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Inflation and Bitcoin: A descriptive time-series analysis

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ABSTRACT

This study examines the time-series relation between Bitcoin and forward inflation expectation rates. Using a vector autoregressive process, we find that changes in Bitcoin Granger cause changes in the forward inflation rate. Furthermore, imposing an exogenous shock to Bitcoin's price results in a persistent increase in the forward inflation rate. Our findings provide support for the notion that Bitcoin may be used as a hedge against inflation as changes in the price of Bitcoin tend to lead changes in the expected inflation.

1. Introduction

The market capitalization for Bitcoin recently eclipsed a trillion dollars. Practitioners and some researchers have suggested that Bitcoin is a viable hedge against inflation. For instance, in May of 2020, Bloomberg News reported that hedge fund manager Paul Tudor Jones responded to concerns about the expansionary policy by many of the world's central banks during the Covid-19 pandemic by purchasing Bitcoin.[1] Likewise, MicroStrategy Inc., the largest publicly traded business intelligence company, raised its holdings of Bitcoin in February of 2021 by about 20,000 coins because it believes the cryptocurrency to be a "dependable store of value".[2] Unlike traditional currencies, Bitcoin has a fixed limit of 21 million coins and trades in a decentralized unregulated system. Schilling and Uhlig (2019) provide a theoretical overview of the interaction between Bitcoin and a more traditional currency that is supplied by a central bank. The authors allow the supply of Bitcoin to grow deterministically and show that Bitcoin can be considered a viable, albeit volatile medium of exchange.[3] The strong demand for, limited supply of, and monetization of Bitcoin gives it the potential to protect against rising prices, which fits the definition of inflation hedge implied by Reilly et al. (1970) and Cagan (1974).

In contrast to the hedging arguments above, other economists have suggested that Bitcoin is simply a speculative investment that does not resemble anything like a traditional monetary instrument.[4] In fact, the Federal Reserve Chairman, Jerome Powell, stated in March of 2021 that cryptocurrencies are "highly volatile and therefore not really useful stores of value... a speculative asset that is essentially a substitute for gold rather than for the dollar".[5] Baur et al. (2018) provide empirical evidence that Bitcoin is uncorrelated with traditional assets such as stocks, bonds, or commodities, suggesting it is mainly used as a speculative investment. Furthermore, Peetz and Mall (2017) argue that Bitcoin is

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1 The Bloomberg article can be found at: https://www.bloomberg.com/news/articles/2020-05-07/paul-tudor-jones-buys-bitcoin-says-he-s-reminded-of-gold-in-70s?srnd=premium&sref=flqbqllF.

2 See the following article at https://www.microstrategy.com/en/investor-relations/press/microstrategy-acquires-additional-19452-bitcoins-for-1-026-billion_02-24-2021.

3 Bouri et al. (2017) show that Bitcoin is a hedge against global equity uncertainty. Selmi et al. (2018) show that Bitcoin is a hedge for oil price movements. Urquhart and Zhang (2019) examine Bitcoin as a hedge for currencies, and find mixed evidence depending on the observed currency. Wu et al. (2019) show that neither Gold nor Bitcoin serves as a strong hedge against economic policy uncertainty.

4 See the New York Time article https://krugman.blogs.nytimes.com/2013/12/28/bitcoin-is-evil/.

5 See the MarketWatch article https://www.marketwatch.com/story/feds-powell-says-bitcoin-is-more-of-a-substitute-for-gold-than-the-dollar-11616424786.

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not a transaction currency for a variety of reasons such as the difficulty to value, the lack of intrinsic worth, and its limited transaction capacity.

Given the conflicting opinions regarding Bitcoin as a potential inflation hedge, a structural analysis of both Bitcoin and expected inflation seems warranted. In this study, we conduct a variety of multivariate time-series tests to examine the lead–lag relation between Bitcoin and the Federal Reserve Bank of St. Louis 5-year forward inflation expectation rates. According to Branch (1974), Fama and MacBeth (1974), and Oudet (1973), a security is an inflation hedge if its returns are independent of the rate of inflation. As noted by Bodie (1976), such independence can be loosely defined as a positive correlation between the nominal rate of return on a particular asset and the rate of inflation.

