

Growth of Crypto Currency and Pre-requisites for CBDC: A Case Study – Indian Context

Srujan Sannidhi^{1*}, Richa Sharma²

¹Student, Department of Informatics, Chirec International, Hyderabad, India

²Research Scholar, Faculty of Humanities and Social Sciences, Symbiosis International University, Pune, India

Abstract: Cryptocurrency, Stablecoins, and Central Bank Digital currency are the new kids on the block. What should the government do? The cryptocurrency market has reached \$1.2 trillion. Now the governments can no longer ignore these or take a passive approach. This paper suggests what governments in developing countries or central banks should do to handle the cryptocurrencies/stablecoins/central bank digital currency.

Keywords: Blockchain, CBDC, Corruption, Cryptocurrency, Developing countries, Digital currency, Economic growth, India, Literacy, Stablecoins.

1. Introduction

Cryptocurrencies are a promising approach for decentralized electronic payments, smart contracts, and other applications [31]. Bitcoin (one of the Cryptocurrency) ideas was coined in 2008 by Satoshi Nakamoto (Pseudonym, real name unknown). It is based on a peer-to-peer networking model. Cryptocurrency (Bitcoin) uses Distributed Ledger Technology (DLT) called Blockchain. In this paper, the authors attempt to list the challenges faced by developing countries like India and make suggestions to address these challenges.

Blockchain is like an expense ledger in a notebook. If expenses run into multiple pages, the running total from one page is copied to the next page. If one page in the middle is removed, one would know that a page is missing or tampered with.

Similarly, in Bitcoin, approximately 2,000 transactions are added to a block, and a key of the current block points to the previous block and so forth. If any block in the middle is removed or transactions are changed, one would know about it.

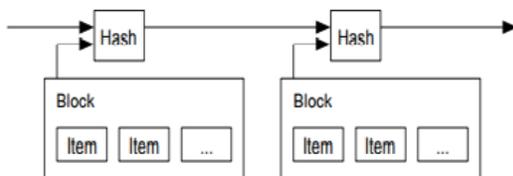


Fig. 1. Blockchain Technology [35]

There are no central banks to maintain accounts. One could generate a private key, and only a person with a private key can access the account (A randomly generated private key to a

public key). Similarly, different cryptocurrencies use different encryptions, and Bitcoin uses the Secure Hash Algorithm (SHA).

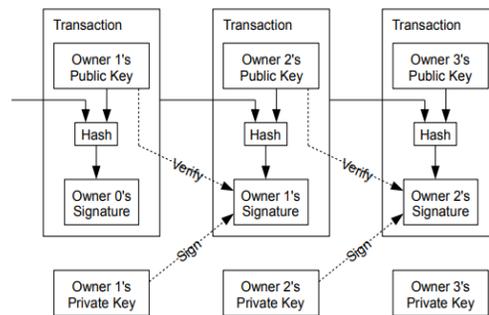


Fig. 2. Bitcoin: A Peer-to-Peer electronic cash system [35]

Since there is no central bank or central authority, blocks are added to the blockchain using consensus. Since it is a peer-to-peer model, miners must validate transactions and solve a complex mathematical puzzle before a block can be added to the blockchain. Solving complex mathematical puzzles is called proof of work. Some Cryptocurrencies use Proof of Stake. Since solving complex mathematical puzzles consumes a lot of electricity, there have been some attempts to do “Proof of Useful work” like training deep learning models [6].



Fig. 3. Bitcoin transaction life cycle [42]

Infographic - original by Patrícia Estavão, available at <https://patestevao.com/work/>

Bitcoin uses the Unspent Transaction Output model (UTXO), let's say somebody mowed my lawn. I will pay the lawn mower in bitcoins, which are kept in a separate kiddy bank

*Corresponding author: srujansannidhi4@gmail.com

(UTXO). The Lawnmower can spend from these separate kiddy banks called UTXOs'. Each transaction is recorded onto a blockchain. The size of the block, rules for transactions, encryption methods (SHA), and consensus mechanism are enclosed in the basic code [45].

