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Risk-Return Trade-Off Between Stocks and Cryptocurrencies

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Abstract

The paper examines the risk-return trade-off between Reliance Industries stocks and Bitcoin over a five-year period from January 2019 to February 2024. It identifies a research gap in comparing traditional and modern investments and aims to analyze volatility and returns using ARCH and GARCH models. Results show Bitcoin outperforms Reliance in CAGR and Daily Average Return with higher volatility confirmed by ARCH-LM tests and the GARCH (1,1) model. The findings underscore the importance for investors to consider both risk and return when evaluating investment options.

Key Words: Stocks, Cryptocurrencies, Arch, Risk-return Trade-Off

1. Introduction:

Investment involves allocating funds or resources with the expectation of future benefits. It encompasses acquiring monetary assets or valuable goods to generate income or appreciation over time. Investments span diverse avenues, from traditional options like stocks and bonds to unconventional ones like real estate and commodities. The core principle is that money should be actively employed to create value rather than remaining idle.

Investing provides numerous avenues for individuals to build wealth and achieve financial objectives. One popular option is purchasing shares of publicly traded companies, offering ownership in the company and potential for both capital appreciation and dividend income. Bonds offer another avenue, involving investment in debt securities issued by governments or corporations, which provide fixed income through regular interest payments. Mutual funds enable investors to pool their funds with others, accessing diversified portfolios managed by professionals across various asset classes such as stocks, bonds, or other securities. Real estate investment involves acquiring property to generate rental income and capitalize on potential appreciation in property value. Commodities, including gold, silver, oil, or agricultural products, serve as effective hedges against inflation or economic uncertainty. Exchange-Traded Funds (ETFs) provide a similar diversification to mutual funds but are traded on stock exchanges like individual stocks, offering liquidity and ease of trading. Cryptocurrency, such as Bitcoin and Ethereum, utilizes blockchain technology for secure peer-to-peer transactions and the potential for investment gains. Options contracts grant holders the right to buy or sell assets at predetermined prices within specified time frames, offering opportunities for leverage and hedging. Precious metals like gold, silver, platinum, or palladium act as stores of value and

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protection against inflation. Lastly, peer-to-peer lending platforms allow investors to earn

interest income by directly lending money to individuals or businesses online. Each of these investment options carries its own set of risks and rewards, catering to diverse investor preferences and financial goals.

Cryptocurrency investment refers to acquiring digital assets such as Bitcoin and Ethereum, anticipating their value to appreciate over time. While both operate on blockchain technology

and are decentralized, they have distinct roles: Bitcoin is often likened to digital gold and serves as a store of value, whereas Ethereum functions as a platform for decentralized applications and smart contracts

Investing in cryptocurrency involves navigating inherent risks stemming from price volatility, regulatory ambiguities, and security vulnerabilities. However, it also presents an enticing opportunity for substantial returns and portfolio diversification. Prudent investors should diligently research, grasp the intricacies of blockchain technology and market trends, and carefully evaluate their risk tolerance and investment objectives before venturing into the world of cryptocurrencies.

2. Literature Review

Cryptocurrency Bitcoin and traditional stocks have garnered significant attention as alternative investment options in recent years. A review of the existing literature reveals various perspectives on their performance, characteristics, and interrelationships within the financial landscape.

(Lembaga Riset, Publikasi, dan Konsultasi Jonhariono) examines the comparative performance of Bitcoin and stocks as alternative investments. Their review encompasses studies evaluating factors such as returns, volatility, risk, and correlation with traditional assets. The findings offer insights into the potential benefits and drawbacks of including Bitcoin in investment portfolios.

(IEEE, 2019) contributes to the understanding of cryptocurrency through a comparative analysis with foreign exchange (forex) and stock markets. Their review surveys research on the characteristics, market dynamics, and regulatory frameworks of these assets, shedding light on the evolving landscape of digital currencies within the broader financial ecosystem.

(Imran Yousaf and Shoaib Ali, 2021) delve into the linkages between stock and cryptocurrency markets, particularly during the COVID-19 outbreak. Their review investigates factors such as market volatility, investor behavior, and the impact of external events on the interconnectedness of these markets, providing valuable insights for intraday analysis and risk

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management strategies.