Results from our multivariate time-series tests are striking. First, we find that changes in the price of Bitcoin Granger (1969) cause changes in the forward inflation rate. However, the opposite direction of causation is not observed. We then estimate a series of vector autoregressive (VAR) equations, where both changes in Bitcoin and changes in the forward inflation rate are treated endogenously. We impose an exogenous shock of the change in Bitcoin and estimate impulse response functions for changes in the forward inflation rate. Interestingly, accumulated impulse response functions become positive shortly after the exogenous stock to the change in Bitcoin. Moreover, the results are robust across the pre- and post-Covid periods and the inclusion of several different lags in the VAR framework.[6]

Our findings provide general support for the idea that Bitcoin could be used as a viable hedge against inflation as its returns are not only positively correlated with the future inflation expectation rate, but tend to lead it. Thus, our results contribute to the broad literature that focuses on inflation hedging.[7] In particular, Narayan et al. (2019) show that the growth rate in Bitcoin is related to Indonesia's monetary aggregates. Their empirical results suggest that, in the case of Indonesia, changes in Bitcoin are directly related to inflation. Our findings also tangentially contribute to the growing body of research regarding the efficiency of Bitcoin.[8] The relation we find between Bitcoin and the forward inflation rate could stem from structural differences in the respective markets where these instruments trade or it could be an indication of where prices are being discovered.

2. Data description

The data used throughout the analysis are obtained from two primary sources. From CoinMarketCap, we gather daily prices in Bitcoin for the two-year period that ranges from January 1st, 2019 to December 31st, 2020. During this same period, we gather the 5-Year Forward Inflation Expectation Rate (*T5YIFR*) from the St. Louis Federal Reserve Bank. This rate is defined as follows:

$$T5YIFR = \left[\left\{ \left(\frac{\left(1 + \left(\frac{BC_{10YEAR} - TC_{10YEAR}}{100}\right)\right)^{10}}{\left(1 + \left(\frac{BC_{5YEAR} - TC_{5YEAR}}{100}\right)\right)^{5}} \right)^{0.2} \right\} - 1 \right] \times 100 \quad (1)$$

where BC_{10YEAR}, TC_{10YEAR}, BC_{5YEAR}, TC_{5YEAR} are the 10-year and 5-year nominal and inflation-adjusted Treasury securities.[9] We then take the daily percent changes in the *T5YIFR* and Bitcoin, which we denote as *%ΔT5YIFR* and *%ΔBitcoin*, respectively. It is important to note that our sample period includes a portion of the Covid-19 pandemic, which sparked large monetary and fiscal interventions. In fact, the Fed Funds Rate was cut to zero from 0.25 percent, and the Fed announced a $2.3 trillion intervention to assist the economy in the Covid-19 recovery. Additionally, in late March 2020, the U.S. Congress passed a $1.9 trillion stimulus package. The government response to the pandemic provides a great deal of time-series variation, which aids our analysis.

In Table 1, we provide some statistics that summarize our sample of data. As seen in Panel A, the average *T5YIFR* is roughly 1.77% while the average Bitcoin price is about $9,262. In Panel B, we show that the average daily *%ΔT5YIFR* is 0.06% while the average daily *%ΔBitcoin* is 0.52%. We note that the standard deviation of percent changes in daily Bitcoin price is nearly 50% higher than the standard deviation of the percent changes in the daily forward inflation rate.

To ensure stationarity in both *%ΔT5YIFR* and *%ΔBitcoin,* we estimate the specification of the following autoregressive (AR) processes for each:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} \cdots + \delta_5 \Delta y_{t-5} + \varepsilon_t \quad (2)$$

The results from this analysis are reported in Table 2. We estimate augmented Dickey–Fuller statistics ($\gamma = 0$), which test the null hypothesis that a unit root is present in the time series, or that the series is non-stationary. As can be seen from both the Rho and Tau statistics, we reject the null hypothesis at the 0.01 level

Table 1
Summary statistics.

	Mean	Std. Deviation	Minimum	Median	Maximum
Panel A. Forward and Bitcoin Prices					
	[1]	[2]	[3]	[4]	[5]
T5YIFR	1.7709	0.1982	0.8600	1.8000	2.1000
Bitcoin	9262.11	4041.50	3399.47	9180.99	29,001.72
Panel B. Forward and Bitcoin Returns					
%ΔT5YIFR	0.0006	0.0303	−0.2182	0.0000	0.3837
%ΔBitcoin	0.0052	0.0450	−0.3717	0.0016	0.2251

The table reports statistics that describe the time series of the 5-year expected inflation forward rate (T5YIFR) and the value of Bitcoin in USD (Bitcoin). Panel A reports the statistics for these two time-series, while Panel B shows the results when we transform both the *T5YIFR* and *Bitcoin* into daily percent changes.