A. Stablecoins

Stablecoin is one type of cryptocurrency. There has been a lot of volatility in the cryptocurrency market. Bitcoin plunged by 50% in 2010 and rebounded. To address some of the issues like volatility in cryptocurrency, several companies have come up with stablecoins.

The term stablecoin, as used by market participants, denotes crypto-assets that are supposed to have a stable value over time [41]. [11] define stablecoins as "digital units of value that are not a form of any specific currency (or basket thereof) but rely on a set of stabilization tools which are supposed to minimize fluctuations of their price in such currency".

B. Central Bank Digital Currency (CBDC)

For businesses that want to trade with other countries and remittances, the existing system is costly and not very efficient. SWIFT, introduced after World War II worked well, but the charges are high and are not very efficient. For cross-border payments using SWIFT, transfers could take anywhere from 1 to 5 working days. Scalability, volatility, transaction processing time, time to settle transactions, money laundering, lack of traceability, and lack of accountability are some of the issues that Cryptocurrencies face.

To address these challenges, several central banks or governments are trying to develop their own CBDC. CBDC has generally been defined as central bank money in a digital format, denominated in the national unit of account that is a direct liability of the central bank and can be used for retail payments and/or wholesale settlement. "Many central banks around the world are currently exploring, conceptually and technically, the possibility of issuing a CBDC, either in retail or wholesale form or both". "various CBDC experiments have also been conducted to make cross-border payments faster, cheaper, and more efficient [25].

A key characteristic that distinguishes suitable forms of money is that there is strong predictability to their supply, which guarantees to holders that they will not unexpectedly witness a quick drop in the purchasing power of the currency, making them attractive as a store of value [1].

Some of the potential benefits of CBDCs are efficient cross-border payments, better monetary policy transmission, improved efficiency of monetary systems, and National CBDCs to prevent Digital Dollarization by other countries' CBDCs [38].

2. Review of Literature

This paper reviews some of the essential studies made in the field of Crypto Currencies, the effect of digital payments on Corruption, and policy recommendations for developing countries.

[43] explore the relationship between digital payment transactions and corruption in 111 developing countries from 2010- 2018. Based on the study conducted in Upstate New York, crypto mining led to an increase in electricity prices [8].

[38] presented some of the critical issues surrounding CBDC from an Indian perspective. [36] proposed a crypto-sandbox approach to mitigate the potential risks of issuing a national cryptocurrency. [23] proposes specific recommendations in the Indian context related to Cryptocurrencies.

[13] and [37] discuss some challenges and opportunities while investigating blockchain. [32] and [46] propose some approaches for tracing crypto transactions.

[39] conclude that Ripple has all of the advantages over SWIFT despite some minor issues. [25] and [26] discuss the Central Bank Digital Currency and the mBridge.

3. Objectives

After thoroughly reviewing the existing literature, the authors identified a few gaps in the ongoing studies about cryptocurrencies and CBDCs in developing nations, especially, India. The main objective of writing this paper was to fill those gaps. They are:

1. What should a developing country like India do to address the challenges posed by Cryptocurrency, stablecoins, and CBDC?
2. What are the prerequisites for developing countries before embracing central digital currency?

4. Research Methodology

The methodology analyses compiled data (digital payments, international perception index, tax revenue, Gross Domestic Product, internet penetration, literacy rate, cybercrimes) and review literature that focuses on cryptocurrencies in developing countries and the challenges.

The research paper is focused on the Indian scenario and thus falls under the category of a case study. To adequately analyze the situation, secondary data were collected from multiple sources. The prominent ones are National Payments Corporation of India, Reserve Bank of India, National Crime Records Bureau, Transparency International, Government of India – Income Tax Department, CoinMarketCap, World Bank, and "Good and Services Tax Council". The technique of evaluating the collected data was qualitative content analysis.

5. Results and Discussions

A. Cryptocurrencies, Market Capitalization, Ease of Use, Efficiency, and Technology

Table 1 compares cryptocurrency processing time, and confirmation time with other methods (UPI, VISA). From the data, it is evident that the Market Capitalization of Cryptocurrencies is significant, some Cryptocurrency transactions take a much higher confirmation time and these could become impediments to the wider adoption of Cryptocurrencies. To prevent reversibility, several blocks need to be added before transactions can be confirmed.

