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Cryptocurrency as an alternative inflation hedge?

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Abstract
We examine the association of Bitcoin, and other cryptocurrency, returns with changes in inflation expectations, and form a comparison with gold, a traditional inflation hedge. We control for uncertainty in economic policy, cryptocurrency, and financial markets, and show that cryptocurrency returns are positively related to changes in US inflation expectations only for a limited set of circumstances. Unlike with gold, the identified relationship is only significant for short-term inflation expectations, and when inflation or market-implied inflation expectations are below 2% (the Fed's inflation target). Moreover, cryptocurrency returns tend to be lower on days with monthly consumer price index (CPI) announcements and respond negatively to CPI surprises. Our results suggest that cryptocurrencies do not currently offer investors a viable alternative to gold for hedging inflation.

KEYWORDS
Bitcoin, breakeven inflation rate, cryptocurrency, gold, inflation expectations

JEL CLASSIFICATION
E31, G10, G14

1 | INTRODUCTION

In recent years, the proponents of Bitcoin (and other cryptocurrencies) have emphasised the limited supply of coins as a means of preventing the monetary inflation associated with fiat currency. The argument is that increased fiat money supply will eventually lead to price inflation, particularly in light of the expansionary policy responses to the COVID-19 pandemic. The speed with which this occurs is dependent on inflation expectations and the monetary transmission mechanism. If this attribute of cryptocurrencies is prized by investors, then we should expect crypto returns to be associated with changes in inflation expectations. The post-pandemic surge in inflation, together with recognition that this may not be a transitory effect, means that market participants are eager to understand which assets offer a hedging opportunity. We evaluate this relationship in comparison to gold, a traditional inflation hedge.

Introduced in 2009, Bitcoin was the first cryptocurrency and, for much of our sample period, it has accounted for over 55% of total crypto market capitalisation. Because of its relative longevity, much of the crypto-related research to date has focused on Bitcoin, including its ability to act as a hedge or safe haven. There continues to be debate as to the 'true' value of holding cryptocurrencies during times of turmoil. For instance, Blau et al. (2021) and Choi and Shin (2022) suggest Bitcoin is useful as an inflation hedge while Conlon et al. (2021) argue there is no clear evidence of this outside of the COVID-19 crisis period. More generally, Mariana et al. (2021) and Hasan et al. (2021) find that Bitcoin and Ethereum possess short-term safe-haven properties for the stock market response to COVID-19, while Dyhrberg (2016a, 2016b) suggests that Bitcoin has similar hedging abilities to gold. However, this is disputed by Baur et al. (2018) who report that the return and volatility characteristics of Bitcoin differ from those of gold. Chan et al. (2019) note that the hedging ability of Bitcoin is related to the sharp price increase of December 2017, while others (e.g., Conlon & McGee, 2020; Smales, 2019) question whether Bitcoin can be a safe haven, and Corbet, Larkin, & Lucey (2020) suggest it may amplify financial contagion.

In contrast, gold has played an important role in the monetary system for millennia and has garnered a reputation for providing an inflation hedge. However, the empirical evidence for this attribute is mixed. For instance, it is argued that the gold–inflation relationship is sensitive to the time-period chosen and is insignificant once the early 1980s are excluded (Batten et al., 2014; Erb & Harvey, 2013). On the other hand, several studies find that gold is an inflation hedge for the US in the long run (Aye et al., 2016; Bampinas & Panagiotidis, 2015; Beckmann & Czudaj, 2013; Hoang et al., 2016) and protects against an increase in the money supply (Lucey et al., 2017).

This paper also relates to the literature concerning the macroeconomic announcement effect on financial market returns. There is an extensive literature providing evidence of a significant response to macroeconomic news in traditional stock (e.g., Boyd et al., 2005; Flannery & Protopapadakis, 2002; McQueen & Roley, 1993; Nikkinen et al., 2006), bond (e.g., Balduzzi et al., 2001; Green, 2004; Smales, 2021), currency (e.g., Andersen et al., 2003; Brooks & Kwok, 1993; Faust et al., 2007) and commodity (e.g., Cai et al., 2001; Elder et al., 2012) markets. Of particular relevance to our study is the strong reaction of gold prices to the monthly CPI release noted by Christie-David et al. (2000), Cai et al. (2001) and Elder et al. (2012). In contrast, the limited studies focusing on cryptocurrencies find that CPI release has a negligible impact on Bitcoin prices (e.g., Corbet, Larkin, Lucey, et al., 2020; Pyo & Lee, 2020) with Lyocsa et al. (2020) noting that exchange hacking announcements have a much larger influence on price volatility.

We seek to find answers to two related questions. First, does Bitcoin, or cryptocurrency more generally, offer a potential hedge to heightened inflation expectations? If so, is this dependent on particular levels of inflation or inflation expectations? Second, does cryptocurrency offer protection against surprises emanating from monthly scheduled CPI announcements? In both cases, we contrast the cryptocurrency response with that of gold. In doing so, we contribute to the continuing discussion on the utility of cryptocurrencies and their value within a diversified portfolio.

Our measures of inflation expectations include inflation swap rates and the break-even inflation rates (BEIR) inferred from Treasury markets. We incorporate both short-term (5-year) and long-term (10-year) inflation expectations, along with a set of control variables for credit conditions, the term structure and uncertainty in cryptocurrency, economic policy and financial markets. Although we do include a brief discussion relating to monthly actual and survey measures of inflation, we focus on inflation expectations derived from financial instruments as they are available at a daily frequency and provide estimates of 'revealed' rather than 'stated' inflation beliefs. In addition, as the cryptocurrency market has developed, other coins have gained some prominence and Bitcoin's market dominance has fallen. We reflect this by expanding our sample to include other cryptocurrencies and find that they share similar inflation hedge properties to Bitcoin. In demonstrating that cryptocurrency prices have some capacity to respond to innovations in inflation expectations, we also contribute to the literature that demonstrates crypto markets have become more efficient over time (e.g., Bariviera, 2017; Blau, 2017; Nadarajah & Chu, 2017; Tiwari et al., 2018; Urquhart, 2016; Vidal-Tomas & Ibanez, 2018).

We extend the sample period used in the earlier literature to evaluate the cryptocurrency return–inflation relationship during a complete monetary policy cycle.[1] In doing so, we contribute to the literature as the first to consider a full policy cycle, and in turn provide evidence that the inflation-hedging capabilities of cryptocurrency appear to be limited to periods of low inflation. In addition, we evaluate the relative performance of both gold and cryptocurrencies against market-based measures of inflation expectations (BEIR), survey-based measures of inflation expectations (Conference Board and University of Michigan), and realised inflation (CPI and Core CPI).

Our empirical results indicate that both gold and cryptocurrency returns increase when inflation expectations rise, even after incorporating a set of control variables and changes in cryptocurrency uncertainty. This is true whether we measure inflation expectations using daily market-based measures or monthly survey-based measures. We identify a structural break in the return–inflation relationship that occurs in early March 2020, amid the COVID-pandemic. Consistent with asset returns becoming more correlated during times of crisis (Forbes & Rigobon, 2002), we find that gold and bitcoin returns become more positively related to stock returns[2] and changes in inflation expectations post-breakpoint.[3] Further, when inflation and inflation expectations rise above the Federal Reserve's 2% target, we find that the cryptocurrency return–inflation relationship becomes insignificant. In contrast, the gold return–inflation relationship remains positive and significant even when inflation rises above 3% (and higher). Finally, we find that cryptocurrency returns are generally negative on days when there is a monthly CPI announcement, and are negatively related to CPI surprises (i.e., returns are lower when CPI is higher than expected), whereas gold returns are positive on announcement days and insignificantly related to CPI surprises.