Table 2
Augmented Dickey–Fuller tests for unit roots.

	AR(1)		AR(3)		AR(5)	
	%ΔT5YIFR	*%ΔBitcoin*	*%ΔT5YIFR*	*%ΔBitcoin*	*%ΔT5YIFR*	*%ΔBitcoin*
	[1]	[2]	[3]	[4]	[5]	[6]
Rho	−455.73	−469.38	−7,279.55	−500.31	−16,783.79	−605.50
	[<.0001]	[<.0001]	[<.0001]	[<.0001]	[<.0001]	[<.0001]
Tau	−15.0396	−15.2538	−15.1372	−11.0392	−10.9325	−9.1991
	[<.0001]	[<.0001]	[<.0001]	[<.0001]	[<.0001]	[<.0001]

The table reports the unit root tests from an Augmented Dickey–Fuller test for three different autoregressive processes. AR(1) is a first-order AR model while AR(3) and AR(5) are third and fifth-order AR models. In odd-numbered columns, we estimate the AR models using daily percent changes in the expected inflation forward rate (*%ΔT5YIFR*). In the even-numbered columns, the AR models are estimated using the daily percent changes in Bitcoin prices (*%ΔBitcoin*). The table reports both the Rho and Tau from the AR models, which test for the presence of unit-roots. Corresponding p-values are reported in brackets.

6 It is worth noting that our findings could be partially explained by the structural differences between the continuous cryptocurrency market and the Treasury market used to compute forward inflation expectation rates.

7 See, for example, Reilly et al. (1970), Bodie (1976), Chua and Woodward (1982), Schotman and Schweitzer (2000), Anari and Kolari (2001), Ghosh et al. (2004), Wang et al. (2011), Beckmann and Czudaj (2013), Bampinas and Panagiotidis (2015), Van Hoang et al. (2016), and Aye et al. (2016).

8 See, for example, Urquhart (2016), Kurihara and Fukushima (2017), Bariviera (2017), Blau (2017), Nadarajah and Chu (2017), Tiwari et al. (2018), Kristoufek (2018), Al-Yahyaee et al. (2018), Selmi et al. (2018), Wei (2018), Köchling et al. (2019), Dimitrova et al. (2019), Sensoy (2019), Blau and Whitby (2019), Blau et al. (2020).

