

Comparative Analysis of Risk and Return on Bitcoin, Stocks, and Mutual Funds in Investment Decisions

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This study aims to analyze and compare the risk and return characteristics of three investment instruments representing different asset classes, namely Bitcoin as a cryptocurrency asset, the S&P 500 index as a representation of the conventional stock market, and Invesco QQQ as an exchange-traded fund (ETF)-based mutual fund. The study uses a descriptive quantitative approach by utilizing secondary data in the form of monthly closing prices during the period from January 2020 to December 2024. The analysis is conducted through the calculation of average monthly returns, risk measured using standard deviation, and the coefficient of variation to assess risk efficiency relative to returns. The research results show that Bitcoin has the highest average monthly return of 6.21% along with the highest level of volatility, reflecting the characteristics of a high-risk investment. The S&P 500 index shows the lowest average return of 1.08% with the highest coefficient of variation, indicating relatively low risk efficiency. Meanwhile, the Invesco QQQ ETF shows a balance between risk and return with a better level of efficiency compared to the S&P 500. These findings confirm that the relationship between risk and return differs significantly across investment instruments, so investment decisions need to be adjusted according to the investor's risk profile and financial goals.

Keywords: Bitcoin, stocks, mutual funds, risk and return, investment decisions.

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1. Introduction

Investment is one of the main instruments in financial management aimed at increasing asset value in the future. Along with the development of technology and the globalization of financial markets, the investment instrument options available to investors have become increasingly diverse. In addition to conventional instruments such as stocks, bonds, and mutual funds, investors are now also faced with asset-based investment alternatives, one of which is cryptocurrency. This diversity of options requires investors to have adequate understanding of the risk and return characteristics of each instrument before making investment decisions [1].

In modern financial theory, investment decisions always involve a trade-off between risk and return. Rational investors tend to expect higher rates of return as compensation for higher risk [2]. Therefore, risk and return analysis becomes a fundamental aspect of evaluating the performance of investment instruments. Risk is generally measured through return volatility, while return reflects the level of profit earned by investors over a certain period. Understanding the relationship between these two variables is crucial for developing an optimal investment strategy in accordance with the investor's preferences and risk tolerance [3].

Bitcoin, as the first and most dominant cryptocurrency, has attracted widespread attention due to its potential for very high returns, but it comes with extreme price volatility. This characteristic makes Bitcoin an investment instrument with a much higher risk level compared to traditional financial instruments. The value of Bitcoin is greatly influenced by speculation, technology adoption, and global market sentiment [4].

Comparative Analysis of Risk and Return on Bitcoin, Stocks, and Mutual Funds in Investment Decisions. Sia Lily Bramaputri et.al

On the other hand, stocks—especially those represented by market indices like the S&P 500—have long been a primary choice for investors because they offer long-term value growth with a relatively more measurable level of risk [5]. Meanwhile, exchange-traded fund (ETF)-based mutual funds, such as Invesco QQQ, offer the advantages of diversification and professional management, making them often considered instruments with a more moderate risk profile [6].

Several previous studies have analyzed the risk and return performance of investment instruments partially, whether in cryptocurrencies, stocks, or mutual funds. However, most of these studies still focus on a single type of instrument or use a limited time horizon. In addition, research that simultaneously compares cryptocurrencies, conventional stock indices, and ETFs within a uniform analytical framework with an observation period covering extreme market dynamics, such as the COVID-19 pandemic and the global economic recovery phase, is still relatively limited.

Based on this research gap, this study aims to conduct a comparative analysis of risk and return between Bitcoin, the S&P 500 index, and the Invesco QQQ ETF during the 2020–2024 period. This study is expected to provide an empirical contribution to enrich investment literature, particularly regarding the evaluation of risk and return efficiency across asset classes, as well as providing a more comprehensive basis for investors in making investment decisions according to their individual risk profiles.

2. Literature Review and Problem Statement

The relationship between risk and return is a central concept in modern financial theory. According to Modern Portfolio Theory, investors are assumed to be risk-averse and seek to maximize expected return for a given level of risk [2]. Risk is commonly measured using return volatility, while return reflects the compensation received by investors for bearing uncertainty [3]. Empirical studies in traditional financial markets consistently support a positive risk–return trade-off, particularly in equity markets, where higher systematic risk is associated with higher expected returns [5]. These theories provide the theoretical foundation for evaluating investment performance across different asset classes using statistical measures such as average return and standard deviation.

