Research Paper *IJBARR*
Impact Factor: 4.729 *E- ISSN -2347-856X*
Refereed, Listed & Indexed *ISSN -2348-0653*

CRYPTOCURRENCY GYRATION AND BITCOIN VOLATILITY

Madhavi Eswara
Doctoral Scholar, Department of Finance, GIM, Gitam University, Visakhapatnam.

Abstract
In this era of Digitalization, global economies are slowly moving into digital currencies from fiat currencies and so does emerging economy like India. With this in backdrop, the paper aims to –study effect of (1) volatility of Indiancryptocurrency along with fiveglobal cryptocurrencies and (2)relationship and effect of all fivecryptocurrencies on Indian Bitcoin. The analysis of test results is based on the log returns of the time series data of sixcryptocurrencies,using ARCH and GARCH (1,1)model. The results of Ljung Box test show absence of serial correlation, results of ARCH (LM) test proves that there is no ARCH effect and Histogram normality test proves that residuals are normally distributed. The results conclude that there is significant impact on BTC/INRvolatility due to other cryptocurrencies. The test results alsoshow that BTC/INR is positively correlated to BTC/USD and is least and inversely correlated to BTC/CNY.

Keywords: Digitalization, Cryptocurrency, Bitcoin, Altcoin, Ethereum, Litecoin, Ripple, Dash.

1. Introduction

Emerging economy like India also stepped into this world of cryptocurrency and is catching up soon with other cryptocurrencies. Though cryptocurrency is very prevalent in China, many major global economies started using cryptocurrency since quite some time. According to Gartner**, '**Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business'. Thus, digitalization means Integration of digital technologies into everyday life by the digitization of everything that can be digitized.'Digitization is of crucial importance to data processing, storage and transmission, because it allows information of all kinds in all formats to be carried with the same efficiency and also intermingled'[1]. A cryptocurrency is a digital asset which acts a s a medium of exchange for securing transactions using cryptography which serves as alternative currencies.

Bitcoin was the first cryptocurrency introduced in 2008 under the name Satoshi Nakamoto but was introduced as open source software in 2009. It was introduced as digital payment system which works only on peer-to-peer network (similar to Skype, BitTorrent, a file sharing system, etc) directlybetween users without any intermediary. Bitcoin is either a virtual currency or reference to the technology. Bitcoin is usually referred by BTC. The value of Bitcoin is determined solely based on its demand and supply.

'The unit of account of the bitcoin system is bitcoin. As of 2014, symbols used to represent bitcoin are BTC,XBTand ฿. Small multiples of bitcoin used as alternative units are milli bitcoin (mBTC), micro bitcoin (μBTC), and satoshi. Named in homage to bitcoin's creator, a satoshi is the smallest multiple of bitcoin representing 0.00000001 bitcoin, which is one hundred millionth of a bitcoin. A millibitcoin equals to 0.001 bitcoin, which is one thousandth of bitcoin. One microbitcoin equals to 0.000001 bitcoin, which is one millionth of bitcoin. Microbitcoin is sometimes referred to as simply a bit'[2].

As of 19th July 2017, Bitcoin market cap is approximately USD 80 billion as stated by Coindesk, even though the price of volatility is still fluctuating. Maximum number of Bitcoins supply in the market is fixed at 21 million only. Of which, the available supply of bitcoins for trading is 16.5 million only. The bitcoin protocol specifies that the reward for adding a block will be halved every 210,000 blocks (approximately every four years). Eventually, the reward will decrease to zero, and the limit of 21 million bitcoins will be fully reached by the year 2140. Later, the record keeping will then be rewarded by transaction fees solely.

Though bitcoin is referred as first cryptocurrency it would be best to use it as first decentralized cryptocurrency in 2009. Later many cryptocurrencies have been created referred as Altcoins i.e., bitcoin alternatives or bitcoin substitutes. Even with so many close competitors Bitcoin is still leading the virtual currency pack as altcoins are built up on the basic framework provided by Bitcoin. Examples of few altcoins that gained recognition are Litecoin, Ethereum, Ripple and Dash. Litecoin is seen as the closest competitor to Bitcoin.

Ethereum is created and developed by JP Morgan Chase, Microsoft and Intel alliance as fiercest rival to Bitcoin. Ethereum is not a just a currency but a blockchain platform powered by the *Ether* cryptocurrency and is second largest cryptocurrency followed by Ripple. Ripple is Google-backed altcoin which attracted great deal of venture capital during its inception in 2012 and is used by UBS, Santander and Unicredit companies. It has been increasingly adopted by banks and payment networks as it is said to have number of advantages over other cryptocurrencies in terms of price and security.