9 These data are retrieved from FRED at https://fred.stlouisfed.org/series/T5YIFR.

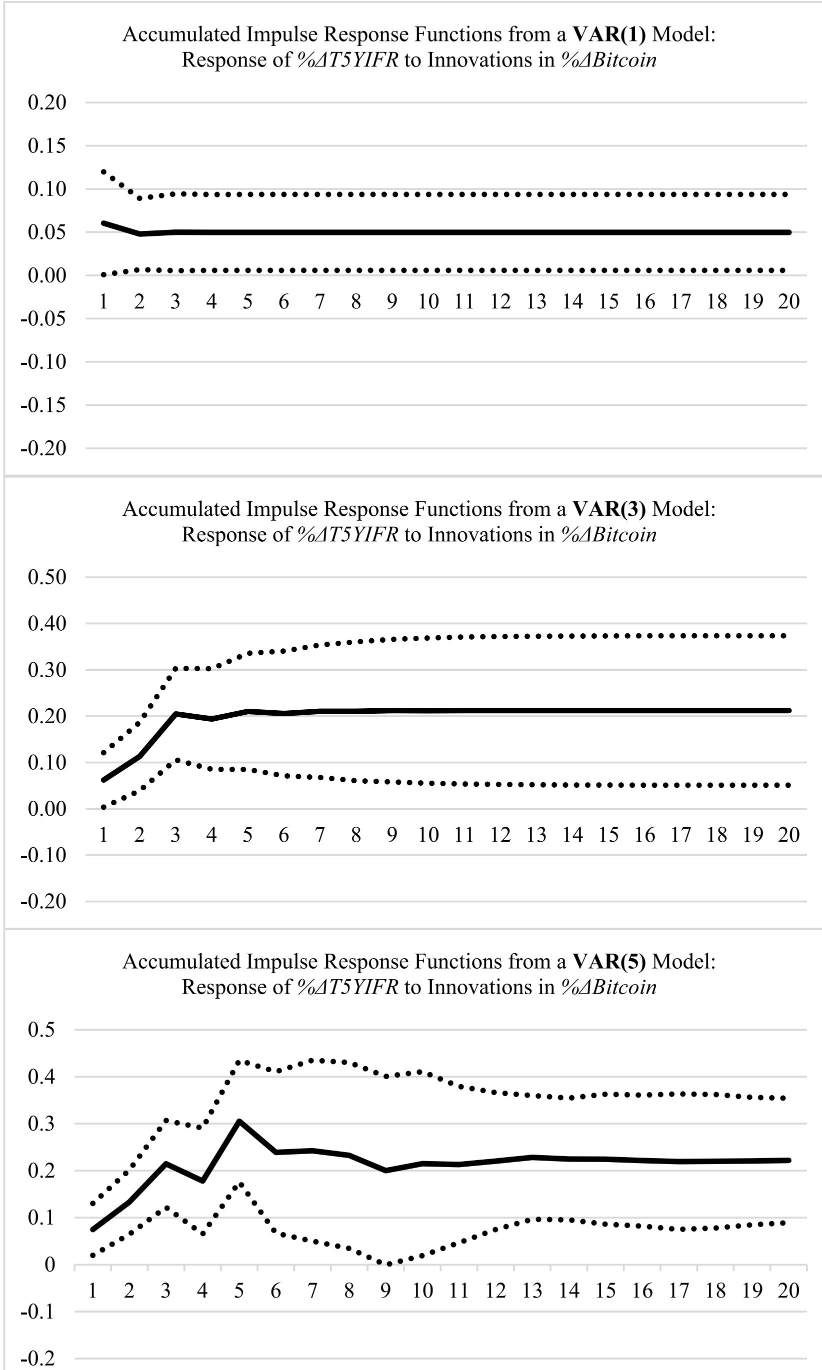

Fig. 1. The figure reports the accumulated impulse response functions from estimating VAR(1), VAR(3), and VAR(5) processes (i.e., one lag, three lags, and five lags) where *%ΔT5YIFR* and *%ΔBitcoin* are treated endogenously. The response of *%ΔT5YIFR* is plotted in response to a one-standard-deviation exogenous shock to *%ΔBitcoin*. The solid line represents the IRF while the dotted lines represent the upper (two-standard deviation) bound and the lower (two-standard deviation) bound.

that unit-roots are present in the time series of both *%ΔT5YIFR* and *%ΔBitcoin* in first-, third-, and fifth-order models.

3. Empirical results

In this section, we present our empirical methods and discuss the results. We estimate specifications of the following vector autoregressive (VAR) process:

$$\begin{bmatrix} \%\Delta T5YIFR_t \\ \%\Delta Bitcoin_t \end{bmatrix} = a_0 + A_1 \begin{bmatrix} \%\Delta T5YIFR_{t-1} \\ \%\Delta Bitcoin_{t-1} \end{bmatrix} + \cdots + A_5 \begin{bmatrix} \%\Delta T5YIFR_{t-5} \\ \%\Delta Bitcoin_{t-5} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}. \quad (3)$$

We estimate both the likelihood ratio test and Akaike's information criterion and determine that the appropriate number of lags in Eq. (3) falls between one and five. To determine the proper ordering of the above VAR model, we begin by estimating Granger Causality tests. We report the results of this analysis in Table 3. The null hypothesis in columns [1], [3], and [5] is that *%ΔBitcoin* do not Granger cause changes *%ΔT5YIFR*. We reject this null hypothesis in each of the three models. Therefore, regardless of the number of lags included in Eq. (3), it appears that daily

