

BITCOIN, DECENTRALIZED FINANCE, AND FRONTIER MARKETS: A CONTROLLED ANALYSIS OF PORTFOLIO DIVERSIFICATION (2020–2026)

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Abstract

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This study analyzes the relationship between Bitcoin returns, the decentralized finance (DeFi) sector, and traditional stock market returns, focusing on the Iraq Stock Exchange (ISX) from January 4, 2020, to March 4, 2026. Growing institutional adoption has strengthened the interconnectedness of digital assets with traditional markets, while the International Monetary Fund (IMF, 2021) warns that this integration may expose frontier economies to new financial risks (Gross & Senner, 2026). Using the autoregressive distributed lag (ARDL) methodology, the results reveal a statistically significant negative short-run impact of Bitcoin returns on ISX returns, with no significant long-run impact for either Bitcoin or DeFi. This suggests cryptocurrencies have acted as alternative assets and liquidity competitors rather than safe havens or hedging tools in the traditional sense, and that Bitcoin may serve as an indicator of global risk trends given its reach into relatively isolated frontier markets like Iraq. In contrast, the lack of DeFi impact is attributed to the novelty of these assets, insufficient investor awareness, limited digital infrastructure, and scarce access to centralized trading platforms in frontier markets.

Keywords: Cryptocurrency, Decentralized Finance, DeFi, Iraq Stock Exchange, ISX, ARDL Model, Frontier Markets, Portfolio Diversification

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1. INTRODUCTION

The global financial system has undergone a profound structural transformation over the past

decade due to the emergence of cryptocurrencies as an emerging investment category that has reshaped a significant portion of the global financial landscape (Gross & Senner, 2026). These assets have

moved from limited and experimental uses to widespread interest from investors, individuals, and institutions alike. Dealing with cryptocurrencies is no longer limited to their status as a technological innovation linked to digital advancements; rather, it has become a complex financial phenomenon with investment, behavioral, and institutional dimensions, contributing to their deeper integration within modern investment portfolios.

This shift has strengthened the interconnectedness of the cryptocurrency market with the dynamics of traditional markets, perhaps partly due to structural factors, most notably the significant expansion of institutional adoption of cryptocurrencies, whether through holding them or developing derivative financial instruments (Gross & Senner, 2026). Partly due to the rapid development of digital market infrastructure, ease of access, and media coverage, all of which have contributed to increased cryptocurrency adoption and enhanced investor confidence. This has ultimately translated into a notable expansion of cross-border trading and the integration of cryptocurrencies into the global financial landscape (International Monetary Fund [IMF], 2021).

Conversely, given the specific characteristics of emerging economies, the IMF (2021) warns that these developments could lead to imbalances or pressures in these economies, resulting from the escalating risks associated with cryptocurrency adoption in emerging markets, including the loss of the ability to regulate capital flows and weakened monetary sovereignty. It is also becoming increasingly clear that stock markets are no longer operating in isolation from the transformations taking place in the cryptocurrency market. They are now influenced by the broader context imposed by these assets as innovative tools that are reshaping investor behavior and risk management patterns.

Recent years have witnessed a noticeable expansion in the decentralized finance (DeFi) system as a natural extension of the development brought about by cryptocurrencies, in particular Bitcoin, as Bitcoin laid the basic building block that contributed to the development of the digital environment for encrypted assets, which later evolved to include various DeFi applications. In this context, Bitcoin is seen as a digital asset that is often used as a store of value and an investment tool, while DeFi reflects a broader development of providing DeFi services based on smart contracts.

Although the relationship between cryptocurrency markets and stock markets is receiving increasing attention, there are still research gaps that have not yet been covered. The increasing role of DeFi systems in shaping the tripartite relationship between these markets is often ignored, with research focusing on limited aspects, such as considering Bitcoin and DeFi assets as a hedging tool, a safe haven, or a vector of infection in times of crisis, which highlights the importance of dynamic analysis that takes into account temporal and spatial conditions, especially since most studies limited their focus to advanced financial markets and relied on fixed analytical models.

This leaves a gap in understanding the dynamic relationship between cryptocurrency markets, DeFi, and local equity markets in emerging and frontier environments. Therefore, this study

aims to bridge these gaps by providing a comprehensive analytical framework for the relationship between cryptocurrency and DeFi market variables and the local stock market index in a frontier market. The study uses a dataset that includes the daily returns of Bitcoin, the DeFi proxy Aave, and the returns of the Iraq Stock Exchange (ISX) Index, during the study period extending from January 4, 2020, to March 4, 2026.

The paper is organized as follows. Section 2 provides the theoretical framework and literature review. Section 3 describes the research methodology. Section 4 presents the results. Section 5 discusses the results and presents the practical implications. Section 6 provides the conclusion, limitations, and future research suggestions.

2. LITERATURE REVIEW

Modern portfolio theory, developed by Markowitz (1952), provides the theoretical framework for analyzing the role of cryptocurrencies within a multi-asset investment portfolio. The principle of diversification explains how to select the optimal mix of assets to maximize the portfolio's expected returns while minimizing risk. Through strategic asset allocation, while ensuring that assets with perfectly correlated returns are avoided, investors can reduce the overall portfolio variance without sacrificing expected returns. In the context of the relationship between cryptocurrencies and stocks, the impact manifests in two main ways. Under the substitution effect, investors allocate capital across asset classes based on expected returns, treating cryptocurrencies and equities as alternative investment channels. A perceived advantage in digital assets may lead to capital outflows from stock markets, placing downward pressure on equity prices and increasing overall market volatility. This pattern illustrates how evolving investor expectations influence the movement of funds between conventional and emerging financial instruments (Umar et al., 2020; Sami & Abdullah, 2021).

