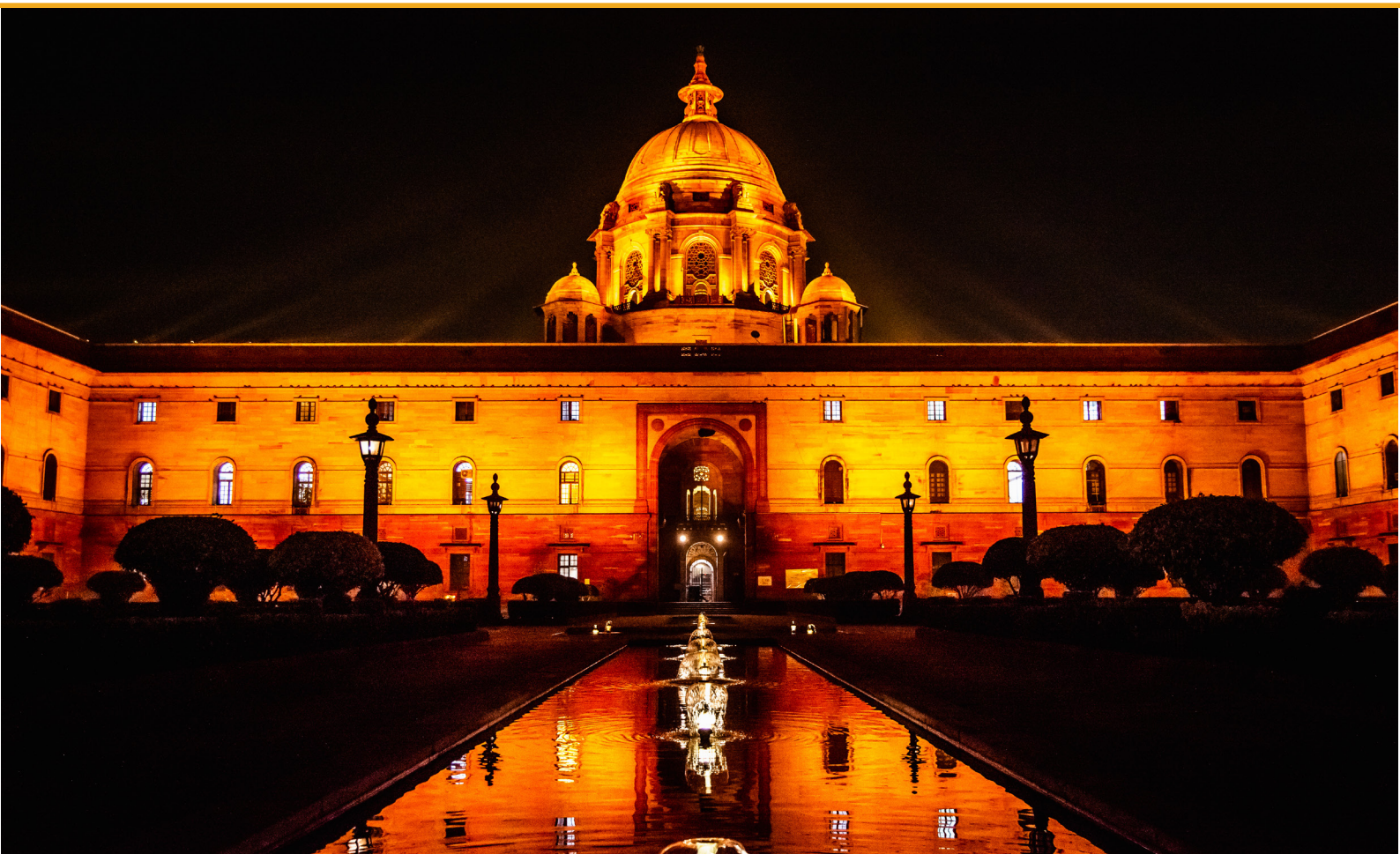# Understanding Cryptocurrency Policy for the People

Ramifications and Implications of Cryptocurrency in Public Policy, Environment, and Taxation; a View from India and Other Developing Nations.

By Yash Bohra, Heramb Podar, and Kaliya Young

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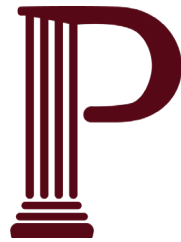
Policy for the People Fellowship

Chapter 1

Introduction

Big Questions and Answers for Some of Them

If you opened a report or a news site today, you'd most likely find an article or two about cryptocurrencies. Chances are, it'll be about Bitcoin and uses the word blockchain.

It seems that cryptocurrency is rapidly becoming a topic of mainstream concern and debate. But when most people google something like "Bitcoin," they face difficult abstract concepts and steep conceptual barriers. After all, most people don't need to know how internal combustion or electric engines work; we just need to know how to accelerate and brake.

This report was researched as part of the policy for the People's Fellowship program under the Harvard Innovations Lab. The core of the report was written between June 2021 and June 2022 with ongoing revisions to the policy section continuing through May 2023. During this period, we decided to reconsider the report as a book, and publish it as such. Our goal was to specifically address Indian policymakers to inform them of the impact this technology can have, although we feel the report would be valuable beyond that audience. We aim to explain cryptocurrency's core basics and review further regulatory options. We believe cryptocurrency has the potential to impact the world, and we don'twant people to be left on the outside because they cannot parse the basics.

We first cover the basics of cryptocurrency to establish a foundation with two unique contributions to this endeavour. To explain Bitcoin's workings, we have used the metaphor of a small village, like those found all over India. We also developed a value network map (see Appendix 1) to showcase the differences in the usage of conventional fiat money to exchange value for goods and the usage of Bitcoin.

Once we have discussed the basics, we cover how cryptocurrency is changing people's ideas of money and affecting the banking sector in economics, along with explanations of CBDCs. We will then discuss the effects of cryptocurrencies in a developing country. Next, we consider the environmental impact of cryptocurrencies, and finally, we discuss government stances and policies, delving into pre-existing governmental outlooks.

We hope that this report sheds light on concepts and principles in the cryptocurrency field that might not be well known to a mainstream audience or even in a legislative context and spreads awareness of nuances and issues in the field from the lens of policymaking.

What is Bitcoin? What is a Cryptocurrency?

Here are some big questions - "What is Bitcoin?", "What is a Cryptocurrency?"

Most people will start looking for answers with this paragraph (hyperlinks and all) from the Wikipedia page (at the time of writing) for Cryptocurrency:
"A cryptocurrency, crypto-currency, or crypto is a digital asset designed to work as a medium of exchange wherein individual coin ownership records are stored in a ledger existing in the form of a computerised database using strong cryptography to secure transaction records, to control the creation of additional coins, and to verify the transfer of coin ownership.[1][2] Cryptocurrency does not exist in physical form (like paper money) and is typically not issued by a central authority. Cryptocurrencies typically use decentralised control as opposed to a central bank digital currency (CBDC).[3] When a cryptocurrency is minted or created prior to issuance or issued by a single issuer, it is generally considered centralised. When implemented with decentralised control, each cryptocurrency works through distributed ledger technology, typically a blockchain, that serves as a public financial transaction database.[4]

Bitcoin, first released as open-source software in 2009, is the first decentralised cryptocurrency. [5] Since the release of bitcoin, many other cryptocurrencies have been created."

There is a lot packed into those paragraphs - some of which you might have understood. We will break apart key aspects of this explanation and make it easier to understand.

A cryptocurrency is a digital type of money. It's usually decentralised money, which means there's no government behind it like the United States backs the US dollar or the Indian government supports the Rupee. But how does decentralised control work with distributed ledger (blockchain) technology? What is a decentralised ledger?

We developed this allegory of a village to explain it.

A Village Example: How A Cryptocurrency Ledger Works

Let's look at a strange little village. The people here use a strange currency called Klingo. But even more strange, everyone knows how much Klingo everyone else has in their wallets! What's more, they all keep a record of every transaction in the village! It only gets weirder from there. Read on:

Here, Maya is going to the market. Instead of only taking some money like in a normal village, she also takes her record book, mask, and unique secret badge here.

At the market, everyone is wearing masks and badges. No one knows who anyone else is.

A cryptocurrency is a digital type of money.

THE VILLAGE EXAMPLE: A METAPHOR FOR BITCOIN
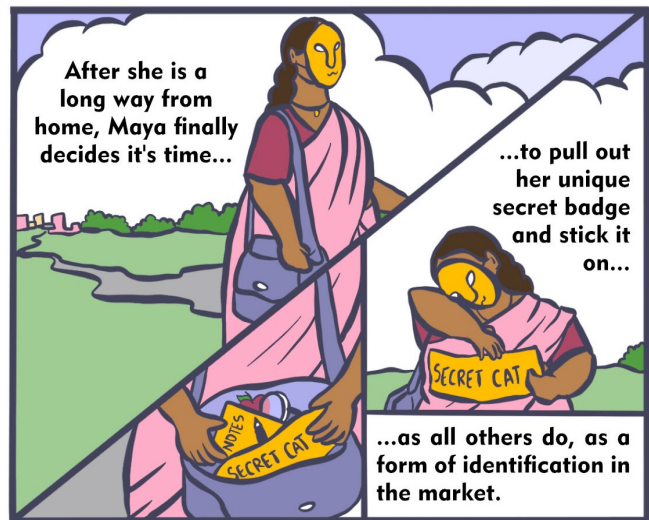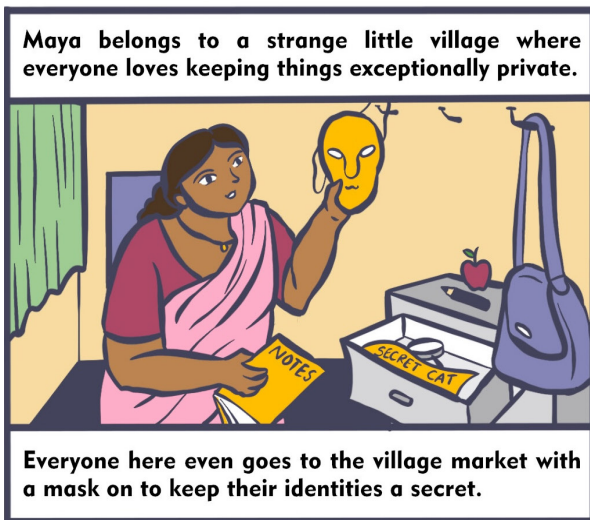
Like a normal market, two people start a transaction. You can see that Secret Cat and Secret Cow are ready to exchange an apple for 3 Klingo! But now, here's where this strange little village is really different:

