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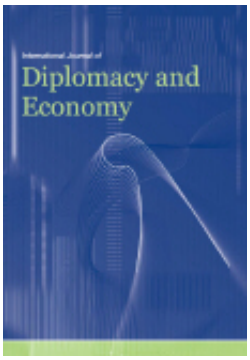

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Impact of cryptocurrencies on inflation: evidence from BICS countries

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Abstract: Academic research on cryptos has exploded over the past decade; however, the impact of cryptocurrency on inflation in emerging markets is an underexplored research area. This study addresses this by investigating the impact of two major cryptocurrencies – Bitcoin and Ethereum, on inflation in four major emerging countries – Brazil, India, China and South Africa (BICS). Monthly data on cryptocurrencies and inflation (WPI and CPI) is taken from Oct 2017 to Nov 2022. The Vector Auto-Regression (VAR) findings indicate that in BICS countries, there is no significant impact of cryptocurrencies –

Bitcoin and Ethereum on the inflation of BICS. The results of this study can be useful for policymakers regarding inflation management and the risks and challenges associated with cryptocurrency adoption.

Keywords: crypto; Bitcoin; emerging market; VAR; VECM.

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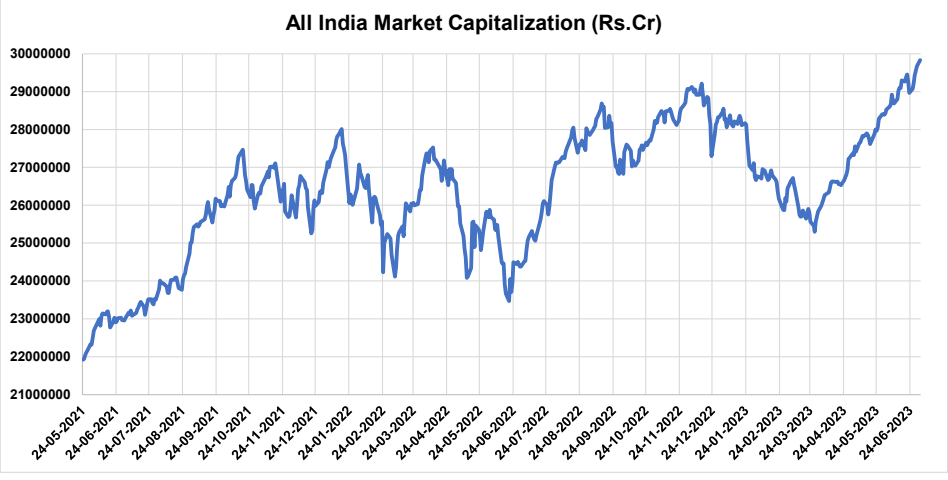
1 Introduction

Cryptocurrencies have garnered significant interest in the past decade as an alternative to traditional fiat currency due to their decentralised nature, making them less susceptible to government control (Aggarwal, 2021). It also makes them an attractive investment class for investors in emerging countries where inflation and currency instability have been persistent risks. However, certain risks associated with digital currencies need to be evaluated due to their increased adoption (Hauwanga et al., 2020). Sommerhuber et al. (2022) argued that digital currency like Diem can increase financial inclusion with a robust regulatory framework to facilitate the adoption.

The cryptocurrency market has experienced tremendous growth in recent years, with the total market capitalisation reaching an all-time high of about $3.64 trillion in July 2023 (BSE Website, 2023), a significant increase since 2021 as shown in Figure 1. The market capitalisation to GDP ratio has sustained above 100% in the last 3 financial years (FY21–FY23), which is above the long-term average of 81%. This increase can be due to several factors, including increased adoption by investors and businesses and increasing interest in Decentralised Finance (DeFi) applications. One of the major reasons for the growth in the cryptocurrency market has been the increasing acceptance of digital assets as an investment class. Many major financial institutions, like JPMorgan and Goldman Sachs, have started providing cryptocurrency-related services to their clients. This growing acceptance has also attracted higher institutional investment in cryptocurrencies, increasing prices and market capitalisation. In addition to mainstream acceptance, the growth of DeFi has also contributed to the expansion of the cryptocurrency market. DeFi refers to a broad set of decentralised financial applications built on blockchain technology, like lending and borrowing platforms, Decentralised Exchanges (DEXs) and yield farming protocols. These applications allow users to transact with cryptocurrencies more decentralised and transparently, without intermediaries like banks or brokerages.

