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Is cryptocurrency a hedging tool during economic policy uncertainty? An empirical investigation

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In light of the increasing investor interest in cryptocurrencies (CR) as alternative financial assets in financial markets, we sought to examine the connection between economic policy uncertainty (EPU) and cryptocurrencies. To do so, monthly data for Bitcoin (BTC), Ethereum (ETH), and Tether (THT) from January 2021 to April 2023 were employed. We utilized quantile regression and Granger causality analysis to investigate the relationship between EPU and cryptocurrencies. The initial results of this study suggest that EPU has little effect on the cryptocurrency market in the short-term. To enhance the strength and validity of these findings, we performed separate evaluations tailored to the unique contexts of the United States and China. The results revealed that the effects of EPU were adverse and statistically insignificant for China, while the situation differed slightly for the United States. Given that the United States has the most developed economy, its policies have a significant influence globally. As a result, cryptocurrencies have the potential to serve as efficient hedging tools. Furthermore, we incorporated nonlinear autoregressive distributed lag (NARDL) analysis to assess the asymmetric impact of EPU on cryptocurrencies by adopting both short-term and long-term perspectives. The outcomes demonstrated that both Bitcoin and Ethereum can serve as hedging tools in the short-term, although this utility diminishes in the long-term. Conversely, Tether displayed a positive association with EPU in the long-term. The findings of this study hold significance for policy-makers, offering valuable insights related to structuring efficient policies. The recommendations include fostering a rational framework for active participation from various stakeholders, including investors, governmental bodies, central banks, stock exchanges, and financial institutions. This collaborative effort aims to mitigate irrational fluctuations and enhance the acceptability of cryptocurrencies. In essence, this research underscores the potential of cryptocurrencies as a secure hedge against short-term EPU. However, we caution against assuming that any single cryptocurrency can consistently serve as a dependable investment haven.

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Introduction

Recently, the fascination with cryptocurrencies has been growing, and Bitcoin has emerged as the most notable (Kristoufek & Lunackova, 2015). Cryptocurrency, in its broadest sense, refers to a form of digital currency that operates on the Internet and independently of any central governing body (Zohuri et al., 2022). Whether cryptocurrencies can serve as a medium of exchange has been the subject of some research, and the results have been mixed (Ammous, 2018). Due to the dramatic surge in cryptocurrency values in 2017, investors worldwide began pouring much of their investment capital into these relatively new forms of financial assets. However, the inflated prices could not be maintained, and the cryptocurrency market experienced a price bubble bust before the year's conclusion. The enormous volatility in the value of cryptocurrencies demonstrates the risk involved in investing in this kind of asset.

Cryptocurrencies are established through various cryptographic algorithms and are exchanged in a digital realm. The ongoing development of this system, which aims to replace existing currencies, payment instruments, and even traditional monetary theory and practices, has increased the significance of this system over time (Alpago, 2018). In contrast, there is a debate among scholars and experts about whether cryptocurrency is a type of money or a volatile asset. Opinions differ on this phenomenon. Global financial markets have seen a rapid increase in cryptocurrency popularity (Białkowski, 2020; Deepa et al., 2022; Liu et al., 2021). As a result, regulators, the media, and individual and institutional investors have all taken an interest in them. Academic cryptocurrency research has also become significant (Almeida & Gonçalves, 2022). A feature of both gold and US dollars, Bitcoin's potential to hedge is known as a medium of exchange or digital gold (Su et al., 2023). Because a positive link exists between the prices of gold and Bitcoin, according to (Selmi et al., 2022), gold and Bitcoin are more likely to complement than compete against one another. A short position in the Bitcoin market enables hedging the risk when investing in various other financial assets Guesmi et al., (2019). In particular, the portfolio's risk from holding gold, oil, and stocks is lower when holding Bitcoin than when not. However, because of restrictions on anti-money laundering and terrorist funding legislation, Bitcoin cannot replace gold

Cryptocurrency markets can be affected in various predictable ways. Existing studies have examined how different uncertainty metrics affect cryptocurrency. Some prevailing studies on Bitcoin have examined the impact of uncertainties and risks on cryptocurrencies' profits and price volatility. In their research, Doumenis et al. (2021) discuss the correlation between the volatility index (VIX) and the volatility of cryptocurrencies. The findings of their analysis reveal that cryptocurrency market volatility tends to increase in response to heightened investor apprehension. In their study, Fang et al. (2020) examine the influence of the News-based Implied Volatility index (NVIX) on the volatility of cryptocurrencies over an extended period. The researchers discovered that the NVIX has an adverse impact on the long-term fluctuations of cryptocurrencies. In their study, (Gozgor, Tiwari, et al., 2019) examine the correlation between the returns of Bitcoin and the uncertainty in trade policies (TPU) in the United States. Their research findings demonstrate a negative impact of TPU on the returns of Bitcoin. In a study by Shaikh (2020), the researcher examines the impact of the economic policy uncertainty (EPU) index on Bitcoin returns in many countries, including the US, the UK, Japan, China, and Hong Kong. The study reveal that uncertainty had a detrimental effect on the Bitcoin market in the US and Japan. Because the modern, financially connected world is more vulnerable to economic policy risk than ever, researchers are currently concentrating on finding an appropriate shelter to protect assets.

