Cryptocurrencies and Risk Mitigation

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Abstract Since their surge in the last decade cryptocurrencies have gained considerable attention in financial markets, and in academic research. Scholars and practitioners are showing interest in the role of cryptocurrencies as part of investors' risk management strategies. Understanding how the returns of different cryptocurrencies, and the associated volatilities, relate to the returns and volatilities of other assets (including other cryptocurrencies, stocks, commodities, and bonds, among others) is crucial to derive conclusions regarding the potential hedging and diversification advantages they could offer to investors' portfolios. The notion of volatility transmission, its intensity and direction, is of importance in explaining the risk management benefits that could stem from adding a specific asset, such as cryptocurrencies, to an existing portfolio.

1 Introduction

When considering the risk-related effect stemming from adding a security to a portfolio, there are many possible classifications for the role such security could play. For instance, a security can be categorized as a hedging asset, a diversifier, or a safe-haven, depending on its properties. Bauer and Lucey (2010) provide detailed definitions to distinguish between these different types. For instance, a diversifier is an asset that is on average positively, but not perfectly, correlated with another asset

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or portfolio. A hedge is an asset that is, on average, uncorrelated or negatively correlated with another asset or portfolio. As these definitions explicitly specify, the correlation properties are only required to hold on average for an asset to be classified as a hedge or as a diversifier. In other words, a hedge or a diversifier might not enable loss reduction under extreme market conditions or turmoil. An asset with the properties of a hedge or a diversifier under regular market conditions could exhibit completely different (correlation) properties under extreme adverse market conditions. On the other hand, a safe-haven, by definition, is an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress; for instance, under extreme adverse market conditions (i.e. bearish eras), the price of such an asset increases when the price of the other assets or portfolio decreases. In quiet (regular) periods, such an asset might behave differently, and possibly exhibit positive correlation with the same asset or portfolio. Baur and McDermott (2010) highlight the distinguishing feature of a hedge compared to a safe-haven, which is the length of the effect. While the correlation property of a hedge should hold on average, the key property of the safe-haven is required to hold during certain periods, such as financial crises. The correlation properties of the same asset with relation to another asset or portfolio could be different during a crisis, than during periods exhibiting regular market conditions. Another aspect that is crucial to be considered by investors is the distinction between a strong hedge, that is negatively correlated with another asset or portfolio, and a weak hedge, that is, on average, uncorrelated with the other asset(s) or portfolio. Whereas a strong hedge might enable an investor to enjoy significant positive returns when the other asset(s) or portfolio suffers from negative returns, the same might not hold for a weak hedge.

2 Cryptocurrency Market Efficiency

An important notion relating to the return and risk relation is that of market efficiency. The efficient market hypothesis, which has been developed by Fama (1970), has been the basis for many foundational theories in finance. A market is said to be efficient if security market prices reflect all available information. Given that security prices are assumed to incorporate all relevant information, no one can persistently beat the market. There are three forms of market efficiency; (1) the weak form, (2) the semi-strong form, and (3) the strong form which respectively refer to the inability of an investor to outperform the market and generate excess abnormal returns (given the level of risk undertaken) based on (1) information on previous security prices, (2) any public information available, and (3) any public or private information available.

Many recent studies have focused on exploring the efficiency of cryptocurrency markets. By examining the liquidity of 456 different cryptocurrencies, Wei (2018) found that higher liquidity is associated with higher efficiency, referring to a lower predictability of future returns. Based on Wei's findings, the Bitcoin market shows signs of efficiency, whereas the returns of other cryptocurrencies exhibit signs of auto-correlation and non-independence and thus their markets are not efficient.

