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Testing Safe Haven Property of Bitcoin and Gold during Covid-19 : Evidence from Multivariate GARCH analysis

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Abstract

We test the safe-haven property of Gold and Bitcoin against equity markets (NSE50, DJIA, SSE, and CAC40) in the backdrop of Covid-19. We employ two multivariate volatility models, namely DCC and cDCC GARCH for analytical purposes. We find both Gold and Bitcoin to be negligibly correlated with equity returns most of the time. However, we observe a positive correlation during the initial phase of Covid-19. The results suggest that both Gold and Bitcoin exhibit the safe-haven property overall. However, during Covid-19, the safe-haven property of both Bitcoin and Gold is found to be partially compromised. We find Gold to exhibit relatively better safe-haven properties.

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1.Introduction

Covid-19 has significantly affected equity markets all over the world, resulting in a severe meltdown. Dow Jones Industrial Average (DJIA) witnessed a drop of 2997 points on March 16, 2020; the most significant drop in a day ever since the 1987 crash. CAC 40 fell by 9% in a day, while S&P 500 circuit breakers were triggered four times during March 2020. Similarly, NSE 30 lost 2900 points, around 25% of its value during March 2020. Similar behaviour was found in other equity markets as well. We can attribute a part of the equity market meltdown to volatility spillover. Due to the continuing deregulation in the financial sector, the extent of financial market integration has increased significantly during the past two decades. Investors spread their portfolio across different markets for diversification and profits. However, the shocks originating from one market can transmit to other markets through this channel, especially during times of turbulence. Equity markets witnessed an increased amount of volatility spillover across during the sub-prime crisis (Nathaniel, and Hesse. 2009., Cheung et al. 2010, Kim et al. 2015.). Covid-19 is a similar, if not more severe situation.

During such times, investors move towards safe-haven assets to protect their investment. A safe-haven asset is one that is uncorrelated or negatively correlated with other assets. During times of crisis, they are supposed to retain their value or even gain in value. Historically, investors use Gold as a trusted safe-haven asset. Baur and Lucey (2010) first proposed testable definitions of hedge, diversifier, and safe-haven and confirmed the safe-haven property of Gold against equity market fluctuations. Later, Reboredo (2013) found Gold to be a diversifier and safe-haven against the US dollar. However, cryptocurrencies were identified as a potential safe-haven instrument lately as they exist outside of the traditional financial system. Bouri et al. (2017) were the first one to identify Bitcoin's potential as a diversifier and safe-haven instrument by employing the GARCH based regression model of Ratner and Chiu (2013). Later, Bouri et al. (2017b) employed a similar method and identified Bitcoin as a hedge and safe-haven against energy commodities. Al-Khazali et al. (2018) studied the impact of macroeconomic news shocks on Bitcoin and Gold. They confirmed the safe-haven nature of Gold, while Bitcoin was to behave like a risky asset. Bouri et al. (2018) used copula-based models and found that Bitcoin can act as a safe-haven against financial stress. Employing a cross-quantilogram approach, Shehzad et al. (2019) confirmed that Bitcoin exhibits weak safe-haven properties. Bouri et al. (2019 a) analyzed the relationship between Global economic policy uncertainty and volatility of Bitcoin, commodities, equities, and bonds. The results suggested that Bitcoin can act as a hedging instrument. In a similar study, Bouri et al. (2019 b) confirmed the hedging effectiveness of Bitcoin against economic uncertainty. Recently, Bouri et al. (2020) found that Bitcoin can act as a hedge against equity market uncertainty arising due to trade policy related uncertainties. In a recent study, Kristjanpoller et al. (2020) showed that Bitcoin exhibits asymmetric cross-correlation relationships with ETFs.