The second trend is complementary assets, which support the benefits of diversification when held together in the portfolio. Their interrelationships tend to be negative; a decrease in the price of one asset will increase demand for the other, thus raising its price and contributing to a reduction in the overall portfolio risk (Umar et al., 2020; Sami & Abdullah, 2021). However, determining how closely cryptocurrencies resemble or deviate from either of these two characteristics usually depends on investors' perceptions and future expectations. Investors tend to view cryptocurrencies as more volatile than stocks, which supports their parallel movement with stocks, thus placing them under the category of alternative assets. Conversely, when the two assets move in opposite directions, cryptocurrencies are more likely to be classified as complementary assets to stocks (Sami & Abdullah, 2021).

Based on the above, several financial studies have documented that Bitcoin's long history of high returns and volatility is among the most compelling factors motivating investors to use the cryptocurrency as a hedging or speculative asset. However, empirical research has revealed

inconsistencies in Bitcoin's effectiveness in fulfilling these roles. For example, Bouri et al. (2017) studied Bitcoin as a potential hedging and safe-haven asset using the dynamic conditional correlation generalized autoregressive conditional heteroskedasticity (DCC-GARCH) methodology from July 2011 to December 2015. Their findings suggest that Bitcoin is not an effective hedging tool and is, therefore, primarily used for diversification. Similarly, Liu and Serletis (2019), using GARCH-in-mean models, confirmed that the cryptocurrency market is interconnected with other markets and can transmit volatility to traditional financial markets, particularly in the United States economy and major global markets. Regarding the varying effectiveness of Bitcoin as an alternative or complementary asset to equities across different time and geographical contexts, Shahzad et al. (2020) emphasized the fundamental differences in the characteristics of cryptocurrencies as hedging or safe-haven assets, which are influenced by market conditions, institutional frameworks, and geographical contexts. Their research analyzed the stock markets of the Group of Seven (G7) countries from November 29, 2010, to May 31, 2018, using quantile regression methodology.

Subsequently, Wang et al. (2022) analyzed eight prominent cryptocurrencies (Bitcoin, Ethereum, Stellar, Ripple, Tether, Cardano, Litecoin, and EOS) using exponential generalized autoregressive conditional heteroskedasticity (EGARCH), DCC-GARCH, and wavelet analysis, and found that the COVID-19 pandemic acted as a catalyst that strengthened the correlation between cryptocurrencies and financial markets, thereby reducing their effectiveness as safe havens during crisis periods. However, given Bitcoin's inherent volatility, Ugolini et al. (2023) emphasized that the relationship between digital assets and traditional markets is not static but rather evolves depending on market conditions and economic contexts.

In light of the foregoing, recent studies reveal the continued and deepening complexity of the dynamics between digital assets and traditional markets. Yousaf and Yarovaya (2022) examined digital assets—including traditional cryptocurrencies, non-fungible tokens (NFTs), and DeFi—within a decentralized global environment from May 2020 to May 2021. Using the CSAD model developed by Chang et al. (2000), they identified time-varying herding behavior in both cryptocurrencies and DeFi assets during short-term investment horizons. Furthermore, Piñeiro-Chousa et al. (2022) demonstrated that the interaction between DeFi currencies and traditional markets extends beyond direct financial channels to include informational and behavioral channels, employing a logit-probit model on data from July 2018 to July 27, 2020.

In expanding the analysis of the effects of digital assets to include various DeFi applications, Ugolini et al. (2023) emphasized the reciprocal relationship between DeFi markets and cryptocurrencies, highlighting the potential role of this relationship in mitigating stock market volatility. Akyildirim et al. (2025) further elaborated, suggesting that this effect may vary depending on media momentum and sentiment indicators shaping

market dynamics, which play a crucial role in pricing DeFi assets. Similarly, Hung (2024) demonstrated that DeFi markets exert a significant short-term influence on equity markets in Central and Eastern Europe, thus supporting the idea of increasing integration of digital assets with regional financial systems. In a related context, Ali and Manel (2025) confirmed this view, using the quantile vector autoregressive (QVAR) methodology, explaining that DeFi assets can enhance the diversification benefits of equity portfolios in emerging markets, a fact that becomes more apparent during periods of economic downturn.

Finally, in the context of studying dynamic effects and focusing on the specificities of local markets, Lin (2026), by examining the Malaysian market as a model for emerging economies and applying dynamic interaction analysis for the period 2014–2024, tested the autonomy of cryptocurrencies as a hedging tool in emerging markets. The results revealed a complex network of interrelationships that limit the autonomy of these assets. In a related vein, Zhang et al. (2025) show that frontier markets' weak international integration can mitigate the transmission of cryptocurrency-market shocks, while Ahmed and Khan (2026) find that when such shocks are transmitted, frontier and emerging markets with fragile regulatory systems and weak information networks are disproportionately affected during periods of uncertainty. Most recently, Nuskabayeva et al. (2026) provide direct evidence consistent with this frontier-market pattern, finding within a vector autoregression (VAR) framework that Bitcoin's influence on the Kazakhstan Stock Exchange is limited, short-lived, and statistically insignificant, despite Kazakhstan's substantial global financial exposure through its oil-export sector. On the portfolio-construction side, Kumar et al. (2025) find that a small allocation to select cryptocurrencies can still improve the return-risk profile of equity portfolios in the thinly traded stock market of Fiji, reinforcing the diversification rationale for cryptocurrency exposure even where direct market linkages are weak. Taken together, these contributions point to a still-unsettled picture in which the strength, sign, and even the time horizon of cryptocurrency-equity linkages in frontier markets remain empirically contested—a gap this study addresses directly for the Iraqi case.