Brauneis and Mestel (2018) also found liquid cryptocurrencies' markets to be more efficient. On the other hand, Charfeddine and Maouchi's (2018) examined the Long-Range Dependence (LRD) behavior of the returns and volatilities of four cryptocurrencies, namely, Bitcoin, Litecoin, Ripple, and Ethereum. Their findings confirmed the inefficiency of all the cryptocurrencies covered by their study, except for Ethereum. Caporale et al. (2018) also concluded based on their study that the Bitcoin, Ripple, Litecoin, and Dash markets are inefficient. Nadarajah and Chu (2017) and Urquhart (2016) added to the evidence on the inefficiency of the Bitcoin market. However, when splitting their sample into subsample periods, Urquhart (2016) found that Bitcoin became more efficient in later periods, and thus concluded that this currency might be in the process of moving towards efficiency. Vidal-Tomás and Ibañez (2018) examined the semi-strong efficiency of Bitcoin in the Bitstamp and Mt.Gox markets to explore how this currency is affected by its own events and the monetary policy. In line with Urquhart's (2016) conclusions, they found that the Bitcoin market is becoming more efficient over time, and that it is not affected by monetary policy news.

Beneki et al. (2019) used innovative VAR methodologies to investigate the volatility transmission from Ethereum to Bitcoin (first and second cryptocurrencies in terms of market capitalization and trading volume) throughout time. They noted a delayed response of Bitcoin's volatility in response to volatility shocks to Ethereum's returns, which is interpreted as signs of inefficiency in the Bitcoin markets. Given that such public information is shown to take time to be incorporated into Bitcoin prices, a profit-making opportunity could exist for investors to benefit from.

3 Risk Mitigation Using Cryptocurrencies

Given that Bitcoins are the first cryptocurrencies to emerge in the market and the one with the largest market capitalization, these have been the most explored by existing studies compared to other cryptocurrencies. A significant thread of the literature on cryptocurrencies studies the role of Bitcoins as a safe-haven, a diversifier, or a hedging asset vis-à-vis other assets, as well as other cryptocurrencies (i.e. Bouri et al. 2017a–c, 2018; Dyhrberg 2016a, b; Brière et al. 2015; Feng et al. 2018; Urquhart and Zhang 2018; Fang et al. 2019). A crucial factor supporting the hedging ability of Bitcoin relates to its independence with relation to economic and financial developments (Polasik et al. 2015; Bouri et al. 2017c; Guesmi et al. 2018), and negative or weak positive (or lack of) correlation with conventional assets (Bouri et al. 2017c; Baur et al. 2015, 2018; Yermack 2013; Dyhrberg 2016a, b; Corbet et al. 2018; Ji et al. 2019; Guesmi et al. 2018; Sun et al. 2018).

On the other hand, there are studies arguing that the little intrinsic value (Yi et al. 2018) and the high volatility in Bitcoin prices (Molnár et al. 2015; Wong et al. 2018), due to the speculative nature of this market, could weaken the role of this cryptocurrency as part of a diversification strategy (i.e. Cheah and Fry 2015). The decentralization and the fixed supplies of cryptocurrencies, including Bitcoin, makes

them more susceptible to short-term price fluctuations (Berentsen and Schar 2018). Using a GARCH (1.1) model, Corbet et al. (2017) examined the effects of international monetary policy changes on the volatility of bitcoin returns, and found these effects to be significant, thus questioning the widespread claims of Bitcoin's independence vis-à-vis government policies. This result entails resemblance between Bitcoin and other store of value assets and currencies, and have implications on the consideration of Bitcoin for hedging and diversification purposes.

According to Guesmi et al. (2018), Bitcoin possesses hedging abilities in various financial markets, and using it as part of a diversification strategy could contribute to reducing the risk of the investment. Such a conclusion is supported by the evidence of uncorrelation of Bitcoin with traditional asset classes provided in Baur et al. (2018); this evidence stemmed from a correlation analysis involving Bitcoin returns and the returns of traditional asset classes. Works by Dyhrberg (2016a, b) also provided evidence on the hedging capabilities of Bitcoin; using the standard GARCH and exponential GARCH (EGARCH) models, they find Bitcoin to have hedging properties and advantages as a medium of exchange, because of the similarities it shares with the gold and dollar markets (Dyhrberg 2016a). Then, in another study, they provided evidence on Bitcoin's role as a hedge against UK equities and the US dollar (Dyhrberg 2016b). There are other studies that have argued for the benefits of including Bitcoin into diversified portfolios by improving the risk-return trade-off (i.e. Halaburda and Gandal 2014; Eisl et al. 2015; Chen and Vivek 2014; Brière et al. 2015).