[1] *Wikipedia on Digitization.*
[2] *www.indiabitcoin.com*

Litecoin is created by former Google engineer Charles Lee as an edge over Bitcoin, in bringing down the creation time of a new block. Dash was created and developed by Evan Duffield as Darkcoin calling it as 'privacy-centric' currency. It received remarkable reception due to its Masternode network feature, thus he renamed Darkcoin as Dash, a shortened form of *digital cash*.

Bitcoin and the Blockchain technology involved in it constantly remains a topic of discussion in world of finance mainly due its potential as a financial asset for its exuberant returns and the trustworthiness of the underlying technology in financial transactions involved with it respectively.

Blockchain is a distributed database with built-in validation that is used to maintain list of records called blocks. Each block has a timestamp and a reference link to the previous block (record) which identifies the previous block by hashing function forming an unbroken chain, hence the name blockchain. It is a ledger of records arranged in data batches called blocks that use cryptographic validation to link themselves. The superiority of this blockchain is because it isa 'distributed' database, meaning the ledger is not stored in a master location or is managed by any particular body but, exists on multiple computers at same time in such a way that anybody with an interest can maintain a copy of it.

Block validation system ensures that none can tamper the records at any time. Old transactions are preserved forever and new transactions are added to the ledger irreversibly. No record can be altered retroactively without alteration of all the subsequent blocks thus allowing the participants to verify and audit transactions easily giving a chance to anyone on the network to check the ledger and see the same transaction history as everyone else. Though, sometimes separate blocks are produced as frequently as every five minutes. In such scenarios peers supporting database will not have same version of history hence they keep highest scoring version of the database by overwriting the old version.

Thus, a blockchain is a kind of independent, transparent and permanent database coexisting in multiple locations and is shared by its community and is referred usually as Mutual Distributed Ledger (MDL). The invention of the blockchain for bitcoin by Satoshi Nakamoto made it the first digital currency to solve the double spending problem, without the use of a trusted authority or central server.

Of late, Bitcoin has been emerging as the well-known electronic currency and gaining popularity worldwide as it has caught attention of its volume trading and volatility. Since its inception Bitcoin was much hyped negatively than its positivity mainly because it was used for illegal purposes and raised many eyebrows for its exorbitant returns. Even before Indian or other emerging economies fully understood it functionality, there wereplans in US to launch Cryptocurrency ETF's which was denied outright by USSEC (United States Securities and Exchange Commission). Hence it was felt quite apt to visit this topic and introduce it to our researchers, analysts and investors. The purpose of this research is to find out how Indian cryptocurrency log returns correlate with other major global cryptocurrencies and to study its volatility to conclude if it is a favorable financial instrument for investors who want to diversify their portfolios.

2. Literature Review

Not much research has been done on this cryptocurrency due to its shadow trading and lack of regulations as many felt it to be a bane than boon. Whatever research that went into this topic is basically from outside India except for couple of in-depth researches in India for theoretical purposes. This may be due to the fact that India ventured into this cryptocurrency only recently.

Reuben Grinberg of Yale University (2011),in his research, concluded that Bitcoin is a novel digital currency which has potential as a player in the micropayment and virtual world commerce markets. He opined that it is a great alternative currency for Gold traders who prefer to hold currencies backed by commodities. He emphasised that though currencies such as Iraqi Swiss Dinar that have no backing by either commodities or government entities indicate Bitcoin to succeed, potential users and investors should be wary of many inherent risks in using such young technology as it operates in legal grey area.

Michal Polasik et al (2013), conducted comprehensive empirical study of the payment and investment features of Bitcoin and their implications for the conduct of e-commerce. They investigated adoption and price formation based on network externality theory. They discovered that Bitcoin returns are driven primarily by its popularity, sentiment expressed in newspaper reports on cryptocurrency and total number of transactions.Their work highlights the importance of the shadow economy in driving Bitcoin use and should prompt authorities to consider how to restrain illegal activities facilitated by the cryptocurrency. Despite Bitcoin disadvantages they argued that the arrival of Bitcoin has ensured that a number of concepts, such as decentralized electronic transactions, distributed public ledgers, management of payment systems and the supply of the currency through cryptographic algorithms have been included in the science and practice of information systems and finance.