After looking into the literature, it is evident that Bitcoin exhibits hedge and safe-haven properties. However, a pertinent question remains as to what extent these asset classes could retain their safe-haven property during a situation like Covid-19. So far, the safe-haven property of Bitcoin did not get tested during periods of extreme market stress. Our article aims to fill that research gap. The objective behind our research is to test the safe-haven property of Bitcoin in the backdrop of Covid-19. With the help of multivariate volatility models, we analyze the dynamics of volatility spillover between equity markets, Bitcoin and Gold; and see if Bitcoin and Gold exhibit safe-haven property. The remainder of this article is structured as follows. Section 2 provides a brief outline of the data and methodology employed. In section 3, we present our results. In section 4, we give the concluding remarks.

2.Data and Methodology

We use daily log-returns of four equity market indices, namely NSE50, DJIA, CAC40, and SSE; Gold prices and Bitcoin prices ranging from 05-01-2015 to 24-04-2020 for our analysis. We select Bitcoin due to its more significant market share among cryptocurrencies. We employ the Dynamic Conditional Correlation (DCC) model of Engle (2002) and the corrected Dynamic Conditional Correlation (cDCC) model of Aielli (2013).

Let r_t be the multivariate return series and $\phi(L)$ the lag polynomial. In the DCC framework, we model the conditional returns as:

$$\phi(L)r_t/\Omega_{t-1} = \mu_t + \varepsilon_t \tag{1}$$

ε_t is the vector containing the error-term and Ω_{t-1} is the information up to the last period.

$$\epsilon_t = H_t^{\frac{1}{2}} z_t \quad , z_t \sim iid(0, I_{NxN})$$

$$, H_t = E[r_t r' | I_{t-1}] \tag{2}$$

, H_t is the conditional covariance matrix where I is a NXN identity matrix. Here, we represent H_t as :

$$H_t \equiv D_t R_t D_t \tag{3}$$

$D_t = diag\{\sqrt{H_{it}}\}$ is a diagonal matrix of time-varying standard deviations, extracted from the univariate *GARCH* processes. R_t is the conditional correlation matrix of the normalized disturbances ε_t. R_t is decomposed into

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{4}$$

Q_t is the positive definite matrix containing the conditional variances-covariances of ε_t and Q_t^{*-1} contains the square root of the diagonal elements of Q_t.The DCC model is then given by:

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha \epsilon_{t-1} \epsilon'_{t-1} + \beta Q_{t-1} \tag{5}$$

α and β are non-negative scalars, s.t. $\alpha + \beta < 1$, This condition is applied to impose stationarity and positive semidefinite property. $\bar{Q}$ is the unconditional covariance of the standardized disturbances ε_t .

Engle suggests a two-step maximum likelihood estimation method to estimate the DCC model, with the likelihood function being given by:

$$\ln\big(L(\theta)\big) = -\frac{1}{2}\sum_{t=1}^{T}\{n \ln(2\pi) + ln|D_t|^2 + \ln(|R_t|) + \varepsilon_t' D_t^{-2} \varepsilon_t \tag{6}$$

Aielli (2013) proposed the corrected DCC model to account for the asymptotic bias in the DCC covariance matrix estimator. He reformulated the correlation process Q_t such that

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha \epsilon^*_{t-1} \epsilon^{*\prime}{}_{t-1} + \beta Q_{t-1} \tag{7}$$

where $\epsilon_t^* = diag(Q_t)^{\frac{1}{2}} * \epsilon_t$

Baur and Lucey (2010) define hedge, safe-haven, and diversifier as follows:

- *A hedge is as an asset that is uncorrelated or negatively correlated with another asset or portfolio on average. A strict hedge is (strictly) negatively correlated with another asset or a portfolio on average.*

- *A diversifier is an asset that is positively (but not perfectly correlated) with another asset or portfolio on average.*
- *A safe-haven is an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil.*

By employing the DCC class models, it will be possible for us to extract the time-varying correlations between Bitcoin, Gold, and the four equity markets. If Bitcoin/Gold exhibits safe-haven properties, then the correlation between these assets should be zero or negative during times of turbulence. If the conditional correlation is zero or negative on average, Bitcoin/Gold can act as a hedge. By employing cDCC model, we account for possible bias in the estimation of time-varying correlations associated with the standard DCC model.