Together, our results suggest that cryptocurrencies only seem to offer an inflation hedge under a restricted set of conditions,[4] consistent with Conlon et al. (2021), when inflation expectations and/or actual levels of inflation (personal consumption expenditures, PCE) are below the Fed's 2% target, and do not hedge against CPI announcement surprises. In other words, cryptocurrencies are unable to hedge against inflation when it is most desirable. In contrast, gold appears to have maintained an ability to fulfil a role as a potential inflation hedge, and so we provide additional evidence that cryptocurrencies are not the 'new gold' (Klein et al., 2018).

The paper proceeds as follows: Section 2 details the data used in our study, focusing on cryptocurrency returns and measures of inflation expectations. Section 3 outlines our empirical analysis and Section 4 concludes.

[1]A monetary policy cycle can be thought of as a trough to peak (and back again) in the Fed Funds target rate.

[2]Gonzalez et al. (2021) and Goodell and Goutte (2021) also note greater interdependency between gold, cryptocurrency and stock returns during the COVID-19 pandemic.

[3]Consistent with Drake (2022), gold returns are negatively correlated with stock returns pre-crisis and positive correlated post-crisis.

[4]Investors should also consider the higher levels of volatility present in cryptocurrency returns.

2 | DATA

We focus on returns in the five largest market capitalisation cryptocurrency coins. This includes Bitcoin (*BTC*), Ethereum (*ETH*), Binance Coin (*BNB*), Dogecoin (*DOGE*) and XRP (*XRP*), but excludes stablecoins and tokens. We also assess the performance of the Bloomberg Galaxy Cryptocurrency Index (*BGCI*), which is an investable index designed to capture the performance of the largest cryptocurrencies. In addition to the nascent cryptocurrency market, our analysis considers the traditional inflation hedge of gold. We focus on the SPDR gold trust ETF (*GLD*) as this is the most prevalent investable instrument for investors.[5]

We employ two types of market-implied US inflation expectation estimates. First, we use the *breakeven inflation rate* derived from 5- (or 10-) year Treasury constant maturity securities and 5- (or 10-) year Treasury inflation-indexed constant maturity securities. Second, we use the 5- and 10-year *inflation swap rates*, where an inflation swap is a financial instrument that involves one party paying a fixed rate in exchange for receiving a floating rate that is linked to an inflation index. In both cases, the rate implies the average level of expected inflation over the next 5 (or 10) years. We focus on US inflation instead of a larger sample of countries because both gold and Bitcoin tend to be priced in US dollars, the inflation rates between developed economies tends to be high (Batten et al., 2014), and the US market for inflation-indexed financial instruments is well established.

Data for gold and inflation expectations are obtained from Bloomberg, and cryptocurrency data are obtained from CoinMarketCap.[6] Our sample period runs from January 2012 to November 2022, with log returns calculated using daily closing prices ($R_t = 100*\log(P_t/P_{t-1})$). Although cryptocurrencies are traded through the weekend, other financial markets are closed. We therefore remove weekend trading (when crypto liquidity is relatively low) from our sample so that the time series align.

Panel A of Figure 1 shows that, after declining at the start of the sample, the gold price rose steadily from mid-2018 to 2020. However, this is vastly outstripped by the increase in Bitcoin's price (along with that of other cryptocurrencies) up until the end of 2021. Subsequently, Bitcoin has declined more than 70% from its peak while gold has remained stable.

Panels B and C illustrate the evolution of inflation expectations and actual inflation (year-on-year CPI and PCE deflator). Both hovered around the Fed target of 2% for much of the sample period, before plunging at the start of the COVID-19 pandemic (March 2020). Subsequently, inflation measures rose sharply, to levels not seen since the early-1980s, before starting to fall at the end of our sample period. Notably, while the measures of actual inflation remain elevated (CPI of 7.7% and PCE of 6.2%), the measures of inflation expectations are back to 2012 levels, indicating that market expectations are for inflation to continue to fall.

Table 1 provides summary statistics for returns (Panel A) and inflation expectations (Panel B). The mean and standard deviation of returns for cryptocurrencies are much higher than for gold. On average, the breakeven inflation rate lies below the equivalent inflation swap rate, and short-term (5Y) inflation expectations are below long-term (10Y). All measures of inflation expectations are within 1 standard deviation of the 2% Fed target, even after the recent inflation surge. All of the time series are stationary (augmented Dickey-Fuller with trend) and exhibit 'fat-tails' common in financial markets.

FIGURE 1 Gold and crypto prices with inflation. *Note*: This figure depicts the prices of gold ETF (*GLD*) and Bitcoin (*BTC*) in Panel A, inflation expectations (breakeven inflation rates and inflation swaps) in Panel B, and monthly inflation releases (CPI YoY and PCE YoY) in Panel C.

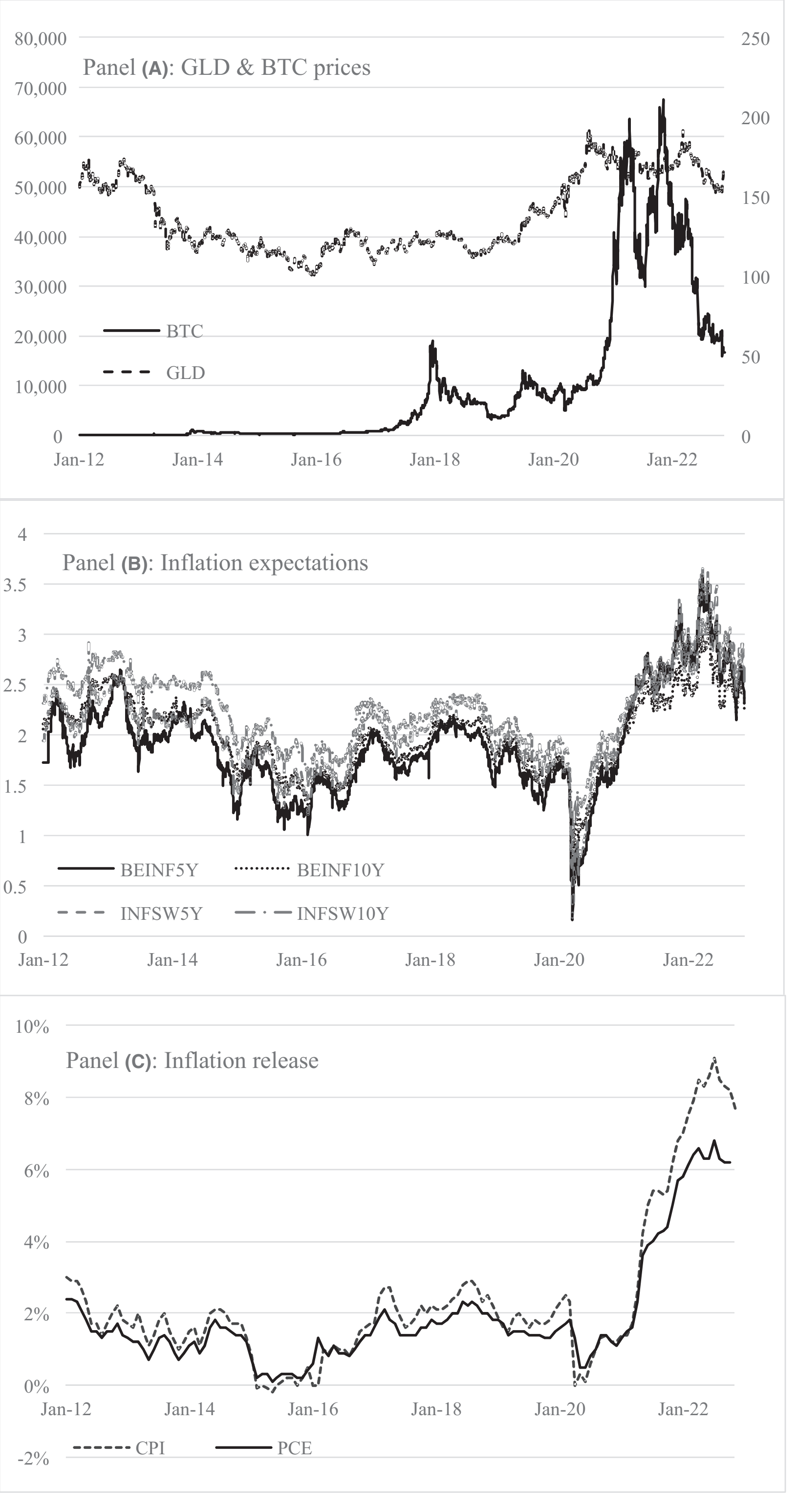
Panel (A): GLD & BTC prices
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
250
200
150
100
50
0
BTC
GLD
Jan-12
Jan-14
Jan-16
Jan-18
Jan-20
Jan-22
Panel (B): Inflation expectations
4
3.5
3
2.5
2
1.5
1
0.5
0
BEINF5Y
BEINF10Y
INFSW5Y
INFSW10Y
Jan-12
Jan-14
Jan-16
Jan-18
Jan-20
Jan-22
Panel (C): Inflation release
10%
8%
6%
4%
2%
0%
-2%
Jan-12
Jan-14
Jan-16
Jan-18
Jan-20
Jan-22
CPI
PCE