Previous studies have been conducted on cryptocurrency, mainly on Bitcoin as a single entity with different uncertainty-related measures. To our knowledge, no earlier studies on cryptocurrency with economic policy uncertainty or on the asymmetric effect of EPU on cryptocurrency returns have been done. The study's goals are twofold: first, to better understand the academic literature already available on crypto investor behavior, compile its knowledge, and identify knowledge gaps to support future studies; and second, to present significant research findings for investors, academics, policy-makers, businesses, professionals, and society. Existing studies have traced the relationship between cryptocurrency and other different factors. To our knowledge, this study is the first to analyze the nexus between cryptocurrency and economic policy uncertainty after Covid-19. We select the top three cryptocurrencies based on their market share—Bitcoin, Ethereum, and Tether. The period is from 1 January 2021 to 1 April 2023. The time selected is after the COVID-19 pandemic, which affected every sector of the world economy. Therefore, we acknowledge the importance of time.

Interestingly, no pandemic or event of more significant uncertainty, including the Spanish Flu, the Global Financial Crisis, and the European Debt Crisis, has ever worsened the stock market and driven down the EPU as much as COVID-19. Because investors are predominantly concerned about losing their investments, often referred to as reflecting risk-averse behavior, increased economic policy uncertainty frequently hinders the flow of investments. Therefore, during financial crises, political unrest, or other periods of substantial uncertainty, such as the COVID-19 pandemic, investors and fund managers are drawn to risk-reduction strategies. Conversely, in China, we observe a beneficial effect of uncertainty on the Bitcoin market (Chen et al., 2021). Their study examines the correlation between Bitcoin returns and Chinese EPU. Their research findings indicate a favorable impact of Chinese EPU on Bitcoin returns. Similarly, (Wu et al., 2021) examine the effect of Twitter-based EPU on the cryptocurrency market. Their results suggest that Twitter-based EPU has a favorable influence on cryptocurrency returns. The Cryptocurrency Uncertainty Index (UCRY) is a novel proxy for measuring uncertainty. UCRY was created by (Karim et al., 2023) and relies on examining textual content.

Significance of the study. Global financial markets are in a revolutionary phase (Johnson, 2020), and digital finance plays a significant role in how financial services are organized worldwide (Johnson, 2020). According to (Hosen et al., 2022), cryptocurrency is considerably improving and moderating traditional financial services. The current state of cryptocurrency developments is usually marked by anomalous behavior and unanticipated occurrences that influence people's views, market behavior, and public legislation (Treiblmaier, 2022). The transmission of fiscal and monetary policies in financial markets has become significantly impacted by uncertainty, which has grown in importance in modern economies (Kang & Yoon, 2019). Regulating cryptocurrency is necessary since it alters "typical" financial transactions (Hossain, 2021); however, keeping up with the legislation in many jurisdictions is challenging (Mohsin, 2022). Since their inception, cryptocurrencies have been popular in the financial industry (Jiménez-Serranía et al., 2021), and the associated markets have a history of volatility (Chokor & Alfieri, 2021).

The prior literature has concentrated mainly on this topic; few research publications have examined other cryptocurrencies. In

line with these concerns, we seek to summarize the literature that has focused on the economic implications of crypto. We carefully searched for existing studies on cryptocurrency in the expanding academic literature to perform this analysis. We use a quantile regression approach to examine the data. The quantile regression methodology is advantageous because it helps us make sense of outcomes that are not normally distributed and have nonlinear relationships with predictor variables by allowing us to understand the relationships between variables outside the mean of the data. We aim to investigate cryptocurrencies with global economic policy uncertainty. Thus, we chose the top three cryptocurrencies (Bitcoin, Ethereum, and Tether) as a variable since they are well-known cryptocurrencies. To check the robustness of the results, we use gold as an alternative hedging for cryptocurrency. In addition, the individual country analysis is also traced in this study. The US and China are well-known to be the two key countries of the world economy, and their shares in cryptocurrency are the highest. Therefore, we select these two countries and run the same analysis.

Growing global EPU has a detrimental effect on Bitcoin's long-term returns. The declining EPU, on the other hand, has a favorable impact, showing that once a concern has eased, investors recover trust in the Bitcoin market. Arguably, these investments do not serve as long-term safe-havens. Tether benefits from rising EPU because of its stable currency status and long-term position as a haven asset. Haven assets such as Bitcoin, Ethereum, and Tether are expected to benefit in the short-term and show potential.

Motivation of the study. Significant downward pressure was placed on economic growth in 2020 due to the pandemic containment measures taken by authorities at all levels. These measures include home isolation, social distancing, travel and transport restrictions, and the temporary suspension of non-essential economic activities. These COVID-19 curtailment steps were a tremendous shock to microfirm capital networks, making it challenging to maintain general operations; according to a poll conducted in February 2020, 72.87% of internet businesses and 68.39% of businesses that primarily functioned offline anticipated being able to maintain their cash flows for no longer than three months. Cryptocurrency is in a unique position as a pioneer in a technology that might fundamentally alter conventional financial institutions (Marella et al., 2020). Disagreement still exists about whether cryptocurrencies fulfill the three functions of money medium of exchange, unit of account, and store of value despite the exponential growth in the number of companies that accept Bitcoin payments (Harb et al., 2022). The roles of stable and unstable cryptocurrencies impact the dynamics of the Bitcoin market (Qiao et al., 2023). Several studies on cryptocurrency economics (Almeida & Gonçalves, 2023) have attempted to determine why cryptocurrency markets go through bubbles. For instance, (Karim et al., 2023) point out that factors including volatility, trading volume, transaction volume, VIX, and Google searches cannot forecast bitcoin returns. While (Huang et al., 2019) suggest that high-dimensional indicators can predict bitcoin returns, (Balcilar et al., 2023) demonstrate that volume can predict returns using nonlinear models. Therefore, in this study, we analyze the nexus between economic policy uncertainty and cryptocurrency returns.

