Market Volatility Assessment—A Comparative Study Between Cryptocurrencies and the Nifty 50 Indices

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ABSTRACT

Financial instruments are subjected to market volatility and volatility helps in evaluating the risk, return and uncertainty associated with the investment. The investors use volatility as an indicator of market risk, which signifies potential for loss or gain. In this paper we have made an attempt to analyze volatility pattern between cryptocurrency, a new age digital asset class and NIFTY 50 Index. We have computed daily returns, Sharpe ratio and volatility metrics (e.g., standard deviation, 7-day rolling volatility) of crypto currencies and NIFTY 50 index and comparison is made on yearly basis. The aim of this research paper is to assess and compare the performance, volatility, and investment attractiveness of 4 major cryptocurrencies (BTC, ETH, SOL, XRP) against Nifty 50, covering (2020-2024) market cycles, global events the COVID-19 Pandemic, regulation changes, increased adoption. For the study purposive sampling has been used to gather data from nift-50 index and 4 most liquid cryptocurrencies. Microsoft excel has been used for initial data cleaning and visualizations and correlation metrics are created using python. The study has revealed that cryptocurrency is more volatile with high return as compared to the low to moderate volatile Nifty 50 Index.

Keywords: Cryptocurrency, NIFTY-50, Volatility, Risk & Returns

INTRODUCTION

In the last decade, cryptocurrencies-a new age asset class have emerged and that has had a profound impact on the financial markets. Among all the digital assets, Bitcoin (BTC), Ethereum (ETH), Solana (SOL) and XRP that are powered by blockchain technology, have reached a global prominence for their high returns, increased liquidity and a revolutionary approach towards value transfer. These are highly speculative assets, which are notoriously volatile, mostly due to market sentiment, investor behaviors, social media trends, etc. These assets are different from traditional financial instruments, which are regulated, follow macroeconomic fundamentals, produce periodic earnings reports, receive institutional activity, trade 24/7 and behave in previously unimagined ways.

For the Indian context, the NIFTY 50 index, containing the 50 most liquid stocks over the NSE, has been functioning as an index for the stock market performance as well as for investor's confidence, which shows relatively stable and predictable behavior with the oversight of Securities and Exchange Board of India (SEBI). BTC; the first cryptocurrency creates a store of value. ETH and SOL, the smart contract platforms and XRP a payment network are selected based on the representation as key segments of digital asset ecosystem. This research on the matter acts as a timely resource considering increasing crypto investment interest in India especially among the younger age groups, which, despite the ambiguity, is still rising, and provides insights on how crypto assets could improve or deteriorate the performance of traditional equity assets. Finally, this research hopes to bring analogous understanding of digital and emerging equity markets together, which is beneficial to investors, policymakers and financial advisors in dealing with risks

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and opportunities in the interrelated financial realms of the digital and emerging equity markets.

LITERATURE REVIEW

Swami, A. & Chakraborty, B. (2022) employ daily return data and a 2-day rolling volatility metric to compare digital assets with traditional indices. The study points that the volatility of the cryptocurrencies (Bitcoin and Ethereum) is nearly three to five times greater than volatility in regulated markets such as the NIFTY 50. The authors suggest that this phenomenon is caused by continuous trading, the lower liquidity, and investor speculation. *Gopalan, R. & Singh, V. (2020)* used econometric models that can capture spillover effects to analyze how shocks to cryptocurrency markets transmit on the traditional market. Their findings suggested both markets are influenced by global events, but cryptocurrencies react quicker, and it is mainly attributable to the decentralized nature of cryptocurrencies and their higher sensitivity to regulatory news. *Desai, R., Patel, S. & Kumar, A. (2021)* examines the risk-return profiles of cryptocurrencies versus traditional assets using the Sharpe ratio and Value at Risk (VaR). They conclude that despite the high returns, cryptocurrencies are risky and less attractive when risk adjusted returns are used for evaluation.

Rao, P. & Menon, K. (2021) mainly focused on measuring the impact that liquidity measures can have on the volatility that has been so often found in cryptocurrency exchanges and discovers that thinner order books and lower market depth contribute to the extreme price swings therein. *Kulkarni, S. & Banerjee, M. (2022)* examine how events and policy changes in this regulatory space cause cryptocurrency volatility. The authors then use event study methodology to illustrate that taxes and KYC norms announcements in the crypto market result in strong subsequent price corrections, in contrast to slowly reversible regulatory interventions in traditional markets.