Building on the theoretical perspectives and empirical gaps outlined above, this study tests three research hypotheses:

H1: Bitcoin returns exert a significant short-run effect on Iraq Stock Exchange returns.

H2: Bitcoin returns exert a significant long-run effect on Iraq Stock Exchange returns.

H3: Decentralized finance (Aave) returns exert a significant effect, in either the short or long run, on Iraq Stock Exchange returns.

3. RESEARCH METHODOLOGY

3.1. Sample and econometric method

Based on previous reference studies in this field and to test the research hypotheses and achieve its objectives, this study draws on daily data from the ISX over the period from January 4, 2020,

to March 4, 2026, yielding a total of 2,252 trading-day observations after removing non-trading days common to all three series.

The autoregressive distributed lag (ARDL) approach developed by Pesaran et al. (2001) is employed as one of the modern econometric techniques used to test the existence of a long-run equilibrium relationship between variables when they differ in their orders of stationarity or integration. This method was chosen for its ability to determine the optimal number of time lags and to derive an error correction model (ECM) that measures the model's ability to return to equilibrium after any disturbance; it can also be applied in the case of small samples.

Alternative techniques were considered and set aside for the following reasons. Multivariate VAR/vector ECM (VECM) frameworks require all series to share the same order of integration, which is more restrictive than the ARDL bounds-testing approach used here. DCC-GARCH and wavelet coherence methods, widely used in this literature

(Bouri et al., 2017; Wang et al., 2022), are well suited to modeling time-varying volatility co-movement but are less suited to isolating a level (long-run equilibrium) relationship of the kind this study's hypotheses require. Given that the primary research questions concern both a short-run dynamic effect and the existence (or absence) of a long-run equilibrium relationship, the ARDL bounds-testing framework was judged the most direct fit; volatility-spillover methods such as DCC-GARCH are noted as a natural extension for future work.

3.2. Variable definition

3.2.1. Dependent variable

Based on the theoretical framework and empirical studies reviewed, and in a manner that reflects the nature of the investigated relationship, the stock market return index is adopted as the dependent variable. It is measured using the growth rate according to the following formula (Shaturaev, 2023):

$$\text{Market return} = \frac{(\text{Current observation} - \text{Previous observation})}{\text{Previous observation}} \times 100\% \quad (1)$$

3.2.2. Independent variables

Bitcoin returns (*BTC*) were adopted as an independent variable representing Bitcoin market performance. DeFi (Aave) returns (*DeFi*) represent the daily price growth rate of the Aave token, used as a proxy for DeFi sector performance given Aave's status as one of the largest liquidity and financial-sovereignty protocols in the DeFi ecosystem, and thus a reasonable indicator of genuine investor demand for DeFi services.

To express the returns of both independent variables, the same growth-rate formula used to measure stock market returns was applied, ensuring consistency in how returns are defined across all three series.

3.3. Model specification

Based on the above, the estimation model can be formulated as a mathematical function upon which the standard economic equation is built, as follows:

$$ISX_t = f\{BTC, DeFi\} \quad (2)$$

$$ISX_t = \beta_0 + \beta_1 BTC_t + \beta_2 DeFi_t + \varepsilon_t \quad (3)$$

where, ISX_t , BTC_t , and $DeFi_t$ denote the growth rates of the ISX index, Bitcoin, and DeFi (Aave) returns, respectively.

3.4. Data sources

The closing price index time series for the ISX and Bitcoin were obtained from the Investing.com database, while the DeFi sector data were obtained based on the Aave protocol (Aave) closing price as a reference variable (proxy), given its status as one of the largest liquidity and financial sovereignty protocols in the DeFi ecosystem. All analyses were conducted in EViews 10.

4. RESULTS

This section reports the empirical results in four steps, following standard ARDL practice:

- 1) unit-root testing to confirm the order of integration of each series;
- 2) lag-order selection;
- 3) bounds testing for cointegration;
- 4) estimation of the short-run (error-correction) and long-run coefficients, followed by diagnostic and stability checks.

Before turning to the formal tests, it is worth noting that daily returns for all three series behave as is typical of high-frequency financial data: means close to zero, visible volatility clustering, and occasional large single-day moves, particularly in the Bitcoin and Aave series, which are considerably more volatile day-to-day than the ISX index. This pattern, visible in Figure 1 below, motivates both the unit-root pre-testing that follows and the later diagnostic check for conditional heteroskedasticity (Table 6). Table 1 first reports the Phillips-Perron (PP) unit root test results for all three series.

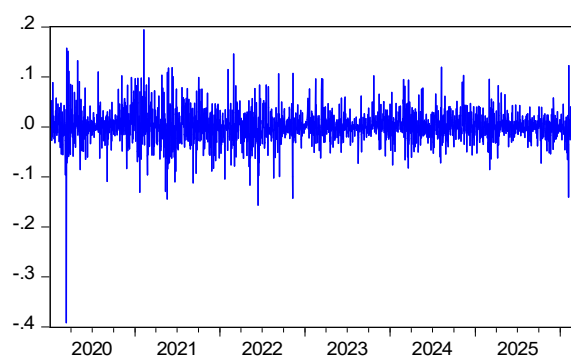
It is also worth situating this dataset relative to related work: whereas Shahzad et al. (2020) studied G7 markets over 2010–2018 and Lin (2026) studied Malaysia over 2014–2024, the present study covers a considerably more volatile and structurally different setting—a frontier market with limited institutional crypto-asset participation—over a six-year window (2020–2026) that spans both the pandemic-era crypto boom and the subsequent period of institutional consolidation described by KuCoin (2026) and Benzinga (Remy, 2026). This context is important for interpreting the magnitude, and not only the sign, of the coefficients reported below.

