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Safe haven or risky hazard? Bitcoin during the Covid-19 bear market

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ABSTRACT

The Covid-19 bear market presents the first acute market losses since active trading of Bitcoin began. This market downturn provides a timely test of the frequently expounded safe haven properties of Bitcoin. In this paper, we show that Bitcoin does not act as a safe haven, instead decreasing in price in lockstep with the S&P 500 as the crisis develops. When held alongside the S&P 500, even a small allocation to Bitcoin substantially increases portfolio downside risk. Our empirical findings cast doubt on the ability of Bitcoin to provide shelter from turbulence in traditional markets.

1. Introduction

Bitcoin has been proposed as a safe haven for traditional assets for many reasons, including independence from monetary policy, a role as a store of value and limited correlation with traditional assets.[1] While many of these arguments are compelling, empirical tests of the safe haven properties of Bitcoin have been devoid of a central component, a severe financial markets crisis. In this paper, we provide a first assessment of the safe haven properties of Bitcoin during a period of significant turmoil in financial markets, the Covid-19 bear market.[2] Specifically, we examine whether an investor with a proportion of wealth allocated to Bitcoin can reduce their exposure to downside risk relative to a portfolio consisting only of equities.

Investor loss aversion implies a greater sensitivity to acute losses than gains and has been demonstrated in experimental settings (Tversky and Kahneman, 1991). Such loss aversion leads to alterations in optimal portfolio choice (Berkelaar et al., 2004) and may prompt investors to seek out safe haven investments such as gold (Conlon et al., 2018; Bredin et al., 2015; Baur and Lucey, 2010).[3] In recent years, the growing popularity of cryptocurrencies has inspired numerous studies of their diversification, hedging and safe haven properties (Urquhart and Zhang, 2019; Smales, 2019; Shahzad et al., 2019; Kliber et al., 2019; Guesmi et al., 2019; Aysan et al., 2019; Corbet et al., 2018b; Bouri et al., 2017b). The ongoing Covid-19 pandemic and associated financial turbulence has led to a profusion of working papers, some examining cryptocurrency implications (Alfaro et al., 2020; Corbet et al., 2020a; 2020b; Jabotinsky and Sarel, 2020; Jana and Das, 2020). Goodell (2020), in particular, sets out a research agenda highlighting possible impacts of COVID-19 on financial markets and institutions. We build upon the previous literature by providing an assessment of the safe haven properties of Bitcoin for a traditional asset during a period of acute price decreases in equity markets.

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[1] Klein et al. (2018) suggest that Bitcoin has been referred to as the *new gold*, highlighting its role as an investment asset.

[2] While we acknowledge that the period we consider, up to 20th March 2020, may not be the conclusion of the decline in asset prices, the study is concerned with the ability of Bitcoin to preserve wealth. In this sense, a downward move of more than 20% in the stock market provides strong evidence regarding any possible safe haven properties.

[3] Baur and Lucey (2010) define a safe haven as an asset which is uncorrelated with stocks and bonds during a market crash.

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Diversification benefits across assets have been shown to decrease in times of high market volatility (Campbell et al., 2002). Although not examined through a period of acute losses, Bitcoin has also been shown to correlate positively with downward markets (Klein et al., 2018), implying that it may act as a store of value during severe market declines. Moreover, Bitcoin is independent of monetary policies and, similar to commodities such as gold, limited in quantity by mining constraints. On this basis we hypothesize that Bitcoin acts as a safe-haven for the S&P 500 during the Covid-19 market downturn. The early empirical evidence regarding Bitcoin's hedging and safe-haven properties are not, however, comprehensively supported. Bouri et al. (2017a) demonstrate that Bitcoin has limited hedging properties and only has safe-haven characteristics for Asian stocks. Baur et al. (2018) demonstrate that Bitcoin is mainly employed as a speculative investment. This speculative nature may result in selling pressure during extreme downward markets, providing limited effectiveness as a store of value (Yermack, 2015). Given this background, we propose an alternative testable hypothesis: Bitcoin is not a safe-haven for S&P 500 investors during the Covid-19 pandemic.

We explicitly test whether any diversification benefits from holding Bitcoin are evident in the highly volatility market associated with the Covid-19 crisis. Specifically, we quantify the relative change in portfolio value at risk (VaR) and conditional value at risk (CVaR), two common measures of downside risk. In calculating VaR and CVaR, we employ the Cornish-Fisher expansion, a method appropriate to incorporate higher-order distributional characteristics associated with extreme price movements. Specifically, we follow the approach of Bredin et al. (2017), by accounting for skewness and kurtosis in a four-moment downside risk framework.

