



DeFi as a Modern Investment Game Changer: A Comparative Analysis with Stocks and Gold

Vivi Indah Bintari^{✉1}, Deasy Lestary Kusnandar², Risna Amalia Hamzah³

Faculty of Economics and Business, Siliwangi University, Kota Tasikmalaya, Indonesia^{1,2,3}

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Abstract

This study aims to compare the investment performance of Decentralized Finance (DeFi), equities (IHSG), and gold during the 2021–2024 period, which represents a full market cycle characterized by high volatility and economic uncertainty. The research objective is to evaluate differences in return, risk (volatility), risk adjusted performance, and inter asset correlations to assess portfolio diversification potential. A quantitative comparative approach is employed using monthly secondary data, analyzed through descriptive statistics, non-parametric difference tests, and correlation analysis. The findings indicate statistically significant differences among the three investment instruments. Gold demonstrates the highest risk efficiency and consistently performs as a safe haven asset. Equities show moderate stability but relatively lower risk adjusted performance. In contrast, DeFi records the highest average returns, accompanied by extreme volatility and low efficiency. Correlation results reveal a strong positive relationship between gold and equities, while DeFi exhibits significant negative correlations with both assets, indicating diversification potential despite elevated systemic risk. This study concludes that gold remains the most resilient investment asset, equities serve as a balanced growth instrument, and DeFi should be positioned as a high risk speculative asset rather than a core portfolio component.

DeFi sebagai Pengubah Permainan Investasi Modern: Analisis Komparatif dengan Saham dan Emas

Abstrak

Penelitian ini bertujuan untuk membandingkan kinerja investasi Decentralized Finance (DeFi), saham (IHSG), dan emas selama periode 2021–2024, yang merepresentasikan satu siklus pasar penuh dengan karakteristik volatilitas tinggi dan ketidakpastian ekonomi. Tujuan penelitian ini adalah mengevaluasi perbedaan return, risiko (volatilitas), kinerja berbasis risiko, serta korelasi antar aset guna menilai potensi diversifikasi portofolio. Pendekatan kuantitatif komparatif digunakan dengan memanfaatkan data sekunder bulanan yang dianalisis melalui statistik deskriptif, uji beda non parametrik, dan analisis korelasi. Hasil penelitian menunjukkan adanya perbedaan yang signifikan secara statistik di antara ketiga instrumen investasi. Emas memiliki tingkat efisiensi risiko tertinggi dan secara konsisten berperan sebagai aset safe haven. Saham menunjukkan stabilitas moderat, namun memiliki kinerja berbasis risiko yang relatif lebih rendah. Sebaliknya, DeFi mencatatkan rata-rata return tertinggi, tetapi disertai volatilitas ekstrem dan tingkat efisiensi yang rendah. Hasil analisis korelasi menunjukkan hubungan positif yang kuat antara emas dan saham, sementara DeFi memiliki korelasi negatif yang signifikan terhadap kedua aset tersebut, yang mengindikasikan potensi diversifikasi meskipun dengan risiko sistemik yang tinggi. Penelitian ini menyimpulkan bahwa emas tetap menjadi aset investasi yang paling resilien, saham berfungsi sebagai instrumen pertumbuhan yang seimbang, dan DeFi sebaiknya diposisikan sebagai aset spekulatif berisiko tinggi, bukan sebagai komponen utama dalam portofolio investasi.

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[✉]Correspondence Address

Institutional address: Jl Siliwangi No. 24, Kahuripan, Tasikmalaya

Email: vivi.indah@unsil.ac.id

INTRODUCTION

Advances in digital technology have fundamentally transformed the financial services industry, reshaping how investors engage with financial markets. One of the most significant innovations arising from this transformation is Decentralized Finance (DeFi), a blockchain based financial system that enables activities such as lending, asset trading, yield farming, and derivatives transactions without reliance on traditional financial intermediaries through the use of smart contracts (Zetzsche et al., 2023). Since the early 2010s, DeFi has gained increasing attention from global investors due to its promise of high returns, broad accessibility, and operational transparency.

Despite its rapid expansion, the DeFi ecosystem is characterized by substantial volatility and systemic risk. While protocols such as Uniswap, AAVE, and Compound demonstrate the potential of decentralized systems to replicate traditional banking functions (Gudgeon et al., 2022; Böhme, 2023), DeFi remains highly vulnerable to cyberattacks, smart contract failures, liquidity shortages, and regulatory uncertainty (Gkillas et al., 2022; Khalid et al., 2023). These risks differentiate DeFi fundamentally from conventional investment instruments and raise concerns regarding its sustainability as a medium to long term investment asset.

