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Original Article

Analysis of Risk and Return on Investments in Cryptocurrency Instruments in Indonesia from 2022 to 2024

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Abstract

Cryptocurrency has a much higher level of risk and volatility compared to traditional investment instruments such as stocks, thus requiring a deeper understanding of the characteristic differences between the two. This research analyzes the risk profile and return on investment of cryptocurrency compared to stock indices in Indonesia during the 2022–2024 period. This research seeks to examine the characteristic differences between cryptocurrency and traditional stock investments. Using purposive sampling techniques, this research involves five types of cryptocurrency (Bitcoin, Ethereum, Tether, Binance, Ripple) and five stock indices (IHSG, MBX, LQ45, Kompas 100, Bisnis-27) with monthly data totaling 350 observations. The methodology used includes the Shapiro-Wilk normality test for data distribution, followed by the non-parametric Mann-Whitney U test for return and risk variables that are not normally distributed, and the Independent Sample t-test for the Value at Risk (VaR) variable that is normally distributed. The findings shed light that although there is no significant difference in the rate of return between cryptocurrency and stock indices (p = 0.494), cryptocurrency has a much higher level of risk based on standard deviation (p = 0.000) and Historical VaR 95% (p = 0.028). The average VaR of cryptocurrency reaches 23.17%, while stock indices only 6.10%, indicating a potential maximum loss nearly four times greater under worst market conditions. These findings confirm that cryptocurrency is a high-risk asset that demands more careful risk management strategies, and provides important implications for investors and policymakers in designing regulations and investment portfolios that are adaptive to digital market dynamics.

Keywords: Cryptocurrency, Indonesian Capital Market, Portfolio Management, Risk-Return Analysis, Value at Risk.

1. Introduction

Investment is an activity carried out by individuals or groups to place funds in an instrument to obtain profits in the future. Generally, investment instruments include shares, bonds, mutual funds, and securities. However, with the development of technology and the economy, cryptocurrency is now part of the capital market ecosystem, even though cryptocurrency is considered the most risky investment instrument because its value is not regulated by the government or central bank, but rather uses blockchain technology (Sihombing et al., 2021). This investment is an attractive option, especially for millennials, as it relies on intellectual ability to analyse volatile markets in order to determine probability strategies combined with technical and fundamental analysis to generate profits (Astawa & Suaryana, 2024). Nadeem et al. (2021) states that the ease of use of Bitcoin has a positive correlation with a person's investment goals.

Investments are generally known for being 'high risk, high return,' meaning that investments have the potential to generate high profits but also carry high risks. Many investors suffer losses because they do not understand probability, cannot control their

emotions, and do not manage their money well, making it difficult to manage the risks and returns they will receive, given that cryptocurrencies are much more volatile than gold and stocks. This is in line with research conducted by Lumbantobing and Sadalia (2021) which states that the risk and return of crypto are higher than gold and stocks.

Cryptocurrency is one of the most popular investment alternatives (Rejeb et al., 2021; Sari, 2023). The type of cryptocurrency that is always in the spotlight is bitcoin. Bitcoin was first created and developed by Satoshi Nakamoto in 2008. Bitcoin has become both a store of value asset and a legal digital payment instrument, particularly in Indonesia since the issuance of Badan Pengawas Perdagangan Berjangka Komoditi (Bappebti) or Commodity Futures Trading Regulatory Agency Regulation No. 7 of 2020, which dictates which crypto assets are permissible for trading in the market. In Indonesia, the crypto market has experienced significant expansion in the last few years. According to Bappebti, as of August 2022, there were 16.1 million crypto investors, marking a growth of around 43.75% from the end of 2021 when there were 11.2 million investors. It is projected that this number will continue to rise, reaching over 22 million by November 2024. This increase reflects the high level of public interest and the increasingly widespread participation in digital asset trading in Indonesia.

Various factors, such as the adoption of Bitcoin by giant global companies and the legalisation of Bitcoin in various countries, have had an impact on the development of Bitcoin prices from year to year. Currently, the price consistently shows a bullish (upward) trend and is attracting more public interest. According to the website www.investing.com in January 2022, Bitcoin was priced at USD 38,526 or approximately IDR 577,890,000. By 2024, its price reached an all-time high of IDR 1,500,000,000 or approximately USD 100,000, an increase of 126.8%.

In comparison to Bitcoin's price movements, the Indonesian stock market showed more stable dynamics. Based on historical data from Investing.com, the Composite Stock Price Index (IHSG) experienced moderate fluctuations during the same period. In January 2022, the IHSG was around 6,580 points, and increased to around 7,300 points by the end of 2024, or an increase of around 10.9% over the last two years. This performance shows that the Indonesian stock market provides relatively stable growth compared to the highly volatile price surges of cryptocurrencies. Meanwhile, according to TradingEconomics (2025) data, the exchange rate of Bitcoin against the rupiah (BTC/IDR) has increased by more than 100% in the last 12 months, reflecting the high potential returns as well as the risks that investors must face. The difference in risk and return profiles between the crypto and stock markets in Indonesia is highlighted in this comparison, serving as a critical factor for the deeper investigation into the correlation between risk and return in these investment avenues.

Research findings from global studies show that the majority of cryptocurrency investments yield significant profits, but they also come with a higher level of risk and price fluctuations when compared to traditional financial assets such as stock indices. Research by Liu and Tsyvinski (2021) shows that cryptocurrencies such as Bitcoin and Ethereum provide significant returns, but their volatility is also much more extreme than stocks or bonds. In addition, Panagiotidis et al. (2022) found that most cryptocurrencies experience volatility clustering, where periods of high volatility tend to occur in sequence rather than randomly, reinforcing the potential investment risk. This finding is supported by research (Daluwathumullagamage & Sims, 2021) which confirms that Bitcoin volatility is persistent and difficult to predict, even with advanced econometric models such as GARCH and LSTM. Overall, international evidence confirms that the cryptocurrency market has high-risk, high-return characteristics, with a heavy-tailed return distribution and a significant tendency for volatility clustering, making it an attractive yet high-risk investment instrument compared to

traditional stock markets. In recent years, cryptocurrency has increasingly gained attention as an attractive alternative investment instrument, driven by its high volatility and significant profit potential (Agustina, 2023; Tjondro et al., 2023). On the other hand, traditional financial instruments such as stock indices remain a major component in Indonesia's investment landscape (Wijaya & Ulpah, 2022).

