On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier?

(preliminary and incomplete)

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Abstract

This paper uses a dynamic conditional correlation model in order to study Bitcoin as a possible hedge and safe haven for major world equity indices, bonds, oil, gold, general commodity indices and US dollars. Strictly speaking, Bitcoin is a poor hedge for most of the indices under study. However, the magnitude of this effect is rather low and from a practical perspective Bitcoin is therefore suitable for diversification purposes. Bitcoin can only serve as a strong safe haven against extreme downward movements in Asian stocks. Interestingly, empirical results imply that Bitcoin can be regarded as a digital commodity, because from all the studied assets it is most strongly related to commodities.

Keywords: Bitcoin, cryptocurrency, diversification, safe heaven, hedging

1. Introduction

Bitcoin is a digital currency first introduced by Satoshi (2009). Its most unique feature is that there is no central authority guaranteeing it or having control over it, as central banks are for conventional currencies. Bitcoin is fully decentralized and depend on a sophisticated protocol. Another unique feature of bitcoin is the fact that the supply is limited by the design of this protocol. Since its introduction in 2009, the value of bitcoin grew rapidly, and as of the end of 2015, its market capitalization exceeds 6 billion USD (coinmarketcap.com). The principles of Bitcoin are explained in Becker et al (2013), Segendorf (2014), Dwyer (2014) and at bitcoin.org.

Due to the growing interest in Bitcoin, it has started to be investigated by economics and finance researchers. Rogojanu and Badea (2014) and Shubik (2014) compare Bitcoin to other alternative monetary systems. However, according to Yermack (2013), Bitcoin appears to behave more like a speculative investment than a currency, because its market capitalization is high compared to the economic transactions it facilitates.

Even though Bitcoin is highly volatile (Molnár, Vagstad and Valstad, 2015), its inclusion into diversified portfolio is highly profitable, see Halaburda and Gandal (2014), Brière, Oosterlinck and Szafarz (2013) and Eisl, Gasser, and Weinmayer (2015). Since the average return of Bitcoin over its existence is extremely high, it is not surprising that it would be beneficial to have Bitcoin included in the portfolio. However, it seems unreasonable to expect that Bitcoin returns will remain as high as they were in the past. Therefore it is interesting to study Bitcoin from a perspective where past average return does not play crucial role.

An asset might be suitable for investment from a risk perspective. If the asset is negatively correlated with another asset, putting them together decreases risk significantly. In line with Baur and Lucey (2010) and Ratner and Chiu (2013), we differentiate between a diversifier, hedge and safe haven. A diversifier is an asset that has a weak positive correlation with another asset on average. A weak (strong) hedge is an asset that is uncorrelated (negatively correlated) with another asset *on average*. A weak (strong) safe haven is an asset that is uncorrelated (negatively correlated) with another asset on average during times stress. Since gold has been traditionally considered a hedge and safe heaven, these concepts have previously been applied mostly to gold

(Baur and McDermott, 2010; Baur and Lucey, 2010). However, it was recently also applied to credit default swaps, see Ratner and Chiu (2013).

Bitcoin is an alternative to mainstream currencies. Sometimes it is even considered as a part of an alternative economy. If some investors lose trust to mainstream currencies, or to the whole economy, they might resort to Bitcoin. This is one of the reasons why bitcoin has sometimes been called digital gold (Popper, 2015). However, research investigating Bitcoin as a diversifier, hedge, or safe heaven is extremely limited. We are aware only of Dyhrberg (2015), who studies how Bitcoin is related to USD/EUR and USD/GBP exchange rates and to the FTSE stock index.

We therefore investigate this topic in detail. Since it is not clear to which asset Bitcoin should be related, we study various assets. With a more explicit modeling technique, our findings complement the findings of Dyhrberg (2015) by assessing to which extent Bitcoin can act as a hedge and/or safe haven against movements in the price of several assets.

