

Relationship Between the Cryptocurrency Market and Stock Market

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Abstract : *In recent times, cryptocurrency has created a powerful place in the financial system. The crypto market is relatively new and innovative in comparison to the traditional financial markets. However, the escalation in the price of cryptocurrency is astonishing. The market of cryptocurrency is also famous of high levels of volatility. This risk might also affect the sentiments of investors investing in the stock market. Hence, it becomes imperative to understand if there is any connectedness between the markets. This study seeks to examine if there is volatility spillover from cryptocurrency market to the stock market, and vice versa. We work with two cryptocurrencies- Bitcoin and Ethereum, and the Sensex represents the performance of the Indian Stock Market. We conclude that markets are not cointegrated. Also, there is no causal relationship between the markets. We do not find volatility spillovers between cryptocurrency and stock market. Hence, investors can choose to invest in equity or crypto currencies based on their risk preferences, without the fear of risk in one market affecting the other.*

Keywords: Bitcoin, Cointegration, Cryptocurrency, Ethereum, GARCH, Granger causality, Sensex, Spillover effect

INTRODUCTION

The modern onset of crypto currencies as a technology-based advanced category of financial assets has created a new market for investors. In the recent years, academicians, regulators, investors and general public have shown curiosity in knowing if there is any interrelatedness between the cryptocurrency and stock market. The relationship is more volatile and dynamic with the occurrence of constant market integration between traditional financial assets and cryptocurrencies (Bouri et al., 2017). Globally, the financial markets have witnessed a major change as crypto assets have emerged as an innovative asset which is evolving at an astounding rate. With Bitcoin's increasing popularity, understanding how its prices are correlated with other financial assets is of interest to investors, regulators, and policymakers (Hachachi and Hachachi 2021). The first digital cryptocurrency, invented by Satoshi Nakamoto was Bitcoin. At present, it is the most favored digital currency amongst global investors. In the recent times, Ethereum and Ripple are also gaining momentum (Cross et. al., 2021). The attractiveness of cryptocurrency is evident from the fact that its global market capitalisation is around \$2.08 Trillion (Bech and Garratt, 2017). In the year 2017, the market capitalisation of cryptomarket increased from \$16 billion to a peak of \$535. This indicates that crypto has become a favourite spot for investors globally.

However, this extraordinary hype about the cryptocurrency price was not sustainable and the market crashed in January 2018. In a transitory period of one-year crypto market has suffered a loss of over \$400 billion. (Cross et. al., 2021).

In the recent years, the Indian Stock Market has turned out to be one of the popular and fastest growing stock markets globally. As per the data released by Trade Economics, the SENSEX has reached a remarkably high benchmark of 73427.59 in January' 2024. An important question here arises if crypto volatility has any spillover effect on the Indian Stock market? In our study, we attempt to find an answer for the same. Our objective is to empirically analyze the relationship between the crypto market and the stock market in India, and also to check the presence of volatility spillovers between the two markets.

The study is comprised of six sections including the present one. A detailed literature review is given in the next

section, whereas the data used and methodology is discussed in the third section. The fourth section states the results of the relationship between stock market and crypto currency market. And the fifth section discusses the research findings of the study. Lastly, we present concluding remarks.

REVIEW OF LITERATURE

The tremendous escalation in the value of cryptocurrencies has created a volatile scenario that may move to another financial market from the crypto market or vice-versa. Hence, it is imperative to understand the presence and pattern of volatility spillover between the markets. Hachicha and Hachicha (2021) have also observed an alignment in the movement of prices of various international stock markets and cryptocurrency market. The existing literature shows the spillover effect between Bitcoin and other financial assets (Dyhrberg 2016).

