Spill-Over Effects of Cryptocurrencies Price Volatilities in Financial Markets: An Empirical Estimation during Global Health Crises

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Abstract

This study is conducted to investigate the potential volatilities and interdependencies among cryptocurrencies during global health crises, i.e., during COVID-19. The top five cryptocurrencies have been selected to assess their interdependencies. These currencies have been ranked as the top five due to their highest market capitalization. These top five currencies are Bitcoin, Ethereum, Tether, USD coin, and BNB. Monthly data for these currencies from the first month of 2019 to eighth month of 2022 is taken from online sources by investing.com. Squared deviations from mean values have been taken as measures of volatilities. These measures are simple but more precise to capture the possibility of potential interrelations in the volatilities of cryptocurrencies through regression analysis. The results of this study showed that the volatility of each cryptocurrencies involved is interlinked with the volatility of at least one other cryptocurrencies.

Keywords: *Cryptocurrencies, volatility, Covid-19, Bitcoin, interdependency*

Introduction

Cryptocurrency is a technology where peer-to-peer digital exchange systems generate and distribute currency units in the form of virtual money. The block chain technology ensures the transparency in all transactions and existing data is disseminated to every user within the Cryptocurrency system. The transaction amounts and units are not spent twice, and this verification system is called mining. Electronic money in the form of Bitcoin was introduced to the world in 2009, but active trade was started in 2013. The electronic transaction records are stored in a database one by one so as to make a series of linear chains or data chains. The recorded data, once entered into the database, cannot be changed or deleted again. So there is authenticity and accuracy is this currency system (Gaporale and Plastun, 2019).

The use of Cryptocurrency as an investment option can be used to diversify the portfolio risks because the daily average returns on cryptocurrencies are higher than those of traditional investments and there are low correlations between two assets. Although there are many issues to consider cryptocurrencies as assets as a class of interest for institutions and business groups. The security of safekeeping without a custodian and trustee, a decentralized governance structure, and dealing with unregulated identities can increase the risk. The risk and uncertainties associated with crypto make it a complex class of investment.

Makarov and Schoar (2020) found that price deviation offers an opportunity for arbitrage during periods of large and small. The large Bitcoin appreciation coin moved and opened up within countries. Since the advent of fiat money, the value of money has seen much fluctuation as money no longer remains a scarce asset. The central bank, according to the needs of the country, can increase the money supply at a nearly negligible cost (Giovannini, 1993). The evolution of currency has taken a new turn when a new form of currency, i.e., digital currency, has surfaced as an alternative to fiat money. The most popular digital currency, called Bitcoin, came into being in 2009 (Metz, 2013). Fiat money has remained subject to fluctuations, but being managed by central authority, these fluctuations usually become extensive only during wars or extensive printing of money to support government expenditures.

Uncertainty in Cryptocurrency price is an essential determinant of future earnings. The impacts and predictive powers are varying according to the market difference between price volatility and price uncertainty. Walther et al. (2019) employed 17 financial and economic indexes to estimate the price volatilities in cryptocurrencies. The economic policy about macroeconomic indicators such as GDP, inflation, unemployment and international trade have a predictive power on crypto returns. Volatility and uncertainty have been found a useful predictive tool for investment in cryptocurrencies.

The focus of present study is to investigate whether fluctuations in digital currencies are interrelated or not. To attain this purpose the squared deviations from mean values are generated as observations to measure fluctuations in time series. Top five digital currencies are selected

namely Bitcoin, Ethereum, Tether, USD coin and BNB. These currencies are ranked top five due to their market capitalization.