Our empirical findings contribute to the literature assessing the effectiveness of safe haven assets. We are among the first papers to isolate the safe haven properties of Bitcoin during a severe market downturn. Our analysis indicates that adding Bitcoin to a portfolio results in increased downside risk relative to holding the S&P 500 alone. This important result is shown to hold across a range of different allocation weightings and periods. These findings indicate that, rather than acting as a safe haven, Bitcoin may instead increase portfolio risk during periods when investors most crave respite from market turmoil. The implication is that investors should not rely on Bitcoin as an alternative asset which provides shelter from turbulence in traditional markets.

2. Methodology - Downside risk measurement

For a portfolio with normally distributed returns, two-moment value at risk (VaR) may be employed to measure the level of tail or downside risk.[4] For a given confidence level, two-moment VaR is defined as the maximum expected loss on a portfolio over a given time interval and is calculated using:

$$VaR_p(1-\alpha) = \mu_p - \sigma_p z(\alpha), \tag{1}$$

where $z(\alpha)$ is the α quantile of the standardized distribution, and μ_p and σ_p are the mean and standard deviation of portfolio returns respectively. When the empirical distribution of returns is normal, the VaR of an asset is just a constant multiple of the standard deviation of asset returns.

It has been heavily documented that financial asset returns do not follow a normal distribution, making it likely that two moment VaR will not accurately capture the risk associated with potentially large non-normal returns. This is particularly true of Bitcoin, which has been shown to be subject to bubble-like dynamics, extreme price movements and price clustering (Corbet et al., 2019; 2018a; Urquhart, 2017). We use the four-moment modified VaR, first defined by Favre and Galeano (2002), to understand the downside risk of a portfolio combining equities and Bitcoin. The Cornish-Fisher expansion, which adjusts the quantiles of a distribution to account for the higher-order moments of skewness and kurtosis, is used to calculate four-moment modified VaR. This expansion approximates the quantile of the distribution as:

$$\hat{Z}(\alpha, S_p, K_p) = z(\alpha) + \frac{1}{6}(z(\alpha)^2 - 1)S_p + \ldots \\ \frac{1}{24}(z(\alpha)^3 - 3z(\alpha))K_p - \frac{1}{36}(2z(\alpha)^3 - 5z(\alpha))S_p^2, \tag{2}$$

where μ_p, σ_p, S_p and K_p are the mean, standard deviation, skewness and excess kurtosis of portfolio P. $z(\alpha)$ is the α quantile of the standard normal distribution. Using the Cornish-Fisher expansion, modified four-moment VaR is then given by

$$MVaR_p(1-\alpha) = \mu_p - \sigma_p \hat{Z}(\alpha, S_p, K_p). \tag{3}$$

This adjusts the two-moment VaR (Eq. (1)) to account for distributional characteristics commonly found in financial time series.

Conditional value at risk (or expected shortfall) is the loss expectation, conditional on the loss being larger than $MVaR_p$, and we define modified CVaR as:

$$MCVaR_p = \mathrm{E}(R_p | R_p > MVaR_p), \tag{4}$$

where R_p is the negative log return. $MCVaR_p$ is calculated numerically, taking an average of $MVaR_p$ across the range of quantiles greater than $1-\alpha$.

Relative portfolio risk is measured as a function of the portfolio downside risk with an allocation to Bitcoin relative to a portfolio

[4] Other approaches to measure crash risk, such as the negative coefficient of skewness and the proportion of down and up-market volatility, have also been proposed (Kalyvas et al., 2019). Rather than employ these high-frequency measures of crash risk, we focus on an approach commonly employed to assess portfolio risk with daily data.

holding only the S&P 500. For MVaR (MCVaR), this is given by $\frac{MVaR_{mix}}{MVaR_{S\&P}}$ ($\frac{MCVaR_{mix}}{MCVaR_{S\&P}}$), where $MVaR_{mix}$ and $MCVaR_{mix}$ are downside risk measures representing the mix portfolio containing $S\&P$ 500 and Bitcoin, respectively.

3. Data

Daily price data for the S&P 500 are obtained from Thompson Reuters Eikon. Price data for Bitcoin are obtained from Coinmetrics, using their CM reference rates. These rates are constructed using a methodology which adheres to the International Organisation of Securities Commissions (IOSCO) Principles for Financial Benchmarks.[5]

We first provide some illustrative price movements beginning at the market inflection point (or market top) in the S&P 500 which occurred on February 13th 2020. We then provide summary statistics and downside risk reduction characteristics over three periods. The first encompasses the entire available price history for Bitcoin, from July 2010 - March 2020. The second, following Conlon and McGee (2019) and Urquhart (2016), considers the period from April 2016 from which the Bitcoin market is more efficient. Finally, we examine a one-year period stretching from March 21st 2019 through March 20th 2020, focusing upon a time-frame encompassing the recent Covid-19 market crisis.

