International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2021, 11(4), 35-40.

Is Bitcoin a Safe Haven? A Study on the Factors that Affect Bitcoin Prices

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Received: 02 May 2021 **Accepted:** 15 June 2021 **DOI:** https://doi.org/10.32479/ijefi.11602

ABSTRACT

Bitcoin and other digital currencies are financial assets with high volatility, which calls for an investigation of the factors that influence their prices and thus has led to a debate on whether they are reliable investment instruments or diversification tools. The present study aims to explore the impact upon Bitcoin prices of commodities such as gold and oil, the S&P 500 index, and the volatility index and financial stress index, which represent the financial risk environment. To this purpose, we analyze this relationship using the Autoregressive Distributed Lag (ARDL) approach based on the monthly data from the 2010-2021 period. The results suggest that both in the long and short run, gold price per ounce does not have a statistically significant effect on Bitcoin price. On the other hand, an increase in crude oil prices has a negative impact on Bitcoin price in the short run, with no significant effect in the long run. The S&P 500 stock market index positively affects the Bitcoin price both in the short and long run. In addition, our analysis results also demonstrate that developments indicating increased risk in the long run tend to reduce Bitcoin returns.

Keywords: Bitcoin, Gold, Oil, Volatility, Autoregressive Distributed Lag
JEL Classifications: G11, B23

1. INTRODUCTION

Historically, change has permeated all aspects of human life with various impacts. Ozaydin (2019) underlines the fact that change is slow in certain periods, while it accelerates in others. This view is based on Thomas Kuhn's (1962) concept of paradigm shift, as he defined the turn-of-the-century revolutions (Jung, 2018). After the 2000s, the Internet and related technologies have given rise to a multitude of transformations both in individual lifestyles and social life and in finance and economy. In particular, the marriage between technology and finance has shifted production-based value creation processes toward financial markets, acting as a catalyst for radical transformations in all financial institutions starting from the banking system. Humanity's drive for gain has continued into the contemporary age with the aim of satisfying individual needs and stepping up in the hierarchy of needs.

The use of technology in finance has become a focus of interest, particularly due to its cost-reducing effects, as well as its swift, reliable, and practical nature for financial market brokers and financial businesses (Ozkan and Şahin, 2020). Specifically, with regard to promoting, globally distributing, and attracting investors for financial products, technological innovations brought about an increase in financial participation. Nevertheless, this positive impact created certain problems over time due to brokerage costs, concentration of money in the hands of certain groups, personal data security, and nontransparent practices. In particular, the 2007 mortgage crisis had global implications as a result of certain financial instruments in the financial markets. Those looking for a way out of the crisis proposed another financial technological innovation, or the Blockchain system and Bitcoin as its by-product, as an alternative to the existing financial system. First introduced in 2008 by Nakamoto (2008), the Blockchain system has developed rapidly until today. The system eliminated the intermediaries in peer-to-peer money and data transfer by using mathematical algorithms made secure through cryptography and storing data in blocks in distributed databases (Nofer et al., 2017). With its claims to address the gaps in the existing financial system, the system created its own ecosystem over time, making its presence felt in almost all areas today through smart contracts and initial coin offering (ICO) (Lockaby, 2018).

As the most significant output of the system, Bitcoin is currently regarded as "an asset for investment" despite its different definitions in the literature (Nadarajah and Chu, 2017; Kaul and Sapp, 2006; Baur and Lucey, 2010). These views are grounded on the fact that Bitcoin lacks the intrinsic qualities of money including being widely accepted, being supported by a central authority, and being lent with interest. All these factors contribute to the fact that Bitcoin is perceived as a commodity like gold, rather than a currency. The recent developments and technological revolution have raised a debate on whether Bitcoin can be a better safe haven than gold (Alberts and Fry, 2015; Mokhtarian and Lindgren, 2018; Lockaby, 2018; Sater, 2018; Smales, 2019; Shahzad et al., 2019). As a concept that has been extensively studied in the finance literature, safe haven has been defined by Kaul and Sapp (2006) and by Baur and Lucey (2010) as a lack of correlation between investment instruments. It has been argued that for an investment instrument to be described as a safe haven, it has to be uncorrelated or negatively correlated with other investment instruments. In this context, whether Bitcoin is a reliable investment instrument or can be used as a diversification or hedge tool depends on the sensitivity of Bitcoin prices to financial market indicators. In this light, the present study investigates how Bitcoin prices are influenced by commodities such as gold and oil, the S&P 500 index, and the volatility index and financial stress index, which represent the financial risk environment.