The rapid growth of DeFi is often reflected in the Total Value Locked (TVL), which measures the total value of crypto assets deposited in DeFi protocols. TVL increased sharply during the early expansion phase of the DeFi market, signaling growing global adoption of decentralized financial services (Gkillas et al., 2022). However, this growth has been accompanied by extreme price fluctuations, highlighting the speculative nature of DeFi assets. Compared to traditional assets such as equities and gold, DeFi exhibits far greater short-term volatility, resulting

in higher potential returns but also significantly higher downside risk (Li & Fang, 2022; Yu et al., 2023). To illustrate these contrasting return characteristics, Table 1 presents a comparison of annual returns of the DeFi Index, equities (IHSG), and gold during the 2021–2024 period.

Table 1. Comparison of Returns of the DeFi Index, IHSG, and Gold during the Period 2021–2024

Year	Gold	IHSG	DeFi Index
2021	1%	15%	229%
2022	1%	4%	-80%
2023	12%	6%	27%
2024	28%	-3%	44%

Source: Processed Data (2025)

Table 1 highlights the substantial return volatility of DeFi relative to traditional assets, providing an initial motivation for examining risk efficiency and diversification potential among the three instruments. In contrast, gold and equities remain central components of traditional investment portfolios due to their relatively stable risk profiles and long-established roles in wealth preservation and capital growth. Gold has consistently been recognized as a safe haven asset, particularly during periods of economic instability, inflationary pressure, and geopolitical uncertainty (Sharma & Gupta, 2022; Zhang et al., 2022; Lubis & Santoso, 2023). Equities, while more volatile than gold, offer long term growth potential supported by macroeconomic conditions and corporate performance. These differing characteristics underscore the importance of evaluating not only returns but also risk, risk efficiency, and diversification potential across asset classes.

Beyond return and volatility, risk efficiency plays a critical role in assessing investment performance. Measures such as the Sharpe Ratio and the Coefficient of Variation provide insight into whether returns adequately compensate investors for

the risks undertaken. Although DeFi may generate high returns during certain periods, its extreme volatility often results in weak risk adjusted performance. Conversely, gold typically delivers lower returns but exhibits superior risk efficiency, reinforcing its role as a stabilizing asset within diversified portfolios. Understanding these tradeoffs is essential for effective portfolio optimization and risk management.

Correlation among investment instruments further influences portfolio diversification strategies. Assets with low or negative correlations can reduce overall portfolio risk by offsetting adverse price movements. Empirical evidence suggests that while gold and equities may exhibit positive correlations under certain market conditions, DeFi often behaves differently from traditional assets, offering potential diversification benefits alongside elevated systemic risk. Consequently, examining the interrelationships among DeFi, equities, and gold is crucial for determining optimal asset allocation strategies.

Despite the growing body of literature on cryptocurrencies and traditional financial assets, existing studies largely focus on short observation periods, isolated asset classes, or single performance indicators. Moreover, few studies comprehensively evaluate DeFi alongside conventional investment instruments across different market phases, including periods of rapid expansion, market collapse, recovery, and consolidation. This limitation creates an incomplete understanding of DeFi's relative position within modern portfolio construction.

Addressing this gap, this study aims to compare the investment performance of DeFi, equities (IHSG), and gold over the 2021–2024 period by examining return, risk (volatility), risk adjusted performance, and inter asset correlations. The novelty of this research lies in its integrated comparative framework, which simultaneously evaluates emerging decentralized financial assets and traditional investment

instruments across a full market cycle encompassing boom, bust, recovery, and consolidation phases.

Theoretically, this study contributes to the digital finance and investment management literature by extending comparative asset analysis to DeFi within a holistic risk–return and diversification perspective. Practically, the findings provide insights for investors and policymakers in assessing whether DeFi should be positioned as a speculative asset, a diversification instrument, or a complementary component within adaptive portfolio strategies under conditions of heightened market uncertainty.

METHOD

Research Design

This study uses a quantitative comparative research design to analyze differences in investment performance among Decentralized Finance (DeFi), equities (IHSG), and gold during the 2021–2024 period. The study applies a non experimental approach using secondary time series data to compare return characteristics, risk profiles, risk efficiency, and inter asset relationships.

Data Types, Sources, and Collection

The study uses secondary quantitative data in the form of monthly time series observations from January 2021 to December 2024. DeFi index data are obtained from CoinGecko and DeFiLlama, IHSG data are sourced from Yahoo Finance and Investing.com, and gold price data are collected from the World Gold Council. Monthly closing prices or index values are systematically collected and processed to ensure consistency across instruments.

Population and Sample

The population consists of DeFi, IHSG, and gold price movements during the 2021–2024 period.