4. Empirical findings

We first illustrate the safe haven properties of Bitcoin in a qualitative manner, examining price movements post the inflection point where the bear market in equities begins, Fig. 1.[6] This provides some initial guidance regarding the safe haven properties of Bitcoin. During the decline in the S&P 500, Bitcoin is observed to generally move in lockstep with the market, decreasing by more than the S&P 500 over the bear market period under consideration. These qualitative results provide an initial indication that Bitcoin investments may increase portfolio risk rather than acting as a safe haven.

Table 1 highlights summary statistics for returns corresponding to the S&P 500, Bitcoin and a mix portfolio consisting of 10% Bitcoin and 90% S&P 500. For each of the periods under consideration we see that Bitcoin has higher returns, a larger standard deviation and greater excess kurtosis. Over the entire period considered an investor in Bitcoin would have increased their wealth over 11 times relative to their initial investment. The maximum one day loss for Bitcoin is 66.49% compared with 12.77% for the S&P 500.

VaR and CVaR at a 1% and 5% confidence level are also shown in Table 1. Regardless of the metric or confidence level examined, Bitcoin is found to have vastly greater downside risk than the S&P 500. Our primary interest is the change in downside risk for the mix portfolio, relative to that associated with the S&P 500. At a 1% confidence level, we observe a 13.6% increase in VaR over the $2019 - 2020$ period for a portfolio holding 10% Bitcoin relative to the S&P 500. Similarly, for CVaR at a 1% confidence level, we find a 15.3% increase from 16.18% for the S&P 500 to 18.65% for the mix portfolio. Similar findings are observed during the other periods examined. These findings, while limited to a potentially suboptimal Bitcoin allocation, highlight that Bitcoin may result in increased portfolio risk, discrediting the safe haven hypothesis for Bitcoin.[7]

For robustness, we examine a comprehensive range of Bitcoin allocation weightings, with a focus on assessing the change in downside risk relative to holding only the S&P 500. The results, detailed in Fig. 2, focus on downside risk at a 1% confidence interval. For all allocation weights, we find increased portfolio VaR and CVaR for a portfolio containing Bitcoin relative to the S&P 500 alone. Moreover, relative downside risk increases monotonically for larger allocations to Bitcoin. Any allocation greater than 28% results in at least a 50% increase in the baseline level of downside risk an S&P 500 investor is exposed to over this period. Similar results are found for the other cohorts examined. Together with the earlier analysis, these findings provide strong empirical evidence that Bitcoin does not consistently act as a safe haven for the S&P 500 during times of crisis. Indeed, during the periods we consider, any inclusion of Bitcoin in a portfolio with the S&P 500 increases the level of downside risk an investor is exposed to.

5. Conclusions

The bear market ensuing from the Covid-19 pandemic provides an initial testing ground for the safe haven properties of Bitcoin. Examining the impact upon an S&P 500 portfolio diversified with an allocation to Bitcoin, our results indicate that Bitcoin does not act as a safe haven. During the period under consideration, we find that the S&P 500 and Bitcoin move in lockstep, resulting in increased downside risk for an investor with an allocation to Bitcoin.

CRediT authorship contribution statement

Thomas Conlon: Formal analysis, Writing - original draft, Methodology, Conceptualization. **Richard McGee:** Formal analysis, Writing - original draft, Methodology, Conceptualization.

[5] This data was selected as it provides Bitcoin price data back to July 2010 and meets the guidance for relevant cryptocurrency prices provided by Alexander and Dakos (2020). Our empirical results are found to be robust over timelines available for alternative Bitcoin data sources.

[6] A bear market is colloquially regarded as one where the stock market decreases by more than 20%. In the case of the Covid-19 crisis this initial decline occurred between 13th February and 12th March 2020.

[7] The notion of hedging effectiveness receding at the very point in time when effective hedges are most required has been previously documented in the futures hedging literature (Spencer et al., 2018).