Table 1. Phillips-Perron unit root test

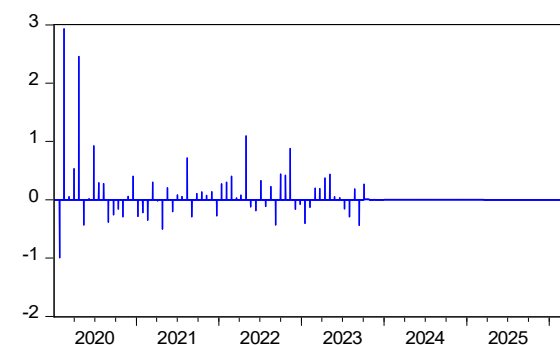
Variable	Model	PP statistic	Prob.*
ISX	None	-32.20813	0.0000
	Intercept	-32.19679	0.0000
	Trend and intercept	-32.21843	0.0000
BTC	None	-50.84348	0.0001
	Intercept	-50.96343	0.0001
	Trend and intercept	-51.00245	0.0000
DeFi	None	-36.20748	0.0000
	Intercept	-36.25593	0.0000
	Trend and intercept	-36.30223	0.0000

Note: * The PP test corrects for serial correlation and heteroskedasticity using a non-parametric correction.

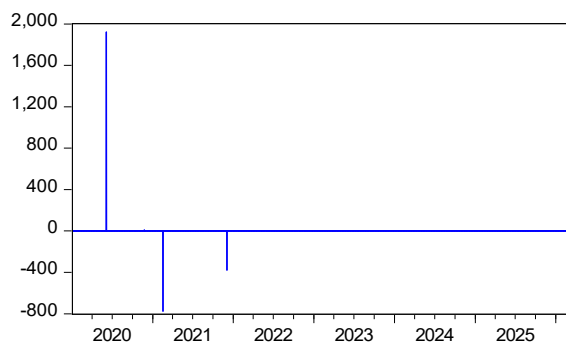
Source: Authors' elaboration.

Figure 1a. Time series plots of daily returns of BTC

Source: Authors' elaboration using EViews 10.

Figure 1b. Time series plots of daily returns of DeFi

Source: Authors' elaboration using EViews 10.

Figure 1c. Time series plots of daily returns of ISX

Source: Authors' elaboration using EViews 10.

The results of the PP unit root test developed by Perron (1988), listed in Table 1, indicate that all variables are stationary at level, as the probability values did not exceed the 0.05 threshold. This means that none of the studied series

requires differencing beyond the level, satisfying the requirements of cointegration testing under the ARDL methodology.

Table 2. Model selection criteria for the ARDL estimation

Model	Adj. R-sq	HQ	BIC	AIC
ARDL(1,3,0)	0.000841	11.21893	11.23966	11.20626

Note: Model selected based on the Akaike information criterion (AIC).
Source: Authors' elaboration.

To determine the optimal lag structure, a set of criteria (AIC, Bayesian information criterion [BIC], Hannan-Quinn information criterion [HQ]) was used, as shown in Table 2. These criteria identify the optimal model as ARDL(1,3,0), with one lag for the dependent variable (ISX), three lags for Bitcoin, and zero lags for DeFi (Aave) returns.

Table 3. ARDL bounds test for cointegration

Significance	I0 Bound	I1 Bound
10%	2.63	3.35
5%	3.10	3.87
2.5%	3.55	4.38
1%	4.13	5.00

Note: Asymptotic critical values are based on Pesaran et al. (2001).
Computed F-statistic = 256.2940, k = 2 (number of regressors).

Source: Authors' elaboration.

The computed F-statistic stands at 256.29, well above the upper-bound (I1) critical value at the 1% significance level. This result confirms the presence of a long-run equilibrium relationship between Bitcoin (BTC) and DeFi (Aave) and ISX returns, and rejects the null hypothesis of no cointegration.

Table 4. ARDL short-run (error-correction) estimates

Variable	Coefficient	Std. error	t-statistic	Prob.
D(BTC)	23.43865	45.08707	0.519853	0.6033
D(BTC(-1))	-4.078481	54.24240	-0.075190	0.9401
D(BTC(-2))	-92.76343	45.11037	-2.056366	0.0400**
CointEq(-1)	-0.996092	0.031065	-32.06501	0.0000***

Note: *** significant at 1%; ** significant at 5%. CointEq(-1) is the error-correction term.

Source: Authors' elaboration.

Table 4 reports the short-run dynamics from the error-correction specification. The second lag of Bitcoin returns, $D(BTC(-2))$, is negative and statistically significant at the 5% level (-92.76343, $p = 0.0400$), indicating a short-run inverse effect of BTC on the ISX that materializes with a two-day lag. The error-correction term, $CointEq(-1)$, is negative and highly significant (-0.996092, $p < 0.001$), confirming valid error-correction dynamics and indicating that roughly the entire deviation from long-run equilibrium is corrected within a single trading day—evidence of rapid adjustment between the two markets.

Table 5. Long-run coefficients—ARDL(1,3,0) estimates

Variable	Coefficient	Std. error	t-statistic	Prob.
BTC	44.44868	110.6647	0.401652	0.6880
DeFi	-0.731271	14.28327	-0.051198	0.9592
C	0.675785	2.053090	0.329155	0.7421

Note: EC = ISX - (44.4487 × BTC - 0.7313 × DeFi + 0.6758).

