"Are cryptocurrencies a threat to financial stability and economic growth of India? Evidence from the cointegration approach"

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
47	**2**	**7**

BUSINESS PERSPECTIVES

businessperspectives.org

© Shrikant Panigrahi, 2023

Shrikant Panigrahi, Ph.D., Assistant Professor, Economics and Finance Department, University of Bahrain, Bahrain.

Shrikant Panigrahi (Bahrain)

ARE CRYPTOCURRENCIES A THREAT TO FINANCIAL STABILITY AND ECONOMIC GROWTH OF INDIA? EVIDENCE FROM THE COINTEGRATION APPROACH

Abstract

The purpose of this paper is to investigate whether the cryptocurrency market affects the financial stability and economic growth of India. The study used time series quarterly data on bitcoin, financial stability, inflation rate, real GDP, economic volatility uncertainty, exchange rate, and market volatility index for the period 2015Q1–2022Q4. The robustness of the findings was confirmed by the fully modified OLS (FMOLS) and canonical cointegration regression (CCR). The study results demonstrated that an increase in cryptocurrency investments will affect the financial stability of India significantly. Each 1% increase in the cryptocurrency would reduce the financial stability by 5% approximately. However, there was a marginal effect of cryptocurrency on economic growth. The results also found that exchange rate volatility and inflationary pressure would also deteriorate the financial stability of the country. Furthermore, the results also identified positive and significant cointegration between economic growth and financial stability. Due to most transactions in the economy being done through the financial system, it is paramount for economic growth. Going forward, aggressive monetary policy tightening, volatility in capital flows and exchange rates, de-anchoring of inflation expectations, faltering in the economic recovery, disruptions due to global supply chains and climate change will be the major risks to the financial stability and economic growth of India.

INTRODUCTION

The uniform functioning of the economy ensures fund security and appropriate allocation of resources. In the past few years, the world economy has experienced several major challenges leading to economic uncertainty. One such challenge for an emerging country like India is to regulate the use of cryptocurrencies. If there is imparity in the financial system functionalities, the fund flow will be reduced leading to the aggregated economy. As per the sociotechnical systems theory, crypto development is dismembered into crypto operating services, governance, practices, operating platforms and practices. Cryptocurrencies have emerged as a pseudo-asset class in the past few years and have become attractive for market participants despite their high volatility rates (Yan et al., 2022). However, it is still debatable whether cryptocurrencies qualify as an actual asset class in the financial market. There has been a growing debate in the world market about legalizing digital currencies and being endowed with a booming

cryptocurrency industry. Many countries like China, Egypt, Qatar, Tunisia, Bangladesh, Algeria, Nepal, Morocco, and Iraq have completely ban on the digital currencies and services surrounding cryptocurrencies. According to the report by the Law Library of Congress, 42 other countries and their jurisdictions have prohibited cryptocurrency exchanges. However, a country like India is taking cognizance of regulating and rationalizing cryptocurrency trade. Governments that have banned cryptocurrencies have revealed that the rise of crypto could destabilize their financial systems and they also possess money laundering from illegal sources. Recently, Reserve Bank of India Governor Shaktikanta Das warned that banks have serious concerns over cryptocurrencies as these are a big threat to the country's financial and macroeconomic stability due to no underlying asset (Khusboo, 2022). He further reiterated that cryptocurrencies pose similar risks to cyber security and warned investors to be cautious and invest at their risks. China fully banned cryptocurrencies in January 2022 due to its special concern about using digital currencies for fraud and money laundering. Indian government's stance on digital assets has considerably changed from an outright ban on cryptocurrencies in 2016. Currently, there is no complete ban on the use of cryptocurrencies in India, however, the Reserve Bank of India (RBI) has ordered banks to avoid supporting crypto transactions. Recently, a high-level Inter-Ministerial Committee (IMC) suggested that all private cryptocurrencies, except any virtual currencies issued by a state, will be prohibited in India (Anulekha, 2022). In the wake of recent economic uncertainties due to the COVID-19 pandemic, there is an urgent need and growing concern about economic policies and financial decisions to avoid any financial and macroeconomic instability.

1. LITERATURE REVIEW

The issue of financial stability has been the main focus of both academicians and policymakers. After the 2008–2009 financial crisis, new regulations were proposed to frame and supervise the financial system (Creel et al., 2015). Due to the unique nature of financial stability as a public good, new regulations have been proposed to frame and supervise the financial system. As shown in Figure 1, the bitcoin price had increased from 10,000 USD to 55,000 USD since 2020 and further declined to USD 14,000 level due to risk assets continued to get crushed. The financial stability of India declined drastically since 2020 together with increased economic volatility. GDP growth was the

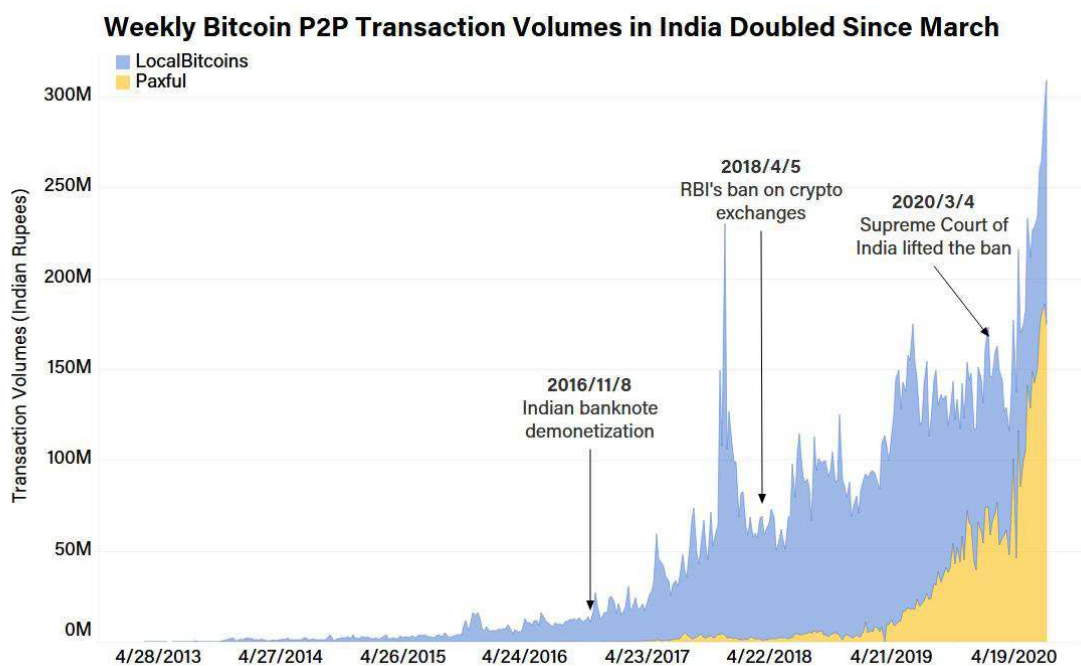Source: Constructed by the author using EViews.

