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Financial Innovation and Sharia Governance: An Empirical Study of Cryptocurrencies and Traditional Banking Risk–Return Dynamics in Indonesia

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Abstract: *This study investigates the risk–return dynamics of Bitcoin and Ethereum compared with traditional fixed-term bank deposits in Indonesia between 2020 and 2024. Using historical daily price data and interest rates, the research calculates annualized returns, volatility, and Sharpe Ratios to assess performance. Results show that cryptocurrencies offer extraordinary potential returns during bullish cycles but also suffer severe downturns, making them suitable only for high-risk, long-term investors. Bank deposits, in contrast, provide stable yet modest returns, reinforced by Indonesia Deposit Insurance Corporation (LPS) guarantees. From a Sharia perspective, bank deposits are problematic due to their riba-based structure, while cryptocurrencies raise concerns over gharar and maysir. The study highlights the rise of Sharia-compliant alternatives such as sukuk and gold-backed digital currencies as ethical solutions. The contribution lies in bridging financial economics with Islamic governance by comparing conventional, digital, and Sharia instruments in the Indonesian context. Future research should extend to investor behavior, transaction costs, and the regulatory role of OJK and DSN-MUI in shaping Islamic fintech.*

Introduction

The rise of cryptocurrencies over the past decade has disrupted traditional financial systems and sparked global discussions around their role as alternative investments. Bitcoin, launched in 2009 by the pseudonymous Satoshi Nakamoto, was envisioned as a decentralized form of money, independent of central banks and governments (Nakamoto, 2008). Ethereum, introduced in 2015 by Vitalik Buterin, expanded this vision by enabling programmable smart contracts, further broadening the utility of blockchain technology (Buterin, 2014).

Globally, cryptocurrencies have gained attention for their potential to democratize finance, improve transaction transparency, and reduce reliance on centralized financial institutions (Catalini & Gans, 2016; Tapscott & Tapscott, 2017). In emerging markets like Indonesia, where banking infrastructure and financial access can be uneven, the appeal of decentralized finance (DeFi) and crypto-based services has been particularly strong (World Bank, 2022).

In Indonesia, the adoption of cryptocurrencies has surged in recent years, driven by growing digital literacy, mobile internet access, and a desire for higher-yielding investment options. According to Bappebti (2023), the number of registered crypto investors in Indonesia surpassed 17 million by mid-2023. A 2021 study by the Indonesian Blockchain Association and Tokocrypto also highlighted the increasing interest of young, tech-savvy Indonesians in digital assets as an alternative to conventional savings products (Tokocrypto & ABI, 2021).

Despite this growth, traditional bank deposits continue to dominate the savings landscape, being perceived as secure and stable, especially among older and risk-averse populations. Traditional banking products in Indonesia, such as time deposits (Deposito Berjangka), offer fixed interest rates with negligible risk and are protected under the Indonesia Deposit Insurance Corporation (LPS). On the other hand, cryptocurrency investments are highly volatile and speculative, with no insurance mechanisms in place. While the potential for high returns exists, it comes with considerable risk (Yermack, 2013).

For Muslim investors, these developments raise fundamental questions about Sharia compliance. Islam prohibits riba (interest), gharar (excessive uncertainty), and maysir (gambling). Deposits involve riba, while crypto assets are associated with gharar and speculation. This ambiguity makes it crucial to assess the financial and ethical performance of both instruments in Indonesia. While prior studies have examined crypto risk–return profiles or savings behavior separately, few have compared them directly in the Indonesian and Islamic finance context. Therefore, the research questions posed are as follows:

1. How do Bitcoin and Ethereum compare with fixed-term deposits in terms of return, volatility, and risk-adjusted performance?
2. To what extent are these instruments consistent with Islamic financial principles?
3. What implications arise for investors and policymakers in Indonesia?

By answering these questions, this study contributes to literature on risk–return tradeoffs, financial inclusion, and Sharia governance in emerging markets.

Literature Review

A substantial body of research has delved into the risk-return profile and volatility dynamics of cryptocurrencies, particularly Bitcoin and Ethereum. These digital assets are known for their extreme price fluctuations, which differentiate them significantly from traditional financial instruments. Baur and Dimpfl (2018) highlighted that cryptocurrencies, especially Bitcoin, demonstrate asymmetric volatility, where large price swings—both upward and downward—occur with minimal predictability. This characteristic makes them appealing to speculative investors but raises caution for risk-averse participants.

Adding to the discussion, Dyhrberg (2016) argued that Bitcoin possesses hybrid qualities, exhibiting behavioral patterns akin to both gold and fiat currencies. She suggested that under certain economic conditions, Bitcoin can act as a hedging instrument, similar to how investors might use gold during periods of financial uncertainty. This duality has sparked interest among portfolio managers exploring diversification strategies in the digital asset space.

Furthermore, Corbet, Lucey, and Yarovaya (2018) identified clear episodes of speculative bubbles within the price trajectories of both Bitcoin and Ethereum. Their analysis cautioned that these assets often diverge from traditional macroeconomic indicators, such as inflation, interest rates, and GDP growth, making their behavior difficult to interpret using conventional financial models. This detachment raises concerns for policymakers and regulators, especially in emerging markets where investor protection frameworks may not yet be fully developed.

