

Comparative Analysis Of Cryptocurrency And Lq45 Stock Portfolio Performance Using Sharpe, Treynor, And Jensen Methods

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Abstract

This study compares the risk-adjusted performance of a cryptocurrency portfolio and an LQ45 stock portfolio on the Indonesia Stock Exchange using the Sharpe, Treynor, and Jensen methods. The sample consists of five major cryptocurrencies (Bitcoin, Ethereum, BNB, Solana, and XRP) and ten LQ45 stocks, observed monthly from January 2021 to June 2026 (66 months), with the Jakarta Composite Index (JCI) as the market benchmark and the Bank Indonesia (BI) Rate as the risk-free rate. Equal-weighted portfolios are formed for each asset class, and differences in performance are tested using the Jobson–Korkie test with Memmel’s correction. The results show that the cryptocurrency portfolio delivers a much higher annualized return (44.1% versus 0.8%) and higher Sharpe, Treynor, and Jensen values than the LQ45 portfolio, but at the cost of extreme volatility and a maximum drawdown of 91%. The difference in Sharpe ratios is not statistically significant over the full sample, though it is significant in 2021–2023. Rankings across the three measures are broadly consistent. Adding a small allocation of cryptocurrency (5–10%) to an LQ45 portfolio improves its Sharpe ratio. The findings suggest that cryptocurrency is better viewed as a small satellite allocation than as a substitute for blue-chip stocks.

Keywords: portfolio performance; cryptocurrency; LQ45; Sharpe ratio; Treynor ratio; Jensen’s alpha

INTRODUCTION

Investment opportunities available to Indonesian investors have expanded considerably over the past decade. Alongside conventional instruments such as stocks, bonds, and mutual funds, crypto assets have become widely accessible through licensed domestic exchanges, and Indonesia has recorded rapid growth in the number of registered crypto investors, in many periods exceeding the number of capital market investors. This shift raises a practical question

that is central to portfolio management: when returns are adjusted for the risks taken, do cryptocurrencies actually reward investors better than established blue-chip stocks?

Cryptocurrencies are known for extraordinary returns and equally extraordinary volatility. Bitcoin, the first cryptocurrency (Nakamoto, 2008), and other major coins have experienced multiple cycles of rapid appreciation followed by drawdowns of more than seventy percent (Corbet et al., 2019; Katsiampa, 2017). LQ45 stocks, by contrast, are the forty-five most liquid and largest stocks on the Indonesia Stock Exchange (IDX), dominated by banks, consumer goods, telecommunications, and natural resource firms, and are commonly regarded as the core holdings of domestic investors. Comparing these two asset classes on raw returns alone is misleading because their risk profiles differ fundamentally. Risk-adjusted performance measures are therefore required.

The three classical measures—the Sharpe ratio (Sharpe, 1966), the Treynor ratio (Treynor, 1965), and Jensen’s alpha (Jensen, 1968)—remain the most widely used tools for this purpose. Each captures a different notion of risk: the Sharpe ratio uses total risk, the Treynor ratio uses systematic risk (beta), and Jensen’s alpha measures abnormal return relative to the Capital Asset Pricing Model (CAPM). Using all three makes it possible to examine whether conclusions depend on how risk is defined, which is especially relevant for cryptocurrencies, whose risk is largely unsystematic relative to stock market indices.

International studies have examined the inclusion of Bitcoin in diversified portfolios (Brière et al., 2015; Kajtazi & Moro, 2019; Platanakis & Urquhart, 2020), but evidence comparing cryptocurrency portfolios directly with Indonesian blue-chip stock portfolios over a period that includes the 2021 boom, the 2022 crash, and the subsequent recovery remains limited. Domestic studies applying the Sharpe, Treynor, and Jensen methods have mostly focused on stocks or mutual funds alone. This study fills that gap by addressing three questions: (1) how does the performance of a cryptocurrency portfolio compare with that of an LQ45 portfolio under the Sharpe, Treynor, and Jensen methods; (2) is the difference in risk-adjusted performance statistically significant and stable across sub-periods; and (3) does adding cryptocurrency to an LQ45 portfolio improve its risk-adjusted performance?