Figure 1. Comparing bitcoin graph with macroeconomic and financial stability factors

most affected since 2019 which declined to –20% in 2020 due to the COVID-19 pandemic.

Figure 2 shows the volume of bitcoin trade in India since 2013. Due to the Indian banknote demonetization in 2016, the volume of bitcoin trading started increasing and it reached a peak of 250 million volume transactions in 2018 before RBI banned the crypto exchanges. In 2020, after the supreme court lifted the ban, the volume of bitcoin trading touched 300 million in 2020. This increase in the volume of bitcoin indicates that either investors are getting attracted to the crypto world or they are using crypto investment as a source to convert their black money to white. Chakravaram et al. (2021), while investigating the threats of cryptocurrencies, found that most people who are investing in cryptocurrencies wish to convert their black money and illegal earnings to white. Few cryptocurrency enthusiasts claim that digital money will democratize finance by redistributing power from the government to the people. Annie (2021) in an interview with key economist Eswar Prasad. He further stated that if cryptocurrencies are not regulated under the financial system to improve investors' protection, it might contribute to financial and monetary instability.

There have been growing studies that focus on the concerns over cryptocurrencies questioning the economic growth paradigm (Leonard & Treiblmaier, 2019a); exploring the relationship between cryptocurrencies and financial assets (Corbet et al., 2018; Gil-Alana et al., 2020); cryptocurrencies and global challenges (Jacobs, 2018); cryptocurrencies and stock market indices (Gil-Alana et al., 2020). However, it must be noted that there is a lack of research focused on the threat that cryptocurrencies pose to the financial stability and economic growth of the country. A financially unstable country will be poised by internal and external shocks. Intuitively, any factor that disrupts the financial system would make the system complex and would affect productive investment, uniform lending, better investment opportunities and economic activity. Theoretically, the economy or financial system is destabilized due to recession, uncertain government policies (policy paralysis), or collapse of financial or non-financial institutions (Mishkin, 1999). Policymakers, whose job it is to ensure the stability of the financial markets, as well as investors with cryptocurrency holdings in their investment portfolios, need to understand the risk associated with cryptocurrency investments. Cryptocurrencies available in

Source: www.coindesk.com.

Figure 2. Bitcoin volume in India (2013–2020)

the form of cryptographic codes, and confirmed through a computer-based mining process, are a 21st century's newly digitized money well known as Blockchain Technology (Chakravaram et al., 2021). Cryptocurrencies are also known as crypto coins, virtual currency, or digital currency that operates in a decentralized medium of financial exchange backed by user consensus primarily.

Bitcoin as a digital currency was first proposed by Nakamoto (2008) for using it as an open-source system. As per the data shown by CoinMarketCap (see: http://www.coinmarketcap.com), the combined market capitalization of cryptocurrencies has received to $1.85 trillion as of February 18, 2022, with bitcoin at $771 worth, followed by Ethereum with $345 billion worth, Tether at $78.7 billion, BNB coin with the worth of $66.7 billion, USD Coin at $52.5 billion. Crypto assets and stablecoins, which typically have no underlying securities and are largely utilized for riskier investments, are examples of new digital assets created as a result of technological advancements fueled by encryption and distributed ledger technology (DLT). From early 2020 to late 2021, when it peaked at approximately USD 3.0 trillion, the market value for crypto assets exponentially increased. It then experienced a dramatic decrease to less than US $ 1 trillion in June 2022.

1.1. Previous studies on cryptocurrency-economic growth relationships

The body of literature on cryptocurrency is expanding quickly nowadays. Researchers have focused in particular on the bitcoin market's potential as a risk management tool. Since it is a young asset class, future research paths will need to fill up any gaps in the existing literature. Particularly during times of greater economic uncertainty, investors either limit their investments, wait for the situation to stabilize, or look for appropriate ways to reduce uncertainty globally. Interestingly, during the period of more unpredictable occurrences, the cryptocurrency market emerged as a risk management tool for domestic and foreign investors of stock and commodity markets all over the world. There has been significant and different opinion on the role of cryptocurrency and its impact on financial innovation and the economy. Table 1 provides the systematic literature review of previous researchers on the aspect of the cryptocurrency-economy crux.

Despite the fact that cryptocurrencies are being used more frequently to purchase products and services as well as financial assets, the economic driving force behind this phenomenon is still up for debate. The majority of previous literature on cryptocurrency and economic performance has

Table 1. Previous literature on cryptocurrency and economic relationship

Authors	Findings	Economic crux
(Chiu & Koeppl, 2017)	The welfare costs should be pinned down with insight through double spending constraints and using costly mining of cryptocurrencies.	Bitcoin creates huge welfare loss to the economy which is about 500 times that of the monetary economy with 2% inflation.
(Lu, 2022)	Cryptocurrency negatively affects economic growth	Cryptocurrencies are a good growth tool for poor nations, but only if their future use leads to an improvement in the level of financial knowledge required to access online resources.
(Miśkiewicz et al., 2022)	Cryptocurrency trading sparked economic growth, which attracted more funding for advancing smart and environmentally friendly technology to reduce carbon emissions from economic growth.	Increasing cryptocurrency trading will improve economic growth and globalization. However, in the long run, the relationship between cryptocurrency and GDP is not confirmed.
(Jati et al., 2022)	the correlation of the Stock Market, Financial Innovation and Cryptocurrency to Indonesia's economic growth, in the long run, all the variables give a positive correlation.	Cryptocurrency will give more impact on economic growth if it is treated as legal money in trading.
(Dasman, 2021)	Cryptocurrency has given the highest returns compared to other investment instruments.	Government should regulate and adopt cryptocurrency to secure investors and economic growth.
(Mikhaylov et al., 2021)	Study of cryptocurrency volatility is important in terms of financial instruments for hedging traditional assets, as well as in terms of pricing	economic factors such as inflation and the Fed rate have a long-term negative effect on the price of Bitcoin.
(Leonard & Treiblmaier, 2019b)	Cryptocurrency may alleviate as a fundamental instrument for economic growth	There is a need of political reforms and alternative currencies for sustainable economy.