Table 1
Cryptocurrency comparison

Crypto	Type of Crypto	Market Capitalization	Transactions/second	Confirmation Time/transaction in secⓈ
Bitcoin BTC	Token	\$ 377.53 B	3-7	2400
Ethereum ETH	Token	\$ 129.53 B	12-25	300
Tether USDT	Stablecoin	\$ 66.37 B	Ⓢ	120-300
USD Coin USDC	Stablecoin	\$ 55.80 B	Ⓢ	300
BNB BNB	Coin	\$ 35.81 B	-	-
Binance BUSD	Stablecoin	\$ 17.57 B	15	3
Ripple XRP	Coin	\$ 16.02 B	1,500	3-5
Cardano ADA	Token	\$ 15.48 B	275	60
Solana SOL	Token	\$ 11.52 B	2,825	0.4
Dogecoin DOGE	Meme Coin	\$ 8.77 B	30	2400

Other Methods	Market Capitalization	Amount Transacted per year	Transactions per second	Authorization Time per transaction in sec
Visa	\$468.55 B	\$ 13,000 BⓈ	24,000	Approx. 7
UPI Ⓢ	-	\$ 968 B	10,000	Instantaneous

source: <https://coinmarketcap.com/coins/>
<https://www.analytinsight.net/>
 as of 30-Jun-2022

- ② Tether uses the infrastructure of existing cryptocurrencies;
- ③ Depends on the blockchain technology;
- ④ as per Kraken;
- ⑤ in 2021 \$10.4T of payments and \$164.7B of transactions were processed on visa networks.
- ⑥ UPI – United Payments Interface

Scalability is one of the main challenges faced by cryptocurrencies. Different cryptocurrencies are trying to address these challenges. Vault is a new cryptocurrency designed to reduce storage and bootstrapping costs. The author claims it achieves its goals using transaction expiration, adaptive sharding, and stamping certificates [31].

The number of digital payments in India and developing countries has gone up. 6.2 billion United Payments Interface (UPI) payments happened in India in the month of July-2022. Current UPI payment is efficient, fast, and cheaper. Even small traders with little or no formal education adopted UPI payments in a big way. The masses have embraced UPI in India largely due to its ease of use, low cost, and the government's push for digital transactions.

B. Blockchain Technology Use Cases

There are several applications of Blockchain technology in Government (digital asset registries), health care, supply chain, banking, and other areas. Blockchain technology has the potential to revolutionize these areas. There are several success stories of blockchain technology around the world whether it is land title registration in Georgia, distribution of humanitarian aid for Syrian refugees in Jordan, the Health Care sector in Sweden, or in the Walmart Supply Chain. Blockchain technology could be useful in providing better healthcare to migrant workers in India. Smart contracts provide programmable contracts that do payouts between two parties

once certain criteria have been met, without involving a middleman [18]. Smart contracts can be useful in financial data recording, digital identity, health records, mortgages and loans. Scalability, adaptability, and interoperability are some of the main challenges in adopting blockchain in the industry.

C. Corruption, Terror Financing, Money Laundering, and Legal

Different authors estimate and argue only a small portion of crypto transactions are illegal. Whereas others argue around 46% are illegal. “We estimate that around \$76 billion of illegal activity per year involve bitcoin (46% of bitcoin transactions)” [20].

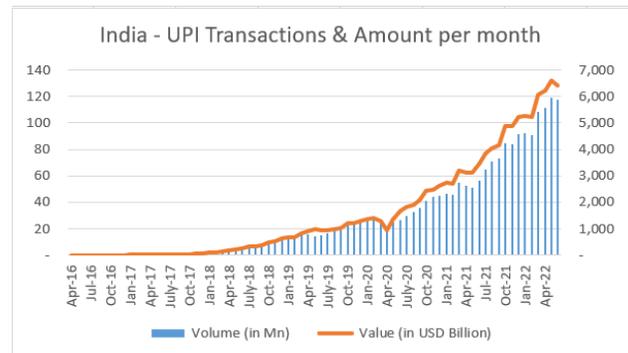


Fig. 4.