This period is selected because it

captures significant market fluctuations that allow a comprehensive comparison of return dynamics, volatility, and diversification patterns across emerging and traditional assets. The sample comprises 48 monthly observations for each investment instrument.

Variables and Operational Definitions

This study evaluates investment performance using four dimensions: return, risk (volatility), risk efficiency, and correlation.

Table 2. Presents the research sample, including the investment instruments, observation period, data frequency, and number of observations.

Instruments	Time Period	Data Frequency	Number of Samples
DeFi	Jan 2021–Dec 2024	Monthly	48 observations
JCI	Jan 2021–Dec 2024	Monthly	48 observations
Gold	Jan 2021–Dec 2024	Monthly	48 observations

Source: Processed Data (2025)

Table 3. Provides the operational definitions of variables, measurement indicators, data sources, and analytical techniques

No	Variable	Sub Variable /Indicator	Operational Definition	Unit of Measurement /Scale	Data Source	Analytical Techniques
1	Return on Investment	Average monthly log return	The percentage of profit or loss on the investment in a given period of time	Ratio	CoinGecko, Yahoo Finance, WGC	Descriptive statistics, ANOVA/Kruskal-Wallis
2	Risk (Volatility)	Standard Deviation return	The rate of deviation of the return value from the average return	Ratio	CoinGecko, Yahoo Finance, WGC	Descriptive statistics, CV, ANOVA
3	Risk Efficiency	Sharpe Ratio	Relative return to risk ratio using risk free rate	Ratio	Return Data + BI Rate/SBN	Sharpe Ratio Formula
		Coefficient of Variation (CV)	Ratio between standard deviation and average return	Ratio	Processed Return Results	CV Formula
4	Correlation	Return Correlation between instruments	Linear relationship between DeFi returns, stocks, and gold	Value -1 to +1	Return Data	Pearson/Spearman Correlation

Source: Processed Data (2025)

Return is measured using average monthly returns, risk is measured by the standard deviation of returns, risk efficiency is assessed using the Sharpe Ratio and the Coefficient of Variation, and correlation is measured to evaluate diversification potential. The operational definitions, measurement scales, data sources, and analytical techniques for each variable.

Data Analysis Techniques

Data analysis follows a structured sequence. First, descriptive statistics summarize the distribution and characteristics of returns for each instrument. Second, normality and variance homogeneity tests determine the appropriate inferential approach. Third, because the data do not satisfy parametric assumptions, the Kruskal–Wallis test is applied to examine differences in return, risk, and risk efficiency across instruments, followed by Dunn’s post hoc test for pairwise comparisons. Finally, Spearman’s rank correlation analysis evaluates inter asset relationships to assess portfolio diversification potential.

RESULT AND DISCUSSION

This study is also adding the analysis of the characteristics of gold, equities (IHSG), and DeFi from the year (2021–2024) based on empirical research as the first section from the chapter of the research results and discusses the descriptive

analysis of the data. Regarding the information, from the central tendency of the data i.e. the minimum, maximum, average, and standard deviation will be presented as the first information about the data which will be used to carry out the inferential analysis and other analyses from the data.

After this stage, risk analysis and efficiency of risk analysis and correlation of risk will be discussed as well as the data from DeFi concerning other traditional assets in the market. There will also be data of other traditional assets in the market to determine the level of portfolio diversification as well as the data of risk in other traditional assets in the market.

Descriptive statistics

Descriptive statistics are presented to provide an overview of the fundamental characteristics of the data used in this study. This analysis summarizes the distribution and variability of gold, equities (IHSG), and DeFi over the period 2021–2024. Key indicators, including the minimum, maximum, mean, and standard deviation, are employed to highlight the central tendency and dispersion of each variable. These measures serve as a basis for understanding the comparative behavior of the three investment instruments before proceeding to inferential statistical testing.

Table 4. Descriptive Statistics of Gold, IHSG, and DeFi Index (Monthly, 2021–2024)

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Gold	48				1.086.437.5000	186.872.912.36
Stock	48	5.497.46	7.670.73	327.796.80	6.829.1000	476.773.38
DeFi	48	56.90	523.17	8.645.52	180.1150	150.173.01
Valid N (listwise)	48					

Source: Processed Data (2025)

Based on Table 4, the lowest price of gold recorded was IDR 911.000 and the highest was IDR 1.567.000. With the average being IDR 1.086.437.50 and a standard deviation of IDR 186.872.91, it is clear that out of the price range, the average was higher. This shows that although the price of the gold fluctuated quite a bit, the asset was still above average. This shows that gold is priced fairly high, which is expected from a safe haven asset, especially during times of global instability.