Singh, R. & Malhotra, D. (2021) use the techniques of sentiment analysis to apply social media data to examine the correlation of investor emotions and behavior to herd in generating various crypto price movements. Sentiment driven trading is found to play a major role in the high volatility seen in cryptocurrencies, as against such a contribution from trading on fundamentals in case of NIFTY 50. *Verma, S. & Gupta, N. (2020)* investigate how digital assets, despite their very high volatility, offer diversification benefits. They used regression analysis and portfolio optimization to demonstrate how crypto assets can even reduce the overall portfolio risk if 5–10% of this is allocated to crypto due to low correlation with traditional assets. *Iyer, L. & Rao, A. (2022)* employ time-series analysis to trace how the effects of macroeconomic news affect volatility in the cryptocurrency market and the equity market. The authors found that NIFTY 50 responds mainly to economic indicators and policy announcements, cryptocurrencies respond almost primarily to global events and shifts in global sentiment. *Thomas, M. & Yadav, S. (2020)* observe the role and amplifying of the cryptocurrency volatility through cognitive biases like overconfidence and herd mentality. The authors demonstrate, via both survey data and empirical analysis, that such behavioral factors result in rapid price increases, then severe corrections, which is a pattern that is less pronounced in a more traditional equity market. *Zhao, T. & Li, J. (2022),* using high frequency trading data, look into the degree that algorithm trading contributes to the quick price fluctuations in cryptocurrencies. The analysis suggests that automated trading provokes excessive volatility during stressed markets whether it be in crypto or other markets that have low liquidity.

Kapoor, R. & Deshmukh, A. (2021) use the vector autoregression (VAR) models for determining the extent of volatility spillover from cryptocurrencies to the NIFTY 50, in terms percentage contribution. Moreover, the results show that there is at least some spillover occurring; however, the correlation remains low, supporting the point of diversification. *D'Souza, F. & Raman, P. (2020)* have made comprehensive digital asset risk management framework which consists of VaR, stress testing, and scenario analysis. Their analysis concludes that though cryptocurrency returns may be enticing, they have significant extreme volatility that needs to be well managed with sophisticated risk mitigation approaches to realize the upside. *Patel, M. & Goyal, V. (2022)* investigate how liquidity restrictions worsen the volatility in Bitcoin and Ethereum by stress-

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testing liquidity measures and various market manipulation techniques. The authors discuss the effect of low liquidity on price stability using order book data and compare these with the liquidity nature of traditional equity markets. *Sharma, K. & Mukherjee, S. (2021)* take a long-run view of cryptocurrency volatility relating price stability with maturity of the market as well as changing regulatory environments. In the mature and improving regulatory clarity of the digital asset markets, volatility levels temper by means of longitudinal data analysis methods used by the authors.