(Meiryani, Marco, Albert, and Nada Ayuanda, 2023) conduct a comparative analysis of investment performance between Bitcoin, gold, and stocks. Their findings highlight differences in returns, volatility, and correlation, aiding investment decisions and portfolio diversification strategies.

(Gil-Alana, Abakah, and Romero Rojo, 2020) explore the relationship between cryptocurrencies and stock market indices. Their review reveals evidence of correlation and co-movement between these asset classes, suggesting potential implications for portfolio management and risk mitigation strategies.

(Permatasari and Widodo's, 2023) literature review compares stock, mutual fund, and cryptocurrency investments, examining factors such as risk, return, and liquidity. Their

findings contribute to understanding the suitability of these assets for investment portfolios and risk management practices.

(Kirsch, 2021) investigates the efficiency and usefulness of cryptocurrency indices relative to traditional benchmarks like stock indices. Their review offers insights into the methodologies, composition, and performance metrics of cryptocurrency indices, aiding investors and analysts in evaluating these alternative investment vehicles.

(Caferra and Vidal-Tomás,) analyze the dynamics of cryptocurrency and stock markets during the COVID-19 pandemic. Their review explores factors such as market volatility, investor sentiment, and government interventions, providing insights into the resilience and divergent behavior of these markets amidst crises.

3. Research Gap

After meticulously reviewing numerous research papers, it has come to light that while there exists a plethora of studies on investment opportunities, surprisingly, no comprehensive comparison has been undertaken between traditional and modern investment avenues. Thus, this endeavour represents our earnest attempt to bridge this gap and shed light on the contrasting dynamics of these two approaches by comparing the volatility of Stocks that represents the traditional approach and Cryptocurrency that represents the modern approach of investment.

4. Objective of the study

The comparison of volatility and return of traditional (Reliance Industries) and modern (Bitcoin) instrument of investment to find out which avenue is suitable for investing is the main objective of the study. Identification of volatility drawdown by using ARCH AND GARCH

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model is the secondary objective of the study.

5. Description of Data and Research Methodology

5.1. Data

For the purpose of fulfilment of the required objective and to address the research gap, we collected price and return data on Reliance Industries and Bitcoin from January 1, 2019, through February 21, 2024, spanning over 5 years. The data for both the investment instruments were accounted on daily basis and extracted from an online website www.yahoofinance.com

The data of both the instruments are represented with the help of the following graph.

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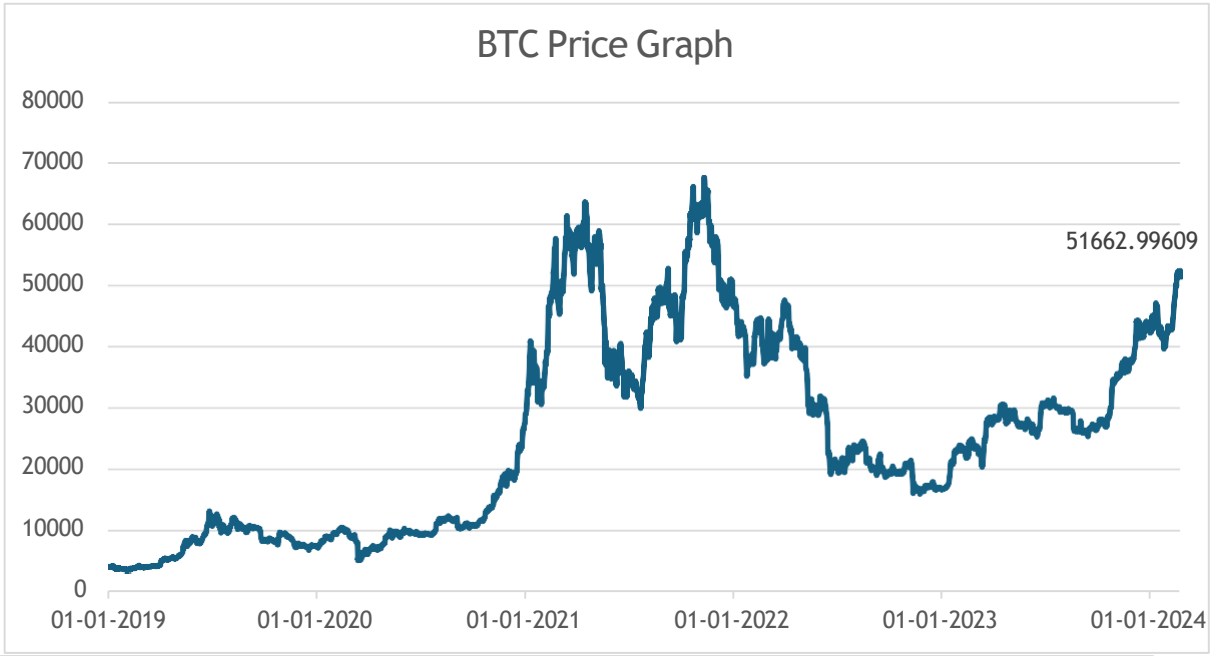