LITERATURE REVIEW

Portfolio Theory and the CAPM

Markowitz (1952) showed that investors should evaluate assets not in isolation but by their contribution to the risk and return of the overall portfolio, and that diversification across imperfectly correlated assets reduces risk without necessarily lowering expected return.

Building on this, Sharpe (1964) and Lintner (1965) developed the Capital Asset Pricing Model, which states that only systematic risk, measured by beta relative to the market portfolio, is rewarded in equilibrium, because unsystematic risk can be diversified away. These frameworks provide the foundation for the three performance measures used in this study and are standard references in Indonesian investment textbooks (Tandelilin, 2010; Hartono, 2017).

Risk-Adjusted Performance Measures

The **Sharpe ratio** (Sharpe, 1966, 1994) measures excess return per unit of total risk (standard deviation). It is appropriate when the portfolio being evaluated represents the investor's entire wealth, because total risk is then the relevant risk. The **Treynor ratio** (Treynor, 1965) measures excess return per unit of systematic risk (beta) and is appropriate when the portfolio is one component of a well-diversified holding. **Jensen's alpha** (Jensen, 1968) is the intercept of a regression of portfolio excess returns on market excess returns; a significantly positive alpha indicates returns above what the CAPM predicts given the portfolio's beta. Modigliani and Modigliani (1997) later proposed the M² measure to express risk-adjusted performance in percentage return terms, but the three classical measures remain dominant in empirical research.

These measures have known limitations. Treynor and Jensen depend on the choice of market benchmark, and Roll (1977) argued that tests based on a market proxy are sensitive to how well that proxy represents the true market portfolio. When an asset has a beta close to zero or estimated imprecisely, the Treynor ratio can become unstable. Comparisons of Sharpe ratios also require formal testing, because differences may arise from sampling error; Jobson and Korkie (1981) proposed a test for the equality of two Sharpe ratios, later corrected by Memmel (2003), while Ledoit and Wolf (2008) developed a version robust to non-normal returns.

Cryptocurrencies as an Investment Asset

Studies of cryptocurrencies as an asset class consistently report very high average returns and volatility, heavy-tailed distributions, and strong volatility clustering (Katsiampa, 2017; Liu & Tsyvinski, 2021). Baur et al. (2018) find that Bitcoin is held mainly for speculation rather than as a medium of exchange. Early research found low correlations with traditional assets, suggesting diversification benefits (Bouri et al., 2017; Corbet et al., 2019). Brière et al. (2015) showed that a small Bitcoin allocation improved the risk–return trade-off of a diversified portfolio, and Kajtazi and Moro (2019) found that Bitcoin improves portfolio performance mainly through higher returns rather than lower risk. Platanakis and Urquhart (2020) report that portfolios including Bitcoin achieve higher risk-adjusted returns under

several allocation strategies. More recent work, however, documents rising correlations between crypto and equity markets after 2020 (Conlon & McGee, 2020; Iyer, 2022), which may reduce these diversification benefits.

Hypotheses

Based on the above, the study proposes the following hypotheses. **H1:** The risk-adjusted performance of the cryptocurrency portfolio differs significantly from that of the LQ45 portfolio. **H2:** The ranking of assets is consistent across the Sharpe, Treynor, and Jensen methods. **H3:** Adding cryptocurrency to an LQ45 portfolio improves its risk-adjusted performance.

METHOD

Sample and Data

This study uses a quantitative descriptive-comparative design. The sample period runs from January 2021 to June 2026, giving 66 monthly observations and covering a full crypto cycle. The cryptocurrency sample consists of five coins selected by market capitalization and continuous availability over the period. The stock sample consists of ten stocks that were consistently included in the LQ45 index and represent its main sectors. Table 1 lists the sample. Monthly closing prices of cryptocurrencies are converted into rupiah to remove exchange-rate differences, the JCI serves as the market benchmark, and the risk-free rate is the BI Rate converted to a monthly rate (average 4.97% per year in the sample). In this illustrative version, prices are simulated (see the notice on the first page).