The recent literature contains research exploring Bitcoin as a safe haven and a hedging or diversification tool against various financial assets by using different methods and data periods; yet, there is still no consensus on the issue. Dyhrberg et al. (2016), Bouri et al. (2017b), and, for certain countries, Shahzad et al. (2019) argue that Bitcoin can be employed as a reliable hedging instrument, while some others claim that Bitcoin can only be used as a diversifier (Bouri et al., 2017a) and Urquhart and Zhang (2019). On the contrary, Mokhtarian and Lindgren (2018), Smales (2019), Conlon and McGee (2020), and Baur and Hoang (2021) all contend that Bitcoin cannot be a hedging instrument. In their analyses using asymmetric GARCH, Dyhrberg et al. (2016) concluded that Bitcoin behaves like a hedge instrument similarly to gold and thus can be used in hedging against stocks. The authors note that it can also be employed as a short-term hedge instrument against the American dollar. On the other hand, Mokhtarian and Lindgren (2018) acknowledge the fact that the technological qualities of the Blockchain system and the novelties it has brought to finance are evidently undeniable; yet, they argue that Bitcoin and other cryptocurrencies cannot be employed as hedge instruments. They justify their argument with reference to an array of factors such as the unregulated nature of the system, its low liquidity that is incomparable to conventional capital markets, and its lack of stability. Bouri et al. (2017a) examined the relationship of Bitcoin prices with stock prices, bond prices, foreign exchange rate, and certain commodities within the 2011-2015 period and found that Bitcoin may be a significant diversifier and can act as a hedge in certain cases.

In their study that used the Volatility Index (VIX) and Bitcoin price data from the 2011 to 2016 period, Bouri et al. (2017b) concluded that Bitcoin can be a useful hedge for investors against the uncertainty in the market. Lim and Masih (2017) analyzed the relationship between Islamic stock indices and Bitcoin and found through various econometric tests that the correlation is rather low or negative, demonstrating that Bitcoin can be employed as a diversifier. Smales (2019), on the other hand, noted that Bitcoin is correlated with other assets during market crises; yet, other attributes of assets that are of interest for investors in periods of crisis are different and should not be ignored. Therefore, the author reached the conclusion that even in normal market conditions, Bitcoin is more volatile, costlier, and less liquid to transact than other assets (including gold - the traditional safe haven) in terms of time and fees so it cannot be considered as a safe haven until the market matures. Shahzad et al. (2019) also investigated the safe haven properties of Bitcoin in extremely volatile market conditions and found that Bitcoin displays weak safe-haven properties for now. Furthermore, the safe-haven properties of gold, certain commodities, and Bitcoin differ according countries' economic development levels. The study findings suggest that Chinese investors more often use Bitcoin as a safe-haven asset. In another study, Urquhart and Zhang (2019) explored if Bitcoin could act as a hedge or safe haven against world currencies. Although they had different results with different currencies, the authors found that Bitcoin acts as a hedge instrument for certain currencies and can be a diversifier for certain others. Conlon and McGee (2020) argue that the crypto-asset market acutely affected by the Covid-19 pandemic led to a price movement in lockstep with the S&P 500 index, reporting that Bitcoin does not display safe-haven properties. In their study, Baur and Hoang (2021) note that Bitcoin is significantly comparable to gold as an investment instrument and investigate whether it is a reliable store of value and a safe haven. As a result, the authors report that Bitcoin is highly volatile but stablecoins (USDT- Tether) or coins whose prices are pegged to fiat money may act as a safe haven against Bitcoin.

As for the research exploring the sensitivity of Bitcoin prices or returns to financial market indicators, Jareno et al. (2020) use linear and nonlinear models to examine the sensitivity of Bitcoin returns to the changes in gold prices, US stock market returns, crude oil prices, interest rates, the volatility index (VIX), and STLFSI stress index for the 2010-2018 period. Their findings suggest that the VIX index and the financial stress index are the strongest influencing factors for the changes in Bitcoin prices and demonstrate a positive correlation with stock returns. In addition, Bitcoin returns negatively respond to the changes in interest rates and crude oil prices. Oztürk et al. (2018) reveal Bitcoin's independent movement from the traditional assets except for gold and from certain commodity prices. Interestingly, the authors found that as a risky asset Bitcoin can reduce the risk of portfolios. In order to determine the factors that influence Bitcoin prices by using the MARS method, Sahin (2020) attempted to measure the effects of global risks (Financial Stress Index and Geopolitical Risk Index) in addition to the variables commonly used in the literature such as gold and the US dollar. As a result, they found that all the study variables could influence the price of Bitcoin under certain conditions. Sovbetov (2018) used monthly data from the 2010 to 2018 period to explore the factors that affect the prices of five most common cryptocurrencies; i.e. Bitcoin, Ethereum, Dash, Litecoin, and Monero. The author examined intervariable correlations by employing the ARDL technique and concluded that market beta, trading volume, and volatility are significant determinants for the five cryptocurrencies and the SP500 index also has a weak positive long-run impact on Bitcoin, Ethereum, and Litcoin. Finally, Georgoula et al. (2015) studied the association between Bitcoin prices and important economic variables, technological factors, and measurements of collective mood derived from Twitter feeds. Their analysis based on machine learning revealed a positive correlation between Twitter sentiment ratio and Bitcoin prices. Their study also demonstrates the positive impact of the number of Wikipedia search requests (showing the degree of public interest in Bitcoins) on Bitcoin prices. In contrast, Bitcoin prices are negatively affected by the exchange rate between the US dollar and the Euro. Furthermore, the Bitcoin price is positively related with the number of Bitcoins in circulation and negatively related with the Standard and Poor's 500 stock market index.