Although the crypto market has experienced rapid growth, comparative research examining the risk and return performance between crypto assets and Indonesian stock indices remains very limited. This limitation is particularly evident after the issuance of Bappebti Regulation No. 7 of 2020, which officially recognizes crypto assets as tradable commodities. Therefore, the purpose of this study is to address the existing gap in knowledge by offering practical insights into how the risk and return of cryptocurrency assets compare to those of the Indonesian stock market after regulatory changes. Theoretically, this research strengthens the connection between Signal Theory and Modern Portfolio Theory (MPT) in analyzing the dynamic relationship between crypto assets and Indonesian stock indices. The price movements of crypto and stocks are viewed as market signals that reflect risk and return expectations, while MPT emphasizes the importance of diversification to manage risk. Thus, this study fills the empirical gap post-Bappebti Regulation No. 7 of 2020 and provides theoretical contributions to the application of MPT and Signal Theory in Indonesia's digital financial market.

Therefore, the main goal of this research is to examine and contrast the levels of risk and return of specific cryptocurrencies and key Indonesian stock indices from 2022 to 2024. The purpose of this study is to offer practical knowledge to investors in Indonesia, especially the younger generation, to help them make knowledgeable choices taking into account the uncertainties and changing nature of these investment options. Furthermore, the results of this research are expected to contribute to the development of financial literacy and understanding of investment behavior among the younger generation in Indonesia, as well as serve as a reference for policymakers and financial institutions in designing strategies to enhance sustainable investment participation.

2. Literature Review

2.1. Signaling Theory

Signaling theory highlights how information serves as a crucial signal for investors during the decision-making process (Spence, 1973, Hartono, 2022). In the crypto market, internal signals such as project transparency and team quality, as well as external signals such as institutional support and regulation, have been proven to influence price perception and movements (Thies et al., 2022). Because the crypto market is not strictly regulated and relies on sentiment, prices become more volatile (Aste, 2019). Thus, transparency and information credibility play an important role in maintaining the stability and trust of the digital asset market.

2.2. Modern Portfolio Theory

Modern Portfolio Theory developed by Markowitz (2008) emphasises the importance of diversification in managing portfolio risk. This theory explains that investors can optimise returns by minimising risk through a combination of assets with low correlation. Diversification can prove advantageous in the world of cryptocurrencies and stocks, particularly when these two assets exhibit contrasting movements.

Several real-world studies have demonstrated that Bitcoin and other cryptocurrencies have significantly higher levels of volatility and show correlations that are distinct from those seen in stock markets. As a result, even a minor investment in crypto assets can potentially improve the overall Sharpe ratio of a portfolio (Platanakis & Urquhart, 2020). Other studies reinforce the findings that crypto can serve as a diversifier or hedge over certain horizons despite having volatility spillover to other markets, which clarifies why its risk-return profile differs from more established stocks (Baur et al., 2018; Guesmi et al., 2019). The relationship between Bitcoin and stock indices is dynamic, so the diversification benefits according to MPT depend on the analysis period. Crypto has a different risk and return profile from stocks; although it can enhance portfolio performance, its high volatility requires risk assessment using Value at Risk (VaR).

2.3. Investment

Investment is the placement of funds at present with the expectation of obtaining profits in the future. According to Dewi and Vijaya (2023), there are two types of investment: direct investment and indirect investment. Direct investments include shares, deposits, securities, cryptocurrencies and others, while indirect investments include mutual funds or investments in company shares managed by professional investment managers (Nuzula & Nurlaily, 2020). In the context of the Indonesian market, investment decisions are influenced not only by fundamental factors but also by investor characteristics. Pradja and Taufiq (2024) found that students in Indonesia consider their investment decisions based on their previous experience with investing, the amount of risk involved, and the impact of social media.

2.4. Blockchain dan Cryptocurrency

Blockchain technology is a peer-to-peer network that securely stores transaction records in a decentralized digital ledger. It maintains the integrity of data through encryption and allows for transparency and validation by the public via agreement protocols like Proof of Work and Proof of Stake. Rather than representing ownership itself, blockchain provides the technological foundation for secure peer-to-peer exchange and record-keeping of crypto assets. Cryptocurrency is a digital currency in the form of an intangible commodity that has been included in the capital market ecosystem as a global payment tool formed using blockchain technology. Cryptocurrency offers businesses and individuals low transaction costs, high efficiency, and high security and privacy (Rejeb & Kheog, 2021).

Based on Forbes data (2024), the five cryptocurrencies with the largest market capitalisation that are the focus of this study are Bitcoin (BTC) worth 816.4 billion US dollars, Ethereum (ETH) worth 266.5 billion US dollars, Tether (USDT) worth US$90.7 billion, Binance Coin (BNB) worth US$38.5 billion, and XRP (Ripple) worth US$33.6 billion. Bitcoin and Ethereum dominate the market due to their functions as investment assets and smart contract networks, while Tether acts as a relatively stable stablecoin. Binance Coin and XRP are widely used for cross-platform and cross-border transactions. These five assets represent the majority of the global cryptocurrency market capitalisation and are the main reference in risk analysis and digital investment returns.