From an Islamic finance perspective, cryptocurrencies present a complex issue. Scholars are divided on whether digital assets comply with Sharia principles. One major concern is the gharar (excessive uncertainty) and maysir (speculation or gambling) often associated with crypto trading, which are prohibited in Islam (Dusuki & Abdullah, 2007). However, some scholars argue that if cryptocurrencies are used as a medium of exchange and not for speculative purposes, and if they are backed by real utility or assets, they may be considered halal (permissible) (Saba & Noor, 2019). This nuanced view emphasizes the importance of purpose, transparency, and the underlying technology in determining Sharia compliance. Together, these studies underline the complex and often unpredictable nature of cryptocurrency investments. While they offer the potential for high returns, they are accompanied by significant risks, making them a highly debated component in modern portfolio theory, regulatory discourse, and Islamic financial ethics.

Traditional Bank Deposits in Emerging Markets and Islamic Banking Traditional banking instruments, particularly time or term deposits, remain a cornerstone of financial systems in emerging markets. These products are especially significant in developing economies where financial literacy and access to complex investment tools may be limited. Claessens and van Horen (2015) emphasized the pivotal role of bank deposits in fostering economic development, stating that they not only provide low-risk returns but also promote financial inclusion by offering accessible savings mechanisms for a broad population segment. This accessibility enables households to build a financial cushion, contributing to both individual resilience and broader economic stability.

In the specific context of Indonesia, Pratama and Sari (2020) conducted an empirical investigation into household saving behaviors and highlighted a strong preference for term deposits among middle-income groups. Their findings revealed that this preference is largely driven by the government-backed deposit insurance scheme and the predictability of returns, which offer a sense of security in uncertain economic conditions. Term deposits, by offering fixed interest rates and principal protection, serve as a reliable savings vehicle for households that are cautious about market-linked volatility. Moreover, the importance of deposits in emerging economies extends beyond household finance. They provide banks with a stable

funding base, enabling financial institutions to extend credit, manage liquidity, and maintain overall systemic stability (Demirgüç-Kunt et al., 2015). This stability becomes especially crucial during periods of economic stress, when public confidence in financial institutions can be fragile.

In the realm of Islamic finance, conventional interest-bearing deposits (riba-based) are not compliant with Sharia law. Instead, Islamic banks offer alternatives such as mudarabah (profit-sharing) or wadiah (safekeeping) contracts, where returns are derived from profit generated by Sharia-compliant investments rather than fixed interest. These structures promote fairness and risk-sharing, aligning with ethical principles central to Islamic finance (El-Gamal, 2006). As such, Islamic deposits not only preserve capital but also uphold socio-religious obligations, making them a favored option among observant Muslim communities. Overall, while the allure of high-yield, high-risk instruments such as cryptocurrencies grows, traditional and Islamic bank deposits continue to play an indispensable role in safeguarding wealth and supporting the development of inclusive, ethical, and resilient financial ecosystems in emerging markets.

Comparative and Local Studies Despite the rapid rise of cryptocurrency adoption and digital finance trends globally, there remains a limited body of comparative research directly analyzing crypto investments versus traditional bank deposits in the Indonesian context. Most studies tend to focus on either asset class in isolation, leaving a gap in understanding how these financial choices interact within the behavior of local investors. Gunawan and Putra (2022), in their qualitative study of Indonesian retail investors, observed that cryptocurrencies are often perceived more as speculative instruments than as vehicles for long-term wealth accumulation or financial planning. Their findings highlighted that many investors were motivated by the prospect of short-term profits, influenced heavily by online trends and social media hype, rather than a comprehensive understanding of blockchain technology or market fundamentals.

Raharjo and Wardhana (2021) added another layer by evaluating the regulatory environment surrounding crypto assets in Indonesia. They pointed out ambiguities in asset classification, noting that cryptocurrencies straddle the line between being treated as commodities and financial instruments, which complicates both taxation and consumer protection measures. The authors stressed the importance of clearer policy direction and targeted investor education, especially as interest in digital assets continues to rise among younger, tech-savvy Indonesians. This is particularly relevant in a country where the population is highly active online but may lack robust financial literacy in emerging asset classes.

Adding the Islamic dimension, there is a growing need for fatwas and scholarly engagement on the use of cryptocurrencies, particularly in Indonesia, which has the world's largest Muslim population. In 2021, the Indonesian Ulema Council (Majelis Ulama Indonesia, MUI) issued a fatwa declaring cryptocurrency as haram due to its speculative nature and potential for harm (MUI, 2021). However, this stance remains subject to debate, as other Islamic scholars and institutions globally have expressed more nuanced or favorable interpretations. The diverse opinions reflect the evolving nature of digital finance and the need for continuous jurisprudential engagement.

Together, these studies emphasize the urgent need for more empirical, data-driven research that considers not just macroeconomic indicators but also cultural, behavioral, regulatory, and religious factors unique to Indonesia. A comparative framework that evaluates risk perception, return expectations, trust in financial institutions versus decentralized technologies, and Sharia compliance would help inform both policy-making and financial education efforts. Such insights could also support investors in making more balanced and informed decisions between high-risk, high-return crypto assets and the stable, insured, and religiously permissible options offered by conventional and Islamic bank products.

Methods

A quantitative approach is applied using historical data from January 2020 to December 2024. Bitcoin and Ethereum daily prices were obtained from CoinMarketCap, while bank deposit interest rates were sourced from Bank Indonesia. The BI 7-Day Reverse Repo Rate is used as the risk-free rate, with sukuk yields considered as Sharia-compliant alternatives.

Formulas applied:

- Daily return = (Pt – Pt-1) / Pt-1
- Annualized return = average daily return × trading days
- Volatility = standard deviation of daily returns × √trading days
- Sharpe Ratio = (Annualized return – Risk-free rate) / Volatility

This framework allows direct comparison of performance across instruments. Additionally, the study integrates Sharia assessment by evaluating instruments against the principles of riba, gharar, and maysir.

