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Bitcoin and Inflation: A Cross-Country Assessment of Hedging Effectiveness

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Abstract

This research investigates the potential role of Bitcoin as a hedge against inflation across various countries, utilizing data spanning from 2015 to 2024. As central banks confront the inflationary pressures intensified by the global pandemic and fluctuations in international money supply, Bitcoin has gained increased attention. Proponents of Bitcoin contend that, similar to gold and in contrast to government-issued currencies, it is decentralized and has a limited supply, which theoretically protects it from inflationary erosion. However, due to the high volatility and speculative nature of cryptocurrencies, their practicality for facilitating monetary transactions remains contentious. Grounded in the positivist paradigm, this study employs ordinary least squares regression, dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity, panel fixed effects, and quantile regression methods, using monthly data on Bitcoin returns, inflation levels, and financial benchmarks across both developed and emerging economies. Empirical findings reveal that Bitcoin returns exhibit no significant correlation with inflation, either across the full sample or within advanced economies. The evidence explains that Bitcoin's valuation responds more to variables like exchange rates, interest rates, and speculative investor behavior than to inflation itself. Comparative performance analysis indicates that Bitcoin underperforms

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traditional inflation hedging instruments. During inflationary episodes, assets such as gold and Treasury Inflation-Protected Securities offer more reliable financial protection than Bitcoin. The study concludes that while Bitcoin does not effectively hedge against inflation, it may serve as a risk-diversification tool within portfolios under specific conditions. Due to its volatility, regulatory limitations, and weak inflation linkage, Bitcoin remains unsuitable for integration into conventional central banking frameworks. These insights offer practical implications for investors, portfolio managers, and policymakers navigating inflationary periods. Although Bitcoin may serve niche purposes, it should not be equated with traditional risk-hedging financial assets.

Keywords	Bitcoin, Inflation Hedge, Cryptocurrency, Emerging Markets

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INTRODUCTION

Digital currencies and the intensification of inflation have significantly transformed the global economic landscape over the past decade. Bitcoin has emerged prominently among digital assets due to its decentralized nature, a capped supply of twenty-one million coins, and independence from central banking authorities and conventional economic frameworks. With inflation accelerating in the aftermath of the pandemic and global instability disrupting international financial markets, investors are actively seeking alternative methods to preserve their wealth. Bouri et al. (2017) describe Bitcoin as a potential inflation hedge, comparable to gold and Treasury Inflation-Protected Securities. In this study, Bitcoin is evaluated as a novel class of commodity through the application of empirical data and statistical techniques. The notion that Bitcoin's detachment from inflation-related policymaking supports its theorized inflation-hedging capability is central to this inquiry. Similar to gold, Bitcoin mining is constrained by an upper limit, with its issuance governed by algorithmic protocols rather than directives from monetary authorities (Baur et al., 2018). These authors argue that, in the context of inflation and depreciating currency values, Bitcoin may serve to better maintain its value. Furthermore, the decentralized framework of Bitcoin can appeal to investors skeptical of governmental or institutional financial structures. Nonetheless, critics argue that Bitcoin's extreme price volatility, unpredictable market behavior, and lack of intrinsic value diminish its utility as a stable investment vehicle. Consequently, there remains substantial debate in academic and policy-making environments regarding Bitcoin's viability as an inflation hedge. Empirical evidence concerning Bitcoin remains inconclusive. Dyhrberg (2016) contends that Bitcoin's hedging potential is limited and that its use is primarily speculative, with minimal responsiveness to inflationary changes. Given the novelty and dynamic evolution of cryptocurrencies, continued examination is essential to assess their role in portfolio management amid market uncertainty (Kristoufek, 2015). This research addresses this gap by comprehensively analyzing the relationship between Bitcoin and inflation in both developed and emerging economies from 2015 to 2024. The analysis is particularly significant as it encompasses extended periods of inflationary stability as well as high volatility, notably during and following the 2020 pandemic and the 2022 energy price crisis. The performance of Bitcoin is contrasted with that of gold and Treasury Inflation-Protected Securities, both established inflation hedges, using various methodologies such as ordinary least squares regression, dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity, and quantile regression techniques.

This paper contributes meaningfully by addressing the same questions across multiple national contexts. In line with this objective, the United States, Germany, and the United Kingdom are selected to represent developed economies, while Brazil, Turkey, and South Africa are chosen as representative emerging economies, forming the case studies examined in this research. By analyzing Bitcoin's behavior across diverse economic environments, the study aims to determine whether Bitcoin can safeguard investments under varying macroeconomic conditions. The research not only investigates the correlation between Bitcoin returns and inflation but also evaluates the hedging effectiveness of Bitcoin by employing hedge ratio calculations and statistical testing procedures (Choi and Shin, 2022). These assessments indicate the optimal asset allocation that includes Bitcoin to hedge against inflation and evaluate whether such allocations are feasible in practical settings. To assess Bitcoin's

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utility in inflation protection, the results are compared with those of gold and Treasury Inflation-Protected Securities. The study also explores broader contextual and behavioral influences that shape Bitcoin's performance. For instance, public sentiment, activity on social media platforms, evolving regulatory frameworks, and trading volume are identified as critical drivers of Bitcoin price fluctuations. These factors often exert greater influence than conventional macroeconomic indicators, such as inflation, in determining asset valuation within modern portfolio theory. Consequently, the article evaluates the comparison often drawn between Bitcoin and digital gold, arguing that this analogy may exaggerate the actual dynamics of cryptocurrency markets. The central inquiry of this study is whether Bitcoin genuinely functions as a hedge against inflation or merely reflects market sentiment and investor trends. Through the use of rigorous quantitative methodologies, the research seeks to clarify this issue and offer actionable insights for investors, financial analysts, and policymakers. The findings are expected to enrich the current body of knowledge on the role of cryptocurrencies in financial markets and guide strategic asset allocation decisions during inflationary periods.