TABLE 1 Summary statistics.

Panel A: Gold/ crypto returns	Level		Daily return					
	Mean	SD	Mean	SD	Skewness	Kurtosis	ADF	No. obs.
GLD	138.60	23.2	0.003	0.96	−0.51	9.12	−52.2*	2704
GOLD	1458.49	253.1	0.004	0.96	−0.60	10.78	−52.9*	2704
BNB	136.47	182.1	0.585	8.81	1.66	43.77	−37.1*	1339
BTC	9797.47	15214.7	0.306	5.34	−0.82	22.14	−53.3*	2704
DOGE	0.035	0.08	0.272	10.16	4.49	62.18	−46.9*	2212
ETH	815.71	1120.5	0.414	7.40	0.53	11.98	−40.9*	1798
XRP	0.305	0.36	0.183	8.31	1.24	17.98	−44.3*	2305
BGCI	1046.90	897.3	0.105	5.24	−0.66	6.87	−36.2*	1333

Panel B: Inflation expectations	Level		Daily return					
	Mean	SD	Mean	SD	Skewness	Kurtosis	ADF	No. obs.
BEINF5Y	1.921	0.51	0.005	3.15	−2.77	122.41	−22.9*	2675
BEINF10Y	2.007	0.38	0.005	1.86	0.29	58.29	−28.9*	2704
INFSW5Y	2.104	0.49	0.009	3.02	0.87	209.13	−19.4*	2695
INSW10Y	2.261	0.38	0.003	1.78	1.39	81.05	−29.1*	2695

Note: This table provides summary statistics for the key variables of interest. Panel A provides information on returns for gold ETF (*GLD*) and bullion (*GOLD*) as well as the five cryptocurrency coins with greatest market capitalisation – Bitcoin (*BTC*), Ethereum (*ETH*), Binance Coin (*BNB*), Dogecoin (*DOGE*) and XRP (*XRP*) – and the Bloomberg Galaxy Crypto Index (BGCI). Panel B provides information on measures of inflation expectations including the 5- and 10-year breakeven inflation rates (*BEINF5Y*, *BEINF10Y*) and the 5- and 10-year inflation swap rates (*INFSW5Y*, *INFW10Y*). *Statistical significance at the 1% level. Sample period: January 2012–November 2022.

As a first step in our analysis, we consider the correlation of gold, Bitcoin, and stock index returns with changes in inflation expectations, and report the Spearman rank-order coefficients in Table 2. Panel A shows that for the whole sample, Bitcoin returns are positively correlated with stock returns (at the 1% level) and changes in inflation expectations (at the 5% level). Similarly, stock returns are positively correlated with changes in inflation expectations. Overall, gold returns are uncorrelated with the other variables.

We then use a structural break occurring in March 2020, identified in our initial regression tests, to separate the sample into pre-COVID and post-COVID periods and illustrate a significant change in the reported correlations. Pre-COVID (Panel B) we find that Bitcoin returns are not significantly correlated with stock returns or inflation expectations, while gold returns are negatively correlated (at the 1% level) with both stock returns and inflation expectations. Post-COVID (Panel C) Bitcoin returns are significantly positively correlated with gold, stocks and inflation expectations, and the gold correlations switch from negative to positive.

3 | EMPIRICAL ANALYSIS

The empirical analysis utilises an OLS regression model of the form:

$$R_t = \alpha + \beta_1 \% \Delta IE_t + \sum_{j=2,3,4,5} \beta_j Control_{j,t} + \beta_6 R_{t-1} + \varepsilon_t \quad (1)$$

TABLE 2 Correlation table.

	r_BTC	*r_GLD*	*r_NASDAQ*	*r_SP500*	*%ΔVIX*	*%ΔBEINF5Y*
Panel A: Whole sample						
r_GLD	*0.045*					
r_NASDAQ	**0.130**	0.014				
r_SP500	**0.117**	0.010	**0.916**			
%ΔVIX	**−0.089**	0.003	**−0.736**	**−0.774**		
%ΔBEINF5Y	*0.044*	0.020	**0.300**	**0.344**	**−0.291**	
%ΔINFSW5Y	*0.048*	−0.012	**0.209**	**0.233**	**−0.210**	**0.661**
Panel B: Pre-COVID break						
r_GLD	0.014					
r_NASDAQ	0.015	**−0.058**				
r_SP500	0.012	**−0.057**	**0.918**			
%ΔVIX	−0.001	**0.066**	**−0.754**	**−0.795**		
%ΔBEINF5Y	0.022	*−0.038*	**0.336**	**0.378**	**−0.312**	
%ΔINFSW5Y	0.030	**−0.081**	**0.209**	**0.231**	**−0.200**	**0.591**
Panel C: Post-COVID break						
r_GLD	**0.122**					
r_NASDAQ	**0.407**	**0.166**				
r_SP500	**0.367**	**0.154**	**0.919**			
%ΔVIX	**−0.337**	**−0.151**	**−0.715**	**−0.748**		
%ΔBEINF5Y	**0.112**	**0.160**	**0.222**	**0.273**	**−0.231**	
%ΔINFSW5Y	**0.099**	**0.142**	**0.202**	**0.236**	**−0.224**	**0.806**

Note: This table provides Spearman rank-order coefficients for variables of interest. This includes returns for gold ETF (*GLD*) and Bitcoin (*BTC*) as well as monthly percentage changes in the 5-year breakeven inflation rates (*BEINF5Y*) and 5-year inflation swap rates (*INFSW5Y*). Stock market variables are included for illustrative purposes, including returns on NASDAQ and S&P500 composite indices, and percentage changes in the CBOE VIX index. Panel A shows the coefficients for the whole sample period. Panel B shows coefficients for the Pre-COVID period (January-2012 to March-2020), and Panel C shows coefficients for the Post-COVID period (March-2020 to November-2022). Bold indicates statistical significance at the 1% level, italics indicate significance at the 5% level. Sample period: January 2012–November 2022.

where R_t is the daily return for gold or cryptocurrency, R_{t-1} is the lagged daily return, and $\%\Delta IE_t$ is the daily percentage change in inflation expectations. A set of four control variables is included to represent the state of the economy and market uncertainty at time *t*. Economic policy uncertainty is captured by the *EPU* index (Baker et al., 2016), financial market uncertainty is encapsulated by the CBOE implied volatility index (*VIX*), the TED spread (*TED*) provides a measure of credit risk, and the difference between 2- and 10-year Treasury yields represents the term premium (*TERM*). Newey-West standard errors correct for heteroscedasticity.