Equities (IHSG) had a minimum of 5.497.46, and a maximum of 7.670.73. The average among them was 6.829.10, with a standard deviation of 476.77. Equities had moderate volatility. This shows that among the 3 of them, equities were the most sensitive to macroeconomic, and policy factors. However, they still appear to be more stable than the other 2, which are digital assets.

Unlike the rest, DeFi exhibited qualitatively different phenomena. The Index fluctuated between 56.90 and 523.17, averaging 180.12 and standard deviation of 150.17. It showed extreme volatility as evidenced by the large standard deviation, as it deviated almost as much as the mean. It stands to strengthen the notion of DeFi as

an asset class with extreme volatility and profitability compared to traditional ones, due to the presence of significant price swings and the high probability of generating returns.

All in all, the findings or the results clearly distinguished the three different asset or investment instruments, where gold is seen to offer a low risk with safety, equities offering a moderate risk with some volatility, and DeFi presenting a very high risk and high profitability.

In the analysis moving forward with the given descriptive statistics, some of the variability in the data is examined, and in particular the tests of normality and homogeneity of variance are examined to identify the most appropriate statistical techniques that will be useful in comparing the three investing instruments.

Residual Distribution Analysis

The normality of return data is examined to assess whether the distributions of gold, equities (Indonesia Stock Exchange Composite Index/IHSG), and the DeFi Index conform to a normal distribution and to determine the appropriate inferential approach.

Table 5. Skewness and Kurtosis Value

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Unstandardized Residual	48	0.532	0.343	0.298	0.674
Valid N (listwise)	48				

Source: Processed Data (2025)

Tabel 5. shows a skewness value of 0.532 with a standard error of 0.343. Since this value falls within the acceptable threshold of ± 2 , the residual distribution can be interpreted as having a slight positive skewness but still approximating symmetry. Furthermore, the kurtosis value of 0.298 with a standard error of 0.674 also lies within the ± 2 range, indicating that the residuals are close to a normal distribution, albeit with a tendency toward platykurtosis (a flatter distribution compared

to a perfectly normal curve).

Overall, these results suggest that the residuals of the research model are approximately normally distributed. Therefore, the normality assumption one of the key prerequisites for regression analysis can be considered satisfied. This provides a strong basis for further analysis, as normally distributed residuals enhance the validity of the statistical inferences drawn from the model.

Table 6. Tests of Normality for Gold, IHSG, and DeFi Index

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Gold	0.203	48	0.000	0.808	48	0.000
Stock	0.154	48	0.006	0.934	48	0.009
DeFi	0.279	48	0.000	0.736	48	0.000

a. Lilliefors Significance Correction

Source: Processed Data (2025)

Normality Test

Based on table 6, normality testing is required to determine the appropriate type of inferential statistical analysis to be applied in the subsequent stage. In this study, the Shapiro–Wilk test was employed as the primary method, given the sample size of fewer than 50 observations. The results of the test provide the basis for selecting between parametric and non-parametric approaches in the hypothesis testing process. The normality test results indicate that the return distributions of gold, equities (Indonesia Stock Exchange Composite Index/IHSG), and the DeFi Index deviate from a normal distribution, as all significance values fall below the 0.05 threshold. This finding suggests that the assumption of normality required for parametric statistical tests is not satisfied.

Given the violation of the normality assumption, non-parametric statistical methods are employed for subsequent analyses. In addition, a homogeneity of variance test is conducted to further assess the suitability of parametric approaches. The outcomes of these assumption tests collectively support the use of non-parametric techniques, such as the Kruskal–Wallis test, for comparing the performance and risk characteristics across the three investment instruments.

Given that the assumptions of normality and homogeneity of variance are not fully met, parametric methods are not appropriate. Therefore, the analysis proceeds using non parametric statistical techniques.

Table 7. Test of Homogeneity of Variance for Gold, Equities, and DeFi

		Levene Statistic	df1	df2	Sig.
Gold	Based on Mean	13.274	3	44	0.000
	Based on Median	12.770	3	44	0.000
	Based on Median and with adjusted df	12.770	3	14.466	0.000
	Based on trimmed mean	13.270	3	44	0.000
Stock	Based on Mean	1.968	3	44	0.133
	Based on Median	1.863	3	44	0.150
	Based on Median and with adjusted df	1.863	3	35.077	0.154
	Based on trimmed mean	2.043	3	44	0.122
DeFi	Based on Mean	19.947	3	44	0.000
	Based on Median	13.110	3	44	0.000
	Based on Median and with adjusted df	13.110	3	22.511	0.000
	Based on trimmed mean	18.477	3	44	0.000

Source: Processed Data (2025)

Variance Homogeneity Test

The homogeneity of variance test is conducted to examine whether return variances across gold, equities (Indonesia Stock Exchange Composite Index/IHSG), and the DeFi Index are equal. The results of Levene’s Test indicate that variance homogeneity is violated for gold and the DeFi Index, while IHSG satisfies the homogeneity assumption.

