Uluslararası İktisadi ve İdari İncelemeler Dergisi
International Journal of Economic and Administrative Studies
https://dergipark.org.tr/tr/pub/ulikidince

UİİİD-IJEAS, 2022 (37) ISSN 1307-9832

QUANTILE CONNECTEDNESS BETWEEN CRYPTOCURRENCIES AND STABLECOINS

Cantürk KAYAHAN[1], Halilibrahim GÖKGÖZ[2], Toga MURAT[3]

Abstract

This paper aims to analyze the volatility spillover relationship between cryptocurrencies and stablecoins dynamically. Within the scope of the study, the daily closing price data of Bitcoin (BTC), Ethereum (ETH), BNB cryptocurrencies, and Tether (USDT) and USD Coin (USDC) stablecoins covering the period from January 1, 2019 to April 6, 2022 was analyzed using the Q-VAR model. Our results suggest that the volatility spillover between the cryptocurrency and stablecoins increased during the Covid-19 pandemic. Moreover, the direction and severity of volatility spillover between cryptocurrencies and stablecoins are affected by global events. While the relationship between cryptocurrencies and stablecoins themselves is strong, the relationship between each other is weak. Our findings suggest that global events influence the interaction between crypto-assets and that cryptocurrencies and stablecoins can be good diversifiers for each other. These findings have important implications for financial market regulators, portfolio investors, and academic research.

Keywords: *Cryptocurrencies, Stablecoins, Volatility Spillover, Quantile Vector Autoregression*
JEL Classification: *C32, G11, G15*

KRİPTO PARALAR VE STABİL COİNLER ARASINDAKİ KANTİL BAĞLANTILILIK

Öz

Bu çalışma, kripto paralar ve stabil coinler arasındaki volatilite yayılım ilişkisini dinamik olarak analiz etmeyi amaçlamaktadır. Çalışma kapsamında 1 Ocak 2019 – 6 Nisan 2022 dönemini kapsayan Bitcoin (BTC), Ethereum (ETH), BNB kripto para birimleri ile Tether (USDT) ve USD Coin (USDC) stabilcoinlerinin günlük kapanış fiyat verileri, Q-VAR modeli kullanılarak analiz ediLmiştir. Bulgularımız, Covid-19 salgını sırasında kripto paralar ve stabil coinler arasındaki volatilite yayılımının arttığını gösterektedir. Ayrıca, kripto paralar ve stabil coinler arasındaki volatilite yayılımının yönü ve şiddeti küresel olaylardan etkilenmektedir. Kripto paralar ve stabil coinler arasındaki ilişki zayıfken; kendi aralarındaki ilişki güçlüdür. Bulgularımız, küresel olayların kripto varlıklar arasındaki etkileşimi etkilediğini ve kripto paralar ile stabil coinlerin birbirleri için iyi çeşitlendiriciler olabileceğini göstermektedir. Bu bulguların finansal piyasa düzenleyicileri, portföy yatırımcıları ve akademik araştırmalar için önemli etkileri vardır.

Anahtar Kelimeler: *Kripto paralar, Stabil coinler, Volatilite Yayılımı, Kantil Vektör Otoregresyon*
JEL Classification: *C32, G11, G15*

[1] Prof., Afyon Kocatepe University, Faculty of Economics and Administrative Sciences, ckayahan@aku.edu.tr, ORCID: 0000-0003-4777-1470
[2] Res. Asst., Afyon Kocatepe University, Faculty of Economics and Administrative Sciences, hgokgoz@aku.edu.tr, ORCID: 0000-0001-8000-9993
[3] PhD Student, Afyon Kocatepe University, Institute of Social Sciences, tolgamurat23@gmail.com, ORCID: 0000-0002-5701-2374

Araştırma Makalesi

Makalenin Geliş Tarihi (Recieved Date): 21.07.2022
Yayına Kabul Tarihi (Acceptance Date): 09.09.2022

Kayahan, C., Gökgöz, H. & Murat, T. (2022). Quantile Connectedness Between Cryptocurrencies and Stablecoins. *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, 37, 143-156. https://doi.org/10.18092/ulikidince.1142872

1. Introduction

The history of the development of money is equivalent to the history of humanity. People's desire to earn more has emerged as a necessity of human nature, and the first elements taken into account at this point were precious metals. In addition, the development intervals of the world in the past have decreased day by day. The main reason for this is the momentum in information technologies and the movement of technology in global world philosophy. Therefore, while the financial system that was created to replace the Bretton Woods system in the 70s accelerated the transformation of an integrated monetary world, after the 2008 crisis, a transformation into a decentralized and more freely movable investment-money system like cryptocurrencies took place. In this structure, the anonymous and decentralized crypto-money system has attracted the attention with the pioneering work of Nakamoto (2008), whose real identity still remains unknown.

Cryptocurrency is money that is developed decentralized and based on blockchain technology. Bitcoin, the first cryptocurrency, has attracted the attention of many investors. While bitcoin was valued very low in the early periods, a systematically future-oriented investment tool was built. As the cycles of world monetary systems were formed according to wars and crises from past to present, the creation of Bitcoin - the dominant cryptocurrency - being founded after the 2008 global financial crisis is not a coincidence. Moreover, significant volatility and increase in value during its development phase can be explained by a global event such as the Covid-19 Pandemic. As stated in the previous financial philosophy-based explanations, the greed of human beings towards a desire to earn more accelerated the formation and development of alternative and different cryptocurrencies. Altcoins, whose names had difficulty finding a place for themselves even in all world alphabets, quickly found their place in the cryptocurrency market. Investors from emerging markets have shown more interest in the cryptocurrency markets with the expectation of high returns. According to the philosophy of the financial system, volatile markets have more risk but provide more returns. Cryptocurrency markets are where the return volatility is high, and the investors seeking to earn more are focused on these markets. For example, cryptocurrencies have become one of the favorite investment tools of the middle class in countries with very different investor profiles, such as China (Pho et al., 2021). On the other hand, the momentum of the development and change in this market has increased the need for safe crypto investment tools that will be an alternative to the development and change in the financial markets. At this point, stablecoins paved the way for the formation of crypto assets that can respond to these needs of the markets and show less volatility. Stablecoins, whose value is fixed to other assets, was created to solve the high volatility problem in cryptocurrencies (Ante et al., 2021).