However, there is limited work on exploring the spillover between cryptocurrencies and stock market. The present literature has two different arguments on the relationship between cryptocurrencies and stock market. One group of literature documents negative or weak correlation between crypto and financial assets such as bonds, stocks, commodities and US Dollar. Iyer (2022) found that equity and crypto markets are highly correlated across economies over a short period. Li and Wang (2017) noticed significant volatility spillover between Bitcoin and stock markets. Baumohl (2019) found an inverse relationship between the foreign exchange and crypto market. Yang (2020) observed a nonlinear but significant relationship between Bitcoin and the Taiwan Stock Exchange index. Bouri et al. (2017) also observed significant spillover effects of Bitcoin on both currencies and equities. Significant connectedness between the financial markets and Bitcoin was reported by Matkovskyy and Jalan (2019).

According to some studies, there is a detachment between the cryptocurrency market and stock market. Handika et al. (2019) observed that price movement of stock market in Asia is not aligned with the crypto market and concluded that crypto currencies do not pose a systematic risk to the Asian financial markets. Gil-Alana et al. (2020) argued on non-existence of integration between cryptocurrencies and stock price movement. In their empirical research Corbet et al. (2018) found no interconnectedness between crypto market and stock market. According to Ji et al. (2018), Bitcoin is not found to affect the stock prices, and it moves in isolation from the mainstream market.

There is limited work on the estimation and quantification of spillover effect between stock market and cryptocurrencies for the Indian market. Terraza et al. (2024) applied a multivariate GARCH model to find the time-varying effect of covariation between Bitcoin, Nasdaq stock market, S&P stock market, and Dow Jones stock market. Harb et al. (2022) employed GARCH and SEM to check volatility spillover among the crypto market and the US equity and Bond market. To check the integration between the crypto market and stock market, Mohanan et al. (2023) employed multivariate regression. Gil-Alana et al. (2020) used techniques based on fractional integration and cointegration to establish connectedness between the two markets. Frankovic et al. 2021 and Diebold and Yilmaz (2012) adopted a generalized variance decomposition model to test the nature of volatility spillover effect and returns.

We aim to analyse the connectedness between crypto markets and the stock market, and evaluate if the spillover effect is present.

METHODOLOGY

To evaluate the existence of volatility spillover between crypto market and the stock market in India, we employ data of two cryptocurrencies viz. Bitcoin and Ethereum. The data of Bitcoin ranges from 1st December 2017 to 18th January 2024 and Ethereum from 29th November 2018 to 18th January 2024. Simultaneously, data for SENSEX is used for these time periods for analysis. The data has been taken from 'Thompson Reuters database' from the date of availability. We use daily closing prices (in INR). Further, logarithmic returns are computed for our estimations. We begin our analysis with the examination of the return and risk of Sensex and cryptocurrencies. To estimate risk, we employ standard deviation. Going further, we attempt to analyse the relationship between the crypto market and the equity market. Firstly, to check if both markets move along each other Johansen co-integration has been used. Next, we model volatility using GARCH (1,1). Lastly, we use the Granger causality test to study the causality between the two markets. Before employing these tests, we check for the stationarity of our data series using the Augmented Dickey-Fuller (ADF) test. To understand the volatility spillover between the crypto market and the stock market it is imperative to check if the two markets share long-term relationship or not. Our data series are of order I(1) but this integration cannot be seen as a guarantee that the return series in question are behaving and moving in the same direction in the long run. To check the existence of long-term relationships, cointegration analysis is performed using the Johansen cointegration test. We establish the following hypothesis:

Null Hypothesis (H_{01}) – Long run relationship/equilibrium does not exist between Bitcoin and Sensex

Null Hypothesis (H_{02}) – Long run relationship/equilibrium does not exist between Ethereum and Sensex.

We model volatility using GARCH (1,1). In a GARCH (p, q) model for conditional variance, forecasts depend on a (non-negatively) weighted sum of past squared residuals (from some conditional mean function model) and past variance forecasts:

$$\sigma^2_t = \omega + \alpha \varepsilon^2_{t-1} + \beta \sigma^2_{t-1}$$

Where $\omega > 0, 0 < \beta \leq 1, 0 < \alpha \leq 1, \alpha + \beta \leq 1$.