Due to the unpredictable and swiftly changing nature of the cryptocurrency market, market capitalization values are subject to constant fluctuation, requiring the utilization of precise technical and fundamental analysis techniques (Dewi & Vijaya, 2023). Sari (2023) analysed the hedging capabilities of cryptocurrencies, particularly Bitcoin, against the Indonesian stock market by comparing normal and abnormal economic conditions. The study found that Bitcoin has hedging capabilities under normal conditions but not during economic crises such as the COVID-19 pandemic. This finding indicates that the risk characteristics of

cryptocurrency are inconsistent across different market conditions, supporting the argument that cryptocurrency has a fundamentally different risk profile from stock indices.

2.5. Stock Index

A stock index is a statistical measure that describes the overall movement of stocks in a particular sector and is evaluated periodically. In this study, the author analyses five stock indices that are often monitored by investors, including:

1) Composite, better known as the Composite Stock Price Index (IHSG), is an average graph that provides a brief overview of all types of shares listed on the exchange.
2) The Main Board Index (MBX) is a main board stock price index intended for issuers with good size and track records.
3) LQ45 is a stock price index that includes the LQ45 list or 45 companies that are actively traded.
4) Kompas 100 is a collaboration between the IDX and the Kompas daily newspaper. It consists of 100 stocks selected based on liquidity and market capitalisation.
5) Bisnis -27 is a collaboration between the IDX and the Bisnis Indonesia daily newspaper. It consists of 27 stocks selected based on liquidity and market capitalisation.

2.6. Return and Risk

Return refers to the gains acquired from financial choices made by organizations, people, and establishments. A greater profit typically corresponds to increased risk. This aligns with the assertion (Lumbantobing & Sadalia, 2021) which states that crypto assets have higher risk and return than stock indices and gold. Risk is the level of return from the average return that is uncertain. Therefore, an investor always tries to minimise the risks that will occur, whether they are short-term or long-term risks, as well as risks in macro and microeconomic conditions. Risk measurement can be done using standard deviation and variance calculations. However, in this study, the researcher used standard deviation calculations.

2.7. Value at Risk (VaR) Historical

Historical Value at Risk (VaR) is a non-parametric method that does not assume a specific distribution of return data. This method uses historical data to estimate the maximum potential loss at a certain confidence level using a percentile approach (Jorion, 2007). Historical VaR is suitable for instruments with abnormal return distributions, such as cryptocurrencies, as it can capture the fat tail characteristics and extreme events that often occur in volatile assets.

2.8. Conceptual Framework

The conceptual framework for this study is derived from the findings of existing research.

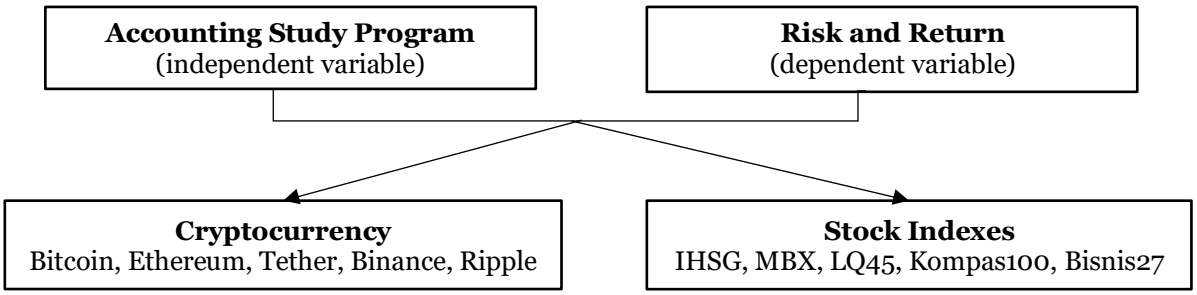

Figure 1. Conceptual Framework

As illuminated in the figure 1, the hypotheses formulated for this research are as follows:

Ho1 = There is no significant difference in the distribution of returns between cryptocurrencies and stock indices.
Ha1 = There is a significant difference in the distribution of returns between cryptocurrencies and stock indices.
Ho2 = There is no significant difference in risk distribution between cryptocurrency and stock indices.
Ha2 = There is a significant difference in risk distribution between cryptocurrency and stock indices.
Ho3 = There is no significant difference in VaR distribution between cryptocurrency and stock indices.
Ha3 = There is a significant difference in VaR distribution between cryptocurrency and stock indices.

3. Methods

3.1. Research Approach and Design

This study utilised a quantitative approach based on secondary data obtained from the websites www.investing.com and www.idx.co.id.

3.2. Data Sources and Types

The study relies on monthly data comprising the final prices of cryptocurrency and stock indices from January 2022 to December 2024. This dataset consists of 350 observations, where each observation represents an asset–month pair (10 instruments × 35 months). Thus, this data structure illustrates time-series variation across instruments, not aggregate values. The type of data used is historical quantitative data collected from trusted online sources. This study is a comparison of time-series data over a three-year period, examining the fluctuations and connections between the cryptocurrency and stock markets in Indonesia. The research encompasses 851 different cryptocurrencies and 46 stock indices traded in the country.

However, Tether (USDT), a stablecoin pegged to the US dollar, was subsequently excluded from statistical analysis because its fixed-value characteristic is fundamentally different from non-stable cryptocurrencies. This exclusion ensures appropriateness and prevents distortion in normality test results and risk distribution. This adjustment is presented here for methodological consistency.

3.3. Population and Sample

The method of sampling employed was purposive sampling, utilizing the subsequent selection criteria for the samples:

1) Historical cryptocurrency data available on the website www.investing.com for January 2022 - December 2024.
2) Historical stock index data available on the website www.idx.co.id for January 2022 - December 2024.
3) The samples are sorted based on the closing price each month and have the largest market cap in the market, resulting in a total of 5 cryptocurrencies and 5 stock indices.
4) The selection of 5 cryptocurrencies and 5 stock indices is based on the highest transaction volume and price volatility in the market as recorded on the websites www.investing.com and www.idx.co.id.