The results of the country-specific EPU-bitcoin nexus demonstrate that the United States EPU, which dominates the global economy, has a persistently negative influence on bitcoin returns. However, China's EPU has little to no long-term impact on Bitcoin. Due to its significant role in the global economy, the United States is vulnerable to these and other global effects

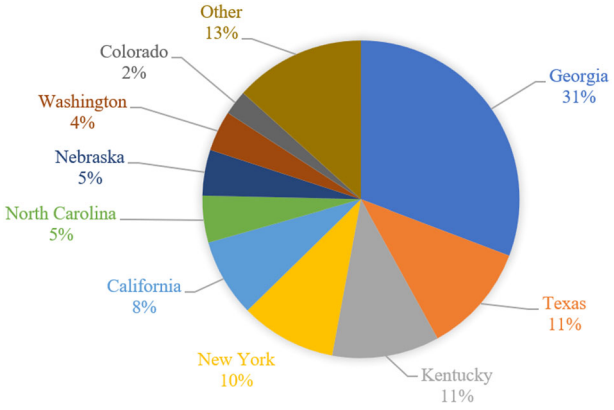

Fig. 1 USA hash rate by state. This figure shows that has rate in the USA by state wise. Source: Made by the author based on the data from Cambridge Alternative Finance.

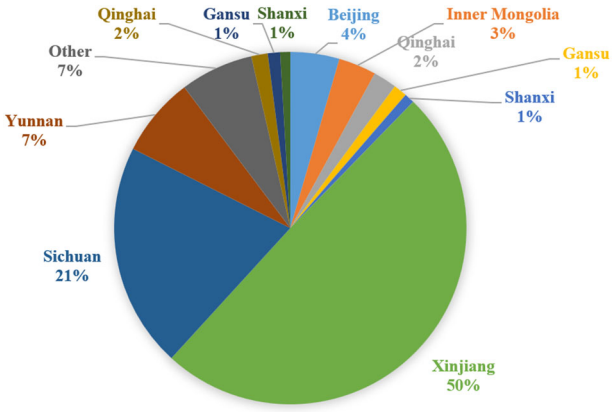

Fig. 2 China hash rate by province. This figure shows that has a rate in by province. Source: Made by the author based on the data from Cambridge Alternative Finance.

(Chowdhury & Abdullah, 2023). EPU had a favorable and significant impact on cryptocurrency returns, except for oil prices. Figures 1 and 2 in the appendix represent the state and provincewise hash rates in China and the US, respectively. Georgia has the highest, followed by Texas and Kentucky. After that, New York and California recorded the largest shares. For China, Xinjiang has the highest with a 50% share, followed by Sichuan and Yunnan with 21% and 7%, respectively.

Literature review

After Satoshi Nakamoto introduced Bitcoin in 2009, the concept of cryptocurrencies remained relatively obscure in finance for some time. Bitcoin investment presented challenges due to technical barriers. Due to its exponential growth in popularity, a diverse range of cryptocurrencies is now readily accessible to institutional and individual investors. In recent years, institutional investors have begun integrating Bitcoin into their asset portfolios to achieve diversification (Huang et al., 2019; Mzoughi et al., 2022). Recent empirical research in the field of finance has focused extensively on the comprehensive examination of cryptocurrencies. Li et al. (2021) investigate the evolutionary patterns within the realm of cryptocurrency studies. Contemporary scholarly investigations on cryptocurrencies may be classified into two main domains: one pertaining to the technological progress underpinning cryptocurrencies and the other focusing on its economic and financial ramifications. However, the primary

inquiry pertaining to cryptocurrencies persists: "Do they function as a medium of exchange or as a financial asset?" Experts offer differing opinions, with recent studies predominantly concentrating on whether Bitcoin or other cryptocurrencies can serve as a hedge similar to gold during uncertain times (Jareño Cebrián & Negrut, 2016; Long et al., 2021).

The opinions among academics and researchers diverge regarding Bitcoin's capacity to act as a haven or risk hedge. Conversely, some studies have challenged the safe-haven characteristics of cryptocurrencies or Bitcoin (Mokni, 2021; Wu et al., 2019) despite numerous studies indicating their hedging capabilities (Demir et al., 2018). These conflicting findings may stem from variations in study periods, an array of factors influencing cryptocurrency values, differing methodologies, or variations in the cryptocurrencies assessed in the studies.

The initial exploration into the relationship between uncertainty and Bitcoin was conducted by Bouri et al. (2017). They discover that Bitcoin hedging is more prevalent during both bullish and bearish market conditions and in shorter timeframes when faced with global uncertainty. Ordinary least squares (OLS) estimations revealed a negative correlation between the two. In their initial research, Demir et al., 2018 employ EPU as a metric of uncertainty to scrutinize its impact on Bitcoin. They find that EPU could forecast Bitcoin returns and demonstrate a negative correlation between EPU movement and Bitcoin using OLS. However, the effect is positive in the upper quantiles, indicating hedging potential in a bull market. According to L. Fang et al. (2019), when considering the influence of EPU, Bitcoin's utility as a hedge slightly improves for both bond and equity portfolios but only in specific economic conditions.

