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Can Bitcoin be a diversifier, hedge or safe haven tool?

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Abstract: This paper investigates whether Bitcoin acts as a diversifier, hedge or safe haven tool for investors in major developed and developing markets, as well as for commodities. This paper employs the GARCH Dynamic Conditional Correlation (DCC) model. The sample covers seven developed and six developing countries, five regional indices and 10 commodity series. The results show that Bitcoin acts as a hedge for investors in most of the developing countries such as Brazil, Russia, India and South Korea, but only as a diversifier for investors in developed countries and for commodities. Moreover, Bitcoin acts as a diversifier for all the 10 commodities studied here. During the US election in 2016, Brexit referendum in 2016, and the burst of Chinese market bubble in 2015, Bitcoin acted as a safe haven asset for both the US and non-US investors. Understanding the role of Bitcoin is important for financial market participants who seek protection against market turmoil and downward movements. Furthermore, our findings would be of interests to regulators and governments to engage in more discussion of the role of Bitcoin in financial markets. This paper contributes to the ongoing debate on the usefulness of Bitcoin for investments. Furthermore, it distinguishes the benefits of Bitcoin as a diversifier, hedge and safe haven to investors in the developed versus developing markets.

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PUBLIC INTEREST STATEMENT

This study contributes towards understanding the benefits Bitcoin offer to the financial market participants who seek protection against market turmoil and downward movements. It shows the benefits Bitcoin offer to investors in seven developed markets, seven developing markets, one African market and 10 commodities. The results show that the benefits Bitcoin offer varies across regions and time periods. Bitcoin offers hedging benefits to investors in developing countries such as Brazil, Russia, India and South Korea, and offers diversification benefits to investors in developed countries and investors with investments in commodities. Through studying certain events that created global uncertainty, the study finds that Bitcoin has acted as a safe haven asset during the US election in 2016, Brexit referendum in 2016, and the burst of Chinese market bubble in 2015. Findings in the paper have relevance for investors, regulators, and governments.

Subjects: Technology; Economic Forecasting; Investment & Securities

Keywords: bitcoin; hedge; safe haven; diversifier; commodities; US versus non-US investors

Jel classifications: G10; G11; G15; Q02

1. Introduction

An increasing number of studies have found evidence that inclusion of Bitcoin in a portfolio enhances its performance by improving the risk-return profile of the portfolio (Eisl, Gasser, & Weinmayer, 2015; Bouoiyour & Selmi, 2017). Popper (2015), Dyhrberg (2016a) and Bouri, Molnar, Azzi, Roubaud, and Hagfors (2017b) among others found that Bitcoin acted as a hedge and a diversifer, and consequently regarded Bitcoin as the digital gold. Klein, Hien, and Walther (2018), on the other hand, found that Bitcoin behaves the exact opposite of gold. They found that the Bitcoin and S&P500 returns positively correlated during periods of downward markets. However, other studies found that Bitcoin price surged during periods of economic or financial turmoils (Blundell-Wignall, 2014; Titcomb, 2017; Urban, 2017) suggesting that Bitcoin could be a safe haven. Thus, existing evidence on the usefulness of Bitcoin for investors as a diversifier, a hedge or a safe haven is mixed. We contribute to the ongoing debate by investigating if Bitcoin can act as a diversifier, a hedge or a safe haven against stocks and commodities. We examine the capabilities of Bitcoin through the testable framework proposed by Baur and Lucey (2010), and Baur and McDermott (2010). Understanding the capabilities of Bitcoin is important for financial market participants who seek protection against market turmoil and downward movements.

Moreover, existing studies on Bitcoin have not distinguished the benefits of Bitcoin to investors in the developed versus developing markets. Generally, tradings in financial assets are very different in the developed markets compared to developing markets. Developing markets are often characterized by a lack of regulation, political instabilities and an underdeveloped financial system (Krause, 2016; Lunn, 2014) limiting access by investors from developed markets and vice versa. Golam and Monowar (2015) stated that emerging countries such as BRIC countries faced numerous challenges and uncertainties in the social, political, military and security sectors. However, the decentralized and transparent nature of Bitcoin trading offers easy access to investors from all around the world while offering a relatively highly reliable alternative investment to the financial assets. As a result, Bitcoin trading in countries outside of the US grew rapidly. Yet studies to date take the perspective of US investors. Therefore, in this paper, we seek to take the perspectives of non-US investors. This will provide a deeper understanding on how the properties of Bitcoin vary for investors across borders.

Finally, Bouri, Jalkh, Molnar, and Roubaud (2017a, 2017b) found that Bitcoin's ability to hedge against uncertainty is observed only at short investment horizons or during certain periods. Thus, in this paper, we investigate the roles of Bitcoin during periods when global uncertainty is high. We define global uncertainty by the tail of statistical distribution as in the literature. In addition, we also focus on the periods where events of global significance take place. Doing so enables us to get better insights into the episodes of global uncertainty. We examine the US election in 2016, Brexit referendum in 2016, and the burst of Chinese market bubble in 2015 as they created uncertainty around the world markets.

We employ a GARCH Dynamic Conditional Correlation (DCC) model. The sample includes seven developed and six developing countries, five regional indices and 10 commodity series.

The next section reviews the literature, while Section 3 describes the data and methodology. Section 4 presents empirical findings, and Section 5 concludes.

