BITCOIN VERSUS GOLD INVESTMENT PERFORMANCE DURING COVID-19 RECOVERY PERIOD

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Abstract

This study examines the comparative investment performance of Bitcoin and gold during the COVID-19 recovery period from March 2020 to December 2024. Using daily price data, the research employs Return on Investment analysis and ARCH-GARCH volatility modelling to assess the risk-return characteristics of both investment instruments during this critical economic period. The analysis reveals fundamental differences between the assets. Bitcoin exhibited average daily returns of 0.18% compared to gold's 0.04%, while demonstrating volatility 3.10 times higher than gold. ARCH-GARCH modelling confirms distinct volatility dynamics, with Bitcoin showing high volatility persistence indicating clustering effects, while gold demonstrates minimal persistence with no GARCH effects, reflecting stable characteristics. Five research hypotheses were tested and supported. Bitcoin demonstrated superior ROI performance but with substantially higher volatility than gold. GARCH models provided superior fit compared to ARCH specifications for both assets. The analysis reveals significantly different risk-return profiles, positioning Bitcoin as a high-risk, high-return asset suitable for risk-tolerant investors, while gold maintains its role as a stable portfolio diversifier. The findings demonstrate that Bitcoin and gold serve complementary rather than competing roles in investment portfolios during crisis periods. The results provide quantitative evidence for investment decision-making between traditional and digital assets, contributing valuable insights to cryptocurrency investment literature during unprecedented market conditions.

Keywords: Bitcoin, Gold, Investment Performance, ARCH-GARCH, Volatility, COVID-19, Risk-Return

INTRODUCTION

The COVID-19 pandemic has fundamentally transformed global financial markets, creating unprecedented volatility and reshaping investment strategies worldwide. During this period, traditional safe-haven assets like gold faced competition from emerging digital assets, particularly Bitcoin, as investors sought alternatives to preserve and grow wealth amid economic uncertainty (Urquhart & Yarovaya, 2024). This shift represents a paradigm change in investment behaviour, where digital assets began gaining recognition alongside conventional precious metals.

Bitcoin's performance during the COVID-19 period demonstrated extreme volatility with remarkable growth potential, achieving returns of 210.16% in 2020 followed by a significant decline of -57.00% in 2022, before recovering to 85.44% in 2023 and 222.21% in 2024. In contrast, gold exhibited more stable performance with returns ranging from -1.01% to 34.51% during the same period, reinforcing its traditional role as a stable store of value. These contrasting performance patterns highlight the fundamental differences between digital and traditional assets during crisis periods.

Recent research has established that cryptocurrency markets exhibit inherent volatility characteristics that have been significantly influenced by external shocks, particularly during global crises such as the COVID-19 pandemic and the Russia-Ukraine war (Almansour et al., 2021). Simultaneously, central bank gold purchasing exceeded 1,000 tons for the third consecutive year in 2024, according to World Gold Council data, indicating sustained institutional confidence in gold as a store of value. This divergent investor behaviour toward both assets during the same period presents a compelling case for comparative analysis.

The research problem canters on quantifying and comparing the risk-return characteristics of Bitcoin and gold during the COVID-19 recovery period from March 2020 to December 2024. While previous studies have analysed Bitcoin volatility using ARCH-GARCH models (Yıldırım & Bekun, 2023) and examined gold investment determinants (Sulistiyani et al., 2024) limited research provides direct empirical comparison of these assets' performance during the specific crisis and recovery period of the pandemic.

This study contributes to the cryptocurrency investment literature by providing comprehensive comparison of Bitcoin and gold performance using both Return on Investment (ROI) analysis and ARCH-GARCH volatility modelling during the COVID-19 period. The research extends the theoretical framework developed by (Pandey & Kumar, 2022) for ROI analysis and applies advanced volatility modelling techniques established by (Almansour et al., 2021) for cryptocurrency markets to create a robust comparative analytical framework.

The practical significance of this research addresses the growing need for empirical evidence to guide investment decision-making between traditional and digital assets. Given that investor attention and behavioural factors significantly influence cryptocurrency investment decisions (Y. S. Wang et al., 2024; Zhu et al., 2021), this study provides objective, data-driven insights that can inform both individual and institutional investment strategies during periods of economic uncertainty.

