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Do cryptocurrencies hedge against EPU and the equity market volatility during COVID-19? – New evidence from quantile coherency analysis

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Abstract

Employing the new measure of the contagion effect of the COVID-19, i.e. the Infectious Disease EMV Index by Baker et al. (2020) and the novel Quantile Cross-spectral (coherency) approach proposed by Barunik and Kley (2019), this study probes into the interconnectedness between EPU and cryptocurrencies as well as that between the COVID-19 pandemic and cryptocurrencies in a time series from August 10th 2015 to June 30th 2020. Our empirical findings indicate cryptocurrencies act as good hedging tools against high EPU, but not during periods of moderate or low EPU and that their hedging properties don’t remain all the time. Several kinds of cryptocurrencies, XRP and XLM specifically, can serve as hedging assets during such period of extreme financial market panic. Evidence from China, the US and the UK insists that timely response to extreme outbreak like COVID-19 is of pivotal significance to prevent the financial market and the economy from descending into a catastrophe. Notably, XLM demonstrates the best hedging properties against high EPU, severe pandemic and other cryptocurrencies. XLM and BTC are excellent choices of hedging assets both for individual investors and institutional investors. The difference lies in that the individual investors have two more options, namely LTC and XMR.

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1. Introduction

With the interconnectedness among global economic policies ascending, the global financial market linkages have risen rapidly and the contagion effect, which is at the core of systemic financial risk (see Silva et al., 2017), has turned out to be enhancing in a staggering speed. Hence, the issue as to whether cryptocurrencies can serve as a good hedge or safe-haven asset or not has sparked wide-ranging concern and the answer has proved to be affirmative by a great many studies (see Dyhrberg, 2016; Yen and Cheng, 2020; Wang et al., 2020; Wu et al., 2019; Demir et al., 2018; Matkovskyy et al., 2020; Kalyvas et al., 2020; Fang et al., 2019; Al Mamun et al., 2020; Bouri et al., 2017a; Corbet et al., 2020a; Ji et al. 2020; Conlon et al. 2020; Mnif et al., 2020 and so on). Nevertheless, the reviving of trade protectionism in recent years has further augmented various uncertainties globally, gravely affecting the safe-haven properties of cryptocurrencies (Gozgor et al., 2019). Worse still, the escalation of COVID-19 has triggered the global uncertainties to a startling extent. ‘Black Swan’ events like the unexpected decline limit of oil price and stock price frequently emerge, increasing the tail risk of assets such as cryp-
tocurrencies and the tail behavior of asset, as Kwon (2020) puts it, is essential to ascertaining what kind of financial instrument it is as well as the role it plays on the market. A fun fact in the cryptocurrency market is that the traders focus on the short term while the retail investors pay more attention to the long term. And even more intriguingly, with the retail investors playing a really significant role in the cryptocurrency market, the impact of their investment behavior on the crypto market cannot be ignored. In the meanwhile, EPU has been proved to exert significant impacts on asset returns and somehow there exists a wait-and-see effect of EPU (Liang et al., 2020). Hence, compared to other factors which may also be correlated with cryptocurrencies’ returns, EPU is the one that deserves more concern. With sales declining, production reducing, companies stuck in severe financial distress, unemployment rates rising, and market expectation remaining low, there is an urgent need to address the question: is there any appropriate hedging tool against the stunningly high EPU and equity market volatility during such an extremely devastating infectious disease as COVID-19? Seeking for an answer to this critical question, our study employs a novel quantile coherency (QC) methodology proposed by Barunik and Kley (2019) to investigate the hedging properties of cryptocurrencies against EPU and the equity market volatility during COVID-19. How does this approach cater to the need of our analysis? The answer lies in the following two aspects. Firstly, one of the most noticeable advantages of the quantile-based methodologies is that they enable a tail-risk analysis, which is of pivot value for clarifying the complex dynamics in lots of macroeconomic and financial time series as the dependence during infrequent periods of large negative values (lower quantiles of the joint distribution) may be totally different from that during infrequent periods of large positive values (upper quantiles of the joint distribution). And as mentioned above, the tail behavior of asset is crucial to ascertaining what kind of financial instrument it is as well as the role it plays on the market, which is essential for the research on the cryptocurrencies’ hedging properties against EPU and the equity market volatility during COVID-19 as high EPU exerts significant impact on the equity market (Christou et al., 2017; Guo et al., 2018; Phan et al., 2018), as well as on the macro-economy (Fernández et al., 2015; Born & Pfeifer, 2014; Caldara et al., 2016). Meanwhile, there exist bubbles in the cryptocurrency market (Geuder et al., 2019; Enoksen et al., 2020; Fruehwirt et al., 2020; Kyriazis et al., 2020), which also calls for the consideration of various quantiles to better detect the potential tail risks. Secondly, to investigate short-, mid-, long-run relationships helps us figure out the exact correlations between EPU, EMV during COVID-19 and cryptocurrency returns across various frequencies, which could be particularly critical for different kinds of investors to make more effective and appropriate investment decisions. Specifically speaking, for long-run holders and portfolio managers, the long-term results are essential, while for the speculators with risk appetite, the short-term results are of greater interest. As for hedgers, they pursue the highest correlated asset market in the short- to - medium term of investment (Omane-Adjepong et al., 2019). And fortunately, the quantile coherency methodology is such a proper and powerful tool which not only enables the analysis at different quantiles, but also under various frequency domains.

There are two main mechanisms through which we can proceed for the impact of EPU on cryptocurrencies and two for that of COVID-19 pandemic respectively. For the former, (1) the first is the market sentiment and investor expectation. High EPU signals violent volatility in the stock market, thus changes the investors’ expectation and market sentiment, leading to a circumstance under which investors are likely to shift their money from stock market to cryptocurrencies or other alternative investment choices (see Bouri et al., 2017a; Sarwar, 2017; Jiang et al., 2019; Chuliá et al., 2017); (2) furthermore, the prospect theory by Tversky and Kahneman (1986) may also well account for this. High EPU results in wild fluctuation of stock market and investors thus turn to cryptocurrencies as a hedge since investors overweight outcomes which are considered certain, relative to those that are merely probable. For the latter, (1) we turn to the sentiment data obtained through social media for the first mechanism through which COVID-19 pandemic affects cryptocurrencies. The sentiment data we are talking about here, based on a lexicon of terms developed to quantify the polarity and subjectivity of time-stamped data (see Corbet et al., 2020a), allows for the analysis of interlinkages between sentiment and cryptocurrencies during the COVID-19 pandemic. With a larger number of entities associated with COVI-19 news, the expected stock market returns gain a much high probability to be lower (see Cepoi, 2020), slightly similar to the argument – the breadth of information diffusion influences stock returns – by Fang and Peress (2009). Therefore investors choose cryptocurrencies as an alternative to shelter from risk. (2) the second is herding effect (see Coskun et al., 2020). As a part of coronavirus family, the COVID-19 has spread dread and misgivings among global investors, in which case irrational actions such as herding behavior can probably spring up, making money pour into the cryptocurrency market.