Table 1 (cont.). Previous literature on cryptocurrency and economic relationship

Authors	Findings	Economic crux
(Riley, 2021)	Legalizing the cryptocurrency is hurdle due to issues like terror funding, illegal transactions and huge tax evasion.	Regulatory policies will shape the development of the global cryptocurrency market.
(Sami & Abdallah, 2021)	Significant relationship between cryptocurrency and stock market performance.	Cryptocurrency returns is an important determinant for stock market performance.
	Adoption of cryptocurrencies is uneven and is dependent on the national development.	Cryptocurrency adoption correlates positively with GDP and negative with the control of corruption.
(Fakunmoju et al., 2022)	Cryptocurrency trading is poised with unlawful and unregulated practices	Cryptocurrency have negative effect on the economic performance.
	Support for the cryptocurrency adoption is high in developed banking service locations	Cryptocurrency adoption is driven by its usefulness and engaged in illicit trading.
(Yue et al., 2021)	Cryptocurrency investigation will remain the hotspot of investigation in the economic literature.	Cryptocurrency markets will be less dependent on the traditional financial markets.
(Yen & Cheng, 2021)	Economic policy uncertainty change predicts cryptocurrency volatility in China.	Regulatory approval on cryptocurrency trading will impact the cryptocurrency volatility.
(Symss, 2023)	Cryptocurrencies can be alternative to the traditional financial instruments during the financial crisis.	Accepting cryptocurrencies as a means of exchange can be considered as an alternative investment purpose to boost economic growth.
(Conlon et al., 2020)	Cryptocurrency are not the safe haven for the economic growth and the equity markets.	Cryptocurrencies are poised with technological, security and liquidity risk that creates issue for the economic stability.
(Abdeldayem & Aldulaimi, 2020)	Cryptocurrencies are riskier to invest than in the equity market.	The development of digital currencies will support efforts to expand the economy financially

focused on the development of prices and regulatory issues. Theoretically, an increase in uncertainty leads to information asymmetry making opaque characteristics of borrowers (Mishkin, 1992). It is quite difficult for lenders to differentiate between good and bad borrowers, leading to investment decline and correction in economic activity consequently. Different aspects of cryptocurrencies as digital assets have been investigated in finance, including risk-return characteristics (Ankenbrand & Bieri, 2018), returns volatility (Katsiampa, 2017) and transaction activity (Koutmos, 2018).

Most of the existing studies have focused on the volatility spillovers of the stock market and cryptocurrencies (Uzonwanne, 2021), cryptocurrencies as a backstop for the stock market (Jeribi et al., 2021), cryptocurrencies as a safe haven for the stock market (Conlon et al., 2020). Despite the wide literature on cryptocurrencies and their empirical relationship with the stock market, few empirical studies have dealt with the financial instability threats that cryptocurrencies possess on the economy. Thus, the main purpose of the study is to investigate the empirical relationship between cryptocurrency, financial stability and economic growth of India. The relevance of the study also stems from the fact that cryptocurrencies spur financial inclusions and the economy immensely.

2. METHODOLOGY

2.1. Data source and type

Secondary data were collected from the World Bank database, also known as World Development Indicator (WDI) database, the policy uncertainty index, investing.com, and from Yahoo! Finance. Annual data for GDP growth rate, inflation rate, exchange rate, financial stability, and lending rate, collected from the WDI database were converted to quarterly data. Whereas, Bitcoin price, India volatility index and economic policy uncertainty were converted from monthly to quarterly data. The new dataset converted to quarterly produced longer time series, improve consistency, and improvised control as suggested by Hollis et al. (2019). Quarterly time series data from 2015 to 2022 of all the constructs, with a total of 32 observations were employed. Data originated in 2015 because bitcoin as a cryptocurrency was first introduced in October 2014. Other cryptocurrencies were excluded from the study investigation due to their lack of data availability and a maximum of them were launched in the recent five years since 2017. It also used quarterly data for lending rates as it precisely reflects the effect of monetary and macroeconomic policy from the central bank.

Numerous scholarly investigations have looked into the variables affecting economic growth and financial stability. To estimate the long-run co-integration between CO2 emissions and economic growth, Khan et al. (2019) performed the FMOLS analysis. Similarly, Pradhan (2016) used FMOLS and VECM estimation to investigate the cointegration between remittance and economic growth. This study used FMOLS for the co-integration between the variables and CCR for the robustness of the model.

2.2. Model description

Following Mbilla et al. (2021), this section specifies an appropriate model for the analysis determining the link between financial stability, macroeconomic stability and cryptocurrency. Financial stability and GDP growth rate were represented as the dependent factors, whereas, bitcoin was the independent factor, and the exchange rate, inflation rate, lending rate, risk-free rate, India volatility index, and economic policy uncertainty were used as control variables for the model.

The regression relationship of the model is stated as:

$$Fin\_stab_{i,t} = \alpha + \beta_1 BTC_{i,t} + \\ + \beta_2 EVIU_{i,t} + \beta_3 EXCH_{i,t} + \beta_4 GDP_{i,t} + \\ + \beta_5 INF_{i,t} + \beta_6 LENDING_{i,t} + \beta_7 VIX_{i,t} + \\ + \beta_8 RFR_{i,t} + \varepsilon_{i,t}, \tag{1}$$

$$GDP_{i,t} = \alpha + \beta_1 BTC_{i,t} + \beta_2 EVIU_{i,t} + \\ + \beta_3 EXCH_{i,t} + \beta_4 Fin\_stab_{i,t} + \\ + \beta_5 INF_{i,t} + \beta_6 LENDING_{i,t} + \beta_7 VIX_{i,t} + \\ + \beta_8 RFR_{i,t} + \varepsilon_{i,t}, \tag{2}$$

where z_scores in eq (1) is the proxy for the financial stability used as a dependent variable, BTC represents the cryptocurrencies, i indexes the country, t represents the quarterly time. Other macroeconomic (economic volatility uncertainty, exchange rate, inflation rate, lending rate, risk free rate) and market-related (Market volatility index) variables were also employed in the modeling framework. Similarly, GDP in eq (2) is the proxy for the economic growth used as a dependent variable.