3.1 | Baseline regression

In Table 3 (Panel A), we report the baseline univariate coefficient estimates, where the return is regressed on a measure of inflation expectation. We initially focus on Bitcoin returns as they offer the longest sample period and Bitcoin continues to constitute a significant portion of the overall cryptocurrency market. We identify a statistically significant positive relationship between inflation expectations and returns in gold and Bitcoin markets. When we include both 5- and 10-year estimates in the same regression model, the short-term (5-year) expectations

TABLE 3 The relationship between inflation expectations and daily returns of Bitcoin and Gold.

	r_GLD	*r_GLD*	*r_GLD*	*r_GLD*	*r_GLD*	*r_GLD*	*r_BTC*	*r_BTC*	*r_BTC*	*r_BTC*	*r_BTC*	*r_BTC*
Panel A: Univariate regression												
Constant	−0.001	0.003	−0.001	0.001	0.001	0.001	0.297***	0.305***	0.297***	0.290***	0.290***	0.290***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.107)	(0.107)	(0.107)	(0.107)	(0.017)	(0.107)
%ΔBEINF5Y	0.026***		0.032***				0.149***		0.114*			
	(0.007)		(0.011)				(0.045)		(0.064)			
%ΔBEINF10Y		0.032*	−0.012					0.230***	0.075			
		(0.018)	(0.026)					(0.087)	(0.119)			
%ΔINFSW5Y				0.020**		0.057***				0.107**		0.079
				(0.009)		(0.015)				(0.048)		(0.066)
%ΔINFSW10Y					0.015	−0.071***					0.173**	0.055
					(0.020)	(0.026)					(0.081)	(0.123)
Adj. R^2	0.007	0.004	0.007	0.004	0.000	0.007	0.008	0.006	0.007	0.003	0.003	0.003
F-statistic	19.83	10.51	10.16	10.64	2.04	10.32	21.44	17.44	11.06	9.98	9.01	5.09
No. obs.	2675	2704	2675	2695	2695	2695	2675	2704	2675	2695	2695	1695
Panel B: Multiple regression												
Constant	−0.005	−0.003	−0.005	−0.003	−0.003	−0.003	0.298***	0.301***	0.298***	0.294***	0.294***	0.297***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.106)	(0.107)	(0.107)	(0.107)	(0.107)	(0.107)
%ΔBEINF5Y	0.033***		0.028**				0.114**		0.099			
	(0.007)		(0.012)				(0.044)		(0.066)			
%ΔBEINF10Y		0.049***	0.012					0.158*	0.034			
		(0.014)	(0.024)					(0.086)	(0.126)			
%ΔINFSW5Y				0.023***		0.049***				0.074*		0.066
				(0.007)		(0.013)				(0.045)		(0.064)
%ΔINFSW10Y					0.229	−0.050**					0.116	0.017
					(0.015)	(0.025)					(0.079)	(0.013)

TABLE 3 (Continued)

	r_GLD	*r_GLD*	*r_GLD*	*r_GLD*	*r_GLD*	*r_GLD*	*r_BTC*	*r_BTC*	*r_BTC*	*r_BTC*	*r_BTC*	*r_BTC*
$\%\Delta EPU$	0.039	0.032	0.039	0.030	0.031	0.029	−0.003	−0.005	−0.003	−0.037	−0.034	−0.037
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.194)	(0.195)	(0.194)	(0.194)	(0.194)	(0.194)
$\%\Delta VIX$	−0.001	−0.002	−0.001	−0.003	−0.004	−0.003	−0.064***	−0.067***	−0.064***	−0.072***	−0.072***	−0.072***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.019)	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)
ΔTED	−0.014**	−0.013**	−0.014**	−0.013**	−0.013**	−0.014**	−0.049	−0.050	−0.048	−0.048	−0.047	−0.048
	(0.055)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.046)	(0.045)	(0.046)	(0.045)	(0.046)	(0.046)
$\Delta TERM$	−4.646***	−4.820***	−4.710***	−4.483***	−4.517***	−4.303***	−4.358	−4.079	−4.545	−3.175	−3.526	−3.236
	(0.681)	(0.699)	(0.699)	(0.676)	(0.701)	(0.683)	(3.003)	(3.094)	(3.219)	(2.964)	(2.997)	(3.064)
Lag(Return)	−0.006	−0.007	−0.007	−0.008	−0.004	−0.009	−0.012	−0.022	−0.012	−0.021	−0.020	−0.021
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Adj. R^2	0.036	0.033	0.036	0.030	0.027	0.032	0.017	0.016	0.016	0.015	0.015	0.014
F-statistic	17.54	16.45	15.10	15.03	13.55	13.62	8.58	8.21	7.37	7.74	7.61	6.64
No. obs.	2675	2703	2675	2695	1695	2695	2675	2703	2675	2695	2695	2695

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on the SPDR gold ETF (*GLD*) or Bitcoin (*BTC*). The key explanatory variable is the daily percentage change in 5- and 10-year breakeven inflation rates (*BEINF5Y*, *BEINF10Y*) or inflation swaps (*INFSW5Y*, *INFSW10Y*). Control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*), and the 2Y10Y term premium (*TERM*). Newey-West standard errors are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period: January 2012–November 2022.

appear to dominate. However, the high variance inflation factors relating to those models mean that we are reluctant to focus on models with both terms to avoid multicollinearity issues.

Once we introduce the set of controls into our model (Panel B) we find that the identified relationships are maintained for gold, but the only association that remains statistically significant for Bitcoin is for the 5-year breakeven inflation rate. This is a first indication that the return–inflation relationship is stronger for gold than for Bitcoin. A 1-standard deviation increase in the 5-year break even inflation rate (3.15) is associated with a GLD ETF return of 10.4 bps or a Bitcoin return of 35.9 bps.

Control variable estimates imply that both gold and Bitcoin returns are higher when credit spreads (*TED*) decline, and when the term structure flattens (*TERM*) although the relationships are only statistically significant for *GLD*. Gold and Bitcoin returns are lower when financial market uncertainty (*VIX*) increases, but this relationship is not well-defined for gold, suggesting that financial market uncertainty is particularly important for Bitcoin (consistent with Choi & Shin, 2022). Economic policy uncertainty appears to have no significant relationship with returns. The results are consistent with gold fulfilling its traditional role as a hedge against changes in inflation and suggest there is limited evidence for Bitcoin offering an alternative hedge, particularly for changes in shorter-term (5-year) inflation expectations. Appendix 1 shows that the baseline results are not significantly impacted by our choice to use changes in *EPU* and *VIX* rather than the natural log of the *EPU* and *VIX* level.

As Bitcoin is the oldest, largest and most widely recognised cryptocurrency, it is possible that it possesses inflation hedging properties that are not held by other cryptocurrencies. We test whether this is the case by repeating our analysis with four other large cryptocurrency coins (*BNB*, *DOGE*, *ETH* and *XRP*), an equally-weighted portfolio of the five coins (*CRYPTO*), the Bloomberg Galaxy Crypto Index (*BGCI*) and a panel model with coin cross-section fixed-effects (*PANEL*). Panel A of Table 4 reports the estimated coefficients in the case where inflation expectations are represented by the 5-year breakeven inflation rate (*BEINF5Y*).[7] In all cases, there is a negative relationship with financial market uncertainty and a positive relationship between inflation expectations and cryptocurrency returns. This suggests that the response to changes in short-term inflation expectations might be held by a range of cryptocurrencies and not limited to Bitcoin alone.

In Panel B we augment our model with the cryptocurrency uncertainty index (*UCRY*) of Lucey et al. (2021). We had excluded this variable from prior models as we wished to utilise a sample period as lengthy as that allowed by availability of Bitcoin data.[8] However, it is possible that part of the identified response is also captured by *UCRY* and so we also consider a model specification with this included as a control variable. As one might expect, Bitcoin (and crypto returns more generally) are negatively related to *UCRY* but not significantly so. The inflation expectation–return relationship remains similar although the level of significance drops for *DOGE* and *CRYPTO*.