Data Collection

For cryptocurrencies, daily closing prices for Bitcoin and Ethereum were obtained from CoinMarketCap, covering the period from January 1, 2020, to December 31, 2024. These two cryptocurrencies were chosen based on their prominence in the market, allowing for a comprehensive comparison. Data on the interest rates for fixed-term bank deposits were collected from official publications by Bank Indonesia for the same period.

Since the study also explores these investments within the context of Islamic finance, a review of the Shariah compliance of cryptocurrencies, as well as traditional bank deposits, is integral. Cryptocurrencies like Bitcoin and Ethereum will be evaluated to determine if they align with the principles of Islamic finance (i.e., prohibition of riba, gharar, and maysir). Similarly, the bank deposits' interest-bearing nature (riba) will be considered in light of Islamic financial ethics. The risk-free rate is represented by the annual yield of Indonesian government bonds, sourced from the Ministry of Finance. For Shariah-compliant investments, sukuk (Islamic bonds) could serve as an alternative for the risk-free rate.

Analysis

The daily return for Bitcoin and Ethereum was calculated using the formula:

Calculation of Daily Return

Daily returns of cryptocurrencies were calculated using the following formula:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\% \qquad (1)$$

Where:

R_t= return on day ttt
P_t = price at day t
P_{t-1} = price at day t−1

Annualized Return

To facilitate comparison with annual bank deposit rates, the average daily return was annualized using:

$$\overline{R}_{\text{annual}} = \overline{R}_{\text{daily}} \times 252 \ (2)$$

Where:
$\overline{R}_{\text{annual}}$= Annualized return
$\overline{R}_{\text{daily}}$= Average daily return
252 = Approximate number of trading days in a year (used for consistency with traditional financial metrics)

Volatility Measurement

Volatility, representing investment risk, was measured as the standard deviation of daily returns. This value was annualized with the following formula:

$$\sigma_{\text{annual}} = \sigma_{\text{daily}} \times \sqrt{252} \qquad (3)$$

Where:
σ_{annual} = Annualized volatility (risk over a year)
σ_{daily} = Standard deviation of daily returns
$\sqrt{252}$ = Square root of trading days in a year (used for traditional asset comparison)

Sharpe Ratio

The Sharpe Ratio was used as a metric for risk-adjusted return, defined as:

$$SR = \frac{\overline{R}_{\text{annual}} - R_f}{\sigma_{\text{annual}}} (4)$$

Where:
$\overline{R}_{\text{annual}}$ = annualized return
R_f = annual risk-free rate
σ_{annual} = annualized volatility

The analysis was supported by visual tools: line graphs showed price trends, and bar charts compared key metrics like return, volatility, and Sharpe Ratio.

Islamic Finance Considerations

Sharia Compliance is crucial in this study. Cryptocurrencies like Bitcoin and Ethereum, due to their speculative nature, may raise concerns regarding compliance with Islamic finance principles, particularly the prohibition of gambling (maysir) and uncertainty (gharar). A detailed assessment will be made on whether these digital assets align with Shariah principles. Similarly, interest-based income from bank deposits is inherently non-compliant with Islamic finance due to the prohibition of riba (interest).

Ethical Investment Alternatives will be explored in the context of Islamic finance. In this light, alternative Sharia-compliant investments, such as sukuk (Islamic bonds) and equity investments in companies adhering to Islamic principles, could offer viable alternatives to conventional investments. The study will also highlight the potential for halal investment strategies that align with Islamic ethical standards.

Social Responsibility is another important aspect. The study emphasizes the importance of socially responsible investing (SRI) in Islamic finance, which avoids investments in industries such as gambling, alcohol, or tobacco. This ethical consideration will be factored into the analysis of Bitcoin, Ethereum, and traditional bank deposits.

Results and Discussion

From an Islamic perspective, financial transactions are guided by the principles of Sharia law, which prohibits riba (interest), gharar (excessive uncertainty), and maysir (gambling). These restrictions play a central role in determining whether modern financial instruments like cryptocurrencies and conventional bank products are permissible (halal) or not (haram).

Price Dynamics of Bitcoin and Ethereum

To establish a clear foundation for return and risk analyses, it is crucial to first explore the historical price behavior of Bitcoin (BTC) and Ethereum (ETH).