Ladislav Kristoufek (2015), contribute to the discussion of Bitcoin by examining the potential drivers of Bitcoin prices, ranging from fundamental sources to speculative and technical ones, and its potential influence in the Chinese market. They found several interesting findings. First being that, though Bitcoin is a speculative asset they found that standard fundamental factors—usage in trade, money supply and price level—play a role in Bitcoin price over the long term, these findings are well in hand with standard economic theory, and specifically monetary economics and the quantity theory of money.

Second, from a technical standpoint, the increasing price of the Bitcoin motivates users to become miners. However, the effect is found to be vanishing over time, as specialized mining hardware components have driven the hash rates and difficulty too high. Third, the prices of bitcoins are driven by investors' interest in the crypto-currency. The relationship is most evident in the long run, but during episodes of explosive prices, this interest drives prices further up, and during rapid declines, it pushes them further down. They examined the evolution of relationships in both time and frequency domains utilizing the continuous wavelets framework, so that they can comment not only on the development of the interconnections in time but also distinguish between short-term and long-term connections. They finally concluded that Bitcoin forms a unique asset possessing properties of both a standard financial asset and a speculative one.

Victoria Louise Lemieux (2016), conducted research to explore the value of Blockchain technology as a solution to creating and preserving trustworthy digital records, presenting some of the limitations, risks and opportunities of the approach.

The results of the analysis suggest that Blockchain technology can be used to address issues associated with information integrity in the present and near term, assuming proper securityarchitecture and infrastructure management controls. It does not, however, guarantee reliability of information in the first place, and would have several limitations as a long-term solution for maintaining trustworthy digital records.

Vavrinec Cermak (2017), conducted research study to examine whether Bitcoin, a digital decentralized currency, can become a viable alternative to fiat currencies. He concluded Bitcoin does not satisfy the criteria for being considered as a currency because it does not act as an effective medium of exchange, unit of account, or as a store of value.

Bitcoin presently acts as a scarce digital commodity with a finite supply. The finite supply and deflationary pressuresmake Bitcoin highly speculative. When compared to other cryptocurrencies,which are also decentralized, anonymous and unregulated, Bitcoin's sole valuelies in its network effect and a first mover advantage. This makes Bitcoinvulnerable to potentially superior alternatives. Apart from the technicalissues such as the scalability, the biggest obstacle preventing Bitcoin frombecoming an alternative to fiat currencies is its volatility. Bitcoin's volatility is far larger than even fiat currencies with a small supply.

3. Research Methodology

I. Objectives

- To study the volatility of Bitcoin using GARCH(1,1) model.
- To analyse the relationship of all six cryptocurrencies using multiple regression.

II. Sample Collection

The research is carried out on secondary data available from many websites. The objectives stated in research methodology are the research questions which would be answered in *Results Discussion* section and briefly in *Conclusion* section of the paper. The five major global cryptocurrencies considered in the research are BTC/USD, BTC/EURO, BTC/GBP, BTC/JPY and BTC/CNY along with BTC/INR.The secondary data is collected from www.Coingecko.com which gives maximum past 90 days data at any given time. The time series data of all the six cryptocurrencies are taken for past four months (4th April, 2017 – 21st July, 2017) resulting in to 105 observations using EVIEWS statistical software.

4. Results Discussion

Using the GARCH (1,1) model the tests were run for Serial Correlation, ARCH Effects and Histogram Normality Test and found that Normal Distributionis more pertinent to the current study hence the test results are discussed here in detail.

A. Descriptive Statistics

The descriptive statistics table above gives us the central value of a variable (Mean) and the spread of the data around that variable. Standard Deviation (SD) explains the volatility of the distribution. Skewness tells us if the distribution is normal or not. If Skewness is ZERO then the values are normally distributed. Kurtosis gives us the trends in the chart for the data points plotted on a graph. A high kurtosis value gives us a flat and even distribution with fat tails and a low kurtosis value gives us a peak distribution with skinny tails.