Objectives

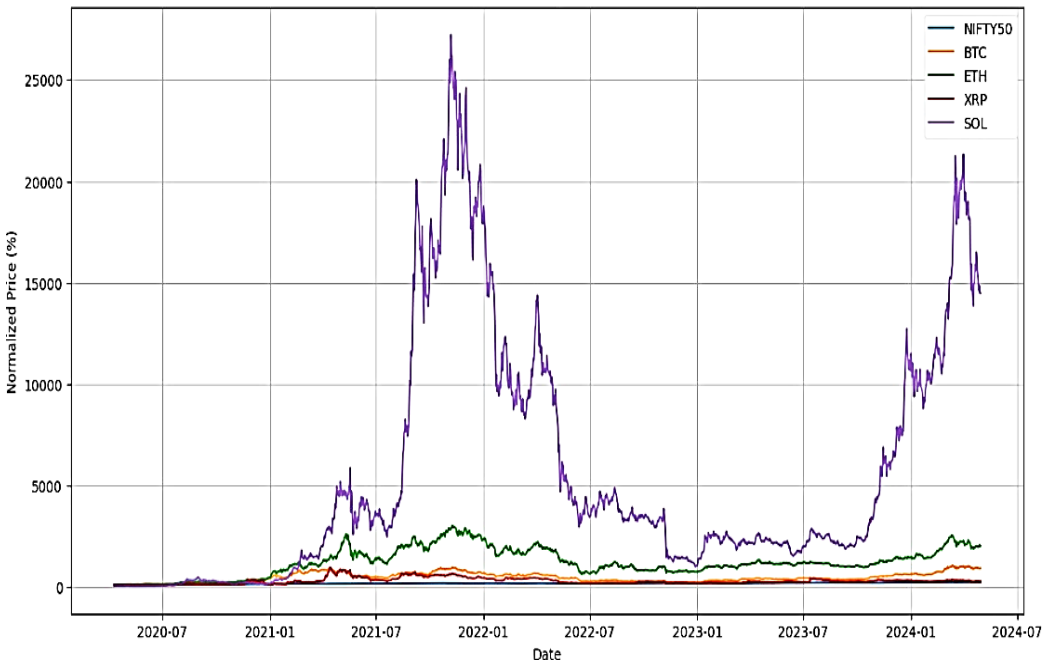
- To study the theoretical foundation and conceptual framework of crypto currencies.
- To evaluate the risk and return of cryptocurrency markets and NSE nifty 50 indices.
- To assess and compare the volatility pattern and price performance of selected Cryptocurrencies with NIFTY-50.

DATA & METHODOLOGY

Targeted population for the study consists of Indian stock market indices and cryptocurrencies. To find the better match for the study authors have chosen NSE Nifty 50 Index and 4 most liquid and most traded cryptocurrencies (BTC, ETH, SOL, XRP). Five years data (2020-2024) related to daily closing prices, trading volumes, and returns are sourced from Yahoo Finance, NSE India, cryptocurrency exchanges and aggregators like Investing.com using purposive sampling methods. Microsoft excel has been used for initial data cleaning and statistical calculations. Python programming has been used for data visualization, comparison of volatility patterns, market dynamics and running advanced calculations.

Data Analysis And Interpretation

Figure 1.1 Price Performance Comparison (2020–2024)



The above graph shows the normalized price trends of all the four cryptocurrencies (BTC, ETH, XRP, SOL) and the NIFTY 50 index for a period of 5 years. This translates to the fact that cryptocurrencies have much lower price volatility than NIFTY 50, their returns are also much higher with steep rallies and steep falloffs