Selgin (2022) suggests that by incorporating rules akin to monetary regulations found in finance and economic studies, a theory of numerical money could be developed. Nevertheless, important to note is that cryptocurrencies cannot serve as traditional forms of money due to the absence of centralized management, fluctuating demand, and a fixed supply. Selgin (2022) emphasizes the increasing adoption of cryptocurrency by businesses and highlights that several well-known corporations now accept Bitcoin, showcasing that "it is now possible to purchase nearly anything with cryptocurrency through websites like Overstock, Wikipedia, KFC, and Burger King" (Ammous, 2018). Yermack argues that since all cryptocurrencies possess inherent value, only Bitcoin qualifies as money (Yermack, 2015). On the other hand, Fang et al. (2022) contend that Bitcoin may be considered to possess unique value as money due to its role as a medium of exchange and store of value. Cryptocurrency can only establish credibility if it convinces users that its supply will not rapidly increase, thus preserving its value. Bitcoin is well-known for having a limited number of units that can be mined, using a logarithmic growth model rather than a logistic distribution (Giungato, 2017).

Recent interest in EPU is partly attributable to significant events such as the China–USA trade war, the COVID-19 pandemic, and the Russia-Ukraine conflict. EPU was initially developed by Baker et al. (2016) and is now considered a proxy for economic uncertainty (Farooq et al., 2023). Both direct and indirect pathways can elucidate how EPU affects Bitcoin volatility. The direct routes reveal how government decisions significantly impact the Bitcoin market. For instance, when the People's Bank of China reaffirmed a blanket ban on digital asset transactions on September 24, 2021, the price of Bitcoin dropped by 5.5% on the following trading day, as reported by the cryptocurrency market tracking service CoinMarketCap.

Regarding indirect routes, elevated EPU can erode investor confidence in fiat currencies or raise concerns about the overall state of the economy. Consequently, investors may reassess their investments. Cryptocurrency is showcased as independent from traditional financial assets and is transformed into an alternative asset when investors seek a potential hedge during periods of uncertainty (Iqbal et al., 2023).

Data and methodology

Sample and data. This empirical study spans from 1 January 2021 to 1 April 2023 and uses monthly data. The purpose of selecting the period for this study is to take the data after COVID-19. The data for dependent variable cryptocurrency returns, is derived from www.coindesk.com. Data for policy uncertainty are from www.policyuncertainty.com. Similarly, gold return data is taken from investing.com.

Model of the Study

$$CR_t = \beta_0 + \beta_1 EPU_t + GRT_t + CV_t + \mu_t \quad (1)$$

CR denotes cryptocurrency at time *t*, $(EPU)_t$ denotes the daily EPU index time t, and GRT represents gold returns. CV stands for the control variable, and **μ**t indicates the error term.

Variable description

Cryptocurrency (CR). We select the top three cryptocurrencies' (Bitcoin, Ethereum, Tether) returns as a proxy variable for measuring crypto returns. A cryptocurrency is a decentralized, digital, and encrypted form of money. A cryptocurrency's value is not managed and maintained by a single entity such as the US dollar or the euro. Instead, these trades are broadly divided among cryptocurrency users via the internet (Zohuri et al., 2022).

Economic policy uncertainty (EPU). A concern exists about economic policy uncertainty when the future of government policies and regulatory frameworks is unclear. Due to market uncertainty, this phenomenon may induce firms and people to delay purchases and investments (Wang et al., 2022).

Gold returns (GRT). An extremely secure investment is gold. Because gold prices often do not fluctuate with market values, they are meant to serve as a haven when markets decline. Because the price of gold does not constantly increase, even when markets are booming, gold t might thus be thought of as a risky investment. Investors frequently gravitate to gold when there is anxiety in the market and a decline in stock prices is anticipated (Shang et al., 2022).

Estimation procedures. Least-squares linear regression is the gold standard for determining the conditional mean of the outcome variable for a range of feature values. When the linear regression assumptions are not met, quantile regression can be used as an alternative to obtain the conditional median of the result variable.

The central premise of linear regression cannot be confirmed.
Deviations from the norm in the residuals of the data.
The variance in errors grows with the size of the result variable.

The connection between dependent and independent variables can be estimated using the quantile regression method (hereafter QR) (Koenker and Basset, 1978). Compared to the ordinary least square (OLS) approach, QR may analyze the multiple ways the dependent variable responds to changes in the independent variables through their various quantiles and not just the median (Jareño Cebrián & Negrut, 2016; Sevillano & Jareno, 2018). Finally, the QR estimator is resilient in the face of outliers (Jareno et al., 2016), rejecting the limiting assumption of the same distribution of error terms (Ferrando et al., 2017).

Let Y be a real-valued random variable with a cumulative distribution function. $F_Y(y) = P(Y \le y)$. The τth quantile of Y is given by:

$$q_Y(\tau) = F_Y^{-1}(\tau) = inf\{y : F_Y(y) \ge \tau\}$$

where $\tau \in (0, 1)$.