Additionally, there is a chance that cryptocurrencies will affect inflation, but economists and researchers disagree on how much. On the one hand, some contend that cryptocurrencies cannot significantly affect the prices of goods and services in the larger economy because of their relatively tiny market capitalisation compared to traditional currencies and their limited impact on inflation (Bhimani et al., 2022, 2021; Niebel, 2018; Yue et al., 2021). On the other hand, some contend that cryptocurrencies' influence on the money supply can have an impact on inflation (Othman et al., 2020; Rastogi and Kanoujiya, 2022; Sakurai and Kurosaki, 2023). Overall, even though it is unclear exactly how cryptocurrencies will affect inflation, they are likely to have some effect on the larger economy in the long run due to their rising adoption and popularity.

Figure 1 All India market capitalisation trend



Source: www.bseindia.com

Through the lens of supply and demand, the connection between cryptocurrencies and inflation can be understood. Like Bitcoin, other cryptocurrencies have a fixed supply, which means the total number of units that can be produced is constrained. This can reduce the risk of inflation brought on by a rise in the money supply, which is frequently the case with fiat currencies that central banks can print. The demand for cryptocurrencies, however, has a tendency to vary greatly, which may have an impact on their exchange rates and value. A particular cryptocurrency's value may grow if demand for it rises, creating inflationary pressure.

The purpose of this research paper is to address the research gap by examining the impact of cryptocurrency on inflation in emerging countries of Brazil, India, China and South Africa (BICS). To the best of our knowledge, only one previous study in the extant literature has investigated the relationship between Cryptos and Inflation in the emerging country of India (Rastogi and Kanoujiya, 2022). Our study examines four major emerging countries to examine whether the results are consistent and can be generalised. This research is important because it can provide valuable insights for policymakers and investors who are considering the adoption of cryptocurrency as a means of addressing inflation and currency instability. The remainder of the paper is as follows. Section 2 covers the literature review and Data & Methodology in Section 3. Section 4 covers the results and discussion, followed by a conclusion in Section 5. The limitations and future scope of the study are discussed in Section 6.

2 Literature review

Supply and demand can be used to analyse the connection between cryptocurrencies and inflation. With a fixed supply, which means there is a predetermined cap on the total number of units that can be issued, cryptocurrencies like Bitcoin are established. As is

frequently the case with fiat currencies that central banks can issue, this can reduce the possibility of inflation brought on by an increase in the money supply. Cryptocurrency demand, however, is subject to huge swings that may have an impact on exchange rates and value. The value of a particular cryptocurrency may increase as demand grows, creating inflationary pressure. In contrast, if demand declines, the value may decline, thus creating deflationary pressure. The effect of cryptocurrencies on inflation can also be influenced by more general economic issues, including interest rates, economic growth and governmental policies. For instance, increasing demand and potential inflationary pressure could result from government regulation of cryptocurrencies in a way that boosts their use and acceptance as a form of trade. Cryptocurrencies and inflation have a complicated relationship that is influenced by a number of institutional and economic factors. As a result, it continues to be a hot topic for discussion and research among economists and decision-makers.

The literature on the influence of cryptos on inflation is rather scant and with conflicting results. Some studies have found that adopting cryptocurrencies has led to a decline in Inflation (Cheah and Fry, 2015; Dwyer, 2015). The possible theoretical rationale is that, unlike fiat currencies, cryptocurrencies like Bitcoin have a pre-defined maximum supply level. On the other hand, many studies have also found an increase in inflation because of cryptocurrency growth. The price rise in Bitcoin was found to have increased inflation in Indonesia (Narayan et al., 2019). The forward expected inflation rate was found to be majorly impacted by Bitcoin (Blau et al., 2021). A study conducted in USA markets found significant causation from Bitcoin to CPI (Wang et al., 2022). Further, Bitcoin was also found to significantly impact inflation in other developed countries of the United Kingdom and Japan (Sarker and Wang, 2022). Tang and Chow (2018) found evidence of the significant impact of cryptocurrencies on the inflation rate. On similar lines, a major impact on the forward inflation rate from cryptos was detected using the wavelet approach (Conlon and McGee, 2020).