Figure 1: Bitcoin Deviations

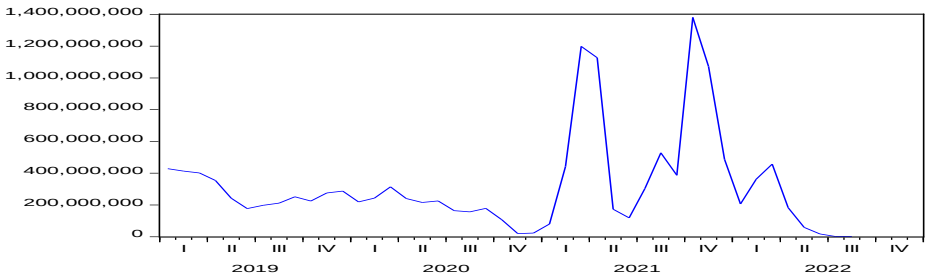


Figure 2: Ethereum Deviations

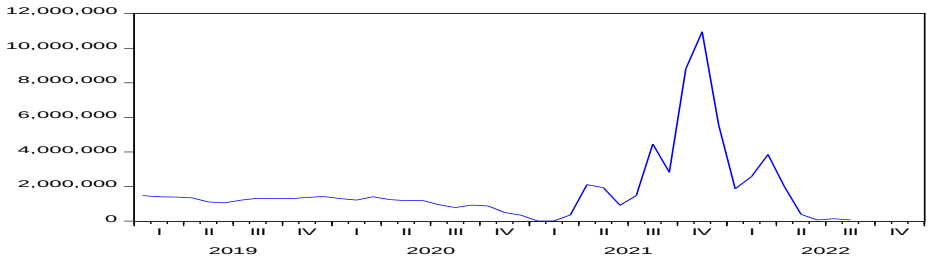


Figure 3: Tether Deviations

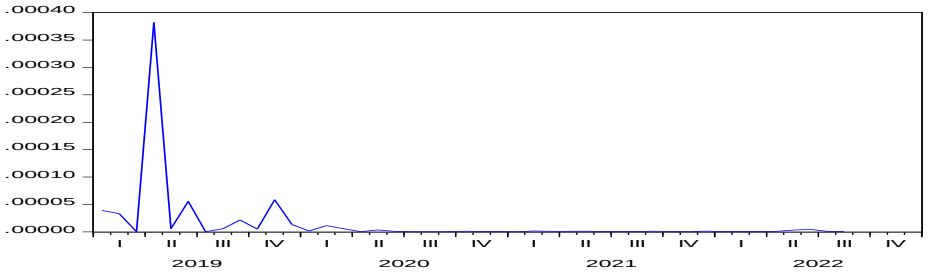


Figure 4: USDCoin Deviations

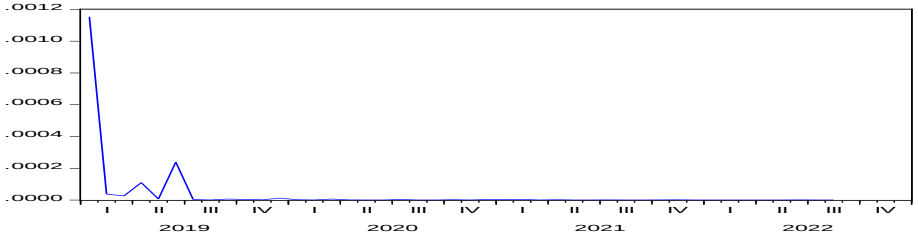
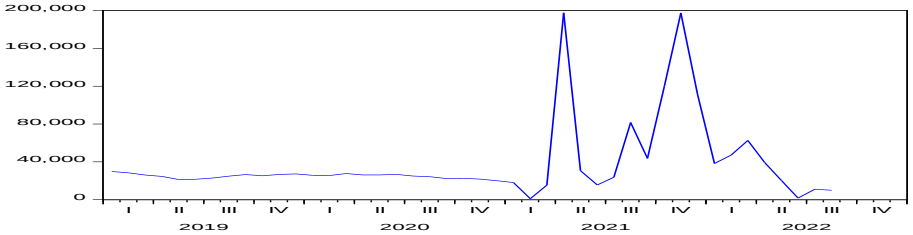


Figure BNB Deviations



The graph 1 shows the fluctuation in the Bitcoin. These data is monthly from first January, 2019 to eight August, 2022. It is quite vivid that the fluctuations are much more explosive from the

mid of fourth quarter of 2020 in Bitcoin as shown in figure 1. These variations last till the mid of second quarter in 2022 and damped out completely. The variations in Ethereum start from the first quarter of 2021 and last till the mid of 2022. On the other hand, the variations in Tether are more explosive during 2019 and then these variations settle down. Fluctuations in USD coin remain more or less damped throughout the sample span. The deviations in BNB crypto currency start in first quarter of 2021 and these variations continued till the third quarter of 2022. It seems that most of these currencies have affected due Covid-19 spread which was a pandemic and can be expected to create an impact on these digital currencies which are working as global currencies.