The rest of the paper is organized as follows. Section 2 describes the data, section 3 explains the method, section 4 presents the results and section 5 concludes.

2. Data and preliminary analysis

The dataset we investigate consists of price index values for Bitcoin and several financial assets that include stocks, bonds, currencies, and commodities from 18th July 2011 to 22nd December 2015. Time span is constrained by availability of Bitcoin prices. We use daily and weekly prices obtained from Thomson Reuters DataStream. For each time series we have 1133 daily observation and 226 weekly observations.

The proxy for Bitcoin prices is the exchange rate of Bitcoin to USD from the Bitstamp marketplace, since it is one of the largest bitcoin exchanges (Brandvold, Molnár, Vagstad and Valstad, 2015). Bitstamp is a UK based exchange and it is considered to be a rather safe exchange by market participants around the world. The historical Bitcoin price is plotted in Figure 1.

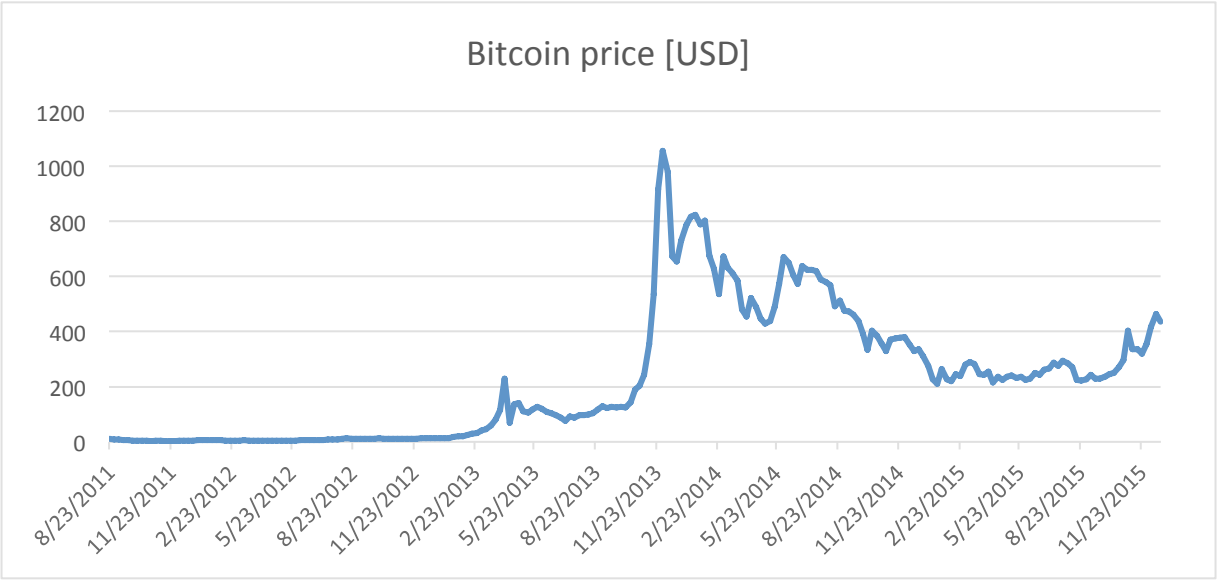

Figure 1. Evolution of the Bitcoin price.

Table 1. Summary statistics of daily returns. Notes: Bitcoin prices are represented by the exchange rate of Bitcoin to USD form the Bitstamp marketplace, US stocks are represented by the S&P 500 index, UK stocks are represented by the FTSE 100 index, German stocks are represented by the DAX 30 index, Japanese stocks are represented by the Nikkei 225 average, Chinese stocks are represented by the Shanghai A-share index, international stocks are represented by the MSCI World index, European stocks are represented by the MSCI Europe index, Asian Pacific stocks are represented by the MSCI Pacific index, bonds are represented by the Pimco Investment Grade Corporate Bond Exchange-Traded Fund index, the performance of the US currency is represented by the dollar index, commodities are represented by the SPGS commodity index, the oil market is represented by Crude oil spot prices, and the gold market is represented by the gold spot price per ounce.

