Comparison Between Risk Parity and MVO

Investment Assets	Weight	
	Risk Parity	MVO
Bitcoin	4.34%	39.70%
Gold	30.94%	6.99%
LQ45	22.01%	0.00%
ABF IBI	42.71%	53.31%
Total	100.00%	100%
	Risk Parity	**MVO**
Portfolio Return	9.69%	48.20%
Portfolio Risk	8.94%	40.44%
Sharpe Ratio	55.47%	107.48%
	Benchmark Index	
JCI Sharpe Ratio	-0.98%	

Portfolio Performance Evaluation

In this section, portfolio performance evaluation will be proceeded by comparing the Sharpe ratio of each benchmark asset allocation method portfolio with the Sharpe ratio of mean-variance optimization portfolio. The process will be firstly taking the portfolio risks resulted from the benchmark portfolios and using them as the adjusted risk for mean-variance optimization portfolio.

1. Equally Weighted

Table 8. Portfolio Performance Evaluation between Equally Weighted and Mean-Variance Optimization.

Investment Assets	Weight	
	Equally Weighted	MVO
Bitcoin	25%	25.40%
Gold	25%	17.28%
LQ45	25%	0.00%
ABF IBI	25%	57.31%
Total	100%	100%
	Equally Weighted	**MVO**
Portfolio Return	31.63%	32.95%
Portfolio Risk	26.44%	26.44%
Sharpe Ratio	101.75%	106.72%
	Benchmark Index	
JCI Sharpe Ratio	-0.98%	

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Table 8 above shows the risk-adjusted return of mean-variance optimization portfolio using the standard deviation of equally weighted portfolio. For the same level of risk, the mean-variance optimization portfolio produces a greater portfolio return and Sharpe ratio with values of 32.95% and 106.72%, respectively. Compared to the Sharpe ratio of benchmark index, its Sharpe ratio is much higher. It is clear that shifting investment away from the underperforming asset (LQ45) can lead to a higher return.

2. 60/40 Portfolio

Table 9. Portfolio Performance Evaluation between 60/40 Portfolio and Mean-Variance Optimization.

Investment Assets	Weight	
	60/40 Portfolio	MVO
Bitcoin	0%	11.07%
Gold	0%	25.70%
LQ45	60%	6.31%
ABF IBI	40%	56.92%
Total	100%	100%
	60/40 Portfolio	MVO
Portfolio Return	3.69%	17.44%
Portfolio Risk	13.32%	13.32%
Sharpe Ratio	-7.84%	95.35%
	Benchmark Index	
JCI Sharpe Ratio	-0.98%	

The risk-adjusted return of the mean-variance optimized portfolio using the standard deviation of traditional 60/40 portfolio is shown in Table 9 above. Since the 60/40 portfolio gives a negative Sharpe ratio, it is obvious that mean-variance optimization portfolio is a much better method.

3. Risk Parity

Table 10. Portfolio Performance Evaluation between Risk Parity and Mean-Variance Optimization.

Investment Assets	Weight	
	Risk Parity	MVO
Bitcoin	4.34%	4.74%
Gold	30.94%	28.44%
LQ45	22.01%	12.33%
ABF IBI	42.71%	54.49%
Total	100.00%	100%
	Risk Parity	MVO
Portfolio Return	9.69%	10.46%
Portfolio Risk	8.94%	8.94%
Sharpe Ratio	55.47%	64.07%
	Benchmark Index	
JCI Sharpe Ratio	-0.98%	

The portfolio performance evaluation between risk parity and mean-variance optimization portfolio above shows that mean-variance is indeed superior between among the asset allocation method. With the same level of risk, it gives the better value of portfolio return as 10.46% compared to 9.69%. Its Sharpe ratio is also higher as 64.07% compared to 55.47%.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Therefore, in this study, the maximizing Sharpe ratio parameter of mean-variance optimization is concluded as the best approach to get the optimal portfolio. Figure 1 below displays the optimal weight allocation of mean-variance optimization portfolio where 53% will go to the ABFI, 40% to Bitcoin, and 7% to gold.