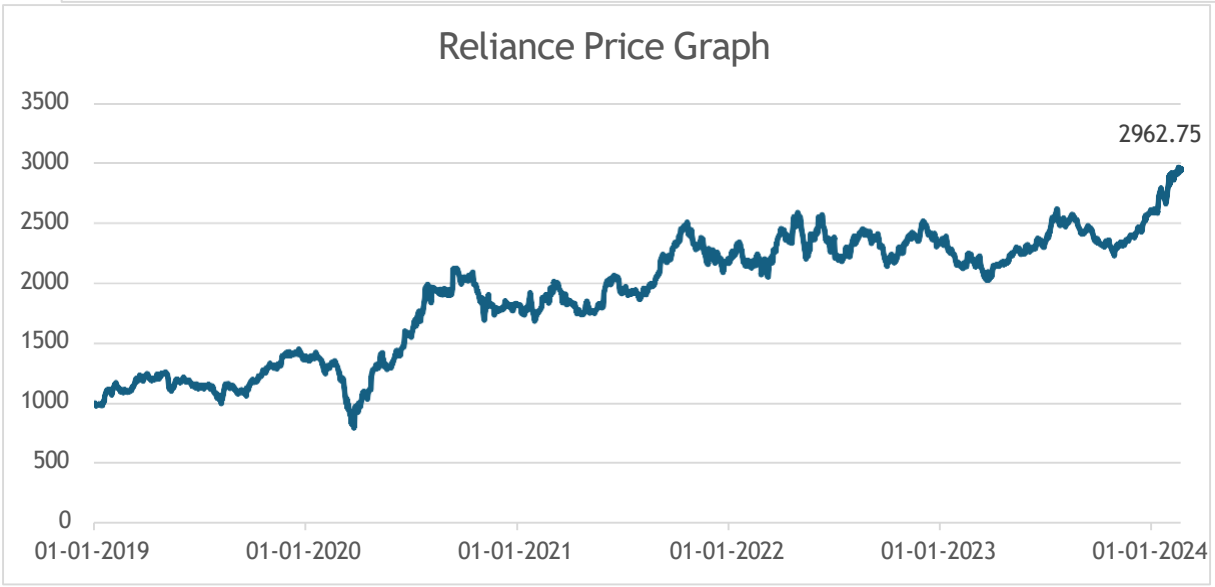

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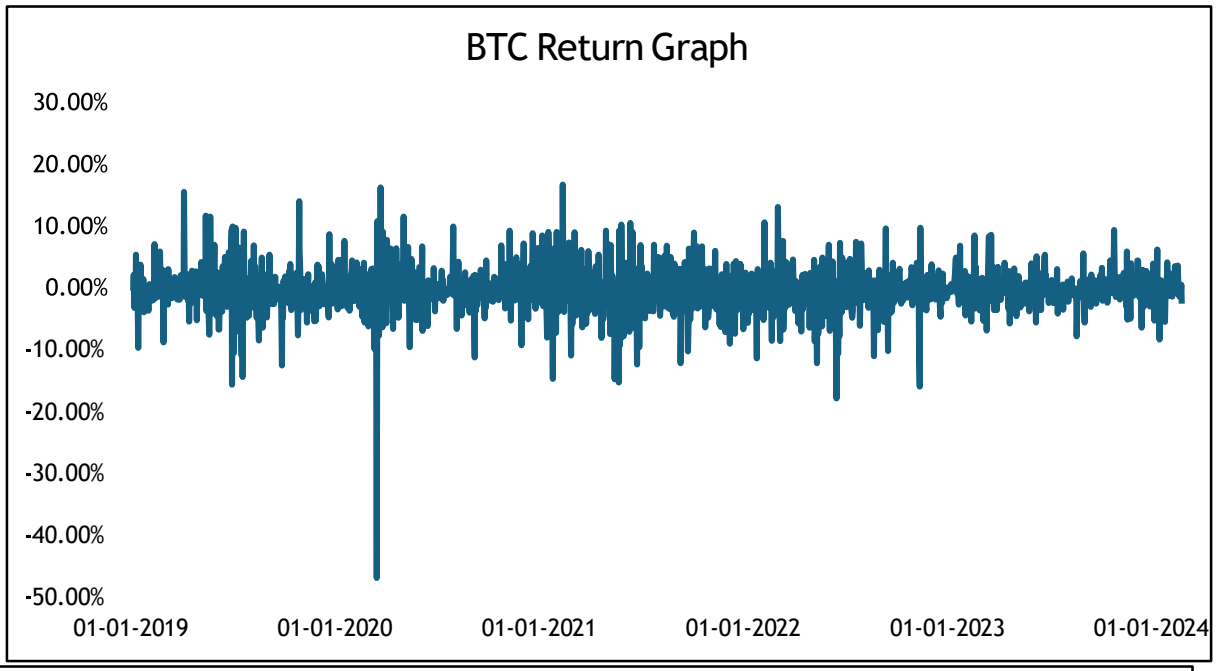