The alpha value measures the responsiveness of the variable to new information. Higher value of α refers to higher responsiveness of returns towards new information. Whereas β shows the persistence level of volatility. Higher β value is indicative of longer and stronger memory of conditional variance. In this case, fading out of its effect from markets takes longer than usual. Lastly, we check if there is causal relationship between the cryptocurrency market and stock market. For this, we use the Granger Causality test. Granger Causality exists whenever change in one variable occurs due to another but at a time difference. It implies that a change in one variable or shock in one market becomes a cause of bringing shock into other markets. Therefore, one is cause and the other is the effect of the cause. To evaluate the lead lag relationship between markets the following specifications are used:

$$\sigma_{s,t} = \alpha_1 + \sum_{i=1}^p \beta_{1i} \sigma_{s,t-i} + \sum_{j=1}^q \gamma_{1j} \sigma_{c,t-j} + \varepsilon_{1,t}$$

$$\sigma_{c,t} = \alpha_2 + \sum_{i=1}^p \beta_{2i} \sigma_{c,t-i} + \sum_{j=1}^q \gamma_{2j} \sigma_{s,t-j} + \varepsilon_{2,t}$$

Where α_s is the volatility of Sensex, α_b volatility of crypto currency and ε_{1t} and ε_{2t} are white noise residuals. The above tests are examined for Bitcoin and Ethereum. The granger causality test involves testing the follow-ing null hypothesis using the F-Statistic. The granger causality test is applied of lag p=2 and lag q=2 in accor-dance with the minimization criteria of SIC. The test examines if Sensex volatility granger causes crypto cur-rency volatility and vice versa if crypto currency volatility granger causes sensex volatility.

RESULTS

The descriptive statistics are reported in Table 1.

Table 1: Descriptive Statistics

Particulars	Bitcoin	Ethereum	Sensex
Mean	0.001105	0.002504	0.000495
Median	0.001060	0.001394	0.000885
Maxi-mum	1.431424	1.763262	0.085947
Mini-mum	-1.460166	-1.763402	-0.141017
Std. Dev.	0.086269	0.088156	0.011609
Skewness	-0.146266	-0.178049	-1.517335
Kurtosis	173.0187	254.1104	25.68708
Jarque-Bera	1824719.	3334117.	33071.99
Probabil-ity	0.000000	0.000000	0.000000
Sum	1.674525	3.177325	0.750229
Sum Sq. Dev.	11.26777	9.854153	0.204031
Observa-tions	1515	1269	1515

The mean return of all three-time series is positive and close to zero. The level of standard deviations clearly a show that cryptocurrency market is operating at more risk as compared to the stock market. The distribution shows leptokurtic signs attributable to high value of kurtosis. The data is not normally distributed indicated by negative skewness and high value of Jarque-Bera statistics.

Table 2: Results of Unit Root Test

Prob.Value	Bitcoin	Ethereum	Sensex
At level	0.6946	0.5715	0.9535
At First Diffeence	0.0001	0.0000	0.0000

The ADF tests show that price series of all the three variables were non-stationary at level, but stationary at first difference. Therefore, the return series do not have existence of unit root problem and are suitable for further analysis.

Table 3: Results of Johansen Cointegration

Hypothesized No. of Co-integrating Equations (CEs)	Unrestricted Co-in-tegration Rank Test (Trace)	Unrestricted Co-in-tegration Rank Test (Max-Eigen)
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BITCOIN AND SENSEX

	Trace Sta-tistics	Prob.	Max- Eigen Statistics	Prob.
NONE	5.30838	0.7752	5.29887	0.7037
AT MOST 1	0.00951	0.922	0.00951	0.922

ETHEREUM AND SENSEX

NONE	5.01332	0.8074	4.91195	0.7529
AT MOST 1	0.10137	0.7502	0.10137	0.7502

Johansen integration is performed based on Trace Value and Max-Eigen Value. Results in Table 3 show the acceptance of the null hypothesis that there is no co-integrated or long-term relationship between the series. The prob. value also confirms that the null hypothesis is rejected. Both the markets are not moving in the same direction. This nullifies the probability of existence of any long-term relationship.