	Mean (%)	Maximum	Minimum	Std. Dev. (%)	Skewness	Kurtosis
Bitcoin	0.35	0.48	-0.66	6.80	-1.14	23.06
S&P 500	0.05	0.04	-0.04	0.90	-0.18	5.43
FTSE 100	0.02	0.04	-0.05	0.90	-0.16	5.59
DAX 30	0.06	0.05	-0.05	1.30	-0.03	4.84
Nikkei 225	0.07	0.07	-0.08	1.30	-0.32	5.94
MSCI China	0.03	0.06	-0.09	1.50	-0.91	9.28
MSCI World	0.03	0.04	-0.04	0.80	-0.26	6.64
MSCI Europe	0.02	0.06	-0.06	1.20	-0.11	6.28
MSCI Pacific	0.01	0.05	-0.05	1.00	-0.28	4.83
Bond Index	0.00	0.01	-0.04	0.30	-1.87	23.18
US dollar index	0.02	0.02	-0.02	0.50	-0.04	4.93
Commodity Index	-0.08	0.05	-0.07	1.10	-0.16	6.39
Oil	-0.10	0.10	-0.09	1.60	0.17	7.37
Gold	-0.05	0.05	-0.10	1.10	-1.04	11.90

The stock market index for the US, UK, Germany, Japan, and China respectively is the S&P 500, FTSE 100, DAX 30, Nikkei 225, and Shanghai A-share. As a proxy for World, European, and Asian Pacific stocks, we use three regional and international benchmarks from Morgan Stanley Capital International (MSCI) indices. The US dollar index, which tracks the performance of the USD against a basket of major foreign currencies, is used a proxy for the currency market. The proxy for the commodity market and the overall bond market respectively is Standard & Poor's Goldman Sachs (SPGS) commodity index and the Pimco Investment Grade Corporate Bond Index Exchange-Traded Fund. We also consider Brent Crude oil and gold spot prices.

For each price index, the continuously compounding return is computed as the first difference of the logarithm of closing prices. Table 1 shows summary statistics of return series for the examined variables.

Table 2. Summary statistics of weekly returns. Bitcoin prices are represented by the exchange rate of Bitcoin to USD form the Bitstamp marketplace, US stocks are represented by the S&P 500 index, UK stocks are represented by the FTSE 100 index, German stocks are represented by the DAX 30 index, Japanese stocks are represented by the Nikkei 225 average, Chinese stocks are represented by the Shanghai A-share index, international stocks are represented by the MSCI World index, European stocks are represented by the MSCI Europe index, Asian Pacific stocks are represented by the MSCI Pacific index, bonds are represented by the Pimco Investment Grade Corporate Bond Exchange-Traded Fund index, the performance of the US currency is represented by the dollar index, commodities are represented by the SPGS commodity index, the oil market is represented by Crude oil spot prices, and the gold market is represented by the gold spot price per ounce.

	Mean (%)	Maximum	Minimum	Std. Dev. (%)	Skewness	Kurtosis
Bitcoin	2.41	0.70	-1.21	16.00	-1.20	21.20
S&P 500	0.23	0.05	-0.12	1.90	-1.26	9.16
FTSE 100	0.05	0.07	-0.07	2.00	-0.16	3.99
DAX 30	0.27	0.08	-0.07	2.60	-0.26	3.32
Nikkei 225	0.37	0.10	-0.14	3.00	-0.58	5.68
MSCI China	0.18	0.10	-0.17	3.40	-1.06	7.80
MSCI World	0.15	0.06	-0.10	1.90	-0.81	6.00
MSCI Europe	0.08	0.07	-0.07	2.40	-0.04	3.68
MSCI Pacific	0.07	0.07	-0.10	2.10	-0.70	5.26
Bond Index	-0.01	0.02	-0.04	0.70	-1.11	7.61
US dollar index	0.11	0.03	-0.03	1.00	0.11	3.54
Commodity Index	-0.41	0.08	-0.07	2.50	-0.07	4.22
Oil	-0.53	0.16	-0.11	3.80	0.16	5.85
Gold	-0.23	0.06	-0.13	2.20	-1.02	7.78