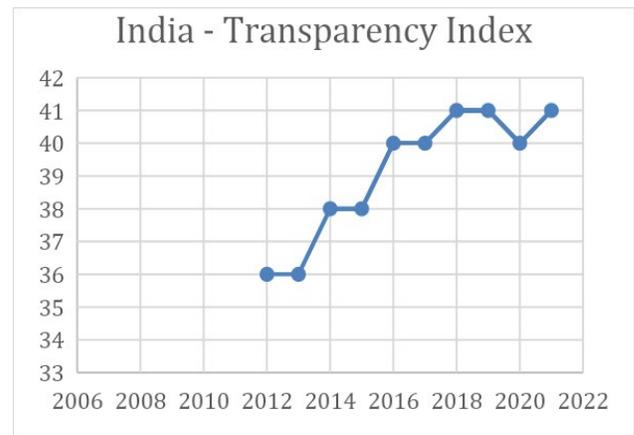


Fig. 5.

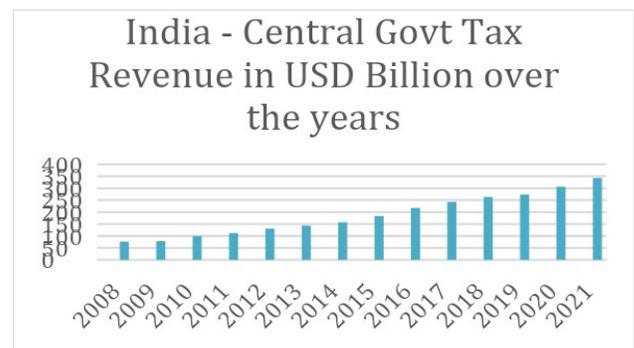


Fig. 6.

Needless to say, that transparency in monetary transactions reduces money laundering. Law enforcement agencies should

devise ways and means to ensure that these technologies are not misused and reduce terror financing and money laundering. In fiat currencies, when the loot is captured, it does not give much traceability but whereas in cryptocurrencies, all the transactions are recorded onto the blockchain. When illegal trade is caught in some cryptocurrencies, it will give the whole book.

“Cryptocurrency, despite the purported anonymity it grants criminals, provides law enforcement with an exceptional tracing tool: the blockchain. While the blockchain’s historical ledger will not list the parties’ names to transactions, it provides investigators with ample information about how, when, and how much cryptocurrency is being transferred. Moreover, this information is publicly available; Blockchain provides law enforcement with immediate, significantly more accurate information than a cash transaction. When compared to monetary transactions, this sort of information might take months or even years to get, necessitating subpoenas and court orders” [13].

Instead of taking a passive approach, governments should take an active role in addressing the new challenges and leverage the advantages to the benefit of the public. Governments should approach new technologies with an open mind.

Governments should explore the potential benefits of the technology behind cryptocurrencies because the benefits to payment players are overall positive [36]. If effectively used, digital payments or central bank digital currency can become an important tool in reducing corruption in developing countries. This alone cannot reduce corruption, along with several other measures that need to be taken to reduce corruption in developing countries.

The Reserve Bank of India constructed Digital Payments Index (RBI-DPI) with March 2018 as a base to capture the extent of digitization of payments across the country. The index for March 2022 stands at 349.30 against 304.06 for September 2021 (RBI).

Based on the analysis conducted by different authors and the quantitative study conducted, an inference can be drawn that an increase in digital payments leads to less corruption.

Demand for gold spiked on November 8 and 9 after the Indian government demonetized ₹500 and ₹1,000 notes [34]. As governments move to digital currency, some may try to look for other avenues for money laundering, terror financing, or illicit uses. Other doors and avenues must be tightened to reduce corruption and money laundering.

D. Cyber Fraud, Traceability, and Accountability

One of the government’s functions is to protect the wealth of its citizens. The global yearly cost of cybercrime reached \$6 trillion at the end of 2021. Governments need to focus on enhancing digital literacy across the country. What tools do governments/law enforcement agencies have to protect their citizens?