Since cryptocurrencies are decentralised and not controlled by the state, it is critical to examine their impact on the monetary system and the economy (Tomić et al., 2020). It is also possible that the influence of cryptocurrencies can be asymmetric across different economies (Nguyen et al., 2019). Further, since there is extreme volatility in cryptocurrencies compared to fiat currencies (Aggarwal and Doifode, 2020; Cermak, 2017; Naimy et al., 2020; Othman et al., 2020; Umar et al., 2021b), it can create significant turbulence in the economic system through pass-on effect via inflation.

Most past studies have argued that cryptocurrency is mostly used for speculation and cannot be considered a medium of exchange. Baur et al. (2018) argued that examining the pattern of historical Bitcoin transactions depicts its usage as a speculative asset only. Yermack (2015) argued that cryptos are unsuitable for transactions and storing value due to potential theft risks and no federal insurance regulations. On the other hand, some studies advocate cryptos as a medium of exchange. In a study by Yan et al. (2022), Bitcoin was found to have characteristics of a medium of exchange. Bitcoin was found to have suitable traits for a medium of exchange like the dollar and gold (Dyhrberg, 2016).

Many studies have also examined cryptocurrencies' haven and hedging properties but with varying results. Some studies have found significant evidence of cryptos acting as a hedge (Mariana et al., 2021; Stensås et al., 2019; Umar et al., 2021; Wang et al., 2019). On the contrary, Conlon and McGee (2020); Nedved and Kristoufek (2023) and Smales (2019) argued that cryptos do not exhibit suitable hedging properties for investors.

The extant literature review has some limitations that need to be addressed. Firstly, the research studies on the impact of cryptocurrency on inflation in emerging countries are limited in number and scope and often rely on a small sample size. This makes it difficult to draw definitive conclusions about the relationship between cryptocurrency and inflation in these countries. This study addresses these gaps by empirically investigating the influence of two major cryptos – Bitcoin and Ethereum on Inflation in four major emerging countries – BICS.

3 Data and methodology

The study used the monthly Consumer Price Index (CPI) of BICS countries from Oct 2017 to Nov 2022. Out of the BRICS nations, Russian CPI data is intentionally not considered for our study due to the ongoing war with Ukraine, as the overall results/output of our research can be spurious and will be void for arriving at any conclusions. Thus, BICS nations are considered for our research as past researchers have also discussed about the strong growth story of these countries (Agrawal, 2015; Guru and Yadav, 2019). The closing prices of Bitcoin and Ethereum were retrieved from coinmartketcap.com. The 30 days average of the daily closing prices was computed to convert the frequency from daily to monthly.

3.1 Test of stationarity

3.1.1 Augmented Dickey-Fuller Test

A common econometric technique for determining whether time series data are stationary is the Augmented Dickey-Fuller (ADF) test. A time series is said to be stationary if its statistical characteristics, such as mean and variance, stay constant across time. The ADF test examines the possibility that a unit root exists in the time series data. Nonstationary time series, in which the series displays a persistent trend and its statistical features fluctuate with time, are characterised by a unit root.

$$\Delta Y_t = \rho Y_{t-1} + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + ... + \alpha_p \Delta Y_{t-p} + \varepsilon_t$$

where Δ represents the first difference of the time series data, Y_t is the dependent variable, ρ is the coefficient of the lagged dependent variable and ε_t is the error term. The lagged first difference terms $\alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + ... + \alpha_p \Delta Y_{t-p}$ represent the short-term dynamics of the time series.

In essence, the ADF test checks to see if the coefficient substantially differs from 1, which would indicate the existence of a unit root and non-stationarity. The unit root null hypothesis is rejected and the time series is regarded as stationary if the test statistic is smaller than the crucial value.

3.1.2 Cointegration test

The paper aims to comprehend the relationship between cryptocurrencies and inflation. This interconnection may have a short-term or long-term effect. The cointegration test determines if these asset types have any long-term relationships. We can develop an error correction model to ascertain the equilibrium over time between the cryptocurrencies if cointegration is found.