Based on Levene’s test results presented in Table 7, variance homogeneity is not satisfied for gold and the DeFi Index, as their significance values fall below the 0.05 threshold. In contrast, equities represented by the Indonesia Stock Exchange Composite Index (IHSG) exhibit homogeneous variance, indicating that variance equality is violated for the majority of the variables examined.

Combined with the earlier normality test results, these findings indicate that the assumptions required for parametric statistical techniques are not fully met. Therefore, the analysis adopts a non-parametric approach using the Kruskal–Wallis test to compare the performance and risk characteristics of gold, IHSG, and the DeFi Index.

Comparative Test of Performance and Risk

Differences in performance and risk among gold, IHSG, and the DeFi Index are examined using the Kruskal–Wallis test. The results reveal statistically significant differences across the three investment instruments.

Table 8. Kruskal–Wallis Test Statistics

Test Statistics ^{a,b}	Value
Kruskal-Wallis H	127.124
df	2
Asymp. Sig.	0.000

a. Kruskal Wallis Test

b. Grouping Variable: Investment

Source: Processed Data (2025)

The Kruskal–Wallis test results presented in Table 8 indicate statistically significant differences among gold, equities (Indonesia Stock Exchange Composite Index/IHSG), and the DeFi Index (Asymp. Sig. <0.05). These findings demonstrate that the three investment instruments exhibit fundamentally different distributional characteristics, thereby justifying further post hoc analysis to identify specific pairwise differences.

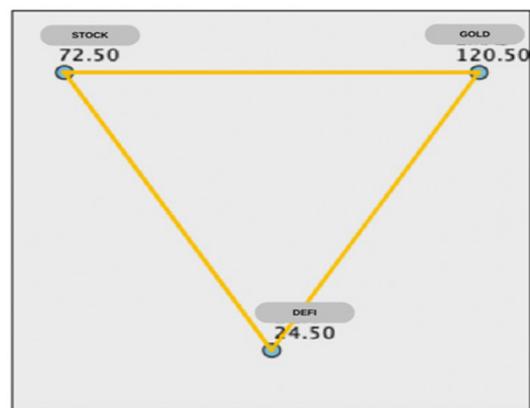


Figure 1. Pairwise Comparison and Investment

Source: Processed Data (2025)

The pairwise comparison results shown in Figure 1 provide further evidence of statistically significant differences among the three investment instruments. Gold records the highest mean rank, followed by equities (Indonesia Stock Exchange Composite Index/IHSG), while the DeFi Index exhibits the lowest mean rank, indicating distinct performance and risk profiles across assets.

These findings suggest that gold demonstrates the most stable and risk efficient performance, equities occupy an intermediate position with moderate risk and growth potential, and DeFi reflects a high risk, speculative investment profile.

The ranking pattern supports the role of asset diversification, where combining traditional and digital assets allows investors to manage varying levels of risk and return.

Table 9. Dunn’s Post hoc Test

Comparison	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
DeFi–Equities	48.000	8.514	5.637	0.000	0.000
DeFi–Gold	96.000	8.514	11.275	0.000	0.000
Equities–Gold	48.000	8.514	5.637	0.000	0.000

Source: Processed Data (2025)

The results of Dunn’s post hoc test presented in Table 9 confirm that all pairwise comparisons among gold, equities (Indonesia Stock Exchange Composite Index/IHSG), and the DeFi Index are statistically significant at the 5% level. These findings indicate that each investment instrument differs meaningfully from the others in terms of performance and risk characteristics.

The largest divergence is observed between the DeFi Index and gold, highlighting the contrast between a highly volatile digital asset and a traditional safe haven instrument. Equities occupy an intermediate position between gold and DeFi, reflecting moderate risk and growth potential. Overall, the post hoc results reinforce the need for strategic portfolio diversification across assets with distinct risk–return profiles.

Figure 2. illustrates the mean rank comparison derived from Dunn’s test, showing that gold records the highest mean rank, followed by equities (Indonesia Stock Exchange Composite Index/IHSG), while the DeFi Index exhibits the

lowest mean rank. This ranking pattern indicates that gold demonstrates the most stable and risk efficient performance, equities occupy an intermediate position, and DeFi reflects the highest volatility and risk profile. Risk and risk efficiency are further evaluated using the standard deviation of returns, the Sharpe Ratio, and the Coefficient of Variation (CV) to assess how each investment instrument compensates investors for the risks undertaken Correlation Analysis Among Instruments.