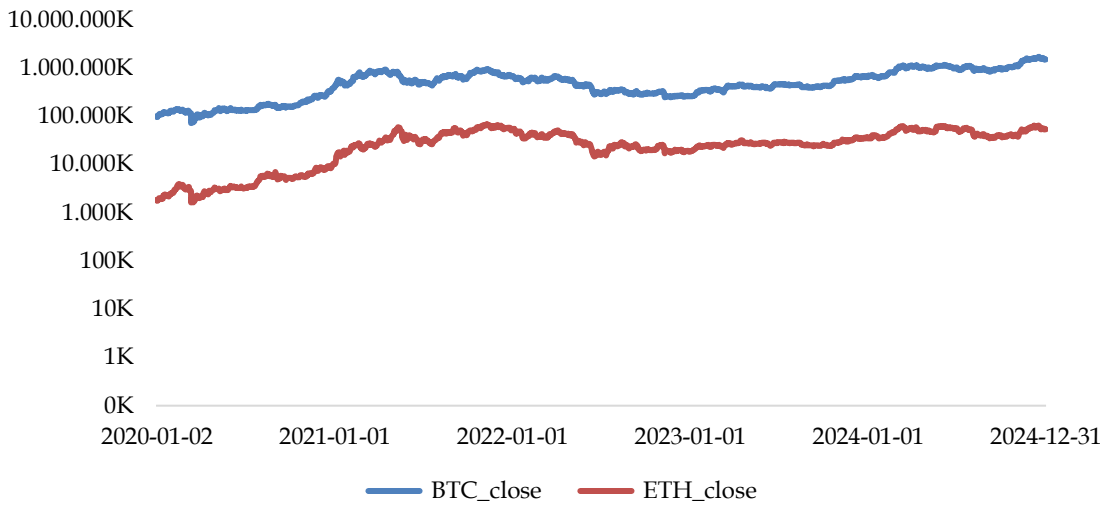

Figure 1. Daily closing prices of Bitcoin (BTC) and Ethereum (ETH) in Indonesian Rupiah (IDR), 2020–2024. The chart is plotted on a logarithmic scale to accommodate the wide range of values and highlight relative trends.

As shown in Figure 1, both cryptocurrencies underwent substantial price movements, marked by rapid surges and significant downturns. These price swings reflect the broader market cycles and the volatile nature of the crypto asset class. In 2020, both BTC and ETH experienced a strong upward trend, which accelerated in 2021. This period coincided with a widespread bull market driven by rising interest in digital assets, the expansion of decentralized finance (DeFi), and increased participation from institutional investors. Bitcoin reached new all-time highs, and Ethereum followed a similar trajectory, though at a lower absolute price level. The scaling difference between the two is clearly visible in the figure, which uses a logarithmic scale to allow a more meaningful visual comparison. By 2022, the bullish trend was abruptly reversed. The crypto market faced a broad correction, triggered by increased global economic uncertainty, tighter monetary policy, and a loss of investor confidence following the collapse of major crypto firms. This shift resulted in sharp declines in both BTC and ETH prices. The downturn illustrates the susceptibility of digital assets to external shocks and sentiment-driven fluctuations.

The year 2023 brought a phase of stabilization, with prices recovering gradually and more consistent trading patterns emerging. Bitcoin began to regain momentum, and Ethereum exhibited narrower fluctuations as it moved toward greater maturity. By 2024, both assets appeared to be in a more stable yet cautious phase, with moderate growth and reduced volatility compared to the previous high-intensity cycles. Throughout the five years, Ethereum consistently traded at a lower price than Bitcoin, reflecting their differing market capitalizations and roles within the crypto ecosystem. However, the log scale presentation highlights that Ethereum's relative growth, particularly in the early years of the period, was often sharper than Bitcoin's. These contrasting patterns underline the need for a detailed return and risk assessment, which is presented in the following sections.

Annual Returns of Bitcoin, Ethereum, and Indonesian Bank Deposits

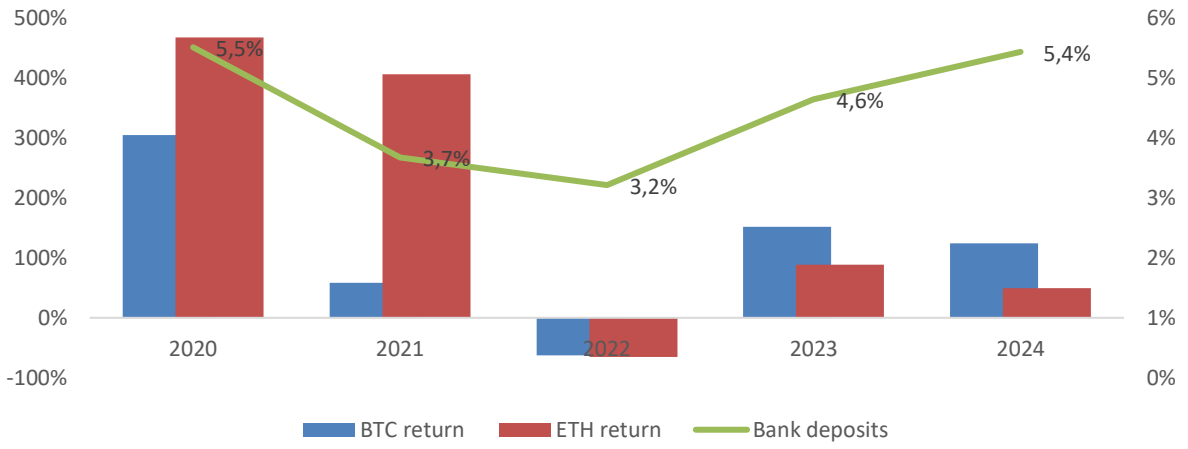

Figure 2. Annual returns of Bitcoin (BTC), Ethereum (ETH), and Indonesian bank deposits.

The annual returns of Bitcoin (BTC), Ethereum (ETH), and Indonesian bank deposits from 2020 to 2024 are presented in Figure 2. Overall, the performance of these three investment types reveals a stark contrast between the high-risk, high-reward nature of cryptocurrencies and the stable, low-yield characteristics of traditional bank deposits.