Our study contributes to the extant literature along three essential dimensions as follows: (a) we utilize a neoteric quantile cross-spectral (coherency) approach proposed by Barunik and Kley (2019) to probe into the intercorrelations between EPU and cryptocurrencies and those between COVID-19 pandemic and cryptocurrencies. As the averagely correlated (uncorrelated) variables under study may be actually independent (dependent) from each other under various quantiles and different frequencies, the conventional models derived from averaged quantities and single frequency may deliver misleading results. This QC methodology enables a more persuasive and powerful analysis by closely detecting any general type of dependence structure in various quantiles of the joint distribution and under different frequencies, namely the short, medium and long run. (b) With the escalation of COVID-19 pandemic, the global financial market is now facing more uncertainties, accompanied by the reducing production, rising unemployment rates, frequently emerging ‘Black Swan’ events (like the unexpected decline limit of oil price and stock price). In consideration of the contagion effect of the grave infectious disease on global financial markets, we reference the Infectious Disease EMV tracker newly developed by Baker et al. (2020) and we further take the wait and see effect of EPU (Liang et al., 2020) into account in our paper to better detect the effect of such a devastating epidemic as COVID-19 on cryptocurrencies. (c) Our study is of pivotal practical value in the meantime. On the one hand, we employ the daily economic policy uncertainty index which allows for an evaluation on the relative importance of large negative values (lower quantiles of the joint distribution) may be totally different from that during infrequent periods of large positive values (upper quantiles of the joint distribution). And as mentioned above, the tail behavior of asset is crucial to ascertaining what kind of financial instrument it is as well as the role it plays on the market, which is essential for the research on the cryptocurrencies’ hedging properties against EPU and the equity market volatility during COVID-19 as high EPU exerts significant impact on the equity market (Christou et al., 2017; Guo et al., 2018; Phan et al., 2018), as well as on the macro-economy (Fernández et al., 2015; Born & Pfeifer, 2014; Caldara et al., 2016). Meanwhile, there exist bubbles in the cryptocurrency market (Geuder et al., 2019; Enoksen et al., 2020; Fruehwirt et al., 2020; Kyriazis et al., 2020), which also calls for the consideration of various quantiles to better detect the potential tail risks. Secondly, to investigate short-, mid-, long-run relationships helps us figure out the exact correlations between EPU, EMV during COVID-19 and cryptocurrency returns across various frequencies, which could be particularly critical for different kinds of investors to make more effective and appropriate investment decisions. Specifically speaking, for long-run holders and portfolio managers, the long-term results are essential, while for the speculators with risk appetite, the short-term results are of greater interest. As for hedgers, they pursue the highest correlated asset market in the short- to - medium term of investment (Omane-Adjepong et al., 2019). And fortunately, the quantile coherency methodology is such a proper and powerful tool which not only enables the analysis at different quantiles, but also under various frequency domains.

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of short and long-term EPU shocks (see Bartsch, 2019) and it also reflects uncertainty about legislation and regulation (Enoksen et al., 2020) while previous studies mostly use monthly data which are unable to distinguish between the effect of EPU occurring in the same day and the one lagging as long as thirty days. And for CNEPU specifically, we adopt a new Economic Policy Uncertainty for China constructed by Huang and Luk (2020) based on Chinese newspapers, which reflects the actual economic policy uncertainty China faces more precisely. On the other hand, the recent years have witnessed the extreme rises and falls of the short-term Bitcoin returns more and more frequently. Besides, going long or short in the cryptocurrency market features high leverage, which will certainly increase the probability of the occurrence of forced liquidation in cryptocurrency, gravely jeopardizing investors’ interest. And thus, the tail risk of cryptocurrency deserves more attention and much deeper investigation. Hence, our empirical findings are of substantial value for policy makers, portfolio managers and individual investors in their pursuit of secure hedging strategies against high EPU and the drastic turbulence of global financial market owing to the COVID-19 pandemic. To the best of our knowledge, this paper is the first attempt, with the newly developed Infectious Disease Equity Market Volatility Index proposed by Baker et al. (2020) and the China EPU index at daily frequency by Huang and Luk (2020), to investigate cryptocurrencies’ hedging properties against EPU and the COVID-19 epidemic employing a neoteric QC (quantile coherency) approach (Barunik and Kley, 2019) in different quantiles and in diversified frequency domains.

With the utilization of the QC method, our primary empirical findings can be summarized as follows: Cryptocurrencies act as good hedging tools against high EPU, but not proper hedge candidates during periods of moderate or low EPU. Moreover, the truth is further suggested by our quantile coherency results that the US and the UK, faced with the COVID-19 pandemic, adopt passive measures to cope with it and focus their policies more on the stabilization of the capital market, thus causing the surge of economic policy uncertainty while on the contrary, China takes immediate actions to deal with the COVID-19 and remains at a low EPU level, greatly calming the market sentiment. Evidence from China, the US and the UK insists that timely response to extreme outbreak like COVID-19 is of pivotal significance to prevent the financial market and the economy from descending into a catastrophe. Several kinds of cryptocurrencies, XRP and XLM specifically, can serve as safe-haven assets during such period of extreme financial market panic according to our empirical findings revealed in both the QC and RQ approach. Notably, XLM demonstrates the best hedging properties against high EPU, equity market volatility during the COVID-19 and other cryptocurrencies. XLM and BTC are excellent choices of hedging assets both for individual investors and institutional investors. The difference lies in that the individual investors have two more options, namely LTC and XMR.