Evidence on the dynamic hedging abilities of Bitcoin against many stock indices was provided in a study by Chan et al. (2019); these indices included Euro STOXX, Nikkei, Shanghai A-Sharpe, S&P 500, and the TSX index. In this study, they have used GARCH models and constant conditional correlation models for daily, weekly, and monthly returns covering the period from October 2010 until October 2017. The movements of the daily returns have been decomposed into high, medium, and low frequency movements using the frequency dependent model. The insignificant correlation exhibited between Bitcoin and the indices' returns over the daily and weekly horizons undermines its hedging abilities against market risk in the short run. However, for monthly horizons, the hedging abilities of Bitcoin improve significantly, due to the significantly negative correlations exhibited towards the indices considered.

Using a dynamic conditional correlation GARCH (DCC-GARCH) method, Bouri et al. (2017c) found support for the role of Bitcoin as a diversifier rather than a hedge against stock indices, bonds, oil and gold. Their evidence also shows Bitcoin to possess strong hedging abilities against the commodity index and that it can act as a strong safe-haven against extreme down movements in Chinese stocks and Asia Pacific stocks. However, Bitcoin's hedging and safe-haven properties differed across time. For instance, the hedging abilities of Bitcoin against the commodity index exhibited through daily data vanished with weekly data, and the hedging properties against the Japanese stocks for daily data faded with weekly data. The hedging and safe-haven properties against the Chinese stocks revealed through weekly data were not present with daily data. In addition, for the Asia Pacific stocks,

Bitcoin played a hedging role based on daily data, and progressed to act as a safe-haven based on weekly data.

In another study, Bouri et al. (2017a) used the asymmetric GARCH method to identify how Bitcoin's risk-reduction abilities have changed after its price crash in 2013. They found that, while before the price crash Bitcoin had similar safe-haven properties as gold, these properties have vanished in the subsequent periods. In addition, they reported evidence that adding Bitcoin to US equity portfolios enables risk reduction.

The findings of Dyhrberg (2016a, b) also support the role of Bitcoin in reducing risk (like gold) through its hedging capabilities, specifically against the Financial Times Stock Exchange (FTSE) Index and the US dollar. Therefore, as part of her conclusions, she classified Bitcoins as a hybrid between a currency and a commodity. By focusing on emerging stock markets, Guesmi et al. (2018) were able to highlight the role of Bitcoin as a diversifier, even in portfolios including oil and gold. Selmi et al. (2018) argue for similarities between Bitcoin and gold in mitigating portfolio risk related to fluctuation in oil price movements.

By focusing on the three cryptocurrencies that account together for more than 40% of the total cryptocurrency market capitalization (Bitcoin, Litecoin, and Ripple), Wong et al. (2018) found that Bitcoin and Litecoin have negative or zero correlations with other asset classes, and can thus act as hedges, and that Ripple exhibits diversification properties (slight positive correlations with the other asset classes). In contrast with Bouri et al. (2017c), Wong et al. (2018) found that Bitcoin can act as a hedge against stocks (S&P500) due to the presence of a significant negative correlation between the two, whereas the former study found Bitcoin to be a diversifier in relation to the S&P500. A possible explanation of these differing results, according to Wong et al., is due to the difference in the sample periods covered by the two studies. Corbet et al. (2018) conducted a spillover analysis in which they examined the relation between Bitcoin, Ripple, and Litecoin, and other asset classes. Their findings revealed that these cryptocurrencies are rather immune to external market shocks, therefore they can be considered to be useful as diversifiers and safe-havens over short time horizons, and that when added to a portfolio, they result in an enhanced risk-return trade-off.