2.3. Variable description

2.3.1. Bitcoin as cryptocurrency

Bitcoin was first introduced by a code developer named Satoshi Nakamoto, and it was then conceived as a decentralized digital currency validated by cryptography (Gopane, 2019). Since then, bitcoin has been attractive to traders as a means of exchange. Bitcoin was represented as the main cryptocurrency and is described in US Dollars. Bitcoin is a digital asset that operates free of any central control and relies on peer-to-peer software and cryptography (Xu et al., 2017). A bitcoin transaction is kept private with the help of cryptography and is electronically signed (Al Kawasmi et al., 2015). In early October bitcoin started trading officially on the online platform and reached the price of $123 by December 2014. Thus, this study included the data for bitcoin from 2015Q1 till 2022Q4. Table 2 describes the variables used in this study and the sources of these variables. Amongst the different cryptocurrencies, only Bitcoin was chosen due to its popularity and maximum market capitalization in the global as well as the Indian cryptocurrency market. Data for Bitcoin was obtained from the official website www.coinmarketcap.com.

Financial stability for India was calculated using the z-score value retrieved from the WDI database. Z-score is the common measure of stability at the level of individual institutions or countries. It compares returns or capitalization with the risk to measure a bank's solvency risk. The probability of insolvency is low when the z-score level is high. Many previous studies (Kasman & Kasman, 2015; Mare et al., 2017; Phan et al., 2021) have used the z-score as a proxy to measure financial stability. Financial instability may lead to hyperinflation, bank runs, and stock market crash. GDP growth was measured as a percentage change in GDP. The yearly data for GDP was extracted from World Bank Database and was converted to quarterly data.

The inflation rate was calculated as a change in the consumer price index. The data for the inflation rate was extracted from World Bank Development Indicators. The lending rate was calculated as the interest rate of lending by the banks. The exchange rate was calculated as the currency exchange rate between the United States Dollar (USD) and Indian Rupee

Table 2. Variable descriptions

Variables	Descriptions	Source
Dependent variables		
Financial stability (z-scores)	Country level z-score	World Bank Global Financial Development Database
GDP Growth	Percentage changes in GDP	World Bank Development Indicators (WDI)
Explanatory variable		
Cryptocurrency	Bitcoin prices (closing basis)	www.coinmarketcap.com
Control variables		
Inflation rate	Consumer price index (CPI) changes	World Bank Development Indicators (WDI)
Lending rate	Interest rate of lending	World Bank Development Indicators (WDI)
Exchange rate	The currency exchange rate between USD/Indian Rupee	World Bank Development Indicators (WDI)
Risk free rate	Government bond maturity	www.investing.com
Market volatility index (VIX)	Volatility index to measure market's anticipation for volatility and fluctuations.	www.yahoofinance.com
Economic policy uncertainty	Possibility of government policies and regulatory frameworks becoming ambiguous	www.policyuncertainty.com

(INR). The data for the inflation rate, exchange rate, and lending rate was extracted from World Bank Development Indicators. The risk-free rate was calculated by government bond maturity. The data for the risk-free rate was extracted from the investing. com website. Indian market volatility index (VIX) was used to measure the market anticipation for volatility and fluctuations. VIX was extracted from the yahoo finance website. Economic volatility index uncertainty (EVIU) is the possibility of government policies and regulatory frameworks becoming ambiguous shortly. The data for EVIU was taken from the policy uncertainty website. The EVIU takes into account volatility, which may cause enterprises to postpone spending and investments.

3. RESULTS

Empirical analysis using time series secondary data was performed for the quarterly data from 2015 to 2022. Table 3 presents the basic characteristics of

the variables in the study showing the mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera and probability statistics. The Jarque-Bera test supported the normal pattern of the variable and represented the peak by kurtosis (Abbasi et al., 2021; Panigrahi, 2017).

The mean value of bitcoin was found to be $13,123.46, which is quite lower as compared to the current price of $23800 as of 28 February 2023. Exchange rate mean value was found to be 70.45 INR/USD, followed by the GDP growth mean value of 5.477%. Inflation rate mean value was 4.96% which is quite lower as compared to the current inflation rate of 7%. This increase in the inflation rate was due to a recent hike in the interest rate by the central bank to curb inflation.

To test the associations between the dependent, explanatory and control variables, it is important to confirm the stationarity through the integration of order one. To confirm the stationarity, unit

Table 3. Descriptive statistics

Descriptive	1	2	3	4	5	6	7	8	9
Mean	13123.46	70.45	21.370	5.477	4.962	7.024	6.952	18.115	74.165
Median	7187.08	70.49	21.2475	6.587	4.915	7.130	6.900	16.256	73.067
Maximum	55868.94	82.71	23.82	20.09	6.62	7.880	6.26	64.400	134.573
Minimum	238.65	62.092	19.24	−7.252	3.33	5.910	4.34	11.666	39.882
Std. Dev.	15893.32	5.249	1.5618	4.445	0.990	0.618	0.644	9.148	18.155
Skewness	1.4114	0.050	0.070	−1.432	0.235	−0.261	−0.225	4.169	0.960
Kurtosis	3.807	2.593	1.650	4.030	1.779	1.825	1.791	21.456	5.159
Jarque-Bera	11.182	1.597	2.450	10.807	1.997	2.210	1.941	546.71	11.186
Probability	0.003	0.441	0.299	0.005	0.368	0.333	0.379	0.000	0.003

Note: 1) Bitcoin; 2) Exchange rate; 3) Financial Stability using z-score; 4) GDP Growth; 5) Inflation rate; 6) Lending rate; 7) Risk free rate; 8) India volatility index; 9) Economic policy uncertainty.

root tests by applying Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) were inspected. The empirical results in Table 4 show that there is no stationarity in all the variables at the level, thus accepting the ADF and PP hypothesis. However, at the first difference, the ADF and PP hypotheses were rejected confirming there is stationarity for all the variables.

Table 4. Unit root test results

Source: Calculated by the author using the EViews-12 software.

Constructs	ADF	PP	Stationarity level
BTC	1.72	−1.70	−
Δ BTC	−5.898*	−5.900*	I(1)
FIN_STAB	−1.886	−1.579	
Δ FIN_STAB	−2.692*	−2.748*	
GDP	−3.552*	−3.564*	−
Δ GDP	−7.793*	−8.855*	I(1)
EXCH	0.363	0.081	−
Δ EXCH	−3.65*	−3.61*	I(1)
EVIU	−4.08*	−4.11*	−
Δ EVIU	−7.00*	−7.38*	I(1)
INF	−1.62	−1.85	−
Δ INF	−5.049*	−5.04*	I(1)
VIX	−4.57*	−4.59	−
Δ VIX	−8.28*	−21.86*	I(1)
LR	−1.52	−1.83	−
Δ LR	−3.82*	−3.80*	I(1)
RFR	−2.77	−1.94	−
Δ RFR	−4.22*	−4.31*	I(1)

Note: ADF − Augmented Dickey-Fuller test, PP − Phillips-Perron test. * means significance at the 5% level.