Descriptive statistics	BTC/INR Returns	BTC/JPY Returns	BTC/CNY Returns	BTC/USD Returns	BTC/EUR Returns	BTC/GBP Returns
Mean	0.00656	0.00683	0.00764	0.00677	0.00601	0.00633
Standard Error	0.00412	0.00414	0.00459	0.00413	0.00414	0.00419
Median	0.00831	0.00716	0.00517	0.00888	0.00522	0.00641
Standard Deviation	0.04226	0.04237	0.04707	0.04231	0.04241	0.04289
Sample Variance	0.00179	0.00180	0.00222	0.00179	0.00180	0.00184
Kurtosis	2.25848	2.41302	2.17607	2.74649	2.29245	2.97769
Skewness	0.07543	0.04610	0.05230	0.17435	0.14180	0.31150
Range	0.28087	0.28755	0.31126	0.29216	0.28355	0.29293
Minimum	-0.10714	-0.11199	-0.12943	-0.10887	-0.10735	-0.10232
Maximum	0.17373	0.17555	0.18184	0.18330	0.17620	0.19061
Sum	0.68878	0.71702	0.80248	0.71034	0.63145	0.66501
Count	105	105	105	105	105	105

BTC/EURlog returns has the lowest mean value (0.00601) followed by BTC/GBP log returns with mean value (0.00633). Standard Error is least for BTC/INR followed by BTC/USD. Standard error is one of the important aspects dealt here when finalizing the better model over the other models. BTC/INR has lowest standard deviation (0.04226) followed by BTC/USD (0.04231) and then by BTC/JPY (0.04237). The mean value is highest for BTC/CNY log returns (0.00764) along with highest standard deviation (0.04707) thus, proving that it is more volatile and unstable than the other cryptocurrency returns. we can see that BTC/GBP has normal distribution from its Kurtosis value which is almost equal to 3 followed by BTC/USD (2.74649). whereas, other cryptocurrency returns are around 2.2 value in Kurtosis implying that it is flatter or Platykurtic distribution. Skewness is entirely positive throughout all cryptocurrency returns. BTC/INR, BTC/JPY and BTC/CNY show more normal distribution whereas other 3 cryptocurrencies are more right tailed (right skewed). The following correlation table shows us that BTC/INR is more correlated to BTC/USD followed by BTC/EURO and is least correlated to BTC/CNY.

CORRELATION	BTC/INR Returns	BTC/JPY Returns	BTC/CNY Returns	BTC/USD Returns	BTC/EUR Returns	BTC/GBP Returns
BTC/INR Returns	1					
BTC/JPY Returns	0.993700	1				
BTC/CNY Returns	0.890959	0.883782	1			
BTC/USD Returns	0.998321	0.994161	0.893975	1		
BTC/EUR Returns	0.994961	0.993585	0.887508	0.995520	1	
BTC/GBP Returns	0.992404	0.991394	0.885836	0.994478	0.995069	1

B. GARCH Model

Least squares method is the fundamental concept in statistics and widely used across many fields. Least squares determine how a dependent variable change in response to the variation of another variable (independent variable). The least squares approach assumes that the squared error has the same magnitude across the entire data set. This assumption is known as homoscedasticity but financial data of time series fluctuate with high and low periods known as heteroskedasticity.

The Table 1 gives us the values of Mean and Variance from GARCH (1,1) model and Chart 1 gives us error distribution of the ARCH model. The p-value of the equation is highly significant. The p-value of this NLS/ARMA equation shows that the model is significant at 1% and holds the goodness-of-fit test. Hence the experiment is continued using returns of all six cryptocurrencies for GARCH (1,1) model.