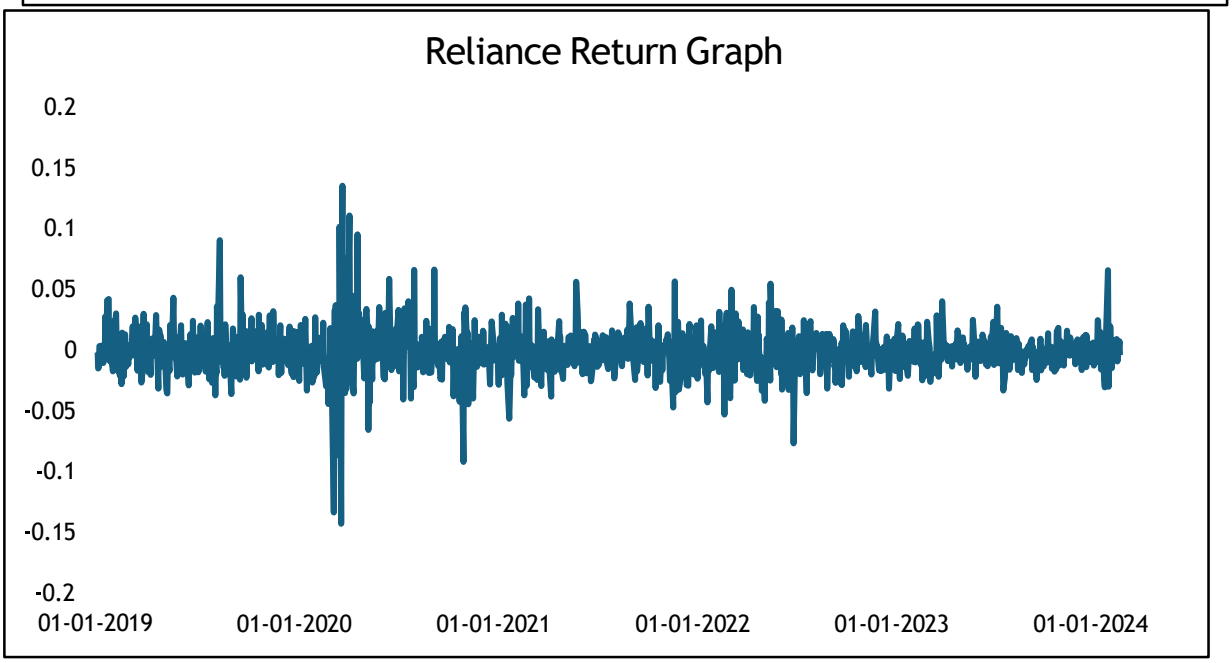

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5.2. Methodology

Descriptive statistics, a tool for summarizing and structuring data, served as the foundation for comparing the volatility of returns for Reliance Industries and Bitcoin. This comparison provided valuable insights into the inherent risk associated with each investment, aiding investors in making informed decisions.