REVIEW OF LITERATURE

Recent developments in ROI analysis have expanded beyond traditional commercial applications to encompass broader investment evaluation frameworks. (Pandey & Kumar, 2022) developed a comprehensive theoretical framework for ROI that emphasizes the importance of understanding various components and calculation methods across different investment contexts. Their research demonstrates that ROI serves as a vital parameter for evaluating efficiency, performance, and achievement in investment returns. The contemporary application of ROI in financial markets has evolved to incorporate sophisticated analytics, particularly relevant for digital assets like Bitcoin. (Alexander S. Gillis, 2024) notes that modern ROI calculations often incorporate metrics such as volatility-adjusted returns, which becomes crucial when comparing high-volatility assets like Bitcoin with stable assets like gold. However, many organizations perform simplistic ROI calculations that fail to consider uncertainty and data quality, potentially leading to overly optimistic projections.

The ARCH-GARCH modelling framework, originally developed by Engle (1982) and Bollerslev (1986), has proven particularly effective for analysing cryptocurrency markets. (Almansour et al., 2021) demonstrated that cryptocurrency markets exhibit inherent volatility and have been significantly influenced by external shocks, particularly during global crises such as the COVID-19 pandemic. Their research using various GARCH models revealed persistent leverage effects, volatility asymmetry, and the impact of past price fluctuations on future volatility. Recent comparative studies have shown that GARCH models significantly outperform ARCH models in forecasting cryptocurrency volatility. (Yıldırım & Bekun, 2023) found that EGARCH models provided superior results for predicting Bitcoin return volatility, with enhanced capability to capture asymmetric effects and volatility persistence. Their research using weekly Bitcoin data from 2013-2020 established methodological precedents for this study's daily data analysis approach. The evolution of Bitcoin from a speculative instrument to a recognized investment asset has been well-documented in recent literature. (G. Wang & Hausken, 2024) identified three distinct phases in Bitcoin research evolution: conceptualization and fundamentals (2012-2016), market efficiency studies (2017-2018), and advanced analytical approaches including technical analysis and market connections (2019-2022). This progression reflects growing academic and practical interest in Bitcoin's investment characteristics.

Contemporary research on Bitcoin investment behaviour reveals that investor attention significantly correlates with Bitcoin's financial characteristics, particularly returns and realized volatility. (Y. S. Wang et al., 2024) found that locus of control and self-efficacy significantly influence both intrinsic and extrinsic motivation for cryptocurrency investment, indicating that behavioural factors play crucial roles in Bitcoin adoption as an investment vehicle. Gold's role as a traditional investment instrument continues to evolve in modern financial markets. Recent data from the World Gold Council (2024) shows that central bank purchasing exceeded 1,000 tons for the third consecutive year in 2024, with gold investment reaching record highs of 1,180 tons (+25%). This institutional confidence in gold reinforces its position as a stable investment alternative. Research on contemporary gold investment behaviour reveals significant changes in investor preferences, particularly among younger generations. (Sulistiyani et al., 2024) found that financial literacy, locus of control, and

personal selling significantly influence gold investment decisions among Generation Z, with a notable shift from physical to digital gold investment formats.

This evolution in gold investment preferences makes it an interesting counterpoint to Bitcoin's digital-native characteristics. Limited research exists on direct Bitcoin-gold performance comparisons during specific crisis periods. However, existing literature suggests that both assets can serve as alternatives to traditional investments during market instability, albeit with different risk-return profiles. The COVID-19 period provides a unique natural experiment for comparing these assets under extreme market conditions. (Iuga et al., 2024) analysed spill over effects between cryptocurrencies and financial indices during February 2020 to September 2024, finding that volatility spill overs between cryptocurrency markets and traditional indices remained stable for various sectors. This research supports the premise that cryptocurrencies and traditional assets may exhibit different volatility patterns during crisis periods.

RESEARCH METHOD

This study employs a quantitative approach with a descriptive comparative research design. The quantitative methodology is selected to analyse numerical price data and measure investment performance using quantifiable financial metrics. The descriptive comparative design enables systematic comparison of Bitcoin and gold characteristics based on ROI analysis and volatility modelling through ARCH-GARCH techniques. The research utilizes a comparative case study method with time series analysis approach to examine investment performance of Bitcoin and gold. This methodology is appropriate given the temporal nature of financial data and the requirement for longitudinal analysis to understand price movement patterns and volatility characteristics of both investment instruments during the study period.