3.2 | Stability of estimated relationships

We conduct additional tests on the prior models to determine whether there is any evidence of structural breaks. We use the Bai and Perron (2003) method to allow for multiple breaks at unknown dates. In all cases, the tests indicate with a high degree of significance that a structural break occurs between 9 March 2020 and 13 March 2020. This is the breakpoint referred

[7]We repeat the analysis with our other measures of inflation expectations (*BEINF10Y*, *INFSW5Y* and *INFSW10Y*) and find qualitatively similar results to those found for BTC in Table 2.

[8]We are able to obtain Bitcoin data as of January 2012, while the UCRY index is available from December 2013 (https://sites.google.com/view/cryptocurrency-indices/home).

TABLE 4 The relationship between inflation expectations and the daily returns of leading cryptocurrencies.

	r_BTC	*r_BNB*	*r_DOGE*	*r_ETH*	*r_XRP*	*r_CRYPTO*	*r_BGCI*	*r_PANEL*
Panel A: Excl. *UCRY*								
Constant	0.298***	0.600**	0.250	0.368**	0.171	1.298	0.117	0.307***
	(0.106)	(0.274)	(0.212)	(0.167)	(0.185)	(0.841)	(0.145)	(0.077)
$\%\Delta BEINF5Y$	0.114**	0.088	0.106***	0.153**	0.057	0.500**	0.120***	0.105***
	(0.044)	(0.076)	(0.041)	(0.068)	(0.054)	(0.253)	(0.045)	(0.027)
$\%\Delta EPU$	−0.003	−0.658	−0.079	0.472	0.527	−1.861	−0.466	0.113
	(0.194)	(0.635)	(0.365)	(0.343)	(0.352)	(1.691)	(0.288)	(0.170)
$\%\Delta VIX$	−0.064***	−0.187***	−0.137***	−0.138**	−0.103***	−0.821***	−0.120***	−0.119***
	(0.019)	(0.043)	(0.035)	(0.030)	(0.024)	(0.148)	(0.023)	(0.014)
ΔTED	−0.049	−0.049	−0.068	−0.062	−0.024	−0.266	−0.072*	−0.050**
	(0.046)	(0.051)	(0.060)	(0.057)	(0.046)	(0.254)	(0.041)	(0.024)
$\Delta TERM$	−4.358	−1.987	−8.263	−3.845	−3.321	−2.035	−5.261	−5.659**
	(3.003)	(5.370)	(6.228)	(5.582)	(4.734)	(21.870)	(3.949)	(2.266)
Lag(Return)	−0.012	−0.006	0.004	0.047	−0.080**	−0.034	0.001	0.024
	(0.031)	(0.038)	(0.037)	(0.030)	(0.034)	(0.032)	(0.032)	(0.023)
Adj. R^2	0.017	0.036	0.014	0.039	0.017	0.071	0.062	0.020
F-statistic	8.58	9.21	6.17	13.00	7.56	18.06	15.58	22.46
No. obs.	2675	1338	2211	1797	2304	1338	1332	10,330
Panel B: Incl. *UCRY*								
Constant	0.158	0.644**	0.236	0.392**	0.121	1.409*	0.149	0.275***
	(0.101)	(0.279)	(0.204)	(0.169)	(0.177)	(0.842)	(0.146)	(0.077)
$\%\Delta BEINF5Y$	0.116***	0.085	0.102**	0.154**	0.054	0.492*	0.120***	0.103***
	(0.044)	(0.077)	(0.041)	(0.069)	(0.053)	(0.259)	(0.046)	(0.028)
$\%\Delta UCRY$	−0.118	−0.473*	−0.214	−0.209	−0.112	−0.529	−0.265	−0.139
	(0.170)	(0.251)	(0.365)	(0.226)	(0.211)	(1.101)	(0.196)	(0.110)
Controls	YES	YES	YES	YES	YES	YES	YES	YES

(Continues)

TABLE 4 (Continued)

	r_BTC	*r_BNB*	*r_DOGE*	*r_ETH*	*r_XRP*	*r_CRYPTO*	*r_BGCI*	*r_PANEL*
Adj. R^2	0.028	0.037	0.015	0.038	0.019	0.070	0.064	0.024
F-statistic	10.05	8.15	5.74	10.96	7.09	15.02	13.65	22.04
No. obs.	2166	1304	2166	1763	2166	1304	1298	9565

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on a set of cryptocurrencies including Bitcoin (*BTC*), Binance Coin (*BNB*), Dogecoin (*DOGE*), Ethereum (*ETH*) and XRP (*XRP*), along with an equally weighted portfolio of the five cryptocurrencies (*CRYPTO*) and the Bloomberg Galaxy Crypto Index (*BGCI*). The key explanatory variable is the daily percentage change in 5-year breakeven inflation rates (*BEINF5Y*). In Panel A the control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*) and the 2Y10Y term premium (*TERM*). In Panel B the cryptocurrency uncertainty index (UCRY) is added. Cross-section fixed-effects are included for the panel data shown in the last column. Newey-West standard errors are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period in Panel A: January-2012 to November-2022. Sample period in Panel B: December-2013 to September-2022.

TABLE 5 Structural break and stability of identified relationships.

	Pre-COVID break			Post-COVID break		
	r_GLD	*r_BTC*	*r_PANEL*	*r_GLD*	*r_BTC*	*r_PANEL*
Constant	−0.006	0.361***	0.326***	−0.006	0.079	0.237*
	(0.021)	(0.128)	(0.096)	(0.034)	(0.170)	(0.125)
%ΔBEINF5Y	0.021	0.096	0.101*	0.034***	0.102***	0.084***
	(0.116)	(0.070)	(0.057)	(0.011)	(0.036)	(0.027)
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.021	0.000	0.006	0.091	0.159	0.084
F-statistic	8.04	1.03	5.16	12.38	22.38	32.44
No. obs.	1995	1995	6930	680	680	3405

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on the SPDR gold ETF (*GLD*), Bitcoin (*BTC*) or panel of five leading cryptocurrencies (*PANEL*). The key explanatory variable is the daily percentage change in 5-year breakeven inflation rates (*BEINF5Y*). Unreported control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*) and the 2Y10Y term premium (*TERM*). Cross-section fixed-effects are included for the panel data. Newey-West standard errors are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period: January 2012–November 2022 with the COVID breakpoint occurring on 09-March-2020.

to in Table 2 and we demonstrate the effect on the stability of our regression analysis in Table 5. The estimated results confirm that the return–inflation relationship is only significant in the post-COVID break period.

Additional evidence on the varying nature of the estimated relationship is provided in Figure 2. We re-run Equation (1) over a rolling 2-year window and plot the estimated inflation expectation coefficient (*%ΔBEINF5Y*). To ease readability, we do not include confidence intervals in Figure 2. However, we note that the estimated coefficients for *r_BTC/BEIR* are only statistically significant for the period from March 2020 onwards; this is due to the large standard error of the rolling estimates that is related to the highly variable coefficient. In contrast, the rolling estimates for *r_GLD/BIER* have a low standard error and are statistically significant for much of the sample period. This estimate is positive and reasonably stable through time, except for a short period from June 2019 to March 2020 when it becomes slightly negative.