In 2020, both BTC and ETH experienced exceptional gains. Ethereum led the way with a staggering return of over 470%, while Bitcoin followed with a strong return of approximately 300%. This period was marked by post-pandemic economic stimulus and increasing global interest in digital assets, both from retail and institutional investors. In contrast, Indonesian bank deposits provided a modest return of 5.5%, reflecting their role as a conservative investment choice. The following year, 2021, still saw a robust performance in cryptocurrencies. Ethereum again outperformed Bitcoin, returning over 400%, while Bitcoin saw a noticeable drop in performance, returning only around 60%. Bank deposit rates fell slightly to 3.7%, in line with global trends of low interest rates during continued economic recovery efforts. However, in 2022, the cryptocurrency market experienced a sharp downturn. Both BTC and ETH posted negative returns, marking the only year in this period where crypto investments lost value. This coincided with a global tightening of monetary policy and internal issues within the crypto industry, including major platform collapses and regulatory scrutiny. Meanwhile, Indonesian bank deposits continued to yield positive, albeit low, returns at 3.2%.

A modest recovery occurred in 2023, with BTC and ETH regaining positive momentum, although at a much more restrained pace compared to earlier years. Bitcoin returned around 160%, while Ethereum delivered approximately 90%. In 2024, the growth slowed further, with Bitcoin and Ethereum returns declining but still positive. Bank deposit rates, on the other hand, climbed gradually to 5.4% by 2024, reflecting rising interest rates and inflationary adjustments. These trends highlight the highly volatile nature of cryptocurrency returns, offering both the potential for extraordinary gains and the risk of severe losses. Bank deposits, while lacking in dramatic performance, maintained consistent, positive returns throughout the period, reinforcing their traditional role as a safe, low-risk investment vehicle.

Volatility Analysis

In assessing investment performance, it is essential to consider not only returns but also volatility, which serves as a proxy for risk. Volatility represents the degree of variation in asset prices over a specific period, indicating how stable or unstable an investment might be.

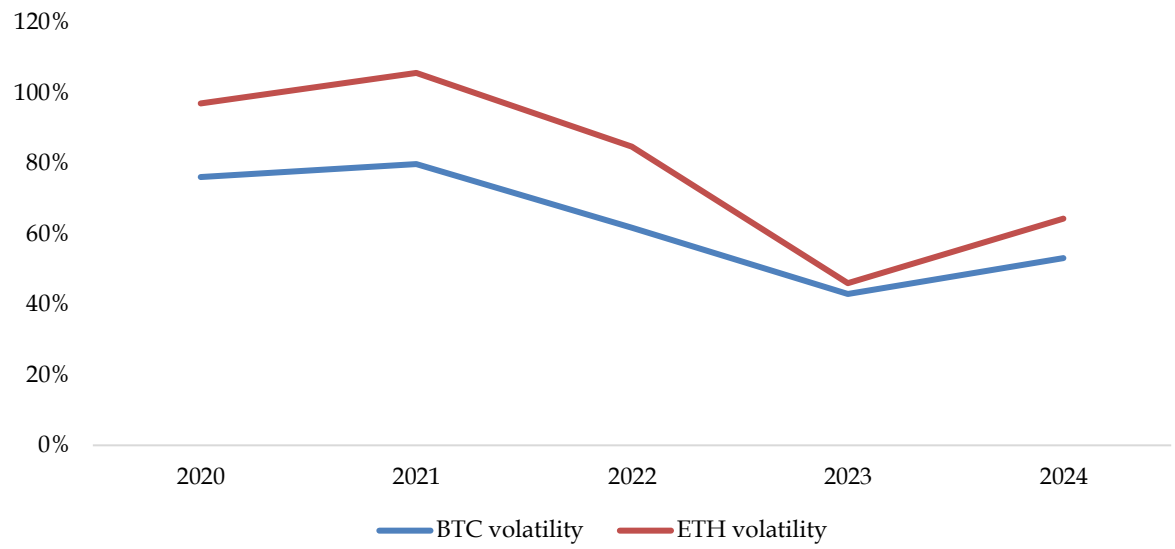

Figure 3. Annual volatility (%) of Bitcoin (BTC) and Ethereum (ETH) from 2020 to 2024

From 2020 to 2024, both Bitcoin (BTC) and Ethereum (ETH) exhibited significantly higher volatility compared to traditional financial instruments such as bank deposits. ETH in particular showed exceptionally high volatility in 2021, reaching 106%, followed by BTC at 80%. These values suggest substantial price fluctuations, where investors may have experienced sharp gains but also rapid losses.

A notable trend was observed in the decline of volatility in subsequent years. By 2023, BTC's volatility had reduced to 43% and ETH's to 46%, reflecting a relative stabilization of the crypto market compared to previous periods. However, these figures remain considerably high in absolute terms, reinforcing the perception of crypto assets as high-risk instruments. In contrast, bank deposit rates were excluded from volatility calculations due to their minimal price variability. The interest rates offered by banks remained relatively stable, with annual rates fluctuating modestly between 3.2% and 5.5%. This consistency underscores the traditional role of bank deposits as low-risk, low-return investment vehicles.

Risk-Adjusted Performance Analysis: Sharpe Ratio Perspective (2020–2024)

To evaluate the efficiency of returns relative to risk, the Sharpe Ratio was computed for both Bitcoin (BTC) and Ethereum (ETH) using the BI 7-Day Reverse Repo Rate as the proxy for the risk-free rate. The resulting values, as presented in Table 1, reveal noteworthy differences in performance over the five years.