In the next step, the correlation between the variables as available in Table 5 was examined. The results indicated that there is a negative association between bitcoin price and financial stability. Meanwhile, exchange rate, GDP growth and the Indian volatility index were found to have a pos-itive association with bitcoin price. Furthermore, the exchange rate is negatively correlated to financial stability and GDP growth. In addition, GDP growth was also having a negative relationship with the inflation rate.

A co-integration test was performed to check the long-term association between the variables. Long-term effect of bitcoin on financial stability and economic growth and other macroeconomic factors discussed in this study are expressed quantitatively, and it can be said that there is a strong interaction with each other. The results of FMOLS and CCR model estimation with financial stability as a dependent variable are presented in Table 6. The result finds that there is negative and significant cointegration between financial stability and bitcoin (β = −5.73, p < 0.001), indicating that in the long run, cryptocurrencies may contribute to the monetary and financial instability of the country if they were to spawn a large and unregulated financial system and retail investor's protection. The interaction between financial stability and economic growth estimated that a 1% increase in economic growth would result in an increase of 0.15% in the financial stability of the country. When the effect of the exchange rate is considered, it can be estimated that a 1% increase in the exchange rate would yield to decrease of 0.10% in financial stability. The results obtained are similar to previous studies (Eichengreen, 1998; Golovnin & Oganesian, 2018), which mentioned that exchange rate volatility may decline the financial stability or stress of a country. The cointegration between economic volatility uncertainty and financial stability was not significant, indicating that in the long run, economic uncertainty is

Table 5. Correlation matrix for the variables

Source: Calculated by the author using the EViews-12 software.

	1	2	3	4	5	6	7	8	9
Bitcoin price	1	0.572	−0.394	0.595	0.425	−0.565	−0.452	0.040	−0.023
Exchange rate		1	−0.573	−0.176	0.551	−0.382	−0.318	0.277	0.277
Financial Stability			1	0.066	−0.608	0.354	0.317	−0.385	−0.492
GDP Growth				1	−0.367	0.421	0.387	−0.063	−0.169
Inflation rate					1	−0.314	−0.219	0.348	0.323
Lending rate						1	0.964	−0.225	−0.353
Risk free rate							1	−0.260	−0.390
Volatility Index								1	0.276
Economic Uncertainty									1

Note: 1) Bitcoin; 2) Exchange rate; 3) Financial Stability using z-score; 4) GDP Growth; 5) Inflation rate; 6) Lending rate; 7) Risk free rate; 8) India volatility index; 9) Economic volatility index uncertainty.

unable to destabilize the Indian financial system. Indian financial system displays resilience because they came into the epidemic with relatively solid balance sheets that were bolstered by greater liquidity buffers and stronger capital. Losses have been manageable, and unlike during the global financial crisis (GFC), when banks deleveraged and reduced lending, global bank lending has remained strong. It is reassuring to note the stability of these institutions' fundamental solvency and liquidity positions. Furthermore, inflation was found to have strong negative cointegration on financial stability estimating 1% increase in the inflation rate would yield to decrease the financial stability by 1.65%. Reflecting the uncertainty due to the COVID-19 pandemic and war, rising interest rates in response to hardening inflationary pressures will further tighten the financing conditions.

Table 7 presents the cointegration test for the variables with GDP growth as a dependent variable. The study findings divulge that cryptocurrencies are subjected to have a marginal effect on economic growth in the long run. However, financial stability was having strong cointegration with economic growth. The interaction between financial stability and economic growth is estimated that a 1% increase in financial stability would yield to increase of 3.45% in economic growth. Despite a hostile foreign climate, the Indian economy and local financial system continue to be strong and resilient thanks to solid domestic macroeconomic fundamentals. The Indian financial system is well-positioned to help the economy grow due to strong capital buffers and rising asset quality levels. The interaction between the exchange rate and economic growth estimated that a 1% increase in the exchange rate would result in an increase of

Table 6. Long-run model estimation with financial stability as a dependent variable

Source: Calculated by the author using the EViews-12 software.

Variables	FMOLS estimation		CCR	
	Coefficients	t-statistics	Coefficients	t-statistics
BTC	−5.94***	−2.240	−5.75***	−4.39
EXCH	−0.22***	−3.20	−0.11***	−3.23
EVIU	0.001	0.440	0.001	0.200
INF	−1.65***	−9.52	−1.667***	−6.67
VIX	0.129**	2.45	0.134**	1.98
LR	−10.06***	−11.88	−10.18***	−12.56
RFR	3.06***	12.57	3.10***	11.68
C	112.47***	13.69	114.27***	14.00
R^2	0.959***		0.961***	

Note: $p < 0.001$ − ***, $p < 0.05$ − **. BTC – Bitcoin, GDP – gross domestic product, EXCH – exchange rate, EVIU – economic volatility index uncertainty, INF – inflation, VIX – Indian volatility index, LR – lending rate, RFR – risk-free rate, R^2 – Regression square.

Table 7. Long-run model estimation with GDP as a dependent variable

Variables	FMOLS estimation		CCR	
	Coefficients	t-statistics	Coefficients	t-statistics
BTC	0.003***	8.310	0.003***	5.72
Fin_stab	4.45***	5.270	3.48***	6.23
EXCH	0.579***	4.179	0.62***	3.61
EVIU	−0.02	−1.470	−0.019	−0.70
INF	6.80***	6.060	6.96***	5.22
VIX	−0.99***	−4.597	−1.048**	−3.13
LR	46.21***	10.47	47.63***	9.28
RFR	−13.36***	−8.011	−13.67***	−7.78
C	−490.9***	−8.990	−505.73***	−8.29
R^2	0.903***		0.907***	

Note: $p < 0.001$ − ***, $p < 0.05$ − **, $p < 0.10$ − *, BTC – Bitcoin, FIN_STAB-financial stability, EXCH – exchange rate, EVIU – economic volatility index, INF – inflation, VIX – Indian volatility index, LR – lending rate, RFR – risk free rate, R^2 – Regression square.