Perhaps of more concern for investors seeking a potential inflation hedge are the circumstances under which the return–inflation relationship changes. In particular, investors will be interested as to whether the relationship differs according to the pervading level of inflation. In managing monetary policy, the Federal Reserve has a target of 2% growth in the PCE price index. To maintain inflation around this target, it is important to also anchor inflation expectations in the 2% range. Therefore, there is a possibility that our findings differ when either expected or actual inflation is above or below this target. We assess this by repeating our earlier analysis with the sample disaggregated into periods when actual inflation (PCE price deflator), or inflation expectations (*BEINF5Y*), are above or below the 2% target.[9]

In Table 6 we disaggregate the sample according to whether actual inflation is at or below (Panel A), above (Panel B) or far above (Panel C) the Fed target. For both gold and cryptocurrencies, the estimated relationship is positive regardless of the prevailing PCE price index. For cryptocurrencies, the relationship becomes insignificant once inflation rises above the

[9]The choice of the 2% threshold level is based on the official Fed inflation target. If we adopt the method of Hansen (1996) to estimate the threshold level of PCE, allowing the threshold variable to vary from the 15th to 85th percentile and a delay parameter of up to 6 months, then we identify a level of 2.3%. This is close to our intuitive level of 2% and is effectively encapsulated by Panels B (>2%) and C (>3%) of Table 6.

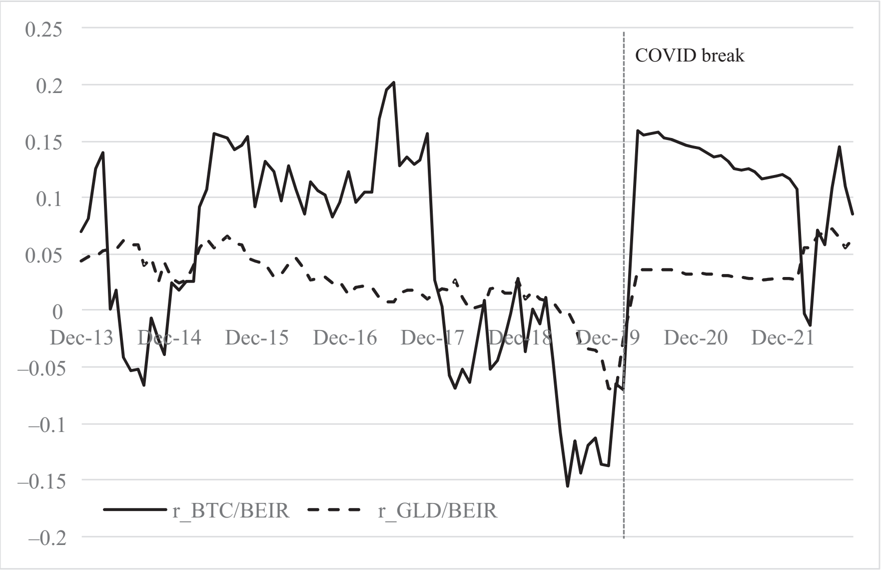

FIGURE 2 Rolling coefficient estimates. *Note*: This figure depicts the rolling coefficient estimates for the association between percentage changes in the 5-year breakeven inflation rate (*BEIR*) and Bitcoin (*BTC*) or gold (*GLD*) returns.

Fed target. However, for gold the relationship remains statistically positive even when the actual level of inflation rises above 2% (and 3%). The explanation for the differing results can be related to the likelihood of Federal Open Market Committee (FOMC) monetary policy actions and 'novelty bias'. When inflation is low (below 2%) there is not likely to be a significant FOMC response, monetary policy can remain loose (supporting 'risky' assets such as cryptocurrency). Additionally, investors may pay relatively little attention to the inflation rate since it has been subdued for some time. However, bouts of high inflation are new or novel, so investors pay more attention at a time when it becomes more likely that the FOMC will tighten monetary policy (decreasing the attractiveness of 'risky' assets).

Similar results are found in Table 7 when we disaggregate the sample dependent on inflation expectations (*BEINF5Y*[10]) below (Panel A), above (Panel B) or far above (Panel C) the 2% objective. The relationship between changes in expected inflation and gold returns is positive and significant regardless of whether inflation expectations are above or below 2%. Indeed, as with PCE levels, the magnitude of the coefficient is larger when inflation measures are above 2%. Intuitively, this fits the purpose of an inflation hedge since a greater response is elicited when inflation is perceived to be more likely to exceed the Fed's remit. In contrast, the identified relationship for Bitcoin (and other cryptocurrencies) is only present when inflation expectations are below 2%. That is, the inflation hedge properties of Bitcoin only seem to be present when they are least required.

3.3 | Alternative inflation measures

To this point, we have focused on inflation expectations as implied by traded financial instruments. This has the advantage of providing high frequency (daily) measures of inflation expectations based on the actions of market participants, providing 'revealed preference' of

[10]Qualitatively similar results are obtained when using alternative measures (*BEINF10Y*, *INFSW5Y* and *INFSW10Y*) to disaggregate the sample.

TABLE 6 What happens when inflation deviates from the Fed's target?

	r_GLD	*r_GLD*	*r_BTC*	*r_BTC*	*r_PANEL*	*r_PANEL*
Panel A: PCE ≤2%						
Constant	0.002	0.002	0.446***	0.446***	0.460***	0.463***
	(0.020)	(0.020)	(0.126)	(0.126)	(0.095)	(0.095)
%ΔBEINF5Y	0.033***		0.125***		0.113***	
	(0.007)		(0.046)		(0.029)	
%ΔINFSW5Y		0.023***		0.084*		0.044
		(0.007)		(0.049)		(0.028)
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.042	0.036	0.010	0.006	0.014	0.012
F-statistic	16.51	14.09	4.39	3.27	11.43	9.86
No. obs.	2103	2103	2103	2103	7614	7614
Panel B: PCE >2%						
Constant	−0.026	−0.017	−0.240	−0.267	−0.127	−0.132
	(0.035)	(0.035)	(0.176)	(0.181)	(0.124)	(0.125)
%ΔBEINF5Y	0.067***		0.070		0.092	
	(0.024)		(0.123)		(0.068)	
%ΔINFSW5Y		0.058**		0.050		0.045
		(0.028)		(0.114)		(0.073)
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.046	0.035	0.098	0.100	0.069	0.068
F-statistic	5.54	4.55	11.30	11.89	21.04	21.04
No. obs.	572	592	572	592	2716	2736
Panel C: PCE >3%						
Constant	−0.003	−0.003	−0.311	−0.313	−0.104	−0.104
	(0.043)	(0.044)	(0.210)	(0.211)	(0.147)	(0.148)
%ΔBEINF5Y	0.063**		0.107		0.123	
	(0.026)		(0.119)		(0.080)	
%ΔINFSW5Y		0.054*		0.099		0.078
		(0.030)		(0.114)		(0.077)
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.038	0.026	0.153	0.152	0.095	0.095
F-statistic	3.69	2.83	13.37	13.31	22.80	22.56
No. obs.	412	412	412	412	2065	2065

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on the SPDR gold ETF (*GLD*), Bitcoin (*BTC*) or panel of five leading cryptocurrencies (*PANEL*). The key explanatory variable is the daily percentage change in 5-year breakeven inflation rates (*BEINF5Y*). Unreported control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*) and the 2Y10Y term premium (*TERM*). Cross-section fixed-effects are included for the panel data. Newey-West standard errors are shown in parentheses. Panel A reports results when PCE deflator is ≤2%, Panel B when PCE >2% and Panel C when PCE >%. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period: January 2012–November 2022.

their inflation beliefs. However, Faust and Wright (2009) argue that this type of measure may be too volatile to represent long-run expected inflation, while Ang et al. (2007) and Hong et al. (2022) show that narrative-based forecasts, such as surveys, outperform other

TABLE 7 What happens when inflation expectations differ from the Fed's target?