Law enforcement authorities need to be proactive in addressing the challenges posed by these technologies. Though the blockchain contains transaction history, identifying an individual or group of persons in the activity is the real

challenge. Different Crypto exchanges use different levels of KYC norms; when cryptocurrency is exchanged for fiat currency, one would know about the real person. Pseudonymity poses challenges to law enforcement agencies. The IP address should be recorded when the transactions occur, and IP addresses cannot be traced retroactively. In bitcoin transactions, when you send your transaction to a bitcoin node, the IP address is transmitted along with the transaction. Bitcoin miners/operators could record IP addresses and transactions. Law enforcement agencies could collect raw data at internet routing exchanges.

Different cryptocurrencies provide different levels of anonymity (transparent blockchain, opaque blockchain). “Monero provides a high level of anonymity for both users and their transactions. However, many criminal activities might be committed with the protection of anonymity in cryptocurrency transactions”. “Balancing users’ privacy and accountability remains a major challenge in decentralized cryptocurrencies” [32].

Different tools and techniques are used to identify the person(s). “a forensic investigator can use artifacts obtained from volatile memory to identify cryptocurrency hardware wallet use, extract the transaction history, and associate a specific hardware wallet device with a host computer by serializing data structures identified by YARA scans” [46].

It is a cat-and-mouse game, researchers/law enforcement agencies are developing better techniques to trace the identity of a person involved in crypto trading, and some companies are coming up with ways and means to hide the identity. If law enforcement agencies try to investigate after the crime has occurred, it may be too late and may have missed the boat. Governments should partner with other nations in fighting cyber fraud.

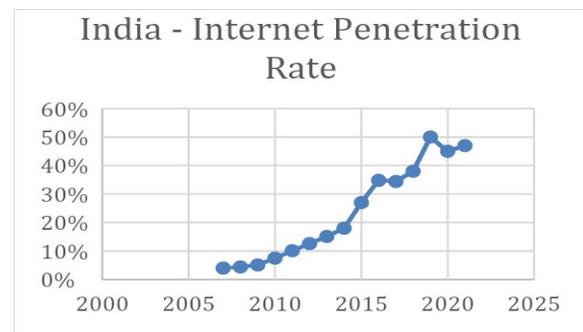


Fig. 7.

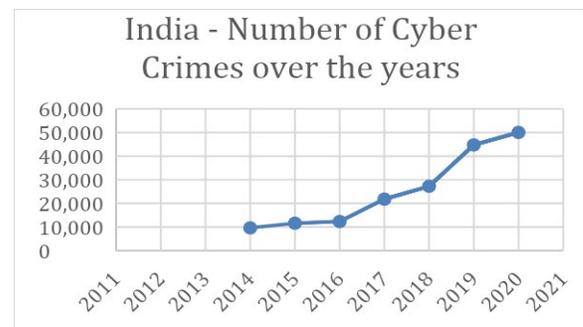


Fig. 8.

Table 2
Pearson Correlation coefficient

Description	Correlation coefficient
Digital Payments vs Transparency Index - CPI	0.95
Digital Payments vs Tax Revenue	0.91
Internet Penetration vs Tax Revenue	0.91
CPI - Corruption Perception Index	
Pearson Correlation Coefficient	

From the table 2, there is a positive correlation between Digital Payments and Transparency Index, Tax Revenue. Positive Correlation between Internet Penetration percentage and Tax Revenue. Only from these, we do not conclude there is a causal relationship.

E. Treatment of Cryptocurrencies

There is no commonality in how Cryptocurrencies are treated across the globe. Some governments treat Cryptocurrencies as currency or some treat them as property. "The Internal Revenue Service (IRS) in the USA considers bitcoin as a property for tax regulation, and not as a currency" [47].

According to the European Court of Justice, bitcoin is a currency, not a property. Although no VAT is withheld when buying and selling bitcoins, other transactions may be taxed, for example, income tax or capital gains tax [2].

The Financial Crimes Enforcement Network (FinCEN) recognizes cryptocurrency exchanges as money transmitters. Meanwhile, the Commodities and Futures Trading Commission (CFTC) has treated cryptocurrencies as commodities

In sum, determining which regulator and regulatory framework are applicable to a given cryptocurrency appears to be a complicated process.