2. MODEL, DATASET, AND METHODOLOGY

This study empirically analyzes the safe-haven properties of cryptocurrencies using the case of Bitcoin. For this purpose, the following model was constructed by drawing from the studies by Oztürk et al. (2018) and Jareno et al. (2020):

$$BTC_t = \alpha + \beta_1 GOLD_t + \beta_2\ OIL_t + \beta_3 SPX_t + \beta_4 VIX_t + \beta_5 FSI_t + \mu_t \tag{1}$$

where α denotes the constant term and μ denotes the error term. In the model, the dependent variable is Bitcoin price in US dollars (*BTC*), while the independent variables are gold price per ounce (*GOLD*), crude oil price (*OIL*), the S&P 500 Index (*SPX*), volatility index (*VIX*), financial stress index (*FSI*), respectively. Specifically, *GOLD* and *OIL* represents the commodity market, *SPX* represents the stock market, and *VIX* and *FSI* represent financial risk environment. The data from the 2010:08-2021:04 period was obtained on a monthly basis and included logarithmically. The data on the volatility and financial stress indices were retrieved from the Federal Reserve Bank website, while data for the rest of the variables were retrieved from the investing.com database.

During the first step of analysis, we used Augmented Dickey-Fuller (ADF) unit root test to test the stationarity of the series. Developed by Dickey and Fuller (1979), the test is based on the following equation:

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{i=1}^{z} \theta_i \Delta Y_{t-i} + \mu_t \quad \mathrm{t} = 1, \ldots, \mathrm{T} \tag{2}$$

where Δ denotes the first difference, Y_t is for the series used, t for time, μ_t for error term, and z for lag of the independent variable. Lag length is determined by using Akaike Information Criterion. The null hypothesis denotes non-stationarity for the series, while the alternative hypothesis assumes that the series are stationary.

Following the unit root test, we explored both the short-term and long-term correlations of Bitcoin prices with gold, oil, S&P 500 index, volatility and financial stress indices using the ARDL method developed by Pesaran et al. (2001). The method has a key advantage in that it allows for analyzing series with different levels of stationarity. Moreover, it provides reliable estimations by showing the short-run and long-run correlations simultaneously. For the specific model adopted in the study, the basic equation for the ARDL bounds test can be presented as follows:

$$\begin{aligned} \Delta \mathrm{BTC}_t &= \alpha + \sum_{i=1}^{z} \beta_{1i} \Delta (BTC)_{t-i} + \sum_{i=0}^{z} \beta_{2i} \Delta (\mathrm{GOLD})_{t-i} + \\ &\sum_{i=0}^{z} \beta_{3i} \Delta (\mathrm{OIL})_{t-i} + \sum_{i=0}^{z} \beta_{4i} \Delta (\mathrm{SPX})_{t-i} + \sum_{i=0}^{z} \beta_{5i} \Delta (VIX)_{t-i} + \\ &\sum_{i=0}^{z} \beta_{6i} \Delta (FSI)_{t-i} + \beta_7 (\mathrm{BTC})_{t-1} + \beta_8 (\mathrm{GOLD})_{t-1} + \\ &\beta_9 (\mathrm{OIL})_{t-1} + \beta_{10} (\mathrm{SPX})_{t-1} + \beta_{11} (VIX)_{t-1} + \beta_{12} (FSI)_{t-1} + \varepsilon_t \end{aligned} \tag{3}$$