3.4. Data Analysis Techniques

The study utilized the Shapiro-Wilk normality test as it is known for its sensitivity and accuracy for samples less than 50. The test was used to evaluate if the risk and return data followed a normal distribution. Additionally, the study also employed the Independent Sample t-test and Mann-Whitney U test to analyze the data. The testing tools used in this study were Microsoft Excel 2019 and SPSS version 26 with a significance level of 0.05 or 5%. The standards used were as follows:

a. If the significance value is greater than 0.05, then the data is normally distributed, and an Independent Sample t-test is performed.
b. If the significance value is less than 0.05, then the data is not normally distributed, and a Mann-Whitney U test is performed.

In this study, returns were calculated using realised returns based on historical data, while risk was calculated using the Historical VaR method with a confidence level of 0.95 or 95% using the following formula:

1) Return Calculation

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}} \quad \text{..... (1)}$$

Explanation:
R_it = Return at time t
P_it = Price or value in period t
P_(it-1) = Price or value in the previous period

2) Calculation of Standard Deviation

$$\sigma(\%) = \sqrt{\frac{\sum_{i=1}^{i=n} (r_i - r)^2}{n}} \quad \text{..... (2)}$$

Explanation:
σ (%) = Standard deviation (SD)
'r' _'i' = Return in period i
r = Average return
n = Number of data observed

3) Historical VaR Calculation

Percentile Position = (1 - α) × n

$$VaR_{95}\% = -R_{0.05} \quad \text{..... (3)}$$

Explanation:
a = confidence level (0.95 for 95%)
n = number of observations
R_0.05 = return at the 5th percentile
A negative sign indicates potential loss

This study uses a significance level of 5% with the following criteria:

a. If the p-value (significance) is <0.05, then Ho is rejected and Ha is accepted (there is a significant difference).
b. If the p-value (significance) is >0.05, then Ho is accepted and Ha is rejected (there is no significant difference).
c. All statistical analyses were conducted using Microsoft Excel 2019 and SPSS version 26 with a 5% significance level.

4. Results and Discussion

4.1. Research Results

4.1.1. Time Series Data

Cryptocurrency has very high volatility, meaning that data fluctuates relatively quickly. The data fluctuates from the highest to the lowest and back to high or low within a certain time frame.

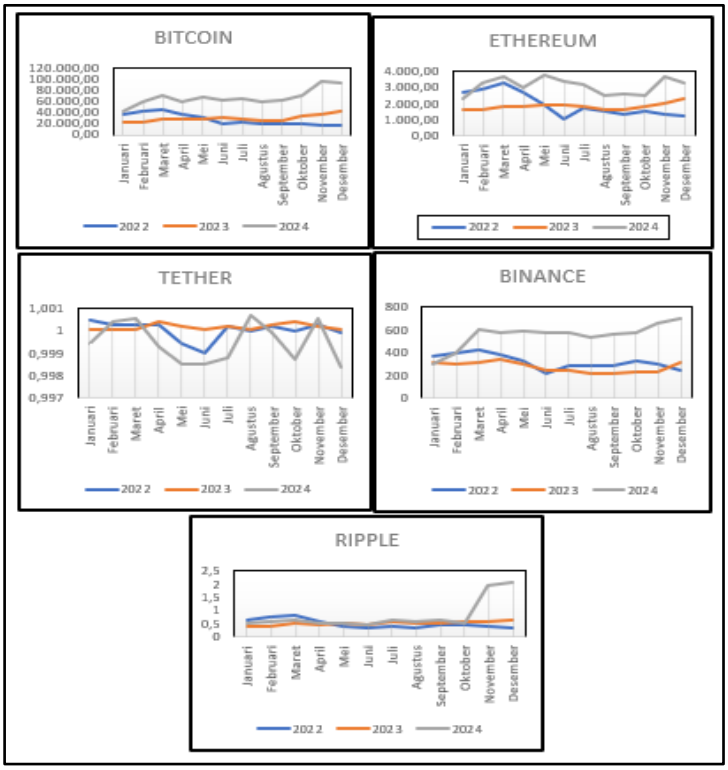

Figure 2. Monthly Cryptocurrency Price Fluctuations from 2022 to 2024
Source: Secondary data from www.investing.com

The graph of cryptocurrency price fluctuations for the period 2022–2024 shown in Figure 2 illustrates the dynamics of price movements that reflect the highly volatile nature of the digital asset market. Bitcoin and Ethereum exhibit fluctuating price patterns with a downward trend in 2022–2023, followed by a significant increase towards the end of 2024. This pattern indicates market reactions to global macroeconomic factors, changes in institutional adoption rates, and investor sentiment. These findings are consistent with the results of Sovbetov's (2018) research, which states that volatility, trading volume, and investor appeal are the main determinants in cryptocurrency price formation.

Meanwhile, Tether, as a stablecoin, demonstrates relatively high value stability, closely tracking its reference unit with minimal fluctuations. This stability reflects the effectiveness of the peg mechanism, supported by reserve assets and arbitrage activities in the market, as explained (Sovbetov, 2018) which emphasises that the price stability of stablecoins depends on the reliability of reserves and market liquidity.

Binance Coin and Ripple show more moderate movement patterns compared to Bitcoin and Ethereum, with a tendency towards stagnation in the middle of the period and an increase at the end of 2024. However, the sharp surge in Ripple in the final months indicates the influence of specific external factors such as regulatory policies or litigation events that have an impact on market perception. Consistent with the research by Pessa et al. (2023) which

found that market capitalisation and asset age affect the level of cryptocurrency price variation.