Source: Authors' elaboration.

In contrast to the short-run result, Table 5 shows that neither *BTC* ($p = 0.688$) nor *DeFi* ($p = 0.959$) has a statistically significant long-run coefficient. This indicates that while Bitcoin exerts

a short-lived, delayed inverse effect on the *ISX*, no stable long-run equilibrium relationship of practical magnitude exists between either digital-asset series and *ISX* returns once the system has fully adjusted.

Table 6. Model diagnostics

Test	Test statistic	p-value
Serial correlation (Lagrange multiplier [LM] test)	$F(2,1027) = 0.04665$	0.9544
Heteroskedasticity (Breusch-Pagan-Godfrey [BPG] test)	$F(6,1029) = 0.95335$	0.4558
Heteroskedasticity (autoregressive conditional heteroscedasticity [ARCH] effect)	Obs. * $R^2 = 2050.586$	0.0000

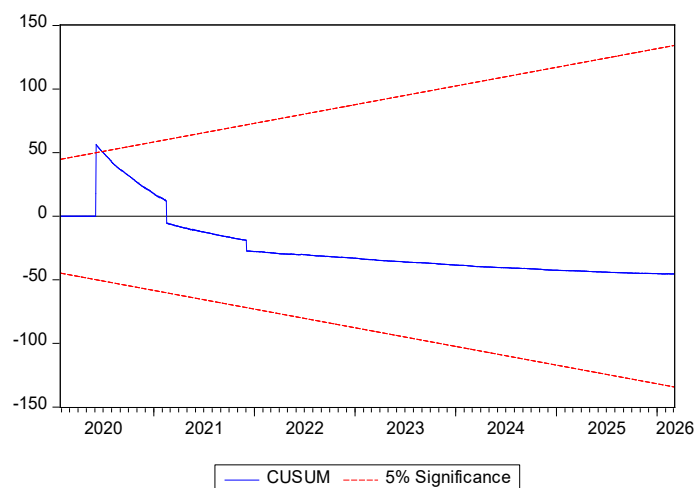
Source: Authors' elaboration based on EViews 10 results.

The Breusch-Godfrey LM test finds no evidence of residual serial correlation, and the BPG test finds no evidence of general heteroskedasticity, supporting the adequacy of the estimated ARDL specification. The ARCH-effect test, however, indicates significant conditional heteroskedasticity (volatility clustering) in the residuals. This is a common feature of high-frequency financial return series and does not invalidate the reported coefficient estimates; it does suggest that ARCH/GARCH-family volatility modeling would be

a natural direction for follow-up research, and that heteroskedasticity-consistent standard errors provide an additional robustness check.

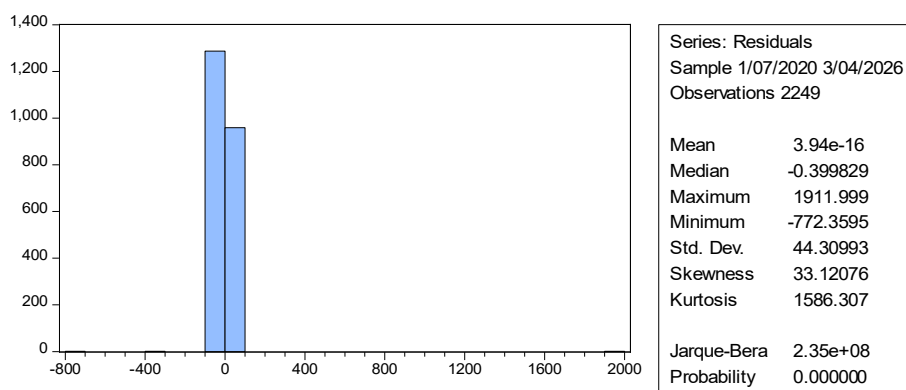
The cumulative sum (CUSUM) and CUSUM-of-squares tests confirm the stability of the parameters throughout the study period, indicating consistency of the model's coefficients and the absence of sudden structural changes affecting the estimated relationship, thereby supporting the reliability of the results.

Figure 2. Cumulative sum test for model stability



Source: Authors' elaboration using EViews 10.

Figure 3. Cumulative sum of squares test for model stability



Source: Authors' elaboration based on EViews 10 results.

5. DISCUSSION

According to the long-run estimates, Bitcoin and DeFi (Aave) returns show no statistically significant effect on *ISX* returns, with probability values

exceeding the 0.05 threshold. This reflects the limited explanatory power of these variables for *ISX* returns once the system has fully adjusted to equilibrium. One possible explanation lies in the structural features of the *ISX*, which operates as

a frontier market with shallow financial depth and limited exposure to global financial flows (Zhang et al., 2025). According to their analysis, weak international integration may mitigate the transmission of shocks from cryptocurrency markets to some emerging markets. At the same time, there may be significant and widespread changes in global cryptocurrency markets, stemming from a marked contraction in circulating supply, reflecting a strategic shift by institutional and individual investors towards longer-term asset holdings (Remy, 2026). As a result, the shift of large amounts of cryptocurrency to holding wallets has isolated a significant portion of the Bitcoin market from active trading, so that price signals from this market have less impact on less integrated markets, such as Iraq.

This view is supported by the argument that Bitcoin has transcended its reputation as a fast-moving investment asset and transformed into a long-term investment, driven by a trend among institutional and individual investors in developed markets to acquire Bitcoin as a long-term strategic holding, which has mitigated the transmission of its volatility to emerging markets (KuCoin, 2026; Moro Visconti, 2025). Moro Visconti (2025) makes a related point, explaining that when financial markets experience turmoil, Bitcoin tends to mimic the price behavior of risky assets; however, under normal circumstances and in the long run, it exhibits a degree of relative independence from other markets.