The remainder of our paper is arranged as follows. The next section presents the literature review. Section 3 gives an exhaustive description of dataset and empirical methodology adopted. We visualize and analyze our empirical results in Section 4. Eventually, Section 5 briefly concludes this research and offers some implications of essential importance

2. Literature review

Our study relates to two major strands of the extant literature. The first strand focuses on the impact of EPU on the cryptocurrencies. Not a few of them declare the cryptocurrencies’ hedging properties against uncertainty (see Yen and Cheng, 2020; Wang et al., 2020; Wu et al., 2019; Matkovskyy et al., 2020; Kalivas et al., 2020; Fang et al., 2019; Demir et al., 2018; Al Mamun et al., 2020; Bouri et al., 2017a), among whom, only Wu et al. (2019), Demir et al. (2018) and Bouri et al. (2017a) apply quantile-related methods and the EPU data used are partly at monthly frequency (see Yen and Cheng, 2020; Matkovskyy et al., 2020; Fang et al., 2019; Al Mamun et al., 2020 etc.) with the rest literature aforementioned at daily frequency. Less studies, in contrast, claim that cryptocurrencies don’t act as a hedge against uncertainty (Gozgor et al., 2019 etc.) or they are less effective than the traditional safe haven assets such as gold (Das et al., 2019; Klein et al., 2018; Gkillas and Longin, 2019; Kurka, 2019). Similar to our findings, Qin et al. (2020) demonstrate that Bitcoin cannot always be regarded as a new basket for eggs since it doesn’t always hedge global economic policy uncertainty. Besides, some literature draws attention to cryptocurrencies’ hedging property varying from country to country. Take Wang et al. (2020) for example, they make a comparison between the effect of US EPU and the effect of the UK EPU upon Bitcoin, discovering that the impact of the US EPU on BTC is larger than that of the UK EPU on BTC. Shaikh (2020) utilizes two empirical methods -OLS and Quantile regression- to inquire into the relationship between policy uncertainty and Bitcoin returns among different countries and it turns out that Bitcoin returns are more responsive to EPU in the US, China and Japan. To be more concrete, in the US and Japan, uncertainty is found to exert a negative impact on the Bitcoin market whereas in China it exerts a positive one. Focusing on bubbles, Enoksen et al. (2020) concludes a generally negative association between the VIX-index and cryptocurrency bubbles plus a positive one between EPU-index and cryptocurrency bubbles. There is no lack of other interesting research perspectives. For instance, focusing on crypto bubble behavior, Geuder et al. (2019) provide evidence of the existence of frequent bubble periods in Bitcoin prices with the employment of two different approaches (i.e. the PSY and the LPPL model) and they further enrich the extant literature by concluding that some institutional changes such as the introduction of Bitcoin futures, the use of Bitcoin for web-based transactions, governments restricting the use of cryptocurrencies along with other regulatory changes might have exerted significant impacts on Bitcoin price behavior. With a view to herding behavior, Coskun et al. (2020) notices an anti-herding behavior occurrence during the high volatility regime and that uncertainty has a significant influence upon the anti-herding behavior. Bouri et al. (2020) finds that trading volume and uncertainties turn out to be crucial determine factors of integration in the cryptocurrency market with a DECO model. Conspicuously, most of the
literature mentioned in this paragraph is conducted with the data of Bitcoin (see Das et al., 2019; Klein et al., 2018; Wang et al., 2020; Wang et al., 2019; Shaikh, 2020; Wu et al., 2019; Yu, 2019; Demir et al., 2018; Matkovskyy et al., 2020; Kalyvas et al., 2020; Fang et al., 2019; Gozgor et al., 2019; Al Mamun et al., 2020; Qin et al., 2020; Bouri et al., 2017a).

The second strand of literature reflects the interconnectedness between the COVID-19 epidemic and cryptocurrencies, which, due to the recentness of COVID-19, is to date much more limited than the first strand. Within the limited researches into the correlation cryptocurrencies have with the COVID-19 pandemic though, some argue that COVID-19 generates a positive impact on the cryptocurrency market efficiency (see Mnif et al., 2020; Corbet et al., 2020a; Ji et al., 2020). Nevertheless, some other literature concludes the opposite: it’s risky to consider cryptocurrencies as a safe haven during big crises as the COVID-19 pandemic (Lahmiri and Bekiros, 2020; Corbet et al., 2020b; Goodell and Goutte, 2020; Conlon and McGee, 2020).

Various methodologies have been employed for the investigation over the effect of COVID-19 on cryptocurrencies such as the MDFA approach, the GARCH model, the wavelet coherence, the largest Lyapunov exponent, the sequential monitoring test on the tails, VaR and the cross-quantilogram approach etc. Noticeably, Conlon et al. (2020) concludes that Tether acts as a safe haven during COVID-19 turmoil whereas Bitcoin and Ethereum don’t by testing the widely mooted safe haven properties of Bitcoin, Ethereum and Tether from the perspective of international equity index investors.

From the aforementioned literature, a few characteristics stand out. First, there unfolds a violent controversy surrounding the cryptocurrencies’ hedging properties against EPU and the COVID-19 pandemic and the positive answers exceed the negative ones. Second, mostly those analyses are conducted with cryptocurrencies returns (see Colon et al., 2020; Okorie et al., 2020; Sebastião et al., 2020; Papadamou et al., 2020; Charfeddine et al., 2020 etc.), while rarely do they focus on various frequency domains which are critical for investors to make investment decisions in a more effective and appropriate way (Qiao et al., 2020). And very few quantile-relevant approaches that enable a detection over the relationship among variables in different quantiles are applied for the investigation over the effect of EPU, especially over that of COVID-19 on cryptocurrencies. Third, the EPU data used for their researches, either at monthly frequency or at daily frequency, primarily comes from the one developed by Baker et al. (2016) where the daily China EPU index which can reflect the actual economic policy uncertainty China faces precisely is not included. Last but not the least, not a representative proxy for the effect of COVID-19 pandemic has been introduced, let alone utilized in their studies. Hence, we carry on this study in an attempt to contribute to the related literature by filling the possible gaps covered above.

3. Data, methodology and preliminary analysis

3.1. Dataset

The purpose of this study is to examine whether cryptocurrencies can act as a hedge asset against EPU and the equity market volatility during the COVID-19 pandemic. The USEPU, UKEPU and the Infectious Disease Equity Market Volatility (EMV for short) indexes are all obtained from http://www.policyuncertainty.com/. As for the daily CNEPU, we gain it from the work of Huang and Luk (2020) which is compiled based on the 10 authoritative newspapers including People’s Daily from https://economicpolicyuncertaintyinchina.weebly.com/. We take into account the USEPU, UKEPU and CNEPU mainly due to the following facts: The US owns the most complete cryptocurrency market around the world; the UK hasn’t enacted any law specifically targeted at digital currencies and according to Crypto Compare, the UK cryptocurrency market is one of the most active and the most liquid ones globally while China has the biggest number of the investors in cryptocurrency. The data of six cryptocurrencies (i.e. Bitcoin, Stellar, Litecoin, Ripple, Ethereum, Monero) is obtained from https://www.coingecko.com/en, the choice of which is based on the sum of their market capitalization, making up about 78.58% of the total cryptocurrency market. Our data spans the period from August 10th 2015 to June 30th 2020. Table 1 reports descriptive statistics.