3.Results and Discussion

First, we present the summary statistics of the series under analysis. Next, we examine the pair-wise correlation between Bitcoin, Gold, and the four equity index returns. We display the results in tables 1 and 2.

Table 1: Summary Statistics

Series	Minimum	Mean	Maximum	Std. Dev
SSE	-0.03854	-6.50E-05	0.02472	0.00685
CAC	-0.05689	2.44E-05	0.034987	0.005781
BTC	-0.20183	0.001221	0.097768	0.021626
NSE	-0.06038	3.26E-05	0.036482	0.005152
GOLD	-0.02238	0.000132	0.022294	0.003932
DJIA	-0.06011	0.000113	0.046749	0.005499

Standard deviation values show that Bitcoin is the most volatile asset among the lot, while Gold is the least volatile asset. Bitcoin is characterized by extreme fluctuations, as evidenced by the minimum and maximum values of returns.

Table 2: Correlation Matrix

	BTC	NSE	DJIA	CAC	SSE	Gold
BTC	1	0.075543	0.139401	0.129532	0.022281	0.118724
NSE	0.075543	1	0.402953	0.531052	0.251741	0.027841
DJIA	0.139401	0.402953	1	0.632974	0.193068	0.102471
CAC	0.129532	0.531052	0.632974	1	0.250304	-0.07368
SSE	0.022281	0.251741	0.193068	0.250304	1	0.004717
Gold	0.118724	0.027841	0.102471	-0.07368	0.004717	1

Looking into the pair-wise correlation values between Bitcoin and Equity market returns, we see that they are minimal but positive. In the case of Gold, we find the correlation value to be negative for CAC. For the other three markets, the correlation values are positive. We find that Bitcoin and

Gold are positively correlated. Next, we test for the presence of volatility clustering and autocorrelation in the given series. Towards this, we apply the ARCH LM test and Box-Pierce(Q) test on the six return series for a lag of 5. From the results of the ARCH LM test and Box-Pierce (Q) test, we can confirm the presence of autocorrelation and volatility clustering in all the return series. W present the results in Table 3.

Table 3: ARCH LM test and Box Pierce(Q) test

Series	ARCH LM (5)	BP-Q (5)
NSE	**53.014**	**375.320**
DJIA	**148.44**	**820.338**
CAC40	**56.905**	**340.029**
SSE	**32.114**	**265.019**
GOLD	**14.587**	**98.0550**
BITCOIN	**6.4796**	**37.5126**

Note: For the ARCH LM test, H0 is the absence of volatility clustering. For the Box-Pierce test, H0 is the absence of autocorrelation. Values in bold show rejection of the null hypothesis at 5% significance level.

After confirming the presence of volatility clustering and autocorrelation, we proceed towards multivariate volatility modelling using DCC and cDCC models. We include the cDCC model to account for the possible bias in DCC GARCH estimation as pointed out by Aielli (2013). We present the results in Tables 3 and 4. We estimate two models viz. VAR (1)-DCC GARCH (1,1) and VAR (1)-cDCC GARCH (1,1) for the analysis.

Table 3 exhibits univariate GARCH results, whereas table 4 displays the DCC GARCH results. Univariate GARCH estimation results show that all the markets under analysis are significantly volatile. We find statistically significant ARCH effect and GARCH effect in all the series. Based on the β values, we find SSE to be the most volatile market, followed by CAC and NSE. From the high value of the GARCH coefficient, we can understand that volatility is persistent in all the markets. Between Bitcoin and Gold, Gold is exhibiting more conditional volatility.