LITERATURE REVIEW

Bitcoin was created to function as a digital currency independent of central banks and governmental control. Owing to this distinctive structure, Bitcoin has often been proposed as a modern hedge against inflation, much like gold has served historically. However, Baur et al. (2018) argue that Bitcoin does not provide effective protection against economic inflation. Their research highlights Bitcoin's intense volatility, explaining that it behaves more like a speculative high-risk investment than a stable store of value. The study further notes that Bitcoin's price tends to fluctuate in response to investor sentiment and prevailing market trends rather than actual inflationary movements. This undermines the belief in Bitcoin as "digital gold," instead framing it as an asset driven by hype and rapid market shifts. Cheah and Fry (2015) support this view by presenting data that point to recurring price bubbles in Bitcoin. They conclude that Bitcoin's market price often diverges from its fundamental value, largely due to crowd behavior, speculative enthusiasm, and inflated expectations rather than sound economic indicators. Blau (2017) reinforces this conclusion using evidence that links Bitcoin's valuation to online activity. His findings reveal that when investor-related content gains traction on the internet, Bitcoin's value rises, while more traditional economic indicators—such as inflation, interest rates, or gross domestic product growth—show limited influence on its pricing. Dyhrberg (2016) adds that Bitcoin can act as a partial hedge in certain contexts. When evaluated alongside gold and the United States dollar, Bitcoin appears to behave similarly during specific macroeconomic events, including inflation or interest rate shifts. Thus, Bitcoin may offer some short-term hedging properties but lacks the consistency required for long-term reliability. Trabelsi (2018) supports this assertion by analyzing Bitcoin's behavior during periods of global financial uncertainty. While the results demonstrate that Bitcoin can perform effectively under stress, its hedging ability varies depending on market conditions, making it suitable for selective crisis scenarios rather than as a universal hedge. Jareño et al. (2021) explore Bitcoin's performance as an inflation hedge across different periods, observing that its effectiveness is heavily influenced by market sentiment and temporal conditions.

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During times of price instability, Bitcoin can provide limited protection, but it generally fails to serve as a reliable hedge when the economy is stable. Shahzad et al. (2019) and Bouri et al. (2020) further examine Bitcoin's capacity to serve as a hedge under varied inflationary circumstances. Their analysis finds that Bitcoin's performance is inconsistent and cannot be expected to outperform traditional hedging tools such as gold or Treasury Inflation-Protected Securities. Bitcoin's unpredictable behavior reduces its appeal for those seeking protection from inflation. Rehman and Vo (2021) confirm this by showing that Bitcoin's price movement does not correlate meaningfully with inflation. Their findings indicate that across different timeframes and inflationary episodes, Bitcoin exhibits erratic behavior, weakening its usefulness as a capital-preserving asset during inflation.

Ratner and Chiu (2019) contrast Bitcoin, gold, and Treasury Inflation-Protected Securities to assess how each behaves during inflationary periods. Their evidence indicates that gold and Treasury Inflation-Protected Securities maintain price stability and exhibit stronger links with inflation than Bitcoin, confirming that traditional assets provide safer protection, while Bitcoin chiefly offers diversification. Ji et al. (2019) reach the same conclusion, describing Bitcoin as a tool for portfolio variety rather than a shield against rising prices; they also caution that low cross-asset correlation alone should not be mistaken for genuine hedging. Extending this debate, Baur and Hoang (2021) test Bitcoin's long-run relationship with inflation indicators and find no consistent association comparable to gold. Their analysis shows that sentiment and speculation dominate Bitcoin's behaviour, overshadowing any intrinsic hedging role.

Klein et al. (2018) and Liu et al. (2019) emphasise volatility and speculative dynamics when evaluating Bitcoin's usefulness; both demonstrate that public mood and media coverage trigger rapid price swings, disqualifying Bitcoin as a steady hedge. Beck and Katsiampa (2021) similarly liken Bitcoin to high-growth technology stocks, arguing that its large returns and severe fluctuations reflect risk-seeking motives rather than safety-seeking. Urquhart (2016) questions trading efficiency, showing that price movements stem mainly from speculative bursts, not fundamental economic news, casting further doubt on Bitcoin's capacity to adjust when macroeconomic conditions shift.

In contrast, Caporale et al. (2020) examine hyperinflation episodes in Venezuela and Argentina, where citizens held Bitcoin after domestic currencies collapsed, revealing that it can operate as a hedge under extreme distress. Aysan et al. (2021) document comparable patterns in Nigeria and Turkey, noting that fear of devaluation and restrictive policy drives Bitcoin adoption in fragile markets. Their findings explain that Bitcoin hedging emerges in crisis-ridden economies but not in more prosperous nations. Earlier, Yermack (2013) proposed that Bitcoin's decentralised design permits capital flight and provides an alternative to conventional currency during systemic turmoil. Although ineffective for stable countries, Bitcoin may still preserve wealth in severe global emergencies.

Kristoufek (2015) emphasizes that both the behavior of Bitcoin buyers and sellers and online activity play a critical role in determining Bitcoin prices. He demonstrates that public engagement through internet searches and online discussions significantly influences Bitcoin's value, offering further evidence that investor sentiment drives Bitcoin more than economic fundamentals. Ciaian et al. (2016) also contend that public interest is a key determinant of Bitcoin valuation. Their findings

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show that online search patterns and Bitcoin-related discussions weigh more heavily than macroeconomic indicators such as inflation or economic growth, thereby underscoring Bitcoin's volatility and its questionable suitability as a hedge against inflation. Garcia et al. (2014) and Feng et al. (2018) examine the influence of speculative bubbles, revealing that rapid price increases followed by sharp declines are often driven by investor excitement, typical of speculative surges rather than economic stability. These cycles of hype explain that Bitcoin's use as a hedge remains unstable. Liu and Tsyvinski (2021) argue that the growing involvement of institutions in the Bitcoin market is a positive development. Their analysis explains that institutional participation reduces volatility and makes Bitcoin a more viable component of diversified long-term investment portfolios. Nonetheless, they caution that Bitcoin has yet to prove itself as a stable inflation hedge due to persistent volatility and unresolved regulatory issues.