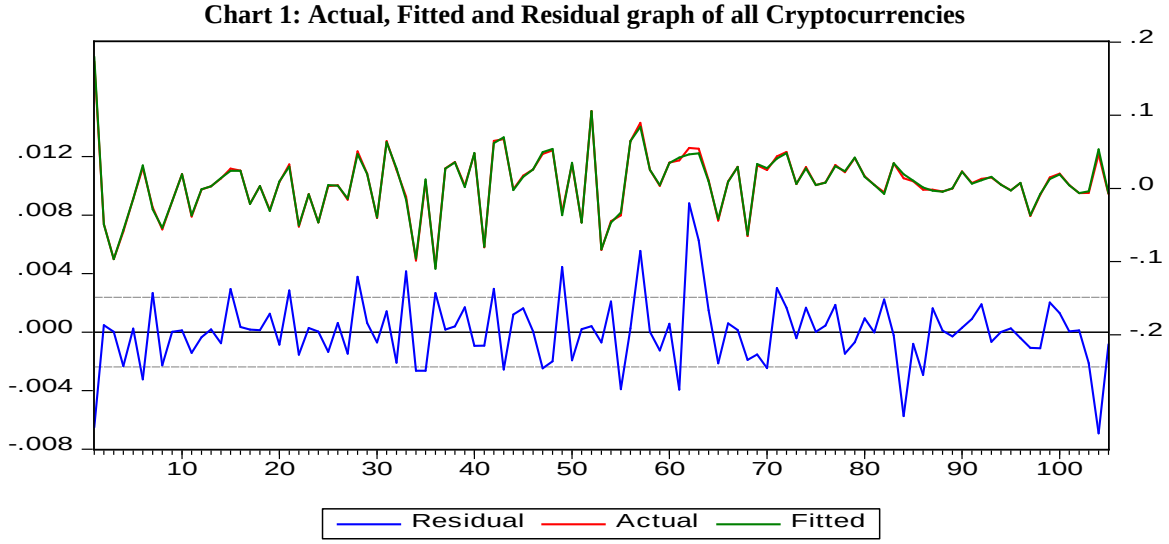
Table 1: NLS/ARMA Test Results

Dependent Variable: BTC_INR_RETURNS			
Method: Least Squares			
Date: 07/19/17 Time: 21:25			
Sample: 1 105			
Included observations: 105			

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
BTC_USD_RETURNS	0.893838	0.072794	12.27908	0.0000
BTC_EUR_RETURNS	0.163396	0.071016	2.300852	0.0235
BTC_GBP_RETURNS	-0.130768	0.060342	-2.167124	0.0326
BTC_JPY_RETURNS	0.077498	0.055450	1.397616	0.1654
BTC_CNY_RETURNS	-0.005139	0.011128	-0.461769	0.6453
C	-0.000132	0.000240	-0.547511	0.5853
R-squared	0.996984	Mean dependent var		0.006560
Adjusted R-squared	0.996832	S.D. dependent var		0.042262
S.E. of regression	0.002379	Akaike info criterion		-9.189015
Sum squared resid	0.000560	Schwarz criterion		-9.037361
Log likelihood	488.4233	Hannan-Quinn criter.		-9.127562
F-statistic	6545.669	Durbin-Watson stat		2.071509
Prob(F-statistic)	0.000000			

The residuals from this estimation equation of NLS/ARMA equation gives rise to the following Chart 1 showing the volatility of all cryptocurrencies. As can be seen from the top portion of the graph the actual and fitted values are not distinguishable i.e., almost same. The test results ofDurbin -Watson tells us upfront that there is no autocorrelation between the variables being used in the study as the value is close to 2. R-square value is 99%, log likehood is positive as AIC, BIC values are negative and standard error is negligible.

Chart 1: Actual, Fitted and Residual graph of all Cryptocurrencies



The basic ARCH model requires basic assumption about the error term i.e., residual. This residual can be estimated using 3 distributions – Normal Gaussian distribution, Student's t distribution and Generalized Error Distribution (GED) using GARCH (1,1) model. Each of these distributions, test for three specifications (1) Serial Correlation (2) Arch Effects and (3) Residuals normal distribution. The criteria used to select best model out of these ARCH models are the values from R-Square, Std. error, Log likelihood, Akaike info criterion (AIC), Schwarz criterion (SC) and Durbin-Watson test results.Here Normal Distribution is discussed in detail.

Table 2: GARCH (1,1) Test Results

Dependent Variable: BTC_INR_RETURNS			
Method: ML - ARCH (Marquardt) - Normal distribution			
Date: 07/19/17 Time: 21:29			
Sample: 1 105			
Included observations: 105			

Convergence achieved after 34 iterations				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(7) + C(8)*RESID(-1)^2 + C(9)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
BTC_USD_RETURNS	0.903969	0.054987	16.43957	0.0000
BTC_EUR_RETURNS	0.117136	0.063229	1.852570	0.0639
BTC_GBP_RETURNS	-0.108602	0.048448	-2.241605	0.0250
BTC_JPY_RETURNS	0.105852	0.046603	2.271358	0.0231
BTC_CNY_RETURNS	-0.013382	0.008852	-1.511717	0.1306
C	-9.50E-05	0.000212	-0.448792	0.6536
	Variance Equation			
C	2.60E-06	1.13E-06	2.306537	0.0211
RESID(-1)^2	0.508605	0.194073	2.620690	0.0088
GARCH(-1)	0.087614	0.193346	0.453148	0.6504
R-squared	0.996903	Mean dependent var		0.006560
Adjusted R-squared	0.996746	S.D. dependent var		0.042262
S.E. of regression	0.002411	Akaike info criterion		-9.258178
Sum squared resid	0.000575	Schwarz criterion		-9.030696
Log likelihood	495.0544	Hannan-Quinn criter.		-9.165998
Durbin-Watson stat	2.054849			