The purpose of this research is to unearth the interdependencies between top 5 digital currencies during global health emergency. In other words, purpose of this study is to investigate whether variations in one digital currency penetrate into other digital currencies or not. Since these currencies are working or supposed to work as global currencies and volatility in one currency may be the forerunner of uncertainties in other digital currencies.

Literature Review

Modeling the volatility of economic and financial variables has always been a subject of keen interest among researchers. Recent past studies concentrated on evaluating the efficiency of markets that are associated with cryptocurrencies. Studies by Ramirez and Rodriguez (2021) and Urquhart (2016) are done on this aspect. Use of cryptocurrencies for portfolio diversification can be found in studies by Akhtaruzzaman et al. (2020) and Damianov and Elsayed (2020). The use of cryptocurrencies as speculative purposes can be found in the research works of Baur et al. (2018) and Cheah and Fry (2015). Dyhrberg et al. (2018) worked on cryptocurrencies as assets for investment. Corbet et al. (2020) also looked into the part of these currencies that makes them safe haven assets.

Liu and Serletis (2019) studied the how do Cryptocurrency volatilities are independence. The study use the GARCH-in-mean models to examine the relationship between returns volatilities of leading cryptocurrencies in financial market. The findings showed a statistically significant impact from Cryptocurrency market to other financial market as well as leading companies of developed world.

An interesting aspect of research on cryptocurrencies deals with interconnectivity of risk-sharing nature of these currencies. These risk-sharing interconnectivities are explored by Yi et al. (2018), Ji et al. (2019), Conlon and McGee (2020) and Akhtaruzzaman et al. (2022) are some instances in this regard. The commonality of last two studies was the focus of risk-sharing nature during Covid-19 period. Furthermore, all these studies try to explore interconnectivity among different cryptocurrencies by modeling systematic risk sharing among these currencies.

Research on the estimation of risks in economics and finance is still in beginning era. There exist a research gap in literature about the assessment of level of uncertainty experienced by the

investors about cryptocurrencies price volatilities and their interdependence particularly during the period of global crises. This paper is an attempt to estimate the spell over effects of interdependence of these currencies.

Research Methodology

Data Source

The volatility based interconnectivity between cryptocurrencies during Covid-19 is assessed by including top five cryptocurrencies. This ranking is based on market capitalization that is done in these currencies. These currencies are Bitcoin, Ethereum, Tether, USD coin and BNB. The source of this data is investing.com which is a platform for financial news and data. The frequency of data is monthly and ranges from January, 2019 to August, 2022.

Hypothesis of study.

The general hypothesis of this study is to assess whether the uncertainties of five digital currencies are interconnected or not. The specific hypothesis are written as follows:

H_1: Does volatility in Bitcoin is interlinked with volatilities of Ethereum, Tether, US coin and BNB.

H_2: Does volatility in Ethereum is interlinked with volatilities of Bitcoin, Tether, USD coin and BNB

H_3: Does volatility in Tether is interlinked with volatilities of Bitcoin, Ethereum, USD coin and BNB

H_4: Does volatility in USD coin is interlinked with volatilities of Bitcoin, Ethereum, Tether and BNB

H_5: Does volatility in BNB is interlinked with volatilities of Bitcoin, Ethereum, Tether and USD coin

Analytical Models

This study employed a modeling volatility or volatility by squared standard deviations of top five cryptocurrencies. This technique is simple but robust in the sense that uncertainties in squared deviations are more pronounced and there is more potential for a regression model to capture interrelation between volatility. In order to model interconnectivity between variables of interest, following models have been constructed.