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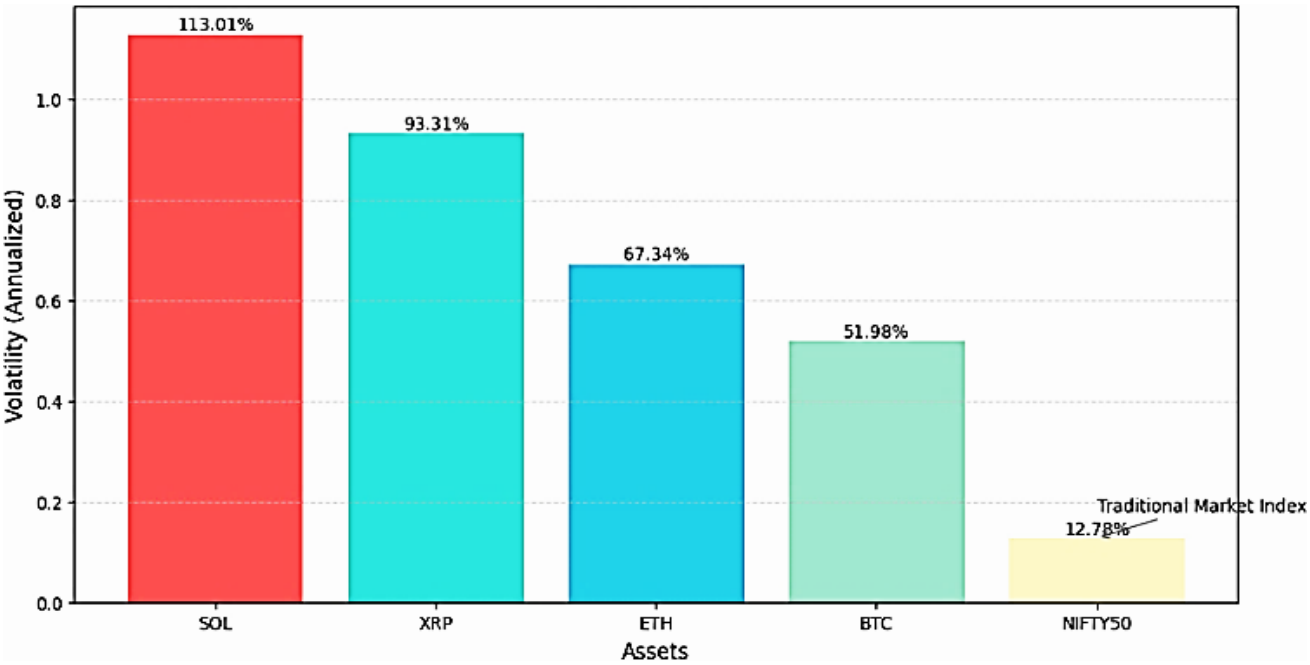
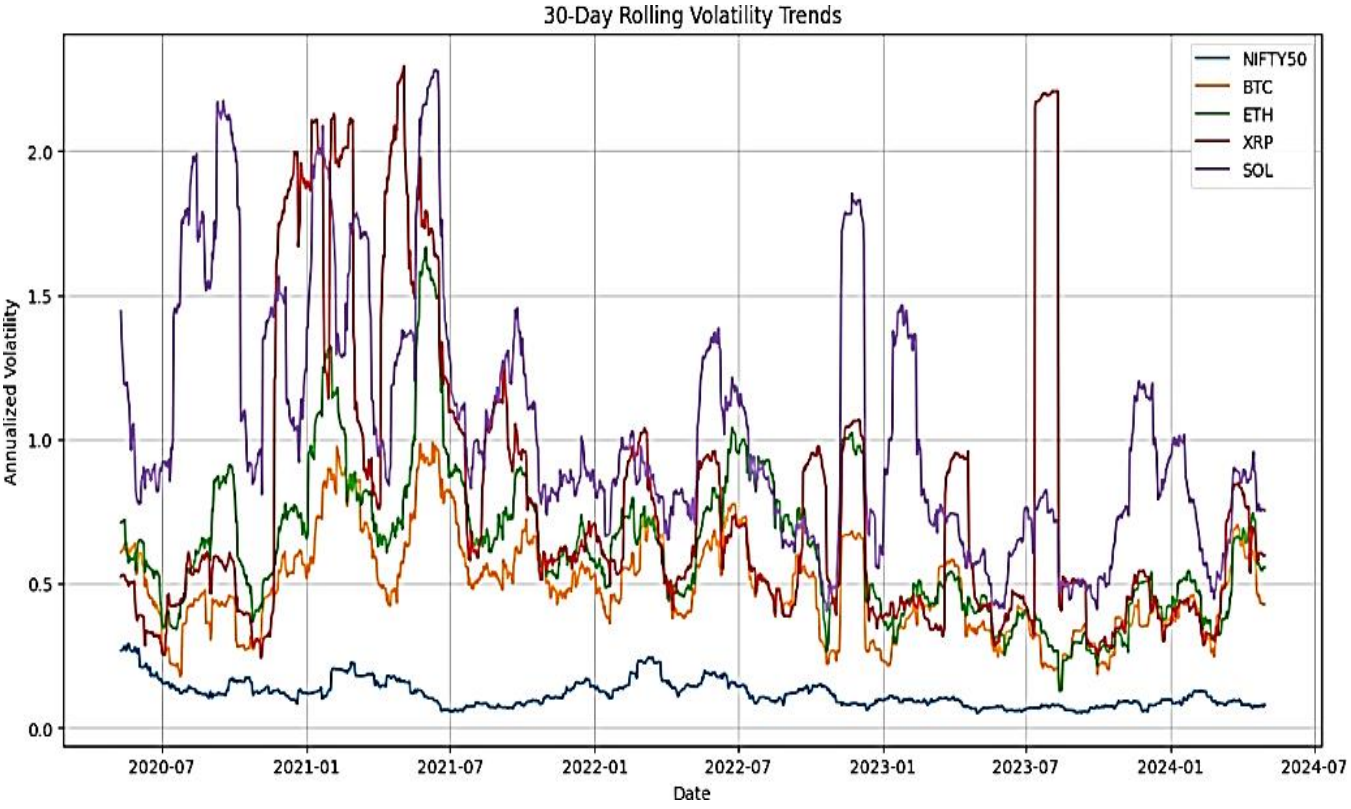
Figure 1.2: Annualized Volatility Comparison (2020–2024)