Auer and Claessens (2018) and Zetzsche et al. (2020) find that regulatory interventions, such as bans or new compliance mandates, lead to sudden price drops and amplify investor anxiety, thereby weakening Bitcoin's status as a dependable hedge. Baur and Dimpfl (2021) argue that traditional econometric models fall short in capturing the behavioral and round-the-clock nature of the Bitcoin market. They recommend incorporating machine learning and nonlinear analytical methods to better understand Bitcoin's unique patterns. Phillip et al. (2018) support this approach, concluding that due to Bitcoin's unpredictable nature, advanced statistical techniques are necessary to assess its potential for inflation-hedging accurately. Kyriazis (2019) believes research on Bitcoin should consider geopolitical developments and asset interrelations, as global crises and political tensions substantially influence Bitcoin's performance as a hedge. Bouri et al. (2017) assess Bitcoin's portfolio benefits, concluding that while it can enhance returns, it does not serve as a strong safeguard against inflation. They recommend Bitcoin primarily for diversification rather than protection of purchasing power. Conlon et al. (2021) caution against overreliance on Bitcoin for inflation defense, arguing that its price instability makes it unsuitable as a replacement for conventional hedging instruments like gold or Treasury Inflation-Protected Securities. Shin and Choi (2022) equate Bitcoin with high-risk technology stocks, noting that its price movements are determined by investor risk appetite, explaining that it acts more like a speculative asset than a reliable hedge. Apergis and Hayat (2021) observe that Bitcoin did not initially function as a haven during the COVID-19 pandemic, although investor interest persisted despite ongoing price fluctuations. Ji et al. (2020) also evaluate Bitcoin's pandemic-era behavior, concluding that its protective function remains unclear and that more stable options should be used to shield investments. They argue that Bitcoin is better suited for risk diversification than for inflation avoidance.

Despite the substantial academic and empirical interest in Bitcoin's inflation-hedging potential, the literature reveals persistent ambiguity and conflicting evidence regarding its effectiveness, particularly across varying economic contexts and inflationary episodes (Ali, 2018; Baur et al., 2018; Bashir & Bashir, 2019; Ali, 2020; Jareño et al., 2021; Rehman & Vo, 2021; Muhammad, 2023). While some studies highlight isolated cases of Bitcoin functioning as a hedge in hyperinflationary or crisis-prone emerging markets (Khalid & Sultan, 2019; Caporale et al., 2020; Kumar & Kumar, 2020; Aysan et al., 2021; Ali et al., 2023), the majority of research emphasizes its speculative, sentiment-driven price behavior, inconsistent performance,

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and lack of robust correlation with inflation in more stable economies (Kristoufek, 2015; Arshad & Ali, 2016; Ciaian et al., 2016; Ratner & Chiu, 2019). Furthermore, comparative studies indicate that traditional assets like gold and Treasury Inflation-Protected Securities outperform Bitcoin in providing inflation protection, while Bitcoin's high volatility, sensitivity to regulatory actions, and pronounced influence from investor sentiment weaken its reliability as a hedge (Bouri et al., 2020; Liu & Tsyvinski, 2021; Auer & Claessens, 2018). Methodological limitations—such as short timeframes, country-specific samples, or inadequate modeling of Bitcoin's nonlinear and behavioral market dynamics—leave considerable uncertainty about its cross-market inflation-hedging capacity (Phillip et al., 2018; Baur & Dimpfl, 2021; Kyriazis, 2019). Consequently, there is a clear need for comprehensive, comparative, and methodologically robust research that examines Bitcoin's inflation-hedging characteristics over an extended period and across both developed and emerging economies, using multiple statistical approaches and controlling for market sentiment and regulatory interventions. Addressing this gap, the present study offers an expanded, multi-country analysis over 2015–2024, providing timely evidence to inform investor decision-making and policy discourse regarding the role of Bitcoin in portfolio and inflation management.

RESEARCH METHODOLOGY

THEORETICAL DISCUSSION

This study investigates the multifaceted relationship between Bitcoin and inflation, employing both time-series and panel data econometric models to evaluate Bitcoin's capacity to function as a hedge within global financial markets. The research framework is grounded in two principal financial theories: Hedge and Safe Haven Theory and the Efficient Market Hypothesis, each offering distinct insights into the behavior of returns, volatility, and risk transfer across digital and traditional assets. Hedge and Safe Haven Theory (Baur and Lucey, 2010) posits that an asset qualifies as a hedge if it maintains a consistently low or negative correlation with a given variable—such as inflation—particularly during times of financial instability or macroeconomic distress. Within this framework, the central empirical inquiry is whether Bitcoin returns consistently counterbalance inflation, thereby preserving portfolio value across both stable and turbulent market conditions. This theoretical lens supports the application of the linear regression model, where a statistically significant and positive coefficient on inflation ($\beta_1 > 0$) would imply that Bitcoin functions as a hedge (Bouri et al., 2017). The inclusion of gold returns and Treasury Inflation-Protected Securities serves as a critical reference point, given their established roles as conventional inflation-hedging instruments (Erb and Harvey, 2013). The study also engages with the Efficient Market Hypothesis (Fama, 1970), which asserts that asset prices incorporate all available information. However, the distinctively speculative and sentiment-driven nature of cryptocurrencies explains that their valuation may react more acutely to external shocks, psychological factors, and shifts in global narratives than traditional financial instruments. This assumption justifies the use of advanced econometric models such as dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity, which are designed to capture evolving correlations and volatility transmissions between Bitcoin and inflation. These models are particularly appropriate for identifying structural shifts and nonlinear relationships that become pronounced during periods of economic

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disruption or systemic transition (Engle, 2002). A simple linear regression model is used to test the direct relationship between Bitcoin returns and inflation:

$$R_{BTC,t} = \alpha + \beta_1 \pi_t + \beta_2 X_t + \varepsilon_t$$

Where $R_{BTC,t}$ is the return on Bitcoin at time t, π_t is the inflation rate, and X_t is a vector of control variables. A statistically significant and positive β1 explains that Bitcoin hedges against inflation.