Define the loss function as $\rho_\tau(m) = m(\tau - \Pi_{(m<0)})$, where Π is an indicator function. A specific quantile can be found by minimizing the expected loss of $Y - \mu$ concerning μ: (pp. 5–6):

$$q_Y(\tau) = \arg\min_{\mu} E(\rho_\tau(Y-\mu)) = \arg\min_{\mu}\{(\tau-1)\int_{-\infty}^{\mu}(y-\mu)dF_Y(y) + \tau\int_{\mu}^{\infty}(y-\mu)dF_Y(y)\}$$

This can be shown by computing the expected loss derivative by applying the Leibniz integral rule, setting it to 0, and letting q_τ be the solution to $0 = (1-\tau)\int_{-\infty}^{q_\tau} dF_Y(y)$. This equation reduces to $0 = F_Y(q_\tau) - \tau$ and then to $F_Y(q_\tau) - \tau$. If the solution q_τ is not unique, we must take the smallest solution to obtain the τth quantile of the random variable Y."

Data analysis

Before empirically answering the question, data treatment is essential.

Table 1 reports the unit root test of the variables. As previously mentioned, quantile regression does not need hard and fast data rules. Similarly, when the assumption of OLS fails, quantile regression occurs. Table 1 represents the stationarity check of the variables, which shows that the variables are stationary at different levels. Table 2 illustrates the pairwise correlation among the variables of this study. The results do not report any values with estimation-related problems. Specifically, the highest correlation is between EPU and Bitcoin. According to the rule of thumb, the correlation must be lower than 0.7, which creates estimation bias. Therefore, initially, the sample has no problem.

Table 2 shows the summary statistics of the sample selected for the study. The summary statistics do not report problems in the data that create serious bias in the estimation procedure.

Table 3 represents the pairwise correlation among the variables. The pairwise correlation value does not reflect the most considerable variation or relation apart from the average. All of the values are below 0.70. According to the rule of thumb, if the correlation value between two variables surpasses 0.70, it leads to some econometric problems in the estimation, such as multicollinearity and autocorrelation.

Table 4 reports the causality between variables. The Granger causality approach is used to study the causal link structures between variables. The Granger causality test is a statistical hypothesis test to detect whether one time series helps forecast another.

Table 5 represents quantile regression estimation among cryptocurrency, economic policy uncertainty, and gold returns. Column 1 reports the quantile regression between economic policy uncertainty and bitcoin returns. The initial quantiles are positive, while the higher quantile shows a negative and significant relationship between economic policy uncertainty and bitcoin returns. The results are in line with the previous study by (Chen et al., 2021). The second column shows the relationship between ET and EPU; the results are slightly different from those of the relationship between Bitcoin and EPU. The third column shows the relationship with Tether. The results are different from the previous two. Most of its relationship is positive but insignificant. The results show that EPU has no significant impact on Tether returns. The overall results show that fluctuations in economic policy uncertainty do not affect cryptocurrency returns. The empirical research (Aysan et al., (2019); Bouri et al., 2018; Bouri et al., 2017; Demir et al., 2018) has revealed a link between Bitcoin and an increase in the upper quantiles of uncertainty, indicating that cryptocurrency serves as a safeguard only in the face of more significant uncertainty and risk.

As a consequence of reviewing the previously mentioned research, the findings of this study are comparable. Similarly, to check the robustness of the result between the bitcoin returns and EPU, we followed the (Gozgor, Lau, et al., 2019) results, which are robust. Similarly, as previously mentioned, gold is the safest investment tool against economic uncertainties. Therefore, we compared gold returns as an alternative. To check the overall cryptocurrency and EPU relationship, we form an index by combining the three cryptocurrencies through principal component analysis (PCA) and regress. The results, reported in Table 6, are gold and overall cryptocurrency (CR) and ETH since both these currencies are at the top of the list.

Table 1 Stationarity check.

Variables	Level			
	Intercept		Intercept and level	
	ADF	*p*-value	ADF	*p*-value
EPU	2.439595	0.1426	3.127606	0.1236
BTC	−1.360538	0.5862	−1.854721	0.6497
ETH	1.378205	0.5778	1.068863	0.9161
THT	3.567236	0.0136	4.311261	0.0106
Gold	−3.058214	0.0421	−2.774736	0.2177
Interest	−1.547142	0.4939	−0.718972	0.9603
	1st Difference			
	Intercept		Intercept and level	
EPU	7.426789	0.0000	7.298217	0.0000
BTC	−4.289728	0.0025	−4.188526	0.0144
ETH	4.861940	0.0006	4.913119	0.0029
THT	−7.754694	0.0000	−7.742618	0.0000
Gold	−5.158398	0.0003	5.198192	0.0015
Interest	−1.907874	0.3235	−5.441752	0.0010

Source: Author's calculation.

Table 2 Summary statistics.

	EPU	CR	ETH	THT	GOLD	INTEREST
Mean	5.483439	10.40846	7.655304	0.000239	7.507547	1.433316
Median	5.486279	10.49529	7.565199	0.000200	7.504804	0.325789
Maximum	5.799738	11.02369	8.440075	0.002397	7.612782	4.691739
Minimum	5.170585	9.713380	6.974526	−0.001001	7.411496	0.018000
Std. Dev.	0.193029	0.402495	0.406095	0.000559	0.049119	1.794773
Observations	24	28	28	28	28	27

Source: Author's calculation.

Table 3 Pairwise correlation.

Variables	EPU	BTC	ETH	THT	Gold	Interest
EPU	1.000					
BTC	0.404	1.000				
ETH	−0.269	0.380	1.000			
THT	−0.260	0.383	0.115	1.000		
Gold	0.098	0.222	0.331	−0.145	1.000	
Interest	0.592	−0.686	−0.614	−0.393	−0.120	1.000

Sources: Author's calculation.

Table 4 Granger causality.