$$BCOINSQDEV_t = \alpha_0 + \alpha_1 ETHRSQDEV_t + \alpha_2 TETHSQDEV_t + \alpha_3 USDCSQDEV_t + \alpha_4 BNBSQDEV_t + u_t \quad (1)$$

$$ETHRSQDEV_t = \beta_0 + \beta_1 BCOINSQDEV_t + \beta_2 TETHSQDEV_t + \beta_3 USDCSQDEV_t + \beta_4 BNBSQDEV_t + \varepsilon_t \quad (2)$$

$$TETHSQDEV_t = \gamma_0 + \gamma_1 BCOINSQDEV_t + \gamma_2 ETHRSQDEV_t + \gamma_3 USDCSQDEV_t + \gamma_4 BNBSQDEV_t + \epsilon_t \quad (3)$$

$$USDCSQDEV_t = \delta_0 + \delta_1 BCOINSQDEV_t + \delta_2 ETHRSQDEV_t + \delta_3 TETHSQDEV_t + \delta_4 BNBSQDEV_t + \vartheta_t \quad (4)$$

$$BNBSQDEV_t = \rho_0 + \rho_1 BCOINSQDEV_t + \rho_2 ETHRSQDEV_t + \rho_3 TETHSQDEV_t + \rho_4 USDCSQDEV_t + \mu_t \quad (5)$$

Where,

$BCOINSQDEV$ = Squared deviations of Bitcoin from its mean value.

$ETHRSQDEV$ = Squared deviations of Ethereum from its mean value.

$TETHSQDEV$ = Squared deviations of Tether from its mean value.

$USDCSQDEV$ = Squared deviations of USD coin from its mean value.

$BNBSQDEV$ = Squared deviations of Ethereum from its mean value.

The absence of interconnectivity between Bitcoin and other currencies of this study will lead to acceptance of following null hypothesis.

$H_{0|1}$: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$

Similarly, the absence of interconnectivity between Ethereum and other currencies of this study will lead to acceptance of the following null hypothesis.

$H_{0|2}$: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

Likewise, the absence of interconnectivity between Tether and other currencies of this study will lead to acceptance of the following null hypothesis.

$H_{0|3}$: $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$

In the same way, the absence of interconnectivity between USD coin and other currencies of this study will lead to acceptance of the following null hypothesis.

$H_{0|4}$: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$

Consequently, the absence of interconnectivity between BNB and other currencies of this study will lead to acceptance of the following null hypothesis.

$H_{0|5}$: $\rho_1 = \rho_2 = \rho_3 = \rho_4 = 0$

The stationarity of the time series involved in this study is tested by Augmented Dicky Fuller (ADF) test. The estimation of these models is done by ordinary least squares as all variables are stationary.

Results

Results of correlation analysis are shown in table 1. It is easy to see that volatility of Bitcoin is strongly correlated with volatilities of Ethereum and BNB as these values are greater than bench mark value of 0.5. On the other hand, Tether and USD coin volatilities seems to be independent of each other as well as other currencies of these studies.

Table 1

Correlation Analysis					
Cryptocurrency	BCOINSQDEV	ETHRSQDEV	TETHSQDEV	USDCSQDEV	BNBSQDEV
BCOINSQDEV	1.000000	0.676712	0.003647	0.040714	0.731463
ETHRSQDEV	0.676712	1.000000	-0.055557	-0.038143	0.809011
TETHSQDEV	0.003647	-0.055557	1.000000	0.174250	-0.080676
USDCSQDEV	0.040714	-0.038143	0.174250	1.000000	-0.051189
BNBSQDEV	0.731463	0.809011	-0.080676	-0.051189	1.000000

Table 2 contains results of ADF unit root test for the volatility of cryptocurrencies. The probability values for all cryptocurrencies are less than five percent. It means that the null hypothesis of unit-root for all cryptocurrencies can be rejected at conventional five percent level of significance. It can be deduced that all variables are stationary and can be estimated with estimation technique of OLS.