The race is on! Instead of directly exchanging money, in this strange village, everyone else pulls out their notebooks to note down the transaction! Secret Elephant is the first to do it! Maybe that's because they're very fast, or maybe because they can afford a good pencil. (This will be discussed later.)
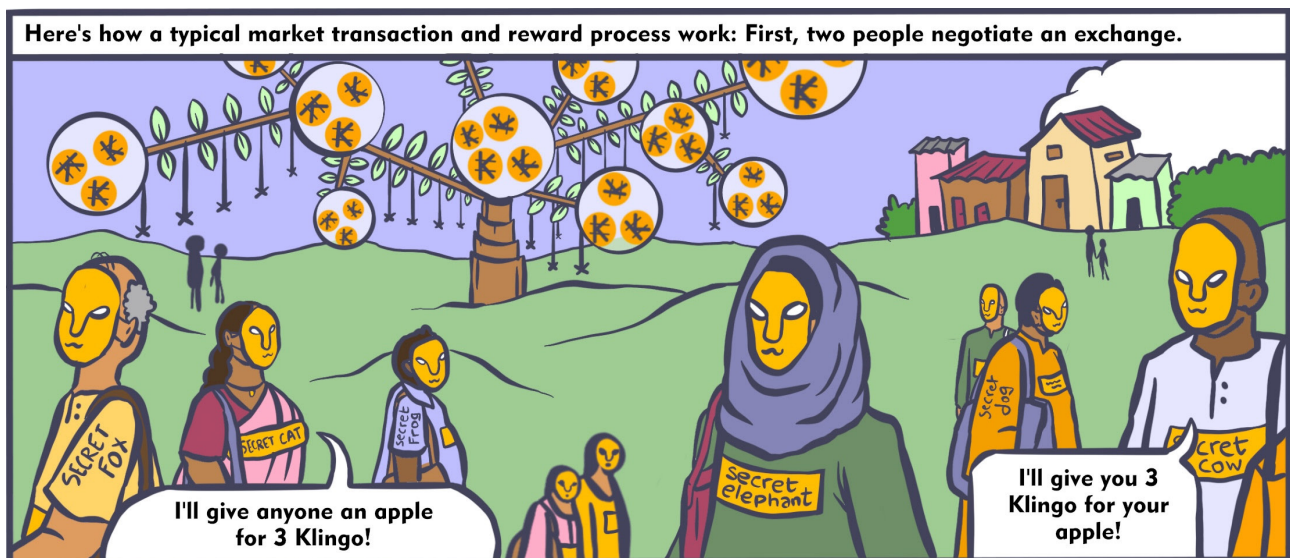
Now, because everyone checks and validates the transaction slip and then notes it themselves, everyone's records are correct and up to date! Remember, no transaction goes through until a majority agrees that it is valid on both sides!
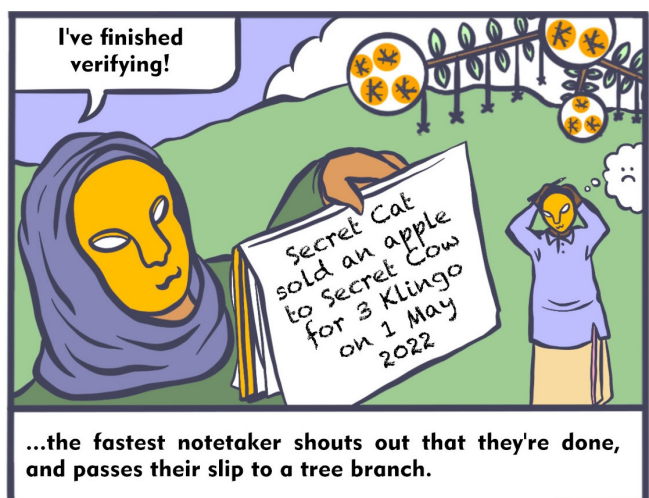
Whoever submits their record for verification and is verified first gets a reward of Klingo. This is the only way new currency enters the market by participating and assisting the process. This ensures that people are motivated to keep this strange system going. It's a sort of community-based bank!
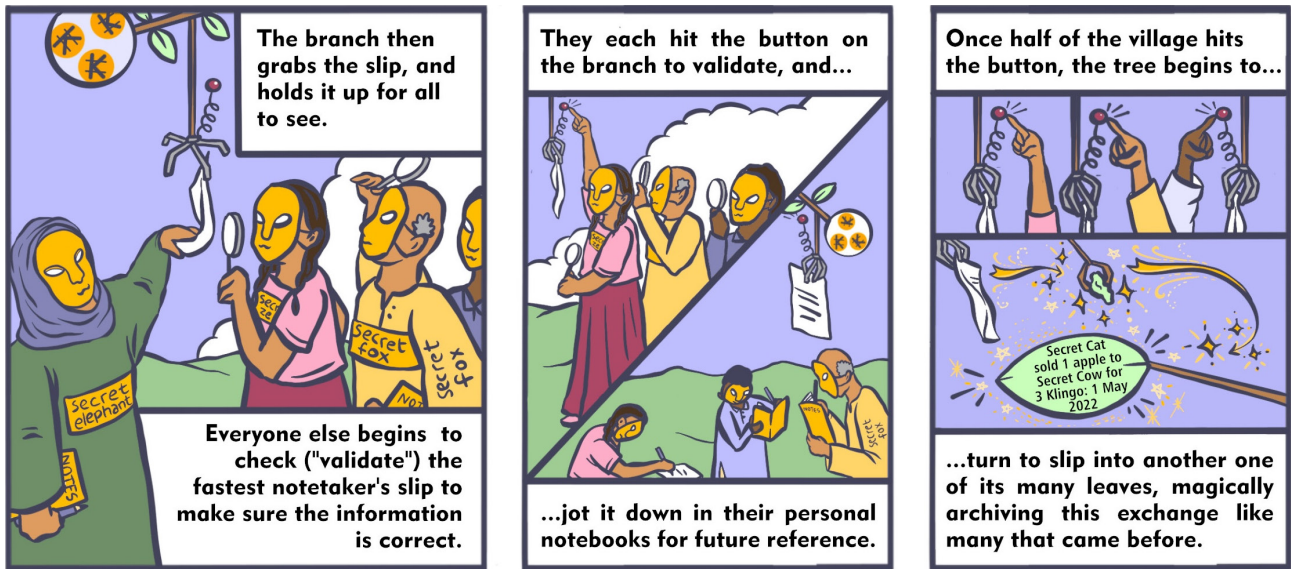
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by Heramb Podar, Yash Bohra and Kaliya Young

Comic by Kruthika N.S.
@TheWorkplaceDoodler

1. Someone makes a transaction while wearing a mask.

2. Someone else, also wearing a mask, outside the transaction notes it down in their records, checks the validity and proposes an addition to everyone else's records.

3. Everyone else, all wearing masks, validate the checking and add it to their own records.

4. The transaction goes through, and a record of it is kept in multiple independent record books!

5. New money is "minted" and issued through a reward to the person who was verified first.

In this unique village, transaction verification is decentralised and communal. That means the village makes the records together, and that there is no central record keeper with his one record book. Everyone keeps a record book for safety purposes. There is safety in numbers; you can't corrupt that many record books. It's harder to corrupt than traditional centralised systems.

No one cares what's being traded, really, and they're wearing their masks for privacy (some readers will have realised that if you wear the same mask every time, it will be pretty easy to find out who you are outside the market, we will discuss this later as well).

The villagers aren't just doing things differently for the sake of it. There is a real advantage to a system like this, where there is not just one teller keeping the records, but where multiple people maintain independent records, and it's all kept public to prevent corruption in the dark while still maintaining privacy and anonymity (mostly). There are also some disadvantages, of course, but those will be discussed later.

With this idea of a decentralised transaction system in mind, let's use this village to explain some cryptocurrency terms you've heard, such as blockchain, miners, hash functions, double spending, etc.

NOTE: The village doesn't perfectly represent a decentralised system. Privacy features like the mask aren't in the definition of a decentralised system. But a traditional decentralised system doesn't help explain decentralised cryptocurrencies, which often emphasise privacy. So we decided to compromise. Please refer to Appendix 2 to view the comic in one continuous flow.

Cryptocurrency Terms and Definitions

Having walked through the village example metaphor, let's now understand how key concepts of cryptocurrencies work. This section walks through the key terms and definitions of (as an example) Bitcoin's working structure while referencing key aspects of the village story we just shared.

Blockchain

A blockchain is a ledger made up of a chain of blocks, each of which contains some data. Each block of the ledger contains transactions linked to the previous block through a unique data fingerprint. Each block has this digital fingerprint, called a hash, at the end of the block. This hash is included at the start of the next block and thus forms a chain of blocks linked together by the hashes.

Miners

In cryptocurrency, "miners" is the term for the computers that validate the transaction and add it to the blockchain. They are not the owners of the computers themselves. As miners are just computers, they are not corruptible and can't be influenced like normal humans. This answers the question of how the villagers are sure the people recording the transaction are honest. In cryptocurrencies, the miners aren't people. In real life, the validator villagers are the miner computers who validate transactions by solving a mathematical problem instead of writing down a transaction.

Cryptographic Problem and Hash Functions

What are cryptographic problems and hash functions? And even computers can be corrupted and influenced, so how does Bitcoin fix that? We assume that people are honest in the village, but we can't be so idealistic in the real world. Both these questions are answered here:

In Bitcoin (as an example), miners validate transactions with several steps.

> 1. They are compiling a set or block of transactions to broadcast to the rest of the network within ten minutes (Bitcoin adds a new block of transactions roughly every ten minutes). The new block also includes the address of the last valid block (making a chain).
>
> 2. Once they have compiled this block, they try to find the block's hash function, which has specific properties (it must begin with a sufficient

number of zeros). To find this hash function, they run repeated calculations over the block (many 1000's of other miners are doing this, too).

One of the miners wins the race to find the hash with the right properties (enough zeros at the beginning).

3. Then, this hash is added to the top of the next block (forming a link to the chain of previous blocks) that the global community of miners is racing to validate by finding the correct hash.

Miners can only validate the transaction by finding the right solution for the set of transactions they are validating via repeated calculations.

What is a hash function? It's the mathematical function at the centre of Bitcoin. For some input (e.g., AB32412342GD), it gives a completely unique output. No two inputs will have the same output. That means there is only one unique output for an input of some new transactions. Change even one of the transactions, and the whole output is changed.

Also, this function can't be solved like a straight-line equation, where if you have two points on the line (two inputs), you can figure out the equation. It is such that you can't realistically use the output (transactions) to find the input, and you absolutely can't find two different inputs with the same output.

So, a hash function is the complex problem that miner computers try to solve by randomly guessing the answer. Why does it have to be so complex? Well, this complexity ensures there is no way to corrupt the validation process at the miner level (If it were easy, the value of Bitcoin would drop as it would be easy to mine). This means that the problem of someone corrupting the recording as they write it down is not possible (which it would be if the validators were people). The only way to record and validate the transaction is through computers randomly guessing the answer to the hash function.

Pseudo Anonymity

You might have been told that Bitcoin gives you complete anonymity and that you can buy whatever you want without anyone knowing. This is not entirely true. Bitcoin's ledger of transactions is stored on a public blockchain, accessible by anyone. Each

block of the blockchain contains all the information on the transactions passed. One of the things recorded are the addresses (hashes of public keys) of the digital wallets on both sides. These addresses are how people can be identified on the blockchain.

Just like in the village example, they only note down that Secret Cat gave Secret Cow a payment of "3 Klingo" for some transaction. But say the villagers wear the same mask every time, and the villager Secret Cat always wears a cat mask. Then, if someone sees a villager eating an apple right after someone in a cat mask bought an apple from someone in a cow mask, then they know that villager is Secret Cat!

This is essentially how law enforcement has been tracking criminals on public blockchains like Bitcoin. So, remember! Bitcoin is not anonymous; it is pseudoanonymous. Yes, the blockchain does not store any real-world IDs, but there are ways to find out who you are, such as through your IP address and checking your recent spurchases (such as a new car instead of an apple), etc.

Miner Rewards and Currency Issuance

Now, you might be wondering why someone would be paid a decent amount just for noting the transaction first. Well, that's in the imaginary village. In real life, Miner computers furiously run through random solutions to the highly complex hash function to validate the solution and be rewarded. These problems are not easy to solve. You can't sit down with a calculator and work them out.

The problem is purposely difficult to solve since mining is the only way new currency is issued (like with Klingo in the village), keeping the flow of new currency stable. Otherwise, too much currency would be issued, and the currency's value would drop.

If the problems are hard, it's hard to make transactions go through, which ensures the legitimacy and assists in defending against double-spending. No one wants to put in massive amounts of effort to get very little result. So, miners are well rewarded for their validation work, as it is difficult work. Keep in mind that this is not representative of all cryptocurrencies. Some of them don't even involve mining. We will figure that out later.

These are some of the fundamental concepts needed for a deeper understanding of cryptocurrency. We provided the example of a village because decentralised transaction validation systems are unusual for most people. Banks and other centralised organisations are far more common, which is one of the key issues in understanding cryptocurrency for many. The village people do this so that no one has to worry that the broker or the person on the other side will cheat them because there are too many people to easily corrupt. It also ensures that the people validating the process are rewarded for maintaining the system's legitimacy.

If the problems are hard, it's hard to make transactions go through, which ensures the legitimacy and assists in defending against double-spending. No one wants to put in massive amounts of effort to get very little result.

This is precisely the ideology behind many decentralised cryptocurrencies. They are usually formed from a belief that financial institutions are misleading, hurting the common people, and under corrupt influence. In fact, some might even posit that centralisation comes hand in hand with some form of corruption.

It might also seem inefficient to wait for so many people to validate your transaction, but this is mitigated by some people choosing to work only as validators. They simply work in the system that has been set up and are rewarded for maintaining the system. These are stand-ins for Bitcoin miners and their owners, with some individuals setting up communal mining pools and dividing up any gains.

So, now that you understand these basic terms let's turn to how cryptocurrencies like Bitcoin can be corrupted.

Double Spending

Cryptocurrencies are a form of money, and money is usually possible to counterfeit. In digital money, double spending is the analogue to counterfeiting. Double spending is the spending of the same piece of cryptocurrency for two different transactions

simultaneously. It's like using the same rupee in two separate transactions. But if you buy a newspaper, you can't buy a toy with that same rupee as it's already been spent. Not so with digital currencies.

How can you double spend?