The equation denotes the difference between Δ and the lag of the dependent and independent variables. This difference between the lags indicates short-term dynamics, while the long-term dynamics are demonstrated by the ratio of the coefficient of each lag value to the coefficient of the dependent variable. Once the presence of a long-term cointegration relationship is established, the Error Correction Model is employed, which can be formulated as follows:

$$\begin{aligned} \Delta \mathrm{BTC}_t &= \alpha + \sum_{i=1}^{z} \beta_{1i} \Delta (\mathrm{BTC})_{t-i} + \sum_{i=1}^{z} \beta_{2i} \Delta \left(\mathrm{GOLD}\right)_{t-i} + \\ &\sum_{i=1}^{z} \beta_{3i} \Delta (\mathrm{OIL})_{t-i} + \sum_{i=1}^{z} \beta_{4i} \Delta (\mathrm{SPX})_{t-i} + \beta_{5i} (VIX)_{t-i} + \\ &\beta_{6i} (FSI)_{t-i} + \beta_{7i} ECT_{t-1} + \varepsilon_t \end{aligned} \tag{4}$$

A negative and statistically significant ECT coefficient is an expected result of the error correction model, which indicates that short-term imbalances will reach an equilibrium in the long run.

After determining the cointegration relationship using ARDL bounds test, we performed Vector Error Correction Model (VECM) to analyze causality between the variables. Granger (1988) proposed using VECM to estimate causality between cointegrated series and the relevant equation is formulated as follows:

$$\Delta y_t = \varnothing_0 + \sum_{i=1}^{z} \varnothing_{1i} \Delta y_{t-1} + \sum_{i=1}^{z} \varnothing_{2i} \Delta x_{t-1} + \sum_{i=1}^{z} \varnothing_{3i} \Delta ECT_{t-z} + u_t \tag{5}$$

The model employs Wald test to reveal short-term causality between the series.

3. RESULTS

We first explored the presence of unit roots in the series using ADF unit root test, the results of which are presented in Table 1. From the data given in the table, we concluded that BTC, GOLD, OIL, and SPX variables are stationary in the first difference, while VIX and FSI are stationary at level.

The results of the stationarity test evidenced that the series have different levels of integration; i.e. I(0) and I(1), which justified the adoption of ARDL bounds test approach in this study. Table 2 summarizes the results of our ARDL analysis and first presents the findings that indicate the existence of a cointegration relationship. This allowed us to establish that the variables are cointegrated in the long run. Based on this result, we proceeded to estimating the coefficients for the model both for the short and long run.

The short-term and long-term results investigated using the ARDL approach can be evaluated in relation to commodity market, stock market, and financial risk environment. First of all, as seen in Table 2, we did not detect any statistically significant effect of the gold price per ounce on Bitcoin prices either in the short and long run. On the other hand, an increase in the price of crude oil negatively influences Bitcoin prices in the short run but does not have any long-term significant effects. All these results suggest that the reaction of Bitcoin prices to the volatilities in the commodity market is quite limited (only to oil in the short run).

Table 1: ADF unit root test results

Variable	Level	1st Difference
BTC	−1.343378	−8.831241***
GOLD	−1.748780	−11.93928***
OIL	−1.972173	−7.074065***
SPX	−0.003457	−9.433390***
VIX	−4.531786***	−6.543865***
FSI	−3.442401**	−7.326824***

***and **imply %1 and %5 statistically significance levels.

Table 2: ARDL cointegration and coefficient estimation results

Cointegration	F-stat.	I(0)-I(1)
ARDL (2, 0, 0, 0, 0, 0)	5.152	3.06-4.15***
Long run results	**Coefficient**	**Standard error**
GOLD	2.155855	2.359527
OIL	−1.908660	1.317820
SPX	6.293256***	1.404772
VIX	−1.641001	1.135950
FSI	−1.140649*	0.627715
C	−19.53876***	6.367835
	Short run results	
GOLD	0.260786	0.244805
OIL	-0.230884*	0.135973
SPX	0.761272**	0.346632
VIX	-0.198506*	0.113409
FSI	-0.137980**	0.065069
ECT[-1]	-0.120966	0.019653
Diagnostic tests	**F-stat.**	**Prob.**
Breusch-Godfrey LM test	0.548911	0.5791
Heteroskedasticity test	0.987406	0.4438
Ramsey reset test	2.049114	0.1549

***, ** and *imply %1, %5 and %10 statistically significance levels

The S&P 500 stock market index has a positive impact on Bitcoin prices both in the short and long run. Thus, based on this result, we were able to establish that the price of Bitcoin is directly correlated with the stock market. The positive effect in question has to do with the fact that, with particular respect to the US stock market, the rises in the stock market promote positive expectations about financial markets and thus increase Bitcoin purchases.