Table 1. Sharpe Ratios of Bitcoin (BTC) and Ethereum (ETH), 2020–2024, calculated using the BI 7-Day Reverse Repo Rate as the risk-free benchmark

Year	BTC sharpe	ETH sharpe
2020	3.95	4.76
2021	0.68	3.80
2022	-1.07	-0.82
2023	3.39	1.79
2024	2.21	0.68

In 2020, Ethereum demonstrated the highest risk-adjusted return, with a Sharpe Ratio of 4.76, outperforming Bitcoin's already impressive 3.95. This reflects a strong upside relative to their respective volatilities, indicating that both assets rewarded investors well beyond the risk-free benchmark during this bullish period. The year 2021 presented a divergence in asset behavior. Ethereum maintained a robust Sharpe Ratio of 3.80, suggesting efficient performance despite market fluctuations. In contrast, Bitcoin's ratio declined significantly to 0.68, indicating that although returns remained positive, they were not compelling when adjusted for risk. This may point to heightened volatility or reduced returns compared to prior performance. By 2022, both assets registered negative Sharpe Ratios—Bitcoin at -1.07 and Ethereum at -0.82—signaling underperformance relative to the risk-free rate. This outcome highlights the significance of risk-adjusted metrics, as nominal returns alone may obscure the actual investment quality during downturns. The following year, 2023, marked a recovery. Bitcoin led with a Sharpe Ratio of 3.39, while Ethereum followed at 1.79. This rebound suggests that both assets offered relatively attractive returns, although Bitcoin's performance was more favorable in terms of risk efficiency. Similarly, in 2024, Bitcoin continued to outperform Ethereum on a risk-adjusted basis, with Sharpe Ratios of 2.21 and 0.68, respectively.

As shown in Table 1, the Sharpe Ratio analysis underscores key shifts in crypto performance dynamics and emphasizes the necessity of incorporating risk into investment evaluation. While Ethereum held an early lead in risk-adjusted returns, Bitcoin demonstrated stronger resilience in later years. Importantly, this analysis also reinforces why traditional bank deposit instruments, which lack volatility metrics, are typically excluded from Sharpe Ratio comparisons.

Empirical Insights into BTC and ETH Price Dynamics Over Five Years

As illustrated in Figure 1, both Bitcoin (BTC) and Ethereum (ETH) experienced significant price swings between 2020 and 2024, reflecting the broader volatility and cyclical nature of the cryptocurrency market. These movements—characterized by dramatic rallies followed by steep declines—are typical of speculative asset classes driven by sentiment, innovation, and macroeconomic factors (Corbet, Lucey, & Yarovaya, 2018; Cheah & Fry, 2015).

In 2020, both BTC and ETH entered a strong upward trend that accelerated in 2021. This period coincided with heightened retail and institutional interest in digital assets. The global economic environment—shaped by the COVID-19 pandemic—saw central banks implement expansive monetary policies, leading investors to seek alternative stores of value (Baur & Hoang, 2021; Liu & Tsyvinski, 2021). Bitcoin, often seen as "digital gold," benefited from this trend, reaching new all-time highs in late 2021 (Baur, Hong, & Lee, 2018).

Ethereum, while priced lower than Bitcoin, followed a similar trajectory. Its growth was amplified by the explosive rise of decentralized finance (DeFi), a sector that primarily operates on the Ethereum blockchain (Schär, 2021). As a platform for smart contracts and decentralized applications, Ethereum attracted both developers and capital, further boosting its market valuation (Catalini & Gans, 2016). The use of a logarithmic scale in Figure 1 helps to better

visualize the relative growth of both assets. While Bitcoin's higher nominal price dominates on a linear scale, Ethereum's percentage gains were often steeper during this bullish cycle (Liu & Tsyvinski, 2021). The bullish momentum came to a halt in 2022, with both assets experiencing sharp price corrections. This market downturn was driven by a combination of macroeconomic tightening—particularly interest rate hikes by major central banks—and internal disruptions within the crypto industry (Liang, Li, & Yao, 2023). Investor confidence was severely shaken by the collapse of major platforms such as Terra-Luna, Celsius, and FTX, exposing systemic vulnerabilities, including excessive leverage, lack of regulation, and poor transparency (Auer & Tercero-Lucas, 2023; Liang et al., 2023). Bitcoin and Ethereum saw significant declines during this period, highlighting the speculative nature of crypto assets and their susceptibility to market sentiment and external shocks (Cheah & Fry, 2015). This phase reinforced the need for more robust governance and infrastructure within the digital asset space (Corbet et al., 2018).

In 2023, the market entered a period of relative stabilization. Bitcoin began to recover steadily, bolstered by narratives around its role as a hedge against inflation and store of value (Baur et al., 2018). Ethereum, meanwhile, began exhibiting narrower fluctuations and showed signs of maturing, particularly after its successful transition to proof-of-stake through The Merge in late 2022 (Buterin, 2022). This upgrade drastically reduced Ethereum's energy consumption and increased investor confidence in its long-term viability (Schär, 2021). By 2024, both BTC and ETH were in a more stable but cautious growth phase. Price volatility had reduced compared to earlier years, and investor behavior appeared more measured, reflecting growing market sophistication and institutional involvement (Catalini & Gans, 2016; Liu & Tsyvinski, 2021).

Throughout the five-year period, Ethereum consistently traded below Bitcoin in absolute terms. This reflects not only their differing market capitalizations but also their distinct purposes: Bitcoin as a value-preserving asset, and Ethereum as a functional platform for decentralized applications (Baur et al., 2018; Schär, 2021). However, when plotted on a log scale, Ethereum's relative growth appears more pronounced, especially in earlier phases of the cycle. This underscores the importance of considering both absolute and relative performance when assessing crypto assets for risk and return (Liu & Tsyvinski, 2021). These diverging trends between BTC and ETH emphasize the need for deeper return-risk analysis, which is presented in subsequent sections.