	r_GLD	*r_GLD*	*r_BTC*	*r_BTC*	*r_PANEL*	*r_PANEL*
Panel A: $BEINF5Y \leq 2\%$						
Constant	0.019	0.022	0.324***	0.318***	0.441***	0.439***
	(0.022)	(0.023)	(0.120)	(0.122)	(0.094)	(0.094)
$\%\Delta BEINF5Y$	0.034***		0.128***		0.110***	
	(0.007)		(0.045)		(0.029)	
$\%\Delta INFSW5Y$		0.027***		0.080*		0.052*
		(0.006)		(0.048)		(0.029)
Fixed effects	N/A	N/A	N/A	N/A	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.054	0.049	0.014	0.009	0.017	0.015
F-statistic	16.52	15.08	4.92	3.42	12.44	10.63
No. obs.	1645	1654	1645	1654	6490	6499
Panel B: $BEINF5Y > 2\%$						
Constant	−0.046	−0.041	0.255	0.252	0.070	0.076
	(0.027)	(0.027)	(0.193)	(0.192)	(0.133)	(0.134)
$\%\Delta BEINF5Y$	0.072***		0.069		0.129*	
	(0.026)		(0.117)		(0.073)	
$\%\Delta INFSW5Y$		0.052**		0.102		0.068
		(0.024)		(0.094)		(0.076)
Fixed effects	N/A	N/A	N/A	N/A	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.050	0.036	0.023	0.023	0.028	0.028
F-statistic	10.03	7.44	4.95	5.14	12.19	12.06
No. obs.	1030	1041	1030	1041	3840	3851
Panel C: $BEINF5Y > 3\%$						
Constant	−0.127	−0.125	−0.459	−0.452	−0.629***	−0.589**
	(0.010)	(0.110)	(0.488)	(0.476)	(0.238)	(0.235)
$\%\Delta BEINF5Y$	0.168***		0.169		0.172	
	(0.051)		(0.255)		(0.118)	
$\%\Delta INFSW5Y$		0.163***		0.141		0.144
		(0.052)		(0.217)		(0.111)
Fixed effects	N/A	N/A	N/A	N/A	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Adj. R^2	0.175	0.158	0.352	0.350	0.379	0.371
F-statistic	3.87	3.53	8.35	8.27	26.06	25.15
No. obs.	82	82	82	82	82	82

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on the SPDR gold ETF (*GLD*), Bitcoin (*BTC*) or panel of five leading cryptocurrencies (*PANEL*). The key explanatory variable is the daily percentage change in 5-year breakeven inflation rates (*BEINF5Y*). Unreported control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*) and the 2Y10Y term premium (*TERM*). Cross-section fixed-effects are included for the panel data. Newey-West standard errors are shown in parentheses. Panel A reports results when 5-year breakeven inflation rates are ≤2%, Panel B when *BEINF5Y* >2%, and Panel C when *BEINF5Y* >3%. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period: January 2012–November 2022.

forecasting methods. We complement our analysis by considering inflation expectations that are part of monthly Conference Board (*CONFBOARD_IE*) and University of Michigan (*UMICH_IE*) consumer confidence surveys.[11] These lower frequency measures therefore provide 'stated preference' of inflation beliefs. Panel A of Table 8 first confirms the positive relationship for *%ΔBEINF5Y* at the monthly frequency, although this is significant only for *GLD* returns. Next, a positive association is identified for *%ΔCONFBOARD_IE* and *%ΔUMICH_IE* – both associations are positive for *GLD* returns, only *%ΔUMICH_IE* is significant for the panel of cryptocurrency returns, while neither are significant for *BTC* returns. This provides additional evidence as to the stronger inflation-hedging properties of gold.

We also test whether there is a relationship between returns and the actual prevailing level of inflation. We replace measures of inflation expectations with the year-on-year change in core (*CPI_CORE*) and headline CPI (*CPI*) in our regression models. The estimates in Panel B of Table 8 show that there is a positive relationship between actual inflation and returns, but this is only statistically significant for *CPI_CORE*. This could be due to the higher variability of *CPI* owing to inclusion of food and energy prices.

3.4 | Inflation announcement effects

We have identified that cryptocurrency offers limited inflation hedging properties in general, and that those properties seem to fail when inflation rises above 2%. As a final step, we question whether cryptocurrency may at least offer some ability to hedge inflation announcement effects.

We consider this by augmenting Equation (1) in two different ways. First, we include an announcement dummy variable (*CPI_ANN*) that indicates whether a monthly CPI announcement occurs on day *t* (1) or not (0). Second, we capture the news effect of each CPI announcement by introducing a surprise variable (*CPI_SURP*). We follow Balduzzi et al. (2001) in computing a standardised surprise measure as:

$$CPI\_SURP_t = \frac{CPI\_ACT_t - CPI\_EST_t}{\sigma_{CPI\_SURP}} \tag{2}$$

where CPI_ACT_t is the actual value of CPI indicated in the data release on day *t*, CPI_EST_t is the median of the Bloomberg forecast survey for the announcement, and σ_{CPI_SURP} is the standard deviation of *CPI_SURP* across all observations. A positive (negative) surprise therefore occurs when the CPI release is greater (lower) than market expectations.

Table 9 reports the estimated coefficients. Panel A shows that gold returns tend to be positive on days with a CPI announcement which is consistent with the results of Christie-David et al. (2000). In contrast, cryptocurrency returns tend to be negative but are statistically insignificant, as Pyo and Lee (2020) report for Bitcoin returns. Panel B reports results relating to the CPI news effect. Whereas CPI surprises have negligible influence on same-day gold returns, the effect is significant and negative for cryptocurrency returns. In other words, cryptocurrency returns are lower when the CPI release is higher than expected, and vice versa. This result differs from Corbet, Larkin, Lucey, et al. (2020) as they find a positive relationship that is weakly significant. The difference is largely explained by their sample ceasing in September 2019, prior to the post-March 2020 surge in inflation and the accompanying number of positive CPI surprises. When we adjust our sample to end on 30

[11]Monthly survey and actual inflation data are obtained from DataStream.

TABLE 8 The relationship between survey-based inflation expectations, actual inflation and monthly returns of gold and leading cryptocurrencies.

	r_GLD	*r_GLD*	*r_GLD*	*r_BTC*	*r_BTC*	*r_BTC*	*r_PANEL*	*r_PANEL*	*r_PANEL*
Panel A: Inflation expectations									
Constant	−0.228	−0.238	−0.236	2.301**	5.312**	5.448**	6.398***	6.447***	6.385***
	(0.358)	(0.343)	(0.350)	(2.381)	(2.454)	(2.402)	(1.976)	(1.992)	(1.960)
%ΔBEINF5Y	0.080**			0.050			0.294*		
	(0.038)			(0.127)			(0.158)		
%ΔCONFBOARD_IE		0.140**			0.001			0.215	
		(0.070)			(0.488)			(0.411)	
%ΔUMICH_IE			0.098**			0.500*			0.595**
			(0.043)			(0.294)			(0.234)
%ΔEPU	0.027*	0.017	0.024*	−0.188	−0.192	−0.216	−0.077	−0.118*	−0.132**
	(0.015)	(0.013)	(0.014)	(0.159)	(0.144)	(0.155)	(0.070)	(0.068)	(0.067)
%ΔVIX	0.004	−0.003	−0.006	−0.150**	−0.157**	−0.159**	−0.064	−0.103	−0.098
	(0.012)	(0.013)	(0.014)	(0.067)	(0.069)	(0.071)	(0.079)	(0.076)	(0.075)
ΔTED	−0.002	−0.009	−0.015	−0.202*	−0.208**	−0.198**	−0.208**	−0.244***	−0.257***
	(0.012)	(0.010)	(0.011)	(0.105)	(0.102)	(0.100)	(0.097)	(0.096)	(0.094)
ΔTERM	−6.262**	−6.634**	−5.850**	−2.756	−2.567	−3.012	−1.707	−0.063	2.367
	(3.050)	(2.817)	(2.808)	(17.771)	(18.654)	(17.278)	(15.019)	(15.247)	(14.964)
Lag(Return)	−0.026	−0.020	−0.022	0.167	0.167	0.173	0.030	0.034	0.019
	(0.066)	(0.071)	(0.072)	(0.121)	(0.123)	(0.123)	(0.048)	(0.048)	(0.048)
Adj. R^2	0.070	0.073	0.055	0.077	0.077	0.098	0.027	0.019	0.035
F-statistic	2.61	2.76	2.26	2.79	2.77	3.32	2.17	1.80	2.52
No. obs.	129	129	129	129	129	129	381	381	381
Panel B: Actual CPI									
Constant	−0.211	−0.256		0.392**	0.121		0.149	0.275***	
	(0.362)	(0.367)		(0.169)	(0.177)		(0.146)	(0.077)	