In addition, the correlation between crypto assets is also an important factor in explaining similar price movement patterns on charts. Kushwah et al. (2024) revealing the existence of strong volatility transmission between major cryptocurrencies, such that price shocks in Bitcoin can have a direct impact on the price movements of Ethereum, Binance Coin, and Ripple. Thus, it can be concluded that the 2022–2024 period reflects a phase of consolidation and recovery in the cryptocurrency market following the extreme volatility of previous years, where fundamental factors, market liquidity, and inter-asset correlations become the primary determinants of global cryptocurrency price movements.

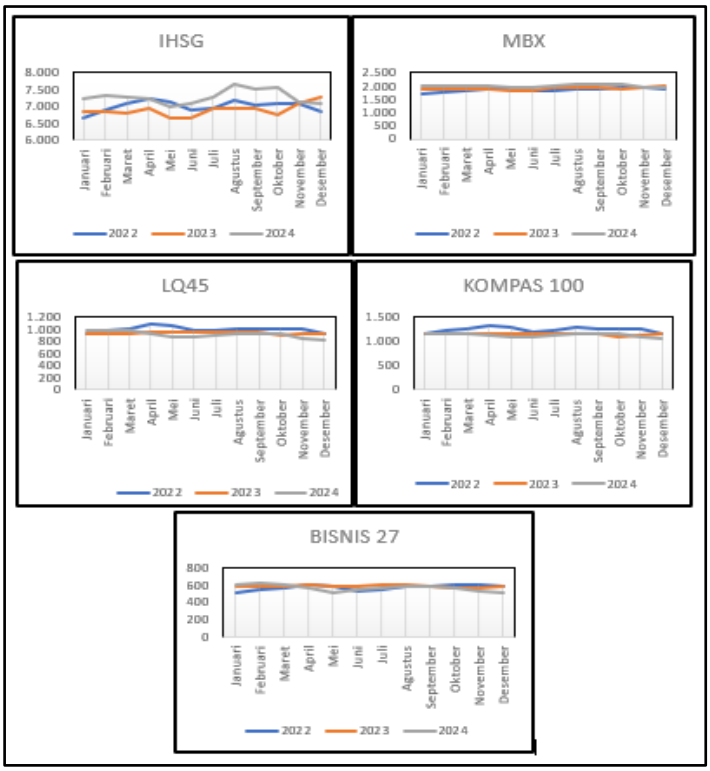

Figure 3. Monthly Stock Index Price Fluctuations from 2022 to 2024
Source: Secondary data from www.idx.co.id

Based on observations of fluctuations in the prices of major stock indices in Indonesia, including the IHSG, MBX, LQ45, KOMPAS 100, and BISNIS 27 during the period 2022–2024, there were variations in price movements that reflected the dynamics of market responses to changes in domestic and global economic conditions. In 2022, all indices showed relatively high volatility, particularly the IHSG and LQ45, which experienced a significant decline in the middle of the year due to global inflationary pressures and monetary tightening policies by central banks in developed countries. This condition was in line with the volatility of international commodity prices, which also affected investors' perception of risk in the Indonesian stock market. Entering 2023, the movement of the index showed stabilisation with a more controlled level of fluctuation, although a downward trend was still apparent in the first quarter of the current year. This phenomenon correlates with the normalisation of fiscal policy and declining demand for major commodity exports. Meanwhile, in 2024, the index movement pattern indicates a stronger recovery phase with a gradual upward trend, reflecting

increased investor optimism about the prospects for national economic growth, exchange rate stability, and the sustainability of adaptive macroeconomic policies.

Based on previous research findings, the volatility and monthly fluctuations of Indonesian stock indices (such as the JCI and thematic indices such as the LQ45) are greatly influenced by macroeconomic variables. For example, Utomo et al. (2019) found that exchange rates, BI interest rates, and inflation have a real correlation with the movement of the LQ45 index on the IDX (Utomo et al., 2019). Majok et al. (2024) concludes that interest rates have a strong influence on the Indonesian stock market in the medium to long term, although the effects of inflation and exchange rates are weaker in some periods. Marpaung and Pangestuti (2024) analysed the volatility of the Jakarta Composite Index before and after the pandemic, and found that macroeconomic factors also influenced the market's response to external crises. Raihan and Saksana (2023) reinforces evidence that interest rates have a negative effect on the volatility of the Indonesian stock index, while exchange rates and global economic uncertainty (GEPU) have a significant positive effect on volatility. In addition, according to Fauzi and Wijoyo (2025), the IHSG is significantly influenced negatively by exchange rate fluctuations and economic growth, but interest rates have a positive impact. Inflation does not have a significant impact on the IHSG.

4.1.2. Descriptive Statistics

As shown in Table 1, Tether, as a stablecoin, showed a return close to 0% in line with its characteristics designed to maintain value stability.

Table 1. Descriptive Statistics of Return and Risk

Instrument	Average Return (%)	Risk (Std. Dev) (%)
Cryptocurrency		
Bitcoin	3.70%	16.94%
Ethereum	2.71%	20.84%
Tether	-0.01%	0.08%
Binance	3.08%	16.58%
Ripple	9.35%	50.39%
Stock Index		
IHSG	0.22%	2.61%
MBX	0.41%	2.59%
LQ45	-0.30%	3.57%
Kompas 100	-0.23%	3.43%
Business 27	0.12%	4.14%

Source: Processed data (2025)

In terms of volatility, cryptocurrencies exhibit significantly greater price fluctuations than stock indices. Ripple shows the highest volatility with a standard deviation of 51%, followed by Ethereum at 21%, and both Bitcoin and Binance Coin at 17%. Meanwhile, stock indices display relatively lower volatility, ranging between 3-4%. These results indicate that cryptocurrencies are subject to higher market uncertainty. However, since standard deviation assumes normally distributed returns, it may underestimate extreme downside risks; thus, future studies should consider alternative measures such as Value at Risk (VaR) or Conditional VaR (CVaR) for a more comprehensive risk assessment.