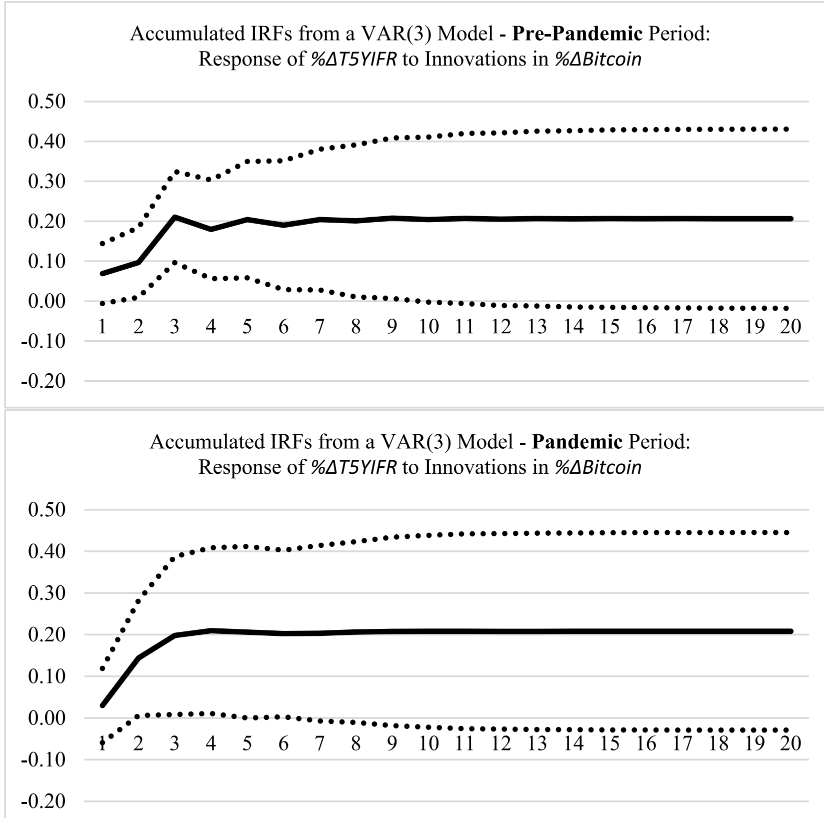

Fig. 2. The figure reports the accumulated impulse response functions from estimating a VAR(3) process (i.e., three lags) where *%ΔT5YIFR* and *%ΔBitcoin* are treated endogenously. The response of *%ΔT5YIFR* is plotted in response to a one-standard-deviation exogenous shock to *%ΔBitcoin*. The solid line represents the IRF while the dotted lines represent the upper (two-standard deviation) bound and the lower (two-standard deviation) bound. The top panel reports the IRF for the pre-pandemic period (1/1/2019 – 3/24/2020) while the bottom panel reports the IRF for the pandemic period (3/25/2020 – 12/31/2020).

changes in Bitcoin prices Granger cause changes in the forward inflation rate. In columns [2], [4], and [6], the null hypothesis is that changes in *%ΔT5YIFR* do not Granger cause changes in *%ΔBitcoin*. We fail to reject the null hypotheses in each of the model specifications with one, three, and five lags. Hence, these initial tests indicate that changes in Bitcoin prices lead to changes in expected inflation but not vice-versa.

While the results above are suggestive of a causal relation from changes in Bitcoin to changes in the expected inflation rate, it is possible that an endogenous relation still exists. Accordingly, we estimate equation (3) with various lags and simulate shocks to the system that are uncorrelated across equations. We then plot out the effects of these shocks on the potentially endogenous variables using accumulated impulse response functions (IRFs). In the figures that follow, the horizontal axis displays the units of time from the VAR process (days). The vertical axis shows the units of the variable *%ΔT5YIFR*.

The impulse response functions from estimating a VAR(1) model, or one lag, in Eq. (3) are reported in the first panel of Fig. 1. We find that an exogenous shock to *%ΔBitcoin* results in an immediate increase in *%ΔT5YIFR*. Economically, a one-standard-deviation increase in the percent change in the price of Bitcoin is associated with a 6- to 7-basis point increase in the percent change in the expected inflation rate. We find that the response by the expected inflation rate remains elevated for at least 20 days following the shock to Bitcoin. In unreported tests, we do not find a feedback effect, where a shock to the *%ΔT5YIFR* results in a meaningful response from Bitcoin in the VAR(1) model.

We also estimate impulse response functions for a VAR(3) and VAR(5) model, in Eq. (3) and report results in the second and third panels of Fig. 1. The results show that an exogenous shock to the percent change in the price of Bitcoin leads to a dramatic increase in the forward inflation rate. In economic terms, a one-standard-deviation unexpected shock to *%ΔBitcoin* results in an immediate increase in expected inflation by roughly 20 basis points for the VAR(3) and 30 basis points for the VAR(5), which remains elevated for at least 20 days. Again, we do not find a feedback effect from the forward inflation rate to changes in Bitcoin prices in the VAR(3) and VAR(5) models.