Recent studies have extended risk–return analysis to alternative assets, particularly cryptocurrencies. Several empirical findings suggest that Bitcoin offers significantly higher returns than traditional assets but exhibits extreme volatility, indicating a speculative nature rather than a stable investment instrument [7]. Conversely, other studies argue that Bitcoin may provide diversification benefits when combined with traditional assets due to its low correlation with equity markets [8]. Meanwhile, research on exchange-traded funds (ETFs) highlights their efficiency, diversification advantages, and relatively lower risk compared to individual stocks [9]. However, most previous studies examine these asset classes separately or focus on limited time horizons, resulting in inconsistent conclusions regarding their comparative risk efficiency. Moreover, few studies conduct a simultaneous comparison between cryptocurrencies, stock market indices, and ETFs using a uniform analytical framework over periods of extreme market uncertainty, such as the COVID-19 pandemic and post-pandemic recovery.

Based on the existing literature, several research gaps can be identified. First, prior studies predominantly analyze Bitcoin, equities, or ETFs in isolation, limiting the ability to draw comparative conclusions across asset classes. Second, there is inconsistency in empirical findings regarding whether Bitcoin functions primarily as a speculative asset or as an effective diversification instrument [10]. Third, limited research evaluates the efficiency of risk relative to return using comparable metrics, such as the coefficient of variation, across heterogeneous investment instruments within the same observation period. These gaps indicate the need for a comprehensive and systematic comparison of risk and return characteristics across

cryptocurrency, stock market indices, and ETFs within a single analytical framework. Grounded in the identified research gaps, this study seeks to address the lack of comprehensive empirical evidence comparing the risk and return efficiency of heterogeneous investment instruments. Specifically, despite the growing interest in cryptocurrencies and ETFs, investors and researchers still lack clear guidance regarding how these instruments perform relative to traditional stock market indices when evaluated using consistent risk–return measures over periods of market turbulence. Accordingly, the research problems formulated in this study are as follows:

1. How do the average monthly returns of Bitcoin, the S&P 500 Index, and the Invesco QQQ ETF differ during the period 2020–2024?
2. How does the level of investment risk, measured by the standard deviation of returns, compare across these instruments?
3. Which investment instrument demonstrates the highest risk–return efficiency when evaluated using the coefficient of variation?

To answer these questions, this study employs a quantitative descriptive approach using historical monthly data, with the aim of providing empirical insights that support more informed investment decision-making based on investors' risk profiles.

3. Method

This study uses a descriptive quantitative approach with the aim of analyzing and comparing the risk and return characteristics of three investment instruments representing different asset classes, namely cryptocurrency, the stock market, and exchange-traded fund (ETF)-based mutual funds. A quantitative approach is chosen because it enables objective and systematic measurement of investment performance using historical numerical data, allowing the research findings to be empirically tested and replicated [11] [12]. The descriptive method is used to illustrate the return patterns and risk levels of each investment instrument without examining causal relationships. This approach aligns with the research objective, which is to evaluate the differences and risk–return efficiency among investment instruments based on standardized statistical indicators.

Research Object

The research objects in this study consist of three investment instruments, selected purposively to represent the three main asset categories in the global financial market, namely:

1. Bitcoin (BTC) as a representation of crypto assets, chosen because it has the largest market capitalization and the highest liquidity among other cryptocurrencies.
2. The S&P 500 Index as a representation of conventional stock markets, reflecting the performance of about 500 of the largest publicly traded companies in the United States and often used as a benchmark for global stock market performance.
3. Invesco QQQ ETF as a representation of ETF-based mutual funds, which tracks the Nasdaq-100 Index and reflects the characteristics of a diversified portfolio with high exposure to the technology sector.

The selection of these three instruments aims to enable cross-asset class comparisons with fundamentally different risk and return characteristics.

Types and Sources of Data

The data used in this study is secondary data in the form of monthly closing prices for each investment instrument during the period from January 2020 to December 2024. Monthly data was chosen to reduce

short-term extreme volatility and provide more stable and representative estimates of risk and return. The data sources were obtained from credible online financial sites that are widely used in empirical research, namely:

1. Bitcoin (BTC/USD) prices were obtained from CoinMarketCap and Yahoo Finance.
2. S&P 500 Index data were obtained from Yahoo Finance and the official Standard & Poor's website.
3. Invesco QQQ ETF data were obtained from NASDAQ, Yahoo Finance, and the official Invesco website.