Null hypothesis:	Obs	*F*-statistic	Prob.
BTC does not Granger cause EPU	22	3.35856	0.0590
EPU does not Granger cause BTC		2.36971	0.0964
ETH does not Granger cause EPU	22	5.86100	0.0116
EPU does not Granger cause ETH		4.11586	0.0305
Gold does not Granger cause EPU	22	0.11099	0.8956
EPU does not Granger cause Gold		0.21301	0.8103
Interest does not Granger cause EPU	22	5.14419	0.0179
EPU does not Granger cause Interest		0.42308	0.6617
THT does not Granger cause EPU	22	2.41267	0.1086
LEPU does not Granger cause THT		0.59296	0.5637
ETH does not Granger cause BTC	26	0.84966	0.4417
BTC does not Granger cause ETH		1.75386	0.1975
Gold does not Granger cause BTC	26	0.08322	0.9205
BTC does not Granger cause Gold		0.60311	0.5563

Sources: Author's calculation.

Table 5 Quantile regression for global EPU with BTC, ETH, and THT.

Quantiles	BTC	ETH	THT
0.10	0.00121	−0.00155	−0.000796
	(0.00348)	(0.00225)	(0.00137)
0.20	0.0062	−0.00206	−0.000309
	(0.00373)	(0.0028)	(0.00109)
0.30	−0.00538	−0.00218	0.000476
	(0.0035)	(0.00262)	(0.000896)
0.40	0.00569**	0.00432**	0.000308
	(0.00206)	(0.00174)	(0.000759)
0.50	−0.00578*	−0.00309	0.000307
	(0.00288)	(0.00209)	(0.000481)
0.60	−0.00322	−0.000664	0.000123
	(0.00261)	(0.00277)	(0.000655)
0.70	−0.00112	−0.000229	−0.000371
	(0.00296)	(0.00259)	(0.000843)
0.80	0.00252**	0.02112*	0.000517
	(0.00129)	(0.00225)	(0.000691)
0.90	−0.00234*	−0.00325**	−0.000453
	(0.00128)	(0.00122)	(0.00226)

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Sources: Author's calculation.

Table 6 Quantile regression for global EPU with gold and CR.

Quantiles	Gold	CR
0.10	−0.0439 (0.142)	−0.0053 (0.0093)
0.20	−0.00176 (0.132)	−0.0074 (0.0104)
0.30	0.108 (0.118)	0.00121 (0.0112)
0.40	0.0921 (0.107)	0.00114 (0.0106)
0.50	0.086 (0.0862)	0.00912** (0.0041)
0.60	0.0316 (0.0648)	0.00937** (0.0039)
0.70	0.0928 (0.0787)	0.00387 (0.0094)
0.80	0.106 (0.0786)	0.00394 (0.0092)
0.90	0.109** (0.0446)	−0.0026 (0.0071)

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source: Author's calculation.

Table 7 Country-specific quantile regression.

Quantiles	China	US
0.10	−0.143 (0.56)	−0.128 (0.496)
0.20	0.224 (0.665)	0.814 (0.569)
0.30	0.0213 (0.998)	0.852*** (0.264)
0.40	0.399 (1.157)	1.166** (0.419)
0.50	0.0492 (0.804)	1.211** (0.505)
0.60	−0.212 (0.719)	−1.414** (0.586)
0.70	−0.361 (0.665)	−0.994* (0.578)
0.80	−0.627* (0.338)	0.859* (0.43)
0.90	−0.748*** (0.244)	−0.428 (0.30)

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Author's calculation.

Country-specific EPU and Bitcoin. This illustrates how country-specific uncertainty affects Bitcoin returns. We want to determine how the cryptocurrency market responds to uncertainty in various nations. The two major economies those of the US and China have been considered.

The US has the most capacity for trading Bitcoin futures since it is the largest developed economy in the world (Yen & Cheng, 2021). The world's two largest rising economies—China and India—offer tremendous investment possibilities. These three nations are also in the top 10 globally for adopting cryptocurrencies. The policy uncertainty in these economies may significantly affect cryptocurrency investments. The largest and most well-known cryptocurrency, Bitcoin, is selected for this research country by country. As a result, we use the same process as that of quantile regression and the approach mentioned above to investigate how US EPU and China EPU affect Bitcoin returns.

In Table 7, although the coefficients of EPU are negative for China, they are insignificant, indicating that, unlike the US, policy uncertainty in China does not have a long-term impact on bitcoin returns. This could be because cryptocurrencies are managed independently of centralized authorities due to their decentralized structure. The crypto market is worldwide in scope, making it less vulnerable to the long-term effects of economic policy uncertainties in any given nation Aysan et al., (2019). However, we can observe that the US EPU results match those of the global EPU impacts, illustrating the apparent effect of the US being the largest advanced economy on global policy uncertainty. Since the US disproportionately impacts the global financial system, economic policies and political unpredictability are more strongly felt by cryptocurrency markets.

Furthermore, China could not be as tightly correlated with the cryptocurrency markets as the US economy, which might further restrict their long-term influence on bitcoin gains. Crucial to keep in mind is that these are only hypotheses and that more variables may influence the patterns that have been noticed.