The figure 1.2 compares the volatility between different cryptocurrencies (SOL, XRP, ETH, BTC) and traditional assets. During speculative trading, the volatility of SOL (113.01%) and XRP (93.31%) is very high while the level of liquidity is low. Smaller cryptos are volatile compared to ETH (67.34%) and BTC (51.98%). The NIFTY 50 (12.78%) and the broader Traditional Market Index are less volatile due to regulatory oversight, the existence of institutional participation, and stable fundamentals.

Figure 1.3: 30-Day Rolling Volatility Trends



30 days rolling volatility trends track volatility as it moves around during short periods. It is a key insight where cryptos face frequent volatility spikes.

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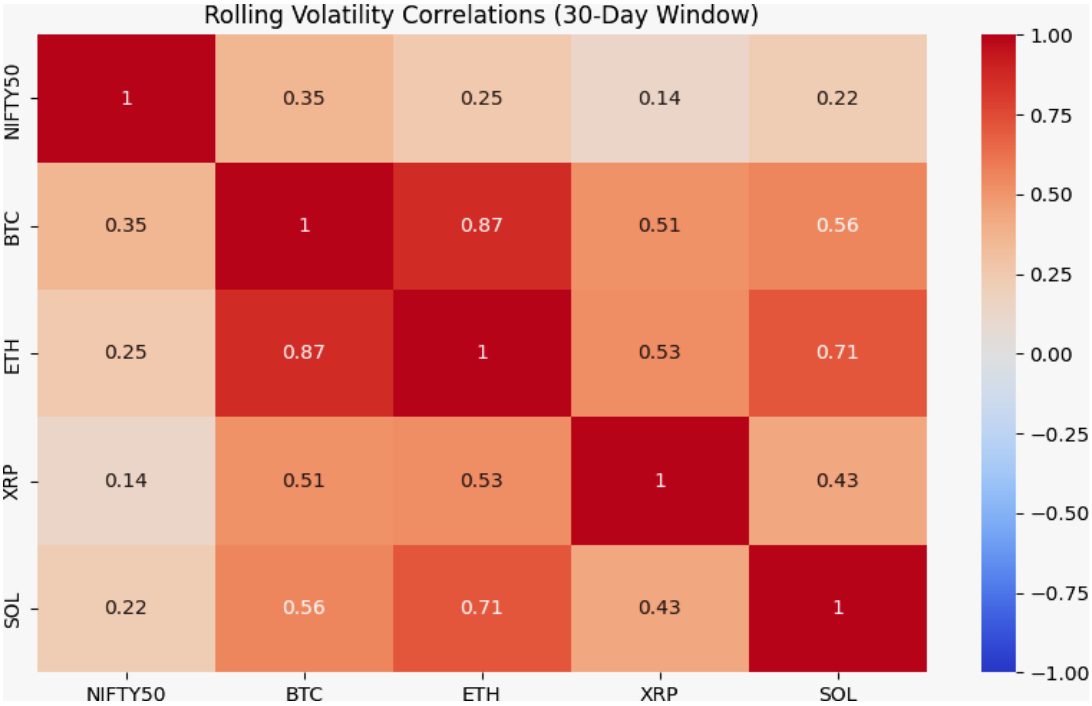
Table 1.1 Risk Metrics Comparison

	Annualized Volatility	Max Daily Return	Min Daily Return	Sharpe Ratio (Rf=0)	VaR (95%)	Max Drawdown
NIFTY50	12.78%	4.74%	-5.74%	127.69%	-1.25%	17.23%
BTC	51.98%	18.75%	-15.97%	99.05%	-5.02%	76.63%
ETH	67.34%	25.95%	-27.20%	109.93%	-6.32%	79.35%
XRP	93.31%	73.08%	-42.33%	62.20%	-7.19%	83.25%
SOL	113.01%	47.28%	-42.28%	130.95%	-9.26%	96.27%