Table 4: Univariate GARCH Estimation Results

Parameters		**CAC**	**NSE**	**DJIA**	**BTC**	**GOLD**
AR(1)	0.034	-0.0603	0.0172	-0.1492	0.0549	-0.0056
Cst(V) x 10^6	**0.2895**	**0.8657**	**0.6809**	**0.6661**	**0.3493**	**0.0558**
ARCH(Alpha1)	**0.075**	**0.0886**	**0.1138**	**0.1494**	**0.2064**	**0.0326**
GARCH(Beta1)	**0.9216**	**0.8797**	**0.8587**	**0.8200**	**0.7484**	**0.9659**

Note: values in bold denote 5% statistical significance

Table 5: DCC and cDCC Estimation Results

Parameters	DCC	cDCC
$\boldsymbol{\rho}$(CAC,SSE)	**0.243**	**0.242**
$\boldsymbol{\rho}$(NSE,SSE)	**0.274**	**0.273**
$\boldsymbol{\rho}$(DJIA,SSE)	**0.193**	**0.192**
$\boldsymbol{\rho}$(BTC,SSE)	-0.010	-0.010
$\boldsymbol{\rho}$(GOLD,SSE)	-0.012	-0.013
$\boldsymbol{\rho}$(NSE,CAC)	**0.432**	**0.431**
$\boldsymbol{\rho}$(DJIA,CAC)	**0.618**	**0.616**
$\boldsymbol{\rho}$(BTC,CAC)	0.029	0.027
$\boldsymbol{\rho}$(GOLD,CAC)	**-0.213**	**-0.217**
$\boldsymbol{\rho}$(DJIA,NSE)	**0.318**	**0.316**
$\boldsymbol{\rho}$(BTC,NSE)	-0.010	-0.011
$\boldsymbol{\rho}$(GOLD,NSE)	-0.072	-0.075
$\boldsymbol{\rho}$(BTC,DJIA)	0.004	0.002
$\boldsymbol{\rho}$(GOLD,DJIA)	**-0.097**	**-0.101**
$\boldsymbol{\rho}$(GOLD,BTC)	0.056	0.053
$\boldsymbol{DCC\_\alpha}$	0.014	**0.015**
$\boldsymbol{DCC\_\beta}$	**0.897**	**0.911**
LL	27241.953	27243.886

Note: values in bold denote 5% statistical significance

From the DCC GARCH (1,1) results, we can see that there are positive conditional correlations between the equity market returns. Among the markets, DJIA and CAC are highly correlated, with a value of 0.61. In the second place, we have NSE and CAC. We find emerging markets like NSE and SSE moderately correlated with the developed markets. In the case of Gold, we find a significant negative correlation between Gold/CAC and Gold/DJIA. There is no significant correlation between Gold and other equity market returns. There is also no statistically significant correlation between Bitcoin and Gold. In the case of Bitcoin, we observe that no significant conditional correlations exist between Bitcoin and equity market returns. Looking into the overall significance of the model, we can see that DCC_α is not statistically significant whereas DCC_β is statistically significant and high, indicating a joint GARCH effect.

Looking into the cDCC GARCH (1,1) result, we can see that the conditional correlation values have decreased slightly, but the structure of conditional correlation remains the same. Further, DCC_α is found to be statistically significant, indicating a joint ARCH effect in the model. The DCC_β is slightly high in the cDCC model, indicating higher volatility spillover compared to the DCC model. From the log-likelihood (LL) values, we can understand that cDCC model is relatively better as it has a higher LL value.

From the conditional correlation values, it may seem that both Bitcoin and Gold are potential safe-haven instruments. However, a detailed examination may be needed before we can reach a conclusion. Towards that, we examine the pair-wise conditional covariance plots for both the models to examine the volatility spillovers. First, we present the conditional covariance of the DCC model in figure 1.