Asymmetric impact of EPU on cryptocurrency. The financial literature has used several techniques over the years, including

Granger causality, cointegration, and ordinal least squares quantile regression (QR), among others, to estimate short- and long-term interactions under the assumption of symmetric relationships. However, these earlier approaches have limitations because they cannot identify potential asymmetries. Since asymmetries may be predicted in the short and long-term, we use the nonlinear ARDL cointegration technique (NARDL). This approach is used to investigate whether the time series is nonlinearly cointegrated and results in the decomposition of the regressors' positive and negative partial sums to test for short- and long-term nonlinearities. Finally, this method enables measurement of the regressors of the asymmetric dynamic multipliers' distinct reactions to positive and negative shocks. For example, Arize et al. (2017) and Jareno et al. (2019, 2020) suggest that the NARDL technique has certain benefits.

They specifically contend that the NARDL methodology's suitability for small samples, regardless of the static nature of the variables, is one of its key benefits. The methodology also generates estimates of the short- and long-term coefficients. The NARDL model exhibits independence from residual correlation, suggesting that it is not prone to lag bias omission.

Table 8, which shows how the model's long-term coefficients are estimated, indicates that all three cryptocurrencies are highly affected by positive EPU shocks, with a coefficient of EPU+ being significant in all models. The returns of Bitcoin and Ethereum have negative coefficients, indicating that an increase in EPU adversely affects their long-term values.

On the other hand, Tether is positively impacted in the long-term by increased EPU with a positive coefficient. Thus, over time, most crypto returns decrease as policy uncertainty increases, and EPU has an inverse relationship with crypto returns.

Therefore, Tether cannot be employed as a long-term hedge against the economic unrest brought on by policy uncertainty. Tether appears to be a haven asset since it produces positive effects over a longer period. Its unique behavior is related to the stablecoin it is by nature, which makes it tied to the US dollar and, thus, less erratic. However, why a shareholder selects Tether assets over US dollar holdings is unclear (Colon et al., 2021). During financial unrest, the US dollar peg is vulnerable to increasing security, technological hazards, and questions about its stability. Understanding that the declining negative coefficient of the independent variable in an asymmetric model represents an increase in the dependent variable is necessary for its interpretation. Here, the elasticities of EPU for Bitcoin and Ethereum exhibit substantial negative coefficients, demonstrating that they increase when uncertainty declines over a more extended period, behaving similarly to the stock market (Nusair & Al-Khasawneh, 2022) and showing how investors feel about the future after doubts are removed. As a stable cryptocurrency, Tether exhibits unique qualities and behaves more like a haven asset. In addition, the size of the coefficients for declining EPU is often more significant than that for growing EPU, showing that reducing uncertainty has a more substantial influence than increasing uncertainty.

Table 8 Long-run impact of Global EPU on cryptocurrencies.

	BTC	ETH	THT
EPU^{+}	−5.3392***	−7.05241	0.8606**
	(1.92923)	4.62664	(0.000198)
EPU^{-}	−4.6494***	−4.76818	1.886**
	(2.2917)	2.78396	(0.00121)

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Author's calculation.

Table 9 illustrates the short-term estimate of the NARDL equation. For positive EPU shocks, the initial difference lagged coefficients considerably favor Bitcoin and Ethereum, indicating that when EPU increases, investors acquire more cryptocurrencies in the near term, driving up their prices.

The coefficients clearly show that declining EPU has a more significant effect on most cryptocurrencies in the near future than increasing EPU. The Wald test also supports notable short-term asymmetry. To reduce risk, these major cryptocurrencies immediately attract investors. Given escalating uncertainty, Tether exhibits negative returns at various lags, demonstrating that it is not the preferred option for investors to insure against short-term concerns. This seems evident, given how Tether differs from other stablecoins. Ethereum's complicated short-term reactions to EPU are illustrated by its negative contemporaneous adjustments to positive shocks but lagged (3 lags) positive adjustments to positive shocks. Investors might not react quickly to shifting uncertainties. The multiplier plots allow us to see the intricate patterns of Bitcoin reactions. Most of the differenced lag coefficients demonstrate that when EPU declines in the near term, all cryptocurrencies' returns increase.

To check the heterogeneity of EPU across cryptocurrencies, we use the slope equality and symmetry quantiles tests. The results are reported in Table 10. The test results, which often disprove the null hypothesis of equal coefficient estimates, support the heterogeneity. The figures and other diagnostic tests are listed in the Appendix.

Results and conclusion

In this study, we employed quantile regression to assess the symmetric impact of economic policy uncertainty (EPU) on cryptocurrencies and nonlinear autoregressive distributed lag (NARDL) to examine the asymmetric effects of EPU on cryptocurrencies. Symmetrically, cryptocurrencies can serve as a viable hedge, carrying implications for portfolio diversification and risk management, which is consistent with the findings of Bouri et al.

Table 9 Short-term impact of EPU on crypto.

	BTC	ETH	THT
C	−10.7650*	−6.1623***	−4.159376*
	(6.567)	(3.190)	(3.015982)
ΔR_{t-1}	0.562399**	0.60421*	3.068198
	(0.248541)	(0.4887)	(2.268089)
ΔR_{t-2}	0.65673**	−0.47619	3.937456**
	(0.363295)	(0.2738) **	(1.830405)
ΔR_{t-3}	−0.30788	−0.47526	1.187684
	(0.30359)	(0.429634)	(2.747129)
ΔEPU^{+}	7.702**	2.7247	3.71504*
	(2.2766)	(0.31813)	(2.15578)
ΔEPU^{+}_{t-1}	10.650*	9.695495***	3.6056***
	(6.7022)	(3.88524)	(1.4023)
$\Delta EPU + {}^{+}_{t-2}$	24.79**	0.07037	4.08523*
	(11.8208)	(9.72952)	(3.0950)
ΔEPU^{+}_{t-3}	16.666***	2.52577	−1.2543
	(4.3843)	(1.58733)	(0.25534)
ΔEPU^{-}	−4.6514**	−7.54491***	−4.0667
	(2.0362)	(3.23838)	(5.045)
ΔEPU^{-}_{t-1}	−9.9083	−4.6795**	−9.7306***
	(7.9140)	(2.10217)	(2.3556)
ΔEPU^{-}_{t-2}	−5.542*	−26.3821***	−8.536***
	(3.08325)	(13.43391)	(1.63534)
ΔEPU^{-}_{t-3}	−9.6291*	−1.53802	−6.44678***
	(5.38234)	(0.46942)	(1.91234)