While descriptive statistics have been used to compare the volatility of Reliance Industries and Bitcoin, it's crucial to understand how each measure contributes and their limitations in this context. Here's how:

Central tendency (mean, median, mode):

- **Mean:** Identifies the single "typical" value for each asset's historical returns.
- **Median:** Indicates the value at the center of the data, potentially less affected by outliers compared to the mean.
- **Mode:** Shows the most frequent return value, highlighting potentially recurring price levels.

Measures of spread (standard deviation, range, IQR):

- **Standard deviation** is a statistical measure that quantifies the amount of variation or dispersion of a set of data from its mean. In simpler terms, it tells you how spread out the data is from the average value.
- **Range** refers to the difference between the highest and lowest values in a dataset.
- **IQR**, or Interquartile Range, is another measure of variability in statistics, focusing on the middle 50% of the data. It offers valuable insights compared to range, especially when dealing with skewed distributions or outliers.

Shape of distribution (skewness, kurtosis): Reveal how frequent large price movements are.

- **Skewness** is a measure of the asymmetry of a distribution. A distribution with a positive skew has a larger tail on the right side, whereas a distribution with a negative skew has a longer tail on the left. The distribution in this instance has a somewhat longer tail on the right side, as indicated by the slightly positive skewness.
- **Kurtosis** is a metric used to quantify how peaked a distribution is. In comparison to a normal distribution, a distribution with a high kurtosis is more peaked, and one with a low kurtosis is flatter. Because of the negative kurtosis in this instance, the distribution is flatter than a normal distribution.

Jaruqe-Bera: The Jarque-Bera test is a statistical test for normality. It tests the null hypothesis that the data come from a normal distribution against the alternative hypothesis that the data do not come from a normal distribution.

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The test statistic is calculated as follows:

JB = n/6 * (S^2 + (K-3) ^2)

n = sample size

S = sample skewness

K = Kurtosis

5.2.1. Logarithmic Return

Logarithmic return, also known as continuously compounded return or log return, is a way to measure the rate of return on an investment over a period of time. It is calculated using the natural logarithm of the ratio of the final value of the investment to its initial value.
The formula for calculating the logarithmic return r is:

$$z_t = \log\left(\frac{p_t}{p_{t-1}}\right)$$

Pt = initial value of the investment

5.2.2. ARCH Effect Test

Moving ahead with analysing the data, in the wake of checking the stationarity through unit root test, it is important to satisfy another credential which estimates the presence of ARCH/GARCH impact. In order to verify the existence of heteroscedasticity in the residuals the Auto Regressive Conditional Heteroscedasticity Lagrange Multiplier Test (ARCH-LM) is being adopted. (Mr. Vikram Singh, Ms. Ankita Hotwani, Dr. Anil Kumar Goyal, 2022)

H0 = There is no ARCH effect

$u^2_t = \gamma_0 + \gamma_1 u^2_{t-1} + \gamma_2 u^2_{t-2} + \ldots + \gamma_p u^2_{t-p} + v_t$

where

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u = squared residual

5.2.3. GARCH Model

The ARCH/GARCH Family models are supposed to be the development procedures which are utilized for estimating or foreseeing the instability and are supposed to be the way better methods which were prior being taken on generally to gauge or anticipate the unpredictability, as these models have beaten the constraints of conventional models. (Mr. Vikram Singh, Ms. Ankita Hotwani, Dr. Anil Kumar Goyal, 2022)

The least difficult yet most generally acknowledged and took on GARCH model is GARCH (1,1) model. The provisions of GARCH (1,1) model is stated beneath. (Brooks & Rew, 2002)

Conditional Mean Equation:

$$y_t = \beta_0 + \varepsilon_t$$

Conditional Variance Equation:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i \, h_{t-i}$$

Yt = Conditional Mean

ε_r = Error Team

h_t = Conditional Variance

P and Q = Lags of error term

On the basis of AIC and SIC criterion the optimum lag is decided. In the model GARCH(1,1) where the equation (5) converted to equation (6) and P=1 and Q=1.

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

Where

α = Coefficient of ARCH term

β = Coefficient of GARCH term

'α_0' and 'β_0' denote constant terms. If the α is higher, it means that you are responding better

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to the information, and if the β is higher, it means that it will take the time for the change to decrease. α + β observes the persistence of the series.