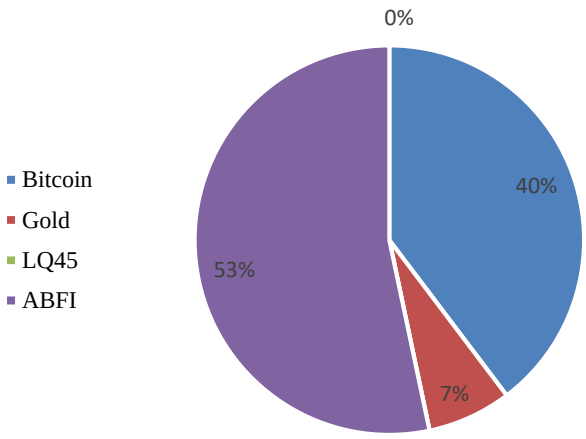

Figure 1. The Optimal Weight of Mean-Variance Optimization Portfolio

Investment Strategy

Table 11. Buy and Hold Strategy Simulation

	Weight	June 1st, 2018			June 30th, 2023			Gain/Loss
		Price	Quantity	Value	Price	Quantity	Value	
Bitcoin	40%	IDR 104,658	0.38	IDR 39,698	IDR 464,350	0.38	IDR 176,134	IDR 136,436
Gold	7%	IDR 18,085	0.39	IDR 6,991	IDR 28,658	0.39	IDR 11,077	IDR 4,087
LQ45	0%	IDR 1	0	0	IDR 1	0	0	0
ABFI	53%	IDR 354	1504.28	IDR 53,312	IDR 51	1504.28	IDR 77,169	IDR 23,858
Total	100%	-	-	IDR 100,000	-	-	IDR 264,380	IDR 164,380
							Return	**164.38%**

Table 12. Annual Rebalancing Strategy Simulation

	Weight	June 1st, 2018			June 30th, 2023			Gain/Loss
		Price	Quantity	Value	Price	Quantity	Value	
Bitcoin	40%	IDR 104,658	0.38	IDR 39,698	IDR 464,350	0.25	IDR 117,328	IDR 77,630
Gold	7%	IDR 18,085	0.39	IDR 6,991	IDR 28,658	0.68	IDR 19,352	IDR 12,362
LQ45	0%	IDR 1	0	0	IDR 1	0	0	0
ABFI	53%	IDR 354	1504.28	IDR 53,312	IDR 51	3000.22	IDR 153,911	IDR 100,600
Total	100%	-	-	IDR 100,000	-	-	IDR 290,591	IDR 190,591
							Return	**190.59%**

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Table 13. Semi-annual Rebalancing Strategy Simulation

	Weight	June 1st, 2018			June 30th, 2023			Gain/Loss
		Price	Quantity	Value	Price	Quantity	Value	
Bitcoin	40%	IDR 104,658	0.38	IDR 39,698	IDR 464,350	0.36	IDR 165,172	IDR 125,474
Gold	7%	IDR 18,085	0.39	IDR 6,991	IDR 28,658	0.60	IDR 17,112	IDR 10,121
LQ45	0%	IDR 1	0	0	IDR 1	0	0	0
ABFI	53%	IDR 354	1504.28	IDR 53,312	IDR 51	2646.53	IDR 135,767	IDR 82,456
Total	100%	-	-	IDR 100,000	-	-	IDR 318,051	IDR 218,051
							Return	**218.05%**

Table 14. Quarterly Rebalancing Strategy Simulation

	Weight	June 1st, 2018			June 30th, 2023			Gain/Loss
		Price	Quantity	Value	Price	Quantity	Value	
Bitcoin	40%	IDR 104,658	0.38	IDR 39,698	IDR 464,350	0.32	IDR 146,333	IDR 106,635
Gold	7%	IDR 18,085	0.39	IDR 6,991	IDR 28,658	0.71	IDR 20,473	IDR 13,482
LQ45	0%	IDR 1	0	0	IDR 1	0	0	0
ABFI	53%	IDR 354	1504.28	IDR 53,312	IDR 51	3051.82	IDR 156,558	IDR 103,247
Total	100%	-	-	IDR 100,000	-	-	IDR 323,363	IDR 223,363
							Return	**223.36%**

The investment strategy simulation will be conducted after gaining the optimal investment portfolio. This process aims to find the best investment strategy which suits the portfolio constructing from cryptocurrency as an investment asset. The investment strategies which will be used for this simulation process are the buy and hold strategy, annual, semi-annual, and quarterly rebalancing strategy. In this simulation, the investment capital is assumed to be 100,000,000 IDR and the five-year time horizon runs from June 1st, 2018, to June 30th, 2023.

Compared to other investment strategies, the quarterly rebalancing strategy gives the best return in the end of period. The quarterly rebalancing strategy is the last scenario that will be arranged. The process is the same with other rebalancing strategies. The difference lies in the period of simulation where quarterly rebalancing will be conducted 20 times for every March, June, September, and December. Table 14 shows the result of simulation with the 223.36% return and 223,363-million-rupiah profit, the highest among investment strategies.

Business Solution

The main issue of this research is to determine whether cryptocurrency can be used as an alternative investment asset to construct an investment portfolio. The high volatility of cryptocurrency is well-known. A common characteristic of cryptocurrencies is their significant volatility. In comparison to other financial assets, it does provide a high return, but big returns also carry significant risks. From the calculation and analysis process, the result shows that Bitcoin has a low correlation with other investment assets such as gold, LQ45 index, and ABF index. It means that Bitcoin can be combined with those investment assets in the portfolio.