3.2. Calculations of the EPUs and the Infectious Disease EMV tracker

In this part, how the EPUs employed in our paper, namely daily USEPU, UKEPU and CNEPU are calculated will be presented according to the work of Baker et al. (2016), Huang and Luk (2020). Firstly, the daily USEPU is produced with the utilization of the Newsbank news aggregator, in which about 1500 U.S. newspapers are covered. The digital archives of each paper is searched to gain a daily count of articles which contain terms in all three categories with respect to economy (or economic), policy (or policy terms such as “legislation”, “regulation”, and Congress etc.), and uncertainty (or uncertain). The raw counts are scaled by the total number of articles in the newspaper and on the same day. And then each daily newspaper-level series is standardized to unit standard deviation and further averaged across the 1500 papers by day. Eventually, the 1500-paper series are normalized to get the daily EPU time-series index. The daily UKEPU is constructed by the same approach. The compilation strategy of the daily CNEPU by Huang and Luk (2020) refers to Baker et al. (2016), but one important difference to notice is that their work is based on 114 general interest Chinese-language newspapers, which can fully mirror the level of economic policy uncertainty in China. And the Infectious Disease EMV Tracker is calculated as the overall EMV tracker value multiplied by the share of EMV Articles in which there exists one or more of the terms below: epidemic, pandemic, virus, flu, disease, coronavirus, MERS, SARS, Ebola, H5N1, H1N1 (Baker et al., 2020).
3.3. Quantile coherence

With regard to hedge, the hedge effectiveness between assets has been taken into account in some researches (see Batten et al., 2019; Jiang et al., 2021), among which Batten et al. (2019) further analyze how the hedge effectiveness varies over time, clearly visualizing the hedge performance. Nevertheless, on the one hand, as EPU (EMV) is not an asset, the hedge effectiveness measures which examine the hedge performance between two kinds of assets may not hold for our research. On the other hand, a lot of previous literature (Das et al., 2019; Coskun et al., 2020; Shaikh, 2020; Wu et al., 2019; Demir et al., 2018; Bouri et al., 2017a) on whether the cryptocurrencies can hedge against EPU has also put their focus on the correlation between the returns of cryptocurrencies and EPU, and most of them have amassed evidence for the cryptocurrencies’ hedge properties against EPU. Hence, we focus on the correlation between cryptocurrencies’ returns and EPU (EMV) as well.

The measurement of the dependence between economic variables is one of the basic issues a researcher in economics is confronted with. Nevertheless, too often the truth is that the strongly correlated variables under study may be actually independent from each other, which means the measured correlation may be merely spurious. Another equally deceiving fact is that uncorrelated variables may exhibit dependence at various frequencies (i.e. with respect to cycles), or in different parts of the joint distribution. Such phenomena may occur naturally in many macroeconomic or financial time series, from which misleading results will emerge. Hence, it’s of paramount importance to quantify the dependence between economic variables in various quantiles of the joint distribution and under varying frequencies, and this is exactly where QC approach shines.

Pursuant to the work of Barunik and Kley (2019), which enables close detection over any general type of dependence structure which may occur between the variables under study with a new class of cross-spectral densities that estimate the dependence in quantiles of the joint distribution across frequencies, we define the dynamic dependence between two stationary processes - EPU (EMV) \( A_t = \{a_t\} \) and cryptocurrency returns \( B_t = \{b_t\}, t \in \mathbb{Z} \), where \( A_t \) and \( B_t \) separately denote the logarithmic return series of a given EPU (EMV) and cryptocurrency returns by the equation below:

\[
\mathbf{R}^{A,B}(\omega; \tau_1, \tau_2) = F^{A,B}(\omega; \tau_1, \tau_2) = \left( F^{A,A}(\omega; \tau_1, \tau_2)F^{B,B}(\omega; \tau_1, \tau_2) \right)^{-1/2}
\]

where the quantile cross-spectral and quantile spectral densities of processes \( \{a_t\} \) and \( \{b_t\} \) are respectively indicated by \(-\pi < \omega < \pi, \tau \in [0, 1]\), \( F^{A,A}, F^{B,B} \), gained from the Fourier transform of a matrix of quantile cross-covariance kernels

\[
T_k(\tau_1, \tau_2) = \left( \Gamma_k^{\tau_1, \tau_2}(\tau_1, \tau_2) \right)_{AB}
\]

where

\[
\Gamma_k^{\tau_1, \tau_2}(\tau_1, \tau_2) = \text{CoV}\{I\{A_{t+k} \leq q_{\tau_1}(t)\}, I\{B_t \leq q_{\tau_2}(t)\}\}
\]

for \( k \in \mathbb{Z} \), while the indicator function of an event “E” is expressed by \( I\{E\} \). Moreover, this measure corresponds to the difference in the copula of \( \{A_{t+k}, B_t\} \) and the independent copulas for the cases of continuous analysis. Not only does the varying \( k \) disclose information about serial dependence, but also it gives information about cross – section dependence, hence yielding the metric for the frequency domain as follows:

\[
F(\omega; \tau_1, \tau_2) = \langle 2\pi \rangle^{-1} \sum_{k=-\infty}^{\infty} \Gamma_k^{\tau_1, \tau_2}(\tau_1, \tau_2)e^{-ik\omega}
\]

\footnote{The reason why we don’t employ the multivariate analyses capable of controlling the influence of the third variables is that those models fail to explore the relationship between two variables both at different quantiles and under various frequencies, unable to unravel the real roles of cryptocurrencies under high EPU and COVID-19 pandemic.}
The quantile coherency is estimated with the utilization of the smoothed quantile cross-periodograms, according to Barunik and Kley (2019). The estimation of quantile coherency matrices in our study is conducted at three quantiles, i.e. 0.05, 0.50 and 0.95 as well as all their combinations, namely the left tail, the middle and the right tails of distributions. To be more concrete, three frequency domains are taken into account in our paper, which are short term (one week), medium term (one month), and long term (one year).