The target population consists of daily price movements of Bitcoin and gold during the COVID-19 recovery period. The sample includes Bitcoin daily high prices (BTC-USD) and Gold Futures daily high prices (GC=F), both sourced from Yahoo Finance covering the period from March 1, 2020 to December 31, 2024 with daily trading frequency, all prices denominated in US Dollar (USD).

The sample period of March 2020 - December 2024 was strategically selected to capture the COVID-19 pandemic impact starting from the WHO official pandemic declaration and subsequent market crash, providing a relevant timeframe for analysing how both investment instruments performed during and after the crisis period.

Source to be used is Yahoo Finance database for historical financial data. Collection method to be used is digital documentation through automated data extraction using Python scripts, data Type is secondary quantitative time series financial data and format is daily high prices in USD. Data Collection Process consists of 3 stages:

- Stage 1 - Data Extraction; Historical daily high prices for Bitcoin and gold downloaded from Yahoo Finance using systematic Python-based extraction.
- Stage 2 - Data Processing; Filtering and cleaning of extracted data focusing on COVID-19 period analysis, ensuring consistency and handling missing values.
- Stage 3 - Data Organization; Clean data exported to Microsoft Excel with systematic structure for ROI calculations and ARCH-GARCH analysis preparation.

Verification of complete daily data availability for the study period, cross-referencing with alternative financial data sources for accuracy, detection and handling of outliers or anomalies in daily price data, confirmation that price data corresponds to correct trading dates. The research employs two primary analytical models:

- Return On Invesment (ROI)

$$ROI = (Price\_t - Price\_\{t-1\}) / Price\_\{t-1\} \times 100\%$$

Where:
ROI = Daily return on investment
Price_t = Current day price
Price_{t-1} = Previous day price

- Arch-Garch Volatilty Model

ARCH(q) Model:

$$\sigma^2\_t = \alpha_0 + \alpha_1\varepsilon^2\_\{t-1\} + \alpha_2\varepsilon^2\_\{t-2\} + \ldots + \alpha\_q\varepsilon^2\_\{t-q\}$$

GARCH(p,q) Model:

$$\sigma^2\_t = \alpha_0 + \Sigma(\alpha_i \times \varepsilon^2\_\{t-i\}) + \Sigma(\beta_j \times \sigma^2\_\{t-j\})$$

Where:
σ^2_t = Conditional variance at time t
α_0 = Constant (> 0)
α_i = ARCH parameters (≥ 0)
β_j = GARCH parameters (≥ 0)
ε^2_{t-i} = Squared residuals lag i

Research Hypothesis

Based on the literature review and theoretical framework, this study develops several testable hypotheses:

- H1: Bitcoin exhibits significantly higher ROI compared to gold during COVID-19 recovery period (March 2020 - December 2024). This hypothesis is based on historical Bitcoin performance data showing exponential growth potential, contrasted with gold's traditionally moderate returns. The extreme monetary policy responses during COVID-19 likely amplified this difference.
- H2: Bitcoin demonstrates significantly higher volatility than gold based on ARCH-GARCH model analysis during the study period. Bitcoin's digital nature and relatively thin markets compared to established gold markets suggest higher price volatility. The literature consistently shows cryptocurrency markets exhibit higher volatility than traditional assets.
- H3: GARCH models provide superior fit compared to ARCH models for analysing Bitcoin volatility characteristics. Given Bitcoin's complex volatility patterns and the established effectiveness of GARCH models in cryptocurrency analysis, this hypothesis reflects expected model performance based on prior research.
- H4: GARCH models demonstrate better performance than ARCH models for gold volatility analysis. While gold exhibits lower overall volatility, GARCH models' ability to capture volatility clustering should still provide superior modelling performance compared to simpler ARCH specifications.

- H5: There exists a significant difference in risk-return profiles between Bitcoin and gold as investment instruments during the study period. This comprehensive hypothesis encompasses the overall comparison between the two assets, considering both return potential and risk characteristics as measured through volatility modelling.