The inability of DeFi assets to have a tangible long-run impact on ISX returns is attributed to their novelty and relatively recent adoption (Piñeiro-Chousa et al., 2022), as well as limited access to centralized platforms, particularly in emerging markets (Organisation for Economic Co-operation and Development [OECD], 2022).

In contrast to the long-run findings, the short-run results revealed a different pattern. The second lag of Bitcoin returns, $D(BTC(-2))$, proved to have a significant negative effect on ISX returns at the 5% level (-92.76343), reflecting a delayed rather than immediate reaction from investors in the Iraqi market: the transmission of uncertainty shocks from the Bitcoin market to the ISX appears to unfold over roughly two trading days rather than instantaneously. This finding aligns broadly with recent evidence that cryptocurrency-equity contagion varies systematically by region, with frontier and emerging markets exhibiting comparatively weaker—though still present—shock transmission than developed markets (Ahmed & Khan, 2026). In the Iraqi case specifically, this pattern is consistent with the ISX's documented institutional fragility: a market shaped by sanctions-related constraints, geopolitical instability, and information asymmetry that structurally limit its integration with global financial markets (Al-Dabbagh, Shehab, et al., 2026). The delayed, rather than contemporaneous, nature of this transmission is also consistent with broader evidence that structurally less-integrated markets absorb external shocks primarily through a gradual, uncertainty-driven channel rather than an immediate price-based one: in the DeFi domain specifically, geopolitical energy shocks have been shown to transmit to decentralized derivative protocols mainly via implied-volatility channels, with multi-day lags and volatility half-lives markedly longer than in the underlying commodity market

itself (Al-Dabbagh, Al-Iraqi, et al., 2026). Read together, these findings suggest that the two-day transmission lag documented here for the ISX reflects a more general pattern in which structurally less-integrated markets—whether frontier equity markets or decentralized protocols—price external shocks with a delay driven by uncertainty absorption rather than direct price discovery.

This short-run negative relationship is consistent with a substitution effect between Bitcoin and Iraqi equities: higher Bitcoin returns are followed, with a short lag, by lower ISX returns. This interpretation is supported by the findings of Özer et al. (2024), who emphasize Bitcoin's role as a major source of volatility transmission, even in emerging markets.

The error-correction term, which met the necessary and sufficient conditions for valid error correction (negative and significant), reached a value of -0.996092, indicating that the process of correcting short-run imbalances and returning to equilibrium takes place within approximately one trading day. The overall F-statistic of 256.294 further confirms the joint significance of the estimated model, with the associated probability value approaching zero.

Taken together, the short-run and long-run results tell a coherent story rather than a contradictory one. In the very short run, Bitcoin price movements appear to pull liquidity away from Iraqi equities, consistent with a substitution-effect channel; but because the ISX remains only loosely connected to global capital flows, this effect does not compound into a lasting equilibrium relationship. In other words, Bitcoin behaves less like a systematic risk factor priced into ISX valuations over time, and more like an occasional, short-lived drain on local trading liquidity whenever global crypto sentiment shifts sharply. This distinction matters for how the finding should be used: it supports tactical, short-horizon monitoring of Bitcoin-driven liquidity shifts rather than a structural repricing of Iraqi equities around cryptocurrency market conditions.

Cryptocurrencies and DeFi can be analyzed from three perspectives: cryptocurrencies as an alternative investment asset, their role as a diversification and risk-management tool, and the limited impact of DeFi and its implications for the Iraqi market. These perspectives are not mutually exclusive: the same short-run substitution effect that makes Bitcoin a liquidity competitor for local equities is, from a portfolio-construction standpoint, also the source of its short-horizon diversification value. The practical guidance below is organized around this dual character, distinguishing what each finding means for market participants from what it means for those responsible for market oversight.

First, cryptocurrencies as an alternative investment asset under current market conditions. Given weak market liquidity and volatility, investors may be forced to take on more risk or seek safe havens. Cryptocurrencies are considered high-risk investments. This study found that Bitcoin acts as a liquidity competitor, attracting liquidity away from the local stock market due to the short-run inverse relationship between them.

For investors, the takeaway is straightforward: when Bitcoin prices climb, it may signal that capital

is quietly shifting away from local equities in the short run. That movement, even if subtle, is worth monitoring, as it could prompt a closer look at current positions and whether they still make sense.

For those overseeing the market, the implication runs a bit deeper. If local stocks drop without an obvious domestic cause, it is reasonable to examine whether liquidity is being pulled toward crypto markets. Monitoring these flows more closely could help distinguish a short-lived fluctuation from something with more lasting significance. For regulatory bodies, maintaining stock market stability requires studying the phenomenon of liquidity migration and developing tools to monitor and, where appropriate, mitigate it.

Second: Bitcoin as a portfolio diversification tool (risk management). The short-run inverse relationship is particularly relevant for investors due to its connection to price volatility and its potential use in risk management. For example, an investor with a portfolio heavily concentrated in Iraqi stocks might find that adding a modest Bitcoin position helps offset short-run portfolio volatility, since Bitcoin tends to move in the opposite direction of local stocks over short horizons. Moreover, in the absence of a significant long-run relationship, Bitcoin can offer diversification value that is distinct from, rather than a substitute for, local market exposure. However, this type of diversification carries inherent risks due to Bitcoin's own high volatility and should be sized accordingly within a broader risk framework.