1. You can "copy" a coin and send it to someone while retaining the
2. original.
3. You can simultaneously send the same coin to two different people
4. You can reverse a transaction already made after receiving the goods paid by it, hence keeping the goods and the money.

Double spending is the spending of the same piece of cryptocurrency for two different transactions simultaneously

A double sending visualisation

NOTE: Double spending is not necessarily restricted to using the same coin in transactions occurring simultaneously. Many attacks use a corrupt transaction that occurred before a legal transaction to cancel out the legal transaction on the blockchain.

Currency Limit

In the village example from earlier, we can assume the tree will grow indefinitely and produce new currency as a reward forever. This way, the villagers' economy will grow with time. This is how fiat currencies work, with the government printing more money as the economy grows! However, this is not the same for large cryptocurrencies such as Bitcoin. These currencies have a maximum number of coins that can be issued (or, in Bitcoin terms, mined). Bitcoin's cap is 21 million bitcoins. After the last bitcoin is awarded to a miner, no new coins will ever be issued by the network. This is done to prevent inflation by ensuring scarcity. In Bitcoin, because there is a cap on rewards, the network also has transactors pay the miners verifying their transactions a small fee. This ensures the miners are rewarded for maintaining the blockchain even after all the bitcoins have been mined.

Blockchain Ledger

So, as we explained above, a blockchain is a ledger. It's a record of data. What's so important about it is that it makes it possible for multiple sources to add to the blockchain while retaining security, transparency, and accuracy. Before, if you brought in many people to make records of their taxes, you had to trust them to some extent to be fair and honest

What blockchain does is remove the human trust element in this specific context? The blockchain makes the process of recording a transaction harder to corrupt. This is why they are known as "trustless". Not because they cannot be trusted but because they remove any need for trust in many record-keeping contexts. It's a compelling argument that the way forward is to simply remove the need for certain kinds of trust, mainly in the record-keeping context.

> **A blockchain is a ledger. It's a record of data.**

But it is not perfect.

For example, a blockchain is not the perfect next step for ballot votes. If a particular group of people gained majority control, they would then control what is added to the blockchain. In essence, majority control would allow a group of people to add votes in other people's names.

At the least, there is great value in a financial ledger system that is, in many cases, far harder to corrupt than traditional records.

A blockchain is not a magic bullet that wipes away any need for trust

So much of the functioning of the financial industry relies on trust in institutions that are prone to ledger corruption to some extent. The blockchain can also provide more transparency on either side of a transaction and also help reduce fraud in bookkeeping and records.

Blockchains can be used in monitoring supply chains and logistics, real estate and title transfers, secure data storage, tax records, and many other use cases involving analogue or digital record keeping.

There are so many systems in every field of the world, and so many of our interactions with those systems can rely on serious privacy flaws. Of course, a blockchain is not a magic bullet that wipes away any need for trust. But it can be a handy tool in quite a few areas (refer Appendix 3 for an easy visual guide on whether a blockchain might be an ideal tool in your use case).

Beyond the scope of this article, we are aware of the work at the Trust over IP Foundation that supports developing and deploying large-scale formal trust frameworks for different industries to scale trust globally.

To understand the transaction capabilities cryptocurrencies bring to the table, we've portrayed them through a value network mapping (refer to Appendix 1) as payment options side by side with traditional, everyday fiat options.

Transaction Value Network Mapping
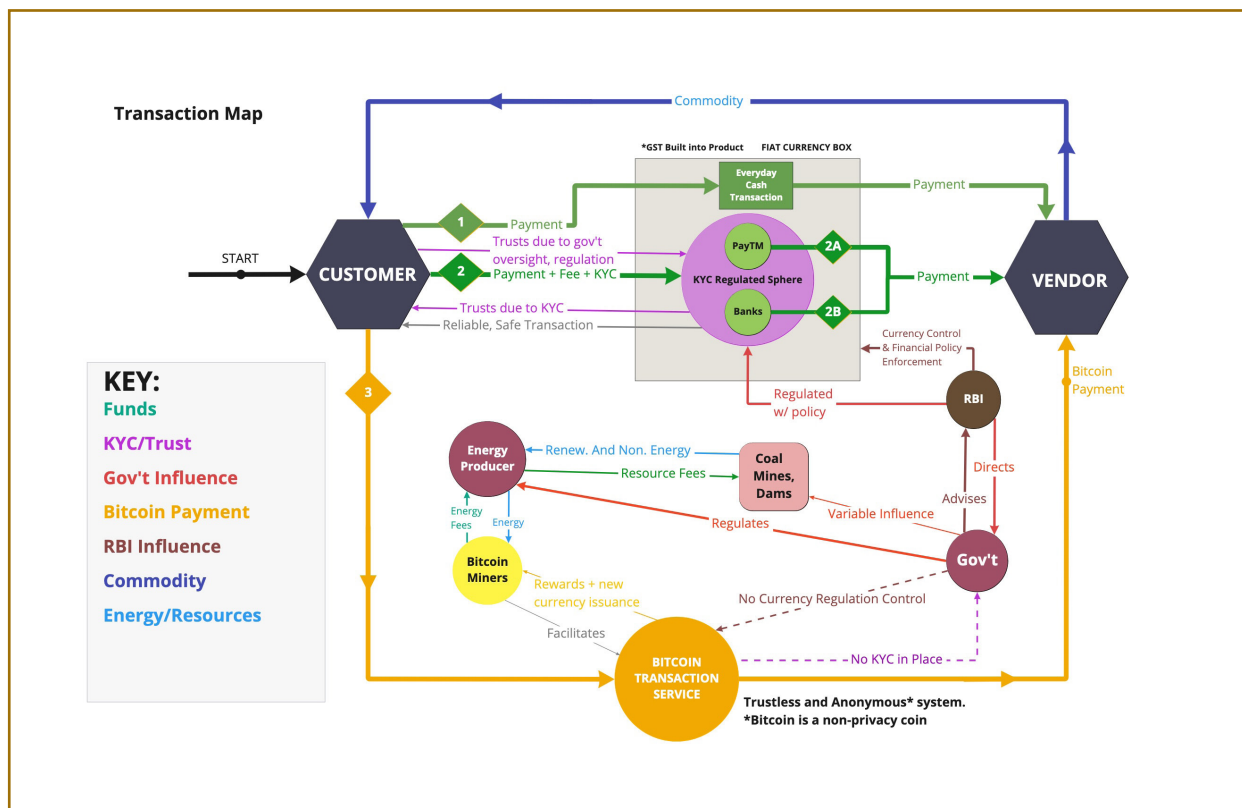
Payment options available today

www.cryptopolicyforthepeople.com

THE DESCRIPTION BELOW IS MEANT TO BE READ SIDE BY SIDE WITH THE DIAGRAM

Note: For further information on VNM (value network mapping), see Appendix 1.

The centre of this diagram (a value network map) is the customer performing a transaction buying some goods from a vendor. Three Payment arrows branch off, each representing a different payment option for a customer in the context of Bitcoin and traditional payments.

Payments 1 and 2

Payments 1 and 2 are the traditional options. An Indian customer looking to buy some goods from a vendor would have access to three "traditional" options.

- Everyday cash
- Digital payment vendors (PayTM or Google Pay)
- Banking services (Net banking or cheques)

These three options come under the Fiat Box of the economy, as they all occur with the medium of exchange being the Indian rupee. You can notice the Government's influence on the fiat sphere of transactions through the central bank (RBI) and policy regulations.

Payment 1

Payment 1 is everyday cash. The transaction only requires the note to be valid. That is easily verified. The only governmental influence here is by inflation/policies on the fiat cash currency used here.

Payment 2

Payment 2 goes explicitly through the KYC Sphere and splits into PayTM (representing digital payment companies) and banks (representing net banking and checks).

To break this down further, PayTM (representing private digital payment services) and the Banks (representing all financing and payment services offered by a bank) enforce KYC requirements in the KYC Sphere because of regulation, which means any organisation offering financial services must have verified identification from their customers to prevent money laundering and/or crime funding. In India, KYC is usually fulfilled through the Aadhar card.

Both the customer and vendor offer KYC to gain access to the services in the KYC sphere. The organisations in the KYC sphere are all trust-based systems, and the admittance of KYC information is essential in their checks and balances. Remember, with cash, one only has to check and trust that the fiat note is authentic, so cash payments fall under the Fiat Box but are not under KYC.

Payment 3

Payment 3, on the other hand, goes through Bitcoin, and following that payment arrow, you can see how the government has no currency regulation control nor any KYC in place on the Bitcoin network.

Bitcoin (and other cryptocurrencies) is a newer payment option that does not use the Indian rupee as the medium of exchange, nor does it record the KYC information of its users.

Note: Bitcoin is pseudo-anonymous and is not a "privacy coin" due to its public ledger.

This means governments cannot regulate the Bitcoin exchange to provide KYC information like it regulates fiat currency because the Bitcoin network simply does not have fiat in it, and nor does it have much KYC info to give.

"Miners" is the term for computers that solve complex mathematical calculations to verify and confirm transactions. The Bitcoin network is facilitated by these miners, who verify transactions with no idea of the end user's identity in exchange for a reward along with transaction fees.

The Bitcoin network comprises millions of miners today and requires immense amounts of electricity due to its proof-of-work nature.

The miner-energy sector relationship is also explored. The miners purchase renewable and non-renewable electricity from the energy sector. The government can regulate the miners indirectly by regulating the energy sector.

The advent of blockchain technology and cryptocurrencies has serious ramifications for the traditional banking system as it exists today, how it's perceived, and the transactions we do daily.

Now, while cryptocurrencies are ushering in a transitional era in finance, the world of finance is still, rest assured, about moneydigital money, virtual money, strange meme coin money, but money nonetheless.

To understand how cryptocurrencies are changing how banks work, we first have to understand what money is.

Economics

How Money Works Right Now, and How Cryptocurrency Changes That

To really understand cryptocurrencies, we must take a step back and question what money is and how current financale systems were established. This section unpacks how money works, how trust upholds the finance world and how banks work. Once we understand the current state of the finance world, we can then fully appreciate how cryptocurrency impacts and changes the role of money and banks.

What is Money?

In the past, societies used the barter system to avail goods and services - tomatoes for potatoes, pigs for cows etc. Some kingdoms used coins (usually metallic) to pay soldiers, all stamped with symbols (usually a ruler) to prove authenticity.

At different times in history, many commodities have become ubiquitous currency. In 1980s Communist Romania, Kent cigarettes were money; they served as a medium of exchange.

Money is Euros if you live in Europe, Rupees for Indians, and USD if you're in the United States. But what gives these coloured pieces of paper value? Why do we give value to certain pieces of paper printed with a particular design?

A collection of fiat notes

Well, they have utility. You can buy goods with them; you can buy services from a plumber. But why these specific pieces of paper? What gives them value? It can't be the fact that dollars have always been how we buy things because what convinced people to start using them initially? Why, even today, does a car salesman take cash?

A collection of ancient coins

What quality does he see in that cash? It's not really about the specific paper, the colour, the design, or the texture. It never has been. It's about belief.

A rupee note has value because people believe it has value - it is a shared social construction. Money, in general, gets its value from belief (Davila, 2020). If everyone wants it, it's valuable; if everyone believes it has value, it has value.

This is an implicit framework of trust where you completely trust that a rupee note has value. Knowingly or unknowingly, you have invested your trust into this system every time you have transacted with money. You trust this paper note has value because everyone else trusts it does. The car salesman has also invested trust in this system. It's why he's happy to let you drive off with that new car in exchange for a suitcase of notes (or a check)—the same for Amazon, Google and your local coffee shop. Money has value because everyone wants it, and everyone wants it because everyone believes it has value.

> **Money has value because everyone wants it, and everyone wants it because everyone believes it has value.**

A bitcoin is just a somewhat more abstract form of money than most people are used to, in that it doesn't have a physical note and isn't backed by a government, but it is still "money". Granted, it is too volatile right now to be used as a store of value, and some lawmakers rule it as an asset, not a currency (we will discuss the implications of how a crypto coin is legally defined later), but that basic idea of a currency backed solely by belief is valid in Bitcoin. That's how paper money works as well.

We all are nodes in this vast belief system of money, putting in our trust to build a consensus framework of meaning that is present throughout the world. But where does this vast and seemingly infinite quality of money come from, and why do we trust it so much? A stranger could tell me to trust that the sun will eclipse tomorrow, but that doesn't mean I'll believe them and trust them. So why do we trust this?

Well, much of the world's money comes from banks, but not in the physical note-printing way. So let's look at banks, and why we trust them. Once we understand them, let's then see how they are affected by cryptocurrencies.