As shown in Table 1, the summary statistics of daily returns indicates that Bitcoin has by far the highest levels of the mean and volatility. All the return series are found to be leptokurtic and have a negative skewness. As for the summary statistics of weekly returns, Table 2 also shows

that kurtosis of some assets (bond ETF and gold) is significantly decreased, but the kurtosis of Bitcoin remains high.

3. Method

This section describes the econometric modeling procedure we use to assess the hedge and safe haven properties of Bitcoin. First we present the bivariate asymmetric DCC model of Engle (2002) that we use to estimate the dynamic conditional correlation between the return series. Then, we then present the regression that we employ to assess the hedge and safe haven properties of Bitcoin against stocks, bonds, currency, and commodities.

Dynamic conditional correlations

Unlike other multivariate GARCH models such as the BEKK (Baba-Engle-Kraft-Kroner) and the constant conditional correlation (CCC) models that may experience convergence problems and unreasonable parameters estimates, the dynamic conditional (DCC) model of Engle (2002) has the ability to capture the time-varying and dynamic relationship across return series with less computational complications (Cho and Parhizgari, 2008). In this sense, the DCC model is used to parametrize the conditional correlation directly and has the flexibility of a univariate GARCH model (Engle, 2002). For the purpose of this study and given the large number of return series, the DCC model is estimated for pairs of return series separately and not for all the return series simultaneously. In doing so, a small possibility of getting biased estimates of parameters in higher dimensions will be prevented (Hafner and Reznikova, 2012).

The estimation of the bivariate DCC model is carried out in two steps. In the first step, a univariate GARCH (1,1) model is estimated. In the second, a time-varying correlation matrix is computed using the standardized residuals from the first-stage estimation.

The mean equation of the DCC model is specified as:

$$r_t = \mu_t + \omega\, r_{t-1} + \varepsilon_t \quad (1)$$

where r_t is the vector of the price return of Bitcoin and that of the other asset, μ_t is the conditional mean vector of r_t, and ε_t is a vector of residuals. The variance equation is specified as:

$$h_t = c + a\, \varepsilon^2_{t-1} + b\, h_{t-1} \quad (2)$$

where h_t is the conditional variance; c is the constant; a is the parameter that captures the short run persistence or the ARCH effect; b represents the long run persistence of volatility or the GARCH effect.

The DCC(1,1) equation is given by Q_t which is a square positive-definite matrix such as:

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha\, \varepsilon_{t-1}\varepsilon'_{t-1} + \beta\, Q_{t-1} \quad (3)$$

where Q_t is the time-varying unconditional correlation matrix of ε_t; ε_t is a vector of standardized residuals obtained from the first step estimation of the GARCH(1,1) process; α and β are parameters that represent, respectively, the effects of previous shocks and previous dynamic conditional correlations on current dynamic conditional correlation [1].

The dynamic conditional correlation between assets *i* and *j* is calculated by:

$$\rho_{ij,t} = \frac{q_{ij,t}}{(\sqrt{q_{ii,t}}\sqrt{q_{jj,t}})} \quad (4)$$

Hedge and safe haven

To assess the extent to which Bitcoin can be considered as hedge and/or safe haven against different financial assets, we follow the method used by Ratner and Chiu (2013). First are the dynamic conditional correlations extracted from the DCC model into separate time series and then regressed on dummy variables (D) representing extreme movements in the lower 10th, 5th or 1st percentile of the return distribution.