Fig. 2 provides some additional robustness. We replicate the analysis in Fig. 1 but estimate the VAR process separately for the pre-pandemic period from January 1, 2019, to March 24, 2020, and the pandemic period from March 25, 2020, to December 31, 2020. On March 24, 2020, the U.S. Senate passed the CARES Act in response to the global pandemic, which increased the general worry regarding potential inflation.[10] The top panel reports the IRF for this pre-pandemic period. The bottom panel shows the IRF for the pandemic period. As seen in the figures, the results are fairly similar. Furthermore, we find that accumulated responses of *%ΔT5YIFR* become positive and significant in response to innovations in *%ΔBitcoin*. These results suggest that our findings generally hold for both the pre-pandemic and the pandemic periods, respectively, and are not driven by this unique economic period.[11]

10 See, for example, the following article that was written after the CARES Act was signed into law: https://www.barrons.com/articles/expect-the-unexpected-after-the-crisis-inflation-51585323090.

11 We note that we have estimated the VAR process for other time series, such as all of 2020, July 2019 to June of 2020, April 2019 to March 2020, and we find results are qualitatively similar to those reported in the figures.

Table 3
Granger causality tests.

Null:	VAR(1)		VAR(3)		VAR(5)	
	No Granger Causation from B to F	No Granger Causation from F to B	No Granger Causation from B to F	No Granger Causation from F to B	No Granger Causation from B to F	No Granger Causation from F to B
	[1]	[2]	[3]	[4]	[5]	[6]
χ^2 Statistic	4.13	0.02	18.28	2.07	49.20	3.37
p-value	[0.0421]	[0.8760]	[0.0004]	[0.5582]	[<.0001]	[0.6426]

The table reports the results from estimating a vector autoregressive process using one lag (columns [1] and [2], three lags (columns [3] and [4]), and five lags (columns [5] and [6]). Null hypotheses are stated in the column headings. For instance, column [1] tests the null that no Granger causation exists from *%Bitcoin* (B) to *%ΔT5YIFR* (F). Likewise, the null in column [2] states that no Granger causation exists from *%ΔT5YIFR* (F) to *%Bitcoin* (B). We report the Granger causality tests for the three different VAR processes. Corresponding p-values are reported in brackets.