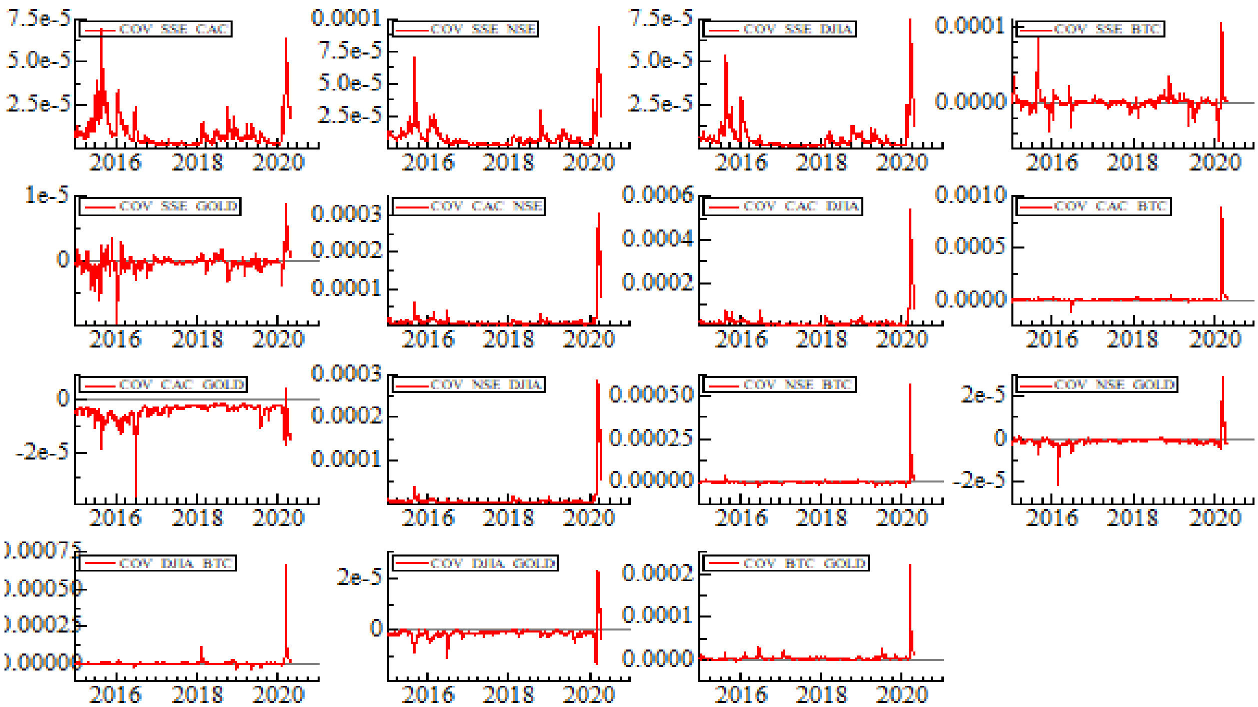

Figure 1: Conditional covariance plot – DCC model

From the above analysis, we can see significant volatility spillover between equity markets. We also observe an increased amount of spillover during the period of Covid-19. We found that the covariance between Gold and equity markets are mostly negative. However, they were positive during the initial phase of Covid-19 and found to be decreasing after that. In the case of Bitcoin, the volatility spillover between Bitcoin and equity markets are negligible except with SSE. However, the spillover dies out after 2017. During the Initial days of cryptocurrency mining, China was a hotbed of cryptocurrency activity. However, during 2017, the government initiated a crackdown and put a ban on cryptocurrency-related operations which might have resulted in a reduced amount of spillover. We also observe significant spillover between equity markets and Bitcoin during the initial period of Covid-19. However, we observe that the spillover is reducing in the later stages. Next, we examine the conditional covariance plots generated by the cDCC model, shown in figure 2.