3.4. The BDS test and the Pearson’s correlation matrix

The results of the Broock, Dechert and Scheinkman (BDS) test (Broock et al., 1996) of linearity based on the residuals of the EPU (EMV) and cryptocurrency returns in a VaR for different sectors are visualized in Table 2, from which we can conclude the existence of nonlinear structures among all of these variables. The basic Pearson correlation matrix above indicates several simple implications as follows. First, we can obviously notice that the UKEPU exerts the greatest impact on cryptocurrencies’ returns, followed by USEPU and CNEPU. Second, the EMV is found to have negative effect upon the returns of all the six chosen cryptocurrencies, which is stronger than that of the CNEPU, but weaker than that of the USEPU. Third, it’s noteworthy that among all of the cryptocurrencies we have selected, Ethereum is the one which receives the largest influence from USEPU, and this influence turns out be negative. Similarly, this relationship also holds true for that between the EMV and Bitcoin, as well as that between CNEPU and Bitcoin. Nevertheless, things are different with the UK which shows a positive effect on Litecoin, the greatest one among all the six cryptocurrencies. In brief, these sectors exhibit a fairly strong dependence, suggesting that a high integration exists among them (see Fig. 1).

4. Empirical results

4.1. Rolling window quantile regression

Following Naifar et al. (2020), we utilize the rolling window quantile regression and we set the size of rolling window as 95 to preliminarily visualize the variation of cryptocurrencies’ hedging properties against EPU and EMV. Besides, two extreme quantiles (i.e. 10% and 90%) are employed in this part. As visualized in Fig. 2, it’s evidently noticed that the coefficients are nearly insignificant for the highest quantile whether in the case of USEPU, UKEPU or CNEPU except for the CNEPU-ETH pair, the UKEPU-XMR pair and the USEPU-BTC pair which are negatively significant at the beginning of year 2018 and from the middle of 2017 to early 2018 (the UKEPU-XMR pair and the USEPU-BTC pair share the same trend), respectively. One possible explanation for the insignificance before the COVID-19 may be that the global regulation on the digital assets like cryptocurrencies is quite stringent at average times, thus leading to an impact of EPU on cryptocurrencies which is not that significant when no massive systemic risk occurs. With regard to the lowest quantile in the case of USEPU, UKEPU and CNEPU, clear significance, whether positively or negatively, has been observed to different extent and during different sample periods. Nevertheless, exception exists when it comes to the CNEPU-XMR pair where insignificance occurs for both the lowest and the highest quantiles.

To be more concrete, for the USEPU-BTC pair, the USEPU is seen to exert a mostly positive impact on the lowest and the highest quantiles of BTC returns with both of them undergoing direction transferring, partly in line with Shaikh (2020) who claims that EPU in the US generates a positive impact on Bitcoin returns in a period with low volatility. We attribute this phenomenon to the fluctuation in the dollar against other major currencies due to the high economic policy uncertainty of the U.S., which drives the global investors and market participants to look for replaceable currencies free of the regulation from central bank. And Bitcoin, as the indisputable leader of all cryptocurrencies, has naturally become the investors’ first choice. For the USEPU-ETH pair, we can easily the lowest quantile experiences some drastic fluctuations especially in 2018 when the US initiated the trade war against China while another eye-catching peak appears around January 2019 when the US Fed releases the signal to cut interest rates, generating more uncertainty to the global financial market. Furthermore, as the same as the USEPU-LTC pair, April 2019 witnessed a violent fluctuation in the USEPU-XRP pair, which we owe to the inversion of the US Treasury Bonds in late March 2019 and the derived pervading economic uncertainty confronted by the US.

Taking a look at the effect of UKEPU on the cryptocurrency market, we can easily note that the UKEPU mainly exerts positive impacts on the returns of the cryptocurrencies’ under study for the highest quantile, implying good hedging properties of cryptocurrencies against UKEPU during extreme events. We believe this has something to do with the blockchain technology and the speculative character of cryptocurrencies which drives intense investment motivation (Diersksmeier & Seele, 2018).

On both the highest and the lowest quantiles, the CNEPU mostly has a positive impact on the BTC returns and a negative effect gradually becomes significant from the autumn of 2019 to the spring of 2020, which we believe can be due to the giant uncertainty arising from the COVID-19. As China was the first country where the COVID-19 pandemic massively broke out, panic was soon sparked among the Chinese investors, partly leading to the fluctuation in the returns of Bitcoin. Apart from this, the role Bitcoin plays in the investment portfolio has been amplified as a result of the incompleteness in the structure of...
China’s capital market (which leads to the insufficiency of investment choices for Chinese investors) and the lack of rationality among the retail investors who account for the vast majority of Chinese investors. Taking an overview of all the cases of CNEPU, we can easily observe that the CNEPU-BTC pair is more significant than other CNEPU pairs, i.e. CNEPU-ETH, CNEPU-XLM, CNEPU-XMR, CNEPU-XRP and CNEPU-LTC, partly consistent with Cheng and Yen (2020) demonstrating that China EPU exhibits a much stronger relation with BTC than LTC, XRP and ETH and one mild difference lies in that they test the role of Chinese government with a regression model and conclude the ban on cryptocurrency trading in September 2017 does improve the predictability power of the China EPU index for Bitcoin returns, but not the other cryptocurrencies.

Something in common can be easily perceived in all the cases of EMV, that is, all the cryptocurrencies in our sample, LTC excluded, are negatively affected by the EMV Infectious Disease index during the escalation of COVID-19 epidemic around February 2020 in the worldwide range and this negative effect turns out to be significant. This preliminary judgment is to some degree supported by Lahmiri and Bekiros (2020) in that they argue cryptocurrencies, embedding higher instability and irregularity, are thus considered to be riskier compared to equities during such big crises as COVID-19. Next we focus on a more detailed analysis of the differences and similarities between multifarious pairs. If we make a comparison between the performances of BTC and ETH during the COVID-19 pandemic, an eye-catching finding will soon come into view that BTC displays better hedging properties through COVID-19 than ETH, which conflicts with the conclusion of Mnif et al. (2020) demonstrating that Bitcoin, being the most efficient before the epidemic outbreak though, is found to be less efficient than Ethereum after the COVID-19 breaks out. One possible reason we attribute this divergence to is the fact that we employ different methodology and a novel Infectious Disease EMV Index by Baker et al. (2020) to better measure the risk arising from the COVID-19 in a much more rigorous and precise way. There is no lack of scholars who contend that Bitcoin can potentially act as a safe haven during COVID-19 (see Corbet et al., 2020a; Ji et al., 2020). Intriguingly, sharper fluctuation emerges in the