Table 1. Research sample

Asset class	Assets
Cryptocurrency (5)	Bitcoin (BTC), Ethereum (ETH), BNB, Solana (SOL), XRP
LQ45 stocks (10)	BBCA, BBRI, BMRI, BBNI (banking); TLKM (telecommunications); ASII (automotive/conglomerate); ICBP, UNVR (consumer goods); ADRO (energy); ANTM (mining)
Benchmark	Jakarta Composite Index (JCI)
Risk-free rate	BI Rate (monthly)

Portfolio Construction and Returns

Monthly returns are calculated as $R_{i,t} = (P_{i,t} - P_{i,t-1}) / P_{i,t-1}$. Two equal-weighted portfolios are formed and rebalanced monthly: a cryptocurrency portfolio (P_CRYPTO) consisting of the five coins and an LQ45 portfolio (P_LQ45) consisting of the ten stocks. Equal weighting avoids the dominance of the largest asset in each class and is a common, transparent

benchmark strategy. Beta is estimated by regressing asset excess returns on market excess returns.

Performance Measures

The three performance measures are computed as follows:

$$\text{Sharpe: } S_p = (\bar{R}_p - \bar{R}_f) / \sigma_p \quad (1)$$

$$\text{Treynor: } T_p = (\bar{R}_p - \bar{R}_f) / \beta_p \quad (2)$$

$$\text{Jensen: } R_{p,t} - R_{f,t} = \alpha_p + \beta_p(R_{m,t} - R_{f,t}) + \varepsilon_t \quad (3)$$

where $\bar{R}_p$ is the average portfolio return, $\bar{R}_f$ the average risk-free rate, σ_p the standard deviation of portfolio returns, β_p the portfolio beta, and $R_{m,t}$ the JCI return. A higher value indicates better performance for all three measures; a positive and significant α_p indicates performance above the CAPM benchmark.

Hypothesis Testing

The equality of the Sharpe ratios of the two portfolios is tested with the Jobson and Korkie (1981) test with the Memmel (2003) correction, and the difference in mean excess returns with Welch's t-test. The significance of Jensen's alpha is assessed with the t-statistic of the regression intercept. Consistency of rankings across the three measures (H2) is assessed with Spearman's rank correlation. To test H3, mixed portfolios are formed with crypto weights of 0%, 5%, 10%, 20%, 50%, and 100%. Robustness is assessed by repeating the analysis for two sub-periods: 2021–2023, which includes the boom and crash, and 2024–2026.

RESULTS AND DISCUSSION

Return and Risk Characteristics

Table 2 summarizes the return and risk characteristics of each asset. The contrast between the two asset classes is striking. The cryptocurrencies record average monthly returns between 4.3% and 8.7% with monthly standard deviations of 23.1% to 51.2%, whereas the LQ45 stocks have average monthly returns between –1.7% and 2.9% with standard deviations of 4.9% to 12.3%. Every cryptocurrency suffered a maximum drawdown of at least 79%, reflecting the 2022 crash, compared with 17% to 71% for the stocks. At the portfolio level, the crypto portfolio achieved an annualized return of 44.1% with an annualized volatility of 126.4%, while the LQ45 portfolio returned 0.8% with volatility of 14.8%, close to the JCI (0.2% and 12.9%).

Cryptocurrency betas relative to the JCI are large in point estimate (portfolio beta 3.18) but explain little of their variation ($R^2 = 0.11$), whereas LQ45 stocks have betas between 0.53 and 1.52 with much higher explanatory power. Most cryptocurrency risk is therefore

unsystematic with respect to the Indonesian stock market, which matters for interpreting the Treynor and Jensen measures.

Table 2. Return and risk characteristics (monthly, January 2021–June 2026)