0.57% in economic growth. Due to geopolitical conflicts due to increased global uncertainty, the surge in crude oil prices and tightening monetary policy led the USD-INR exchange rate to touch an all-time low of 82.67 on February, 2023.

Similarly, other macroeconomic factors like inflation rate, lending rate, volatility index and risk-free rate have strong cointegration with economic growth. Due to an increase in global financial stability risks, the macroeconomic and financial developments of India have posted a modest improvement. However, due to overwhelming geopolitical tension, maintaining macroeconomic and financial stability would be a great challenge for central banks over the world.

The results from the long-run model show that all the determinants have cointegration with financial stability and economic growth, except economic volatility uncertainty. Bitcoin representing cryptocurrency was found to have a negative relationship with financial stability. This result indicated that a 1% increase in cryptocurrency will decrease a country's financial stability by 5%. Although there have been no big defaults by financial institutions as a result of the recent considerable volatility of crypto-assets, the risks of these events are growing. The coefficient of GDP is positively significant with financial stability at a 1% significance level. Where a 1% increase in GDP growth increases financial stability by 0.15%. Greater financial stability could result from faster economic growth. On the other side, increased inflation or unstable prices could hurt financial stability. The coefficient of the exchange rate was negatively related to financial stability at a 1% significance level. Where a 1% currency depreciation increase would decrease the financial stability by 0.10%. The findings imply that the exchange rate significantly influences the net worth and credit availability of Indian non-financial enterprises. The results of the inflation rate indicated that a 1% increase in the inflation rate decreases financial stability by 1.65%. Significant inflation surprises can cause market volatility and raise the likelihood of an uncontrolled asset revaluation. Market participants attempt to predict how central banks may react to preserve price stability when faced with an inflation shock. Furthermore, the real value of outstanding debt may reduce with a high-er-than-expected increase in inflation. The result of economic volatility uncertainty and financial stability was not significant at the 1% level indicating that economic volatility uncertainty has a greater impact on financial stability in nations with higher levels of competition, lower levels of capital adequacy, and weaker financial systems.

4. DISCUSSION

This study analysis focused on the cryptocurrency, financial stability and economic growth integration. Such a study is valuable because it clarifies what policy makers might prioritize in light of the particular confluence of economic factors present in their country environment. Recent shreds of evidence on the inconclusive findings of cryptocurrency affecting the financial stability and economic growth, is an academic puzzle. Although crypto have made great progress in recent years, especially during COVID-19, they are still divisive in many countries; some hail them as the Web 3.0 of the future, while others paint them as a haven for criminal activity. Cryptocurrency is seen by some as a new fintech trend, and by others as a paradigm shift that challenges the social, political, and economic foundations of society. Some people believed that the buzz around cryptocurrencies was the work of investors and tech enthusiasts. In particular, Leonard and Treiblmaier (2019b) look at how the demand for debt-based money as a medium of exchange may be reduced by cryptocurrencies, easing a key institutional engine for economic growth and facilitating the upkeep of a stable steady-state economy. Similarly, Riley (2021) concluded that majority of countries are reluctant to legalize this payment method because they worry about issues with tax evasion, terrorism financing, and other unlawful transactions. However, the debate over the legalization of cryptocurrency has recently intensified. Governments are aware that despite the lack of legal framework, there are considerable amounts of cryptocurrency transactions taking place on the illegal market.

In line with the findings of (Bhimani et al., 2022; Riley, 2021), cryptocurrency could impact economic growth in the short and long run if it is treated as legal currency tender. However, Bhimani et al. (2022) finds that adoption of cryp-

tocurrencies could negatively impact the economic freedom index and corruption perception index. The likelihood of cryptocurrencies replacing fiat currency in the Indian economy is relatively low. In recent years, cryptocurrency has significantly altered the Indian financial industry and disrupted the country's established traditional banking structure. Although the effects are still being felt, the rising investor interest in cryptocurrencies may have an impact on the economic environment of the nation. Therefore, the administration should not just recognize that regulations themselves influence the economy but also pay attention to the consequences of the volatility caused by frequent reforms in the financial system. This is because economic policy uncertainty has a significant influence on investor sentiment and financial stability. Therefore, while creating policies, the government should carefully assess whether they are consistent with the actual norms of society and should pay closer

attention to how frequently policies are released and changed. The inflation outlook continues to raise concerns, and some market segments have overvalued assets. Despite rising funding costs, emerging and frontier markets still have significant financing needs. Some nonbank financial organizations are experiencing increased risks as they strive to increase yield to satisfy return objectives. Cryptocurrencies may impair capital account control in developing economies, which may affect the management of exchange rates. In addition, disintermediation from the established financial system caused by cryptocurrencies can undermine financial stability.

Finally, going forward aggressive monetary policy tightening, volatility in capital flows and exchange rates, de-anchoring of inflation expectations, faltering in the economic recovery, disruptions due to global supply chains and climate change will be the major risks to the financial stability of India.

CONCLUSION

This study explored the relationship between cryptocurrency, financial stability and economic growth in India for the period 2015Q1–2022Q4. The study utilized eight different financial determinants including bitcoin, exchange rate, economic volatility uncertainty, inflation rate, volatility index, lending rate, and risk-free rate to analyze its impact on financial stability and economic growth. FMOLS regression analysis was performed to explore the relationship whereas; canonical cointegrating regression (CCR) was estimated for the robustness of the model. From the findings it can be concluded that increased financial institution involvement could accelerate the growth of crypto-assets and raise the risks to financial stability. The rising options provided by cryptocurrency exchanges for investors to enhance their exposure through leverage could heighten the threats to financial stability. According to estimates, leverage on crypto assets has significantly increased in recent years. In addition, financial stability can aid monetary policy by enhancing growth and inflation's reaction to changes in interest rates. Regulators should make sure the system runs smoothly and support regional growth. A prerequisite for sustainable economic development is consequently the soundness of financial institutions. The empirical findings show a correlation between India's economic development and a better level of financial system stability. Therefore, strong economic performance is encouraged and is favorably predicted by financial stability. With tighter US monetary policy and a greater depreciation of the rupee against the dollar, credit conditions for businesses often deteriorate. While it may be beneficial to counter US monetary tightening with higher domestic interest rates to slow rapid currency depreciation, doing so is likely to result in more output volatility.