4 Hedging Cryptocurrency Investments

In addition to using cryptocurrencies to reduce risks associated with investing in securities (such as stocks, bonds, among others) and commodities, cryptocurrencies can also be used to mitigate risks resulting from investing in other cryptocurrencies. The heterogeneity exhibited across the risk levels of different cryptocurrencies (Gkillas and Katsiampa 2018; Brauneis and Mestel 2018) could prove to be useful when it comes to the diversification benefits they could entail (Antonakakis et al. 2019). Exploring the risk mitigation effects stemming from combining cryptocurrencies in a portfolio requires examining return and volatility connectedness

or spillovers among these cryptocurrencies to get informed on the information transmission mechanism involved (Yi et al. 2018). For instance, a weak connectedness across cryptocurrencies could present diversification and hedging opportunities for investors (Ji et al. 2019), whereas a higher level of connectedness and spillovers among cryptocurrencies would be expected to limit the hedging and diversification benefits resulting from combining them into a portfolio (Yi et al. 2018).

Beneki et al. (2019) investigated the volatility transmission and hedging properties between Bitcoin and Ethereum throughout time to explore the existence of trading strategies that could result in abnormal profits given the risk levels undertaken by investors. Using innovative VAR methodologies allowed them to examine responses of time-varying volatilities of Bitcoin to time-varying volatilities of Ethereum. They documented a delay in the response of Bitcoin to volatility shocks to Ethereum returns, which was interpreted as inefficiency in the Bitcoin market. This delay could present opportunities for speculation and profit-making for investors. In addition, they found that, during the first half of 2017, when prices of both Bitcoin and Ethereum increased, these two cryptocurrencies had a near-zero correlation, so they acted as diversifiers rather than hedges. The hedging abilities of these cryptocurrencies decreased significantly in later periods and during periods of increased policy uncertainty (Beneki et al. 2019). Findings in Corbet et al. (2018) also outline the diversification benefits that emerge from investing in Bitcoin, Ripple, and Litecoin, specifically for short-term oriented investors.

In a study by Borri (2019) that considered Bitcoin, Ether, Ripple, and Litecoin, he used a CoV aR methodology to examine the conditional tail-risk in the markets of these cryptocurrencies. He found that, despite the high correlations in the returns of these cryptocurrencies, investing in a portfolio of cryptocurrencies allows the reduction of idiosyncratic risk and offers a better risk-adjusted performance and conditional returns than investing in individual cryptocurrencies. Ether, Litecoin and Ripple seemed to be vulnerable to the tail-risk of Bitcoin, whereas Bitcoin seemed to be more resilient to shocks to the returns of the other cryptocurrencies considered. By examining the co-movement between dollar returns on these cryptocurrencies and other global assets, such as gold and US equity, both unconditionally and conditional on these assets being in a state of distress, he found that cryptocurrencies are poorly correlated with, and not exposed to tail-risk with respect to global assets. He concluded that cryptocurrency portfolios could represent hedging properties to investors and offer attractive returns. In a similar vein, Antonakakis et al. (2019) used a TVP-FAVAR connectedness approach to examine the transmission mechanism in the cryptocurrency markets. They have explored co-movements in the markets of the top nine currencies (by virtue of their market capitalization), and one market factor (that entail 45 additional digital currencies) to capture the main return co-movements in the crypto-market. Their results reveal large dynamic variability (ranging between 25 and 75%) across several cryptocurrencies, and stronger (lower) connectedness during periods of higher (lower) market uncertainty. Their conclusion supports their proposition that higher interconnectedness in the crypto-market facilitates portfolio and risk management techniques. By constructing

bivariate dynamic portfolios, their findings suggest that including Bitcoin and Ethereum in a portfolio results in more effective diversification.