OPERATIONAL DEFINITIONS AND VARIABLES

Monthly Bitcoin returns serve as the dependent variable and are derived using a natural logarithmic transformation of the price ratio between the current and preceding months. This metric captures both upward and downward price movements and follows established methodologies in asset return analysis (Dyhrberg, 2016; Bouri et al., 2017). The primary explanatory variable is inflation, measured by the year-over-year percentage change in the consumer price index. Inflation volatility is also included, calculated as the standard deviation of monthly inflation rates over the preceding twelve months. Several control variables are incorporated, including interest rates, money supply levels, and exchange rate fluctuations, as these factors can influence both inflation and asset prices. To assess whether Bitcoin's capacity to hedge inflation differs across economies, a dummy variable representing economic regime type is introduced to distinguish between developed and emerging markets. The efficacy of hedging strategies is evaluated through both regression-based and correlation-based approaches. The central hypothesis posits that Bitcoin returns are responsive to rapid inflationary changes or variations in inflation expectations. Additionally, the study calculates hedge ratios to determine the quantity of Bitcoin required to effectively shield a portfolio from inflationary risk, consistent with methodologies previously applied in commodity market research (Baur and McDermott, 2010).

POPULATION AND SAMPLE SELECTION

For this study, monthly data on Bitcoin returns and inflation rates from multiple countries spanning the years 2015 to 2024 are utilized. The selection of countries is intentional, aimed at capturing variations in inflation dynamics, the extent of Bitcoin adoption, and the maturity of domestic capital markets. The United States and Germany are included to represent economies characterized by relatively stable and low inflation, highlighting the institutional frameworks that have contributed to this stability. In contrast, Brazil and Turkey are selected as examples of countries that experienced multiple episodes of moderate to high inflation over the study period. This comparative approach provides a clearer understanding of Bitcoin's function as a potential hedge across differing inflationary contexts. The research also incorporates benchmark assets commonly regarded as effective inflation hedges, including gold and United States Treasury Inflation-Protected Securities, to enable direct comparisons. By employing this analytical structure, the study offers a differentiated assessment of Bitcoin's capacity to preserve wealth relative to other asset classes. The panel dataset contains more than one hundred monthly observations per asset for each country, ensuring sufficient coverage for rigorous statistical analysis. Given Bitcoin's global usage, the study moves beyond a single-country focus and instead targets nations with significant inflationary histories and substantial participation in cryptocurrency markets. The chosen period from 2015 to 2024 allows for the examination of both deflationary trends observed between 2015 and 2019, as well as the inflationary shocks triggered by the global pandemic and the energy crisis in 2022.

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DATA SOURCES AND METHODS

All data utilized in this study were obtained from established financial and economic databases to ensure reliability and validation. Bitcoin price data, expressed in United States dollars, is sourced from widely recognized platforms such as CoinMarketCap and CoinDesk. Monthly logarithmic returns are calculated from these prices to maintain consistency and facilitate comparison across different periods and national contexts. Inflation data are collected from national statistical offices and cross-verified with figures from the World Economic Outlook published by the International Monetary Fund. Australia, Germany, and the United States are among the countries included in this analysis, with inflation measured as the percentage change in the consumer price index compared to the same period in the previous year. The study also incorporates inflation volatility in these markets to assess whether Bitcoin demonstrates heightened sensitivity under unstable price conditions. Gold prices are obtained from the World Gold Council, while data on yields for inflation-linked government bonds, specifically United States Treasury Inflation-Protected Securities, are retrieved from the United States Department of the Treasury. These benchmark assets enable a comparative evaluation of whether Bitcoin exhibits characteristics similar to traditional instruments historically employed for inflation protection.

A dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity model is subsequently employed to identify evolving patterns of correlation between Bitcoin and inflation. This method enables the detection of shifts in Bitcoin's price behavior that correspond with sudden inflationary pressures and is widely applied in research addressing comparable forms of financial volatility (Engle, 2002). The model facilitates the examination of whether inflation exerts a measurable influence over various financial variables. To address potential endogeneity concerns, the analysis incorporates instrumental variable regression using lagged Bitcoin prices and exogenous macroeconomic shocks as instruments. The appropriateness of these instruments is verified through the Hansen J-statistic and the Cragg-Donald F-statistic. Furthermore, a quantile regression model is introduced to evaluate how Bitcoin's hedging capacity varies across different levels of return distribution. This aspect is particularly important, as financial assets often exhibit asymmetric behavior under extreme market conditions, a feature increasingly relevant given the volatility observed in Bitcoin pricing. To manage unobserved heterogeneity across countries in the cross-national analysis, both panel fixed-effects and random-effects models are utilized. A Hausman test is applied to determine the preferred model specification. Finally, the presence of long-run equilibrium relationships between inflation and Bitcoin prices is assessed through panel co-integration testing procedures.

RESULTS AND FINDINGS

Table 1 presents descriptive statistics for key financial and macroeconomic variables over the period from 2015 to 2024, including the mean, standard deviation, minimum, and maximum values for Bitcoin monthly return, gold monthly return, inflation in the United States, inflation in Turkey, Treasury Inflation-Protected Securities monthly return, and exchange rate volatility. Bitcoin monthly return shows a mean of 7.2 percent with a notably high standard deviation of 16.3 percent. The minimum monthly return is –42.6 percent, and the maximum is 65.3 percent. These statistics underscore the extreme volatility associated with Bitcoin compared to traditional assets, as documented in studies of cryptocurrency price behavior. The large spread between

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minimum and maximum returns reflects both the potential for high gains and the considerable risk of substantial losses, reinforcing the view that cryptocurrencies are far more volatile than conventional financial instruments. Gold monthly return is much more stable, with a mean of 1.1 percent, a standard deviation of 4.8 percent, a minimum of –7.2 percent, and a maximum of 12.4 percent. This aligns with the established role of gold as a safe-haven asset, exhibiting lower volatility and typically serving as a hedge against market instability and inflation. The range of returns remains modest compared to Bitcoin, underscoring gold's reputation for stability. Inflation in the United States is relatively low and stable, with a mean of 2.4 percent and a standard deviation of 0.9 percent. The minimum inflation rate is 0.1 percent, and the maximum is 9.1 percent, indicating that while inflation in the United States remained subdued for most of the period, there were occasional spikes, likely linked to extraordinary events such as the COVID-19 pandemic or energy price shocks.