5.2.3. TGARCH Model

(Black, F. ,1976) originated the anticipated volatility model to observe the unsymmetrical behaviour of a series. Further this framework was endorsed by other researchers, such as (Schwert, 1990). The TGARCH conditional variance equation is as follows (Enders, 2004):

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \lambda \varepsilon_{t-1}^2 d_{t-1}$$

were d_{t-1} = dummy variance taken as 1 when $\varepsilon_{t-1} < 0$ and is zero if $\varepsilon_{t-1} \geq 0$. Dummy signifies the existence or nonexistence of some of the attributes. If the dummy variable coefficient (λ) is statistically significant, it says that there is a presence of leverage effect.

6. Empirical Results

6.1. Descriptive Statistics

Table 1 presents the descriptive statistics of the differenced data of the traditional and modern investment avenue. The mean for both the investment instruments are positive indicating about the increment of the average return over a period of time. BTC has a significantly higher standard deviation, suggesting it is more volatile compared to Reliance. BTC indicating higher average return compared to Reliance Ltd. BTC returns have a negative skew, suggesting more frequent negative returns, while Reliance returns have a slight positive skew. BTC has a higher sample variance, indicating greater dispersion in returns. Both assets have positive kurtosis, indicating heavy tails and potential for extreme returns, but BTC's kurtosis is significantly higher, indicating even greater potential for extreme returns or outliers.

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Table 1. Descriptive Statistics of Reliance Industries Ltd. and Bitcoin.

Descriptive statistics		
	Reliance Return	**Btc Return**
Mean	-0.000847	0.001379
Median	-0.000628	0.000810
Maximum	0.141032	0.171821
Minimum	-0.137307	-0.46473
Std. Dev.	0.019041	0.035174
Skewness	-0.140003	-1.227193
Kurtosis	12.70743	22.05549
Jarque-Bera	4986.776	28884.87
Probability	0.000000	0.000000
Sum	-1.074756	2.589606
Sum Sq. Dev.	0.459731	2.322182
Observations	1269	1878

6.2. Return Comparison

To assess the performance of Reliance Industries and Bitcoin over a five-year period from January 1st, 2019, to February 22nd, 2024, the comparison is made based on two metrics: Compound Annual Growth Rate (CAGR) and Daily Average Return. These metrics are utilized to identify the instrument that has generated the highest return during the specified timeframe.

Table 2. Return comparison based on CAGR and Daily Average Return.

	Reliance	**BTC**
End Value	2942	51213
Begin Value	1004.360291	3843.52
Period	6	6
CAGR	**19.62%**	**53.97%**
Daily Average Return	**0.08%**	**0.14%**

The provided table offers a comparative analysis of the performance metrics for Reliance and BTC spanning five years from January 1st, 2019, to February 22nd, 2024. It includes the final and initial values of each investment, indicating the duration of the investment period. Notably,

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BTC outperforms Reliance in both metrics: Compound Annual Growth Rate (CAGR) and Daily Average Return. With a CAGR of 53.97% and a daily average return of 0.14%, BTC exhibits significantly higher growth and return rates compared to Reliance, which achieved a CAGR of 19.62% and a daily average return of 0.08%. This underscores BTC's superior performance over the specified period.

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6.3. ADF Test

After meeting the necessary prerequisites in the descriptive statistics for a financial time series and finding evidence in the values, we proceed by conducting a stationarity test on both exchange rates. The table below presents the results of the Augmented Dickey-Fuller Test, which assesses the stationarity of the series, as part of our study's objective.

Table 3. Unit Root Test Results Table (ADF Test)

H_0: the variable has a unit root.

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

		At Level	
		RELIANC...	BTC_RETURN
With Constant	t-Statistic	-37.3335	-45.6009
	Prob.	***0.0000*** ***	***0.0001*** ***
With Constant & Trend	t-Statistic	-37.3224	-45.6030
	Prob.	***0.0000*** ***	***0.0000*** ***
Without Constant & Trend	t-Statistic	-37.2708	-45.5392
	Prob.	***0.0000*** ***	***0.0001*** ***
		At First Difference	
		d(RELIA...	d(BTC_RETURN)
With Constant	t-Statistic	-21.4264	-19.1439
	Prob.	***0.0000*** ***	***0.0000*** ***
With Constant & Trend	t-Statistic	-21.4178	-19.1386
	Prob.	***0.0000*** ***	***0.0000*** ***
Without Constant & Trend	t-Statistic	-21.4349	-19.1490
	Prob.	***0.0000*** ***	***0.0000*** ***

6.4. Heteroskedasticity Test (ARCH-LM Test)

The next step in the stationarity testing involves the ARCH-LM test, which confirms the existence of ARCH effects in the financial time series data. The ARCH effect refers to the presence of heteroskedasticity in the residuals. The differenced data of both investment instruments underwent ARCH-LM Tests, and the results, as shown in Table 3 and Table 4, indicate that both series exhibited ARCH effects.