As for the impact of the volatility and financial stress indices, which were adopted as indicators of the market risk environment in the study, any developments signaling increased long-term risk in these indicators reduce Bitcoin returns. Yet, the financial stress index coefficient is negative and statistically significant in the short run as well. Therefore, in the Bitcoin sample, the pricing of the cryptocurrencies is highly sensitive to the market risk environment.

We investigated the causality relations between the variables by using Granger causality test based on Vector Error Correction Model. The results of this analysis are given in Table 3, which displays a unidirectional causality running from the volatility index to Bitcoin price. This finding is compatible with the coefficient estimation results that evidence the impact of financial risk upon Bitcoin prices. We also detected a unidirectional causality running

Table 3: Granger causality test based on vector error correction model

Dep. Var.: D(BTC)	Chi-square	Prob.
D(GOLD)	1.045844	0.3065
D(OIL)	0.014697	0.9035
D(SPX)	1.492520	0.2218
D(VIX)	3.000140	0.0833
D(FSI)	0.887592	0.3461
Dep. Var.: D(GOLD)	**Chi-square**	**Prob.**
D(BTC)	0.464540	0.4955
D(OIL)	0.244309	0.6211
D(SPX)	0.317168	0.5733
D(VIX)	1.121279	0.2896
D(FSI)	0.666559	0.4143
Dep. Var.: D(OIL)	**Chi-square**	**Prob.**
D(BTC)	0.484768	0.4863
D(GOLD)	0.159408	0.6897
D(SPX)	1.185352	0.2763
D(VIX)	4.520466	0.0335
D(FSI)	0.133901	0.7144
Dep. Var.: D(SPX)	**Chi-square**	**Prob.**
D(BTC)	4.008080	0.0453
D(GOLD)	1.547112	0.2136
D(OIL)	1.996713	0.1576
D(VIX)	6.801204	0.0091
D(FSI)	1.204153	0.2725
Dep. Var.: D(VIX)	**Chi-square**	**Prob.**
D(BTC)	0.360139	0.5484
D(GOLD)	1.503804	0.2201
D(OIL)	4.664202	0.0308
D(SPX)	0.690520	0.4060
D(FSI)	1.065985	0.3019
Dep. Var.: D(FSI)	**Chi-square**	**Prob.**
D(BTC)	1.905153	0.1675
D(GOLD)	0.176806	0.6741
D(OIL)	2.368017	0.1238
D(SPX)	1.468131	0.2256
D(VIX)	15.42210	0.0001

from the volatility index to the S&P 500 and financial stress indices and a bidirectional causality from the volatility index to crude oil prices. Finally, another finding of the study is that there is a unidirectional causality running from Bitcoin price to S&P 500 index.

4. CONCLUSION

Although many different digital currencies have recently emerged, Bitcoin was the first digital currency that appeared on the market. Cryptocurrencies rapidly grew around the globe following the emergence of Bitcoin and have now become a focus of interest for many investors. Nevertheless, due to their high volatility, digital currencies have been defined as high-risk investment instruments. In this context, the particular question of whether Bitcoin is a reliable investment instrument has to do with the sensitivity of its price to financial market indicators. In this study, we explored the relationship of Bitcoin prices with the prices of commodities such as gold and oil, the S&P 500 stock index, and the volatility and financial stress indices, which are commonly used for financial risk assessment by using monthly data from the 2010:08-2021:04 period. Our results showed that increased financial risk both in the short and long run leads to a decrease in Bitcoin prices, while an index increase pertaining to the US stock market increases Bitcoin prices. Gold prices were found to have no statistically significant effect on the price of Bitcoin, while crude oil prices negatively influence Bitcoin prices in the short run.

Although cryptocurrencies are not official currencies issued by governments, their returns are related to other financial indicators under current circumstances. Therefore, investors of cryptocurrencies like Bitcoin must take account of other financial market indicators when forming expectations toward their potential returns. Yet, cryptocurrencies involve specific risks and are also affected by other financial market developments globally. Both of these factors confirm the highly risky nature of these currencies as investment instruments and thus limit their reliability. In this light, we can argue that when investing in cryptocurrencies, investors should have a good knowledge of the developments in both national and international financial markets and also have a strong grasp of how cryptocurrencies function.

The results of the present study are important in that they are based on current data and thus reflect recent developments as well. In fact, both the uncertainty and risk environment created by the COVID-19 pandemic in financial markets and the sharp falls in Bitcoin prices have certain implications for the relationships that this study focuses on. An up-to-date approach to the future research on the pricing of cryptocurrencies and even studying subcoins along with Bitcoin may have significant contributions to the finance literature.

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