The fact that stablecoins have less volatility than cryptocurrencies has caused them to be used as a store of value as an alternative to cryptocurrencies and to be compared with cryptocurrencies. Especially recently, many studies have been added to the literature examining the relationship between stablecoins, cryptocurrencies, and traditional financial assets. Studies have mainly examined the relationship between stablecoins and cryptocurrencies, as well as comparing the role of the two assets in diversifying portfolio investments. In this context, the lack of consensus in the literature makes it important to examine the relationship between stablecoins and cryptocurrencies and points to the position of our study in the literature. In addition, recent studies in the literature have examined the relationship between stablecoins and cryptocurrencies with dynamic volatility spillover analysis. However, the number of studies that make their evaluations in the context of global events is very few. The volatility spillover relationship between three cryptocurrencies and two stablecoins with the highest market value was analyzed with the Q-VAR (Quantile - Vector Autoregression) model. In addition to the fact that the method is used in a small number of studies in the literature, showing the change in the strength and direction of the volatility spillover relationship between cryptocurrencies and stablecoins, and financial evaluation of the findings within the context of global events can be explained as additional contributions of this study to the literature.

The general content of the following sections of the study is; a literature review of similar studies analyzed in an intensified manner, the analysis of the three cryptocurrencies and two stablecoins with the highest market value using the Q-VAR model and daily data, and the conclusions and general evaluation of the findings.

2. Literature Review

Studies examining the relationship between cryptocurrencies and stablecoins have recently intensified in the literature. Most studies examining the relationship between cryptocurrencies and stablecoins have analyzed the relationship between the variables with volatility spillover models while revealing the direction and severity of volatility spillover. The characteristics of the studies reviewed in the literature are summarized in Table 1.

Table 1: **Characteristics of Studies Investigating Cryptocurrencies and Stablecoins in the Literature**

AUT. (S)	DATA PERIOD & FREQUENCY	METHOD	VARIABLES	CONCLUSIONS
Wei (2018)	Daily Price, Aggregate Trading Volume and Market Capitalization (2016-2018)	Granger Causality & Unrestricted VAR	USDT Trading Volume, BTC Trading Volume, USDT Grant, BTC Returns	No evidence found regarding USDT issuances causing increase in BTC returns. Tether issuances are highly autocorrelated and may cause subsequent increases BTC and USDT trading volume in the short term.
Kumar & Anandarao (2019)	Daily Price (2015 – 2018)	IGARCH & DCC-GARCH	BTC, ETH, XRP, LTC	The volatility of a cryptocurrency is largely autocorrelated, meaning cryptocurrency volatility could be explained by its own price fluctuations. The correlation between the crypto-pairs weakens during the market crashes, indicating the existence of investor panic. Volatility spillover among cryptocurrencies only existed after 2017; it is a moderate spillover effect and only evident in the short term.
Fakhfekh & Jeribi (2020)	Daily Price (2017 – 2018)	EGARCH, TGARCH, PGARCH, FIGARCH, FIEGARCH	BTC, REP, BTS, DASH, EOS, ETH, IOTA, KMD, LSK, XMR, NEO, QTUM	Unlike in the stock markets, an asymmetric effect was found between the cryptocurrencies. The volatility increases as a response to the positive shocks rather than to adverse shocks.
Huynh (2020)	Daily Price (2013 – 2019)	Transfer Entropy	BTC, LTC, ETH, XEM, DASH, DOGE, XMR, VTC, XVG, DGB, USDT, XLM, MAID, XRP, GOLD	The stablecoins pegged to the USD are more volatile than the USD because they send and receive shocks. Gold is still a good tool while hedging cryptocurrency investments. Bitcoin is not the most substantial shock creator in the cryptocurrency market; coins with small market capitalization are likely to be more volatile and cause and bear shocks. Among the cryptocurrencies, Bitcoin is still the best hedging tool.

Table 1 (Continued): **Characteristics of Studies Investigating Cryptocurrencies and Stablecoins in the Literature**

AUT. (S)	DATA PERIOD & FREQUENCY	METHOD	VARIABLES	CONCLUSIONS
Wang et al., (2020a)	Daily Price (2015 – 2019)	DCC GARCH & Dummy Variable Regressio n	USDT, BitUSD, USNBT, BTC, LTC, XRP, USD, DGD, HGT, XAUR, GOLD	USD pegged stablecoins help reduce the losses in extreme downward market conditions. Tether is the best performing one amongst the USD pegged stablecoins regarding risk reduction. When compared, portfolios including gold-backed stablecoins perform much worse than those with USD-pegged stablecoins. Gold is a better hedger than gold-backed stablecoins.
Wang et al., (2020b)	Daily Price, Daily EPU (2011 – 2018)	DCC-GARCH	BTC/USD Volume, BTC/GBP Volume, US EPU, UK EPU	Returns around the high EPU days are significantly higher than those around the lowest EPU days; also, while US EPU is increasing the volatility and trading volume of BTC/USD in the US BTC market, UK EPU has weaker effect on UK BTC market. Moreover, while US EPU has an inversely proportional trend with BTC price trends, UK EPU has no significant relationship.
Yousaf & Ali (2020)	Hourly Price (2019 – 2020)	VAR-DCC-GARCH	BTC, ETH, LTC	Volatility transmission is not significant between the cryptocurrency pairs during the pre-Covid-19 period. During the Covid-19 period, volatility spillover is unidirectional from BTC to ETH and bidirectional between the ETH and LTC, while there is no volatility spillover between BTC and LTC.
Baur & Hoang (2021)	1-min, hourly and daily returns (2018 – 2019)	Standard Safe Haven Test	BTC, USDT, USDC, TUSD, PAX, DAI, GUSD	Stablecoins are not stable. However, stablecoins provide a safe haven against the extreme volatility of BTC.
Bouri et al., (2021)	Daily Price (2015 – 2020)	Quantile VAR	BTC, ETH, XRP, LTC, XLM, XMR, DASH	While the strongest return spillover is observed between the BTC and LTC, the weakest spillover is observed between the BTC and XRP. While XRP, XMR, and DASH are receivers of the spillover, BTC, ETH LTC, and XML are the net transmitters.
Grobys et al., (2021)	Daily High, Low and Closing Prices, (2013 – 2020)	Realized Volatility Using Grobys (2021), Rogers and Satchell (1991)	BTC, USDT, USDC, DAI, BUSD, TUSD.	Stablecoins are statistically significantly unstable, and BTC volatility exhibits a spillover effect on the stablecoins.
Hoang & Baur (2021)	5-min intraday prices and market capitalization, 24h trading volume (2018 – 2019)	GARCH & T-GARCH	BTC, USDT, USDC, TUSD, PAX, SAI, GUSD, EURS, DGX, S&P500, USDX, GOLD	None of the stablecoins is absolutely stable, but compared to the BTC, stablecoins are relatively stable. Stablecoins increase the volatility of BTC.