The cointegration test, developed by Johansen (1988); Johansen and Juselius (1990) is used to measure cointegration. Any long-term link between the nonstationary variables that suggests the existence of a shared stochastic trend is often utilised to describe such relationships. Cointegration tests require that the variables' integration orders match. The non-stationary variable vector autoregressive structure is a determinant of it.

$$\Delta_{Qt} = \alpha + \forall Q_{t-1} + \sum_{i=1}^{j-1} K_i \Delta Q_{t-1} + \varepsilon_t$$

Here, $\forall$ is a matrix (order $n \times n$) of parameters that have rank as much as the number of independent cointegrating vectors and *K* are $n \times n$ matrices of parameters. ε_t is white noise error term. All Q_t will become unit root once the rank of $\forall$ become zero, and there exists zero combination (linear) of the Q_t processes which is stationary. If $\forall$ is full rank (rank of $\forall = n$, number of variables) then several equations are overlapping, and all the variables do not have unit root. So, to ensure the cointegration of the variables, the rank of $\forall$ should lie between 0 and *n*. There are two statistical tests (Johansen, 1988) to determine cointegration.

The first compares a generic alternative to the null hypothesis that there are less than or equal to unique cointegrating vectors.

$$\partial_{trace}(r) = -M \sum_{i=r+1}^{n} \ln\left(1 - \partial^i\right)$$

The second compares the alternative $r+1$ cointegrating vectors to the null hypothesis that there are r cointegrating vectors. The term '∂max' refers to the maximum eigenvalue test.

$$\partial_{\max}(r, r+1) = -M \ln\left(1 - \partial^{r+1}\right)$$

Here, *n* is the total quantity of variables used in the test, *M* is the count of observations and $\partial \hat{} t$ is the predicted value of the eigenvalue produced from the predicted matrix. The crucial values are employed as provided by Johansen and Juselius (1990) to test both hypotheses.

3.1.3 Vector auto-regression (VAR)

To know the impacts of the cryptocurrency on inflation in the case of no cointegration the vector autoregression is applied by following equation:

$$\Delta Q1t = \alpha + \sum_{i=1}^{k} \beta_i \Delta Q1_{t-i} + \sum_{i=1}^{k} \gamma_i \Delta Q2_{t-i} + \sum_{i=1}^{k} \delta_i \Delta Q3_{t-i} + \varepsilon_t$$

Various methodologies are used in estimating volatility across different financial markets and financial securities (Aggarwal et al., 2022, 2021, 2020; Aggarwal and Tiwary, 2022; Rastogi et al., 2021).

4 Results and discussion

Stationary testing the non-stationarity of the data would result in spurious regression; hence it is highly necessary to examine the stationarity of the data. Therefore, this study used the prominent Augmented Dickey Fuller (ADF) test to check the stationarity of the data. In a preliminary analysis, the study found that the series is not stationarity, hence log differences of the series are taken to check the stationarity. Table 1 presents the results of the ADF test. The results states of the ADF test reflect that all the series are stationary at the first difference. Hence, all series are *I*(1).

Table 1 ADF results

	Test statistic	*P-value*
Brazil	–4.40477	0.0044
India	–6.16493	0.0000
China	–6.28570	0.0000
South Africa	–6.65581	0.0000
Bitcoin	–5.01057	0.0007
Ethereum	–5.50533	0.0001

Further, we developed cointegration frameworks to examine the long-term link between inflation and cryptocurrencies (Engle and Granger, 2015). Cointegrating relationships are comparable to a long-term phenomenon where underlying factors may change in the near term, but their link is predicted to return with time. The nonstationary character of the underlying variables, which would provide erroneous regressions using the OLS approach, and the corresponding findings of VARs, from which it would be difficult to conclude, are major additional justifications for undertaking cointegration analysis. Although it is generally accepted to use stationary data in this situation after first or higher orders have differentiated them, cointegration analysis is in some ways more practical for preventing spurious regressions without running the risk of losing any long-run information present in the data.

Table 2 presents the results of the Johanson cointegration test. The results of the Trace and Marks statistics show that there is no cointegration in the series.

As all the series are stationary and not cointegrated, Vector Auto-Regression (VAR) is the appropriate method to check the impact of the cryptocurrencies on inflation. The results of the VAR model are presented in Table 3.