Data Collection Techniques

Data collection was carried out using the documentation method, by downloading historical monthly closing price data from official and reliable sources. The obtained data were then selected and adjusted to have the same observation period, allowing for consistent comparison between instruments. All data were processed using Microsoft Excel software to ensure transparency and ease of replication of statistical calculations.

Data Analysis Techniques

The data analysis in this study was carried out through the following several stages:

1. Monthly Return Calculation

Monthly returns are calculated based on the change in closing prices from the end of the previous month to the end of the current month. The return for each instrument is calculated using the formula:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

for

R_t is the return in period t ,

P_t is the closing price at the end of period t , and

P_{t-1} is the closing price at the end of the previous period.

2. Calculation of Average Monthly Return

The average monthly return is calculated to describe the average level of profit earned by investors during the study period. The average return is calculated using the formula:

$$\bar{R} = \frac{1}{n} \sum_{t=1}^n R_t$$

where n is the number of observation periods.

3. Risk Measurement (Standard Deviation)

Investment risk is measured using the standard deviation of monthly returns, which reflects the level of volatility or deviation of returns from their average value. The standard deviation is calculated using the formula:

$$\sigma = \sqrt{\frac{1}{n} \sum_{t=1}^n (R_t - \bar{R})^2}$$

The larger the standard deviation value, the higher the level of risk inherent in that investment instrument.

4. Coefficient of Variation

To assess risk efficiency in relation to return, this study uses the coefficient of variation (CV), which is calculated using the formula:

$$CV = \frac{\sigma}{\bar{R}}$$

The coefficient of variation indicates the level of risk that an investor must bear for each unit of return earned. Instruments with a lower CV value are considered more efficient in generating returns relative to risk.

Framework for Interpreting Results

The results of the calculations of average return, standard deviation, and coefficient of variation were compared among the three investment instruments to evaluate:

1. The differences in average monthly returns among the instruments.
2. The level of risk inherent in each investment instrument.
3. The risk–return efficiency of each instrument based on the coefficient of variation values.

This analytical framework is used to address the research problem formulation and provide an empirical basis for investors to adjust their investment choices according to their risk profile and financial goals.

4. Results and Discussion

This study aims to compare the performance of three investment instruments, namely Bitcoin, the S&P 500 Index, and the Invesco QQQ ETF, using indicators of average monthly returns and risk measured through standard deviation, as commonly applied in modern portfolio theory [2] [1]. In addition to returns and risk measured by standard deviation, this study also uses the coefficient of variation (CV) to measure the relative risk that investors must bear for each unit of return they obtain. The coefficient of variation is calculated as the ratio between the standard deviation and the average return, and it is commonly used to compare the performance of assets with different levels of return [1] [13].

Monthly Data Return

a. Bitcoin (BTC/USD)

Monthly Bitcoin return data was obtained from reliable sources, covering the period from January 2020 to December 2024. Here is a summary of Bitcoin's monthly returns during that period.

Table 1. The monthly return data of Bitcoin

	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Oct	Nov	Des
2020	29.91	-8.62	-	34.56	9.57	-3.38	24.06	2.74	-	28.04	42.77	46.97
			24.94						7.46			
2021	14.37	36.41	30.11	-1.78	-	-6.09	18.63	13.42	-	39.9	-7.22	-
					35.38				7.02			18.75
2022	-16.71	12.18	5.41	-17.3	-	-37.32	16.95	-	-3.1	5.53	-	-3.65
					15.56			13.99			16.26	
2023	39.83	0.02	23.1	2.73	-6.96	11.97	-4.07	-	3.95	28.51	8.84	12.09
								11.27				
2024	0.61	43.79	16.53	-	11.3	-7.12	3.1	-8.73	7.35	10.89	37.42	-3.23
				14.96								

b. S&P 500 Index

The monthly return data of the S&P 500 Index for the same period are as follows:

Table 2. The monthly return data of the S&P 500 Index

	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nov	Des
2020	-0.59	-8.7	-13.1	16.59	6.11	2.02	5.32	6.45	-4.12	-3.42	9.87	3.02
2021	-1.34	2.14	3.39	4.72	0.29	1.92	2.2	2.63	-4.89	6.68	-0.95	3.55
2022	-5.5	-3.14	3.58	-8.8	0.01	-8.39	9.11	-4.24	-9.34	7.99	5.38	-5.9
2023	6.18	-2.61	3.51	1.46	0.25	6.47	3.11	-1.77	-4.87	-2.2	8.92	4.42