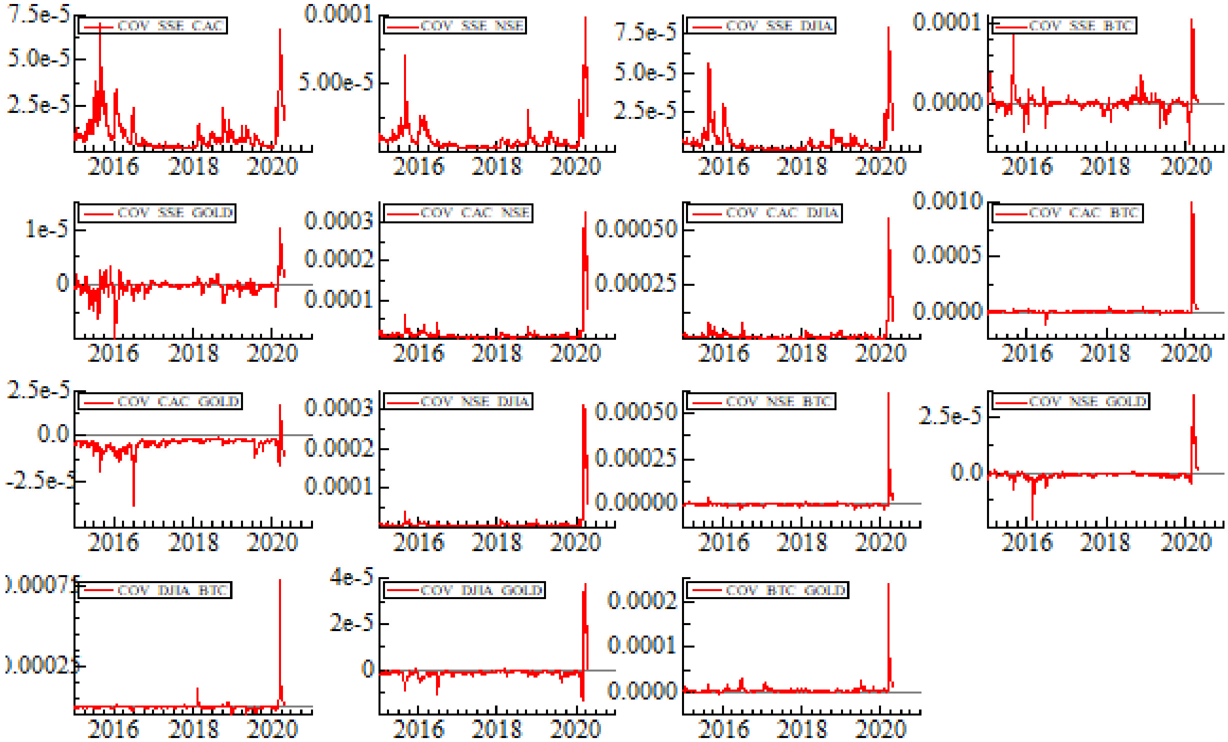

Figure 2: Conditional covariance plot – cDCC model

The pair-wise conditional covariance values estimated from cDCC model follow a similar pattern as exhibited by the DCC model. There was a significant volatility spillover between equity markets, Gold and Bitcoin during the initial phase of Covid-19. Nevertheless, it is decreasing during the latter period.

Next, we analyze the dynamic conditional correlation values generated by the DCC and cDCC models with the help of the conditional correlation plots. They are shown in figures 3 and 4, respectively. In the case of Gold, we can see that it is negatively correlated with equity markets for most of the time except in the case of SSE. Here, the property of Gold as a potential diversifier is confirmed (Baur and Lucey,2010). During the Covid-19 induced crisis, we can see that the dynamic correlation between Gold and Equity markets was positive for a brief period. However, it is found to be decreasing and turned negative. For CAC40, Gold could act as a safe-haven for almost all the time. We can say that shocks originating from other markets briefly affected Gold prices. However, it could recover fast.

Looking into the case of Bitcoin, we can observe that correlation between Bitcoin and equity markets are minimal, indicating the suitability of Bitcoin as a potential diversifier instrument. There are instances where the correlation is negative, confirming the hedging ability of Bitcoin, as evidenced by Bouri et al. (2019a). However, Bitcoin prices were affected by shocks from equity markets during Covid-19, as evidenced by the relatively high amount of positive dynamic conditional correlation exhibited during early 2020. We find that Bitcoin is susceptible to global economic uncertainty, as evidenced by Bouri et al. (2019a). Like in the case of Gold, Bitcoin also started recovering, as showed by the decreasing correlation values. However, the values are positive, indicating that Bitcoin's safe-haven nature during Covid-19 was compromised.