Furthermore, the results also identified positive and significant cointegration between economic growth and financial stability. Since most transactions in the economy are carried out through the financial system, it is paramount for economic growth. Financial instability may lead to bank runs, a stock market crash, and hyperinflation, and it can severely shake financial and economic confidence. The latest Global Financial Stability report in 2021 by International Monetary Fund (IMF) described the risk posed by the crypto ecosystem due to a lack of strong operational, governance and risk practices. Thus, it is rec-

ommended to policymakers, regulators and supervisors monitor rapid developments in the crypto eco-system and the instability they create in the financial system. Regulators should also emphasize the risk that crypto poses to economic functions. Time is important, and appropriate action needs to be taken, which must be broad, quick and well-coordinated to address the vulnerabilities.

AUTHOR CONTRIBUTIONS

Conceptualization: Shrikant Panigrahi.
Data curation: Shrikant Panigrahi.
Formal analysis: Shrikant Panigrahi.
Funding acquisition: Shrikant Panigrahi.
Investigation: Shrikant Panigrahi.
Methodology: Shrikant Panigrahi.
Project administration: Shrikant Panigrahi.
Resources: Shrikant Panigrahi.
Software: Shrikant Panigrahi.
Supervision: Shrikant Panigrahi.
Validation: Shrikant Panigrahi.
Visualization: Shrikant Panigrahi.
Writing – original draft: Shrikant Panigrahi.
Writing – review & editing: Shrikant Panigrahi.

REFERENCES

1. Abbasi, K. R., Shahbaz, M., Jiao, Z., & Tufail, M. (2021). How energy consumption, industrial growth, urbanization, and CO2 emissions affect economic growth in Pakistan? A novel dynamic ARDL simulations approach. *Energy, 221,* 119793. https://doi.org/10.1016/j.energy.2021.119793

2. Abdeldayem, M. M., & Aldulaimi, S. H. (2020). Cryptocurrency in the GCC Economy. *International Journal of Scientific and Technology Research, 9*(2), 1739-1755.

3. Al Kawasmi, E., Arnautovic, E., & Svetinovic, D. (2015). Bitcoin-based decentralized carbon emissions trading infrastructure model. *Systems Engineering, 18*(2), 115-130. https://doi.org/10.1002/sys.21291

4. Ankenbrand, T., & Bieri, D. (2018). Assessment of cryptocurrencies as an asset class by their characteristics. *Investment Management and Financial Innovations, 15*(3), 169-181. http://dx.doi.org/10.21511/imfi.15(3).2018.14

5. Annie, N. (2021). Cryptocurrencies could lead to financial instability cnbc.com. Retrieved from https://www.cnbc.com/2021/10/13/cryptocurrencies-could-lead-to-financial-instability-author-warns.html

6. Anulekha, R. (2022). *Govt committee recommends a ban on cryptocurrency in India.* Retrieved from https://www.livemint.com/market/cryptocurrency/govt-com-mittee-says-ban-all-cryptocurren-cies-except-those-issued-by-state-fm-11612866715432.html

7. Bhimani, A., Hausken, K., & Arif, S. (2022). Do national development factors affect cryptocurrency adoption? *Technological Forecasting and Social Change, 181,* 121739. https://doi.org/10.1016/j.tech-fore.2022.121739

8. Chakravaram, V., Ratnakaram, S., Agasha, E., & Vihari, N. S. (2021). Cryptocurrency: Threat or Opportunity. In *ICCCE 2020* (pp. 747-754). Springer.

9. Chiu, J., & Koeppl, T. V. (2017). *The economics of cryptocurrencies–bitcoin and beyond* (Bank of Canada Staff Working Paper, No. 2019-40). Ottawa: Bank of Canada.

10. Conlon, T., Corbet, S., & McGee, R. J. (2020). Are cryptocurrencies a safe haven for equity markets? An international perspective from the COVID-19 pandemic. *Research in International Business and Finance, 54,* 101248. https://doi.org/10.1016/j.rib-af.2020.101248

11. Corbet, S., Meegan, A., Larkin, C., Lucey, B., & Yarovaya, L. (2018). Exploring the dynamic relationships between cryptocurrencies and other financial assets. *Economics Letters, 165,* 28-34. https://doi.org/10.1016/j.econlet.2018.01.004

12. Creel, J., Hubert, P., & Labondance, F. (2015). Financial stability and economic performance. *Economic Modelling, 48,* 25-40. https://doi.org/10.1016/j.econ-mod.2014.10.025

13. Dasman, S. (2021). Analysis of return and risk of cryptocurrency bitcoin asset as investment instrument. *Accounting and Finance Innovations, 51.* https://doi.org/10.5772/intechopen.99910

14. Eichengreen, B. (1998). Exchange rate stability and financial stability. *Open Economies Review, 9*(1), 569-608. https://doi.org/10.1007/978-1-4757-5450-6_9

15. Fakunmoju, S. K., Banmore, O., Gbadamosi, A., & Okunbanjo, O. I. (2022). Effect of cryptocurrency trading and monetary corrupt practices on Nigerian economic performance. *Binus Business Review, 13*(1), 31-40. https://doi.org/10.21512/bbr.v13i1.7305

16. Gil-Alana, L. A., Abakah, E. J. A., & Rojo, M. F. R. (2020). Cryptocurrencies and stock market indices. Are they related? *Research in International Business and Finance, 51,* 101063. https://doi.org/10.1016/j.ribaf.2019.101063

17. Golovnin, M., & Oganesian, G. (2018). The relationship between financial stability indicators and exchange rate in Russia. Being a Paper Submitted to *Management International Conference*. Bled, Slovenia.

18. Gopane, T. J. (2019). The Interest Rate Behaviour of Bitcoin as a Digital Asset. *International Conference on Digital Economy*. Cham.

19. Hollis, D., McCarthy, M., Kendon, M., Legg, T., & Simpson, I. (2019). HadUK-Grid – A new UK dataset of gridded climate observations. *Geoscience Data Journal, 6*(2), 151-159. https://doi.org/10.1002/gdj3.78

20. Jacobs, G. (2018). Cryptocurrencies & the challenge of global governance. *Cadmus, 3*(4), 109-123. Retrieved from https://www.cadmusjournal.org/node/677

21. Jati, W., Rachmawaty, R., Holiawati, H., & Syatoto, I. (2022). Correlation of Financial Innovation, Stock Market, Cryptocurrency on Economic Growth. *Economics Development Analysis Journal, 11*(3), 329-338. https://doi.org/10.15294/edaj.v11i3.57121

22. Jeribi, A., Jena, S. K., & Lahiani, A. (2021). Are cryptocurrencies a backstop for the stock market in a COVID-19-led financial crisis? Evidence from the nardl approach. *International Journal of Financial Studies, 9*(3), 1-36. https://doi.org/10.3390/ijfs9030033