Both static and dynamic volatility connectedness among cryptocurrencies have also been investigated in a study by Yi et al. (2018). They have studied eight cryptocurrencies that were selected based on their market capitalization and long trading history (Bitcoin, Ripple, Litecoin, Peercoin, Namecoin, Feathercoin, Novacoin and Terracoin). They also considered key events that may affect their connectedness. They found that connectedness varies cyclically, and that it has exhibited an upward trend since the end of 2016, which prompted them to dig deeper into the period from December 2016 until April 2018. Then, they based their analyses on a network view using the LASSO-VAR approach to explore the volatility connectedness using an expanded sample of 52 cryptocurrencies. The results, both based on the eight cryptocurrencies sample and the 52 cryptocurrencies sample, showed that, despite its significant high market capitalization, Bitcoin is not the dominant player of volatility connectedness in the crypto-market. They also found that the 52 cryptocurrencies are tightly interconnected.

Interestingly, Ji et al. (2019) have reached differing results with regards to the leading role of Bitcoin in terms of volatility spillovers. They have measured connectedness by following Diebold and Yilmaz (2014); they built positive/negative connectedness networks, then they used regression to identify the drivers of the degree of connectedness among the cryptocurrencies studied. By studying the return and volatility spillovers across six large cryptocurrencies during the period from August 2015 until February 2018, they found that Bitcoin is the most influential in terms of volatility spillovers, and that Bitcoin and Litecoin are the leading cryptocurrencies in terms of the effects of shocks to their returns on other cryptocurrencies. Ethereum (the second in terms of market capitalization) is shown to be rather a recipient of spillovers. Connectedness via negative returns seemed to be significantly stronger than via positive ones. They also found that Dash and Ethereum showed very low connectedness, which could justify their use for hedging in the crypto-market. Therefore, cryptocurrencies' market capitalization did not prove to be a primary determinant of the significance of the connectedness effects of a cryptocurrency on other cryptocurrencies. In addition, they documented a positive effect of global financial distress periods on both returns and volatility connectedness in the cryptocurrency market. They attributed this result to the speculative nature and lack of transparency in the crypto-market, which makes it highly volatile; such conditions, along with periods of financial distress would be expected to encourage herding behaviors (Baur et al. 2018; Demirer and Kutan 2006), thus positively affecting connectedness among cryptocurrencies.

Understanding price dynamics in the cryptocurrency market and the interconnectedness among cryptocurrencies is crucial to determine how portfolios' risk can be better managed. An important characteristic that could limit the diversification potential is the existence of systematic structural breaks, which indicates market integration. Canh et al. (2019) analyzed structural breaks and volatility spillovers in seven cryptocurrencies; Bitcoin, Litecoin, Ripple, Stellar, Monero, Dash, and Bytecoin. They have used various econometric models in their study, such as

cumulative sum test for parameter stability, Granger Causality test, LM test for ARCH and Dynamic Conditional Correlation MGARCH model. Their findings confirm the existence of structural breaks, and volatility spillovers with strong positive correlations among these cryptocurrencies; correlations between six out of the seven cryptocurrencies considered exceeded 0.4, with the largest correlation existing between Bitcoin and Litecoin with a value of 0.746. They also found the structural breaks to spread from smaller cryptocurrencies to the larger ones; the prices of cryptocurrencies with lower market capitalizations change first, and those of larger cryptocurrencies follow. Evidence points to the significance of the non-diversifiable risk within the cryptocurrency market, which can be due to the existence of common economic factors affecting these cryptocurrencies within a short period of time. The interdependence across cryptocurrencies' prices has been outlined in many other studies, such as Ciaian et al. (2018) and Boako et al. (2019).