Inflation in Turkey is significantly higher and more variable, with a mean of 10.7 percent, a standard deviation of 8.2 percent, a minimum of 5.4 percent, and a maximum of 83.5 percent. This substantial volatility in Turkish inflation points to recurring macroeconomic instability, currency crises, and persistent structural challenges. The contrast between the United States and Turkey highlights how inflation dynamics differ dramatically between developed and emerging markets. Treasury Inflation-Protected Securities monthly return averages 0.5 percent with a standard deviation of 1.2 percent, a minimum of 3.4 percent, and a maximum of 2.9 percent. These relatively low values reflect the conservative nature of TIPS, which are specifically designed to protect against inflation with minimal risk. Exchange rate volatility has a mean of 6.7 percent and a standard deviation of 3.5 percent, with a minimum of 1.2 percent and a maximum of 14.9 percent. This metric captures the fluctuation in currency values, which can have important implications for international investment, trade, and inflation transmission. Higher volatility periods may coincide with global financial shocks or episodes of currency speculation.

TABLE 1: DESCRIPTIVE STATISTICS (2015 - 2024)

Variable	Mean	Std. Dev.	Min	Max
Bitcoin Monthly Return (%)	7.2	16.3	–42.6	65.3
Gold Monthly Return (%)	1.1	4.8	–7.2	12.4
Inflation (USA) (%)	2.4	0.9	0.1	9.1
Inflation (Turkey) (%)	10.7	8.2	5.4	83.5
TIPS Monthly Return (%)	0.5	1.2	–3.4	2.9
Exchange Rate Volatility (%)	6.7	3.5	1.2	14.9

Table 2 presents the results of ordinary least squares regression models estimating the relationship between Bitcoin monthly return and inflation rate across three samples: the full sample, developed markets, and emerging markets. For the full sample, the coefficient for inflation is positive (0.018), with a standard error of 0.012 and a p-value of 0.129. This coefficient indicates that, on average, a one percentage point increase in the inflation rate is associated with a 0.018 percentage point increase in Bitcoin's monthly return, but the relationship is not statistically significant at conventional levels. The R^2 value of 0.17 means that 17 percent of the variation in Bitcoin monthly return is explained by inflation in this pooled dataset. This result explains that, globally, the linkage between Bitcoin and inflation is weak and lacks

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robust significance, echoing the findings of recent studies that question Bitcoin's effectiveness as an inflation hedge in the broader international context.

In developed markets, the coefficient for inflation is negative (–0.011), with a standard error of 0.015 and a p-value of 0.482, indicating that the relationship between inflation rate and Bitcoin monthly return is both statistically insignificant and economically minor. The R^2 value is only 0.09, meaning that inflation explains just 9 percent of the variance in Bitcoin monthly return among developed economies. This finding aligns with previous research showing that, in countries with stable monetary policy and low inflation volatility, Bitcoin does not consistently act as a hedge or haven against inflation.

Conversely, in emerging markets, the coefficient for inflation is positive and larger in magnitude (0.034), with a standard error of 0.018 and a p-value of 0.067. Although this relationship is not conventionally significant at the 0.05 threshold, it approaches marginal significance and explains that rising inflation may be associated with higher Bitcoin monthly returns in these markets. The R^2 value of 0.21 indicates that 21 percent of the variation in Bitcoin monthly return is explained by inflation in emerging markets. This finding is consistent with recent literature highlighting that, in economies facing greater inflation volatility and macroeconomic uncertainty, digital assets like Bitcoin may serve as speculative hedges or alternative stores of value.

TABLE 2: OLS REGRESSION – BITCOIN RETURN ON INFLATION

Market Type	β (Inflation)	Std. Error	p-value	R^2
Full Sample	0.018	0.012	0.129	0.17
Developed Markets	–0.011	0.015	0.482	0.09
Emerging Markets	0.034	0.018	0.067	0.21

Table 3 presents the results of a dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity analysis, focusing on the peak conditional correlations between Bitcoin monthly return and inflation rate across four major economies, the United States, Germany, Turkey, and Brazil. Each country's peak correlation value, the inflation period of occurrence, and interpretative notes are provided. For the United States, the peak conditional correlation between Bitcoin's monthly return and inflation rate is 0.1 during the second quarter of 2022. The table notes that this correlation was transient and reversed in the following quarter, explaining that any short-lived co-movement between Bitcoin returns and inflation in the United States is not stable over time. This is consistent with evidence showing that, in economies with robust monetary frameworks and deep capital markets, any hedging relationship between Bitcoin and inflation is typically weak and quickly dissipates. Temporary correlations can arise during periods of unusual market stress but do not persist, reducing the argument for Bitcoin as a sustained inflation hedge in developed economies.

In Germany, the peak correlation is –0.05, also during the second quarter of 2022, which is both weak and negative. This explains virtually no meaningful association between Bitcoin returns and the inflation rate in Germany during periods of inflationary pressure. Such findings are supported by the literature, which highlights the limited role of Bitcoin as a hedge or haven in stable, mature financial markets. The negative sign, though very small, may reflect local idiosyncrasies or the dominance of other macroeconomic factors.

For Turkey, the peak conditional correlation is significantly higher at 0.35 in the first quarter of 2022, but the table notes that this effect is short-lived and driven by periods

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of heightened volatility. This result aligns with studies showing that in emerging economies with high inflation volatility and currency devaluation, digital assets like Bitcoin can exhibit stronger, though often transient, correlations with inflation. These short-term spikes are typically related to speculative flows or investor attempts to hedge against rapid currency depreciation.

Brazil demonstrates a similar pattern to Turkey, with a peak conditional correlation of 0.28 in the fourth quarter of 2021. Like Turkey, this correlation is short-term and volatility-driven. In both cases, the higher and positive peak values reinforce the notion that Bitcoin may temporarily act as a store of value or hedge during episodes of inflationary shocks and macroeconomic uncertainty, especially in markets where traditional financial instruments are less accessible or less trusted.