Third: The limited impact of DeFi and its implications for the Iraqi market. The structural characteristics of the Iraqi stock market, limited digital infrastructure, scarce access to centralized trading platforms, the relative novelty of DeFi assets, and limited investor awareness of them may collectively explain the absence of a measurable DeFi effect on ISX returns. Accordingly, the practical implications are as follows:

For local investors, there is little basis at this stage for prioritizing DeFi exposure as a factor in ISX positioning, since it is not currently moving the market. Domestic economic conditions, regional political developments, and the structural factors that have long shaped Iraqi stock performance remain the primary drivers to monitor.

For researchers and policymakers, the limited influence of DeFi observed here should not be read as evidence that Iraq is structurally isolated from global digital-asset finance. Rather, it suggests that the channels through which DeFi could transmit to local markets—regulatory clarity, platform access, and investor familiarity—are still developing. The relevant task for future research and policy is to understand why those channels remain underdeveloped and what might support their gradual formation.

6. CONCLUSION

This study examined the relationship between Bitcoin, DeFi (Aave) returns, and the ISX over the period January 4, 2020, to March 4, 2026. The key findings are as follows: 1) Bitcoin returns have a short-run inverse effect on the ISX, materializing with a two-day lag—when Bitcoin rises, local stocks tend to fall shortly after; 2) Bitcoin returns show no statistically significant long-run effect on the Iraqi market; 3) DeFi (Aave) returns show no measurable effect on the ISX, in either the short or long run.

These findings support hypothesis *H1* (a significant short-run Bitcoin effect), but do not support *H2* (a significant long-run Bitcoin effect) or *H3* (a significant DeFi effect). Taken together, the results suggest that Bitcoin functions as a short-run alternative asset and liquidity competitor rather than as a haven or hedging tool in the traditional sense. This effect may also indicate that Bitcoin can serve as an indicator of global risk sentiment, given its reach even into relatively isolated frontier markets like Iraq, while DeFi asset technologies and their transmission channels into this market remain in an early stage of development.

This study is subject to several limitations that also point toward directions for future research. First, the analysis relies on a bivariate set of digital-asset proxies (Bitcoin and Aave); future work could incorporate a broader basket of cryptocurrencies and DeFi tokens, or a composite DeFi activity index, to test the robustness of the null long-run DeFi result. Second, the significant ARCH effect detected in the residuals (Table 6) suggests that a GARCH-family or DCC-GARCH extension—already used productively elsewhere in this literature (Bouri et al., 2017; Wang et al., 2022)—could usefully complement the ARDL framework by modeling time-varying volatility spillovers directly. Third, the scope of the study could be expanded to control for additional economic and non-economic factors affecting ISX returns (such as oil-price shocks, regional political events, and monetary-policy conditions), and to extend the sample period further as more data on Iraqi crypto-asset adoption becomes available. Finally, future studies could examine whether the short-run Bitcoin effect documented here is asymmetric—stronger during episodes of global risk-off sentiment than during calmer periods—which would have direct relevance for regulators seeking to distinguish routine liquidity migration from crisis-driven contagion. Addressing these directions would help decision-makers regulate, integrate, or hedge against the risks associated with these new financial instruments more effectively.

REFERENCES

- Ahmed, I., & Khan, M. H. (2026). Crypto-contagion and capital flows: Interconnectedness across emerging and traditional cryptocurrencies, ethical equities, and regional markets. *International Review of Economics & Finance*, 105, Article 104834. <https://doi.org/10.1016/j.iref.2025.104834>
- Akyildirim, E., Aysan, A. F., Cepni, O., & Corbet, S. (2025). News sentiment and DeFi coin returns: An empirical analysis. *International Review of Economics & Finance*, 103, Article 104483. <https://doi.org/10.1016/j.iref.2025.104483>
- Al-Dabbagh, N. K., Al-Iraqi, B. A., & Ahmed, M. E. (2026, August 23-25). *Oil shock transmission to decentralized derivatives markets: Evidence from geopolitical disruptions in the Gulf region (2020-2026)* [Conference paper]. 10th International Conference on Applied Economics and Business, Florence, Italy.