Given the high volatility in the prices of cryptocurrencies, the existent evidence on the interconnectedness and correlation among them, and the significant losses that could result should the prices in the cryptocurrency market fall (i.e. price crash in the early 2018), considering the use of other financial assets to hedge against cryptocurrencies' down-side price movement is of value. Pal and Mitra (2019) examined the possibility of Hedging bitcoin using other financial assets; they have considered the S&P500 composite index (to represent stocks), wheat (to represent commodities), and gold (to represent precious metals). Their results revealed that each of these assets can be used as a hedge against cryptocurrencies, with the gold being the strongest hedge, compared to wheat and the S&P500 index, with a hedge ratio of 0.7005 obtained through the Generalized Orthogonal GARCH (GO-GARCH) model. The interpretation of this ratio is that a US$1 long position in Bitcoin can be hedged by a short position in the gold market for 70 cents.

As with other financial assets, hedging cryptocurrencies' risk exposure, can be performed using derivatives, such as futures, forwards, swaps, and options. Research on cryptocurrency derivatives is relatively scarce, as this market is still in its early stage of development. For instance, the first trading of Bitcoin's futures contracts has taken place in the Chicago Mercantile Exchange and the Chicago Board Options Exchange in December 2017. Brito et al. (2014) address the emergence of derivatives in the context of Bitcoin, with a focus on the regulatory aspects relating to it. In a more recent study, Corbet et al. (2018) examined the introduction of Bitcoin futures, and found that these are not effective hedging instruments, given that spot volatility has increased following the introduction of these contracts.

5 Economic Policy and Market Uncertainties

An important and intuitive observation noted by Ji et al. (2019) is that the role of a cryptocurrency as a transmitter or a receiver of a shock alternates, and the significance of the returns' connectedness and volatility spillovers changes throughout time. Many external factors, such as economic policy uncertainty (EPU), stock

market uncertainty and the prices of other securities and commodities could affect the return of, and the dynamics of the connectedness among cryptocurrencies, and between cryptocurrencies and other conventional assets. Taking into consideration such aspects is crucial for investors when deciding their investment and risk management strategies depending on the economic and policy-related conditions.

There is evidence in the existing literature on the negative correlation between EPU and stock returns (Chiang 2019), and on the negative relation between EPU and stock prices (Kang and Ratti 2014; Antonakakis et al. 2013). Demir et al. (2018) found that the US EPU index can be used to predict Bitcoin returns, and is negatively correlated with these returns; therefore Bitcoin can be used as a hedge against EPU. They argue that, in a state of high economic policy uncertainty, investors tend to have a lower level of trust in the global financial systems and conventional currencies, and therefore they become more attracted to invest in Bitcoin. Matkovskyy and Jalan (2019) analyzed the effects of EPU on the interdependence between Bitcoin and traditional financial markets. Their study considered both the return- and volatility-related effects. They used five stock market indices (NASDAQ100, S&P500, Euronext100, FTSE100 and NIKKEI225), and measured EPU based on economic policy, monetary policy, financial regulation, taxation policy, and the news-based policy uncertainty index for the U.S., U.K., Europe and Japan. Their results show that, the connectedness between Bitcoin and traditional financial markets in terms of volatility is higher than their connectedness in terms of returns, and that EPU shocks have a negative impact on the interdependence between Bitcoin and traditional financial markets. The findings also provide support for the role of Bitcoin as a hedge against US economic uncertainty shocks.

Fang et al. (2019) examined the effects of global economic policy uncertainty (GEPU) on the long-run volatilities of Bitcoin, global equities, commodities, and bonds, using the GARCH-MIDAS model and its extension, the DCC-MIDAS model. Their findings revealed that the global economic uncertainty has a significant effect on the long-term volatility of Bitcoin, equities, and commodities, a negative significant impact on the Bitcoin-bonds correlation, and a positive impact on the Bitcoin-equities and Bitcoin-commodities correlations. Such findings suggest that Bitcoin can be used as a hedge against bonds during periods of high GEPU, and against equities and commodities during periods of low GEPU. Through further investigation, they found a weak effect of the state of economic uncertainty on the hedging abilities of Bitcoin. Bitcoin hedging abilities against equities and bonds have increased only slightly after accounting for the effect of the economic policy uncertainty. This led them to conclude that Bitcoin's hedging abilities are not only conditional on the strength of the GEPU, but also on how the other markets are related to it, and that the GEPU has a stronger effect on the volatility of global stock and bond indices than on Bitcoin.