$$DCC_t = m_0 + m_1 D(r_{other\ asset}\ q_{10}) + m_2 D(r_{other\ asset}\ q_5) + m_3 D(r_{other\ asset}\ q_1) + v_t \quad (5)$$

Where DCC is the pairwise conditional correlation between Bitcoin and each of the other asset under study, $r_{other\ asset}$ is the return of each of the other asset and v_t is the error term. Bitcoin is a weak hedge against movements in the other asset if m_0 is zero or a strong hedge if m_0 is negative. Bitcoin is a weak safe haven against movements in the other asset if the m_1, m_2, or m_3 coefficients are not significantly different from zero, or a strong safe haven if these coefficients are negative.

[1] For a detailed explanation on the GARCH DCC model and its estimation the reader can refer to Engle (2002).

4. Results

The DCC model

In the DCC model, an autoregressive (AR) specification of the mean Equation (1) is estimated to capture the autocorrelation of the residuals. Specification results based on the Schwarz information criteria indicated that an AR(1) model was sufficient to eliminate the substantial degree of autocorrelation in the returns. As for the optimal number of lags for the estimation of the univariate variance process, the GARCH (1,1) was found to be the best fit. Following the same logic, a comparison of the likelihood values across alternative lag specifications implies that the DCC (1,1) is the best choice.

It is worth noting that for all cases, most of the coefficients in the mean, variance, and DCC equations are significant at 5% significance level. In the variance equation, the sum of the ARCH and GARCH parameters are close to one, suggesting that the high degree of persistence in the variance process. Furthermore, diagnostics tests show that the selected model is well fitted, given that no problem of autocorrelation or heteroscedasticity remained in the return series. However, we do not elaborate on the DCC results, which are not presented here but are available from the authors. The initial purpose of DCC modeling was not to derive estimates of the equations but to extract the pairwise dynamic conditional correlations in order to use them for assessing the hedge and safe haven properties of Bitcoin against several financial assets (see Equation 5).

Hedge and safe haven properties of Bitcoin

Following the estimation of the DCC model, the pairwise dynamic conditional correlations are generated into separate time series and then used to assess the hedge and safe haven properties of Bitcoin. For example, the series of the DCC between Bitcoin and the S&P 500 is regressed on a constant (m_0) and three dummy variables (m_1, m_2, m_3) representing extreme movements in US stocks in the negative 10th, 5th, and 1st quantiles of the return distribution. Table 3 presents the coefficient estimates from the regression model specified in Equation (5) for daily data and Table 4 for weekly data.

Table 3. Estimation results on hedge and safe haven properties of Bitcoin for daily data. This table presents the estimation results from equation (5); ***,**,* indicate statistical significance at 1%, 5% and 10% levels respectively.

	10% quantile (m_1)	5% quantile (m_2)	1% quantile (m_3)	Hedge (m_0)
S&P 500	0.0013	-0.0022	-0.0011	0.0083***
FTSE 100	-0.0005	0.0006	0.0007	0.0026***
DAX 30	-0.0024	-0.0001	0.0022	0.0316***
Nikkei 225	-0.0002	0.0008	0.0050	-0.0049***
MSCI China	-0.0065	0.0339	-0.0476	0.0348***
MSCI World	0.0002	0.0031	0.0005	0.0075***
MSCI Europe	0.0002	0.0008	0.0018	0.0101***
MSCI Pacific	0.0006	0.0013	0.0079***	-0.0061***
Bond Index	0.0004	0.0000	0.0004	0.0022***
US dollar index	-0.0009	-0.0003	-0.0004	0.0074***
Commodity Index	0.0006	-0.0005	0.0003	-0.0242***
Oil	0.0021*	-0.0016	-0.0011	0.0116***
Gold	-0.0018	-0.0031	-0.0014	0.0434***

Following the definitions of a diversifier, hedge and safe haven, we report the following results of daily and weekly analyses.