4. Conclusion

We find that changes in Bitcoin Granger cause changes in the forward inflation rate, but not vice-versa. We also find strong evidence that an unexpected increase in the price of Bitcoin is associated with a significant and persistent increase in the forward inflation rate. The findings in this paper have important implications for both investment managers and policymakers. First, our results suggest that Bitcoin can act as a hedge against expected inflation. This is important for investment professionals looking for inflation-risk protection. Second, our results show that movements in Bitcoin precede changes in expected inflation. Therefore, it appears that Bitcoin behaves similarly to a commodity that can be used as a means of exchange, which is important for policymakers and firms considering the use of an electronic currency.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Al-Yahyaee, K.H., Mensi, W., Yoon, S.M., 2018. Efficiency, multifractality, and the long-memory property of the Bitcoin market: A comparative analysis with stock, currency, and gold markets. Finance Res. Lett. 27, 228–234.
Anari, A., Kolari, J., 2001. Stock prices and inflation. J. Financ. Res. 24 (4), 587–602.
Aye, G.C., Chang, T., Gupta, R., 2016. Is gold an inflation-hedge? Evidence from an interrupted Markov-switching cointegration model. Resour. Policy 48, 77–84.
Bampinas, G., Panagiotidis, T., 2015. Are gold and silver a hedge against inflation? A two-century perspective. Int. Rev. Financ. Anal. 41, 267–276.
Bariviera, A.F., 2017. The inefficiency of Bitcoin revisited: A dynamic approach. Econom. Lett. 161, 1–4.
Baur, D.G., Hong, K., Lee, A.D., 2018. Bitcoin: Medium of exchange or speculative assets? J. Int. Financ. Markets Inst. Money 54, 177–189.
Beckmann, J., Czudaj, R., 2013. Oil prices and effective dollar exchange rates. Int. Rev. Econ. Finance 27, 621–636.
Blau, B.M., 2017. Price dynamics and speculative trading in bitcoin. Res. Int. Bus. Finance 41, 493–499.
Blau, B., Griffith, T., Whitby, R., 2020. Comovement in the cryptocurrency market. Econ. Bull. 40 (1), 1.
Blau, B.M., Whitby, R.J., 2019. The introduction of Bitcoin futures: An examination of volatility and potential spillover effects. Econ. Bull. 39 (2), 1.
Bodie, Z., 1976. Common stocks as a hedge against inflation. J. Finance 31 (2), 459–470.
Bouri, E., Molnár, P., Azzi, G., Roubaud, D., Hagfors, L.I., 2017. On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier? Finance Res. Lett. 20, 192–198.
Branch, B., 1974. Research and development activity and profitability: a distributed lag analysis. J. Polit. Econ. 82 (5), 999–1011.
Cagan, P., 1974. Inflation and market structure 1967–1973. NBER Working Paper, w0033.
Chua, J., Woodward, R.S., 1982. Gold as an inflation hedge: a comparative study of six major industrial countries. J. Bus. Finance Account. 9 (2), 191–197.
Dimitrova, V., Fernández-Martínez, M., Sánchez-Granero, M.A., Trinidad Segovia, J.E., 2019. Some comments on Bitcoin market (in) efficiency. PLoS One 14 (7), e0219243.
Fama, E.F., MacBeth, J.D., 1974. Tests of the multiperiod two-parameter model. J. Financ. Econ. 1 (1), 43–66.
Ghosh, D., Levin, E.J., Macmillan, P., Wright, R.E., 2004. Gold as an inflation hedge? Stud. Econ. Finance 22 (1), 1–25.
Granger, C.W., 1969. Investigating causal relations by econometric models and cross-spectral methods. Econometrica 424–438.
Köchling, G., Müller, J., Posch, P.N., 2019. Does the introduction of futures improve the efficiency of Bitcoin? Finance Res. Lett. 30, 367–370.
Kristoufek, L., 2018. On Bitcoin markets (in) efficiency and its evolution. Physica A 503, 257–262.
Kurihara, Y., Fukushima, A., 2017. The market efficiency of Bitcoin: A weekly anomaly perspective. J. Appl. Finance Bank. 7 (3), 57.
Nadarajah, S., Chu, J., 2017. On the inefficiency of Bitcoin. Econom. Lett. 150, 6–9.
Narayan, P.K., Narayan, S., Rahman, R.E., Setiawan, I., 2019. Bitcoin price growth and Indonesia's monetary system. Emerg. Mark. Rev 38, 364–376.
Oudet, B.A., 1973. The variation of the return on stocks in periods of inflation. J. Financ. Quant. Anal. 24, 7–258.
Peetz, D., Mall, G., 2017. Why Bitcoin is not a currency but a speculative real asset. Available at SSRN 3098765.
Reilly, F.K., Johnson, G.L., Smith, R.E., 1970. Inflation, inflation hedges, and common stocks. Financ. Anal. J. 26 (1), 104–110.
Schilling, L., Uhlig, H., 2019. Some simple bitcoin economics. J. Monetary Econ. 106, 16–26.
Schotman, P.C., Schweitzer, M., 2000. Horizon sensitivity of the inflation hedge of stocks. J. Empir. Financ. 7 (3–4), 301–315.
Selmi, R., Tiwari, A., Hammoudeh, S., 2018. Efficiency or speculation? A dynamic analysis of the Bitcoin market. Econ. Bull. 38 (4), 2037–2046.
Sensoy, A., 2019. The inefficiency of Bitcoin revisited: A high-frequency analysis with alternative currencies. Finance Res. Lett. 28, 68–73.
Tiwari, A.K., Jana, R.K., Das, D., Roubaud, D., 2018. Informational efficiency of Bitcoin—An extension. Econom. Lett. 163, 106–109.
Urquhart, A., 2016. The inefficiency of Bitcoin. Econom. Lett. 148, 80–82.
Urquhart, A., Zhang, H., 2019. Is Bitcoin a hedge or safe haven for currencies? An intraday analysis. Int. Rev. Financ. Anal. 63, 49–57.
Van Hoang, T.H., Lahiani, A., Heller, D., 2016. Is gold a hedge against inflation? New evidence from a nonlinear ARDL approach. Econ. Model. 54, 54–66.
Wang, K.M., Lee, Y.M., Thi, T.B.N., 2011. Time and place where gold acts as an inflation hedge: An application of long-run and short-run threshold model. Econ. Model. 28 (3), 806–819.
Wei, W.C., 2018. The impact of Tether grants on Bitcoin. Econom. Lett. 171, 19–22.
Wu, S., Tong, M., Yang, Z., Derbali, A., 2019. Does gold or Bitcoin hedge economic policy uncertainty? Finance Res. Lett. 31, 171–178.