Table 2 Cointegration results

	No. of cointegrating equations	*Eigenvalue*	*Trace statistic*	*P-value*	*Max-Eigen statistic*	*P value*
	None	0.249803	22.72904	0.2596	16.95778	0.174
Brazil	At most 1	0.092935	5.77126	0.7224	5.754921	0.6449
	At most 2	0.000277	0.016338	0.8981	0.016338	0.8981
	None	0.157529	16.97903	0.6416	10.11353	0.7339
India	At most 1	0.109833	6.865498	0.5933	6.864396	0.5053
	At most 2	1.87E-05	0.001103	0.9731	0.001103	0.9731
	None	0.144184	17.14441	0.6294	9.186297	0.8171
China	At most 1	0.110896	7.958111	0.4699	6.934951	0.4969
	At most 2	0.017192	1.02316	0.3118	1.02316	0.3118
	None	0.154689	19.13354	0.4833	9.914977	0.7526
South Africa	At most 1	0.10936	9.218566	0.3456	6.833071	0.5091
	At most 2	0.039626	2.385495	0.1225	2.385495	0.1225

Note: There is no cointegrating equation as per Trace and Max-Eigen Statistics.

Table 3 VAR results

Dependent variable	*Constant*	*Bitcoin*		*Ethereum*		*Brazil*		*India*		*China*		*South Africa*	
		(–1)	(–2)	(–1)	(–2)	(–1)	(–2)	(–1)	(–2)	(–1)	(–2)	(–1)	(–2)
Brazil	0.000947	0.00080	–0.00657	0.00445	0.00340	0.51602	–0.00796	–	–	–	–	–	–
India	0.002217	0.00085	–0.00198	–0.00697	0.00788	–	–	0.131105	–0.18	–	–	–	–
China	0.00069	0.00076	0.01282	–0.00379	–0.00835	–	–	–	–	0.216	–0.1829	–	–
South Africa	0.001705	0.00064	–0.00184	–0.00076	0.00242	–	–	–	–	–	–	0.33	–0.31

Results of VAR show that in BICS countries, there is a positive association between cryptocurrency and inflation; however, the relationship is not significant for the impact of both cryptocurrencies, Bitcoin and Ethereum.

Inflation is often seen as a bad event, gradually devaluing money and eroding customers' buying power. Central banks in BICS nations often control the amount of money in the economy by adjusting interest rates and money supply to prevent inflation. Central banks may affect the overall inflation rate by managing the money supply.

5 Conclusion

Cryptocurrencies operate outside of the control of governments and central banks. Cryptocurrencies are decentralised and based on blockchain technology, unlike conventional fiat currencies, supported by government guarantees and central bank reserves. The influence of cryptocurrencies on inflation is likely limited for several reasons, even though they can upend established financial institutions and broaden financial inclusion. In BICS nations, cryptocurrencies are not often used as payment. In BICS nations, only a tiny portion of the population now uses cryptocurrencies for payment, and the entire market for cryptocurrencies is very modest compared to conventional financial markets, according to a new analysis by the World Bank. Second, the value of cryptocurrencies may change dramatically and is very volatile. Its capacity to affect inflation is limited because they are unstable as a value store and a trade medium. Finally, businesses in BICS nations do not yet generally accept cryptocurrency. Owing the absence of regulation around cryptocurrencies and the possibility of fraud and scams, many businesses are still hesitant to employ them. Fourth, the usage of cryptocurrencies is subject to stringent rules in BICS nations. For instance, India has suggested a ban on cryptocurrencies, while China has outlawed cryptocurrency exchanges and Initial Coin Offerings (ICOs). These regulatory measures constrain the potential influence of cryptocurrencies on inflation in BICS nations. Fifth, central banks in BICS nations are taking action to control cryptocurrency usage and lessen its negative effects on the overall economy. For instance, the People's Bank of China has taken action to limit the usage of cryptocurrencies in the nation, while the Reserve Bank of India has warned investors about the dangers of investing in cryptocurrencies.

5.1 Limitations and future scope of research

There are a few limitations to this research. First, the inflation numbers reported are reported monthly; hence the number of observations is limited. Most existing research studies focus on Bitcoin, which is just one type of cryptocurrency. There are many other cryptocurrencies in the market, each with unique characteristics that may impact inflation in emerging countries differently. Therefore, future research should focus on a broader range of cryptocurrencies and their impact on inflation in emerging countries. Further, Future research should examine the potential impact of cryptocurrency adoption on the ability of central banks to regulate the money supply and the economy. More studies should examine the potential impact of cryptocurrency adoption on market stability in emerging countries.

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