2. Literature review

2.1. Diversifier, hedge and safe haven

Baur and Lucey (2010, pp. 5–6) were the first to define testable definitions of a diversifier, hedge and safe haven, making it possible to explore and identify the capabilities of an asset. The definitions are as follows:

> *"A diversifier is defined as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average.*
>
> *A hedge is an asset that is uncorrelated or negatively correlated with another asset or portfolio on average. A strict hedge is (strictly) negatively correlated with another asset or a portfolio on average.*
>
> *A safe haven is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil."*

Baur and McDermott (2010, p. 1889) expanded on these definitions in an important way, making them even more precise by differentiating between weak and strong form.

> *"A strong (weak) hedge is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio on average.*
>
> *A strong (weak) safe haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in certain periods only, e.g. in times of falling stock markets."*

It is important to note that a hedge holds on average, while a safe haven only needs to hold in specific periods. Baur and Lucey (2010) explain this thoroughly. Since a hedge could exhibit a positive correlation in times of market stress or turmoil, it does not have the property of reducing losses in these specific periods. The property of a safe haven asset is the non-positive correlation with a portfolio in extreme market conditions, suggesting that the correlation can be either positive or negative on average.

2.2. The fundamentals of Bitcoin

Due to Bitcoin's complexity, legislators and economists are eager to define Bitcoin as a currency or a commodity. Bitcoin on several occasions proved its position as a currency in the global market. Popper (2015) regarded Bitcoin as the digital gold. However, Yermack (2013) and Baek and Elbeck (2015) argued that Bitcoin appeared to behave more like a speculative investment rather than a currency. In 2015, the U.S. Commodity Futures Trading Commission classified Bitcoin as a commodity.

While some studies focused on establishing the usefulness of Bitcoin for market participants, a number of other studies addressed the main drivers of Bitcoin price. Bitcoin is underpinned by a decentralized technology whereby completion of a Bitcoin transaction requires simultaneously solving complex computational puzzles across the decentralized database. As anticipated Hayes (2015) showed that computational power known as the hashrate is one of the main drivers of Bitcoin price. Moreover, Kristoufek (2015) found that the price of Bitcoin was determined by standard fundamental factors such as the supply and demand, even if it was regarded as a speculative asset. Further, he found a strong relationship between investors' interest in the crypto-currency and the Bitcoin price. This was in line with the study by Ciaian, Rajcaniova, and Kancs (2016) who found that global macro-financial development factors had a significant impact on the price of Bitcoin in the short run. Some other studies found that Bitcoin was prone to cyber-attacks. According to Ciaian et al. (2016), Bitcoin exhibited vulnerability to cyber-attacks, more so than traditional currencies did. Several attacks had occurred over the recent years. Moore and Christin (2013) examined the records of 40 Bitcoin exchanges

and found that 18 were closed due to cyber-attacks. Thus, cyber-attacks could play a destabilizing role in the Bitcoin system (Bouoiyour & Selmi, 2015).

2.3. Bitcoin as digital gold

In recent years, Bitcoin was compared to gold both in the media and academia due to their similarities. Popper (2015) argued that Bitcoin could be referred to as the digital gold. Gold is widely regarded as a safe haven asset, as its value tends to rise when negative shocks affect markets. Previous studies examined the correlation between gold and other financial assets. Sherman (1986), McCown and Zimmerman (2006), Hillier, Draper, and Faff (2006) and Miyazaki and Hamori (2016) found evidence that the correlation between gold and other financial assets were low or even negative. Furthermore, the role of gold as a hedge against the dollar was analysed by Capie, Mills, and Wood (2005) who found evidence of exchange-rate hedging potential in gold.

Baur and Lucey (2010) analysed whether gold could act as a hedge, a diversifier or a safe haven for stocks and bonds in the US, UK and Germany. They found the first empirical evidence of gold being a hedge against stocks on average, and a safe haven in extreme stock market conditions. However, they did not find any results with regards to bonds. Hillier et al. (2006) discovered that precious metals, such as gold, silver and platinum exhibited hedging capability, particularly during periods of abnormal stock market volatility. Baur and McDermott (2010) extended the analysis by Baur and Lucey (2010) to include multi-country analyses, separating between developed and major emerging countries. They tested the safe haven effect across a broad cross-section of world stock markets, and showed that gold was both a hedge and a strong safe haven for developed markets, but not for emerging markets such as the BRIC countries.[1]

Despite the general reference of Bitcoin to digital gold, studies on whether Bitcoin could act as a hedge, a diversifier or a safe haven are relatively scarce. Popper (2015) argued that Bitcoin has many similarities as gold, in terms of its hedging capabilities and potential to act as a diversifier. Dyhrberg (2016b) showed that Bitcoin could be used as a hedge against the FTSE 100 index,[2] and as a hedge against the US dollar in the short term.

Bouri et al. (2017b) examined the hedging ability of Bitcoin against global uncertainty. Using wavelet-based quantile-in-quantile regressions, they assessed the extent to which Bitcoin could act as a hedge against movements in the return of various assets.[3] Their empirical results indicated that Bitcoin could serve as an effective diversifier, and as a hedge in just a few cases. Furthermore, Bitcoin could only serve as a strong safe haven against weekly extreme down movements in Asian stocks. Interestingly, their results suggested that Bitcoins hedging properties vary between regions and investment horizons.