How Banks Work?

To understand how cryptocurrencies affect banks, we first have to know how banks work. A bank is a financial institution licensed to receive deposits and make loans. Although one might say that a bank simply just keeps its customers money safe and secure, the main work of a modern bank is usually taking in deposits and giving them to those who need them in the form of loans. Modern banks work on the idea that if someone's money is just sitting around unused, someone else might as well make good use of it. They are essential to the modern economy.

Bank loans and services fund businesses and individuals and are a way for money to keep moving in an economy, which is very important. The same ten-rupee note buys a taxi ride, a bottle of water, a vada pav, and much more in one day. Banks essentially do the same with the money in their accounts and vaults. This process of using the same money in multiple ways works through fractional reserve banking.

Suppose person A deposits $1000 into a bank with a specific interest rate. At some point, the bank lends out 900$ of that money to person B at some interest rate.

Share of Currencies in
Composition of Foreign Exchange Reserves

Source: International Monetary Fund

Legend: U.S. Dollars, Euro, Chinese Renminbi, Japanese Yen, Pounds Sterling, Australian Dollars, Canadian Dollars, Swiss Francs, Deutsche Mark, ECUs, French Francs, Netherlands Guilders, Other Currencies
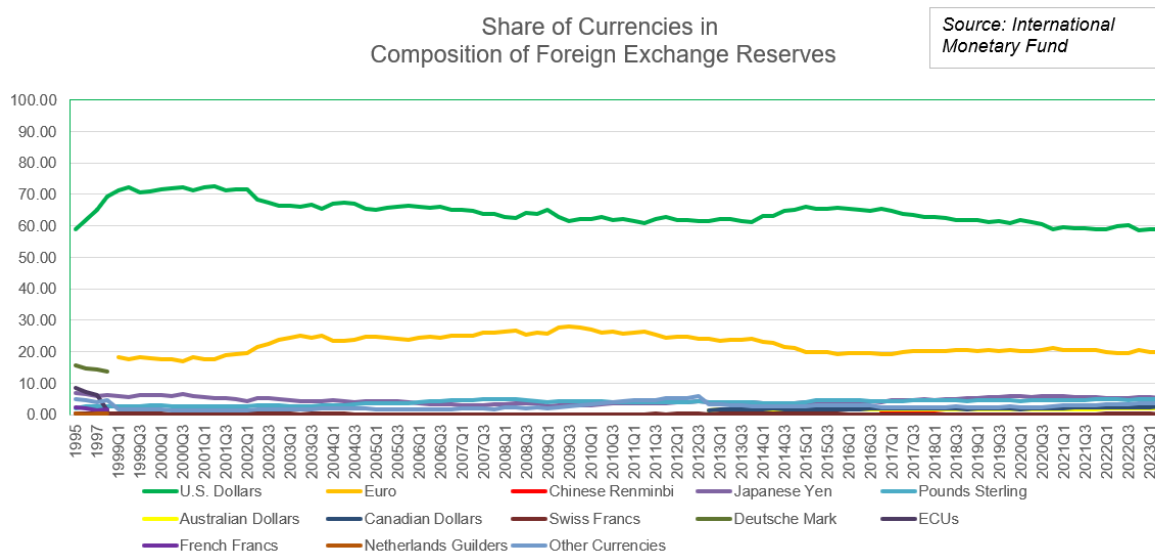
Source: World Currency Composition of Official Foreign Exchange Reserves International Monetary Fund

We now effectively have $1900 in circulation. But the notes haven't increased by $900. It's still that same stack of $1000 sitting in A's account. A is still owed $1000 by the bank if he chooses to reclaim it. But person B still has $900 in their pocket, and we now have effectively $1900 in circulation despite there being only the same single $1000 stack in existence. Yes, the bank has just created money out of debt. And that's what money is, more or less - an instrument made out of the need to create and pay debts in society. Most of the money in the world is in debt, loaned out by banks.

The same ten-rupee note buys a taxi ride, a bottle of water, a vada pav, and much more in one day. Banks essentially do the same with the money in their accounts and vaults.

Fractional Reserve Banks

How much money the private banks in a country get to loan out is actually determined by the central bank through something called the 'fractional reserve rate'. With a fractional reserve rate of 1%, a bank making a loan of 1 million USD must have an ond-hand reserve of 10,000 USD. This fractional reserve rate is also an effective way for the central banks and the government to control the money supply in the economy.

This modern banking system offers credit cards, debit cards, mutual funds, and various other schemes for its customers, individuals and organisations alike, all built on debt. In fact, even your everyday note literally has a promise to fulfil a debt printed

on it. In the US, for instance, "This note is a legal tender for all debts..." is printed on all dollars notes; in India, you find, "I promise to pay the bearer a sum of..." is issued. And we trust in it because everyone trusts in it and because the government backs it, and because of the regulations stabilising the note's value. What we are exchanging at shops or theatres is just an IOU note (I owe you) backed by trust in the government within the broader implicit trust framework in which society finds itself. We trust our society, we trust our government, we trust our banks, and so we trust our money has value.

Bank Runs

A major flaw in a reserve banking system is the bank run. People deposit their money in a bank because they trust the bank's stability and want to use its interest and fixed deposit services. A fractional reserve bank, by definition, has in its reserves only a tiny fraction of the amount it lends and donates in its reserves. They exist in a continuous equilibrium, a sort of tightrope walk, betting on the fact that a large population will not withdraw their funds all at once, which would mean the reserves run out. So what happens when people don't trust the bank?

A bank run is when a large enough population stops trusting the bank and withdraws all their funds at once.

When many withdrawals are made simultaneously, the bank's reserves could fall below the rational reserve rate or even run out. Now it would need to rapidly sell off its assets at whatever price and even take loans from other large banks or financial institutions (creating more money in the form of debt ironically) to repay the depositors.

A bank run is when a large enough population stops trusting the bank and withdraws all their funds at once

This is also why governments insure deposits made at banks (by the Federal Deposit Insurance Corporation in the United States, for example) to mitigate any fear and insecurity that depositors might have, thereby granting the banks greater stability and trustworthiness.

So, the banking system has to be based on trust to remain stable. People often trust that a bank will be stable because it has always been stable.
Cryptocurrencies have not been stable. They have yet to ever be stable. They have incredibly volatile price fluctuations (Bitcoin has gained massive value and then lost it all the same day), and this is not because people don't trust Bitcoin as a currency. It's because not enough do. Most people buy and sell it as a speculative investment, trying to ride the hype.

Cryptocurrencies, if they become mainstream, could threaten the viability of traditional banking services, leading to weaker banks if banks don't participate in the flow of cryptocurrencies.

Cryptocurrencies' "value", the price that people are willing to pay for them, is also a function of a belief and thus trust in the overall system that other people will be ready to accept bitcoins when they want to buy goods. A different type of "run" on

25.942,60 USD

+131,60 (0,51%) ↑ today

+ Follow

2 Sept, 15:34 UTC · Disclaimer

| 1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max |

| 1 | BTC ▾ | 25942,6 | USD ▾ |

Feedback

More about Bitcoin →

Source: Google Search of Bitcoin's price history in USD, up to 6th March 2023. (Notice the volatility)

cryptocurrencies is possible if people no longer believe in their value and there is a sell-off. The currency's value can fall dramatically. Bitcoin has lost half its value from $60,000 on 14th April to $30,000 on 19th May 2021. This is not uncommon.

On May 10, 2022, Bitcoin's price crashed to below $30K from $45K on April 1st, with half of the supply at a loss, meaning investors owning those bitcoins were at a loss. Here is a Wikipedia section where you can see the volatility. The graph below is sourced from google finance, and the price is in USD.

How Cryptocurrencies Affect Banks?

We took a long detour to understand what money is, the current banking system and its implications. Where does the world of cryptocurrency and decentralised finance fit into all of this? The answer is – it doesn't. If anything, believers in cryptocurrencies envisage traditional banks becoming obsolete, and there is some concern in the banking sector about this coming true.

Where does the world of cryptocurrency and decentralised finance fit into all of this? The answer – it doesn't.

Cryptocurrencies sidestep the banking system and provide for fast, direct transactions
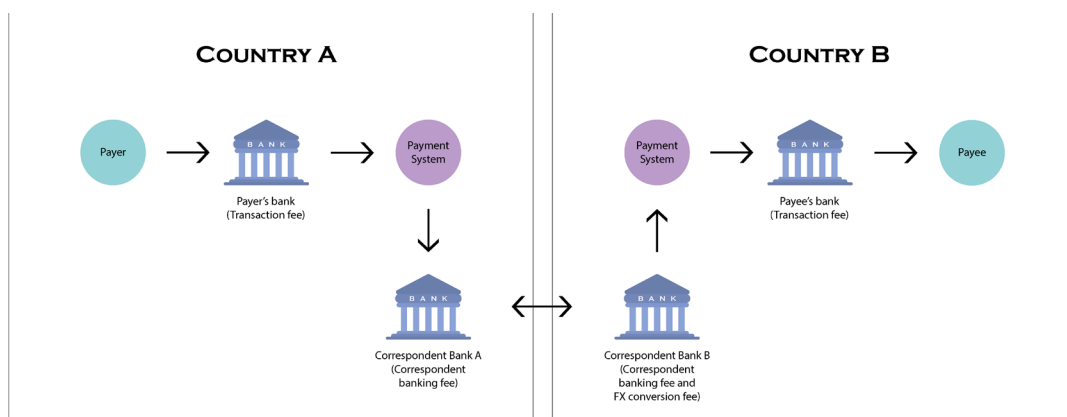
An illustration of B2B transactions across borders

without the need for a financial intermediary. Fees and timely convenience are indeed major issues with bank transfers. These fees create great incentives towards cryptocurrencies, especially for remittances and small businesses.

The correspondent banking model illustrates bank-to-bank transactions between different banks across different countries. (Imagine the fees for such a transaction.)

Many blockchains use a public ledger that is highly accessible to those who don't want to use a bank that records transactions. A blockchain that claims anonymity is very appealing.

Secondly, since cryptocurrencies are inherently encrypted, banks are less essential for safekeeping than they previously were. With many blockchains you cannot even sabotage discretely, as the security systems are based on software. Blockchain code written by developers cannot be changed without approval from the majority of users. If the users don't want the currency's code to change, it won't. This gives many a degree of control in their financial system of choice (which might also cause bad decisions by inexperienced lay persons).

A bank's value is in its trustworthiness in its record-keeping, i.e., in its ledger. No one wants a bank that falsifies deposits. It is not possible to manipulate transactions on blockchains without majority agreement. Also, since all nodes are seen as equal in most cryptocurrency ecosystems, essentially anyone can generate and distribute the tokens, eliminating the need for any network of banks required to distribute the cryptocurrency.

Blockchains can also connect investors directly to businesses and start-ups, opening up the investment market in a massive way by allowing anyone to invest on a completely transparent, incorruptible ledger, making bank intermediaries less absolutely necessary and allowing for other options.

Cryptocurrencies can even be used to establish fractional reserve banks. This type of banking is not restricted to fiat, although the government backing and safety nets of fiat can help build the trust required to invest in a reserve bank.

Traditional banks do not have to be completely disconnected from this new technology; they can get involved in cryptocurrency by offering custody services, safely holding cryptocurrency wallets for their customers, and alleviating some of

the technical and hacking concerns. They can also act as points of AML/KYC, tying identities to the generally anonymous wallets, similar to exchanges, but keeping that information encrypted/accessible by the user only. Banks can also integrate blockchains into their wire transfer and/or payment systems, allowing for faster transactions. However, the lack of clear regulations makes many banks hesitant to integrate with cryptocurrencies.

Online Transaction Systems vs Cryptocurrencies

A thought might occur, don't we already have digital money transfer systems in the form of net banking and other online transaction systems? What is the difference? After all, one can't touch the digital currency kept in their e-bank wallet, can they? Online transaction systems such as PayTM, Venmo, and Google Pay all work inside of the fiat currency system set up by a nation. You link your bank account to the payment app, and although the payment is instantaneous, it's actually later on that the money is transferred from your bank account to the vendor's. The government usually regulates this industry of payment apps.

> **While using cryptocurrencies, one is circumventing the fiat system.**

While using cryptocurrencies, one is circumventing the fiat system. You don't link your bank account to your bitcoin e-wallet. You are transacting in a system separate from the traditional banking system and the greater fiat currency system. This can result in lower transaction fees and greater freedom against restrictions regarding potential censorship and sending money across borders. Cryptocurrencies do not operate under regulations like payment apps. There is no centralised regulatory authority behind cryptocurrency transactions, although that may change.