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 10 Slope equality and symmetry quantile test.

Quantile slope equality test

Test summary	Chi-Sq. statistic	Chi-Sq. d.f.	Prob.
Wald test	282.8927	40.00	0.0000
Symmetric quantiles test			
Wald test	22.20758	24	0.56690

Sources: Author's calculation

(2017) and Demir et al. (2018), who also find a positive link between EPU and Bitcoin returns. In contrast, during excessive market volatility, cryptocurrencies can act as a hedge against uncertainty and as portfolio diversifiers in typical market conditions. These results highlight that higher government and central bank-induced economic policy uncertainty creates information asymmetry among investors and varying expectations, aligning with studies by Eom et al. (2019), Simran and Sharma (2023) and L. Fang et al. (2019) that position Bitcoin as an investment asset akin to gold. Robustness checks on gold returns were also conducted. Recent debates about the legal status of cryptocurrencies across countries were examined, revealing varying responses from legalization to opposition, with some countries contemplating the introduction of their own cryptocurrencies. A lag in EPU does not significantly impact Bitcoin's returns, making it a valuable hedge against policy unpredictability at higher quantiles. Given the cryptocurrency market's early stage, U.S. authorities should be aware that their economic policy uncertainties can substantially affect Bitcoin returns. Moreover, our research underscores the U.S. Economic Policy Uncertainty (USEPU) index's ability to predict Bitcoin returns effectively at higher quantiles. Hence, the cryptocurrency market is highly susceptible to risk, akin to economic policy volatility, necessitating consideration of cryptocurrency's inherent uncertainty in investment decisions. This empirical study explored the correlation between the U.S. EPU index and cryptocurrency returns and revealed a positive relationship between Bitcoin returns and EPU at the highest quantiles, signifying Bitcoin's role as a hedge during elevated economic policy-related uncertainty. Further research into cryptocurrency market mechanisms and factors is recommended, with consideration of the potential impact of the COVID-19 pandemic on the cryptocurrency market, especially Bitcoin. Consistent with Dyhrberg (2016), gold exhibits lower volatility than the cryptocurrency market, with Bitcoin being highly volatile and speculative, suggesting that a short-term investment approach for cryptocurrencies and a long-term strategy for gold may be prudent. In the expanding academic literature on digital currencies and economic volatility, our study contributes by exploring cryptocurrencies' risk-hedging capabilities amidst increasing global uncertainty attributed to policy factors. Employing the NARDL method, we uncovered that growing EPU negatively affects the long-term returns of Bitcoin and Ethereum, implying that they are not reliable safe-haven investments during rising EPU periods. Conversely, decreasing EPU restores investor confidence, driving market growth and reflecting risk-averse investor behavior during heightened uncertainty, particularly in the short-term. Tether, due to its stablecoin characteristics, exhibits safe-haven behavior in both the short and long terms.

Policy implications. The results of this study show that a precipitous decrease in cryptocurrency asset values has a detrimental impact on investors' financial standing. Traditional financial institutions are susceptible to direct exposure through various operations, such as trading, custodial services, and market-making. Financial institutions may indirectly connect to the crypto asset industry if they provide financing to the sector or accept crypto assets as loan collateral. Furthermore, runs on stablecoins can occur, primarily if inadequately controlled, resulting in massive liquidations of reserves and cascading impacts on asset values. The presence of leverage, concentration, and interlinkages among crypto asset holders increases the potential risks associated with these assets.

The extensive acceptance of cryptographic assets, particularly stablecoins, has the potential to disrupt traditional bank deposits, particularly in nations with vulnerable financial infrastructures. This can potentially redirect accumulated funds and weaken the process of facilitating credit transactions. Further elaboration on the implications for banking will be provided in subsequent sections.

Future research directions. In the present study, we have empirically analyzed cryptocurrency and economic policy uncertainty. The results of this study show that cryptocurrency can be used as a short-term hedging instrument. Therefore, future studies are directed to determine whether this case is only for the US or other countries. Other than economic policy uncertainty, some countries have introduced or will introduce their cryptocurrency; therefore, whether a cryptocurrency will replace traditional currency (bank notes) needs to be studied. Many previous studies have targeted the environmental concerns of cryptocurrency; however, a minimal number of studies have determined the economic impact of cryptocurrency.

Data availability

The datasets generated and analyzed during the current study are available online. The data about cryptocurrency is taken from www.coindesk.com and data for policy uncertainty is taken from www.policyuncertainty.com.

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Appendix

Figure 1
Figure 2

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Conceptualization: SAS, HC; methodology & data curation: SAS and WT; data analysis: SAS, LY, and WT; writing, review, and editing: SAS, HC, and LY; supervision: HC.

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