Next, we analyze conditional correlation plots of the cDCC model, exhibited in figure 4. After analyzing the dynamical conditional correlation values obtained from the cDCC model, we can confirm the patterns observed in the previous section. We find Both Bitcoin and Gold exhibiting safe-haven properties. However, we find the safe-haven property of both of these assets compromised during the peak of the Covid-19 induced market crisis. We find Bitcoin influenced by Global economic uncertainty triggered due to the Covid-19 pandemic.

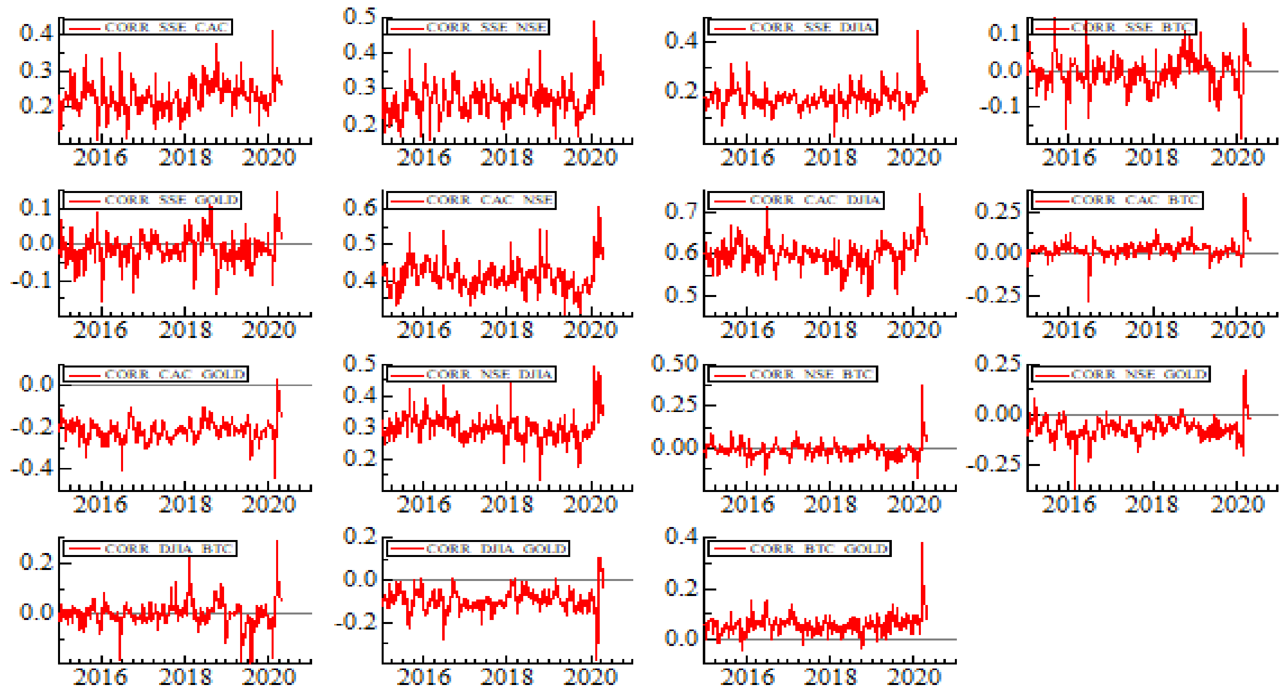

Figure 3: Conditional correlation plot- DCC model

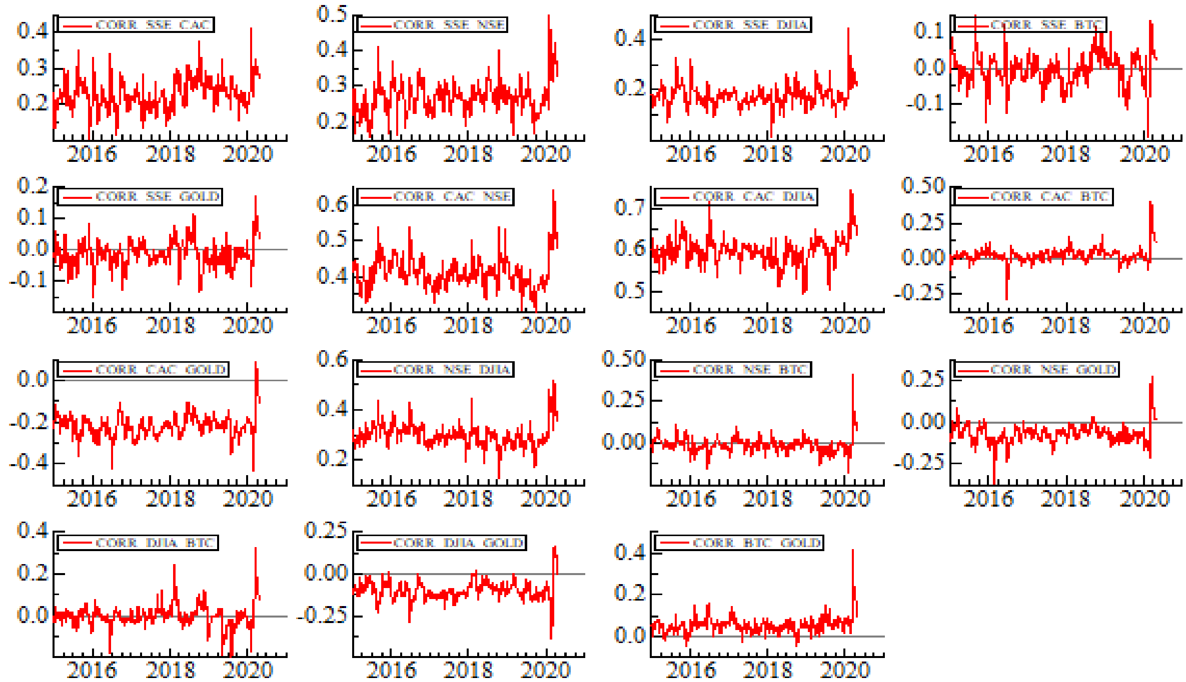

Figure 4: Conditional correlation plot- cDCC model

In contrast to the previous studies (Bouri et al. 2018, Shehzad et al. 2019), Our results reject Bitcoin's safe-haven property during Covid-19. We find Gold to be a better safe-haven compared to Bitcoin during times of turbulence. Our results confirm the findings of Al-Khazali et al. (2018) to a large extent.

4.Concluding Remarks

Using multivariate GARCH models, we analyzed the safe-haven property of Gold and Bitcoin against equity markets in the backdrop of Covid-19. The results confirmed the overall safe-haven property of Bitcoin and Gold. However, we find both these assets to be partially affected by the meltdown triggered by Covid-19. Among the two assets, we find Gold to exhibit better safe-haven property during the Covid-19 induced market turbulence. We find Bitcoin to be affected by shocks originating from other financial markets, as evidenced by the dynamical conditional correlation patterns. From an investor perspective, we would suggest that it is better to use Bitcoin as a hedge or diversifier. During periods of extreme market stress, we advise investors to stick with Gold.

Cryptocurrencies, as a financial asset class are still evolving. Further, they are susceptible to exogenous shocks originating from other financial markets. While these assets can be used as a short-term hedge/diversifier, using them as a safe-haven instrument during times of crisis may not be a prudent decision. However, drawing concrete conclusions it is not possible to make further at this stage. As global financial markets are still reeling under the impact of Covid-19, we may have to wait for some time until the final picture emerges. For future research, we plan to extend the analysis by employing the methodology proposed by Saeed et al. (2020). Further, we will consider implementing wavelet-based methods in order to capture investor behaviour across different time horizons.

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