- Al-Dabbagh, N. K., Shehab, K. M., & Al-Iraqi, B. A. (2026, August 23-25). *Oil-linked financial integration of the Iraq Stock Exchange with global markets: A DCC-GARCH analysis (2009-2026)* [Conference paper]. 10th International Conference on Applied Economics and Business, Florence, Italy.
- Ali, S., & Manel, Y. (2025). Unlocking the diversification benefits of DeFi for ASEAN stock market portfolios: A quantile study. *Financial Innovation*, 11(1), Article 3. <https://doi.org/10.1186/s40854-024-00678-4>
- Bouri, E., Molnár, P., Azzi, G., Roubaud, D., & Hagfors, L. I. (2017). On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier? *Finance Research Letters*, 20, 192-198. <https://doi.org/10.1016/j.frl.2016.09.025>
- Chang, E. C., Cheng, J. W., & Khorana, A. (2000). An examination of herd behavior in equity markets: An international perspective. *Journal of Banking & Finance*, 24(10), 1651-1679. [https://doi.org/10.1016/S0378-4266\(99\)00096-5](https://doi.org/10.1016/S0378-4266(99)00096-5)
- Gross, M., & Senner, R. (2026). *From par to pressure: Liquidity, redemptions, and fire sales with a systemic stablecoin* (IMF Working Paper No. 2026/005). International Monetary Fund (IMF). <https://doi.org/10.5089/9798229036795.001>
- Hung, N. T. (2024). Price spillovers from decentralized finance to CEE stock markets. *Politická Ekonomie*, 72(3), 565-596. <https://doi.org/10.18267/j.polek.1416>
- International Monetary Fund (IMF). (2021). *Global financial stability report: COVID-19, crypto, and climate: Navigating challenging transitions*. <https://www.imf.org/en/publications/gfsr/issues/2021/10/12/global-financial-stability-report-october-2021>
- KuCoin. (2026, January 15). *KuCoin Ventures <> Animoca Research: Crypto outlook 2026 report Q&A*. <https://www.kucoin.com/blog/en-kucoin-ventures-animoca-research-crypto-outlook-2026-report-q-a>
- Kumar, R. R., Ghanbari, H., & Stauvermann, P. J. (2025). Can including cryptocurrencies with stocks in portfolios enhance returns in small economies? An analysis of Fiji's stock market. *Journal of Risk and Financial Management*, 18(9), Article 484. <https://doi.org/10.3390/jrfm18090484>
- Lin, G. Y. B. (2026). *Examining the interactions between cryptocurrency, FX and stock markets in Malaysia* (Economics Working Paper No. 2026-1). ISEAS-Yusof Ishak Institute. https://www.iseas.edu.sg/wp-content/uploads/2026/01/ISEAS_EWP_2026-1_Lin-1.pdf
- Liu, J., & Serletis, A. (2019). Volatility in the cryptocurrency market. *Open Economies Review*, 30(4), 779-811. <https://doi.org/10.1007/s11079-019-09547-5>
- Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77-91. <https://doi.org/10.1111/j.1540-6261.1952.tb01525.x>
- Moro Visconti, R. (2025). Decoupling and contagion in Bitcoin markets: Evidence from a Bayesian volatility model. *Finance Research Open*, 1(4), Article 100048. <https://doi.org/10.1016/j.finr.2025.100048>
- Nuskabayeva, L., Syzykova, A., & Azretbergenova, G. (2026). Decoupled or connected? Bitcoin and global financial spillovers to the Kazakhstan Stock Exchange. *Risks*, 14(7), Article 156. <https://doi.org/10.3390/risks14070156>
- Organisation for Economic Co-operation and Development (OECD). (2022). *Institutionalisation of crypto-assets and DeFi-TradFi interconnectedness* (OECD Business and Finance Policy Papers). OECD Publishing. <https://doi.org/10.1787/5d9dddbe-en>
- Özer, M., Frömmel, M., Kamışlı, M., & Vuković, D. B. (2024). Do Bitcoin shocks truly cointegrate with financial and commodity markets? *International Review of Financial Analysis*, 95, Article 103354. <https://doi.org/10.1016/j.irfa.2024.103354>
- Perron, P. (1988). Trends and random walks in macroeconomic time series: Further evidence from a new approach. *Journal of Economic Dynamics and Control*, 12(2-3), 297-332. [https://doi.org/10.1016/0165-1889\(88\)90043-7](https://doi.org/10.1016/0165-1889(88)90043-7)
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-326. <https://doi.org/10.1002/jae.616>
- Piñeiro-Chousa, J., López-Cabarcos, M. Á., Šević, A., & González-López, I. (2022). A preliminary assessment of the performance of DeFi cryptocurrencies in relation to other financial assets, volatility, and user-generated content. *Technological Forecasting and Social Change*, 181, Article 121740. <https://doi.org/10.1016/j.techfore.2022.121740>
- Remy, H. (2026, January 9). Bitcoin exchange balances are falling as market structure evolves. *Benzinga*. <https://www.benzinga.com/Opinion/26/01/49812023/bitcoin-exchange-balances-are-falling-as-market-structure-evolves>
- Sami, M., & Abdullah, W. (2021). How does the cryptocurrency market affect the stock market performance in the MENA region? *Journal of Economic and Administrative Sciences*, 37(4), 741-753. <https://doi.org/10.1108/JEAS-07-2019-0078>
- Shahzad, S. J. H., Bouri, E., Roubaud, D., & Kristoufek, L. (2020). Safe haven, hedge and diversification for G7 stock markets: Gold versus Bitcoin. *Economic Modelling*, 87, 212-224. <https://doi.org/10.1016/j.econmod.2019.07.023>
- Shaturaev, J. (2023). Impact of cryptocurrency markets on the performance of stock markets: An empirical study. *International Journal of Capital Market*, 1(25), 24-38. <https://mpira.ub.uni-muenchen.de/118244/>
- Ugolini, A., Reboredo, J. C., & Mensi, W. (2023). Connectedness between DeFi, cryptocurrency, stock, and safe-haven assets. *Finance Research Letters*, 53, Article 103692. <https://doi.org/10.1016/j.frl.2023.103692>
- Umar, M., Hung, N. T., Chen, S., Iqbal, A., & Jebran, K. (2020). Are stock markets and cryptocurrencies connected? *The Singapore Economic Review*. <https://doi.org/10.1142/S0217590820470050>
- Wang, Y., Yin, L., & Ji, Q. (2022). Cue the volatility spillover in the cryptocurrency markets during the COVID-19 pandemic: Evidence from DCC-GARCH and wavelet analysis. *Financial Innovation*, 8, Article 12. <https://doi.org/10.1186/s40854-021-00319-0>
- Yousaf, I., & Yarovaya, L. (2022). Herding behavior in conventional cryptocurrency market, non-fungible tokens, and DeFi assets. *Finance Research Letters*, 50, Article 103299. <https://doi.org/10.1016/j.frl.2022.103299>
- Zhang, Y., Lo, D., & Sutthiphisal, P. (2025). Inter-market mean and volatility spillover dynamics between cryptocurrencies and an emerging stock market: Evidence from Thailand and sectoral analysis. *Risks*, 13(4), Article 77. <https://doi.org/10.3390/risks13040077>