Diverging Paths: High Volatility vs. Stable Yields in Crypto and Bank Investments

The comparative performance of Bitcoin (BTC), Ethereum (ETH), and Indonesian bank deposits from 2020 to 2024 clearly illustrates the stark divergence between high-risk crypto assets and low-risk traditional banking instruments. This period showcased the extreme volatility of cryptocurrencies against the consistent but modest yields of bank deposits. In 2020 and 2021, cryptocurrencies posted extraordinary gains. Ethereum led with returns exceeding 470% in 2020 and over 400% in 2021, while Bitcoin yielded approximately 300% and 60%, respectively. These rallies coincided with unprecedented monetary easing following the COVID-19 pandemic, rapid growth in decentralized finance (DeFi), and increased institutional

participation (Corbet et al., 2020; Baur & Dimpfl, 2021; Yermack, 2021). Indonesian bank deposits, in contrast, delivered returns of 5.5% in 2020 and 3.7% in 2021. These relatively low but stable returns aligned with the central role of savings accounts as a conservative store of value during economic uncertainty (Bank Indonesia, 2023).

The trend sharply reversed in 2022. Both BTC and ETH recorded negative returns, their only losses during this period. These declines were largely driven by global monetary tightening, rising inflation, and internal disruptions in the crypto sector, including the collapse of high-profile platforms such as Terra-Luna and FTX (IMF, 2023; Chen et al., 2023). Meanwhile, Indonesian bank deposits continued to yield modest positive returns of around 3.2%, further underscoring their role as a risk-averse option. Recovery signs emerged in 2023. Bitcoin surged by around 160%, and Ethereum gained about 90%, although this recovery was more muted compared to earlier boom cycles. By 2024, both assets showed signs of maturing, with slower but still positive growth. In tandem, Indonesian bank deposit rates rose to 5.4%, reflecting tighter monetary policy and efforts to control inflation (World Bank, 2024).

These contrasting trends emphasize the speculative nature of crypto markets, where high returns often come with heightened risk and sensitivity to external shocks (Fang et al., 2022). On the other hand, the stability of bank deposits, while less exciting, reflects their reliability for capital preservation. The performance gap supports traditional portfolio theories such as the Modern Portfolio Theory, which stresses the importance of diversification and aligning asset selection with individual risk tolerance (Markowitz, 1952).

On Sharpe Ratio

The Sharpe Ratio was computed for both Bitcoin (BTC) and Ethereum (ETH) from 2020 to 2024, using the BI 7-Day Reverse Repo Rate as the proxy for the risk-free rate. The results in Table 1 offer critical insights into how these two leading cryptocurrencies performed when adjusted for volatility. The Sharpe Ratio is a widely accepted metric for evaluating risk-adjusted returns. It measures the excess return per unit of risk (Sharpe, 1994). A higher Sharpe Ratio indicates that an investment provides better returns for each unit of volatility. In this context, the Sharpe Ratio helps identify whether crypto assets genuinely delivered value over relatively stable instruments like government bonds or money market rates (Liu & Tsyvinski, 2021; Baur & Hoang, 2021).

In 2020, both BTC and ETH posted exceptionally high Sharpe Ratios of 3.95 and 4.76, respectively—reflecting outstanding risk-adjusted performance. Ethereum notably outperformed Bitcoin on this front. This surge can be linked to a combination of post-pandemic stimulus, low-interest environments, and rising enthusiasm for decentralized finance (DeFi), which primarily relies on the Ethereum network (Schär, 2021). During this bullish market, the volatility of both assets was more than compensated by their high returns, justifying investor enthusiasm despite inherent crypto market risks (Catalini & Gans, 2016). The year 2021 revealed a stark contrast in performance. While Ethereum sustained a robust Sharpe Ratio of 3.80, Bitcoin's dropped sharply to 0.68. This divergence likely stemmed from differences in underlying demand dynamics. Ethereum benefited from a surge in smart contract usage and

NFT transactions, while Bitcoin's returns were more muted amid growing concerns over its energy usage and regulatory pushback in key markets like China (Baur, Hong, & Lee, 2018; Auer & Claessens, 2018).

Both assets registered negative Sharpe Ratios in 2022—Bitcoin at -1.07 and Ethereum at -0.82—indicating that their returns failed to compensate for the elevated levels of risk. This period was marred by the collapse of major crypto institutions (e.g., FTX, Terra-Luna), leading to widespread loss of confidence and liquidity stress in the market (Auer & Tercero-Lucas, 2023; Liang, Li, & Yao, 2023). Negative Sharpe Ratios highlight the severity of drawdowns experienced by investors and reinforce the importance of incorporating volatility metrics when assessing performance, particularly in high-risk environments (Cheah & Fry, 2015).

Bitcoin demonstrated a stronger recovery in 2023, with a Sharpe Ratio of 3.39, while Ethereum lagged at 1.79. Bitcoin's improved performance may be attributed to increased institutional interest, narratives around digital scarcity, and relative stability compared to newer altcoins (Baur & Hoang, 2021). In contrast, Ethereum's more complex ecosystem, including its shift to proof-of-stake and transition risks post-Merge, may have moderated its recovery pace (Buterin, 2022). The trend continued into 2024. Bitcoin maintained its lead with a Sharpe Ratio of 2.21, whereas Ethereum's fell to 0.68. This suggests a stabilization of BTC's reputation as a "crypto safe haven" and greater resilience in risk-adjusted terms (Baur et al., 2018). Ethereum's weaker performance may reflect lingering concerns over scalability, regulatory uncertainty for DeFi platforms, or competition from emerging Layer-1 chains (Schär, 2021). The Sharpe Ratio effectively captures inter-temporal shifts in investment quality, beyond what raw returns can reveal. Ethereum's early lead reflects the rapid adoption and innovation associated with DeFi and NFTs. However, Bitcoin's consistent performance during recovery periods indicates its stronger appeal as a long-term store of value (Corbet, Lucey, & Yarovaya, 2018).