Table 2
Estimation results for BDS test.

|       | m = 2  | m = 3  | m = 4  | m = 5  | m = 6  |
|-------|--------|--------|--------|--------|--------|
| BTC   | 9.4230*** | 11.5530*** | 13.0924*** | 14.6487*** | 16.1592*** |
| ETH   | 11.3258*** | 12.8324*** | 14.0543*** | 15.1863*** | 16.3875*** |
| XRP   | 14.4952*** | 15.5637*** | 16.9177*** | 17.9520*** | 18.8950*** |
| LTC   | 8.6602*** | 10.9555*** | 12.5844*** | 14.4274*** | 16.1652*** |
| XLM   | 12.4751*** | 14.5296*** | 15.8565*** | 16.9794*** | 17.9563*** |
| XMR   | 9.3545*** | 11.1765*** | 12.7441*** | 14.2594*** | 15.5220*** |
| USEPU | 12.8266*** | 13.1711*** | 13.0200*** | 12.7012*** | 12.4931*** |
| CNEPU | 18.7848*** | 19.0390*** | 18.0747*** | 17.0678*** | 16.3824*** |
| UKEPU | 14.2333*** | 14.8105*** | 14.2791*** | 13.6457*** | 13.0906*** |
| EMV   | 30.3327*** | 31.1882*** | 32.1492*** | 33.1783*** | 34.6535*** |

Note: ***. **, * indicate significance at the 1%, 5%, 10% level, respectively.

Fig. 1. Pearson’s correlation matrix between EPU (EMV) and cryptocurrencies returns [Note: When there exist no (or low) correlations between cryptocurrencies returns and EPU (EMV), the weak hedging properties of cryptocurrencies are implied; when correlations are high and positive, the strong hedging properties of cryptocurrencies are implied.]
Fig. 2. Rolling window quantile regression estimates of the impact of the EPU and EMV on cryptocurrencies’ returns. Note: The blue (red) solid line represents the 10% (90%) quantile. The fraction of the statistically significant coefficients across the quantiles is represented by the grey line. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
case of the EMV-XLM pair in around May 2019 while during the outbreak of the COVID-19 the trend is steadier instead and transfers from positive to negative, from which we conclude that XLM can be considered as a good choice to serve as a hedging tool against the COVID-19 pandemic, aligned with our findings gained from the QC approach.

In short, the coefficients are nearly insignificant for the highest quantile whether in the case of USEPU, UKEPU or CNEPU before the COVID-19 but for several particular exceptions. The insignificance can be possibly due to the explanation that the global regulation on the digital assets like cryptocurrencies is quite stringent at average times, thus leading to an impact of EPU on cryptocurrencies which is not that significant when no massive systemic risk occurs. Moreover, compared to the UKEPU and the CNEPU, the USEPU more significantly affects the cryptocurrency efficiency during the COVID-19 epidemic, which we believe has something to do with the fact that the USA has now become the most severely involved country and every single policy it makes will cause a chain reaction spreading to the global financial market. Last but not the least, if we focus on the significance, one phenomenon will jump into our sight that all the cryptocurrencies in our sample, LTC excluded, are negatively affected by the Infectious Disease EMV Index during the escalation of COVID-19 epidemic around February 2020 in the worldwide range, indicating that cryptocurrencies, though exhibiting hedging properties against giant crises like the COVID-19 pandemic, may not remain a hedge tool all the time, partly in line with Lahmiri and Bekiros (2020). But once we conduct a further analysis, it’s so big a surprise for us to find out that during the outbreak of the COVID-19 the trend of the EMV-XLM pair is relatively steady and transfers from positive to negative, from which we conclude that XLM can be considered as a good choice to serve as a hedging tool against the COVID-19 pandemic, totally in accordance with our findings obtained from the QC approach.

4.2. Quantile coherency results

Fig. 3 visualizes the dependence structures between various pairs (i.e. EPUs and cryptocurrencies’ returns, EMV and cryptocurrencies’ returns, EPU and EMV, EPU of the US, the UK and China, returns of the six cryptocurrencies) under different quantiles and various frequency domains. We conduct the estimation of quantile coherency matrices at three quantiles, i.e. 0.05, 0.50 and 0.95 as well as all their combinations, namely the left tail, the middle and the right tails of distributions. As for the frequencies, three frequency domains are taken into account in our paper, which are short term (one week), medium term (one month), and long term (one year).

(1) The correlations between EPUs and cryptocurrencies returns

With respect to the dependence structures between EPUs and cryptocurrencies, several findings below grabbed our attention. There exist not a few significant quantile coherences between EPUs and cryptocurrencies in all frequency domains, which is understandable since cryptocurrencies, by their nature, challenge the effectiveness of traditional financial structures and interrelate with other investment options, particularly during periods of economic turmoil. Hence, it’s odds-on that cryptocurrency returns may be influenced by the EPU index. Notably, whether in the short run or in the long run, the USEPU, compared with the UKEPU and CNEPU, shows more quantile coherences with cryptocurrencies, inconsistent with Miao Yu (2019) demonstrating that EPU seems not to impact the future Bitcoin volatility in his sample period, which we suppose results from the diverse methods applied in our respective papers. Two possible explanations could shed light on our more frequent USEPU-cryptocurrencies findings separately: a rather complete cryptocurrency market of US allows rapid information delivering, hence leading to timely responses of cryptocurrency market in the short term; with a certainty of the economic environment, investors are less sensitive to recent news while faced with high uncertainty, they may alter their conviction and patterns of investment, which takes a while without doubt, that is to say, there is a wait and see effect from a long perspective. In striking contrast, however, both the UKEPU and CNEPU generate more quantile coherences with cryptocurrencies than the USEPU in the middle term, which we attribute to the poor efficiency of the cryptocurrency market of the UK and China resulting from the stringent regulation and a lack of completeness. This finding is in line with Wang et al. (2020) from the short-term and long-term perspective but mildly different from Imlak Shaikh (2020) who simply argues that USEPU has a negative effect on the Bitcoin market while China exerts a positive one, which we put down to the QC methodology adopted in our study and that we refine our analysis into 3 frequency domains, namely, the short, medium and long term.