F. Impacts on Society: Energy Consumption

Crypto mining consumes a lot of energy. It is estimated that between 300 kWh to 900 kWh (kilo Watt hours) of electricity is consumed per bitcoin transaction [16], which is equivalent to the electric energy consumption of 10 – 30 homes/day in India. Estimates suggest that technology processing passed the milestone of consuming 1% of world energy in 2010 and is on the trajectory to increase to 6% by 2030 [33].

Based on the study conducted at Upstate New York where crypto mining led to an increase in electricity prices [8].

UPI has been a huge success, and it has reached the masses in India. Lessons learned from UPI need to be taken into account while implementing CBDC. The government must be proactive in addressing the societal impact of cryptocurrency and these technologies. Dr. Seny Kamara, associate professor at Brown University says we cannot use the "One Size Fit All" approach and an in-depth analysis needs to be done while coming up with a solution. Social problems are not well defined and teams from several domains and backgrounds should work together to arrive at a solution [12].

Based on the survey published in the world economic forum, 73.1% of respondents felt by 2025 Tax is going to be collected for the first time by a government via a blockchain and 57.9% of the respondents felt that 10% of global gross domestic

product is going to be stored on blockchain technology. Once blockchain gains critical mass and will lead to increased financial inclusion in emerging markets. Blockchain is going to lead to an explosion in tradable assets [18].

6. Conclusion

For developing countries, it is a challenge to prioritize projects with limited resources on-hand. Based on data that has been compiled, it is evident that there is a Positive correlation between digital payments and Tax Revenue. There is a negative correlation between digital payments and corruption. Due to the lack of accurate data on digital literacy could not draw strong inferences between digital literacy and Cyber Crimes. Blockchain technology has several applications and has the potential to revolutionize several industries. Future scope of work includes based on a study in different developing countries when would we say a country is ready for central bank digital currency? What metrics should the policymakers look at before saying "Yes" to CBDCs and digital payments? Does urbanization increase or decrease how fast a society learns? Come up with predictive models that include literacy rates, digital literacy, cyber frauds as a percent of digital payments, average time to resolve cyber fraud cases, number of law enforcement personnel working in cybercrimes/frauds division, % of people living in urban areas. Quantitative measurements should be done about the amount of money spent on the prevention of cybercrimes vs the impact on GDP. Randomized controlled trials should be conducted to measure the outcome of different variables. Do these technologies increase the digital divide?

7. Suggestions

Based on the analysis done, reviewing the literature in this area following suggestions are made. Some of the benefits of own CBDCs are better monetary policy transmission, preventing Digital Dollarization of other countries' CBDCs, and reduced corruption. Efficient digital payments are one of the key enablers of economic growth and for reducing corruption.

- 1) Governments should approach the new technologies with an open mind and leverage the advantages of the new technologies and try to address the loopholes.
- 2) Governments should use digital payments and central bank digital currency as one of the tools in their arsenal in reducing corruption.
- 3) Digital literacy reduces the amount of money lost in cyber fraud. Developing countries should accelerate efforts to impart formal education and take efforts to improve digital literacy.
- 4) There has been a significant jump in Cyber Fraud, governments should strengthen the cybercrime division. Government should collaborate with other nations to reduce terror financing, tax evasion, reduce illicit use, and money laundering. Cybercrimes division should take proactive steps and Governments should improve the time taken to resolve cyber frauds, should have a sound legal framework, and strengthen

the justice system.

- 5) Once countries migrate towards full digital payments and reduce/eliminate fiat currency other doors for money laundering should be tightened as well. Like Gold, Jewelry purchases, and real estate. Government should incentivize the public in linking existing real estate ownership to the KYC.
- 6) There are several factors that come into play when a country wants to roll out new methods or new technologies. Countries should conduct randomized controlled trials, measure the outcomes, address the issues, and gradually roll out CBDCs to the rest of the country.
- 7) Government should allocate resources to do further research into Blockchain technology, CBDCs, and Cryptocurrencies so that benefits can be realized. Public Private partnerships could accelerate unlocking the potential of blockchain technology.

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