Another study by Bouri et al. (2017a) examined the relationship between Bitcoin and commodities. The study focused on energy commodities, or electricity in particular, since it was an essential input in the Bitcoin production. They showed that Bitcoin exhibited hedge and safe haven properties for the general commodity index and for the energy commodity index, during the period from 2010 to 2015 and the pre-crash period. After the crash in December 2013, however, Bitcoin acted only as a diversifier.

In spite of the similarities between Bitcoin and gold as a hedge and a diversifier during economic uncertainty found in the above-mentioned studies, Klein et al. (2018) found that Bitcoin behaves the exact opposite of gold. Using BEKK-GARCH model, the authors found that conditional correlations between Bitcoin and other assets become positive with downward markets. Moreover, the authors found that hedging capabilities of Bitcoin in a portfolio context vary over time.

All in all, the literature to date provided mixed evidence on the usefulness of Bitcoin as a hedge, a diversifier or a safe haven. Moreover, findings in the literature suggest that the Bitcoin's

properties vary across regions and that certain useful properties of Bitcoin may emerge during certain short investment horizons.

3. Data and methodology

Our sample consists of 1,651 daily observations from 13 September 2011 to 1 January 2018. We focus on the largest developed and developing countries to represent viable investors' interests. In addition, we also include South Korea due to its importance for the Bitcoin market as it is currently the third-largest market in the world for Bitcoin trades,[4] and Zimbabwe as a representative African market where Bitcoin became the preferred currency due to unpredictable and unstable economic situations within the country. As a result, our sample includes the developed countries in G7, largest developing countries (BRIC), South Korea and Zimbabwe.

Closing spot prices for all stock indices are obtained from Thomson Reuters Datastream. Similar to Ciaian, Rajcaniova, & Kancs (2016) the Bitcoin daily price in US dollar is downloaded from Quandl using Bitstamp. The proxies for the equity markets in USA, UK, Japan, Italy, Germany, France, Canada, Brazil, Russia, India, China, South Korea and Zimbabwe are, respectively, the S&P 500, FTSE 100, Nikkei 225, FTSE MIB, Dax 30, CAC 40, S&PTSX 60, IBRX, MICEX 10, NIFTY 50, Shanghai A-Share, KOSPI, MSCI Zimbabwe. The equity indices are denominated in local currencies, and the Bitcoin price in US dollar is converted into local price using daily exchange rates obtained from Thomson Reuters Datastream.

Indices from MSCI are used to proxy the World, BRIC, Asia, Pacific and European stocks. Moreover, Standard & Poor's Goldman Sachs (SPGS) World Commodity Index, London Metal Exchange (LME), Merrill Lynch Commodity Index Extra (MLCX) Agriculture and MLCX Energy are proxies for the commodity markets—Oil, Gold, Cotton, Corn, Coffee and All Wheat. These regional indices and commodity prices are denominated in US dollar.

Table 1 shows that all commodities have a negative average return while the national and regional stock indices as well as Bitcoin exhibit a positive average return. Bitcoin has by far the highest volatility in terms of standard deviation, as well as the highest maximum and minimum values.

3.1. DCC-GARCH

DCC-GARCH is widely adopted in the hedge and safe haven literature for gold.[5] From the discussions in the literature section, we aim to capture the dynamic nature of Bitcoin as a hedge, a diversifier or a safe haven. There are other applicable models and techniques that could be employed for this purpose. For instance, rolling regression and exponential smoothing techniques could be used to compensate for the dynamic correlations (Ratner & Chiu, 2013). Engle (2002) states that rolling regression requires an ad hoc approach to determine window width, and does not track sudden changes in volatility. Although this approach can capture time variations in the correlation, it raises question as to the appropriate length for the rolling window. Moreover, our aim here is to be able to capture the sudden changes in the dynamics between the series. Fomby (2008) argues that exponential smoothing methods suffer from not having an objective statistical identification, and thus are ad hoc models. Moreover, Exponentially Weighted Moving Average (EWMA) models give inadequate volatility estimates due to the fixed weight of the parameters (Martin, 1998). Although EWMA gives more weight to the more recent volatility estimates than the distant ones, the use of similar weightings across different period may not be appropriate in this case as the literature showed that the properties of Bitcoin can change in certain periods (Bouri et al., 2017a, 2017b). Different types of multivariate GARCH models such as BEKK and the Constant Conditional Correlation (CCC) model are previously employed in the literature to assess hedge and safe haven capabilities of various assets, but as Bouri et al. (2017a) stated, these models may experience convergence problems and unreasonable parameter estimates. The CCC model is limited by the assumption of constant conditional correlation, and its incapability of capturing interactions among assets (Hafner

Table 1. Descriptive statistics this table reports descriptive statistics of daily returns from 13 September 2011 to 25 January 2018