The Emergence of Central Bank Digital Currencies

Central banks are usually very concerned about the mainstream use of cryptocurrencies in a national economy. Central banks govern an economy by conducting monetary policy, controlling loan and interest rates, and issuing currency. Their purpose is to conduct monetary policy, regulate the banks, help manage

economic fluctuations, provide a stabilising influence, and prevent inflation. The sovereignty of a central bank over the economy is most notably through its control and issuance of fiat currency in the nation's economy.

However, cryptocurrencies, which are almost all decentralised and nationless currency systems, can eat away at the usage of the fiat currency and take enforcing power and influence away from central banks. Additionally, cryptocurrencies may bring a destabilising influence on the economy. This was the case with El Salvador which has planned huge investments in Bitcoin ($500 Million) to further its Bitcoin agenda. In May 2022, after a massive cryptocurrency market crash, the country lost 36 million USD on an investment of 103 million USD. Thousands have protested the country's investment in Bitcoin, fearing economic instability. Still, the El Salvadoran president has responded to the crash by buying even more cryptocurrency at a low price and tweeting it as an opportunity to "buy the dip."

Many central banks (87, representing over 90% of world GDP, including China, the USA, Russia and India) have announced plans to implement CBDCs (Central Bank Digital Currencies) to counter this shift..

The different types of money flowing through an economy
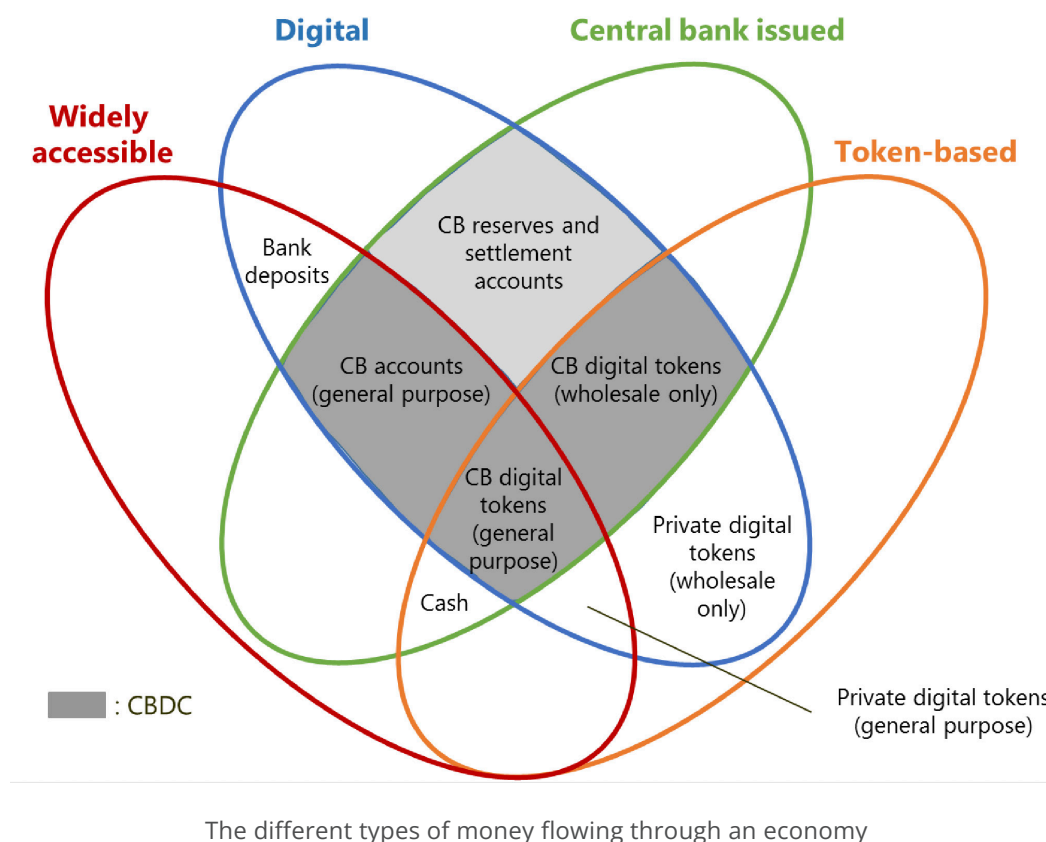
What are CBDCs?

CBDCs aren't legal cryptocurrencies. A CBDC is the virtual form of a country's fiat currency. It's a piece of code that's given the same monetary value as a fiat paper note.

Its value comes from the same source as the physical fiat note, it's backing by the government, the guarantee of the bank to redeem it, the structure of regulations and laws surrounding its counterfeiting and usage, and the general stability due to its usually dominant usage as a currency.

CBDCs aren't legal cryptocurrencies. A CBDC is the virtual form of a country's fiat currency. It's a piece of code that's given the same monetary value as a fiat paper note.

It is literally a digital rupee/dollar/euro, not a payment system built on the rails of the physical banking system. This is different from e-payment systems such as PayTM and GPay, where the number on your phone screen is still tied to your money in commercial bank accounts. These systems simply shift the money in your bank account to the shop sometime after the quick and convenient electronic transaction is complete. These payment systems still rely on being linked to traditional physical money systems.

Currently, physical cash is the only way for consumers to have access to central bank money, which has so far been available only to commercial banks and the government. (Financial institutions use a digital payment system to pay other institutions in central bank money, i.e. money that is the central bank's liability.) This ensures commercial banks can then take over servicing individuals and businesses with money they generate through reserve banking, money that is the liability of that specific bank.

In a transaction, existing payment systems such as PayTM transfer money that is the liability of the commercial bank providing the user's account. Central banks are far safer (not completely free of risk, nothing is risk-free) as they can always print money and therefore are not as likely to fail as private banks can from bank runs. However, central banks aren't meant to lend to consumers directly. That is the job of consumer banks, which are more innovative in the private sector. This two-tiered system of

consumer banks lending money from central banks and then through fractional reserve banking giving out loans themselves is the norm worldwide. This ensures stability through the central bank and innovation through the private banks.

Different Implementations

Because of this tiered system, there is no one single type of CBDC implementation. Some implementations might cause bank runs or cause private banks to become less competitive, as consumers can simply do their banking at a safer central bank; other implementations might have different problems.

The major design considerations of a CBDC are

1. Public distribution and holder of liability of CBDC,

2. If the ledger system to be used should be a decentralised ledger, traditional infrastructure or a hybrid.

3. Should the CBDC be account or token-based.

4. Regarding cross-border payments; whether a CBDC can be spent abroad.

However, implementing a CDBC is far more complex and varied than these basic distinctions.

1. Distribution and Liability

Distribution and liability address whether the central banks will issue CBDCs directly or will they have intermediaries in the form of commercial banks. Who will redeem the CBDC (remember, your hundred rupee money notes have text saying the government promises to pay you, the bearer, the sum of one hundred rupees?)

Central banks can either issue and transact CBDC directly with the public, or they can have commercial banks as an intermediary, just like the pre-existing two-tier systems, where the money in a customer's bank account is a claim on the commercial bank which holds a reserve with the central bank, not the central bank directly. In the direct system, the CBDC would be a claim on the central bank, bypassing the private banks. You can also have a hybrid system where commercial banks handle transactions while the CBDC is a claim redeemed directly by the central bank.
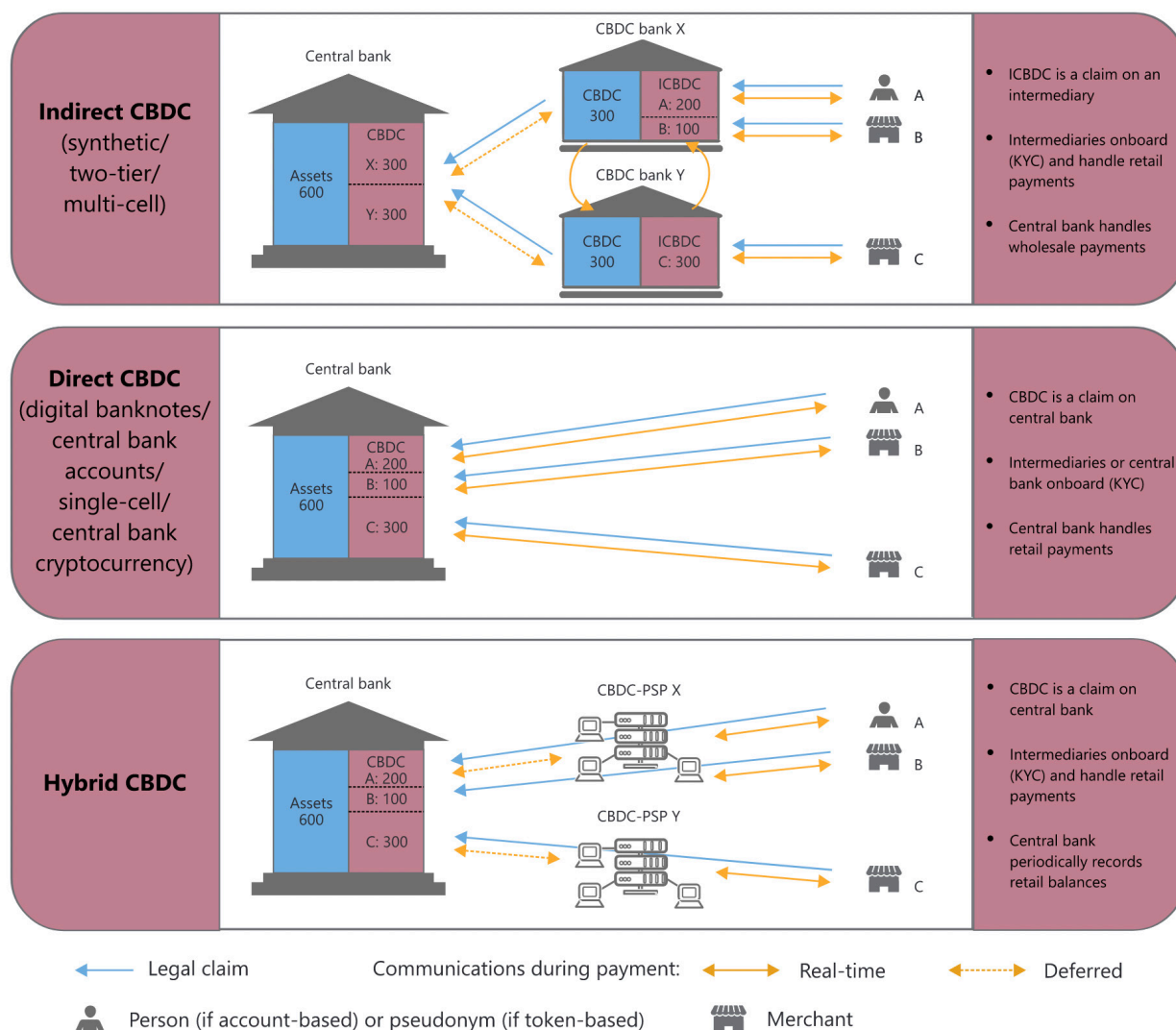
Figure _: Overview of potential CBDC structures

Source: The technology of retail central bank digital currency - bank of international settlements

This means there are three major implementations according to distribution and transaction handling and who redeems the claims, all with their pros and cons. A direct CBDC gives the end-user access to stable central bank money, but would seriously weaken private banks and cause very intense bank runs due to the digital nature of CBDCs (you could easily transfer digital CBDCs from a private bank to the more stable central bank). It would also require the central bank to establish and maintain KYC on its own, which could result in massive scaling of operations (you would also need to scale customer services, accounting and records infrastructures, essentially replacing private banks in this area). The direct system might also not be as efficient as the private sector is generally considered more innovative. (Consider the current credit card system as an example.) As recommended by the IMF (for low-

income and small island countries in the Pacific), a direct access system might benefit economies with underdeveloped financial sectors with a strong central bank. This way, there are no intermediary institutions to weaken.

Like normal fiat money, an indirect approach would allow private banks to handle innovation, distribution, liability and KYC, but would only give consumers access to CBDCs on commercial banks' liabilities, losing the stability of direct access to central bank liability and avoiding making private banks weak.

A hybrid system with a direct claim on the central bank and services provided by the commercial banks requires far less central bank expansion and lower cost than direct system, but still more access than the indirect system. It might require the central bank to record a synced balance sheet with the commercial banks, which could be a resource concern. However, if a payment service provider is failing, the central bank could shift its customers to a stable provider, allowing for end-user protections from bank failures.