Using quantile and quantile-on-quantile regressions, Bouri et al. (2017b) investigated the hedging properties of Bitcoin against global uncertainty, measured by the first principal component of the volatility indices (VIXs) of 14 developed and developing stock markets. The VIX is an indicator of market uncertainty as it reflects market sentiment and investor expectations. Higher VIX values signal higher market

uncertainty. The results obtained highlight the importance of exploring the different investment horizons of Bitcoin returns, rather than just studying the entire conditional distribution of Bitcoin returns or just the conditional mean. For short-term horizons, Bitcoin is found to display hedging properties against global uncertainty only when the market is performing well (in a bull market context). In addition to the market conditions (bull or bear markets), the degree of uncertainty (whether there is a high or a low level of uncertainty) is also found to affect the hedging abilities of Bitcoin against uncertainty. Bitcoin was found to act as a hedge against uncertainty for shorter investment horizons at extreme ends of Bitcoin returns and uncertainty (when uncertainty is too high or too low). In a more recent study, Bouri et al. (2018) examined the quantile conditional dependence and causality between Bitcoin returns and the Global Financial Stress Index (GFSI). Using copula-based approach, they found that Bitcoin can act as a safe-haven against global financial stress.

To explore the prediction power of the daily EPU index on the daily Bitcoin returns, Demir et al. (2018) used the Bayesian Graphical Structural Vector Autoregressive model, the Ordinary Least Squares and the quantile-on-quantile Regression. Their findings revealed that the EPU has a predictive power on Bitcoin returns, and that Bitcoin returns are negatively associated with the EPU; an increase in the EPU results in a decrease in Bitcoin returns. However, this relation does not hold at the extreme ends of Bitcoin returns and uncertainty. At both the lower and higher quantiles of Bitcoin returns and EPU the effect becomes positive and significant. This finding is in line with the findings of Bouri et al. (2017b) that support the hedging abilities of Bitcoin against uncertainty during times of bull-market, and its diversification abilities during times of bear-market. Given the potential effect of a high level of policy uncertainty on investors' trust towards the economy and conventional currencies, one could justify the consequences of such conditions on cryptocurrencies' returns; under such conditions investors find Bitcoins more attractive.

Wang et al. (2018) used the US EPU index, the VIX and the equity market uncertainty index as proxies for EPU to investigate the risk spillover effect from EPU to Bitcoin. In terms of proxying for EPU, this study provides more comprehensive measures compared to Demir et al. (2018) and Bouri et al. (2017b) who have, each, used only one proxy for EPU (US EPU index or the VIX). Using a multivariate quantile model (MVQM) and the Granger causality risk test, on daily and weekly Bitcoin and EPU data, they found that the EPU has, in general, a negligible risk spillover effect on Bitcoin. These results, despite not being aligned with Demir et al.'s (2018) and Bouri et al.'s (2017b) findings, they supported the researchers' initial hypothesis; Wang et al. argue that, given the independence of Bitcoin with regards to the economic and financial system, one would expect the effect of EPU shocks on Bitcoin to be negligible, or non-existent. This weak spillover effect enables Bitcoin to act as a safe-haven or a diversifier when there is a high level of economic policy uncertainty.