TABLE 8 (Continued)

	r_GLD	*r_GLD*	*r_GLD*	*r_BTC*	*r_BTC*	*r_BTC*	*r_PANEL*	*r_PANEL*	*r_PANEL*
%ΔCPI_CORE	0.100**			0.154**			0.120***		
	(0.043)			(0.069)			(0.046)		
%ΔCPI		0.003			0.112			0.139	
		(0.004)			(0.211)			(0.110)	
Controls	YES	YES		YES	YES		YES	YES	
Adj. R^2	0.029	0.006		0.038	0.019		0.064	0.024	
F-statistic	4.42	1.13		10.96	7.09		13.65	22.04	
No. obs.	129	129		1763	2166		1298	9565	

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the monthly return on the SPDR gold ETF (*GLD*), Bitcoin (*BTC*) or a panel of cryptocurrencies including Bitcoin, Binance Coin, Dogecoin, Ethereum and XRP. In Panel A, the key explanatory variable is the monthly percentage change in 5-year breakeven inflation rates (*BEINF5Y*) and 1-year inflation expectations from the Conference Board (*CONFBOARD_IE*) or University of Michigan (*UMICH_IE*) consumer confidence surveys. In Panel B, the key explanatory variables are core CPI (*CPI_CORE*) and headline CPI (*CPI*). The control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*) and the 2Y10Y term premium (*TERM*). Newey-West standard errors are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period: January-2012–October-2022.

TABLE 9 CPI announcement effect.

	r_GLD	*r_GLD*	*r_BTC*	*r_BTC*	*r_PANEL*
Panel A: Announcement effect					
Constant	−0.005	−0.042	0.327***	0.318***	0.326***
	(0.019)	(0.036)	(0.112)	(0.110)	(0.079)
CPI_ANN	0.160**	0.354**	−0.452	−0.439	−0.414
	(0.081)	(0.164)	(0.459)	(0.449)	(0.349)
%ΔBEINF5Y		0.032***		0.115***	0.105***
		(0.007)		(0.044)	(0.027)
Controls	NO	YES	NO	YES	YES
Adj. R^2	0.001	0.036	0.000	0.017	0.020
F-statistic	3.265	15.397	0.839	7.47	20.53
No. obs.	2704	2675	2704	2675	10,330
Panel B: News effect					
Constant	0.003	−0.005	0.314***	0.306***	0.325***
	(0.018)	(0.018)	(0.108)	(0.106)	(0.077)
CPI_SURP	−0.006	−0.047	−1.055**	−1.086**	−1.666***
	(0.083)	(0.077)	(0.512)	(0.467)	(0.295)
%ΔBEINF5Y		0.033***		0.120***	0.113***
		(0.007)		(0.044)	(0.028)
Controls	NO	YES	NO	YES	YES
Adj. R^2	0.000	0.036	0.001	0.018	0.023
F-statistic	0.004	15.07	4.874	8.128	22.65
No. obs.	2704	2675	2704	2675	10,330

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on the SPDR gold ETF (*GLD*), Bitcoin (*BTC*) or panel of five leading cryptocurrencies (*PANEL*). The explanatory variables are a dummy variable indicating the presence of a monthly CPI announcement on day *t* (*CPI_ANN*), a variable indicating the surprise component of the CPI announcement (*CPI_SURP*) or the daily percentage change in 5-year breakeven inflation rates (*BEINF5Y*). Unreported control variables include economic policy uncertainty (*EPU*), financial market uncertainty proxied by CBOE implied volatility index (*VIX*), the TED spread (*TED*) and the 2Y10Y term premium (*TERM*). Cross-section fixed-effects are included for the panel data. Robust standard errors are shown in parentheses. **, *** indicate statistical significance at the 5% and 1% levels, respectively. Sample period: January 2012–November 2022.

September 2019, as in Corbet, Larkin, Lucey, et al. (2020), we find that the significance of our result disappears although the sign remains negative. The remaining difference could be due to the different sample size owing to differing start dates (July 2010 vs. January 2012) and them including only announcement days as opposed to all trading days (130 vs. 2700 observations).

In summary, the analysis of CPI announcements shows that cryptocurrency returns tend to be lower on announcement days, and respond negatively to CPI surprises, providing additional evidence against using cryptocurrency as an inflation hedge.

4 | CONCLUDING REMARKS

The cryptocurrency market has grown exponentially in recent years and approached a $3 trillion market capitalisation in November 2021. One rationale posited for holding cryptocurrencies is the ability to hedge inflation. Our initial finding of a positive relationship between cryptocurrency returns and changes in inflation expectations for the overall sample period seems to provide some evidence in support of this rationale. However, we also find that this relationship varies greatly over time and is insignificant when actual inflation or inflation expectations are above 2%. Moreover, cryptocurrency returns have a negative association with the surprise component of monthly CPI announcements. Together, the evidence suggests that the crypto-inflation 'hedge' fails when it is most needed. In comparison, although the significance of the positive gold return–inflation relationship appears concentrated in the latter part of our sample, the hedge properties appear to be maintained as inflation surged post-March 2020. One consequence is that investors seeking to hedge inflation shocks should prefer to hold gold over the cryptocurrency alternative.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study have been obtained from four different sources: (a) cryptocurrency price data are obtained from https://coinmarketcap.com/; (b) inflation expectations and data for control variables are obtained from Refinitiv Eikon; (c) CPI announcement data and associated survey data are obtained from Bloomberg; and (d) economic policy uncertainty data are obtained from http://www.policyuncertainty.com/. Restrictions apply as to the availability of data provided by the data vendors (for b and c) which were used under licence.

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APPENDIX 1

USING LEVELS OF EPU AND VIX

	r_GLD	*r_BTC*	*r_PANEL*
Constant	−0.297*	1.939**	1.933***
	(0.167)	(0.941)	(0.732)
%ΔBEINF5Y	0.033***	0.144***	0.160***
	(0.006)	(0.042)	(0.028)
log(*EPU*)	0.056*	0.436**	0.736***
	(0.033)	(0.174)	(0.142)
log(*VIX*)	0.013	−1.287***	−1.754***
	(0.064)	(0.379)	(0.320)
ΔTED	−0.014**	−0.048	−0.051**
	(0.006)	(0.047)	(0.025)
ΔTERM	−4.616***	−2.501	−2.614
	(0.691)	(3.020)	(2.343)
Lag(Return)	−0.008	−0.019	0.019
	(0.026)	(0.032)	(0.023)
Adj. R^2	0.037	0.013	0.011
F-statistic	18.03	6.84	12.49
No. obs.	2675	2675	10,330

Note: This table provide the estimated coefficients for the OLS model shown in Equation (1). The dependent variable is the daily return on the SPDR gold ETF (*GLD*), Bitcoin (*BTC*) or a panel of cryptocurrencies including Bitcoin, Binance Coin, Dogecoin, Ethereum and XRP. The key explanatory variable is the daily percentage change in 5-year breakeven inflation rates (*BEINF5Y*). The control variables include the natural log of economic policy uncertainty (*EPU*) and the CBOE implied volatility index (*VIX*), the daily change in TED spread (*TED*) and the daily change in the 2Y10Y term premium (*TERM*). Cross-section fixed-effects are included for the panel data shown in the last column. Newey-West standard errors are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Sample period: January 2012–November 2022.