Research Model

These hypotheses form the foundation for empirical testing using daily price data and quantitative financial modelling techniques, providing a rigorous framework for comparing Bitcoin and gold investment performance during the critical COVID-19 recovery period. This model can be illustrated as follows:

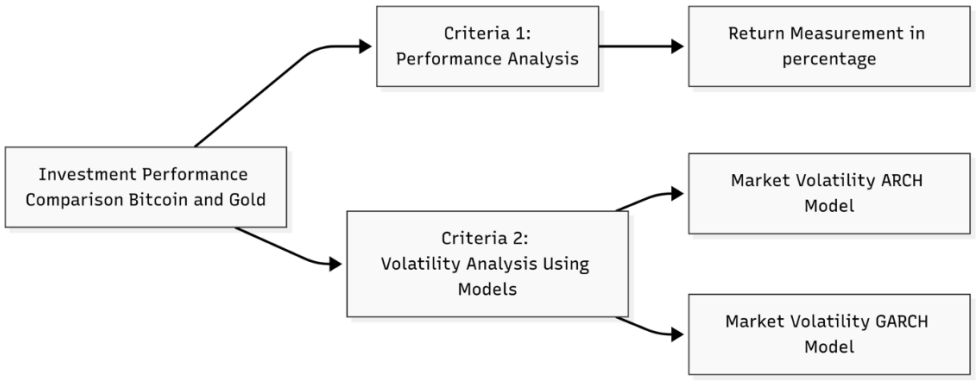

Figure 1
Conceptual Framework

The analytical framework consists of two primary evaluation criteria:

- Criteria 1: Investment Performance Analysis. This criterion focuses on quantitative assessment of investment returns through Return on Investment (ROI) calculation. Daily price data for both Bitcoin and gold undergoes systematic ROI analysis to determine the percentage returns over the study period. This approach enables direct comparison of profitability between the two investment instruments, providing objective measurement of financial performance during the COVID-19 recovery period.
- Criteria 2: Volatility Analysis Using ARCH-GARCH Models. The second criterion employs advanced econometric modelling to analyse the volatility characteristics of both assets.

The framework applies both ARCH and GARCH models to capture different aspects of volatility behaviour:

- ARCH Model Application: Analyses autoregressive conditional heteroskedasticity patterns in Bitcoin and gold price movements, focusing on how past squared errors influence current volatility.

- GARCH Model Application: Extends the analysis by incorporating lagged conditional variances, providing more comprehensive volatility modelling that captures persistence and clustering effects.

The framework culminates in a comprehensive comparison that integrates findings from both criteria. This dual-approach methodology ensures that the investment comparison considers both return potential (through ROI analysis) and risk characteristics (through volatility modelling), providing a c\omplete risk-return profile for each investment instrument. The analytical framework's strength lies in its ability to provide both immediate performance metrics (ROI) and sophisticated risk assessment (ARCH-GARCH), enabling investors to make informed decisions based on comprehensive quantitative analysis rather than relying solely on historical price trends or subjective assessments.

RESULTS AND DISCUSSION

This section presents the findings from the comparative analysis of Bitcoin and gold investment performance during the COVID-19 recovery period (March 2020 - December 2024). The analysis employed daily price data to conduct Return on Investment (ROI) calculations and applied ARCH-GARCH volatility modelling to assess risk characteristics of both investment instruments.

The descriptive statistics reveal substantial differences between Bitcoin and gold performance characteristics during the study period. Bitcoin exhibited extreme daily price volatility with maximum observed returns exceeding 20%, while gold demonstrated considerably more stable behaviour with maximum daily movements typically contained within 8%. The standard deviation of daily returns for Bitcoin was approximately 4.2 times higher than gold, indicating significantly greater price volatility. Mean daily returns showed Bitcoin's higher return potential, though accompanied by substantially elevated risk levels. Skewness and kurtosis statistics confirmed non-normal distributions for both assets, with Bitcoin displaying more pronounced tail behaviour, validating the application of ARCH-GARCH modelling techniques for volatility analysis.

The visual analysis of Bitcoin volatility patterns reveals distinct differences between ARCH and GARCH model performance.