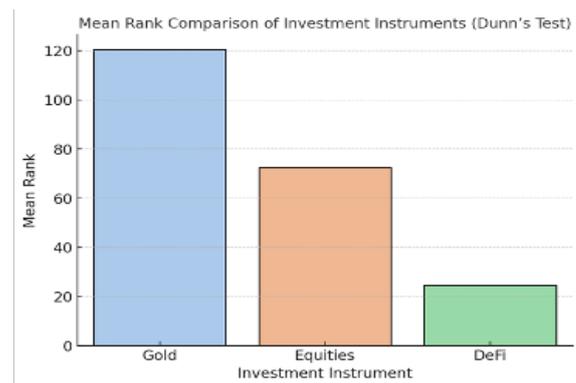


Figure 2. Visualization Of Mean Ranks from Dunn’s Test in Bar Chart

Source: Processed Data (2025)

Table 10. Correlations

			Gold	Stock	DeFi
Spearman’s rho	Gold	Correlation Coefficient	1.000	0.714**	-0.532**
		Sig. (2-tailed)	00.000	0.000	0.000
		N	48	48	48
		Correlation Coefficient	0.714**	1.000	-0.441**
		Sig. (2-tailed)	0.000	0.000	0.002
		N	48	48	48
DeFi		Correlation Coefficient	-0.0532**	-0.0441**	1.000
		Sig. (2-tailed)	0.000	0.002	0.000
		N	48	48	48

Source: Processed Data (2025)

The Spearman correlation analysis reveals statistically significant relationships among gold, equities (Indonesia Stock Exchange Composite Index/IHSG), and the DeFi Index. Gold and equities exhibit a strong positive correlation ($\rho=0.714$, $p<0.01$), indicating that movements in gold prices tend to align closely with those of the equity market. In contrast, gold and the DeFi Index show a moderately strong and significant negative correlation ($\rho=-0.532$, $p<0.01$), suggesting that increases in gold prices are generally associated with declines in DeFi values.

Similarly, equities and the DeFi Index display a moderate negative correlation ($\rho=-0.441$, $p<0.01$), implying that equity market gains tend to coincide with weaker DeFi performance. Overall, these findings confirm distinct relational patterns among the three instruments: gold and equities move in the same direction, while DeFi behaves inversely relative to both. This pattern highlights the potential role of DeFi as an alternative asset for portfolio diversification, although its inverse relationship with traditional assets is accompanied by elevated risk.

Discussion

Comparative Performance of DeFi, Equities, and Gold (2021–2024)

This study sheds light on specific performance patterns of DeFi, equities, and gold across different phases of economic turmoil and relative stability within the time frame of 2021–2024. Results show that gold outperformed all the other financial instruments across all sub periods, equities come second, and gold showed the worst performance. These results seem to indicate that gold remains the most optimal safe haven asset, providing and preserving capital to investors during times of economic and political turmoil (including the COVID-19 pandemic, followed by inflation and geopolitical disturbances).

The poor performance of DeFi is

linked to the general unpredictability of the cryptocurrency markets and the lack of comprehensive regulation. As Baur and Hoang point out, the extreme fluctuations within the market means that cryptocurrency cannot effectively act as a hedge. The DeFi sector in particular bears the brunt of negative publicity arising from system breakdowns, hacking, and the loss of liquidity, which results in a loss of confidence in the market. As a result, DeFi may have a great potential for short-term returns, but offers little in terms of the security of the investment or its long term viability, especially in times of economic turmoil.

While they are also subject to macroeconomic headwinds, equities are more stable than DeFi, albeit inflation and subsequent shifts in monetary policy increase volatility in equity markets. In contrast, more stable macroeconomic conditions increase equity market attractiveness due to the focus on corporate fundamentals and consumer spending. This empirically supports equities as being more growth centric in more stable economic periods (Corbet et al., 2022).

Similar to previous studies, gold still operates as a safe haven in recessionary and expansionary periods. Increased financial stress and inflation within the study period illustrates gold's wealth preservation, contributing to a decrease in portfolio risk (Reboredo, 2013). This study still provides evidence to support gold as a prime investment option during economic turmoil.

In conclusion, DeFi is a major financial innovation with structural risks that primarily include tech, regulation, and liquidity, that limit how safe DeFi is as an investment. Ante (2021) points out the critical weakness of smart contract risks, while Khalaf et al. (2023) point out the lack of regulation and poor liquidity to compel investment. Overall, DeFi may provide some speculative return in stable

periods, but in distressed periods, it is less effective than equities and gold which are more liquid, robust, and safe.