2. Decentralized Ledger Technology (DLT) or Traditional Ledgers

This distinction is on whether to store the transaction records on a traditional centralised ledger or a decentralised ledger that uses blockchain tech.
Those blockchains are updated at great resource cost, and Bitcoin is nowhere near a nation's volume of daily transactions. Current bitcoin-esque blockchains are not scaleable.

In general, blockchains function around consensus mechanisms that require multiple verifications. Even proof of stake, which gives validation and block creation responsibility to one miner, still requires confirmation by other miners. So a DLT system would have to sync each node in the network for each update in each transaction. This is a massive increase in processing and resource usage, and it can constrain DLT CBDCs to smaller transaction volumes.

The validity of these DLT systems will also depend on whether the CBDC distribution is direct, indirect, or hybrid. A directly distributed CBDC will require massive technological expansion by the central bank to maintain a separate record. A hybrid variant might need real-time synergy with commercial banks, and indirect variants will at least have some kind of oversight by the central bank.

Between DLT and traditional centralised methods, there is no clear better defender against cyber attacks. They are both vulnerable to different attacks. Traditional centralization has one focused point of weakness, whereas DLT's consensus mechanism can be spammed or, even worse, overridden and taken control of by an external force.

A centralised record system, even replicated on multiple servers, still serves as a single point of failure. If a single server is compromised, it might be enough to print money or falsify transactions. Placing ledger rewriting control under a single authority with the ability to rewrite transaction histories and records could be very risky for public trust and the robustness of a system.

Who can a central bank trust on a decentralised ledger system with transaction validation of its CBDCs? In the case of a power outage, if distributed networks were down, the potential consensus mechanism could be inactive or weakened.

> **Due diligence is essential for a CBDC.**

There is the issue of reverting a transaction by request or due to falsehood detection. In a centralised system, it is easily done, but as decentralisation becomes more prevalent, it will be harder to revert or remove transactions from the records due to the need of a consensus mechanism amongst the different decentralised operators.

Also, a decentralised system could potentially take control of CBDCs from the central bank. That is central bank money that would no longer be completely under the control of the central bank. Can these decentralised validators be trusted more than the central bank? This might imply lack of monetary control and transaction censorship.

These qualities might be desired in the "digital form of cash", but the lack of authority in a permissionless ledger system similar to a blockchain with miners would open the system to majority attacks and influence. In many miner-based currencies, the top 4-5 mining collectives together control the majority vote in the blockchain and could potentially collude to influence the value of the currency. It could also be difficult to have due diligence on the different "miners" for such a system. Due diligence is essential for a CBDC.

A fundamental thing to note is that a digital ledger system can allow an authority not involved in the transaction to reverse the transaction, meaning DLT CBDCs might not have the same guarantee of cash for vendors.

MIT's own CBDC venture, Project Hamilton, in its Phase I report, found that a DLT was not necessary to achieve its goals for a CBDC, and had performance downsides. In fact, the same report even outlined a need to push beyond a choice of either DLT or traditional ledger, account based or token-based options when developing a CBDC.

3. Account or Token based CBDC

Regarding account-based and token-based CBDCs, if a CBDC was account-based, then all transactions carried out through CBDCs would be most likely recorded on each account. This would raise some privacy concerns if CBDCs replaced cash as a mainstay.

Alternatively, the token route could be taken, which is much closer to physical cash, where it. It is possible that transaction records will not be kept. In cash usage, we don't have to authenticate the transactors' accounts. We don't check if the KYC of the vendor's bank account is valid. Instead, we simply make sure the banknote is genuine. A similar token-based CBDC would have digital convenience along with physical privacy.

Technical AML can still be implemented, such as mandatory consumer identification to access digital wallets and CBDCs. This might prevent the gathering of immense sensitive transaction-related data in a centralised location.

However, double spending is a potential deal-breaker for certain token-based implementations. If the hardware used to transact CBDCs, such as a phone, is compromised, a user could double-spend easily, compromising the whole system.

Additionally, utilising distributed hardware for end-users to own would incentivise attackers to go after the security of the hardware. As mentioned here, graceful degradation is of concern as well. If one person figures out a hack, that program can be easily shared across the internet. This is not the same with cash, where counterfeiting is generally an incredibly delicate and difficult process to scale, let alone even achieve (think of all the sophisticated anti-counterfeiting measures in a single ten rupee note, all of which are constantly updated).

There is also the concern about how digital, anonymous, untraceable cash could lead to a massive rise in money laundering. The idea that a central bank would know how many CBDC "notes" it has issued but would not be aware of who holds how many of the notes is unlikely. One of the concerns with a token CBDC is that it might create challenges for law enforcement trying to trace a money flow. Cash is hard to transport. A single phone with a payment app is not.

Transaction limits, and privacy vouchers are both being considered. Up to a certain limit, transactions could be made private. Privacy vouchers would be periodically released and would be non-transferable between citizens. Vouchers would be spent at a ratio of one to one for a CBDC coin.

Also, in the case of a data breach, a CBDC account would, by KYC and AML regulations, be linked to all sorts of sensitive and personal data. How to defend against this? What about data loss from cyber-attacks, where we might lose certain targeted transactions?

With cash, we don't check if the vendor's KYC is valid. We simply inspect the bank note.

4. Foreign Payments

Nowadays, a cross-border payment comes with a foreign currency exchange fee Foreign exchange fees could be bypassed if a CBDC were allowed to be spent abroad. A tokenbased, "digital cash" system would be most likely accessible to foreigners, whereas, in an account-based system, this would have to be a much more deliberate design choice. (Eg: China has allowed visitors to the Beijing Olympics to use e-CNY through password details).

Despite the convenience and broader interoperability a CBDC could bring to international transactions, addressing many concerns, such as AML compliance, technical standards, and regulator and oversight frameworks would still be necessary International collaboration will be essential.

The removal of a transaction fee and currency exchange fee for cross-border payments could open up foreign markets in an entirely new way, allowing citizens direct, unimpeded access to foreign markets, and even enabling multiple currency transactions.

Conclusion:

Some argue that while the lack of access to banking services is a problem, CBDCs do not have to be the solution given their potential negative consequences. CBDCs are a very complex innovation. Any implementation of CBDCs must come after a discussion on the role of a central bank in the nation's economy and the long-term future of cash in that country.

Existing Implementations:

87 countries are considering the issuance of a CBDC. Of those, 9 have fully launched CBDCs.

China:
China's Renminbi (aka e-CNY) is the foremost example of a CBDC at scale. It is currently in the pilot stage. It uses a hybrid architecture, account-based CBDC. By October 21, it had 123 million individual and 9.2 million corporate wallets, with 142 million transactions and $8.8 billion of transaction value. Early 2022 reports indicate that more than 260 million wallets have been opened. China allowed visitors to the Beijing Olympics to use e-CNY with just passport information. The e-CNY allows offline functionality and different levels of anonymity.

Russia:
A prototype of the digital rouble, using a hybrid, account-based, DLT, and conventional system platform, was announced in Feb 2022, along with a timeline for phased development and the news that two partner banks had completed digital rouble transactions.

United States:
The Federal Reserve has expressed interest in CBDCs, but no further. It has released reports studying and considering the matter and will not proceed further with a CBDC unless given clear support from Congress, "ideally in the form of a specific authorising law."

India:

India already has a robust e-payment system based on UPI that uses the universal identifier of Aadhar to allow all of its citizens to make payments digitally at an unprecedented scale. The country has been decisively anti-cryptocurrencies, even banning them for a two-year period from 2018-2020. The RBI has announced plans to launch a digital rupee in their 2022-23 financial year to ensure monetary sovereignty in the Indian economy and is viewing the CBDC as "just the digital form of paper currency and no distinction whatsoever." If India launches a CBDC, it will be one of the largest economies to do so, with 1.4 billion citizens in the market.

Nigeria:

Nigeria's e-Naira was fully launched in Oct 2021 and has minted $1.21 million. It is the first African CBDC and plans to use Nigeria's universal identification system, similar to Indian Aadhar, NIN (60 million plus sign-ups). A few months prior, Nigeria banned any usage of cryptocurrencies in the country. It uses hybrid distribution with a DLT system and is account-based.

Organisation of Eastern Caribbean Nations: The Eastern Caribbean Central bank (ECCB) launched Dcash in March 2021, available through smartphones on a hybrid distribution, DLT system. However, the system was down for six whole weeks in JanMarch 2022.

It should be noted that without significant international cooperation, one of the main facets of a CBDC, foreign usage and interoperability may be lacking. There are some cross-border payment tests in progress: Project Dunbar (South Africa, Singapore, Malaysia, Australia), Project Aber (UAE and Saudi Arabia) and mCBDC bridge (China, Hong Kong, Thailand, UAE, Saudi Arabia).

What are Stablecoins?

Stablecoins are a middle ground of sorts between cryptocurrency and traditional fiat. They are a cryptocurrency whose value is tied to a tangible asset such as gold or silver or even another fiat currency, such as the USD in the case of Tether, the 3rd largest cryptocurrency overall.

The argument for stablecoins is as follows:

The argument for stablecoins is as follows:
There are only ever going to be 21 million bitcoins. This puts Bitcoin in a position where it is scarce and supply is restricted. Scarcity has also made cryptocurrency an attractive asset for speculation. Cryptocurrencies have seen a lot of volatility and extreme swings in prices. This raised concerns among some people who wanted a much more predictable alternative with less volatility. Enter stablecoins. Stablecoins are essentially a class of coins that have their value pegged to some asset (usually USD or gold). So instead of value being based on scarcity like with Bitcoin, it is tied to a real world asset value.

Stablecoins seek to offer the best of both worlds: the technology, encryption, and privacy of cryptocurrencies and the stability of more traditional assets. Some stablecoins are manipulated algorithmically to keep their value by changing the supply of coins in sync with price variations of their pegged asset.

Even the giant Tether has lost its dollar peg value in the crash and is pegged at slightly less than a dollar.

Stablecoins, however, can have bank-run analogues. Since they are pegged to the value of an asset, such as a dollar, the centralized stablecoin issuing authority is obligated to produce a dollar for a coin if the customer requests. If everyone cashes out a stablecoin, the centralised authority which promises that one stablecoin will always be returned with a dollar will soon run out of reserves. This occurred with Terra, a stablecoin, in November '22 during the crypto crash. Even the giant Tether has lost its dollar peg value in the crash and is pegged at slightly less than a dollar, as the market considers it riskier than a dollar.

Developing Countries

Are Cryptocurrencies Beneficial for Developing Countries?

A developing nation is a rapidly changing and shifting environment. These nations often have lighter regulations and need international expertise to apply to development issues. Financial exclusion, remittances and low institutional trust are some of these issues.

Financial Exclusion

Financial exclusion is the inability to access common financial products and services afforded by financial institutions, such as loans, banking, equity and insurance. It hampers peoples ability to earn, invest, have economic stability, a safety net, and build for the future. Mitigating financial exclusion accelerates economic growth and stability and improves financial health and job safety.

Financial exclusion may be due to living in a rural location, lacking identification papers, low or unstable income, high service costs, inconvenient or poor service and discrimination. Financial inclusion is of essential importance (World Bank, 2022) in a developing country; it has been identified as an enabler for 7 of the UNs 17 Sustainable Development Goals. Financial exclusion is greatest among poor people in emerging and developing countries (UNSGSA).

In emerging markets, at least 200 million (UNSGSA) small- and medium-sized enterprises (MSMEs), the heart of a developing economy, lack access to financing, limiting their ability to grow and thrive. Thus, local companies are severely hampered compared to international counterparts.