Table 2

ADF Unit Root Test Results	
Variables	ADF Test
BCOINSQDEV	0.00
ETHRSQDEV	0.04
TETHSQDEV	0.00
USDCSQDEV	0.03
BNBSQDEV	0.00

Estimation results of equation 1 are shown in table 3. It is quite clear from the results that volatility of Bitcoin is influenced by volatility of BNB Cryptocurrency. A one percent squared deviation in BNB Cryptocurrency from its mean value creates almost 0.57 percent squared deviation in Bitcoin from its mean value. Bitcoin volatility seems to be indifferent from volatilities of all other cryptocurrencies.

Table 3

Estimation Results for Bitcoin		
Variable	Coefficient	Prob.
ETHRSQDEV	0.180039	0.20
TETHSQDEV	0.005862	0.96
USDCSQDEV	0.124470	0.22
BNBSQDEV	0.568641	0.05
C	12.55868	0.0000

Estimation results of equation 2 are presented in table 4. It is quite obvious from the results that volatility of Ethereum is affected by volatilities of Tether and BNB cryptocurrencies. A one percent squared deviation in Tether Cryptocurrency from its mean value creates almost 0.28 percent squared deviation in Ethereum from its mean value. Similarly, a one percent squared deviation in BNB Cryptocurrency from its mean value creates almost greater than percent squared deviation in Ethereum from its mean value. It appears that volatility of Ethereum is much more sensitive to volatility of BNB Cryptocurrency as compared to Tether. Whereas Ethereum volatility appears to be insensitive to other currencies of this study.

Table 4

Estimation Results for Ethereum		
Variable	Coefficient	Prob.
BCOINSQDEV	0.235393	0.1966
TETHSQDEV	0.287322	0.0259
USDCSQDEV	-0.166312	0.1507
BNBSQDEV	1.194754	0.0001
C	-1.396118	0.7005

Table 5 contains Estimation results of equation 3. These results show that volatility of Tether is affected by volatilities of Ethereum, USD coin and BNB cryptocurrencies. A one percent squared deviation in Ethereum Cryptocurrency from its mean value creates almost 0.42 percent squared deviation in Tether from its mean value. Similarly, a one percent squared deviation in USD coin Cryptocurrency from its mean value creates almost 0.44 percent squared deviation in Tether from its mean value. On the other hand, a one percent squared deviation in BNB Cryptocurrency from its mean value creates almost 0.76 percent squared deviation in Tether from its mean value, but in opposite direction.

Table 5

Estimation Results for Tether		
Variable	Coefficient	Prob.
BITCSQDEV	0.011222	0.9599
ETHRSQDEV	0.420673	0.0259
USDCSQDEV	0.435394	0.0010
BNBSQDEV	-0.765325	0.0606
C	-5.681769	0.1913

Table 6 shows Estimation results of equation 4. These results show that volatility of USD coin is influenced by volatility of Tether only. A one percent squared deviation in Tether Cryptocurrency from its mean value generates 0.65 percent squared deviation in USD coin from its mean value. Fluctuations in USD coin seems to be unaffected by fluctuations in other cryptocurrencies.

Table 6

Estimation Results for USD Coin		
Variable	Coefficient	Prob.
BITCSQDEV	0.31	0.22
ETHRSQDEV	-0.31	0.15
TETHRSQDEV	0.56	0.00
BNBSQDEV	0.08	0.85
C	-8.53	0.08

Table 7 presents estimation results of equation 5. These results show that volatility of BNB Cryptocurrency is affected by volatilities of Bitcoin, Ethereum and Tether cryptocurrencies. A one percent squared deviation in Bitcoin Cryptocurrency from its mean value creates almost 0.16 percent squared deviation in BNB from its mean value. Similarly, a one percent squared deviation in Ethereum Cryptocurrency from its mean value creates almost 0.26 percent squared deviation in Tether from its mean value. Contrarily, a one percent squared deviation in Tether Cryptocurrency from its mean value creates almost 0.11 percent squared deviation in Tether from its mean value, but in opposite direction.