Asset	Mean	Std. dev.	Annual return	Max. drawdown	Beta	R ²
BTC	4.31%	23.06%	30.4%	79%	1.84	0.09
ETH	8.68%	46.17%	46.0%	93%	3.83	0.10
BNB	6.73%	29.44%	50.4%	90%	1.80	0.05
SOL	8.01%	51.24%	−1.0%	99%	4.43	0.10
XRP	7.10%	43.92%	29.5%	92%	4.02	0.12
BBCA	1.06%	4.87%	11.9%	17%	0.80	0.37
BBRI	0.12%	7.37%	−1.7%	42%	1.10	0.31
BMRI	−0.24%	5.14%	−4.3%	48%	0.73	0.28
BBNI	0.28%	8.02%	−0.4%	52%	1.35	0.39
TLKM	−0.80%	6.24%	−11.2%	58%	0.53	0.10
ASII	−0.19%	6.24%	−4.5%	46%	0.78	0.22
ICBP	−0.01%	5.61%	−1.9%	51%	0.67	0.20
UNVR	−1.72%	6.52%	−20.9%	71%	0.74	0.18
ADRO	2.89%	11.98%	30.5%	52%	1.52	0.22
ANTM	0.15%	12.27%	−6.7%	71%	1.22	0.14
Crypto portfolio	6.97%	36.48%	44.1%	91%	3.18	0.11
LQ45 portfolio	0.15%	4.26%	0.8%	31%	0.94	0.68
JCI	0.09%	3.74%	0.2%	33%	1.00	1.00

Note: Mean and standard deviation are monthly. Annual return is the compound annual growth rate. Beta and R² from regression of excess returns on JCI excess returns. Source: simulated data.

Sharpe, Treynor, and Jensen Results

Table 3 reports the three performance measures and the ranking of each asset. Under the Sharpe method, the top three assets are BNB, ADRO and ETH; under Treynor, BNB, ETH and BTC; and under Jensen, ETH, SOL and XRP. Cryptocurrencies dominate the upper ranks under all three measures, while most LQ45 stocks record negative Sharpe and Treynor ratios, meaning their returns did not exceed the risk-free rate over the period. Among the stocks, BBCA and ADRO are the only ones with positive Sharpe ratios. Jensen's alpha is positive and significant at the 10% level for ETH, BNB, BBCA and ADRO, and negative and significant for UNVR. The alphas of the cryptocurrencies are large in magnitude but mostly only marginally significant because of their very high residual volatility.

Table 3. Sharpe, Treynor, and Jensen performance and rankings

Asset	Sharpe	Rank	Treynor	Rank	Jensen α	Rank
BTC	0.169	4	0.0211	3	0.0449	5
ETH	0.179	3	0.0216	2	0.0951*	1
BNB	0.214	1	0.0350	1	0.0690*	4
SOL	0.148	6	0.0172	4	0.0904	2
XRP	0.152	5	0.0167	5	0.0800	3
BBCA	0.133	7	0.0081	7	0.0091*	7
BBRI	-0.040	10	-0.0027	10	0.0006	10
BMRI	-0.127	13	-0.0090	13	-0.0042	13
BBNI	-0.017	8	-0.0010	8	0.0030	8
TLKM	-0.194	14	-0.0226	14	-0.0104	14
ASII	-0.097	12	-0.0077	12	-0.0035	12
ICBP	-0.075	11	-0.0063	11	-0.0020	11
UNVR	-0.327	15	-0.0289	15	-0.0190**	15
ADRO	0.207	2	0.0164	6	0.0297**	6
ANTM	-0.022	9	-0.0022	9	0.0013	9

Note: Monthly values. ***, **, * denote significance of Jensen's alpha at 1%, 5%, and 10%. Spearman rank correlations: Sharpe–Treynor = 0.961, Sharpe–Jensen = 0.911, Treynor–Jensen = 0.961. Source: simulated data.

The Spearman rank correlations between the measures are high (Sharpe–Treynor 0.96, Sharpe–Jensen 0.91, Treynor–Jensen 0.96), supporting H2: the three methods produce broadly consistent rankings. Differences appear mainly for assets with similar performance and for ADRO, which ranks 2 under Sharpe but 6 under Treynor and 6 under Jensen. The Treynor ratios of the cryptocurrencies should also be read with caution, because they rely on betas whose R^2 values are only around 0.11. This illustrates the point raised by Roll (1977) that beta-based measures depend on the suitability of the benchmark: for an asset whose risk is mostly unrelated to the JCI, the Sharpe ratio, which uses total risk, is the more informative measure.

Portfolio Comparison

Table 4 compares the two portfolios. The crypto portfolio outperforms the LQ45 portfolio on all three measures: its Sharpe ratio is 0.180 versus -0.061, its Treynor ratio 0.0206 versus -0.0028, and its Jensen's alpha 7.59% per month ($p = 0.082$) versus 0.05% ($p = 0.876$). The LQ45 portfolio performs almost identically to the JCI, with an alpha close to zero, which is consistent with the semi-strong form of market efficiency (Fama, 1970) and with the fact that LQ45 stocks make up a large share of the index.