4.1.3. Shapiro-Wilk Normality Test

Research analysts rely on the Shapiro-Wilk test, as presented in Table 2, to assess the normal distribution of risk and return data. Subsequently, depending on the outcome, they

will proceed with either an Independent Sample t-test for normally distributed data or a Mann-Whitney U test for non-normally distributed data.

Table 2. Shapiro-Wilk Normality Test for Returns

		Normality Test					
	Types of Instruments	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Monthly Return	Cryptocurrency	0.198	175	0.000	0.564	175	0.000
	Stock Index	0.126	175	0.000	0.963	175	0.000

a. Lilliefors Significance Correction

Source: Processed data (2025)

According to the Shapiro-Wilk normality test results in Table 2, it is evident that the monthly returns for both cryptocurrency instruments and stock indices have a significance value of 0.000, indicating a level below the threshold of α = 0.05. These results indicate that the distribution of return data for both types of instruments is not normally distributed. The Shapiro-Wilk statistic value for cryptocurrency is 0.564, indicating a fairly high level of deviation from the normal distribution, while the value of 0.963 for stock indices shows that the deviation is relatively smaller, but still does not meet the normality assumption.

These findings indicate that the volatility of cryptocurrency returns is much higher than that of stock indices, so that their distribution tends to reflect a leptokurtic pattern with the potential for extremes (fat tails). These results are in line with the findings (Albuquerque & Rajhi, 2019) which states that crypto asset returns have non-normal characteristics with high volatility and heavy-tailed distribution patterns. Meanwhile, Tsuruta (2020) also shows that traditional stock markets generally have a more stable return distribution that is closer to normal than digital assets. Thus, the results of this test reinforce the conclusion that analysis of cryptocurrency and stock index returns should not use parametric methods that require normality, but rather use non-parametric approaches or adaptive volatility models such as GARCH or EGARCH to obtain more accurate and representative results.

Table 3. Shapiro-Wilk Normality Test for Risk

		Normality Test					
Types of Instruments		Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Monthly Risk	Cryptocurrency	0.305	175	0.000	0.787	175	0.000
	Stock Index	0.392	175	0.000	0.622	175	0.000

a. Lilliefors Significance Correction

Source: Processed data (2025)

Looking at the Table 3, normality tests were conducted on 140 monthly return/risk observations for each group (cryptocurrency: 4 types x 35 months and stock index: 5 types x 35 months). Tether (USDT) was excluded due to its stablecoin characteristics, which differ fundamentally from other cryptocurrencies. The results of the Shapiro-Wilk normality test indicated that none of the research variables followed a normal distribution. In terms of the return variable, both cryptocurrency and the stock index had significance values of 0.000. Similarly, the risk variable also showed significance values of 0.000 for cryptocurrency and the stock index. Since all significance values were less than 0.05, it can be concluded that the data did not have a normal distribution, leading to the utilization of the Mann-Whitney U non-parametric test for further analysis.

4.1.4. Mann-Whitney U test

1) Return Difference Test

As presented in Table 4, the Mann-Whitney U test results for monthly returns show that cryptocurrency has a mean rank of 179.18 with a sum of ranks of 31,356.00, while the stock index has a mean rank of 171.82 with a sum of ranks of 30,069.00.

Table 4. Mann-Whitney U test for returns

Ranks				
	Type of Instrument	N	Mean Rank	Sum of Ranks
Monthly Return	Cryptocurrency	175	179.18	31356.00
	Stock Index	175	171.82	30069.00
	Total	350		

Test Statistics[a]	
	Monthly Return
Mann-Whitney U	14669.000
Wilcoxon W	30069.000
Z	-0.683
Asymp. Sig. (2-tailed)	0.494

a. Grouping Variable: Types of Instruments

Source: Processed data (2025)

Value (U = 14.669, Wilcoxon W = 30.069, Z = -0.683, p = 0.494 > 0.05). The results show that there is no statistically significant difference in the distribution of returns between cryptocurrencies and stock indices (p = 0.494 > 0.05).

2) Risk Difference Test

As shown in Table 5, the Mann-Whitney U test results for monthly risk show that cryptocurrency has a mean rank of 228.00 with a sum of ranks of 39,900.00, while the stock index has a mean rank of 123.00 with a sum of ranks of 21,525.00.

Table 5. Mann-Whitney U test for Risk

Ranks				
Types of Instruments		N	Mean Rank	Sum of Ranks
Monthly Risk	Cryptocurrency	175	228.00	39900.00
	Stock Index	175	123.00	21525.00
	Total	350		

Test Statistics[a]	
	Monthly Risk
Mann-Whitney U	6125.000
Wilcoxon W	21525.000
Z	-9.938
Asymp. Sig. (2-tailed)	0.000

a. Grouping Variable: Instrument Types

Source: Processed data (2025)

The Mann-Whitney U value obtained was 6,125,000 with a Wilcoxon W of 21,525,000. The calculated Z value is -9.938 with a significance level (2-tailed) of 0.000. Using an alpha of 0.05, the results show that there is a statistically significant difference in the risk distribution between cryptocurrency and stock indices (p = 0.000 < 0.05).

4.1.5. Value at Risk (VaR) Historical Analysis Results

Historical Value at Risk (VaR) analysis with a 95% confidence level was dome to measure the maximum potential loss of each investment instrument. The VaR calculation results using the 5th percentile method of historical return distribution are presented in Table 6.