The following table 3 displays the auto and partial correlations of the squared residuals calculated using 36 lags of Ljung Box test. The Correlogram is used to check autoregressive conditional heteroskedasticity in the residuals for regression equation estimated by least squares method. Q-stats from the table 3 shows the lags involved and p-values reflect the significance of the test. The p-values are all higher than 5% significance proving that the NULL hypothesis of the test cannot be rejected. Thus, ***we accept the null hypothesis of correlogram which says that there is no serial correlation of the data*** used in the study. GARCH (1,1) model holds good from this aspect.

Table 3: Correlogram Test Results

Date: 07/19/17 Time: 21:32						
Sample: 1 105						
Included observations: 105						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	-0.016	-0.016	0.0267	0.870
.|. |	.|. |	2	0.032	0.031	0.1350	0.935
*|. |	*|. |	3	-0.123	-0.122	1.8036	0.614
.|. |	.|. |	4	-0.031	-0.036	1.9121	0.752
.|. |	.|. |	5	0.031	0.039	2.0229	0.846
.|. |	.|. |	6	0.020	0.008	2.0679	0.913
.|. |	.|. |	7	0.008	-0.002	2.0749	0.956
.|. |	.|. |	8	0.044	0.052	2.3029	0.970
*|. |	*|. |	9	-0.090	-0.084	3.2405	0.954
*|. |	*|. |	10	-0.073	-0.080	3.8709	0.953
*|. |	*|. |	11	-0.125	-0.114	5.7365	0.890

.|. |	.|. |	12	-0.029	-0.050	5.8394	0.924
.|. |	.|. |	13	0.021	-0.001	5.8956	0.950
.|. |	.|. |	14	0.051	0.028	6.2198	0.961
.|. |	.|. |	15	0.004	-0.003	6.2222	0.976
*|. |	*|. |	16	-0.074	-0.070	6.9046	0.975
*|. |	*|. |	17	-0.116	-0.105	8.6348	0.951
*|. |	*|. |	18	-0.098	-0.108	9.8646	0.936
.|. |	.|. |	19	-0.028	-0.059	9.9659	0.954
.|** |	.|* |	20	0.231	0.194	17.035	0.651
.|. |	.|. |	21	0.004	-0.027	17.038	0.709
.|* |	.|* |	22	0.181	0.159	21.494	0.490
.|. |	.|* |	23	0.056	0.134	21.923	0.525
*|. |	.|. |	24	-0.066	-0.060	22.535	0.547
.|. |	.|. |	25	-0.044	-0.039	22.807	0.589
*|. |	*|. |	26	-0.080	-0.091	23.729	0.591
.|* |	.|* |	27	0.159	0.101	27.380	0.443
*|. |	*|. |	28	-0.069	-0.157	28.085	0.460
.|* |	.|* |	29	0.118	0.133	30.137	0.407
.|. |	.|. |	30	-0.044	0.013	30.425	0.444
*|. |	*|. |	31	-0.108	-0.073	32.203	0.407
*|. |	.|. |	32	-0.091	-0.035	33.479	0.395
.|. |	.|. |	33	-0.056	-0.058	33.965	0.421
.|. |	.|. |	34	0.000	-0.049	33.965	0.469
.|. |	.|. |	35	0.050	-0.039	34.363	0.499
.|. |	.|. |	36	-0.045	-0.027	34.693	0.531
*Probabilities may not be valid for this equation specification.						

Next, the ARCH effect of the model using ARCH Lagrange Multiplier (LM) test is tested for heteroskedasticity in the residuals. From table 4, we observe that the p-value is greater than 5% indicating that null hypothesis of this test cannot be rejected, thus we accept Null hypothesis. ***The null hypothesis of ARCH LM test of GARCH (1,1) model with normal distribution indicate that there is no ARCH effect*** in the remaining Variance equation, meaning squared residuals of the model exhibit no further autocorrelation. The GARCH (1,1) model holds good on this aspect.