Table 4: GARCH (1,1) Results

Variable	Ω	A	B
ETHEREUM			
Coefficient	0.004827	0.054395	0.098485
Prob. Value	0	0.5829	0
BITCOIN			
Coefficient	0.001618	0.57793	0.176406
Prob. Value	0	0	0
SENSEX			
Coefficient	0.0000023	0.872593	0.111828
Prob. Value	.001	0	0

Table 4 shows the existence of volatility spillovers between stock market and cryptocurrency market. The stock market and crypto market returns are modelled for GARCH (1,1) process. The GARCH process can be used to analyze the short-term dynamic behaviour of volatility. The α value is quite high for Bitcoin, and it is on the lower side for Sensex. Conversely, for Ethereum the value of coefficient α is quite low which infers that Bitcoin market has the highest volatility followed by Sensex and Ethereum. The β coefficient aids in examining the level of persistence of volatility. For all three variables, β is relatively low but significant which indicates a low level of persistence. This indicates that the volatility effect is present, but it fades out quickly. A high value of alpha and a low value of Beta together create more spikes of volatility.

The sum of α and β represent for how long the effect of shock in terms of volatility is observed in the returns movement. Our findings report that for all three series, this value is less than 1. This indicates stability and no violation of the basic condition of GARCH model.

Table 5: Results of Granger Causality

Panel A		
Null Hypothesis	F-Statistic	Prob.
SENSEX does not Granger Cause Ethereum CRYPTO CURRENCY	0.38541	0.6803
Ethereum CRYPTO CURRENCY does not Granger SENSEX	0.07081	0.9316
Panel B		
Null Hypothesis	F-Statistic	Prob.
SENSEX does not Granger Cause Bitcoin CRYPTO CURRENCY	0.1071	0.8984
Bitcoin CRYPTO CURRENCY does not Granger SENSEX	0.12903	0.879

Table 5 Panel A and B shows the values of granger causality results. Our findings accept the null hypothesis that volatility of stock market index does not granger cause volatility in the bitcoin market returns and vice-versa. Also, there is no causal relation between volatility of stock market index and volatility in Ethereum market returns. The prob. value in both the cases is greater than 5%. Hence, the null hypothesis is not rejected. Therefore, we can conclude that there is no volatility spillover effect from one market to another.

DISCUSSION

The findings of the study show that the crypto currency markets such as Bitcoin and Ethereum and sensex are not cointegrated in the long-term. Both the markets are not affected by the same information set. Thereby, crypto currency market can be used as a hedging tool by portfolio investors.

The study addresses the misconception that both markets being speculative market would be interlinked with each other. Further, it is a popular perception that volatility in the crypto currency market can destabilize the stock markets in India. The study checked for volatility spillovers between the markets using granger causality. The causality results confirm that the markets don't send price signals to each other and there is no information transmission between them. These results are imperative for government policy making as they indicate that crypto-currency market doesn't fuel speculative activity in the stock market.

CONCLUSION

Our results confirm non-existence of any significant long term relationship between the stock market and crypto market. As per the Johansen cointegration test, we do not find any alignment in the price movement of both the markets. Furthermore, there are no signs of any identical short movements. Also, to some extent presence of volatility is visible in both the markets. However, our results highlight that the volatility of the cryptocurrency market (specifically for Bitcoin) is quite high, but it faces less persistence in volatility. The results of Granger causality test show no signs of a bidirectional or unidirectional cause-and-effect relationship between the two markets. Our results do not confirm any spillover between both the markets. Hence, we can conclude that there is no significant relationship between the stock market and cryptocurrency market. Movement in one market cannot predict the movement in the other market. Our study has important implications of investors. The

shocks or volatility in the cryptocurrency market does not affect the price movement of stock market in India, and vice-versa. Hence, investors with a high (low) preference towards risk would prefer to invest in the cryptocurrency (equity) market investment to earn abnormal profits. Our findings are also consistent with previous work in the Indian market (Mohan. et. al. 2023), In future, this relationship can be explored further for different time periods, and in the light of certain special events.

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