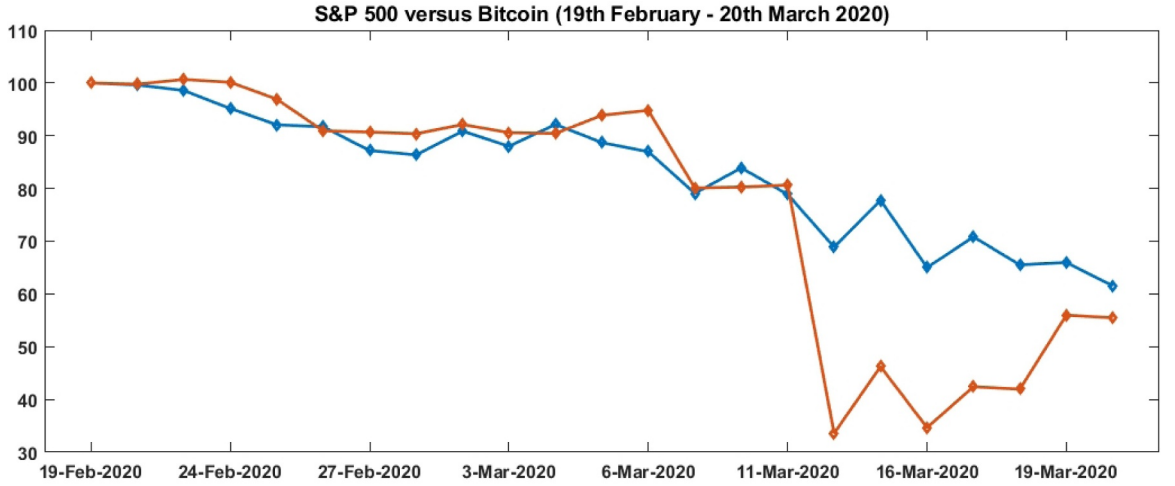

Fig. 1. Price Changes in S&P 500 and Bitcoin (February-March 2020) Both the S&P 500 and Bitcoin price series are standardised to a starting price of 100 on 19th February 2020.

Table 1
Summary Statistics. This table details summary statistics for the S&P 500, Bitcoin and a portfolio consisting of an allocation of 90% to S&P 500 and 10% to Bitcoin. Value at risk and Conditional Value at Risk are calculated using the Cornish-Fisher expansion. Summary statistics are given in percentage terms and mean and standard deviation are annualized.

	2010–2020			2016–2020			2019–2020		
	S&P 500	Bitcoin	Portfolio	S&P 500	Bitcoin	Portfolio	S&P 500	Bitcoin	Portfolio
Mean	7.93	116.36	18.77	2.83	67.98	9.35	−19.39	46.0	−12.84
Standard Deviation	16.45	100.27	18.61	17.68	78.41	18.93	27.52	87.94	28.85
Skewness	−1.44	−0.54	−1.57	−2.39	−0.84	−2.89	−2.17	−2.16	−2.84
Kurtosis	20.12	13.38	19.82	32.93	10.97	37.86	19.56	21.29	25.09
Cumulative Return	76.62	1,124.39	181.40	11.25	269.75	37.10	−20.32	42.64	−14.02
Max One Day Loss	−12.77	−66.49	−13.70	−12.77	−47.06	−13.70	−12.77	−47.06	−13.70
VaR (1%)	6.81	31.33	7.51	9.90	22.10	11.19	10.34	34.87	11.75
VaR (5%)	1.70	9.54	1.92	1.79	8.17	1.88	3.31	9.96	3.48
CVaR (1%)	11.28	50.17	12.37	17.17	33.56	19.53	16.18	55.97	18.65
CVaR (5%)	4.91	23.22	5.43	6.89	16.88	7.74	7.71	25.56	8.65

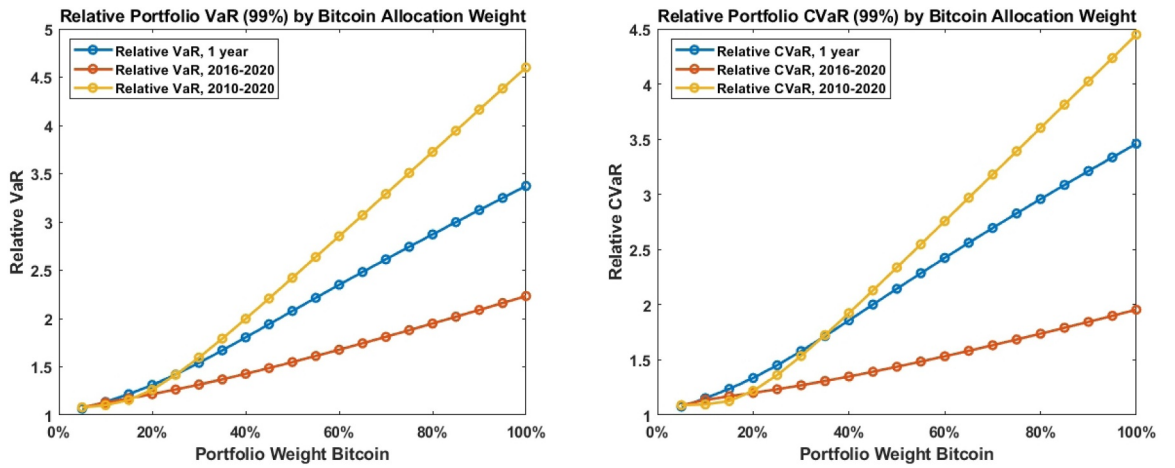

Fig. 2. Relative portfolio risk for different Bitcoin allocation weights.
Relative VaR (CVaR) shows the increase in VaR (CVaR) for a portfolio with proportional allocation to Bitcoin relative to a portfolio holding only the S&P 500.

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Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.frl.2020.101607.

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