Based on the existing business issue and the analysis that has been conducted, several solutions can be concluded:

1. For a risk-seeking investor, Bitcoin can be included to construct an investment portfolio with other investment assets that has a low correlation between them such as gold and bonds. The objective is to diversify the portfolio. Diversification can help lower the portfolio risk by balancing losses in one asset class with profits in another.
2. To construct an optimal portfolio, the best asset allocation method to be implemented is a mean-variance optimization. The analysis showed that a portfolio construction using the mean-variance optimization has beaten other asset allocation method in terms of the Sharpe ratio value. Using this method to construct portfolio might be the best option to get the best result.
3. In order to meet financial objectives while controlling risk, an investment strategy is required to maintain and track the performance of the portfolio. This study shows that rebalancing strategy will give the bigger return compared to buy and hold strategy. So that, using rebalancing strategy, especially quarterly rebalancing, will be the solution to get an optimum result.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

Implementation Plan

Table 15. Implementation Plan

Description	Week 1	2	3	4	5	6	7	8	9	10	11	12
Determining the cryptocurrency that will be chosen	■											
Determining a combination of investment assets		■										
Finding the historical data of each investment asset			■	■								
Calculating the risk and return					■							
Calculating the risk-free rate						■						
Constructing covariance and correlation matrices						■	■					
Calculating the Sharpe ratio							■					
Optimizing the portfolio using mean-variance optimization								■	■			
Comparing the max. Sharpe ratio with Sharpe ratio from other methods and benchmark index									■	■		
Simulating the investment strategy											■	■
Choosing the investment strategy with the highest return												■

The implementation plan is intended for investors who wants to use a cryptocurrency, especially Bitcoin, as an alternative investment in their portfolio with the objective to diversify the portfolio and get the optimum returns while managing risks. The investor should assess their risk tolerance and set the investment objectives before deciding to put cryptocurrency into their portfolio since crypto might be highly volatile and risky. Table 15 above shows the implementation plan.

CONCLUSION

1. The data analysis shows that Bitcoin gives the highest return with the highest risk compared to other investment assets. Bitcoin can diversify the portfolio by combining it with low correlation assets. After assessing the investment strategy, Bitcoin can be considered as a good long-term investment. Furthermore, it always comes with high volatility and the historical data shows that its price always fluctuates. So, it is suitable for the risk-seeker investors.
2. The asset allocation method which gives the optimum weight is the mean-variance optimization by maximizing the Sharpe ratio. It allocates 53% weight to ABFI index, 40% to Bitcoin, and 7% to gold. That optimal weight allocation will give 48.2% portfolio return, 40.44% portfolio risk and 107.8% Sharpe ratio which is the highest Sharpe ratio in the portfolio.
3. The optimal weight from mean-variance optimization portfolio is used to do the simulation for several investment strategies. The quarterly rebalancing strategy gives the highest return at 223.36% compared to other strategies.

RECOMMENDATION

1. Bitcoin, as one of the cryptocurrencies, is suitable for the investors who are the risk-seeker. It gives high potential returns followed by high risks. The risk might be lower using diversification with the low correlation assets such as traditional investment assets.
2. The Mean-Variance Optimization method might be an option for investors to do the optimal portfolio construction. Investment strategy simulation might be used to find the best strategy to be conducted to get the highest return.
3. The market of cryptocurrencies is always having a high volatility. The price is also fluctuated. The further research will be needed to determine whether this study will still be valid or not in the future.

REFERENCES

1. Li, Y., Jiang, S., Wei, Y., & Wang, S. (2021). Take Bitcoin into your portfolio: a novel ensemble porfolio optimization framewrok for broad commodity assets.
2. Maese, V. A., Avery, A. W., Naftalis, B. A., Wink, S. P., & D, V. Y. (2016). Cryptocurrency: A Primer. *Banking. Law J.*

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 08 August 2023
DOI: 10.47191/ijcsrr/V6-i8-17, Impact Factor: 6.789
IJCSRR @ 2023

3. Young, E. &. (2017). *Sustainable Investing : The Millennial Investor*. Retrieved from Retrieved from http://www.morganstanley.com/ideas/sustainable-investing-performance-potential
4. Kristoufek, L. (2015). What are the main drivers of the Bitcoin pricce? Evidence from wavelet coherence analysis. *PLos ONE*.
5. Hsu, J., Moore, P., & Arnott, R. D. (2005). Fundamentals of Efficient Indexation: Why Equal Weighting is Inefficient. *Journal of Indexes*.
6. Clarke, R. G., de Silva, H., & Thorley, S. (2012). Minimum-variance portfolios in the US equity market. *Journal of Portfolio Management*.
7. Roncalli, T. (2013). *Introduction to Risk Parity and Budgeting.* Chapman and Hall/CRC
8. Damodaran, A. (2008). What is the riskfree rate? A search for the Basic Building Block.
9. DeMiguel, V., Garlappi, L., & Uppal, R. (2009). Optimal versus naïve diversification: How inefficient is the 1/N portfolio strategy? . *Review of Financial Studies*.
10. Litterman, R. (2013). *Modern Investment Management: An Equilibrium Approach*. John Wiley & Sons.
11. Markowitz, H. (1952). Portfolio Selection.

Cite this Article: Wildan Syahid Nugraha, Subiakto Soekarno (2023). Optimal Portfolio Construction Using Bitcoin, Gold, LQ45 Index, and Indonesia Bond Index. International Journal of Current Science Research and Review, 6(8), 5518-5532