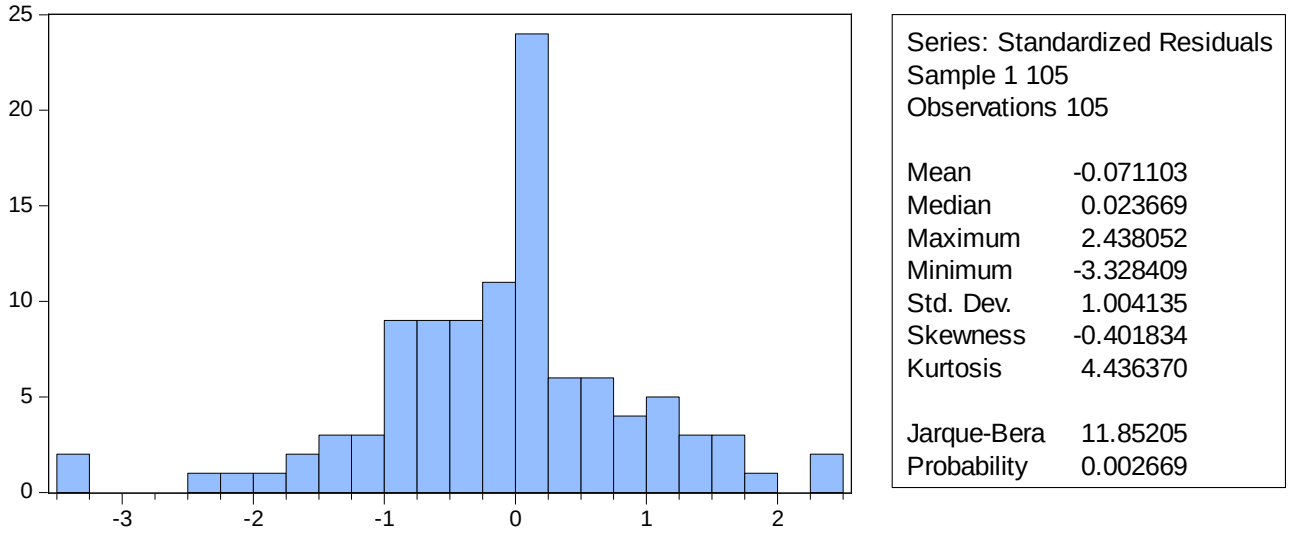
Table 4: ARCH LM Test Results

Heteroskedasticity Test: ARCH				
F-statistic	0.025724	Prob. F(1,102)		0.8729
Obs*R-squared	0.026221	Prob. Chi-Square(1)		0.8714
Test Equation:				
Dependent Variable: WGT_RESID^2				
Method: Least Squares				
Date: 07/19/17 Time: 21:33				
Sample (adjusted): 2 105				
Included observations: 104 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.987917	0.209774	4.709429	0.0000
WGT_RESID^2(-1)	-0.015665	0.097670	-0.160386	0.8729
R-squared	0.000252	Mean dependent var		0.972044
Adjusted R-squared	-0.009549	S.D. dependent var		1.877296
S.E. of regression	1.886238	Akaike info criterion		4.126089
Sum squared resid	362.9050	Schwarz criterion		4.176943

Log likelihood	-212.5566	Hannan-Quinn criter.	4.146691
F-statistic	0.025724	Durbin-Watson stat	1.978336
Prob(F-statistic)	0.872894		

Chart 1: Histogram Normality Test Results

The Chart given below allows us to check the third assumption of residual data i.e. to check if the residuals are normally distributed or not. This test is done using Histogram Normality test based on Jarque-Bera criteria. The null hypothesis of Jarque-Bera test says that the residual data are normally distributed.



From this chart, we can observe that the p-value is very significant at less than 2% thus accepting the null hypothesis of the histogram normality test though there exists couple of outliers. The null hypothesis of Histogram Normality Test says that the residuals are normally distributed, thus, **we accept NULL hypothesis.** From this third and final view point also, the GARCH (1,1) model does hold good. Thus, these test results prove that GARCH (1,1) model is useful for predicting and forecasting the cryptocurrency returns volatility.