Risk and Volatility of DeFi Compared to Equities and Gold

The analysis covers different possible investment instruments, focusing primarily on the different patterns of risk and volatility over the period of economic uncertainty, and the subsequent period of relative economic stability (2021–2024). Out of the three instruments, gold has the highest average price, and the highest price dispersion and range, reflecting greater price volatility. Gold price volatility, however, is driven by the gold price fundamentals and long term gold investor confidence. Gold continues to be a safe haven investment and a store of value especially in times of economic uncertainty such as during the Covid 19 pandemic, the subsequent geopolitical uncertainty and inflation shocks.

On the other end of the risk spectrum is the DeFi Index, which is why the investment risk is highest in the DeFi Index, even though the price changes in the DeFi Index may be perceived to be moderate (or smaller than other price changes). What is often missed is the underlying price volatility of the DeFi Index. Such high measured volatility makes the risk of the DeFi ecosystem highly structural. During 2021-2024 the DeFi system was highly characterized by unidirectional growth in decentralised finance (DeFi) projects, followed by a sharp contraction. Such unidirectional growth and contraction was driven by protocol failures, hack attacks, liquidity crises, collapse of major platforms, etc. These highly impacting aspects of the DeFi ecosystem created a high risk of investment and a low trust in the DeFi market. As noted by Baur and Hoang (2021a): the high volatility of the market makes DeFi lose the ability to perform effective hedging, and low the DeFi market

during the high economic uncertainty despite offering high returns in the short run.

Investments such as the Indonesia Stock Exchange Composite Index (IHSG) have performed adequately over the years when compared to other indexes worldwide considering the volatility and risk associated with them. Focused on the fundamentals of the economy with the potential for corporate growth, the indexes remained stable under the pressure of the pandemic, inflation, and slow growth monetary expansion. Corbet and the other 2022 authors support the case that even though the indexes are sensitive to the economy, the potential for growth risk & returns are far greater when compared to the digital markets, especially with stable economic growth.

The world creates a demand for gold. Investors constantly see gold as a safe haven as it has remained and will continue to be used as a unifying store of value for countless cultures, and economic designs. Gold has provides better overall wealth preservation and risk management. When inflation and geopolitical tensions increase, gold remains the better protector. Gold provides the better hedge and to validate the authors, Renboredo 2013b is better associated with gold than with the economic indicators.

The structural risks of DeFi are a stark contrast to equities and gold. Ante (2021) emphasizes smart contract design risks, and Khalaf et al. (2023) highlight the confidence impact of structural liquidity, uncertainty, and regulation issues. These can be synthesized to demonstrate a clear ranking of safety and risk in investment: gold has the greatest safety, equities are economically risky, and DeFi offers extreme systemic risk. Therefore, gold and equities should be the core of investments in any economy, while DeFi can be a speculative play for stable, high risk investing, particularly when the economy is stable, not in a crisis.

Risk Efficiency of DeFi, Equities and Gold Measured by Sharpe Ratio and Coefficient of Variation

Among the three instruments, gold consistently offers the best risk return trade off. Being the only asset with a positive Sharpe ratio means it has positive excess returns, and coupled with the lowest coefficient of variation, means it has the lowest risk and highest return. This demonstrates good return consistency with low risk and reinforces gold's safe haven asset status in times of economic turmoil. This was evident in the Covid period and when inflation and geopolitical tensions rose in 2021-2024.

During the period, equities, in this case, the Indonesia Stock Exchange Composite Index (IHSG), demonstrated higher risk inefficiency. The negative Sharpe ratio implies insufficient returns for the risks taken, and the high coefficient of variation denotes high risk. This was the case in post pandemic recovery dynamics, when equity markets were highly susceptible to external shocks like increased global interest rates and inflation. Despite the temporariness of the external economic shocks, equities have consistently been good growth assets, given their association with real economic growth and corporate fundamental improvements, especially in the long term.

Decentralized Finance (DeFi) offers a unique, almost contradictory risk and efficiency profile. The DeFi asset drives the highest returns relative to the other assets, yet also has the highest risk, as demonstrated by the extremely elevated standard deviation from the mean. Coefficient variation (CV) is the highest for the DeFi index as well. While the DeFi index has a positive Sharpe ratio relative to the other indexes, the risk adjusted returns relative to gold (which DeFi underperformed) implies that there are excess returns from DeFi, however, gold provides a more stable return. The extremely high risk is indicative of the DeFi sector's risk stemming from bugs in smart contracts, hacking,

regulatory uncertainty, market sentiment uncertainty, sentiment driven volatility, and macroeconomic driven volatility, all of which were pronounced in the later economically unstable phases of the period of study.