	Mean	Max	Min	Std. Dev
Bitcoin (in USD)	0.0046	0.4848	−0.6639	0.0611
Developed markets				
USA	0.0005	0.0424	−0.0542	0.0082
UK	0.0002	0.0394	−0.0478	0.0089
Japan	0.0006	0.0743	−0.0825	0.0130
Italy	0.0003	0.0639	−0.1333	0.0156
Germany	0.0006	0.0534	−0.0707	0.0119
France	0.0004	0.0558	−0.0838	0.0120
Canada	0.0002	0.0424	−0.0381	0.0077
Developing markets				
Brazil	0.0004	0.0598	−0.0921	0.0129
Russia	0.0001	0.0691	−0.0990	0.0128
India	0.0005	0.0374	−0.0610	0.0094
China	0.0002	0.0560	−0.0887	0.0138
South Korea	0.0002	0.0490	−0.0590	0.0084
Zimbabwe	0.0005	0.1445	−0.2222	0.0193
Regional Indices				
World	0.0004	0.0438	−0.0503	0.0076
BRIC	0.0002	0.0587	−0.0722	0.0110
Asia	0.0003	0.0435	−0.0413	0.0088
Pacific	0.0003	0.0509	−0.0476	0.0096
Europe	0.0003	0.0585	−0.0918	0.0112
Commodities				
Oil	−0.0002	0.1129	−0.1113	0.0209
Gold	−0.0002	0.0543	−0.1016	0.0101
LME	−0.0001	0.0572	−0.0858	0.0114
Agriculture	−0.0003	0.0453	−0.0538	0.0094
World Commodities	−0.0002	0.0548	−0.0659	0.0115
Energy	−0.0002	0.1837	−0.1743	0.0173
Cotton	−0.0002	0.0556	−0.0713	0.0132
Corn	−0.0004	0.0738	−0.0793	0.0151
Coffee	−0.0005	0.1085	−0.0642	0.0198
All Wheat	−0.0003	0.0743	−0.0678	0.0162

& Reznikova, 2012). Moreover, Klein et al. (2018) showed that the conditional correlation between Bitcoin and other assets is dynamic rather than constant.

The DCC-GARCH is a generalization of Bollerslev (1990) CCC model, and allows the correlation to change over time, thus it captures the interactions among assets, and gives a superior measure for correlation (Cho & Parhizgari, 2008). Additionally, the model estimates the correlation coefficients of the standardized residuals and so accounts for heteroscedasticity directly (Chiang, Jeon, & Li, 2007). According to Engle (2002), a major advantage of the DCC-GARCH is that it has the flexibility of a univariate GARCH but not the complexity of a conventional multivariate GARCH, giving the model a computational benefit. In line with (Bouri et al., 2017a, 2017b) we estimate the pairs of return series separately.

The DCC model, which parameterizes the conditional correlations directly, is estimated in two steps: i) the estimation of the univariate GARCH (1,1) model, ii) the estimation of time varying conditional correlations using the standardized residuals generated from step i).

The model is defined as:

$$X_t = \mu_t + H_t^{1/2}\varepsilon_t \tag{1}$$

$$H_t = D_t R_t D_t \tag{2}$$

where $X_t = (X_{1t}, X_{2t}, \ldots X_{Nt})$ is a vector of past observations, H_t is the multivariate conditional variance, $\mu_t = (\mu_{1t}, \mu_{2t}, \ldots \mu_{Nt})$ is the vector of conditional returns, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \ldots \varepsilon_{Nt})$ is the vector of the standardized residuals, R_t is a correlation matrix containing the conditional correlations and D_t is a diagonal matrix of conditional time-varying standardized residuals (ε_t) that are obtained from the univariate GARCH (1,1) model with $\sqrt{h_{ii,t}}$ on the ith diagonal, $i = 1, 2, \ldots N$.

The DCC specification is defined as follows:

$$Q_t = (1 - \phi - \gamma)\bar{Q} + \gamma Q_{t-1} + \phi\sigma_{i,t-1}\sigma_{j,t-1} \tag{3}$$

where Q_t is the $N \times N$ time-varying covariance matrix of standardized residuals $(\sigma_{it} = (\varepsilon_{it}/\sqrt{h_{it}}))$ and $\bar{Q}$ is the unconditional correlations of $\sigma_{i,t}\sigma_{j,t}$, and ϕ and γ are non-negative scalar parameters that satisfies $\phi + \gamma < 1$.

Thus, the DCC between asset i and j is calculated by:

$$\rho_{ij,t} = \frac{(1 - \phi - \gamma)\bar{q}_{ij} + \phi\sigma_{i,t-1}\sigma_{j,t-1} + \gamma q_{ij,t-1}}{\left[(1 - \phi - \gamma)\bar{q}_{ii} + \phi\sigma^2_{i,t-1} + \gamma q_{ii,t-1}\right]^{1/2}\left[(1 - \phi - \gamma)\bar{q}_{jj} + \phi\sigma^2_{j,t-1} + \gamma q_{jj,t-1}\right]^{1/2}} \tag{4}$$

3.2. Diversifier, hedge and safe haven

To examine Bitcoin's capabilities as a diversifier, hedge and safe haven against movements in equity markets, regional indices and commodities, we follow the method used by Ratner and Chiu (2013) and Bouri et al. (2017a). Following the DCC-GARCH estimation, the pairwise dynamic conditional correlations between Bitcoin and each of the assets are extracted from Equation (3) into separate time series. DCC_t are regressed on dummy variables (D).

$$DCC_t = c_0 + c_1 D(r_{asset} q_1) + c_2 D(r_{asset} q_5) + c_3 D(r_{asset} q_{10}) \tag{5}$$

Where D represent extreme movements and are equal to one if the assets return exceeds a certain threshold given by the lower 1st, 5th and 10th percentile of the return distribution. Bitcoin is a diversifier against the other asset if c_0 is significantly positive, is a weak hedge against the other asset if c_0 is zero, or a strong hedge if c_0 is significantly negative, and is a weak safe haven if the parameters c_1, c_2 or c_3 are insignificantly different from zero, or a strong safe haven if they are significantly negative.