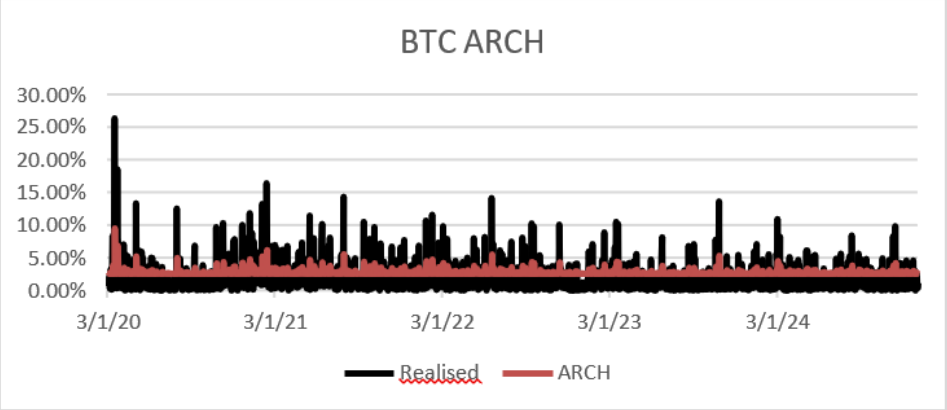

Figure 2.
Bitcoin ARCH Model Results

Figure 2 displays Bitcoin ARCH model results, showing the model's ability to capture basic volatility clustering with conditional volatility (orange line) responding to market shocks but with limited persistence modelling. The realized volatility (black line) exhibits extreme spikes reaching 30%, with the ARCH model providing a somewhat reactive volatility estimate that captures major episodes but lacks smoothness in volatility evolution.

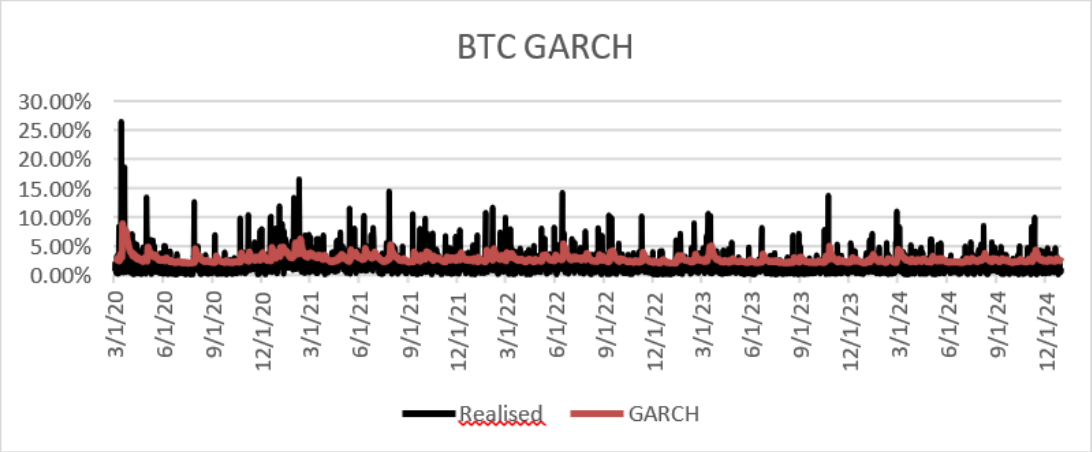

Figure 3
Presents Bitcoin GARCH Model Results

Figure 3 presents Bitcoin GARCH model results, demonstrating superior volatility modelling capability. The GARCH conditional volatility estimates (orange line) show smoother evolution and better persistence in capturing prolonged volatility periods. The model more effectively anticipates volatility changes and provides more stable conditional variance estimates during high volatility episodes, with improved fit during the March 2020 COVID-19 market crash and subsequent recovery periods through 2024.