Table 4. Heteroskedasticity Test: ARCH for Reliance Return

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F-statistic	46.207	**Prob. F(1,1266**	0.03870
Obs*R-squared	44.65033	**Prob. Chi-Square(1)**	0.02270

Table 5. Heteroskedasticity Test: ARCH for BTC

F-statistic	3.094984	**Prob. F(1,1874)**	0.0787
Obs*R-squared	3.093178	**Prob. Chi-Square(1)**	0.0086

6.5. Volatility Comparison (GARCH (1,1) Model)

The results endorse proceeding with ARCH-based models for further analysis. To explore the data, both plain vanilla GARCH (1,1) and E-GARCH models are adopted to forecast the asymmetric, time-varying volatility in the series.

Table 6. Volatility Comparison test using GARCH (1,1) Model

Parameters	Reliance	BTC	p value
Constant	1.09×10^{-5}	9.2×10^{-19}	0.0001
Alpha	0.093701	0.122255	0.0000
Beta	0.876057	0.817264	0.0001
Alpha+ Beta	0.969758	0.939519	
E- Garch	0.975969	0.915493	0.0000
Volatility Die Out Days	**23**	**11**	

The application of the ARCH-GARCH model to analyze the volatility dynamics of Reliance and Bitcoin reveals distinct patterns in their respective behaviors. Reliance exhibits a lower baseline volatility, with a constant of 1.09×10^{-5}, compared to Bitcoin's higher baseline volatility of 9.2×10^{-19}. However, Bitcoin demonstrates a stronger influence of past squared residuals on current volatility, with an alpha coefficient of (0.122255) compared to Reliance's (0.093701). Conversely, Reliance shows a slightly higher impact of past conditional variances on current volatility, with a beta coefficient of (0.876057) compared to Bitcoin's (0.817264). When considering the combined effect of persistence, Reliance has a marginally higher alpha plus beta value (0.969758) compared to Bitcoin (0.939519). Both assets display a strong adherence to past volatility patterns, though Reliance has a slightly higher E-Garch value (0.975969) than Bitcoin (0.915493), indicating a closer relationship between current and past volatility. Additionally, Reliance's volatility takes longer to decay, with a volatility die-out period of (23) days, whereas Bitcoin's volatility dissipates more rapidly, with a die-out period

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of (11) days. In summary, while both assets share similar volatility dynamics, Bitcoin tends to exhibit higher baseline volatility and a shorter duration of volatility persistence compared to Reliance.

7. Conclusion

In conclusion, the research paper contributes valuable insights into the risk-return dynamics between stocks and cryptocurrencies. The empirical results consistently demonstrate Bitcoin's superior performance in terms of growth and returns over the specified period. Despite its higher volatility, the cryptocurrency's potential for substantial gains becomes evident. The findings suggest that investors seeking higher returns may find cryptocurrencies, particularly Bitcoin, to be an attractive option.

The study underscores the importance of understanding the risk associated with each investment avenue and emphasizes the need for investors to consider their risk tolerance and financial goals. The ARCH and GARCH models provide a robust framework for analyzing and comparing the volatility of Reliance and Bitcoin. The identified research gap has been

effectively addressed, offering a comprehensive comparison between traditional and modern investment options.

Overall, the research paper contributes to the growing body of knowledge on the evolving landscape of financial markets, providing valuable insights for investors, researchers, and policymakers navigating the dynamic intersection of stocks and cryptocurrencies.

8. Managerial Implication of the Study

Stock and Cryptocurrency serves as a crucial parameter for identifying better investment avenues. It is being considered as a financial parameter when determining the investment avenues for the traders, investors and big institutions. The fluctuations in the volatility of these instruments have a direct impact on the investment decisions of investors. Hence, predicting the nature of volatility will be helpful for the policy makers and market to make the decision wisely. The study will also help the government in framing the investment policies which will have a direct impact on the economy of the nation.

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