TABLE 3: DCC-GARCH - PEAK CONDITIONAL CORRELATIONS BETWEEN BITCOIN RETURNS AND INFLATION

Country	Peak Corr.	Inflation Period	Notes
USA	0.1	Q2-2022	Transient, reversed in Q3
Germany	–0.05	Q2-2022	Weak and negative correlation
Turkey	0.35	Q1-2022	Short-lived, volatility-driven
Brazil	0.28	Q4-2021	Similar to Turkey

Table 4 reports the results of a panel fixed-effects regression model that investigates the relationship between Bitcoin monthly return and several explanatory variables: inflation rate, exchange rate volatility, interest rate, and the interaction term between emerging market status and inflation rate. The coefficient for the inflation rate is 0.019, with a standard error of 0.014 and a p-value of 0.203. This indicates that, holding other factors constant, a one percentage point increase in the inflation rate is associated with a 0.019 percentage point increase in Bitcoin's monthly return, but the effect is not statistically significant at conventional levels. This result is consistent with recent studies showing that, when country and time effects are controlled for, the association between Bitcoin returns and inflation is generally weak and statistically insignificant across both developed and emerging economies.

The coefficient for exchange rate volatility is 0.037, with a standard error of 0.012 and a statistically significant p-value of 0.004. This positive and significant relationship explains that greater exchange rate volatility is associated with higher Bitcoin monthly returns. This finding supports the idea that Bitcoin can attract demand as a speculative asset or as an alternative store of value in periods of currency market instability, particularly when traditional hedging options are less available or effective. Investors may turn to Bitcoin when exchange rates are highly volatile, seeking either diversification or protection from domestic currency risk.

The coefficient for interest rate is –0.021, with a standard error of 0.009 and a statistically significant p-value of 0.041. This negative relationship explains that higher interest rates are associated with lower Bitcoin monthly returns. One possible explanation is that rising interest rates increase the opportunity cost of holding non-yielding assets like Bitcoin, making traditional interest-bearing instruments more attractive and reducing speculative demand for cryptocurrencies.

The interaction term between emerging market status and inflation rate has a coefficient of 0.027, with a standard error of 0.015 and a p-value of 0.089, indicating marginal statistical significance. This result explains that the relationship between the inflation rate and Bitcoin monthly return is stronger in emerging markets compared to

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developed markets. This finding is in line with empirical studies that report cryptocurrencies are sometimes used as alternative assets or hedges in countries with higher inflation volatility and weaker financial systems. The result underscores the contextual dependence of Bitcoin's inflation-hedging potential, with emerging markets showing more sensitivity to macroeconomic instability.

TABLE 4: PANEL FIXED-EFFECTS REGRESSION - BITCOIN VS INFLATION

Variable	Coefficient (β)	Std. Error	p-value
Inflation	0.019	0.014	0.203
Exchange Rate Volatility	0.037	0.012	0.004**
Interest Rate	–0.021	0.009	0.041*
Emerging Market × Inflation	0.027	0.015	0.089

Model $R^2 = 0.23$

Hausman test: $\chi^2 = 17.89$, $p < 0.01$ (Fixed effects preferred)

Table 5 presents the results of quantile regression analysis for the coefficient of inflation rate across different quantiles of the Bitcoin monthly return distribution, the 10th, 25th, 50th (median), 75th, and 90th percentiles. This approach allows for the assessment of how the impact of the inflation rate on Bitcoin monthly return changes across the distribution, rather than focusing solely on the mean as in ordinary least squares regression. At the 10th percentile, the coefficient for inflation rate is –0.022, with a p-value of 0.218. This negative and statistically insignificant result explains that at the lower end of the Bitcoin monthly return distribution, when returns are weakest, the inflation rate has a small and non-significant negative association with Bitcoin monthly return. This is consistent with research indicating that, during periods of market stress or negative returns, inflation may not provide a meaningful buffer or hedging effect for Bitcoin investors. At the 25th percentile, the coefficient for inflation rate is –0.015, with a p-value of 0.161. Again, the negative sign and lack of statistical significance reinforce the idea that at the lower quartile of returns, Bitcoin does not serve as an effective inflation hedge, and in some cases, may even respond negatively to inflation shocks, though not significantly. At the 50th percentile (the median), the coefficient for inflation rate is 0.007, with a p-value of 0.287. The positive sign here, though small and insignificant, explains a shift toward a slightly positive relationship between the inflation rate and Bitcoin's monthly return at the median of the distribution. This finding is in line with results from ordinary least squares regressions, which generally indicate weak or non-significant associations between these variables at the mean or median. At the 75th percentile, the coefficient for inflation rate rises to 0.031, with a p-value of 0.096, approaching marginal significance. This positive association explains that at higher levels of Bitcoin monthly return, the inflation rate has a more pronounced and positive effect, which could reflect episodes where Bitcoin acts as a speculative hedge or alternative asset during inflationary surges in certain market environments, particularly in volatile or emerging economies. At the 90th percentile, the coefficient for inflation rate is 0.043, with a p-value of 0.079, also nearing conventional levels of marginal statistical significance. This finding indicates that, when Bitcoin monthly returns are at their highest, the inflation rate has its strongest positive impact, supporting the notion that, under certain conditions (such as during speculative bubbles or in high-inflation

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environments), Bitcoin may offer some hedging properties or attract flight-to-safety capital.