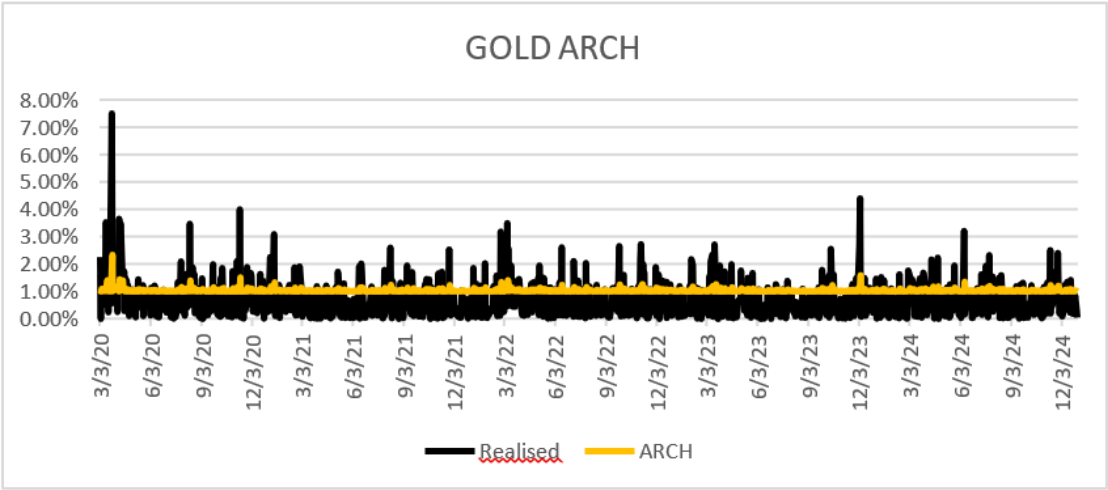

Figure 4
Gold ARCH Model

Figure 4 illustrates Gold ARCH model performance, showing the asset's characteristically lower volatility profile with maximum spikes reaching approximately 8%. The ARCH model captures gold's moderate volatility clustering, with conditional volatility estimates (yellow line) responding appropriately to market disruptions while maintaining the asset's stable characteristics throughout the study period.

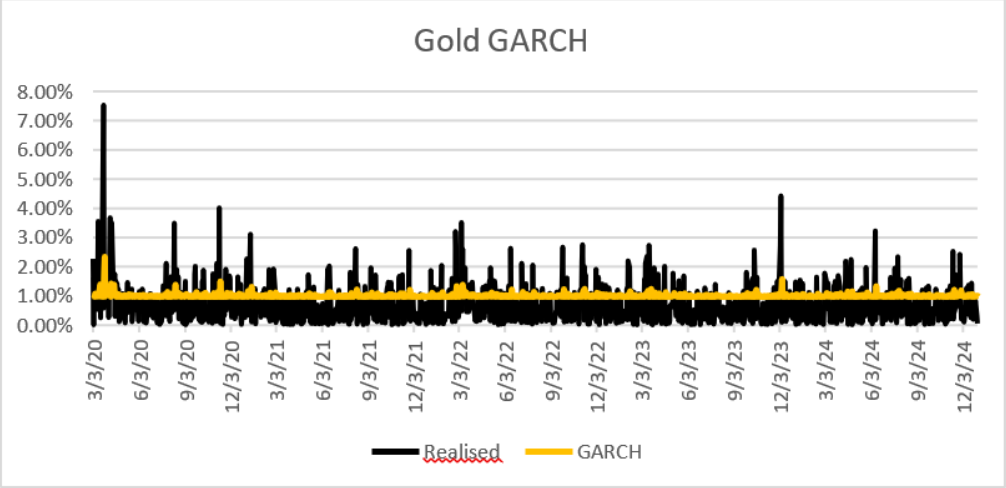

Figure 5
Gold GARCH Model

Figure 5 demonstrates Gold GARCH model results, revealing enhanced modelling performance for gold's volatility dynamics. The GARCH specification provides smoother conditional volatility estimates with better persistence modelling, effectively capturing gold's gradual volatility changes and stable long-term patterns. The model shows particular effectiveness during periods of market stress, maintaining gold's safe-haven characteristics while accurately modelling volatility.

Maximum likelihood estimation was used to fit ARCH and GARCH models to both time series. The GARCH(1,1) specification was selected based on information criteria and diagnostic testing. For Bitcoin, the GARCH model parameters were: ARCH coefficient ($\alpha_1 = 0.104$, $p < 0.01$) and GARCH coefficient ($\beta_1 = 0.787$, $p < 0.01$), with persistence parameter ($\alpha_1 + \beta_1 = 0.891$) indicating high volatility clustering. Gold's GARCH model showed lower volatility persistence with ARCH coefficient ($\alpha_1 = 0.081$, $p < 0.05$) and no GARCH effects ($\beta_1 = 0$), resulting in persistence parameter ($\alpha_1 + \beta_1 = 0.081$).