Table 1 (Continued): **Characteristics of Studies Investigating Cryptocurrencies and Stablecoins in the Literature**

AUT. (S)	DATA PERIOD & FREQUENCY	METHOD	VARIABLES	CONCLUSIONS
Jalan et al., (2021)	Daily Price (2020 – 2021)	Diebold & Yılmaz Spillover Index (2012)	BTC, DGX, PMGT, XAUT, PAXG, TMTG, GOLD	During the Covid-19 period, gold-backed stablecoins show volatility comparable to the BTC; unlike gold, gold-backed stablecoins show no safe haven function. Bitcoin's volatility has no significant effect on the volatility of gold-backed stablecoins
Moratis (2021)	Daily Price (2016 – 2020)	Bayesian VAR	BTC, ETH, XRP, ... (30 cryptocurrencies with the highest market capitalization)	Bitcoin remains the dominator of the spillover effect in the cryptocurrency market. XRP is the net receiver of the shocks.
Zhang & Mani (2021)	Daily Price (2015 – 2021)	MGARCH & DCC	BTC, ETH, DOGE, GOLD	Positive shocks have more significant effects on the volatility of cryptocurrencies compared to adverse effects. Cryptocurrencies have a strong positive correlation among themselves, and all the variables showed extreme volatility during the Covid-19 shutdowns.
Akhtaruzzaman et al., (2022)	Daily Price (2017 – 2021)	COVAR	BTC, ETH, USDT, XRP, DOGE, LTC, ETC, XLM, XMR, NEO, DCR, WAVES, ZEC, DASH, NEM, SC, DGB	During the Covid-19 period, both systematic risk and the transmission of contagious shocks have increased. Compared to the other cryptocurrencies, BTC is relatively stable and less vulnerable to shocks.
Grobys & Huynh (2022)	Hourly Price (2018 – 2021)	Barndorff-Nielsen & Shephard Meth.	BTC, USDT	1% increase in the USDT price can statistically significantly predict a 3.65% - 8.49% value loss of BTC.
Katsiampa et al., (2022)	Hourly Price (2019 – 2020)	Diagonal BEKK, MGARCH, DCC	32 digital assets (15 cryptocurrencies, 10 protocols, 7 dApps)	During the Covid-19 period, ETH and altcoins have become more influential in the cryptocurrency market. Due to the positive contagion, cryptocurrency investors can generate extreme returns during uncertainty periods. Bitcoin still has a substantial influence on affecting the prices of other crypto assets.
Kumar et al., (2022)	Daily Price (2017 – 2020)	Diebold & Yilmaz (2012), Barunik & Krehlik (2018)	BTC, ETH, XRP, LTC, BCH, EOS, BNB, USDT, BSV, TRX	The highest return connectedness was observed in a relatively short time, from one day to one week, and intensified during the Covid-19 period. Volatility connectedness follows the same pattern; it increases in the short term and intensifies during the Covid-19 period. The return and volatility connectedness of cryptocurrencies are crisis sensitive and show their effect in the short term.

Table 1 (Continued): **Characteristics of Studies Investigating Cryptocurrencies and Stablecoins in the Literature**

AUT. (S)	DATA PERIOD & FREQUENCY	METHOD	VARIABLES	CONCLUSIONS
Naeem et al., (2021)	Daily Price (2015-2020)	Koenker & Basset (1978) Diebold & Yılmaz (2012, 2014)	BTC, ETH, XRP, LTC, XMR, XLM, NEM	BTC, XRP, and LTC are the dominant transmitters of return spillovers. ETH is the net receiver. The general strength of spillover is time-varying, and receivers and transmitters change in different periods.
Nguyen et al., (2022)	Daily Price (2018 – 2019)	GARCH & EGARCH	USDC, USDT, PAX, TUSD, EURS, BTC, ETH, XRP, BCH, LTC, US and China interest rates	The US federal funds rate has a more substantial effect on stablecoins and cryptocurrencies compared to Chinese interbank rates. Higher interest rates from the US and China have a compressing effect on the volatility and price of stablecoins and an increasing effect on both prices and volatility of cryptocurrencies.

* In the studies in the literature, while the pre-January 2020 period is considered the pre-Kovid-19 period, post January 2020 is considered the post-Kovid-19 period.

When Table 1 is examined; there is no consensus on the relationship between cryptocurrencies and stablecoins, some studies (Grobys et al., 2021; Hoang & Baur, 2021; Grobys & Huynh, 2022) show that there is a strong relationship between cryptocurrencies and stablecoins; while other studies (Wei, 2018; Huynh, 2020; Wang, 2020a; Baur & Hoang, 2021; Jalen et al., 2021) indicate that there is a weak relationship between the cryptocurrencies and stablecoins. Some other studies (Kumar & Anandro, 2019; Yousaf & Ali, 2020; Akhtarruzzaman et al., 2022; Katsiampa et al., 2022; Kumar et al., 2022) show that the volatility spillover relationship between cryptocurrencies and stablecoins has increased in the aftermath of global events. Some studies show the relationship between cryptocurrencies is strong (Bouri et al., 2021; Moratis, 2021; Zhang & Mani, 2021; Naeem et al., 2021), and cryptocurrencies are related with global events (Wang et al., 2020b; Nguyen et al., 2022), also positive and negative shocks have different effects on cryptocurrencies (Fakhfekh & Jeribi, 2020; Zhang & Mani, 2021). In addition, some of the studies analyzed (Huynh, 2020; Grobys et al., 2021; Hoang & Baur, 2021; Jalan et al., 2021) revealed that stablecoins are volatile, meaning they are not stable. Therefore, the lack of consensus on the relationship between stablecoins and cryptocurrencies makes it essential to examine and study the subject.