6 Cryptocurrencies and Gold

A widespread view on cryptocurrencies' hedging abilities involves outlining its similarities with gold, in terms of scarcity of supply, high price volatility, existence of a finite supply, decentralization and lack of government control. A considerable literature thread found empirical evidence on the similarities between gold and cryptocurrencies due to their positive role in portfolio and risk management (i.e. Dyhrberg 2016a, b; Tully and Lucey 2007; Baur 2012). Cryptocurrencies have even been referred to as the new gold (Klein et al. 2018) or digital gold (Popper 2015). On the other hand, gold exhibits significant differences compared to Bitcoin; such as "tangibility, long history, intrinsic value, low volatility, and usage in the production process" (Al-Khazali et al. 2018).

In order to explore the similarities between Bitcoin and gold in terms of hedging abilities, Dyhrberg (2016b) examined the hedging capabilities of Bitcoin using a research approach (asymmetric GARCH methodology) and explanatory variables that are similar to the ones used in studying the hedging abilities of gold. Such an approach allows for a better comparison of the research findings on the two assets. The results revealed that Bitcoin is, on average, uncorrelated with the assets in the FTSE Index, so Bitcoin returns are not affected by changes in the stock market. This observation illustrates the role that Bitcoin can play in terms of reducing the market risk assumed by investors, and are in line with the findings on the hedging abilities of gold (Bauer and Lucey 2010). However, the hedging abilities of Bitcoin against the dollar appeared to be shorter lived than those of gold. She concluded that Bitcoin has a significant role in portfolio and risk management alongside gold.

In another study, Dyhrberg (2016a) questions whether Bitcoin is more similar to gold (as a store of value asset) or to the US dollar (as a medium for exchange). She identified similarities between Bitcoin and both gold and the US dollar. Bitcoin provides similar risk-management capabilities as gold, given their similarities in terms of their response to exchange rates' changes and large volatility persistence, and they both react symmetrically to good and bad news. She also found that Bitcoin reacts significantly to the US federal funds rate, which points to its role as a currency. An appreciation in the US dollar due to an increase in the federal funds rate, would lead to an increase in online purchases, and consequently to a higher demand, and improved returns, for Bitcoin. In conclusion, she argues that Bitcoin is a hybrid between the gold and the dollar and that it displays hedging capabilities of value in risk and portfolio management.

Gold prices are found to have a significant negative effect on Bitcoin's returns spillovers, which could be explained by the similarities between Bitcoin and gold in terms of their hedging abilities; when the gold price increases, the demand for Bitcoin decreases which would weaken its return spillover effect (Ji et al. 2019). Interestingly, Klein et al. (2018), in their paper entitled "Bitcoin Is Not the New Gold: A Comparison of Volatility, Correlation, and Portfolio Performance" challenge the mainstream view referring to cryptocurrencies as the new gold. They claim that "the two assets could barely be more different" (Klein et al. 2018) as they exhibit

fundamentally different properties as assets and are differently linked to equity markets. The results showed differences in the conditional variance structures of the two assets, and in their correlations behaviors, especially in times of market distress. By evaluating time-varying conditional correlations, using a BEKK-GARCH model, they found that Bitcoin moves in the same direction as the stock markets during down times, which is completely different than the way gold behaves in downward markets. Their findings also contrast with a considerable existing literature thread that highlights the hedging abilities of Bitcoin; Klein et al. concluded that Bitcoin has unstable hedging properties and is not a safe-haven.

In the same vein, Al-Khazali et al. (2018) explored the impact of macro-economic news surprises on the returns and volatilities of gold and Bitcoin, based on a dataset originating from the US, Canada, the Euro Area, UK, and Japan. Using the GARCH methodology, they found gold and Bitcoin to display asymmetric reactions to these news; handing support to the evidence on the difference between the two. Whereas the gold's response exhibited its safe-haven properties, Bitcoin, in general, behaved differently. The noted negative co-movement of gold prices with macro-economic news highlights its safe-haven capabilities, which has also been documented in previous studies (Elder et al. 2012; Bauer and Lucey 2010).

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