Financial intermediaries such as international banks are essential for companies and businesses to be granted loans and funding. This is where cryptocurrencies pitch their case by stating they enable investments from around the world, free of fees. A traditional woodworker could be paid in cryptocurrencies from clients outside his country. However, there are issues with this, as discussed below. First, lets understand remittances and then discuss how cryptocurrencies might struggle to address these issues.
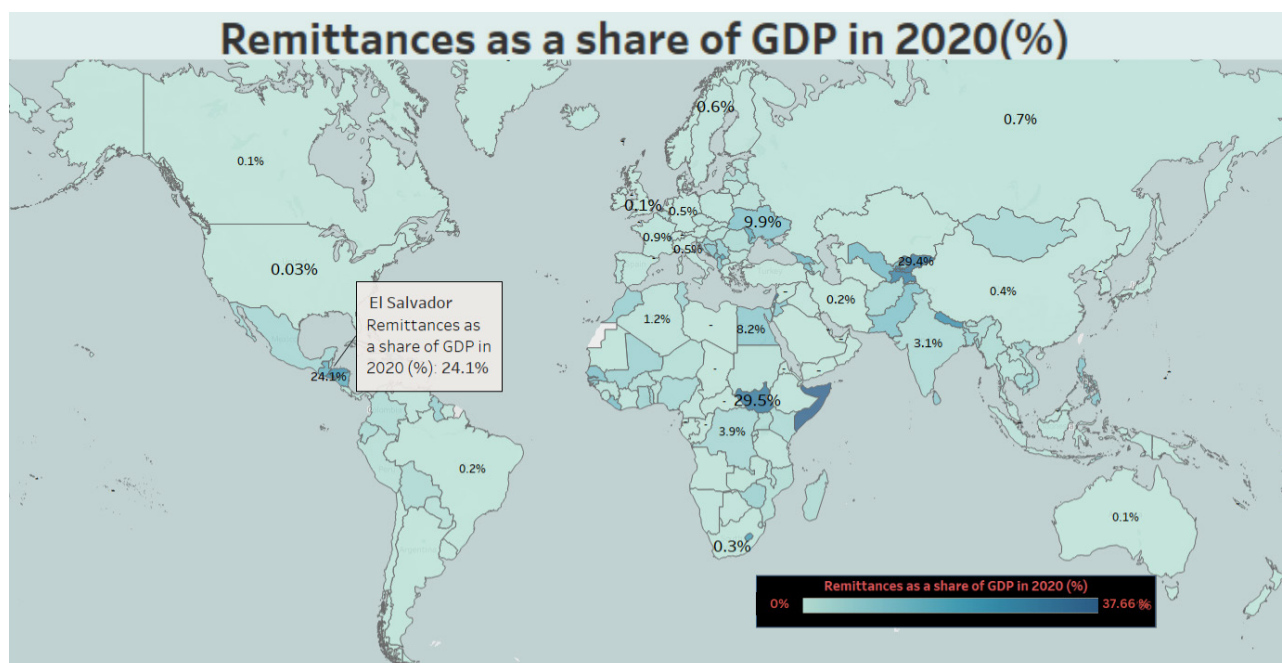
Remittances as a share of GDP in 2020

(Graphic 1, Data from the World Bank)

How Cryptocurrency Impacts Remittances?

Remittances are the money sent back by a worker in a foreign nation to his family in his nation of origin. This remittance is often the workers familys only livelihood.

In the two graphics above, note how in graphic 1, a country with remittance at a high percentage of GDP, like El Salvador, is still at a fraction of the total annual remittance funds of a country such as India (graphic 2), which has remittance at a lower percentage of GDP.
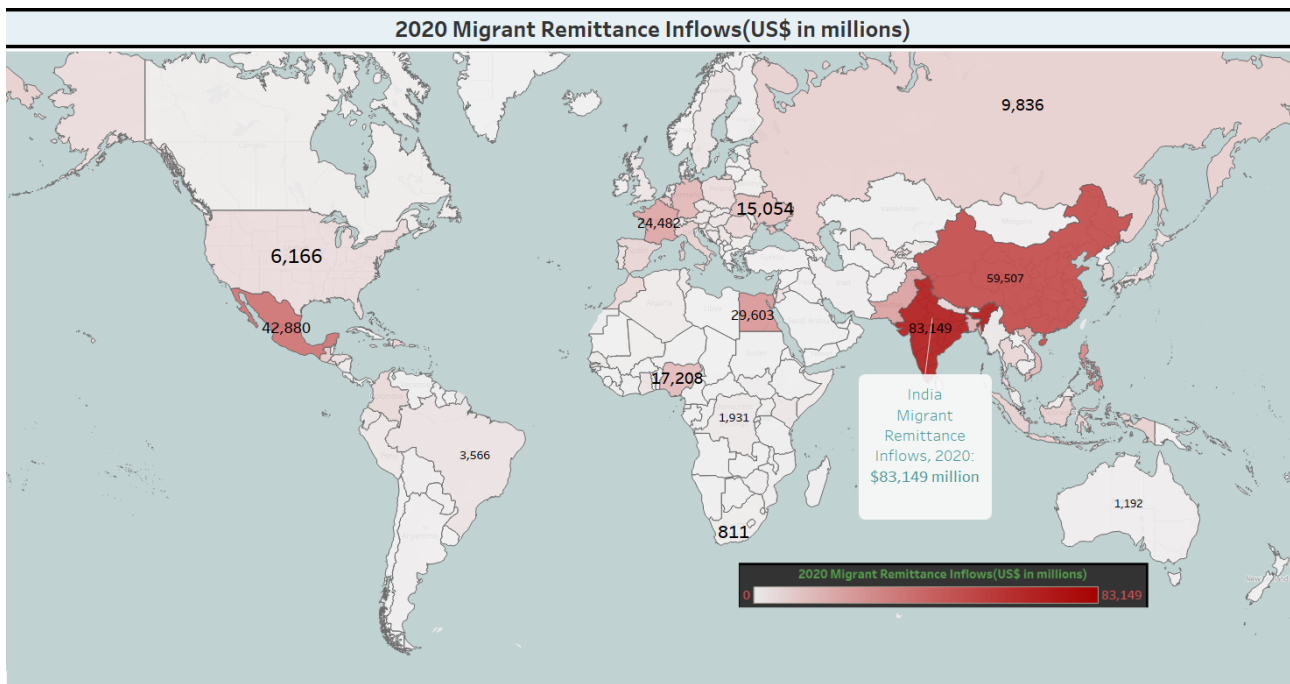
Remittances sent back to each country in millions

(Graphic 2, Data from the World Bank)

Remittances are often the lifeblood of a developing economy. However, according to the UN, the average total fees, including currency conversion, is 7% of amounts sent. The UN also says, "Technical innovations, in particular and blockchain can fundamentally transform the markets, coupled with a more conducive regulatory environment.

Cryptocurrencies can be used to send remittances at lower fees (Financial Times, 2021a). For El Salvador, remittances are 20% of their GDP. They launched a government-run Bitcoin wallet, Chivo, to facilitate remittances and to help strengthen the economy (although that has not turned out well, as discussed below).

However, cryptocurrencies must face certain obstacles before they bring about any change. These issues are similar for financial exclusion and remittances.

These are grassroots issues.

Many developing economies might not have consistent network coverage for cryptocurrency platforms. Therefore, there will be a need for currency exchange. To exchange currencies to fiat, one often needs

Many dependent on remittances might not have access to banking and financial institutions or even the internet.

KYC of some sort. Many needing remittances or struggling with financial exclusion often do not have those documents. This then subjects them to exchange rates just as in traditional remittance. People without identity papers are therefore excluded (Sandner, 2020). Consequently, cryptocurrencies face the same problems which traditional banks are facing. Many dependent on remittances might not have access to banking and financial institutions or even the internet.

Africa in 2019 had a 28.2% population online, compared to Europe at 82.5%. How is a digital currency meant to reach these people? Even if they are reached, where is the grassroots infrastructure so they may pay in cryptocurrencies? The Central African Republic (BBC, 2022c) made Bitcoin legal tender, and less than 10% of the population (data from World Bank) have internet access!

> **Where is the grassroots infrastructure so they may pay in cryptocurrencies?**

Those said to need cryptocurrency banking the most might be the furthest from being able to access it. Additionally, those dependent on remittances need them for food, healthcare, and housing. They are in very insecure positions. Many cryptocurrencies (such as Bitcoin) are far too volatile for this use case, and the others are too small to be liquidable. Price stability is paramount. Tech literacy is another issue as well. Any solutions must prioritise ease of access.

El Salvador made Bitcoin legal tender largely for remittances and even launched a government-issued digital wallet (Chivo) to promote its use. According to Salvadors own Chamber Of Commerces study (NBER, 2022), most of the adult population left the platform after spending their joining reward of 30 USD.

If there is government-based discrimination, cryptocurrency can provide a more legitimate path towards financial freedom than government-backed finance spaces due to their lack of jurisdiction and difficulty to pin down.

In the end, although cryptocurrencies can uplift people from their local surroundings to an international market, those people are still very much living in the same place. A business finding a channel for funds and investment through Bitcoin will not fix the systemic issues of a struggling national economy. In El Salvador, the plan of legalising Bitcoin as legal tender and further moves in that direction met serious failure and wide-scale criticism from the people (CNBC, 2022b).

The government-launched Bitcoin-centric payment app Chivo had issues from the start. 20% of users didnt even know (NBER, 2022b) how to redeem their sign-up bonus on launch, and 61% of adults stopped using (NBER, 2022b) the Chivo service after using their $30 sign-up bonus. Six months after making Bitcoin legal tender in September 2021, the Salvadoran Chamber of Commerce (The New York Times, 2022a) found in March 2022 that only 14% of businesses in El Salvador had conducted Bitcoin transactions since September 2021, and only 3% felt being able to use Bitcoin was valuable. This is all in addition to the 2022 cryptocurrency crash causing the small nation a huge loss on their investment of 2300 Bitcoins worth 106 million USD (Bloomberg, 2022c).

Even if cryptocurrencies do manage to solve the problem of access to financial services, if peoples incomes are too low or irregular, financial services might not be able to help as much. In this case, the general economic situation of the citizens must be addressed by mitigating poverty, raising minimum wages, reducing the prices of necessities and foods, etc. People can be connected to the rest of the world through the internet and cryptocurrencies, but they still live in the same place with the same woes. One may have good revenue from international patrons of their business, but they might still live in a region with horrible housing markets.

> **People can be connected to the rest of the world through the internet and cryptocurrencies, but they still live in the same place with the same woes.**

A cryptocurrency-based solution is restricted in its effect in solving these fundamental issues. With finite government resources, investing purely in decentralised cryptocurrencies takes funds away from strengthening the national economy through traditional financial institutions.

Cryptocurrencies Give A Trustless Solution

Developing countries also often struggle with lower social and institutional trust, which is people's trust in institutions. Financially insecure people report lower institutional trust (UN, 2021). If people in need are sceptical about welfare or social schemes, those schemes will not be as effective due to lower participation (OECD, 2023). This furthers low social trust as the scheme did not turn out as envisioned,

leaving more people in poverty and creating a sort of perpetuating cycle. Additionally, low institutional trust will even mar perceptions (UN, 2021) of well-functioning schemes.
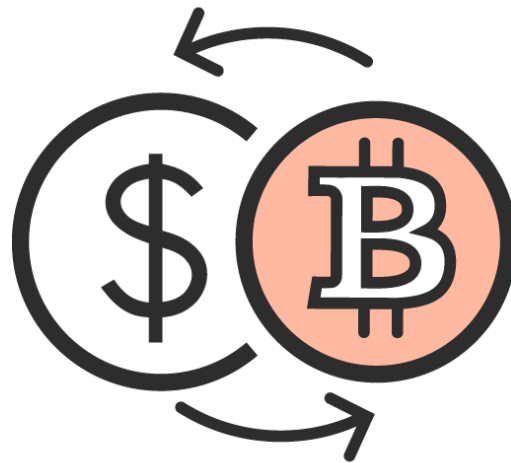
Cryptocurrencies can be a trustworthy alternative to fiat currency and, by extension, the institutions that maintain it in a given country. For many Venezuelan people, cryptocurrency could potentially be a relatively stable alternative compared to their hyperinflated currency, although it would face severe competition against the USD. However, so far, things have been bleak with the controversial launch of Petro (Reuters, 2018b) in the nation.

Developing nations often struggle with corruption. There is usually a greater incidence of corruption in government in developing countries. This extends to social security and welfare systems as well. Money laundering and black money can run rife in these institutions and schemes. As noted by Phillip Sandner (2020), in some cases, corruption can even outweigh the benefits of redistribution programs, such as in Indonesia (Olken, 2006).

Digital coin trades are an ideal way to stash away ill-gotten money secretly.

As noted here, cryptocurrencies can be of great help by providing transparency. Blockchains would allow governments to track their spending better, allowing for better budgeting. Citizens could use a publicly available blockchain of funding to monitor state funds. Smart contracts could also reduce bureaucracy for social welfare schemes and be used in government loans and projects. The relatively transparent record qualities of a blockchain can create opportunities for a new tool to fight corruption (for other use cases where a blockchain could be an ideal tool, refer Appendix 3 for a visual guide).

Governments could devise their own blockchain-based platforms, where cryptocurrencies and transaction use cases are only one facet of a powerful, easily accessible ledger. This would be similar to Ethereum, which is, in fact, an entire platform on which diverse future functionality can be developed rather than just a transaction ledger system.