23. Kasman, S., & Kasman, A. (2015). Bank competition, concentration and financial stability in the Turkish banking industry. *Economic Systems, 39*(3), 502-517. https://doi.org/10.1016/j.ecosys.2014.12.003

24. Katsiampa, P. (2017). Volatility estimation for Bitcoin: A comparison of GARCH models. *Economics Letters, 158,* 3-6. https://doi.org/10.1016/j.econlet.2017.06.023

25. Khan, M. W. A., Panigrahi, S. K., Almuniri, K. S. N., Soomro, M. I., Mirjat, N. H., & Alqaydi, E. S. (2019). Investigating the dynamic impact of CO2 emissions and economic growth on renewable energy production: Evidence from FMOLS and DOLS tests. *Processes, 7*(8), 496. https://doi.org/10.3390/pr7080496

26. Khusboo, N. (2022). RBI Governor: Cryptos have no underlying asset… not even a tulip. *The Indian Express*. Retrieved from https://indian-express.com/article/business/banking-and-finance/crypto-currencies-a-threat-to-financial-stability-of-india-rbi-governor-shaktikanta-das-7766158/

27. Koutmos, D. (2018). Bitcoin returns and transaction activity. *Economics Letters, 167,* 81-85. https://doi.org/10.1016/j.econlet.2018.03.021

28. Leonard, D., & Treiblmaier, H. (2019a). Can cryptocurrencies help to pave the way to a more sustainable economy? Questioning the economic growth paradigm. In *Business transformation through Blockchain* (pp. 183-205). Springer. https://doi.org/10.1007/978-3-319-99058-3_7

29. Leonard, D., & Treiblmaier, H. (2019b). Can cryptocurrencies help to pave the way to a more sustainable economy? Questioning the economic growth paradigm. *Business Transformation through Blockchain, II,* 183-205. http:// dx.doi.org/10.1007/978-3-319-99058-3_7

30. Lu, C. (2022). *Cryptocurrency and Digital Assets: A Positive Tool for Economic Growth in Developing Countries.* http://dx.doi.org/10.2139/ssrn.4177415

31. Mare, D. S., Moreira, F., & Rossi, R. (2017). Nonstationary Z-score measures. *European Journal of Operational Research, 260*(1), 348-358. https://doi.org/10.1016/j.ejor.2016.12.001

32. Mbilla, S. A. E., Atindaana, P. A., Gadzo, S. G., Adeniyi, A., & Salifu, I. (2021). Monetary policy and macro economic indicators: A review of a developing country's perspectives 2002–2017. *Cogent Economics & Finance, 9*(1), 1935530. https://doi.org/10.1080/23322039.2021.1935530

33. Mikhaylov, A., Danish, M. S. S., & Senjyu, T. (2021). A New Stage in the Evolution of Cryptocurrency Markets: Analysis by Hurst Method. In *Strategic outlook in business and finance innovation: Multidimensional policies for emerging economies*. Emerald Publishing Limited. https://doi.org/10.1108/978-1-80043-444-820211004

34. Mishkin, F. S. (1992). Anatomy of a financial crisis. *Journal of Evolutionary Economics, 2*(2), 115-130. https://doi.org/10.1007/BF01193536

35. Mishkin, F. S. (1999). International experiences with different monetary policy regimes). Any views expressed in this paper are those of the author only and not those of Columbia University or the National Bureau of Economic Research. *Journal of Monetary Economics, 43*(3), 579-605. http://hdl.handle.net/10419/83029

36. Miśkiewicz, R., Matan, K., & Karnowski, J. (2022). The Role of Crypto Trading in the Economy, Renewable Energy Consumption and Ecological Degradation. *Energies, 15*(10), 3805. https://doi.org/10.3390/en15103805

37. Panigrahi, S. (2017). Economic Value Added and traditional

accounting measures for shareholder's wealth creation. *Asian Journal of Accounting and Governance, 8,* 125-136. https://doi.org/10.17576/AJAG-2017-08-11

38. Phan, D. H. B., Iyke, B. N., Sharma, S. S., & Affandi, Y. (2021). Economic policy uncertainty and financial stability–Is there a relation? *Economic Modelling, 94,* 1018-1029. https://doi.org/10.1016/j.econmod.2020.02.042

39. Pradhan, K. C. (2016). Does remittance drive economic growth in emerging economies: Evidence from FMOLS and Panel VECM. *Theoretical & Applied Economics, 23*(4), 57-74. Retrieved from https://ideas.repec.org/a/agr/journl/vxxiiiy2016i4(609)p57-74.html

40. Riley, J. (2021). The current status of cryptocurrency regulation in China and its effect around the world. *China and WTO Review, 7*(1), 135-152. Retrieved from https://www.semanticscholar.org/paper/The-Current-Status-of-Cryptocurrency-Regulation-in-Riley/01fdeb97f43001f282e048b1fa19641e7c90e9c6

41. Sami, M., & Abdallah, 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

42. Symss, J. (2023). Can cryptocurrency solve the problem of financial constraint in corporates? A literature review and theoretical perspective. *Qualitative Research in Financial Markets.* https://doi.org/10.1108/QRFM-12-2021-0215

43. Uzonwanne, G. (2021). Volatility and return spillovers between stock markets and cryptocurrencies. *The Quarterly Review of Economics and Finance, 82,* 30-36. https://doi.org/10.1016/j.qref.2021.06.018

44. Xu, X., Weber, I., Staples, M., Zhu, L., Bosch, J., Bass, L., Pautasso, C., & Rimba, P. (2017). A taxonomy of blockchain-based systems for architecture design. *2017 IEEE International Conference on Ssoftware Architecture (ICSA).*

45. Yan, L., Mirza, N., & Umar, M. (2022). The cryptocurrency uncertainties and investment transitions: Evidence from high and low carbon energy funds in China. *Technological Forecasting and Social Change, 175,* 121326. https://doi.org/10.1016/j.techfore.2021.121326

46. Yen, K.-C., & Cheng, H.-P. (2021). Economic policy uncertainty and cryptocurrency volatility. *Finance Research Letters, 38,* 101428. https://doi.org/10.1016/j.frl.2020.101428

47. Yue, Y., Li, X., Zhang, D., & Wang, S. (2021). How cryptocurrency affects economy? A network analysis using bibliometric methods. *International Review of Financial Analysis, 77,* 101869. https://doi.org/10.1016/j.irfa.2021.101869