2024	1.59	5.17	3.1	-4.16	4.8	3.47	1.13	2.28	2.02	-0.99	5.73	-2.5
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c. Invesco QQQ ETF

The monthly return data for the Invesco QQQ ETF over the same period is as follows:

Table 3. The monthly return data of the Invesco QQQ ETF

	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nov	Des
2020	2	-5	-7	15	7	4	6	9	-5	-2	11	3
2021	-1	2.5	3	5	0.5	2	2.5	3	-4	7	-1	4
2022	-6	-2	4	-7	0	-6	8	-3	-8	6	4	-4
2023	5	-1.5	3.5	1	0.2	5	2.5	-1	-3	-1.5	7	3.5
2024	1.5	4	2.5	-3	3.5	2.5	1	2	1.5	-0.5	4.5	-2

Descriptive Statistical Calculation

Based on the processing of monthly closing price data during the period from January 2020 to December 2024, the results of descriptive statistical calculations were obtained, reflecting the characteristics of returns and risks of each investment instrument, as presented in Table 4.

Table 4. Summary of Return and Risk Statistics

	Average of Return	Standard Deviation	Coefficient of Variation
Bitcoin	6.21%	19.71%	317.31%
S&P 500	1.08%	5.38%	496.18%
Invesco QQQ ETF	1.43%	4.54%	318.20%

Based on the data analysis, Bitcoin shows the highest average monthly return at 6.21% with the highest level of volatility as well (standard deviation of 19.71%). This finding is consistent with the risk–return trade-off theory in Modern Portfolio Theory, which states that instruments with higher risk tend to offer higher returns as compensation for the uncertainty borne by investors [2]. Therefore, the empirical results of this study support the theoretical framework that Bitcoin falls into the category of high-risk, high-return assets, making it more suitable for investors with an aggressive risk tolerance.

In the S&P 500 index, research results show an average monthly return of 1.08% with relatively lower volatility compared to Bitcoin. However, the high coefficient of variation indicates that the return-to-risk efficiency for this index is relatively low during the study period. This finding can be explained through the efficient market theory and the stock risk factor model proposed by Fama and French [5], where stock returns reflect increased systematic market risk during periods of economic instability. In other words, even though absolute risk is lower, extreme market conditions can suppress return efficiency, so the empirical results of this study are not entirely contradictory but are contextual with respect to the theory.

Meanwhile, the Invesco QQQ ETF shows a more balanced combination of return and risk with a lower coefficient of variation compared to the S&P 500. These results are in line with portfolio diversification theory, which states that combining various assets in a single portfolio can reduce risk without significantly sacrificing returns [2]. Furthermore, these findings support the research results of Elton et al. [6], which state that ETFs can enhance investment efficiency through diversification and cost efficiency. Thus, both theoretically and empirically, QQQ can be categorized as an instrument with a moderate risk–return profile.

Overall, this study shows that the relationship between risk and return is not perfectly linear, but rather influenced by the structural characteristics of each investment instrument. Bitcoin supports the basic assumption of risk-return theory, the S&P 500 index shows performance variations influenced by macroeconomic factors, while ETFs demonstrate how diversification theory works empirically. This

comparison strengthens the contribution of the research in testing the validity of classical financial theory in the context of modern assets and dynamic market conditions.

5. Conclusion

This study provides a comparative analysis of the risk and return of Bitcoin, the S&P 500 index, and the Invesco QQQ ETF, representing crypto assets, equity markets, and index-based investment instruments. The descriptive statistical and risk analysis results demonstrate notable differences in the risk–return characteristics among the three instruments. Bitcoin shows the highest average returns compared to other instruments, but it comes with a very high level of volatility. These findings confirm that Bitcoin is an asset with a high risk–high return profile, consistent with the risk–return trade-off theory in modern finance. The S&P 500 index has a relatively lower level of risk, but it shows less than optimal risk–return efficiency during the study period, particularly under unstable market conditions. Meanwhile, the Invesco QQQ ETF demonstrates a better balance between risk and return, reflecting the effectiveness of portfolio diversification through ETF instruments.

Overall, the results of this study confirm that there is no investment instrument that is absolutely superior, but rather relative advantages that depend on risk characteristics and investment objectives. These findings reinforce the relevance of diversification theory and modern portfolio theory in the context of both traditional assets and modern assets such as cryptocurrencies. Further research is recommended to use a longer observation period, more diverse risk measurement methods, or to include macroeconomic variables in order to gain a more comprehensive understanding of the dynamics of risk and return across investment instruments.

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