Importantly, this analysis also clarifies why traditional bank deposit instruments are typically excluded from Sharpe Ratio comparisons: they offer minimal volatility, which would result in artificially high or undefined ratios. Such instruments are better evaluated through other measures like interest rate spreads, liquidity, and capital adequacy rather than risk-adjusted returns (Liu & Tsyvinski, 2021).

Islamic Finance Perspective on Cryptocurrency and Banking

From an Islamic perspective, financial transactions are guided by the principles of Sharia law, which prohibits riba (interest), gharar (excessive uncertainty), and maysir (gambling). These restrictions play a central role in determining whether modern financial instruments like cryptocurrencies and conventional bank products are permissible (halal) or not (haram).

Cryptocurrency in the View of Sharia

The permissibility of cryptocurrencies such as Bitcoin and Ethereum under Islamic law is a matter of ongoing debate among scholars. According to some contemporary Islamic scholars, cryptocurrencies can be considered halal if they fulfill certain conditions. They must be used for legitimate transactions and not for speculative trading. Mufti Muhammad Abu

Bakar, a Sharia advisor and compliance officer at Blossom Finance, argues that Bitcoin is permissible as it qualifies as a valid medium of exchange and store of value (Abu Bakar, 2018). However, other scholars raise concerns about the high volatility and speculative nature of cryptocurrencies. According to the Islamic Fiqh Academy, digital currencies may fall under the category of maysir due to their price fluctuations and use in speculative activities. These features could contradict the principle of risk-sharing and transparency in Islamic finance (Islamic Fiqh Academy, 2019). Furthermore, the lack of central authority and regulatory oversight in many cryptocurrencies leads to concerns regarding consumer protection and the potential use of such currencies in illegal activities, such as money laundering, which are unethical from a Sharia point of view.

Conventional Banking and the Issue of Riba

Traditional banking systems rely heavily on interest-based transactions. From a Sharia perspective, riba is strictly prohibited as outlined in the Qur'an: "Allah has permitted trade and has forbidden riba" (Qur'an 2:275). Therefore, saving or investing money in interest-bearing bank accounts is generally considered haram. Islamic finance provides alternatives through instruments like mudarabah (profit-sharing) and wadiah (safe-keeping). In mudarabah, the bank invests depositors' funds into halal ventures and shares the profit or loss according to a pre-agreed ratio, thereby avoiding fixed interest payments.

The Rise of Sharia-Compliant Alternatives

Given the Islamic prohibitions on riba and gharar, there has been a rise in Sharia-compliant financial products and services. For example, gold-backed digital currencies are being developed to offer a stable, asset-backed alternative to volatile cryptocurrencies. Platforms like OneGram and Haqq Network are attempting to create cryptocurrencies that comply with Islamic financial principles by backing their tokens with real assets and avoiding interest-based lending (Shah, 2020).

From a Sharia standpoint, this study incorporates the DSN-MUI Fatwa No. 2021, which explicitly prohibits crypto trading as a medium of exchange due to elements of gharar and maysir. However, the fatwa allows consideration of asset-backed digital instruments and tokenized sukuk as potential halal innovations. This nuanced interpretation reflects a balance between innovation and ethics. While conventional deposits are excluded due to riba, Islamic deposits through mudarabah and wadiah contracts fulfill the principle of fairness and shared responsibility.

Implications for Investors and Policymakers

Findings indicate that Muslim investors in Indonesia are increasingly guided by both financial return expectations and Sharia values. Younger investors show openness to digital assets but remain cautious about halal legitimacy. Many prefer Islamic deposits for their safety and compliance, though curiosity toward Sharia-compliant crypto products (e.g., gold-backed tokens) is growing. This behavioral trend signals the potential market for Islamic fintech innovation.

Regulators such as OJK and DSN-MUI should collaborate to formalize frameworks for Sharia-compliant digital finance, integrating fatwa-based guidelines into fintech regulation. Investor education programs should also emphasize risk management and ethical investment principles.

Conclusion and Recommendations

This study concludes that cryptocurrencies yield higher but unstable returns, while bank deposits offer stable yet lower returns. From a Sharia perspective, conventional deposits are riba based and therefore noncompliant, whereas cryptocurrencies, despite their innovative nature, remain speculative and are subject to the 2021 DSN MUI prohibition. Islamic deposits grounded in mudarabah and wadiah contracts provide a Sharia compliant and ethically sound alternative. Overall, the findings demonstrate that Muslim investors in Indonesia are increasingly balancing financial ambition with faith based values, thereby creating a growing demand for halal digital investment options. This study contributes to the empirical comparison of cryptocurrencies, conventional deposits, and Islamic deposits from both risk return and Sharia viewpoints, integrates the DSN MUI 2021 fatwa into financial evaluation frameworks, offers behavioral insights into Indonesian Muslim investor decision making, and provides policy guidance for OJK and DSN MUI to strengthen the development of Islamic fintech ecosystems.

This study focuses on two cryptocurrencies and deposit instruments only, without transaction cost analysis or primary behavioral data. Future research should examine Sharia-compliant digital asset development, fintech governance, and cross-generational investor attitudes.

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