Given table shows comparative data of the key risk-return metrics for NIFTY 50 and key cryptocurrencies. The NIFTY 50 exhibits low volatility at 12.78%, with modest daily swings—a maximum gain of 4.74% and a loss of -5.74% and a relatively small maximum drawdown of 17.23%. Its Sharpe ratio of 127.69% and VaR of 95% at -1.25% are a sign of a stable performance with little downside risk. Whereas cryptocurrencies like Bitcoin and Solana are highly volatile ranging from 51.98% for Bitcoin and 113.01% for Solana with a maximum daily return as high as 73.08% in the case of XRP and daily entry loss as deep as -42.33% or more. While some crypto assets such as Solana with a Sharpe ratio of 130.95% are attractive from the perspective of risk adjusted returns, at the same time, the maximum drawdown may exceed 96.27%, signifying high risks of losses. Thus, the table shows a balance between the stability of traditional equities and the high risk and reward of cryptocurrencies.

Figure 1.4: Rolling volatility correlation



Crypto volatility is indeed decreasing for institutional adoption, but it does not seem to be able to eliminate the inherent risks of crypto.

Rolling Volatility Correlations (30-Day Window) Displays correlation coefficients between asset volatilities. The low correlation between NIFTY 50 vs. Cryptocurrencies (0.14–0.35) indicates the scope of diversification. BTC and ETH have very high intra-economic correlation (0.87), making them dependent and decreasing diversification potentials within crypto portfolios.

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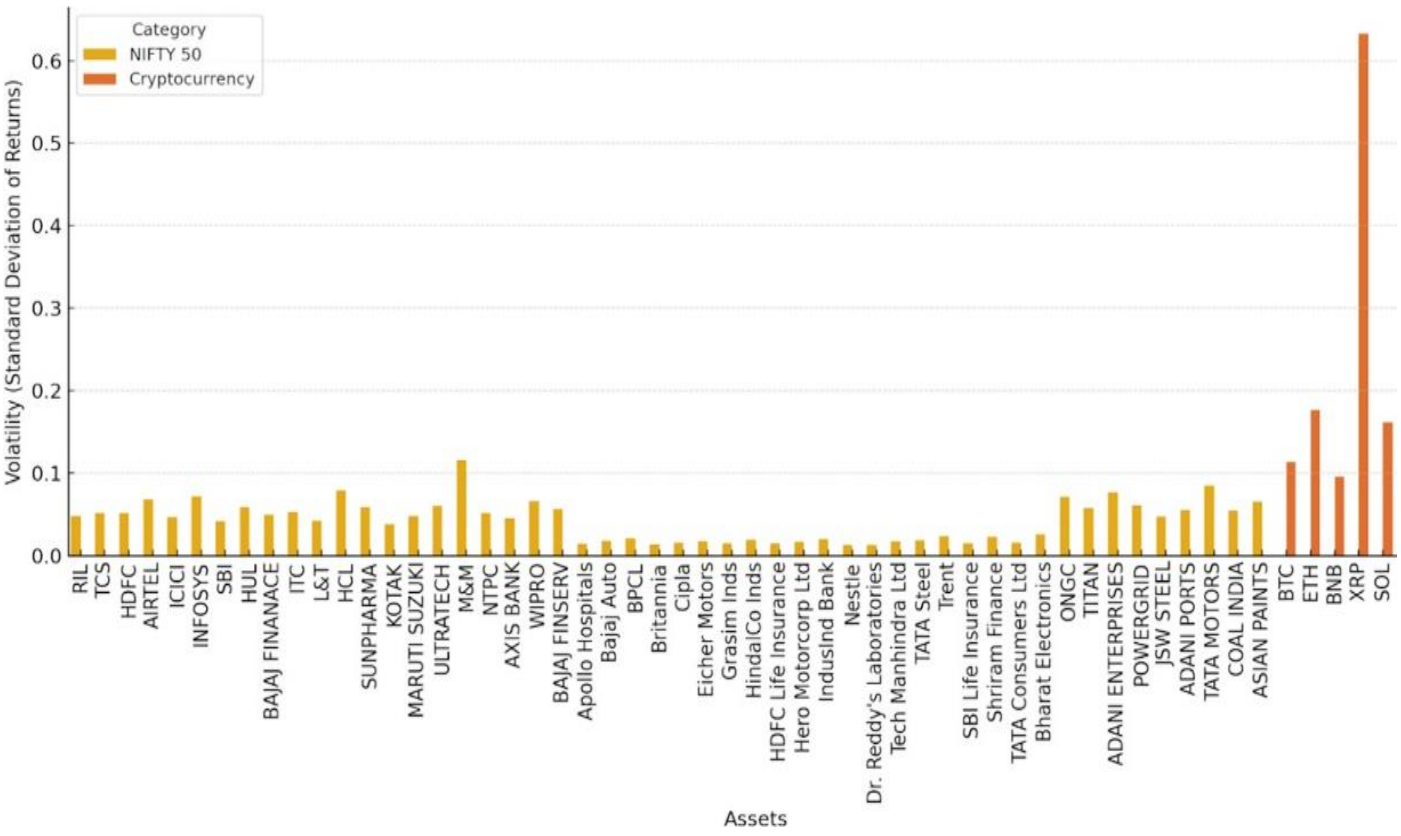
Figure 1.5