TABLE 5: QUANTILE REGRESSION RESULTS - B COEFFICIENTS FOR INFLATION

Quantile (%)	Inflation Coefficient (β)	p-value
10th	–0.022	0.218
25th	–0.015	0.161
50th	0.007	0.287
75th	0.031	0.096
90th	0.043	0.079

Table 6 presents a comparison of hedging effectiveness and average hedge ratios for three assets, Bitcoin, gold, and Treasury Inflation-Protected Securities, based on empirical estimates from the period 2015 to 2024. The hedge ratio represents the proportion of an asset used to offset the risk of an inflation-sensitive position, while hedging effectiveness measures the proportion of variance in portfolio returns reduced by including the asset as a hedge. For Bitcoin, the average hedge ratio is 0.12, described as highly unstable, with a hedging effectiveness of only 0.11. These figures indicate that Bitcoin provides very limited inflation risk reduction in a diversified portfolio, and that its ability to offset adverse price movements in inflation-linked instruments is weak and unpredictable. This outcome aligns with a broad literature explaining that Bitcoin's high volatility, frequent speculative swings, and lack of intrinsic value make it an unreliable hedge, especially over short horizons or in periods of market turbulence. The instability of the hedge ratio reflects Bitcoin's rapidly changing correlations with traditional inflation-sensitive assets. Gold exhibits a higher average hedge ratio of 0.47 and a hedging effectiveness of 0.45. These values indicate that gold can reduce nearly half the variance of portfolio returns exposed to inflation risk, confirming its traditional role as a robust hedge and haven during periods of monetary instability. Numerous studies have demonstrated that gold's value often moves inversely with inflation shocks and currency depreciation, especially during economic uncertainty, making it a reliable asset for portfolio protection.

Treasury Inflation-Protected Securities (TIPS) have the highest average hedge ratio (0.51) and hedging effectiveness (0.51), indicating that TIPS offer the most consistent and substantial protection against inflation risk among the three assets. TIPS are specifically designed to preserve purchasing power by adjusting both principal and interest payments in line with inflation, resulting in superior risk reduction for investors facing inflationary pressures. The nearly one-to-one hedge ratio and high effectiveness score support the argument that TIPS remain the benchmark inflation-hedging instrument for institutional and individual investors alike.

TABLE 6: HEDGING EFFECTIVENESS AND HEDGE RATIOS

Asset	Average Hedge Ratio	Hedge Effectiveness
Bitcoin	0.12 (highly unstable)	0.11
Gold	0.47	0.45
TIPS	0.51	0.51

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DISCUSSION

The findings of this study offer clearer insights into whether Bitcoin operates as an inflation hedge across various economies and during different inflationary episodes. Although Bitcoin is often referred to as digital gold for these reasons, the analysis presented here refutes this notion. Evidence from both high-income and low-income economies throughout the 2015 to 2024 period reveals that Bitcoin does not consistently shield investors from inflation. Although in select high-inflation environments such as Turkey and Brazil, Bitcoin returns occasionally rise alongside inflation, this pattern lacks consistency and robustness. The identified weak relationship (0.034) in emerging economies does not persist across the broader sample or within developed nations, where the connection is generally absent and even slightly inverse. These outcomes challenge the popular narrative that Bitcoin serves as a contemporary equivalent of gold. The regression and hedging effectiveness models confirm that gold continues to function as a strong inflation hedge, displaying stable and positive associations across national and market conditions. Consequently, the findings reinforce the academic consensus that Bitcoin behaves more like a speculative asset than a secure store of value (Baur and Hoang, 2021; Bouri et al., 2017; Bouri et al., 2017; Dyhrberg, 2016).

Early researchers such as Yermack (2015) and Dyhrberg (2016) observed Bitcoin exhibiting characteristics of both commodities and currencies, explaining its potential as a hedging instrument. Dyhrberg demonstrated short-term hedging capacity using generalized autoregressive conditional heteroskedasticity analysis against the United States dollar and the Financial Times Stock Exchange indices. However, more recent findings have increasingly challenged this assumption. Bouri et al. (2017) determined that Bitcoin serves primarily as a portfolio diversifier rather than a hedge or haven in volatile market conditions. In line with these critiques, the present study finds that Bitcoin's association with inflation is occasional and does not reflect the stable performance expected from effective hedging assets. According to the quantile regression results, Bitcoin produces notable returns during high-return intervals but tends to depreciate under adverse conditions, undermining its function as a tool for wealth preservation during inflationary periods (Baur and Lucey, 2010). Analysis using the dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity model reveals that Bitcoin's correlation with inflation modestly intensifies during periods of heightened inflation, though only briefly. These outcomes are consistent with Kristoufek (2015), who argued that Bitcoin does not significantly respond to inflation as a macroeconomic signal. This research supports and extends previous findings, demonstrating that although Bitcoin appears inflation-sensitive under specific conditions, the evidence is insufficient to classify it as a dependable inflation hedge.

It becomes evident that both institutional and regional conditions are essential in understanding the performance of Bitcoin. In environments where inflation is erratic, central banks are ineffective, and national currencies are unstable, as observed in certain countries, local populations may view Bitcoin as a viable option to protect financial assets. For instance, there is evidence of increasing demand for cryptocurrencies in Argentina, Venezuela, and Turkey during periods of inflation (Zhang and Wang, 2022). However, this phenomenon may not reflect traditional hedging behavior within formal financial frameworks. Rather than being driven by inflation directly, Bitcoin price changes in these contexts appear to result from capital

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flight, currency substitution, or speculative reactions to macroeconomic disruptions (Makarov and Schoar, 2020). In countries where institutional frameworks and inflation expectations are stable, Bitcoin's speculative characteristics make it a less attractive hedging tool when compared to assets such as gold or Treasury Inflation-Protected Securities. This reinforces the conclusion that Bitcoin's high volatility undermines its practical use as a hedge. Although inflation may at times coincide with rising Bitcoin prices, broader economic disruptions can just as easily trigger substantial price declines. In both the United States and Europe, despite inflation surging in 2022 and returning the consumer price index to levels not seen in decades, Bitcoin experienced a value decline of over forty percent.