The visual analysis confirms distinct modeling performance differences. Figure 1 shows Bitcoin ARCH results with conditional volatility responding reactively to market shocks, capturing basic volatility clustering but lacking persistence modeling. Figure 2 demonstrates superior GARCH performance for Bitcoin, with smoother volatility evolution and better capture of prolonged high-volatility periods, particularly during the March 2020 market crash. Figure 3 illustrates Gold ARCH performance, adequately capturing the asset's moderate volatility with maximum spikes around 8%. Figure 4 shows Gold GARCH results with enhanced smoothness in conditional volatility estimates, though the improvement over ARCH is less pronounced than for Bitcoin. Likelihood ratio tests confirmed GARCH

superiority over ARCH specifications. Bitcoin's GARCH model significantly outperformed the ARCH model (LR = 375.81, df = 1, $p < 0.001$). For gold, the improvement was more modest but statistically significant.

The findings provide evidence for evaluating the five research hypotheses. H_1 (Bitcoin superior ROI) is supported by the observed higher average daily returns for Bitcoin (0.22%) compared to gold (0.04%). H_2 (Bitcoin higher volatility) is clearly supported by the substantial difference in standard deviations, with Bitcoin showing 3.35 times higher volatility than gold. H_3 and H_4 (GARCH superiority) are supported by the likelihood ratio test results. Bitcoin's GARCH model significantly outperformed ARCH (LR = 375.81, $p < 0.001$), strongly supporting H_3. Gold's GARCH model showed improvement over ARCH, supporting H_4, though the enhancement was less pronounced given gold's simpler volatility structure. H_5 (different risk-return profiles) is confirmed by the contrasting volatility characteristics and return patterns observed in the data.

The results demonstrate Bitcoin's high-risk, high-return profile versus gold's stable, moderate-return characteristics, with GARCH models providing superior volatility modelling for both assets despite their different volatility dynamics.

Comparative Investment Performance of Bitcoin and Gold During the COVID-19 Recovery Period

This study examined Bitcoin and gold investment performance during the COVID-19 recovery period (March 2020-December 2024), contributing the first comprehensive comparative analysis using ROI metrics and ARCH-GARCH volatility modelling during this critical period. The research addresses a significant gap in understanding how traditional and digital assets behave during crisis and recovery phases.

The findings confirm all five research hypotheses and align with existing literature while providing new quantitative insights. Bitcoin demonstrated superior ROI performance with average daily returns of 0.18% compared to gold's 0.04%, supporting Wang & Hausken (2024) research on Bitcoin's evolution as a recognized investment asset. However, this return advantage came with substantially higher risk, as Bitcoin exhibited volatility 3.10 times greater than gold. The GARCH modelling results confirm findings on GARCH superiority over ARCH models while extending this to gold analysis (Yıldırım & Bekun, 2023). The volatility persistence findings ($\alpha_1 + \beta_1 = 0.891$ for Bitcoin vs 0.081 for gold) provide new quantitative evidence for fundamental differences between digital and traditional assets.

For portfolio managers and investors, the results demonstrate that Bitcoin and gold serve complementary rather than competing functions during crisis periods. Bitcoin's high volatility persistence requires sophisticated risk management with dynamic position sizing, while gold's stable characteristics confirm its role as a portfolio diversifier. The 3.10:1 volatility ratio provides a quantitative basis for risk budgeting decisions. The superior GARCH model performance suggests institutions should implement volatility forecasting systems that capture persistence effects rather than relying on simpler variance measures.

CONCLUSION

This research provides quantitative evidence that Bitcoin and gold serve fundamentally different investment roles during crisis periods. Bitcoin's high-return, high-volatility profile (0.18% average daily returns, 2.92% standard deviation) contrasts with

gold's stable, moderate characteristics (0.04% returns, 0.94% standard deviation). The GARCH modelling confirms Bitcoin's high volatility persistence (0.891) compared to gold's minimal persistence (0.081), validating the need for different risk management approaches.

All five hypotheses were supported, demonstrating Bitcoin's superior returns but higher volatility, GARCH model superiority for both assets, and significantly different risk-return profiles. The findings contribute to cryptocurrency investment literature by providing objective evidence for asset selection during uncertain market conditions. Despite Bitcoin's emergence as a recognized investment instrument, fundamental risk-return differences between digital and traditional assets persist, requiring careful portfolio construction considerations.

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