Table 7

Estimation Results for BNBSQDEV		
Variable	Coefficient	Prob.
BITCSQDEV	0.16	0.05
ETHERSQDEV	0.26	0.00
TETHRSQDEV	-0.11	0.06
USDCSQDEV	0.01	0.85
C	2.12	0.20

Discussion

This study has been carried out to unearth spill over relationships that are caused by variation in one Cryptocurrency into other cryptocurrencies during Covid-19. The global crises is ideal time span for testing interdependencies as a pandemic can be assumed to create volatility in unfettered global cryptocurrencies. Squared deviations from mean are used in order to measure volatilities in cryptocurrencies. Each currency is regressed in volatility form on other currencies. Results of this study showed that there exists spill over volatility effects in major cryptocurrencies. Although all cryptocurrencies are dependent upon other cryptocurrencies, but interdependencies do exist between some of these currencies. Since these currencies are assumed to behave like

global digital currencies and are not governed by any central bank. Hence it is not surprising that variation in one Cryptocurrency penetrated in other cryptocurrencies during global health crises.

References

Akhtaruzzaman, M., Boubaker, S., Nguyen, D. K., & Rahman, M. R. (2022). Systemic risk-sharing framework of cryptocurrencies in the COVID–19 crisis. *Finance research letters*, 102787.

Akhtaruzzaman, M., Sensoy, A., & Corbet, S. (2020). The influence of Bitcoin on portfolio diversification and design. *Finance Research Letters, 37*, 101344.

Alvarez-Ramirez, J., & Rodriguez, E. (2021). A singular value decomposition approach for testing the efficiency of Bitcoin and Ethereum markets. *Economics Letters, 206*,109997.

Baur, D. G., Hong, K., & Lee, A. D. (2018). Bitcoin: Medium of exchange or speculativeassets? *Journal of International Financial Markets, Institutions, and Money, 54*, 177–189.

Caporale, G. M., & Plastun, A. (2019). The day of the week effect in the Cryptocurrency market. Finance Research Letters, 31.

Cheah, E.-T., & Fry, J. (2015). Speculative bubbles in Bitcoin markets? An empirical investigation into the fundamental value of Bitcoin. *Economics Letters, 130*, 32–36.

Chuen, D. L. K., Guo, L., & Wang, Y. (2017). Cryptocurrency: A new investment opportunity?. The journal of alternative investments, 20(3), 16-40.

Conlon, T., & McGee, R. (2020). Safe haven or risky hazard? Bitcoin during the COVID–19 bear market. *Finance Research Letters, 35*, 101607.

Corbet, S., Hou, Y., Hu, Y., Larkin, C., & Oxley, L. (2020). Any port in a storm: Cryptocurrency safe-havens during the COVID–19 pandemic. *Economics Letters, 194*,109377.

Damianov, D. S., & Elsayed, A. H. (2020). Does Bitcoin add value to global industry portfolios? *Economics Letters, 191*, 108935.

Dyhrberg, A. H., Foley, S., & Svec, J. (2018). How investible is Bitcoin? Analyzing the liquidity and transaction costs of Bitcoin markets. *Economics Letters, 171*, 140–143.

Giovannini, A. (1993). Bretton Woods and its precursors: rules versus discretion in the history of international monetary regimes. In *A retrospective on the Bretton Woods system: Lessons for international monetary reform* (pp. 109-154). University of Chicago Press.

Liu, J., & Serletis, A. (2019). Volatility in the Cryptocurrency market. Open Economies Review, 30(4), 779-811.

Makarov, I., & Schoar, A. (2020). Trading and arbitrage in Cryptocurrency markets. Journal of Financial Economics, 135(2), 293-319.

Redish, A. (1993). Anchors aweigh: the transition from commodity money to fiat money in western economies. *Canadian Journal of Economics*, 777-795.

Urquhart, A. (2016). The inefficiency of Bitcoin. *Economics Letters, 148*, 80–82.

Walther, T., Klein, T., Bouri, E., 2019. Exogenous drivers of bitcoin and Cryptocurrency volatility - a mixed data sampling approach to forecasting. J. Int. Financ. Mark. Inst. Money 63, 101133.

Yi, S., Xu, Z., & Wang, G.-J. (2018). Volatility connectedness in the Cryptocurrency market: Is Bitcoin a dominant Cryptocurrency? *International Review of Financial Analysis, 60*,98–114.