On the other hand, studies examined in the literature mainly used volatility spillover models to examine the relationship between variables (Kumar & Anandarao, 2019; Fakhfekh & Jeribi, 2020; Bouri et al., 2021; Jalan et al., 2021; Zhang & Mani, 2021; Katsiampa et al., 2022; Kumar et al., 2022; Naeem et al., 2021). These models are multivariate GARCH and DY (Diebold and Yılmaz) derivatives. However, few studies (Wang et al., 2020b; Nguyen et al., 2022) have evaluated the volatility spillover relationship between stablecoins and cryptocurrencies in the context of global events. In this respect, analyzing the volatility spillover relationship between stablecoins and cryptocurrencies with Q-VAR and evaluating the findings in the context of global events are considered as contributions of our study to the literature.

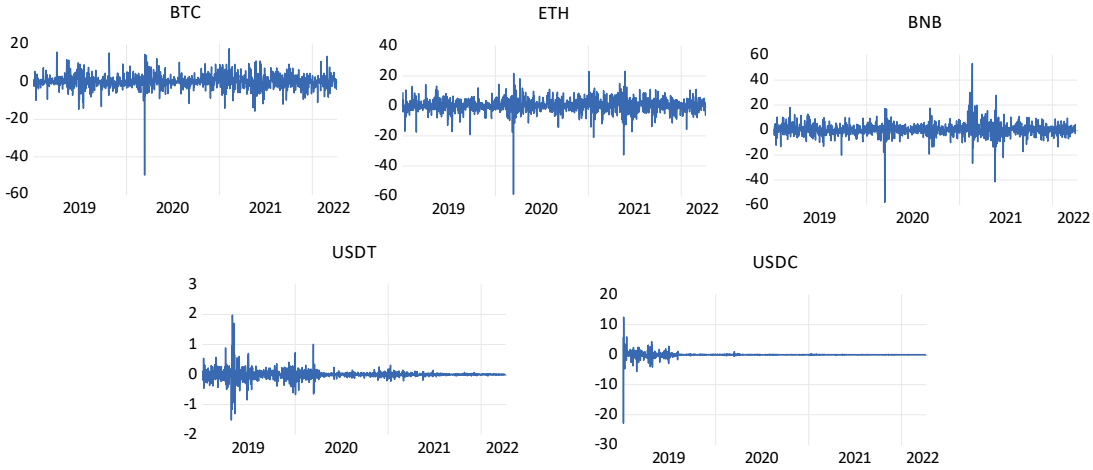
3. Methodology

3.1. Data and Methodology

This study aims to analyze the dynamic volatility spillover relationship between three cryptocurrencies and two stablecoins with the highest market capitalization. In this context, a

dataset of Bitcoin (BTC), Ethereum (ETH) and BNB cryptocurrencies, and Tether (USDT) and USD Coin (USDC) stablecoins covering the period January 1, 2019-April 6, 2022 is used[1]. The data was retrieved from "investing.com" and the daily logarithmic returns of the series were calculated using the following formula ($100*\ln(Observation_t/Observation_{t-1})$). For the analysis, the return series was first tested for stationarity, and the Q-VAR model was applied to the series that were found to be stationary at level.

Figure 1: **Time Series Graphs of Logarithmic Return Series**



Time series graphs of the logarithmic return series of cryptocurrencies and stablecoins are presented in Figure 1. When the graphs are examined, it is observed that the volatility of cryptocurrencies is higher than that of stablecoins, and that cryptocurrency returns deviated too much from the average, especially on the date when Covid-19 was declared a global pandemic. Moreover, the volatility of stablecoins (especially USDC) decreased at the end of the analyzed period compared to the beginning. Descriptive statistics and stationarity tests for cryptocurrencies and stablecoins are summarized in Table 2:

Table 2: **Descriptive Statistics for Cryptocurrencies and Stablecoins**

	BTC	ETH	BNB	USDT	USDC
Mean	0.204623	0.262774	0.357391	-0.000502	-0.000786
Maximum	17.74241	23.07723	53.05742	1.979672	12.46314
Minimum	-49.7278	-58.96385	-58.11581	-1.514497	-22.80838
Std. Dev.	3.973797	5.086636	5.688225	0.179985	0.981143
Skewness	-1.545704	-1.539831	-0.384409	0.900664	-8.762891
Kurtosis	25.34043	21.10824	22.68906	33.93264	273.4004
JB	25241.84***	16743.12***	19266.91***	47643.62***	3643643***
ADF	-37.5745***	-38.2959***	-23.1298***	-15.25***	-14.5398***

Descriptive statistics for cryptocurrencies and stablecoins reveal that the mean and standard deviation of cryptocurrencies is higher, all series exhibit a fat tail (more for stablecoins), and all series are not normally distributed. The ADF test reveals that all series are stationary at the level.

3.2. Q-VAR (Quantile-Vector Autoregression) Time Varying Connectedness

In analyzing the relationship between cryptocurrencies, stablecoins, and other assets, volatility spillover models have come to the forefront in the literature. In this context, we observe the volatility spillover relationship between Bitcoin, Ethereum, BNB cryptocurrencies, and Tether and USD Coin stablecoins using the Q-VAR model. The Q-VAR model is advantageous over static methods in terms of dynamically revealing the volatility spillovers between the series. In addition,

[1] *Since regular data for USDC before January 1, 2019, are unavailable, the sample covers this period.*

while the correlations of the series' volatility are revealed in the multivariate GARCH models, The Q-VAR model reveals which series is the volatility receiver and which series is the volatility transmitter. In this context, we use the Q-VAR model used by Ando et al. (2018) and developed by Chatziantoniu et al. (2021). The Q-VAR (p) model is formulated as shown below:

$$R_{\mathrm{t}} = \phi(\iota) + \sum_{j=1}^{P} \sigma_{\mathrm{j}}(\iota) R_{\mathrm{t-j}} + \mathrm{u}_t(\iota) \quad (1)$$