For 0.95|0.50 quantiles and 0.95|0.95 quantiles, it is noteworthy that the USEPU, UKEPU and CNEPU are almost all positively associated with cryptocurrencies in 3 frequency domains, though to different extent, implying cryptocurrencies’ safe-haven properties against high EPU, which is in line with Yen and Cheng, 2020; Wang, et al., 2020; Wu et al., 2019; Matkovskyy et al., 2020; Kalyvas et al., 2020; Fang et al., 2019; Demir et al., 2018; Mamun et al., 2020; Bouri et al., 2017a. We attribute this frequently examined finding to the impact of EPU on cryptocurrencies through market sentiment and investor expectation. High EPU signals violent volatility in the stock market, thus changes the investors’ expectation and market sentiment, leading to a circumstance under which investors are likely to shift their money from stock market to cryptocurrencies or other alternative investment choices. Likewise, Sarwar (2017) mentions in his research that an increase in the VIX generally results in ‘flights to safety’. The prospect theory by Tversky and Kahneman (1986) may also well account for this. High EPU result in wild fluctuation of stock market and investors thus turn to cryptocurrencies as a hedge since investors overweight outcomes which are considered certain, relative to those that are merely probable. A simple fact that since the eruption of debt crisis and the plunge of Turkish currency – Lira, based on CoinMarketCap, a lot of investors in Turk-
Fig. 3. Quantile coherency (QC) matrices between EPUs (EMV) and cryptocurrencies returns. **Note:** The symbols represent the following: Bitcoin (BTC), Ethereum (ETH), Ripple (XRP), Litecoin (LTC), Stellar (XLM), Monero (XMR), the US economic policy uncertainty (USEPU), China economic policy uncertainty (CNEPU), the UK economic policy uncertainty (UKEPU), the Infectious Disease Equity Market Volatility (EMV). Non-significant values at 5% significance level are set to zero. Red and blue grids denote positive and negative values, respectively. Statistically significant values are shown above the diagonal with non-significant values at 5% significance level set to zero. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
lish have switched their holdings to cryptocurrencies, leading to a turbulence in Turkey’s cryptocurrency market provides further evidence for it as well. Nevertheless, some studies have drawn different conclusions, claiming that cryptocurrencies play a poor, or even no role in hedging or safe haven ability because of their high probability of daily hacking and theft plus riskier storage feature compared to other assets such as gold and stocks (see Yermack, 2015; Kubat, 2015; Das et al., 2019; Gkillas and Longin, 2019; Kurka, 2019; Kristoufek, 2015; Klein et al., 2019; Gozgor et al, 2019; Baek and Elbeck, 2015; Bouri et al., 2017b; Qin et al., 2020). Interestingly, at the upper quantiles (i.e. 0.95|0.95), both USEPU and CNEPU exhibit a positive coherency with XLM, which also applies to EMV’s 0.95|0.50 connectedness with XLM, indicating XLM’s prominent hedging properties during times of stress. Through a meticulous comparison among the 3 frequency domains, we can easily observe that cryptocurrencies respond to high EPUs in a wider range from the short perspective than the medium and long ones, which can possibly derive from investors’ fanatical speculation. The cryptocurrency market, as Coskun et al. (2020) put it, is dominated by short-term speculators. In median dependence, EPUs are negatively related to cryptocurrencies in most cases while in lower dependence, positive and negative associations between EPUs and cryptocurrencies share a similar proportion, suggesting that cryptocurrencies are not good candidates to serve as a hedge in times of moderate or low EPU.

(2) The correlations between EMV and cryptocurrencies returns

The correlations between EMV and cryptocurrencies are conspicuous and of vital investment value at the same time. Quite a good deal of literature insists that cryptocurrencies are not found to be safe havens (see Lahmiri and Bekiros, 2020; Corbet et al., 2020b; Goodell and Goutte, 2020; Conlon and McGee, 2020) and this is where our findings diverge from theirs. The negative associations and positive one between EMV and XRP, XLM on quantiles 0.95|0.05 and 0.95|0.50 reveal that some kinds of cryptocurrencies (especially XLM in our paper), can serve as a safe–haven asset during such period of extreme financial market panic arising from the COVID-19 pandemic, which is consistent with Corbet et al. (2020a), Ji et al. (2020), Conlon et al. (2020), and Mnif et al. (2020). The use of sentiment data obtained through social media allows...
for the analysis of interlinkages between sentiment and cryptocurrencies during the COVID-19 pandemic. The sentiment data we are talking about here is based on a lexicon of terms developed to quantify the polarity and subjectivity of time-stamped data (see Corbet et al., 2020a). As Cepoi (2020) noted, with a larger number of entities associated with COVID-19 news, the expected stock market returns gain a much higher probability to be lower, slightly similar to the argument – the breadth of information diffusion influences stock returns – by Fang and Peress (2009). Therefore investors choose cryptocurrencies as an alternative to shelter from risk. In addition, as a part of coronavirus family, the COVID-19 has spread dread and misgivings among global investors, which may hence cause irrational actions such as herding behavior. With money pouring into the cryptocurrency market, it’s no wonder that the cryptocurrencies’ earnings are pushed up. In sharp contrast, when there exists just a common contagious disease or even no disease, the returns of cryptocurrencies fall in most cases during our sample period, clearly supported by EMV’s 0.50|0.50 connectedness with ETH and LTC, 0.50|0.90 connectedness with XRP and LTC and 0.05|0.95 connectedness with BTC and LTC in the medium run, 0.50|0.50 connectedness with ETH and XRP in the long run.

A painstaking observation over the coherency between high EMV and EPUs helps us gain a deeper insight into the different response measures the USA, the UK and China take separately when facing such extremely destructive outbreak. It’s not hard to notice that China is the only country to take immediate actions against the COVID-19 in the short term with a positive coherency of 0.13 between EMV and CNEPU at quantiles 0.95|0.05. In the medium run, the USA and the UK still haven’t taken effective outbreak response efforts, which planted the seed for the soaring fear gauge and thus their equities plummeted and stock market volatility rocketed upwards, later proved by the truth.