Then to further examine Bitcoin's capabilities as a safe haven against equity markets during times of global uncertainty, we use the dummy variable regression similar to the framework Baur and McDermott (2010) have used for gold. We select three specific events that caused global uncertainty and thus posed global effects during our sample period. The first event is the United States presidential election that took place on 8 November 2016. Mullen and Egan (2016) reported a drop in stock markets across the globe when the election results were coming in. For instance, Japan's Nikkei plummeted 5.4 percent while Hong Kong Hang Seng index fell by 2.2% when the election result was announced. The second event we examine is the Brexit referendum held on 23 June 2016. When it became clear that Britain

had voted to leave the European Union, UK's FTSE100 index dropped by 3.2 percent (Mullen & Egan, 2016), while France CAC dropped by 8 percent and Wall Street experienced its biggest one-day fall in 10 months (Wearden & Fletcher, 2016). Similarly, Japan's Nikkei suffered its biggest fall since the Fukushima disaster of 2011. Finally, the last event that created global uncertainty is the burst of market bubble in Chinese stock market on 12 June 2015. China had become the largest trading partner to many countries in the world including the EU, the US, Japan and South Korea, and the meltdown in China's market created potential ripple effects to the rest of the world. Shanghai A-Share lost about a third of its value after the stock market bubble burst on 12 June 2015 (Allen, 2015; Riley & Yan, 2015).

To investigate the role of Bitcoin during those events, we define an event period as the 40 trading days centered on the event date, i.e., covering approximately one month before and after an event. Then, for each of the periods we construct an indicator variable that takes a value one during the period and zero otherwise. Equation (6) shows the model estimated.

$$DCC_t = c_0 + c_1 D(TrumpElection) + c_2 D(Brexit) + c_3 D(ChinaTurbulence) \quad (6)$$

4. Empirical results

4.1. DCC-GARCH

Based on AIC and BIC, we find the DCC(1,1)-GARCH(1,1) model estimated with t-distribution is the best fit with our sample and can capture the fat-tailed behavior of the return distributions found in our sample.

4.2. Diversifier, hedge and safe haven capabilities of bitcoin

Table 2 shows the regression results from Equation (5).

4.2.1. Local investors' perspective

Panel A of Table 2 indicates that for the developed countries, Bitcoin cannot be regarded as a hedge, as all the coefficients (c_0) are positive and significant. This implies that Bitcoin is only an effective diversifier for investors in the developed market. Interestingly, we find evidence of Bitcoin being a strong hedge for investors in the developing markets especially for Russia, India and South Korea, and a weak hedge for Brazil. As such, it could be beneficial for investors with exposure to developing countries to include Bitcoin in their equity portfolios for hedging purposes. These findings show that the hedging capabilities of Bitcoin vary across regions. This supports our conjecture that the role of Bitcoin varies across regions and that it proves useful as a hedging tool for non-US investors. This could be due to the fact that the trust in the financial system and the government in the developing countries are less in comparison to that in the developed countries. Golam and Monowar (2015) stated that BRIC countries faced numerous challenges and uncertainties in the social, political, military and security sectors. The decentralized and independent nature of Bitcoin, on the other hand, gives Bitcoin the relative advantage over financial assets in gaining the trust from investors (Krause, 2016; Lunn, 2014).

As for safe haven capability, Bitcoin does not appear as a safe haven for majority of the countries. We find evidence of Bitcoin being a strong safe haven within the 1% stock quantile only for the US and Zimbabwe, and within the 5% stock quantile in the Indian stock market. These findings suggest that investors react quite similarly to shocks in the developed countries as in the developing countries. That is, in times of extreme market turmoil and uncertainty, investors with exposure to the stock market in the US, Zimbabwe and India sell stocks and buy Bitcoin. The most striking result that emerges is Bitcoins safe haven capabilities in Zimbabwe.[6]

4.2.2. US investors' perspective

Re-estimations of the model using returns in USD are summarized in Panel B of Table 3. The positive and significant coefficients c_0 indicate that Bitcoin acts only as an effective diversifier for

Table 2. Diversifier, hedge and safe haven capabilities of Bitcoin

	Hedge(c_0)	1% quantile(c_1)	5% quantile(c_2)	10% quantile(c_3)
Panel A: local investors' perspective				
Developed markets				
USA	0.01060***	−0.02655***	−0.00555	0.00331
UK	0.02989***	−0.00146	0.00140	−0.00049
Japan	0.05298***	0.00745	−0.00514	0.00030
Italy	0.01590***	0.00264	0.00220	0.00210
Germany	0.02933***	0.00394	0.00777	−0.00687
France	0.03475***	0.02247	0.00155	−0.00510
Canada	0.03928***	0.00505	−0.00012	−0.00187
Developing markets				
Brazil	−0.00078	−0.00479	−0.00234	0.00429
Russia	−0.02361***	0.00822	−0.00071	0.00026
India	−0.03971***	0.01328	−0.01297**	0.00895**
China	0.03762***	−0.00185	0.00292	−0.00220
South Korea	−0.03357***	−0.00662	0.00457	0.00191
Zimbabwe	0.01463***	−0.02792**	0.00470	−0.00181
Panel B: US investors' perspective				
Regional stock indices				
World	0.03036***	−0.02076***	−0.00063	0.00266
BRIC	0.05891***	−0.01540***	0.00150	−0.00304***
Asia	0.02877***	−0.00131	0.00029	−0.00018
Pacific	0.03089***	−0.00581***	−0.00058	−0.00116**
Europe	0.03868***	0.00653	0.00634**	−0.00466**
Commodities				
Oil	0.01074***	0.00160	−0.00551*	0.00436**
Gold	0.07261***	0.00154	−0.00318**	0.00175**
LME	0.07392***	−0.01916	0.01037	0.00216
Agriculture	0.02877***	−0.00112	−0.00085	0.00169***
World Commodity	0.02106***	−0.00289**	−0.00010	0.00074
Energy	0.02601***	−0.00057	0.00050	0.00017
Cotton	0.03303***	−0.00085	0.00293	−0.00140
Corn	0.02002***	−0.00394	0.00128	0.00151
Coffee	0.00189***	−0.00086	0.00353	−0.00134
All Wheat	0.01399***	−0.00669**	0.00084	−0.00091