Table 6. Results of 95% Historical VaR Calculations

Category	Instrument	Mean Return (%)	Risk/Std Dev (%)	VaR 95% (%)	Interpretation
Cryptocurrency	Bitcoin (BTC)	3.70%	16.94%	37.32%	High Risk
Cryptocurrency	Ethereum (ETH)	2.71%	20.84%	28.80%	High Risk
Cryptocurrency	Tether (USDT)	-0.01%	0.08%	0.13%	Low Risk
Cryptocurrency	Binance (BNB)	3.08%	16.58%	21.62%	High Risk
Cryptocurrency	Ripple (XRP)	9.35%	50.39%	27.96%	High Risk
Stock Index	IHSG	0.22%	2.61%	4.09%	Low Risk
Stock Index	MBX	0.41%	2.59%	3.66%	Low Risk
Stock Index	LQ45	-0.30%	3.57%	6.99%	Medium Risk
Stock Index	KOMPAS 100	-0.23%	3.43%	7.45%	Medium Risk
Stock Index	BISNIS 27	0.12%	4.14%	8.32%	Medium Risk

Source: Processed data (2025)

Based on VaR calculations, cryptocurrencies showed a higher VaR value (average of 23.17%) than stock indices (average of 6.1%). Tether (USDT) as a stablecoin showed the lowest VaR, in line with its characteristic of price stability. Ripple (XRP) had the highest risk, reflecting extreme volatility during the research period.

4.1.6. VaR Normality Test

Table 7. Shapiro Wilk Normality Test for VaR

Types of Instruments		Normality Test					
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
VaR 95%	Cryptocurrency	0.256	5	0.200*	0.888	5	0.346
	Stock Index	0.264	5	0.200*	0.871	5	0.270

*This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Source: Processed data (2025)

As shown in Table 7, the Shapiro Wilk normality test results indicate that all research variables are normally distributed. Cryptocurrency has a p-value of 0.346 and the stock index has a p-value of 0.270. All significance values > 0.05 indicate that the data is normally distributed, so further analysis uses the Independent t-test.

4.1.7. Independent Sample T-Test

The findings from the Independent Sample t-test, presented in Table 8, reveal that the assumption of variance homogeneity has been satisfied, as demonstrated by the Levene's test ($F = 4.232$, $p = 0.074 > 0.05$). Therefore, the row assuming equal variances is utilized. With 8 degrees of freedom, a calculated t-value of 2.689, and a significance level of 0.028, it is evident that there is a significant disparity in VaR between cryptocurrency and stock indices ($p = 0.028 < 0.05$) based on the results obtained using an alpha value of 0.05.

Table 8. Independent Sample t-test for VaR

Group Statistics

Types of Instruments		N	Mean	Std. Deviation	Std. Error Mean
VaR 95%	Cryptocurrency	5	23.1660	14.03663	6.27737
	Stock Index	5	6.1020	2.09384	0.93639

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
VaR 95%	Equal variance assumed	4.23	0.074	2.689	8	0.028	17.064	6.346	2.42819	31.69981
	Equal variance not assumed			2.689	4.17	0.052	17.064	6.346	-0.26556	34.39356

Source: Processed data (2025)

The average VaR difference of 17.06% indicates that in the worst market conditions, cryptocurrency investors face a maximum potential loss that is nearly four times greater than that of stock index investors.

Table 9. Hypothesis Testing Results

Hypothesis	Variables	Statistical Test	P Value	Decision	Conclusion
H1	Monthly Return	Mann-Whitney U	0.494	Ho accepted, Ha rejected	There is no significant difference in the distribution of returns between cryptocurrencies and stock indices.
H2	Risk (Std. Dev)	Mann-Whitney U	0.000	Ho rejected, Ha accepted	There is a significant difference in the distribution of risk between cryptocurrencies and stock indices.
H3	VaR Historical 95%	Independent t-test	0.028	Ho rejected, Ha accepted	There is a significant difference in the distribution of VaR between cryptocurrencies and stock indices.

Source: Processed data (2025)

The hypothesis testing results in Table 9 suggest that there is no significant distinction in the monthly return distribution between cryptocurrency and stock indices, indicating that both assets have similar average returns. However, different results are shown in the risk variable (standard deviation) with a p-value = 0.000 < 0.05, which indicates a significant difference in the level of risk between the two instruments. This means that the volatility of cryptocurrency is proven to be much higher than that of stock indices. In addition, the test results for the 95% Value at Risk (VaR) variable also show a significant difference (p = 0.028 < 0.05), indicating that the maximum potential loss (risk exposure) in cryptocurrency is greater than that of stock indices. Thus, although the returns of the two are not significantly different, cryptocurrency has a higher risk profile, in line with its characteristics as a high-risk, high-return asset.

4.2. Discussion

4.2.1. Comparison of Returns between Cryptocurrency and Stock Indices

The results of this study indicate that although descriptively cryptocurrencies have a higher average return than stock indices in Indonesia. This finding indicates that the "high risk, high return" characteristic of digital assets does not always apply consistently in the context of the Indonesian market, which is still marked by regulatory uncertainty and speculative behavior by retail investors. As reported by Ahmed (2023), the reciprocal relationship between the stock market and the crypto market is often unstable and dependent on external conditions such as global sentiment and policy intervention, causing fluctuations that do not fully reflect economic fundamentals. In addition, extreme volatility in assets such as Bitcoin and Ethereum also amplifies systemic risk in mixed portfolios (Almeida, 2022; Karim, 2023).

Significant differences in risk measured by Value at Risk (VaR) confirm the existence of structural heterogeneity among cryptocurrencies, where non-stable assets such as Bitcoin, Ethereum, Binance Coin, and Ripple exhibit much higher volatility compared to stock indices (Irfan, 2023). The dominance of large-cap assets such as Bitcoin, Ethereum, Binance Coin, and Ripple, which have high volatility, keeps the overall risk distribution of the crypto market much more volatile than stock indices (Almagsoosi, 2022; Bruhn, 2022). This condition aligns with the findings by Aggarwal (2022) which states that although cryptocurrencies have the potential to increase portfolio diversification, their benefits are often eroded by unpredictable market volatility. Thus, the analysis evidence reinforce the view that cryptocurrencies cannot yet fully function as an efficient investment alternative compared to the stock market, which has more structured economic fundamentals and regulations (Li, 2023; Petukhina, 2021).