Daily analysis:

Results from Table 3 show that Bitcoin is a strong hedge against movements in Japanese and Asian Pacific stocks as well as against movements in commodities. As for a potential safe haven role, Bitcoin cannot be regarded as a weak or strong safe haven against extreme movements in any of the assets under study. However, the positive and significant coefficients (m_3) for the case of Asian Pacific stocks and (m_1) for the case of oil only indicate that Bitcoin is no more than an effective diversifier, respectively, in the 1% and 10% quantiles of the return distribution.

In the same sense, it is worth mentioning that significant and positive coefficients on the constant term do not indicate that Bitcoin is a weak hedge. For example, the significant and positive coefficient of 0.0083 indicates that Bitcoin is not a weak hedge against movements in the US stock market, but only an effective diversifier.

Table 4. Estimation results on hedge and safe haven properties of Bitcoin for weekly data. This table presents the estimation results from equation (5); ***,**,* indicate statistical significance at 1%, 5% and 10% levels respectively.

	10% quantile (m_1)	5% quantile (m_2)	1% quantile (m_3)	Hedge (m_0)
S&P 500	0.0009	-0.0012	-0.0060	0.0952***
FTSE 100	0.0020*	-0.0013	0.0042	0.0423***
DAX 30	0.0086	-0.0164	0.2860***	0.1092***
Nikkei 225	-0.0346	0.1297	0.1837	-0.0206
MSCI China	0.0145	-0.0424**	0.0544*	-0.0549***
MSCI World	0.0022	-0.0016	-0.0067*	0.0546***
MSCI Europe	0.0219	0.0247	-0.0499	0.0961***
MSCI Pacific	-0.2104***	0.1721	0.4138	0.0069
Bond Index	0.0027	0.0009	0.0078	0.0279***
US dollar index	-0.0019	0.0830	-0.0838	0.1016***
Commodity Index	0.0206	0.1432	-0.1673	0.1639***
Oil	-0.0493*	0.0752*	0.1407**	0.0992***
Gold	-0.0579	0.0851	0.0173	0.0719***

Weekly analysis:

Results from Table 4 show that Bitcoin is a strong hedge only against movements in Chinese stocks; whereas significant and positive coefficients on (m_0) only indicate that Bitcoin acted as an effective diversifier against the remaining indices under study, except for the case of Japanese and Asian Pacific stocks. Regarding the safe haven role of Bitcoin, estimation results clearly indicate that Bitcoin can be regarded as a strong safe haven against extreme movements in Chinese stocks (in the 5% quantile), World stocks (in the 1% quantile), Asian Pacific stocks and crude oil (in the 10% quantile).

From a simple comparison between daily and weekly results, we imply that the speculative nature of Bitcoin (Yermack, 2013) seems to undermine the *daily* safe haven property of Bitcoin to the detriment of it *weekly* property. It is also interesting to notice the relatively high positive correlation between Bitcoin and the commodity index, suggesting that Bitcoin is somewhat of a digital commodity. This is in line with the findings of Selgin (2015).

5. Conclusion

In this paper we studied how Bitcoin is related to other assets, in particular to major world equity indices, bonds, oil, gold, general commodity index and US dollar. Our main focus was whether Bitcoin can serve as hedge or safe haven for these indices. Our overall result is that Bitcoin can serve as an effective diversifier for most of the cases, whereas it can act as a strong hedge and safe haven in just few cases. Moreover, since Bitcoin is connected to all the studied indices only very weakly, our results suggest that traditional investors haven't started considering Bitcoin as an investment opportunity. Despite the importance of our empirical results to market participants, a word of caution is warranted regarding the liquidity of Bitcoin. First, Bitcoin investments are far less liquid than conventional assets and their accessibility to individual investors can improve a lot with potential emergence of related funds and financial derivatives. Second, the tranquil nature of the sample period under study may inappropriately imply that the diversification ability of Bitcoin are constant over time. This open the door for further studies on the time-varying nature of the diversifier, hedge, and safe haven of Bitcoin.

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