However, the superiority of the crypto portfolio is not statistically robust over the full sample. The Jobson–Korkie–Mennel test does not reject the equality of the two Sharpe ratios ($z = 1.582$, $p = 0.114$), and Welch's t-test finds no significant difference in mean excess returns

($t = 1.507$, $p = 0.136$). Thus, H1 is not supported for the full period: the higher point estimates of the crypto portfolio are accompanied by so much volatility that they cannot be distinguished from sampling variation over 66 months. Figure 1 shows why: the crypto portfolio generated most of its gains in 2021, lost most of them in 2022, and recovered afterwards, while the LQ45 portfolio followed a much smoother path.

Table 4. Performance comparison of portfolios

Measure	Crypto portfolio	LQ45 portfolio	JCI
Annual return	44.1%	0.8%	0.2%
Annual volatility	126.4%	14.8%	12.9%
Maximum drawdown	91.1%	31.0%	32.6%
Beta	3.18	0.94	1.00
Sharpe ratio	0.180	−0.061	−0.087
Treynor ratio	0.0206	−0.0028	−0.0033
Jensen's alpha	7.59%*	0.05%	—
Alpha p-value	0.082	0.876	—
JKM test (Sharpe)	$z = 1.582$; $p = 0.114$		
Correlation (crypto, LQ45)	0.248		

Note: Sharpe, Treynor, and alpha are monthly. JKM = Jobson–Korkie test with Memmel correction. ***, **, * denote significance at 1%, 5%, and 10%. Source: simulated data.

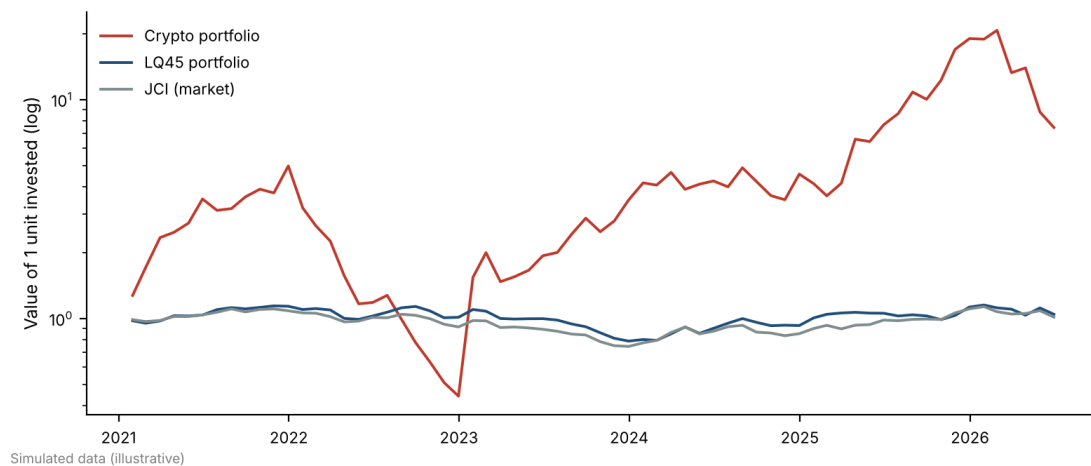


Figure 1. Cumulative value of the crypto portfolio, LQ45 portfolio, and JCI

Source: simulated data (illustrative).

Sub-Period Analysis

Table 5 splits the sample into two sub-periods. In 2021–2023, the crypto portfolio has a significantly higher Sharpe ratio than the LQ45 portfolio (0.187 versus −0.247; JKM $z = 2.355$, $p = 0.019$) and a positive, significant alpha ($p = 0.035$). In 2024–2026, the crypto portfolio still shows a higher Sharpe ratio (0.199 versus 0.127), but the difference is not

significant ($p = 0.785$), and its alpha is no longer significant. The LQ45 portfolio improves markedly in the second period, in line with the JCI. These results show that the relative performance of cryptocurrency is strongly period-dependent, so conclusions drawn from short or favorable windows should be treated with caution.