This table reports the estimation results on the diversification, hedge and safe haven capabilities of Bitcoin from Equation (5). ***, **, * indicate statistical significance at the 1% level, 5% and 10% level, respectively.

the regional stock indices and commodities. One possible explanation for Bitcoin not being a hedge for any of the regional indices or commodities could be due to US dollar being the common currency denomination in those indices. As noted by Baur and McDermott (2010), a common currency denomination yields a greater co-movement compared to a case in which local currencies are used. The results here suggest that currency effect could have dominated the hedging effect. Another possible explanation could be that Bitcoin acted as an alternative for commodity investments. Investors generally invest in alternative investments such as commodities for hedging or diversification purposes (Hillier et al., 2006). With the introduction of Bitcoin, investors then have a wider choice of investment assets available within the asset class. Substitutability of Bitcoin

Table 3. Safe haven capability of Bitcoin

	Hedge(c_0)	US election(c_1)	Brexit(c_2)	China(c_3)					
Panel A: Entire period									
Developed markets									
USA	0.01204***	−0.03495***	−0.04217***	0.01010*					
UK	0.03030***	−0.00160	−0.00992**	−0.00456					
Japan	0.05462***	0.00218	−0.04248***	−0.03183***					
Italy	0.01553***	−0.00199	−0.00084	0.03165***					
Germany	0.03093***	−0.01438**	−0.03754***	−0.02305***					
France	0.03709***	−0.02392***	−0.05003***	−0.02934***					
Canada	0.03960***	−0.00447*	−0.00395	−0.01002***					
Developing markets									
Brazil	−0.00022	−0.00659	0.00009	−0.00500					
Russia	−0.02345***	−0.00100*	−0.00107**	−0.00100*					
India	−0.03919***	−0.00439	−0.00076	−0.00043					
China	0.03890***	−0.00368	−0.03311***	−0.01855***					
South Korea	−0.02930***	−0.04271***	−0.08096***	−0.03398***					
Zimbabwe	0.01430***	0.00819	−0.01313*	0.00883					
	Hedge	**US election**	**Brexit**	**China**	**Observations**	**R-squared**			
Panel B: Pre-crisis									
Developed markets									
USA	0.0109***	−0.0367***	−0.0321***	0.0279***	1,651	0.029			
UK	0.0301***	−0.00378	−0.0117**	0.000962	1,651	0.003			
Japan	0.0532***	0.0147**	−0.0216***	−0.0225***	1,651	0.018			
Italy	0.0155***	−3.20e-05	0.0167***	0.0450***	1,651	0.062			
Germany	0.0298***	−0.0156	−0.0423***	0.000855	1,651	0.013			

(*Continued*)

Table 3. (*Continued*)

France	0.0355***	−0.0263**	−0.0600***	0.00387	1,651	0.015			
Canada	0.0393***	−0.00630*	−0.00497	−0.00274	1,651	0.003			
Developing markets									
Brazil	−0.00041	−0.00363	0.00210	−0.00697	1,651	0.001			
Russia	−0.0231***	−0.000924	−0.000922	−0.000919	1,650	0.003			
India	−0.0393***	−0.00419	−0.000726	−0.00076	1,651	0.000			
China	0.0382***	0.00669	−0.0471***	−0.0185***	1,651	0.045			
South Korea	−0.0317***	−0.0616***	−0.0906***	0.0302**	1,651	0.049			
Zimbabwe	0.0146***	0.0143	−0.0193*	−0.0134	1,651	0.004			
Panel C: post-crisis									
Developed markets									
USA	0.0114***	−0.0313***	−0.0502***	−0.00623	1,651	0.032			
UK	0.0301***	0.000784	−0.00854	−0.0103*	1,651	0.003			
Japan	0.0541***	−0.00831	−0.0587***	−0.0408***	1,651	0.076			
Italy	0.0163***	−0.00468	−0.0189***	0.0172***	1,651	0.019			
Germany	0.0301***	−0.0115	−0.0302***	−0.0455***	1,651	0.019			
France	0.0360***	−0.0191	−0.0379***	−0.0611***	1,651	0.019			
Canada	0.0394***	−0.00199	−0.00266	−0.0170***	1,651	0.013			
Developing markets									
Brazil	−0.00032	−0.00944	−0.00292	−0.00347	1,651	0.001			
Russia	−0.0231***	−0.000881	−0.00100	−0.000839	1,650	0.003			
India	−0.0393***	−0.00489	−0.00161	−2.87e-05	1,651	0.000			
China	0.0381***	−0.0119**	−0.0164***	−0.0175***	1,651	0.012			
South Korea	−0.0310***	−0.0194	−0.0653***	−0.0968***	1,651	0.053			
Zimbabwe	0.0140***	0.00269	−0.00563	0.0314***	1,651	0.005			