Where, "R_{t}" is the vector of endogenous series, "ι" is the applied quantile in the interval [0, 1], "P" is the length of the lag, "$\phi(\iota)$" is the mx1 vector of the conditional mean vector, "$\sigma_{\mathrm{j}}(\iota)$" represents the mx1-dimensional error vector of Q-VAR coefficients, and "$\mathrm{u}_t(\iota)$" mxm represents the mx1-dimensional error vector of "$\sum(\iota)$" which contains the mxm covariance-variance matrix. In the next step, Peseran & Shin (1998) GFEVD (generalized forecast error variance decompositions) calculated. The variance decomposition of generalized errors aims to reveal the effect of a shock in series "j" on series "n":

$$\mathrm{Z}_{nj}^{f}(S) = \frac{\sum \iota_{nn}^{-1} \sum_{s=0}^{S-1} (\mathcal{E}_i' Z_h(\iota) \sum(\iota) \mathcal{E}_j)^2}{\sum_{s=0}^{S-1} (\mathcal{E}_n' Z_s(\iota) \sum(\iota) Z_s(\iota)' \mathcal{E}_n)} \quad (2)$$

$$\tilde{\mathrm{Z}}_{nj}^{f}(S) = \frac{\mathrm{z}_{nj}^{f}(S)}{\sum_{j=1}^{m} \sigma_{nj}^{f}(S)} \quad (3)$$

"$\mathcal{E}_n$", in equation 2 is the zero vector of the unit at the "n" th position "($\sum_{j=1}^{m} \tilde{Z}_{nj}^{f}(S) = 1$" and "$\sum_{n,j=1}^{m} \tilde{Z}_{nj}^{f}(S) = m$)". The TCI (Total connectedness index), which reveals the total volatility of the series, is formulated below:

$$\mathrm{TCI}(S) = \frac{\sum_{n,j=1,n\neq j}^{m} \tilde{\mathrm{Z}}_{nj}^{f}(S)}{m-1} \quad (4)$$

The total volatility spillovers to other series (from the n series to the j series) are shown in equation 5:

$$\mathrm{V}_{n\rightarrow j}^{f}(S) = \sum_{j=1,n\neq j}^{m} \tilde{\mathrm{Z}}_{jn}^{f}(S) \quad (5)$$

The total volatility spillovers from other series (from j series to n series) are formulated as follows:

$$\mathrm{V}_{n\leftarrow j}^{f}(S) = \sum_{j=1,n\neq j}^{m} \tilde{\mathrm{Z}}_{nj}^{f}(S) \quad (6)$$

The result of equation 5 is subtracted from the result of equation 6 to clearly identify whether a series is a transmitter or a receiver of volatility:

$$\mathrm{V}_{n}^{f}(\hat{S}) = \mathrm{V}_{n\rightarrow j}^{f}(S) - \mathrm{V}_{n\leftarrow j}^{f}(S) \quad (7)$$

A positive value means that the series is a transmitter of volatility, while a negative value means that the series is a receiver of volatility. In order to obtain a pairwise picture of the volatility spillovers between the series, the net volatility spillovers are decomposed:

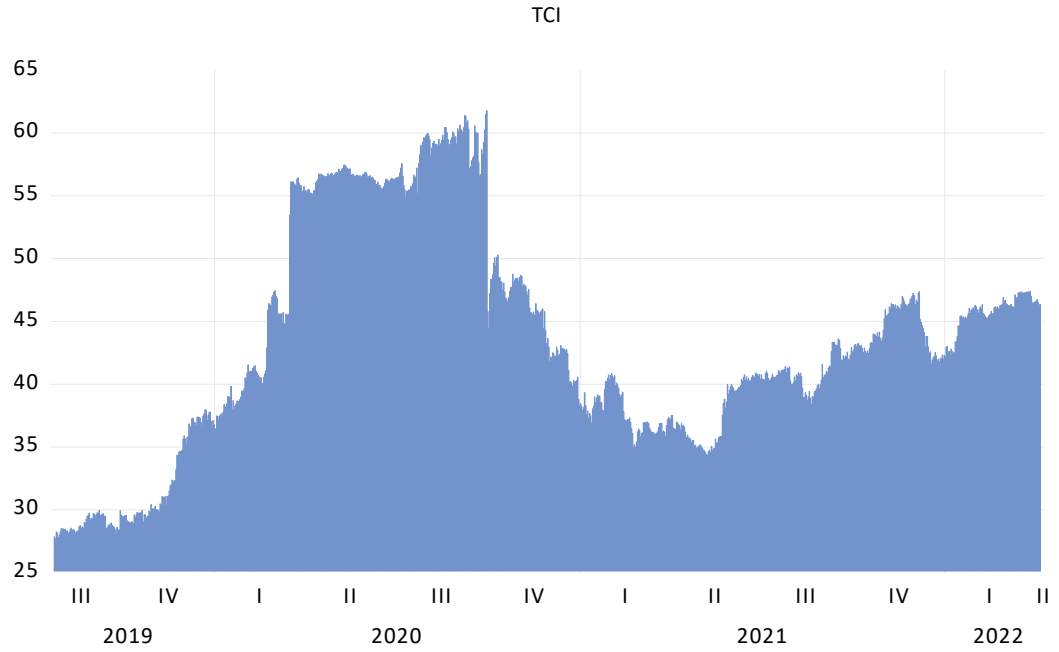
$$\mathrm{Pairwise\ Net\ Spillover}_{\mathrm{nj}}(S) = \tilde{Z}_{jn}(S) - \tilde{Z}_{nj}(S) \quad (8)$$

The net pairwise spillover reveals the volatility spillovers from the "n" and "j" series towards each other. A positive result in the relevant period means that there is a net volatility spillover from "n" to "j" and a negative result means that there is a net volatility spillover from "j" to "n" in that period.

4. Findings

The volatility spillover relationship between the top three cryptocurrencies and the top two stablecoins with the highest market capitalization is analyzed using the Q-VAR model. The time series graph of the total volatility spillover generated by the series is presented in Figure 2:

Figure 2: **Total Volatility Spillover Between the Series**



When the graph of the total volatility spillover between cryptocurrencies and stablecoins is viewed, it is observed that the total volatility spillover between the series started to increase with the Covid-19 process and reached its peak with the official pandemic declaration of WHO (World Health Organization). It is also observed that the total volatility spillover relationship in the post-Covid 19 period (after January 1, 2020) is higher than in the pre-Covid 19 period (January 1 to December 31, 2019). Some of the reasons for this are increased uncertainty about the future, decreased confidence in currencies and financial investment instruments, and increased perception and awareness of cryptocurrencies. In addition, the extremely volatile nature of cryptocurrencies has also drawn attention to new and less volatile crypto assets such as stablecoins. Therefore, this study takes this relationship into account and analyzes the variance decomposition of the volatility spillover between cryptocurrencies and stablecoins and the total volatility spillover of the series, and is shown in Table 3:

Table 3: **Variance Decomposition of Volatility Spillover between Cryptocurrencies and Stablecoins and Total Volatility Spillover**

	BTC	**ETH**	**BNB**	**USDT**	**USDC**	**FROM OTHERS**
BTC	45.65	29.63	20.78	2.11	1.83	54.35
ETH	28.66	44.75	22.90	2.03	1.66	55.25
BNB	21.76	24.61	50.62	1.78	1.22	49.38
USDT	4.20	4.86	3.74	72.75	14.44	27.25
USDC	5.56	5.38	4.49	14.55	70.02	29.98
TO OTHERS	60.19	64.48	51.91	20.47	19.14	216.20
INCLUDING OWN	105.84	109.23	102.53	93.22	89.17	TCI
NET	5.84	9.23	2.53	-6.78	-10.83	43.24

Table 3 shows that the volatility spillover relationship between cryptocurrencies and stablecoins is weak, but the volatility spillover relationship between the cryptocurrencies and stablecoins themselves is high. In addition, it can be emphasized that the volatility spillover relationship between cryptocurrencies is higher than the volatility spillover relationship between stablecoins. It is also observed that cryptocurrencies are net transmitters of volatility (NET>0) while

stablecoins are net receivers of volatility (NET<0). The time series graphs of cryptocurrencies and stablecoins as net receiver-transmitter of volatility spillovers are presented in Figure 3:

Figure 3: **Cryptocurrencies and Stablecoins as Net Volatility Receivers and Transmitters**

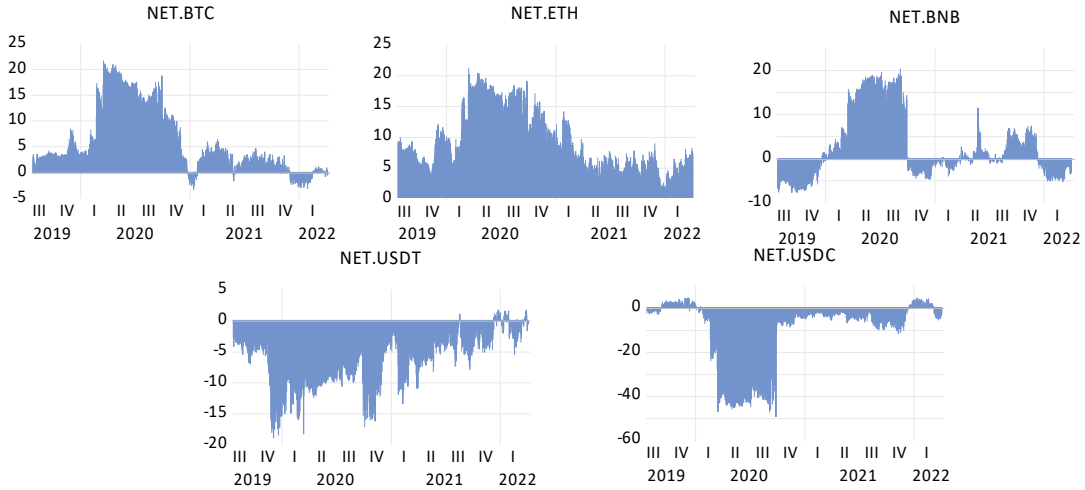
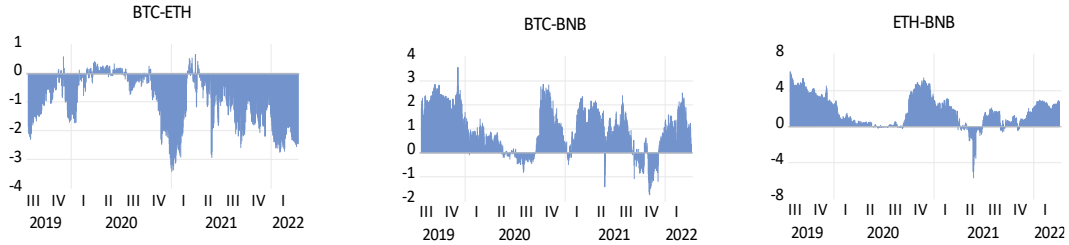


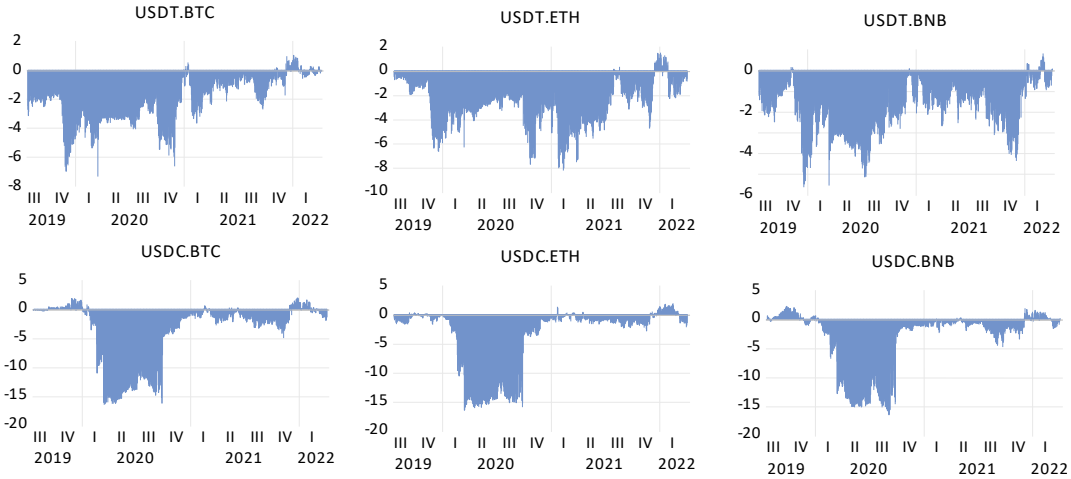
Figure 3 shows that cryptocurrencies were generally net transmitters of volatility over the entire period, while stablecoins were net receivers. A period-based analysis of the volatility spillovers of the series reveals that volatility increased and decreased excessively in some periods, and the volatility spillovers changed direction. The volatility spillover in BTC, ETH, USDT, and USDC series increased/decreased sharply with Covid-19 (January 2020), and the BNB series shifted from a net receiver of volatility to a net transmitter. After Covid 19, the net receiver-transmitter status of volatility weakened for all series. This weakening can be attributed to the increase in mutual spillovers and the decrease in net spillovers due to increased interaction between the series. Moreover, in the initial period of the Ukraine-Russia War (February 2022), the net volatility spillovers of the series either changed direction or their coefficients increased or decreased excessively. Therefore, it can be stated that global events related to political risks affect the direction and severity of the volatility spillover relationship between the series. The time series plots of the net pairwise volatility spillovers between cryptocurrencies are shown in Figure 4:

Figure 4: **Net Pairwise Volatility Spillovers Among Cryptocurrencies**



When the net pairwise volatility spillover graphs between cryptocurrencies are examined, it is observed that there is net volatility spillover from ETH to other cryptocurrencies in general, and ETH is a net transmitter of volatility. Although the direction of the volatility spillover between BTC and BNB changes in some periods, there is generally a net volatility spillover from BTC to BNB. A dynamic analysis of net pairwise volatility spillovers reveal that net pairwise volatility spillovers decreased or changed direction during the Covid-19 period. One of the main reasons for this is the increase in pairwise volatility spillovers during the Covid-19 period. The time series graphs showing the net pairwise volatility spillovers between USDT, USDC stablecoins, and cryptocurrencies are presented in Figure 5:

Figure 5: **Net Pairwise Volatility Spillover between Cryptocurrencies and Stablecoins**



When the net pairwise volatility spillover graphs between cryptocurrencies and stablecoins are viewed, it is observed that there is a general volatility spillover from cryptocurrencies to stablecoins. The intensity and direction of net pairwise spillovers can change in some periods. For example, the increasing net volatility spillover from cryptocurrencies to stablecoins at the beginning of Covid-19 has changed and decreased over time. In addition, it was found that the net pairwise volatility spillovers changed direction with the Ukraine-Russia War (February 2022). Based on these results, it can be stated that the direction and severity of volatility spillover between cryptocurrencies and stablecoins may change depending on global events.

5. Conclusion

This study aims to analyze the volatility spillover relationship between cryptocurrencies and stablecoins and to evaluate their interactions in the context of global events. In this context, the volatility spillover relationship between three cryptocurrencies and two stablecoins with the highest market capitalization is analyzed with the Q-VAR model. In the literature, studies on cryptocurrencies and their relationship with other assets generally focus on volatility spillover models. This study uses the Q-VAR model (Chatziantoniou et al., 2021), which reveals the dynamic volatility spillover relationship between the series with a quantile approach. This method has been used in a few studies in the literature and is expected to contribute to the literature by showing that the strength and direction of the volatility spillover relationship between cryptocurrencies and stablecoins change depending on global events.

In the study, logarithmic return transformations of the series were made before the analysis. In the following part, the Q-VAR model is applied to the series that are found to be stationary. As a result of the analysis, it was observed that the volatility spillover relationship between cryptocurrencies and stablecoins increased with Covid-19 and the relationship was stronger in the post-Covid-19 period than in the pre-Covid-19 period. It is found that the volatility spillover relationship between cryptocurrencies and stablecoins is weak, while the volatility spillover relationship between cryptocurrencies and stablecoins itself is strong. However, the volatility spillover relationship between cryptocurrencies is stronger than the volatility spillover relationship between stablecoins. Cryptocurrencies are generally volatility transmitters against stablecoins, with Ethereum being the overall volatility transmitter against all series. In addition, the net volatility spillovers of the series and the direction and strength of the net pairwise volatility spillovers between the series were found to vary in response to global events such as Covid-19 and the Ukraine-Russia War.

The findings of the study, when considered altogether with the studies reviewed in the literature review, are in line with the findings of the studies conducted by Wei (2018), Huynh

(2020), Wang (2020a), Baur & Hoang (2021), and Jalen et al., (2021) revealing that the relationship between cryptocurrencies and stablecoins is weak. In the literature, the findings of Grobys et al. (2021), Hoang & Baur (2021), Grobys & Hunyh (2022) are similar to the findings of this study, which concludes that cryptocurrencies are strongly correlated with each other, but weakly correlated with stablecoins. Our study is similar to the studies by Bouri et al. (2021), Moratis (2021), Zhang & Mani (2021) and Naeem et al. (2021), who conclude that the inter-correlation between cryptocurrencies is strong. Moreover, the observed increase in the relationship between cryptocurrencies and stablecoins with global events is similar to the findings of Kumar & Anandro (2019), Yousaf & Ali (2020), Akhtarruzzaman et al. (2022), Katsiampa et al. (2022), Kumar et al. (2022).

The volatility spillover relationship between cryptocurrencies and stablecoins increased with Covid-19, while global events affected the relationship between cryptocurrencies and stablecoins. Therefore, it can be stated that global events should be monitored as an essential risk factor in future price movements and developing strategies for cryptocurrencies and stablecoins. In addition, the highly volatile nature of cryptocurrencies has increased the need for alternative coins for these markets. Therefore, the fact that cryptocurrencies are weakly correlated with stablecoins shows that they can be good diversifiers for each other. Adding stablecoins to an investment portfolio containing cryptocurrencies or adding cryptocurrencies to an investment portfolio containing stablecoins contributes to portfolio diversification and risk management. The findings are also important for investors, speculators, and policymakers.

In conclusion, this study analyzes the volatility spillover relationship between the three cryptocurrencies and two stablecoins with the highest market capitalization and evaluates the findings in the context of global events. The findings may not be similar for other cryptocurrencies and stablecoins. Therefore, in future studies, other cryptocurrencies and stablecoins can be used as a sample to examine the relationship between cryptocurrencies and stablecoins. Also, the method used for the analysis cannot reveal the positivity-negativity of the relationship between the series. In future studies, models that can reveal the positive-negative volatility spillover relationship between the series can be applied. Moreover, the fact that stablecoins are pegged to a currency may be seminal in terms of analyzing them together with currencies in future studies.