Table 5. Sub-period performance

Measure	Crypto 2021– 2023	LQ45 2021– 2023	Crypto 2024– 2026	LQ45 2024– 2026
Annual return	51.5%	−7.7%	35.6%	12.0%
Sharpe ratio	0.187	−0.247	0.199	0.127
Treynor ratio	0.0130	−0.0087	0.0312	0.0070
Jensen’s alpha	16.07%**	0.29%	3.26%	0.04%
JKM test p-value	0.019		0.785	
Months	36	36	30	30

Note: Monthly values except annual return. ***, **, * denote significance at 1%, 5%, and 10%. Source: simulated data.

Adding Cryptocurrency to an LQ45 Portfolio

Table 6 shows the effect of allocating part of an LQ45 portfolio to cryptocurrency. Moving from 0% to a 5% crypto allocation raises the Sharpe ratio from −0.061 to 0.017 and reduces the maximum drawdown from 31.0% to 25.7%, and a 10% allocation raises it further to 0.071 with only a moderate increase in volatility. Beyond 20%, however, volatility and drawdowns rise steeply, reaching 70% at a 50% allocation, while the Sharpe ratio improves only marginally. These results support H3 for small allocations and are consistent with Brière et al. (2015) and Platanakis and Urquhart (2020): cryptocurrency adds value mainly as a small satellite position, where its low correlation with LQ45 stocks (0.25) provides diversification and its high return potential lifts portfolio returns without dominating total risk.

Table 6. Performance of mixed portfolios (crypto weight in LQ45 portfolio)

Crypto weight	0%	5%	10%	20%	50%	100%
Annual return	0.8%	4.7%	8.4%	15.3%	31.9%	44.1%
Annual volatility	14.8%	16.7%	20.5%	30.4%	65.4%	126.4%
Max. drawdown	31.0%	25.7%	27.5%	41.2%	69.7%	91.1%
Sharpe ratio	−0.061	0.017	0.071	0.126	0.167	0.180
Treynor ratio	−0.0028	0.0008	0.0036	0.0079	0.0152	0.0206
Jensen’s alpha	0.05%	0.42%	0.80%	1.55%	3.82%	7.59%

Note: Monthly rebalancing; Sharpe, Treynor, and alpha are monthly. Source: simulated data.

Implications

For individual investors, the results indicate that the high headline returns of cryptocurrencies largely reflect compensation for very high risk, and that their superiority over LQ45 stocks on a risk-adjusted basis is neither statistically robust nor stable over time. Investors who hold cryptocurrency as their entire portfolio face drawdowns that few could tolerate, so the Sharpe ratio, which reflects total risk, should be the primary guide. For diversified investors, a small allocation of 5–10% may improve risk-adjusted performance. For investment managers and regulators, the results underline the need to evaluate crypto products using risk-adjusted measures and to communicate drawdown risk clearly to retail investors. The low explanatory power of the JCI for crypto returns also suggests that beta-based measures should be interpreted with care when evaluating crypto assets against a domestic stock benchmark.

CONCLUSION

This study compared the performance of a cryptocurrency portfolio and an LQ45 stock portfolio using the Sharpe, Treynor, and Jensen methods. In this illustrative analysis, the cryptocurrency portfolio delivered higher returns and higher values on all three measures, but with far greater volatility and drawdowns. The difference in Sharpe ratios was not statistically significant over the full period, though it was significant in 2021–2023. The three measures produced broadly consistent rankings, although beta-based measures were less informative for cryptocurrencies because most of their risk is unrelated to the Indonesian stock market. A small allocation of cryptocurrency to an LQ45 portfolio improved its risk-adjusted performance, whereas large allocations mainly increased risk.

The study has limitations. Most importantly, the present results are based on simulated data and must be recomputed with actual market data before any substantive conclusion is drawn. The sample is limited to five cryptocurrencies and ten LQ45 stocks, transaction costs and taxes are not considered, and the three classical measures assume that the standard deviation and beta adequately capture risk, which is questionable for heavy-tailed crypto returns. Future research could use larger samples, alternative weighting schemes, downside-risk measures such as the Sortino ratio or conditional value-at-risk, robust Sharpe ratio tests (Ledoit & Wolf, 2008), and multi-factor benchmarks.

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