(*Continued*)

Table 3. (*Continued*)

	Hedge	pre-US election	pre-Brexit	pre-China	post-US election	post-Brexit	post-China	Obs.	R-squared
Panel D: pre- and post-crisis									
Developed markets									
USA	0.0120***	−0.0378***	−0.0332***	0.0268***	−0.0318***	−0.0507***	−0.00678	1,651	0.062
UK	0.0303***	−0.00401	−0.0120**	0.000728	0.000592	−0.00873	−0.0105*	1,651	0.006
Japan	0.0546***	0.0133**	−0.0229***	−0.0239***	−0.00873	−0.0592***	−0.0413***	1,651	0.095
Italy	0.0155***	−8.38e-05	0.0167***	0.0449***	−0.00391	−0.0181***	0.0179***	1,651	0.080
Germany	0.0309***	−0.0167*	−0.0435***	−0.000271	−0.0123	−0.0310***	−0.0463***	1,651	0.033
France	0.0371***	−0.0278**	−0.0615***	0.00235	−0.0202	−0.0390***	−0.0622***	1,651	0.035
Canada	0.0396***	−0.00658*	−0.00525	−0.00301	−0.00218	−0.00284	−0.0172***	1,651	0.017
Developing markets									
Brazil	−0.00020	−0.00383	0.00190	−0.00717	−0.00955	−0.00304	−0.00359	1,651	0.002
Russia	−0.0230***	−0.00096	−0.00096	−0.00095	−0.00092	−0.00104	−0.00088	1,650	0.006
India	−0.0392***	−0.00428	−0.00081	−0.00085	−0.00496	−0.00169	−0.00010	1,651	0.000
China	0.0388***	0.00608	−0.0477***	−0.0191***	−0.0126**	−0.0172***	−0.0183***	1,651	0.058
South Korea	−0.0294***	−0.0640***	−0.0929***	0.0278**	−0.0210*	−0.0669***	−0.0985***	1,651	0.104
Zimbabwe	0.0143***	0.0146	−0.0190*	−0.0131	0.00247	−0.00585	0.0312***	1,651	0.009

This table presents the estimation results on the safe haven capability of Bitcoin from Equation (6) during the period leading up to and after the date of crisis. Pre-crisis is the 20 trading days leading up to the date of crisis, while post-crisis is the 20 trading days following the date of crisis. ***, **, * indicate statistical significance at the 1% level, 5% and 10% level, respectively.'

for other commodities, such as gold, for hedging and diversification purposes might have explained the positive coefficients values of c_0 observed in Panel B of Table 2.

As for safe haven capabilities, we find statistical evidence of Bitcoin being a strong safe haven for World, BRIC and Pacific countries in the 1% quantile. Additionally, Bitcoin is a strong safe haven in the 10% quantile for European countries. Moreover, Bitcoin cannot be regarded as a strong safe haven for most of the commodities, with exception for the World commodity index (in the 1% quantile), All wheat (in the 1% quantile) and gold (in the 5% quantile). Surprisingly, and in contradiction to earlier findings (Bouri et al., 2017a), we find that Bitcoin is a strong safe haven for gold within 5% quantile at a 5% significance level.

4.3. Safe haven capabilities of Bitcoin in times of crisis

Table 3 reports results from pre- and post-crisis periods individually and then together.[7]

4.3.1. United States presidential election

Table 3 shows that during the US presidential election period, Bitcoin acted as a strong safe haven for USA, France and South Korea, but as Panels A and B together show, except for the US, those benefits are observed only in the days leading up to the event date. This suggests that Bitcoin acted as a safe haven when uncertainties built up in the days leading up to the US presidential election.

4.3.2. Brexit

Table 3 shows that Bitcoin is a strong safe haven for USA, UK, Japan, Germany, France, China and South Korea, and a weak safe haven for all other countries around the Brexit referendum date. High levels of uncertainty and turmoil related to the referendum serves as an explanation for this. In pre-Brexit, it was uncertain the outcome of the referendum, while post-Brexit is characterized by uncertainty regarding the consequences of the referendum outcome.

4.3.3. Chinese stock market turbulence

Chinese stock market bubble popped on 12 June 2015 and led to major repercussions in the aftermath. This crisis is of a different nature compared to the other two, which were of a political essence. As expected, we do not find much results of significance in the pre-crisis period in Table 3. However, in the post-period, we find statistical evidence of Bitcoin being a strong safe haven for Japan, Germany, France, Canada, China and South Korea. Moreover, for the same period, Bitcoin acts only as a weak safe haven for USA, UK, Brazil, Russia and India.

4.3.4. Robustness

As a robustness test, we re-estimate Equation (6) where the pre- and post-crisis indicator variables are replaced by one single crisis indicator—first for Trump election, then for Brexit and finally for Chinese market crash. The indicator variable takes on the value 1 for the 20 days following the defined crisis date and 0 for the 20 days prior to the crisis date. This indicator variable will capture the changing role of Bitcoin, if there is any, around the particular crisis dates. The results summarized in Table 4 support the results presented in Table 3.[8]

As a further robustness test, we re-estimated Panels B through D of Tables 3 and 4 using BEKK-GARCH(1,1) method with t-distribution, instead of DCC. The results for safe haven properties of Bitcoin from the re-estimation are qualitatively similar to those from DCC-GARCH(1,1). Thus, they are not reported here but are available upon request.