Cryptocurrencies (BTC, ETH, XRP, and SOL) exhibit significantly higher volatility than NIFTY 50 stocks. The volatility in the NIFTY 50 stocks is low to moderate because they are in a stable and regulated market environment. Thus, stable or low risk are stocks from NIFTY 50, and high risk but also high reward are Cryptos. It is an advantage to have a mixed portfolio that aims to balance risk and return.

FINDINGS

The study shows major differences between the NIFTY 50 index and cryptocurrencies. For cryptocurrencies, factors like 24/7 trading, low liquidity (e.g., XRP whose 24h volatility lies in the 246% range), and speculation by retail lead to 4 to 8 times more volatility than NIFTY 50 trading at an annualized level (12.78%), and event-driven volatility (e.g., regulatory changes like 30% tax on crypto in India, social media buzz etc) makes the volatility even more extreme. Although cryptos could yield high returns (as witnessed by XRP's +73% daily gain), they also come with catastrophic risks (such as SOL going down by -42% daily and 96% maximum drawdown). While Solana's returns show mixed efficiency, Solana is the more risk-adjusted (Sharpe ratio), marginally beating NIFTY 50's Sharp ratio (130.95% vs. 127.69% respectively), but given the distribution of very high extreme skew, these metrics do not truly depict the threat capacity to wealth of the latter portfolio. Cryptos are potentially diversifiable from traditional equities (low cross-correlation 0.14–0.35), but cryptos have very high intra-crypto correlations (BTC: ETH 87, etc). The presence of risks is notably exasperated by India's regulatory ambiguity, further illustrated by the 70% drop in Indian trading volumes following the deployment of the country's 2022 crypto tax policy, which, thus, contributed to the cryptocurrency's overall volatility.

CONCLUSION

This systematic study of the interplay between volatility dynamics of decentralized cryptocurrencies (Bitcoin, Ethereum, XRP, Solana) and the Indian NIFTY 50 equity index shows across 5 years (2020 – 2024), cryptocurrencies were 4–8 fold more volatile annualized volatility

vs NIFTY 50. What this brings out is how speculative digital assets are, with variables such as 24/7 trading, decentralized governance models, and retail- dominated liquidity, causing periodic large spikes in volatility, of which Solana's 72.56% volatility from 2023 till 2024 is in stark contrast versus NIFTY 50's 9.38% volatility. Even though they showcase remarkably high returns and diversification benefits (via low correlation with the NIFTY 50), investors should acknowledge that there are large tail risks associated with them, which means they require proper risk management techniques, e.g., hedging.

The study indicates to the regulators, especially SEBI and RBI, to act on crypto-equity spillovers through coordinated global frameworks and well-informed investor education to limit retail speculation. At the same time, this research poses a challenge to academia for the creation of consistent metrics and hybrid datasets in order to reconcile the methodological differences of the crypto and traditional markets. Although the NIFTY 50 remains the stable pillar that stimulates economic growth, ultimately, when cryptocurrencies transform from the speculation of coin interest to being viewed as institutional instruments, it is the fine balance of innovation while avoiding danger that will allow these digital assets to become integrated into mainstream finance.

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