The current results are consistent with the established literature that describes gold as a proven asset for risk mitigation (Reboredo, 2013; Corbet et al., 2022), while noting that the lack of safe haven properties of the assets of cryptocurrencies and DeFi are attributed to the excessive volatility and structural risks involved (Ante, 2021; Baur & Hoang, 2021b; Khalaf et al., 2023). From an empirical investment strategy viewpoint, the results imply that gold should be the centerpiece of portfolios when the economy is in an unstable state because of its optimum risk and safety attributes. Equities are still great for medium to long term growth when the economy is stabilizing and DeFi can be a speculative asset with a high risk in the investments; however, that must be managed actively and it will only be appropriate for a smaller portion of the investors, especially those with a higher risk appetite.

Correlation Between DeFi, Equities and Gold in the Context of Portfolio Diversification

The findings show that there is a positive correlation between prices of gold and prices of equities. Increases in gold prices tend to drive increases in equities. Such movements suggest that gold and equities are driven by the same higher order macroeconomic fundamental; these include inflation, interest rates, and global investor sentiment. The Direct correlation means, from the perspective of portfolio diversification, risk reduction from holding a combined position in gold and equities is in fact limited, especially in systemic shock events, when both gold and equities are likely to behave the same way and hence show the same directional movements.

However, simply because gold and equities the same movement in prices does not mean that they both serve the same purpose. Gold is a safe haven asset, the investor's values are preserved when uncertainty in the economy increases. Equities, on the other hand, are a reflection of increases in the aggregate economic activity and the corresponding performance of the underlying companies of the equity. Equities are meant to provide economic growth in a given period. Moreover, these provide a protective buffer. The deterioration of macroeconomic factors, typified by the COVID-19, inflation, and the geopolitical tension, between 2021-2024, is a situation when the potential of gold holding to provide diversification is diminished especially when the equities are driven by the same fundamental (Reboredo, 2013).

The negative correlations between DeFi and both gold and equities suggest possible diversification benefits. An inverse relationship means DeFi tends to behave differently from traditional assets, which, theoretically, decreases portfolio volatility. In modern portfolio theory, negative correlations are said to enhance diversification, especially in times of market calm when non traditional instruments may outperform traditional ones.

The volatility and security concerns, however, limit the diversification advantages DeFi can provide. DeFi's price changes are influenced by speculation, failing protocols, and unproven smart contracts and, as Ante (2021) explains, the design of some smart contracts contains systemic risks that worsen the downside, especially in bad economic times. Because of this, more unstable economic times, including crises like the COVID-19 pandemic, make DeFi's volatility likely to carry more diversification costs and, in fact, increase overall portfolio risk.

These results indicate that DeFi can be incorporated, if at all, with caution and only by investors willing to take the risk. Due to their historical stability and secu-

rity, gold and equities are the main building blocks of a portfolio, and DeFi can be treated as a secondary asset to hold. This aligns with Baur and Hoang (2021a), who, despite the low correlation of cryptocurrencies with traditional assets, argue that high volatility means that, for the long term, they cannot be relied on to hedge anything.

In summary, the correlation analysis provides further confirmation that portfolio construction must be aligned with the current economic environment. In times of uncertainty, the focus must be on security and the preservation of capital, which means gold and defensive equities with long term growth are a must, while in more favourable periods, the addition of high risk, potentially high reward equities can be justified, as long as it is closely managed.

CONCLUSION AND RECOMMENDATION

This study provides a comparative assessment of Decentralized Finance (DeFi), equities (Indonesia Stock Exchange Composite Index/IHSG), and gold over the 2021–2024 period by examining performance, volatility, risk adjusted efficiency, and inter asset correlations under both unstable (COVID-19 and post pandemic shocks) and relatively stable economic conditions. The findings indicate that gold consistently exhibits the highest resilience and risk adjusted efficiency, confirming its role as a safe haven asset during periods of economic instability, while equities offer moderate returns with intermediate risk characteristics, making them suitable for long term portfolio growth. In contrast, DeFi delivers the highest average returns but is accompanied by extreme volatility, low risk efficiency, and substantial systemic and security risks, positioning it as a speculative rather than core investment. The positive correlation between gold and equities limits diversification benefits,

whereas DeFi's negative correlation with traditional assets offers diversification potential that is constrained by its high volatility. The main contribution of this study lies in extending comparative asset performance analysis to include DeFi alongside traditional assets across different economic regimes, highlighting the conditional role of DeFi in portfolio construction. From a practical perspective, the results recommend gold and equities as foundational assets in portfolios under both stable and unstable conditions, while DeFi should be allocated selectively by investors with high risk tolerance. Future research may develop dynamic portfolio optimization models incorporating DeFi, examine regime switching behavior across economic cycles, and explore regulatory and security factors that influence the long term sustainability of DeFi as an investment asset.

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