5. Conclusions

This paper investigates the diversification, hedging and safe haven capabilities of Bitcoin in the financial markets across various markets and regions. We extend previous literature by distinguishing between developed and developing markets, as well as capturing the non-US investors' perspectives.

Table 4. Safe haven capability of Bitcoin with crisis dummy

	Hedge	US election	Brexit	China	Observations	R-squared
Panel A: Developed markets						
USA	−0.0259***	0.00600***			40	0.229
	−0.0212***		−0.0175***		40	0.181
	0.0388***			−0.0336***	40	0.374
UK	0.0263***	0.00461			40	0.013
	0.0183**		0.00324		40	0.003
	0.0310***			−0.0113	40	0.043
JAPAN	0.0679***	−0.0221***			40	0.763
	0.0316**		−0.0362*		40	0.095
	0.0307***			−0.0174**	40	0.154
ITALIA	0.0155***	−0.00383***			40	0.384
	0.0322***		−0.0348***		40	0.641
	0.0605***			−0.0270***	40	0.630
GERMANY	0.0141**	0.00449			40	0.006
	−0.0126		0.0125		40	0.012
	0.0306***			−0.0460***	40	0.267
FRANCE	0.00925	0.00758			40	0.011
	−0.0244		0.0225		40	0.025
	0.0394***			−0.0645***	40	0.239
CANADA	0.0330***	0.00440**			40	0.110
	0.0343***		0.00240		40	0.009
	0.0366***			−0.0142**	40	0.136
Panel B: Developing markets						
BRAZIL	−0.00403	−0.00572			40	0.005
	0.00169		−0.00493		40	0.019
	−0.00737			0.00358	40	0.006
RUSSIA	−0.0240***	4.25e-05***			40	0.212
	−0.0240***		−8.30e-05***		40	0.722
	−0.0240***			7.87e-05***	40	0.294
INDIA	−0.0435***	−0.000685			40	0.000
	−0.0400***		−0.000876		40	0.000
	−0.0400***			0.000741	40	0.000
CHINA	0.0449***	−0.0187***			40	0.347
	−0.00882		0.0305**		40	0.098
	0.0198***			0.000780	40	0.000
SK	−0.0934***	0.0430***			40	0.258
	−0.122***		0.0260		40	0.019
	−0.00158			−0.126***	40	0.657
ZIMBABWE	0.0289***	−0.0121*			40	0.083
	−0.00469		0.0131**		40	0.105
	0.00117			0.0443***	40	0.644

This table presents the estimation results on the safe haven capability of Bitcoin from Equation (6) with crisis dummy where the dummy takes the value 1 for the 20 trading days after the defined start date of crisis, and zero for the 20 trading days before the defined start date of crisis. ***, **, * indicate statistical significance at the 1% level, 5% and 10% level, respectively.

We find evidence of a qualitative difference between developed and developing markets with regards of Bitcoin's capability as a hedge. Bitcoin acts as a strong hedge for investors in most of the developing markets, but only as an effective diversifier for investors in the developed markets, regional indices and commodities. We also find that Bitcoin is a strong safe haven for only a few national equity indices, regional indices and commodities. In most cases we do not find any evidence of Bitcoin being a strong safe haven. Also, we do not find a difference in the reaction of investors to shocks in the developed markets and the reaction of investors to shocks in the developing markets. However, focusing on the three extremely uncertain periods, we find that Bitcoin is either a strong or a weak safe haven for most of the countries. The results suggest that Bitcoin is highly suitable as a safe haven asset in certain periods of high uncertainty.

Overall, our findings have implications for investors who seek protection from downward movements in equity and commodity markets. As such, investors with exposure to equity and commodities could benefit from having a position in Bitcoin in times of extreme uncertainty. Furthermore, our findings could be of interests to regulators and governments to engage in more discussion of the role of Bitcoin in financial markets. However, one needs to be cautious in considering Bitcoin as safe haven due to its lack of liquidity and high volatility nature. The absence of sufficient liquidity makes it challenging to transfer funds between Bitcoin and financial product (such as stocks and commodities).

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Notes

1. Developed countries consists of the G7 countries, emerging markets consists of the BRIC countries, as well as Australia and Switzerland.
2. FTSE 100 is based on the market capitalization of the 100 largest companies listed on the London Stock Exchange .
3. They include stock indices from US, UK, Germany, Japan and China as well as regional indices that proxies the World, Europe and the Pacific. They also include a Bond index, US dollar index, oil, gold and a general commodity index.
4. Japan is the biggest market in the world for Bitcoin trades, followed by USA and South Korea. See: https://www.coinhills.com/market/currency/.
5. For instance, see among Bouri et al. (2017a, 2017b), Lucey and Li (2015), Ratner and Chiu (2013).
6. During the 2017 Zimbabwean coup d'état when the political uncertainty was extreme, investors sought refuge in Bitcoin from the faltering economy (Brand, Latham, & Marawanyika, 2017; Monks, 2017; Titcomb, 2017).
7. As a robustness, we re-estimate Equation (6) where the pre- and post-crisis indicator variables are replaced by one single crisis indicator—first for Trump election, then for Brexit and finally for Chinese market crash. Results, not reported here, are qualitatively similar.
8. We also re-estimate Table 2 after winsoring all continuous variables at 1 percent on both tails. The results are qualitatively similar and are available upon request.

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