4.2.2. Risk Comparison between Cryptocurrency and Stock Indexes

From a technological and market structure perspective, cryptocurrencies operate on blockchain technology, which is still rapidly developing and tends to be unstable. Uncertainty regarding system security, scalability issues, and technological innovation dynamics cause high price volatility (Almeida, 2022; Gupta, 2022). Conversely, stock indices reflect the performance of companies with more established economic fundamentals and financial infrastructure, so that their price movements are more controlled and follow real economic dynamics (Ahmed, 2023).

In terms of liquidity and regulation, the cryptocurrency market generally has lower liquidity and developing regulations, which results in less efficient price discovery and increased risk of price manipulation (Chokor, 2021; Han, 2023). Meanwhile, the stock market in Indonesia operates under the strict supervision of the Financial Services Authority (OJK) with the implementation of circuit breakers and a transparent reporting system, so that volatility can be better controlled. This is in line with the findings by Bowala (2022) and Białkowski (2020) which confirms that strong regulations and market structures can reduce fluctuations in investor portfolio risk.

From a behavioral finance perspective, investor behavior also plays an important role in shaping risk profiles. The cryptocurrency market is dominated by retail investors who tend to exhibit herding behavior and fear of missing out (FOMO), which causes irrational price spikes (Arsi, 2022; Omane-Adjepong, 2021; Papadamou, 2021). In contrast, the stock market is generally followed more by institutional investors who are rational and based on fundamental analysis (Lumbantobing & Sadalia, 2021). This condition reinforces the research results Aggarwal (2022) and Grobys (2021) which found that speculative behavior and psychological biases contribute significantly to the instability of the crypto market.

Our results lend further support to the conclusions of Sari (2020) which states that volatility and liquidity are the main determinants in shaping the risk profile of an investment instrument, the similarity of risk mechanisms through financial leverage and trading volume shows that markets with high volatility such as cryptocurrencies have much greater risks than traditional instruments such as stocks. Thus, these results confirm that the significant difference in risk levels between cryptocurrencies and stock indices is caused by a combination of technological, regulatory, and investor behavior factors, which is in line with global empirical evidence (Bruhn, 2022; Iqbal, 2023; Karim, 2023).

4.2.3. Comparison of Value at Risk (VaR) between Cryptocurrency and Stock Indices

The VaR value of cryptocurrencies is nearly four times greater than that of stock indices, indicating a much higher potential for maximum losses. This condition reflects the presence of fat-tail distribution, where the probability of extreme events occurring is higher than predicted by normal distribution. This indicates that traditional risk measurements tend to underestimate downside risk in crypto assets, thus making the use of Conditional Value at Risk (CVaR) or risk models adjusted for skewness more appropriate in accordance with contemporary financial literature. Likitratcharoen et al. (2023) emphasizes that the Historical Simulation VaR method is effective in measuring extreme risk in the crypto market, thus supporting the approach used in this study. These findings underscore the importance of tail risk management in digital asset investment. Although diversification is commonly used to mitigate risk, the results of this study show that adding cryptocurrency to a stock portfolio actually increases tail risk. This is consistent with Bowala (2022) and Petukhina (2021) which states that high volatility in crypto assets can reduce the efficiency of portfolio diversification.

Empirically, these results are in line with Lumbantobing and Sadalia (2021), who found that cryptocurrencies have higher volatility than stocks and gold. However, this study provides evidence that the premium return of cryptocurrencies is not commensurate with their level of risk. Liu and Tsyvinski (2021) also show that cryptocurrency has different risk factors from traditional assets with high volatility clustering patterns. Additionally, Chi et al. (2023) confirm that the risk difference between cryptocurrency and traditional assets is persistent and not fully explained by conventional asset pricing models. Thus, the results of this study confirm that the risk of cryptocurrency is unique and fundamentally different from stock indices. This is reinforced by the findings of Almeida (2022) and Iqbal (2023), which show that uncertainty and the risk of decline in value dominate long-term profit potential, making cryptocurrency more appropriately categorized as a high-risk speculative asset rather than a stable investment instrument.

Overall, the research results indicate that although crypto returns do not differ significantly from stock indices, the risk is much higher. Based on Modern Portfolio Theory (Markowitz), this condition shows that crypto assets have not yet provided a risk premium commensurate with their volatility, thus their efficiency in portfolios remains low. Portfolio implications confirm that the diversification benefits of crypto are limited, and performance evaluation should preferably use risk-based measures such as the Sharpe ratio or Sortino ratio to assess risk compensation more accurately.

5. Conclusion

After examining the risk and return of cryptocurrencies and stock indices in Indonesia from 2022 to 2024, this research suggests that there is not a notable discrepancy in the returns of these two assets. However, attention should be drawn to the fact tha cryptocurrencies tend to demonstrate higher average returns when describing the data. Cryptocurrency risk is proven to be far higher, reflected in the Value at Risk (VaR) which indicates a maximum potential loss nearly four times greater compared to stock indices. These findings suggest that cryptocurrencies have not provided a risk premium commensurate with their risk level and indicate potential market inefficiency and mispricing in Indonesia's digital asset market. Theoretically, these results support the relevance of Signalling Theory and Modern Portfolio Theory, but also demonstrate that the relationship between risk and return is not always proportional in the cryptocurrency context.

Practically, these findings indicate that crypto assets can serve as a limited diversification instrument for investors in Indonesia, with allocation recommended not to exceed 5-10% of the total portfolio and the implementation of risk management strategies such as stop loss and dollar cost averaging. Institutional portfolio managers need to consider the contribution of VaR and CVaR in assessing overall risk, while regulators such as OJK and Bappebti can use these results to strengthen stability policies and crypto market protection. Research limitations include a short observation period and limited sample coverage, so results need to be interpreted carefully.

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