C. Regression Analysis

In order to understand and study the effect and relationship between these six cryptocurrencies taken in the research, multiple regression is used. The dependent variable is Indian Cryptocurrency returns (BTC/INR) and all the other five variables are independent. The following test results prove that there exists inter-related relationship between all the variables due to high R-Square value. Significance values of the test proves that this model tests the goodness-fit and can be accepted as a good model to discuss the test results. Global cryptocurrencies such as BTC/CNY and BTC/GBP are inversely correlated to BTC/INRas can be seen from Regression Coefficients and variable least correlated to BTC/INR is BTC/CNY. It is observed that BTC/INR is positively correlated to BTC/USD with very significant p-value.

Table 10: Multiple Regression Test Results

Summary Output						
Regression Statistics						
Multiple R	0.998490972					
R Square	0.996984221					
Adjusted R Square	0.996831909					
Standard Error	0.002378777					
Observations	105					
ANOVA						
	df	**SS**	**MS**	**F**	**Significance F**	
Regression	5	0.18520	0.037039185	6545.66887	4.601E-123	
Residual	99	0.00056	5.65858E-06			
Total	104	0.18576				
	Coefficients	**Std**	**t Stat**	**P-value**	**Lower 95%**	**Upper**

		Error				**95%**
Intercept	-0.00013	0.00024	-0.54751	0.58526	-0.00061	0.00035
BTC/JPY Returns	0.07750	0.05545	1.39762	0.16535	-0.03253	0.18752
BTC/CNY Returns	-0.00514	0.01113	-0.46177	0.64526	-0.02722	0.01694
BTC/USD Returns	0.89384	0.07279	12.27908	0.00000	0.74940	1.03828
BTC/EUR Returns	0.16340	0.07102	2.30085	0.02350	0.02249	0.30431
BTC/GBP Returns	-0.13077	0.06034	-2.16712	0.03262	-0.25050	-0.0110

5. Limitations& Scope

As a researcher in finance, the researcher is intrigued by the term cryptocurrency and the name Bitcoin along with the shockwaves it is creating due to its volatility and the new technology it brought along with it, the Blockchain. The financial world attention towards Bitcoin and much hyped media attention about its volatility motivated the researcher to write a paper on this topic, thus resulting in learning and research which is useful to many researchers and analysts further through this research analysis. This research contains bitcoin price index along with six global fiat currencies - European Union's EURO, Britain POUND, USDollar, Japanese YEN and Chinese YUAN, along with Indian Rupee. Though it is slightly easier to get historical data of global currencies from Coindesk and Investing.in it was lot tougher to get BTC/INR historical data.Second and final limitation is, the research is carried only on 105 observations due to the above limitation and there is lot of scope in these two areas for further research.

6. Conclusion

The researcher came to the conclusion that Bitcoin is a favourable instrument to diversify a portfolio but the fact that no Exchange, authority, clearing house or central bank's involvement is present it certainly creates lot of uncertainty for investors and hence its usage should be restricted to those investors with full knowledge and at their own discretion. Trading in Bitcoin is not yet full blown in India and it has track record of being used for supporting criminal activities ever since its inception. Very recently due to its high volatility and illegal trading, India is mulling to put Bitcoin trading under SEBI's purview. If this happens, then in India it can be a legal tender.

From test results, it can be concluded that Indian cryptocurrency has positive relationship from US Dollar and is inversely related to Britain Pound and Chinese Yuan and is also least correlated to Chinese Yuan. The blockchain technology that came along with Bitcoin was a hit in market and is being considered by many companies and departments and is being used in HR, Marketing apart from being used in Finance functions. Overall, the results from this study provide strong evidence that both positive and negative shocks have higher effect on volatility of Bitcoin.

References

1. Grinberg, R. (2012). Bitcoin: An innovative alternative digital currency. Hastings Science & Technology Law Journal, 4(1), 160–208.
2. Krugman, P. (2013). Bitcoin is evil. The New York Times.
3. Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. Retrieved from https://bitcoin.org/bitcoin.pdf.
4. Polasik M, Piotrowska Anna, Wisniewski Piotr Tomasz, Kotkowski Radaslaw, Lightfoot Geoffrey (2014), Price Fluctuations and the use of Bitcoin: An empirical Inquiry, University of Leicester, UK. Electronic copy available at: http://ssrn.com/abstract=2516754.
5. Velde, F. R. (2013). Bitcoin: A primer. Chicago Fed Letter, (317).
6. Wallace, B. (2014). The rise and fall of Bitcoin. Wired Magazine. www.coindesk.com.
7. www.investing.com.
8. www.buybitcoinworldwide.com.
9. www.bitcoincharts.com.