This study strongly indicates that Bitcoin is more responsive to changes in market liquidity, investor sentiment, and general economic uncertainty than to inflation itself, positioning it as an unconventional asset rather than a reliable store of value. The fixed-effects model confirms that fluctuations in exchange rates and interest rates play a significant role in explaining Bitcoin returns. According to Bouri et al. (2020), while Bitcoin is often portrayed as "digital gold," its pronounced volatility renders it unreliable as a long-term value-preserving asset. These findings contradict the notion of Bitcoin as a hedging instrument, as it lacks a negative correlation with inflation. Instead, Bitcoin's performance is driven by low interest rates, risk-seeking behavior, and the pace of technological adoption—factors unrelated to inflation control (Corbet et al., 2018). Results from the quantile regression show that Bitcoin performs well in the ninety-first percentile, a phenomenon likely explained by speculative investor enthusiasm. However, under poor or average market performance, its hedging utility diminishes significantly. The inherent price volatility of Bitcoin runs counter to the principles of inflation hedging, which require consistent performance across economic cycles (Baur and McDermott, 2010).

The hedging effectiveness ratio for Bitcoin, calculated at 0.11, is significantly lower than that of gold at 0.45 and Treasury Inflation-Protected Securities at 0.51, posing notable challenges for investors and policymakers. Incorporating Bitcoin into a portfolio for inflation protection may inadvertently raise overall portfolio risk. This analysis confirms that stable inflation protection via Bitcoin remains difficult to achieve for active asset managers. It further refutes the widespread claim that Bitcoin functions as "digital gold," an idea promoted by both financial commentators and media outlets. In contrast, gold has demonstrated robust hedging capabilities, supported by historical investor behavior and a deep, liquid market (Sharma and Paul, 2021). Although Bitcoin remains a relatively new asset, its lack of intrinsic value, susceptibility to policy and regulatory shifts, and price instability limit its acceptance as a credible hedge. Despite its appeal as a speculative vehicle and potential medium for cross-border payments beyond capital controls, Bitcoin does not possess effective hedging characteristics within financial markets.

The findings demonstrate that Bitcoin, at present, does not pose a threat to central banks or regulatory authorities, contrary to widespread beliefs. In countries experiencing rapid price increases, greater reliance on Bitcoin may reflect eroded trust in national leadership rather than a structured attempt to stabilize economic systems. While Bitcoin may offer a temporary means for individuals to preserve wealth in cases of currency collapse, its uncertain valuation and lack of institutional oversight make it a high-risk choice (Auer and Claessens, 2018). This study advises investors

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and financial advisors to exercise caution in treating Bitcoin as a protective asset against inflation. Allocating substantial capital to an unstable instrument could jeopardize long-term financial security in times of macroeconomic volatility. Accordingly, the results underscore the necessity of enhancing financial literacy and fostering transparent discussions about cryptocurrencies. Popular narratives surrounding Bitcoin often obscure its inherent limitations and risks. Scientific findings, such as those presented in this study, should serve as the foundation for informed public discourse and sound policymaking in the evolving landscape of digital finance.

CONCLUSIONS

The objective of this study is to evaluate whether holding Bitcoin assists individuals in mitigating inflation across various economic contexts. By examining data from multiple countries over the 2015 to 2024 period, the findings reveal that Bitcoin does not function as a reliable hedge against inflation. Its response to inflation varies and is more strongly shaped by external market dynamics than by inflation itself. In economies with stable monetary policy and low inflation volatility, no robust or statistically significant positive relationship is found between Bitcoin returns and inflation, as demonstrated by the ordinary least squares regression and panel data analysis. Generally, Bitcoin exhibits either a weak or non-existent link to inflation. Even in inflation-prone countries such as Turkey and Brazil, any connection to inflation was limited and short-lived, with Bitcoin more responsive to investor sentiment than to underlying macroeconomic indicators. The dynamic conditional correlation-generalized autoregressive conditional heteroskedasticity analysis further reveals that during economic stress, any uptick in Bitcoin's correlation with inflation tends to fade rapidly. Consequently, Bitcoin tends to behave more like a speculative haven, reacting to shock rather than anchoring in times of inflation. Unlike gold and Treasury Inflation-Protected Securities, Bitcoin does not show a consistent or reliable association with inflation. The quantile regression confirms that Bitcoin performs relatively better in the upper percentiles of the return distribution, but such outcomes are usually driven by speculative enthusiasm rather than strong economic fundamentals. Therefore, Bitcoin's success appears to hinge on capital flows and investor sentiment rather than sound inflation dynamics, making it suitable for diversification but not for inflation protection.

Bitcoin's hedging capabilities further deteriorate when measured through hedge ratios and effectiveness metrics. Compared to gold and Treasury Inflation-Protected Securities, Bitcoin exhibits more volatility and lower reliability. In certain instances, holding Bitcoin exposed investors to greater risk rather than offering financial protection. These results support the conclusion that Bitcoin does not function as an effective inflation hedge. Instead, it behaves more like a speculative or high-growth equity, responding to market psychology rather than inflationary forces. Beyond statistical findings, institutional and regional factors shape the demand for Bitcoin. In countries where domestic currencies lose value amid institutional breakdowns, Bitcoin may serve as a reactive vehicle for wealth preservation. However, this behavior is more a reflection of financial system failure than traditional inflation hedging. In economies with robust financial regulation and low inflation, Bitcoin is widely treated as a speculative asset or alternative investment rather than a primary shield against price increases.

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These results challenge claims that Bitcoin undermines fiat currency stability by serving as an inflation hedge. Since cryptocurrencies lack systemic support mechanisms, such concerns appear unfounded. Bitcoin's value remains highly sensitive to regulatory announcements, policy shifts, and financial news, further diminishing its dependability. While Bitcoin can offer diversification in investment portfolios or financial independence in countries experiencing economic turmoil, it does not threaten the autonomy or efficacy of central banking institutions. This distinction is particularly relevant for investors seeking inflation protection. Those aiming to preserve their purchasing power should rely on assets that have demonstrated consistent hedging performance, such as gold or inflation-indexed government bonds. Including Bitcoin in a portfolio may provide exposure during bullish markets, but it also increases volatility and investment complexity. Its popularity should not be conflated with its capacity to safeguard long-term wealth. This research directly challenges the widely held belief that Bitcoin is a dependable inflation hedge. Future research might investigate whether regulatory developments, institutional adoption, or technological improvements can enhance Bitcoin's long-term stability. At present, however, Bitcoin's reputation as digital gold remains more aspirational than evidenced.

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