References

Akhtaruzzaman, M., Boubaker, S., Nguyen, D. K., & Rahman, M. (2022). Systemic Risk-Sharing Framework of Cryptocurrencies in the COVID–19 Crisis*. Finance Research Letters*, 47. https://doi.org/10.1016/j.frl.2022.102787

Ando, T., Greenwood-Nimmo, M., & Shin, Y. (2022). Quantile Connectedness: Modeling Tail Behavior in the Topology of Financial Networks. *Management Science*, 4 (68), 2401-2431. https://doi.org/10.1287/mnsc.2021.3984

Ante, L., Fidler, I., & Strehle, E. (2021). The Influence of Stablecoin Issuances on Cryptocurrency Markets. *Finance Research Letters,* 41. https://doi.org/10.1016/j.frl.2020.101867

Baur, D. G., & Hoang, L. T. (2021). A Crypto Safe Haven against Bitcoin. *Finance Research Letters*, 38. https://doi.org/10.1016/j.frl.2020.101431

Bouri, E., Roubaud, D., Saeed, T., & Vo, X. V. (2021). Quantile Connectedness in the Cryptocurrency Market. *Journal of International Financial Markets, Institutions and Money*, 71. https://doi.org/10.1016/j.intfin.2021.101302

Chatziantoniou, I., Gabauer, D., & Stenfors, A. (2021). Interest Rate Swaps and the Transmission Mechanism of Monetary Policy: A Quantile Connectedness Approach. *Economics Letters,* 204. https://doi.org/10.1016/j.econlet.2021.109891

Fakhfekh, M., & Jeribi, A. (2020). Volatility Dynamics of Crypto-Currencies' Returns: Evidence from Asymmetric and Long Memory GARCH Models. *Research in International Business and Finance,* 51. https://doi.org/10.1016/j.ribaf.2019.101075

Grobys, K., & Duc Huynh, T. L. (2021). When Tether Says "JUMP!" Bitcoin Asks "How Low?". *Finance Research Letters*. https://doi.org/10.1016/j.frl.2021.102644

Grobys, K., Junttila, J., Kolari, J. W., & Sapkota, N. (2021). On the Stability of Stablecoins. *Journal of Empirical Finance,* 64, 207–223. https://doi.org/10.1016/j.jempfin.2021.09.002

Hoang, L. T., & Baur, D. G. (2021). How Stable are Stablecoins? *The European Journal of Finance*. http://dx.doi.org/10.2139/ssrn.3519225

Huynh, T., Nasir, M. A., Vo, X. V., & Nguyen, T. T. (2020). "Small Things Matter Most": The Spillover Effects in the Cryptocurrency Market and Gold as a Silver Bullet. *The North American Journal of Economics and Finance*, 54. https://doi.org/10.1016/j.najef.2020.101277

Jalan, A., Matkovskyy, R., & Yarovaya, L. (2021). "Shiny" Crypto Assets: A Systemic Look at Gold-Backed Cryptocurrencies during the COVID-19 Pandemic. *International Review of Financial Analysis,* 78. https://doi.org/10.1016/j.irfa.2021.101958

Katsiampa, P., Yarovaya, L., & Zięba, D. (2022). High-Frequency Connectedness between Bitcoin and Other Top-Traded Crypto Assets during the COVID-19 Crisis. *Journal of International Financial Markets, Institutions and Money,* In Press. https://doi.org/10.1016/j.intfin. 2022.101578

Kumar, A. S., & Anandarao, S. (2019). Volatility Spillover in Crypto-Currency Markets: Some Evidences from GARCH and Wavelet Analysis. *Physica A: Statistical Mechanics and its Applications*, 542, 448-458. https://doi.org/10.1016/j.physa.2019.04.154

Kumar, A., Iqbal, N., Mitra, S. K., Kristoufek, L., & Bouri, E. (2022). Connectedness among Major Cryptocurrencies in Standard Times and during the COVID-19 Outbreak. *Journal of International Financial Markets, Institutions & Money*, 77. https://doi.org/10.1016/j. intfin.2022.101523

Moratis, G. (2021). Quantifying the Spillover Effect in the Cryptocurrency Market. *Finance Research Letters,* 31. https://doi.org/10.1016/j.frl.2020.101534

Naeem, M. A., Qureshi, S., Rehman, M., & Balli, F. (2021). COVID-19 and Cryptocurrency Market: Evidence from Quantile Connectedness. *Applied Economics*, 54 (3), 280-306. DOI: 10.1080/00036846.2021.1950908

Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. https://bitcoin.org/bitcoin .pdf

Nguyen, T. T., Nguyen, T. V., Nguyen, T. C., Pham, T. A., & Nguyen, Q. M. (2022). Stablecoins Versus Traditional Cryptocurrencies in Response to İnterbank Rates. *Finance Research Letters,* 47. https://doi.org/10.1016/j.frl.2022.102744

Pesaran, H. H., & Shin, Y. (1998). Generalized Impulse Response Analysis in Linear Multivariate Models. *Economics Letters,* 1(58), 17-29. https://doi.org/10.1016/S0165-1765(97)00214-0

Pho, K. H., Ly, S., Lu, R., Van Hoang, T. H., & Wong, W.-K. (2021). Is Bitcoin a Better Portfolio Diversifier than Gold? A Copula and Sectoral Analysis for China. *International Review of Financial Analysis*, 74, 1-30. https://doi.org/10.1016/j.irfa.2021.101674

Wang, G.-J., Ma, X.-y., & Wy, H.-y. (2020a). Are Stablecoins Truly Diversifiers, Hedges, or Safe Havens Against Traditional Cryptocurrencies as Their Name Suggests? *Research in International Business and Finance*, 54. https://doi.org/10.1016/j.ribaf.2020.101225

Wang, P., Li, X., Shen, D., & Zhang, W. (2020b). How does Economic Policy Uncertainty Affect the Bitcoin Market? *Research in International Business and Finance*, 53. https:// doi.org/10.1016/j.ribaf.2020.101234

Wei, W. C. (2018). The Impact of Tether Grants on Bitcoin. *Economics Letters*, 171, 19-22. https://doi.org/10.1016/j.econlet.2018.07.001

Yousaf, I., & Ali, S. (2020). The COVID-19 Outbreak and High Frequency Information Transmission between Major Cryptocurrencies: Evidence from the VAR-DCC-GARCH Approach. *Borsa Istanbul Review,* 20 (1), 1-10. https://doi.org/10.1016/j.bir.2020.10.003

Zhang, S., & Mani, G. (2021). Popular Cryptoassets (Bitcoin, Ethereum, and Dogecoin), Gold, and Their Relationships: Volatility and Correlation Modeling. *Data Science and Management*, 4, 30-39.