(3) The correlations between EPUs and the EMV plus the ones among EPUs

Concerning the quantile coherencies between EPUs and the EMV, an eye-catching finding should be paid great attention to: from the long-term perspective, the correlation between the USEPU and EMV and that between the UKEPU and EMV are both significantly negative while that between the CNEPU and EMV turns out to be insignificant at 0.95|0.95 quantiles. We attribute this to the fact that most of the developed countries including the US and the UK, faced with the COVID-19 pandemic, adopt passive measures to cope with it and focus their policies more on the stabilization of the capital market, thus causing the surge of economic policy uncertainty. On the contrary, China takes immediate actions to deal with the COVID-19 and remains at a low EPU level, greatly calming the market sentiment. As for the correlations among the EPUs, in the short run, USEPU and UKEPU show tight connectedness (i.e. –0.19 at 0.95|0.05 quantiles, –0.15 at 0.95|0.50 quantiles and 0.18 at 0.05|0.05 quantiles) with each other. The “America First” foreign policy put forward by Donald Trump has pushed the USA to a diplomatically isolated position. With Brexit, the UK is also suffering isolation from other EU countries. The facts mentioned above have propelled these two countries to a close cooperation based on the special relationship between the United States and the United Kingdom. Yet things are quite different with China for there unfold relatively loose correlations between CNEPU and USEPU, UKEPU, implying that China has well maintained its policy independence even during the COVID-19 epidemic. According to our quantile coherency results, the low and moderate economic policy uncertainties of China exert a negative impact on the cryptocurrencies mostly, partly in line with Cheng and Yen (2020) claiming that China EPU has predictive power on the Bitcoin returns and further that the ban on cryptocurrency trading in September 2017 by Chinese government has enhanced the predictive power of China EPU for Bitcoin returns. The findings aforementioned hold for the EPUs coherencies in the medium term and the long term as well.

(4) The correlations among cryptocurrencies

In all frequency domains, most of the cryptocurrency pairs are positively correlated with one another, which is the most obvious from the long-term perspective. In the short run, XLM shows zero coherencies with BTC, LTC and XMR in 0.05|0.95 quantiles, even in extreme quantiles (i.e. 0.95|0.95), indicating that XLM exhibits extraordinary hedging properties against BTC, LTC and XMR reciprocally. The safe haven correlation between XLM and BTC also holds true for that in the medium term. Remarkably, when we further look at the upper quantiles (0.95|0.95) from the short-term perspective, BTC is noticeably observed to have a negative association with XRP, which means BTC and XRP could well serve as a strong hedge for each other during times of unrest.

5. Conclusions and implications

Employing a neoteric Quantile Cross-spectral (coherency) methodology pursuant to the work of Baruník and Kley (2019), our study attempts to explore the cryptocurrencies’ hedging properties against EPU and the equity market volatility during such an extremely devastating infectious disease as COVID-19 with a sample period span from August 10th 2015 to June 30th 2020. Remarkably, the newly developed Infectious Disease Equity Market Volatility index proposed by Baker et al. (2020) and the China EPU index at daily frequency by Huang and Luk (2020) are also utilized in our paper to help us gain a revealing insight into the question of whether cryptocurrencies can hedge against violent financial turmoil. And our main conclusions can be drawn as follows.
To sum up, cryptocurrencies act as good hedging tools against high EPU, but not proper hedge candidates during periods of moderate or low EPU and their hedging properties don’t remain all the time, in line with Wu et al. (2019) claiming that Bitcoin shows good properties as a weak hedge and weak safe-haven against uncertainty at the extreme bearish and bullish market (10% and 90%) while it can serve as neither a strong hedge nor safe-haven against EPU at the average times. Moreover, our quantile coherency results further suggest that the US and the UK, faced with the COVID-19 pandemic, adopt passive measures to cope with it and focus their policies more on the stabilization of the capital market, thus causing the surge of economic policy uncertainty while on the contrary, China takes immediate actions to deal with COVID-19 and remains at a low EPU level, greatly calming the market sentiment. Evidence from China, the US and the UK insists that timely response to extreme outbreak like COVID-19 is of pivotal significance to prevent the financial market and the economy from descending into a catastrophe. Several kinds of cryptocurrencies, XRP and XLM specifically, can serve as safe-haven assets during such period of extreme financial market panic. Notably, XLM demonstrates the best hedging properties against high EPU, severe pandemic and other cryptocurrencies. XLM and BTC are excellent choices of hedging assets both for individual investors and institutional investors. The difference lies in that the individual investors have two more options, namely LTC and XMR.

Supplementing the literature about the connectedness between EPU and cryptocurrencies and that between COVID-19 and cryptocurrencies, our study provides implications for policy makers about the prevention of risk arising from COVID-19 as well as advice on hedging strategies against high EPU and violent financial turmoil under the COVID-19 epidemic both for individual investors and the institutional ones. Concretely, for policy makers, besides monitoring the potential downturn risk (sales declining, companies suffering bankruptcy, unemployment rate ballooning, economy being caught in a slump etc.) caused by the COVID-19 pandemic, they also need to be aware of the risk contagion effect between the cryptocurrency market and other equity markets, the stock market especially. What’s worth their special attention is the wait-and-see effect the EPU or the COVID-19 pandemic may have on equities such as cryptocurrencies, which might cause a sudden plummet of the fear gauge. Furthermore, to well manage the investors’ expectation and calm the market sentiment are crucial to the stability of cryptocurrency market since the market sentiment and investors’ expectations are among the mechanisms through which the COVID-19 and EPU may affect the cryptocurrencies’ returns (see Bouri et al., 2017a; Sarwar, 2017). While faced with such highly contagious disease as the COVID-19, all countries are strongly recommended to take prompt actions to minimize any possible risk it may generate, concluded from the cases of China, the UK and the US respectively. And it’s a wiser choice for a country to maintain its independence of policy making in the face of external economic policy uncertainties shocks. For investors, it’s good news for them that some cryptocurrencies, especially XLM, turn out to be good candidates of hedging tools against the COVID-19 and high EPU according to our empirical findings revealed in both the QC and RQ approach. On the one hand, for institutional investors, XLM and BTC are found to have excellent properties to hedge against the equity market volatility during the COVID-19 pandemic in that they responded positively to the Infectious Disease EMV Index and high EPU in the medium and long term. For the individual investors, on the other hand, they have a wider range of hedging choices like LTC and XMR, XLM and BTC included as well for their short-term positive response to the COVID-19.

CRediT authorship contribution statement

Yonghong Jiang: Conceptualization, Validation, Resources, Writing - Review & Editing, Supervision, Project administration, Funding acquisition. Lanxin Wu: Investigation, Writing - Original Draft. Gengyu Tian: Formal analysis, Investigation, Data Curation, Writing - Original Draft, Conceptualization, Methodology, Software. He Nie: Writing - Review & Editing, Supervision.

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