There are, however, also reports that state officials are increasingly using cryptocurrencies to transfer their riches abroad because, similarly to Bitcoin, digital coin trades are an ideal way to stash away ill-gotten money secretly. This is also not to mention the criminal factor.

Efforts by a government to substitute national institutions with cryptocurrencies would actually draw resources from strengthening those institutions.

Developing countries are often less effective at preventing crimes, black markets, terrorists, etc. The potential for anonymity offered by cryptocurrencies is in high demand by criminal classes. KYCs are present for a reason in traditional banking systems. A developing nation would feel these unlawful consequences even more. In El Salvadors case, there is serious concern that decentralised Bitcoin will make it easier for the powerful gangs in the country to move funds around.

How Cryptocurrencies Challenge National Sovereignty

Just as there is a view that cryptocurrencies can act as financial systems for developing nations worldwide, there is also a counterargument. A worldwide cryptocurrency being the foundation of an economy in a country severely weakens that government's economic control, which is one of its most foundational spheres of influence.

Nations are a relatively new concept, but they have come to be the dominant political form on Earth. They are the de facto structure for maintaining and growing human life and civilisation on the planet. If a government were to lose the substantial economic influence over its economy to a decentralised financial system spread across the rest of the world, it would not do so in a vacuum. Other nations would have an advantage of

A cryptocurrency system in place would have to first solve the pre-existing institutional corruption to be effective, which is the source of most of these issues.

a more significant degree of control and influence over their own jurisdictions that the country in question couldnt match. External nations could even exercise power over a country using decentralised, worldwide currencies by influencing the currency directly, as it is decentralised.

This is not to say that cryptocurrencies herald the end of the nations era in the history of civilisation. But it seems that the extent to which they influence a national economy is strongly linked to this discussion.

There is also criticism that efforts by a government to substitute national institutions with cryptocurrencies would actually draw resources from strengthening those institutions El Salvador is a nation that has attempted this approach. Nations in similar situations should at least look to it to learn from the results. Governments dont exist in a vacuum.

Governments alternatively might strengthen their economies, social welfare schemes, etc., instead of relying on decentralised cryptocurrency systems they have no direct control over. El Salvadors treasury has seriously suffered after it invested in Bitcoin and it crashed. Additionally, a cryptocurrency system in place would have to first solve the pre-existing institutional corruption to be effective, which is the source of most of these issues.

Conclusion:

Cryptocurrencies are not miracle workers. They are limited in many ways but can be very useful if considered carefully. Simply throwing blockchains at a problem will not solve it. Alternate digital currency solutions such as CBDCs might be helpful. Although private-based solutions or even decentralised currency-based solutions with no connection to a specific organisation can be compelling, countries must consider if these solutions can stand in for a national framework and to what level they must integrate into their economies.

Chapter 4

Environment

Cryptocurrencies' Balancing Act with the Environment

Today, scientists are blaring climate change alarms and repeatedly arriving at apocalyptic climate predictions through their research. In the midst of this, the environmental impacts of cryptocurrencies are very controversial. Many wonder if cryptocurrency is really worth the cost to the environment. This is highly contentious. Suppose you see cryptocurrencies as the future of economics, a democratising force that brings in those left on the outside of financial institutions. In that case, any environmental concerns might be accepted as short-term growing pains for a new industry with incredible potential. If you see it as a wasteful economic experiment that cant integrate into global economies and is highly limited in its potential growth, then the environmental concerns seem much larger.

Its also hard to be conclusive on Bitcoin as we dont even have accurate numbers on the types of energy it consumes, although total electricity consumption is more easily measured. Regardless, we shouldnt cast blanket statements on cryptocurrencies environmental impacts based on just one coin or trend. Its true that cryptocurrencies are digital currencies and, therefore, use electricity to function and exist, but they are NOT all the same.

Consensus Mechanisms and Energy Per Transaction

As cryptocurrencies are decentralised, transactions are verified by a majority through a consensus mechanism. This is in contrast to the traditional financial systems in place, which are centralised and have one organisation, such as a bank, verify a transaction. Because of this, cryptocurrencies can be prone to being more energy-intensive compared to traditional systems.

For cryptocurrencies, the energy consumed per transaction is complicated. It is heavily tied to their consensus mechanism, which is what allows different miners to validate a transaction by literally agreeing (a consensus) on it. The consensus mechanism differs among cryptocurrencies. They can be Proof Of Work (Bitcoin), Proof Of Stake (Ethereum), Proof of Burn, Proof of Capacity, and so on.

Proof of Work (PoW): The Major Driver of Energy Consumption

Proof of Work means multiple miners are working to win the blockchain lottery by computing the answer to the cryptographic hash function first and earning a Bitcoin reward. This is done by tossing random numbers at the hash function until you get the right one. Its literally guessing the right answer. But only one computer actually gets the correct answer, adds the new block to the chain, and receives the reward: the one who got the answer first.

This is a point of contention, as many argue that this essentially means all the other computers are being unproductive. But Bitcoin has safety in numbers. In POW, the work required to verify transactions is purposely incredibly high so corruption is harder. The more people work separately, the less the chance of a 51% attack, which is where a coordinated group takes control of more than half of the computing power on a blockchain network, allowing them validation authority so they can manipulate

In POW, the work required to verify transactions is purposely incredibly high so corruption is harder.

transactions. This means instead of multiple people holding the pen, all of a sudden, only one person is, with no restrictions on what they can change in the records. This massive energy loss is inbuilt into Bitcoin.

This doesn't mean the detractors point is entirely without merit. The collection of computers does contribute to Bitcoin's safety, but many consensus mechanisms validate transactions without the massive energy loss. Some of these new mechanisms were responses to this exact issue. Of course, these mechanisms have their own issues.

As a side note, Bitcoins safety in numbers is a double-edged sword. The total number of bitcoins is capped at 21 million, and the last is estimated to be mined in 2140. When there is no miner reward, there is a high chance that there will be fewer miners. This will make the system more vulnerable to 51% attacks.

Electrical and CO2 Comparison
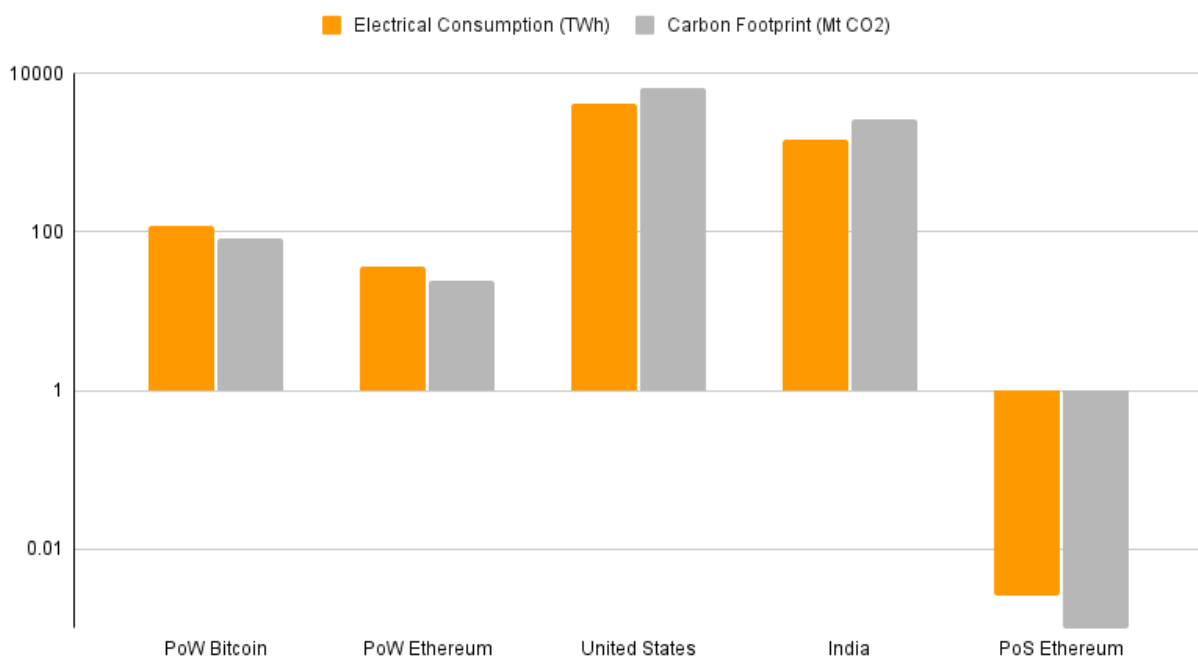
How much energy Bitcoin consumes, and its CO2 footprint

Note: Scale above is logarithmic, NOT linear.

Source: Digiconimist (https://digiconomist.net/), World Bank

When compared with the US and India, the 2nd and 3rd highest energy consumers on the planet, Bitcoin looks negligible in comparison. Even smaller is PoS Ethereum. Let's visualise it in a different way to get a better idea:

Bitcoin currently ranks 23rd by energy consumption compared to nations worldwide, behind Vietnam, South Africa, and Australia, and ahead of Poland. However, keep in mind that compared to countries like the US and China, even 23rd is a fraction.

Country ranking, annual electricity consumption
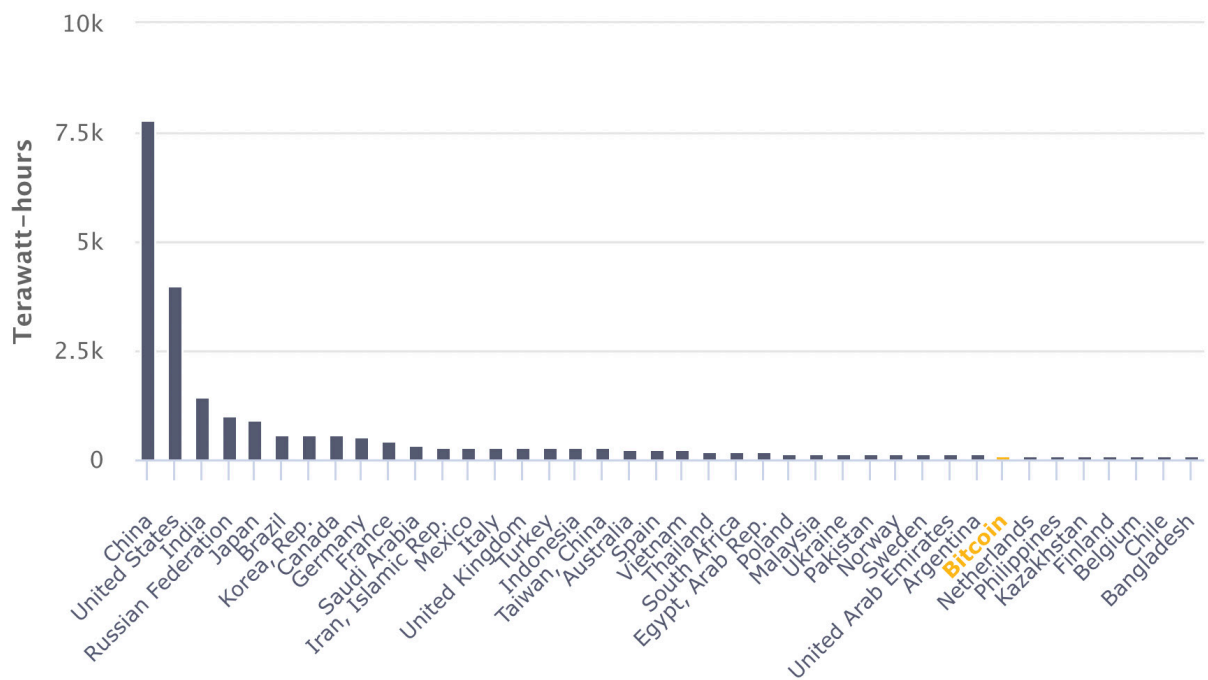
Ranking of countries by annual electricity consumptions

Source: CBECI, 2023

Proof of Stake (PoS)

In proof of stake, all the miners who want to validate a block containing certain transactions put some of their own coins up as stake. The more you stake, the more your chance of being chosen to validate that block. On being chosen, if you fail to validate the block, even if your network just dies abruptly, the coins you staked are burned. This system is far more low energy than proof of work, as only one miner has to work to find the solution to the hash, and the other miners only have to validate the solution, which requires relatively negligible amounts of energy.

Proof of stake systems are criticised for encouraging coin hoarding. Wealth plays a huge role in this system. They are argued to not be as democratic as proof of work, where one requires more physical computers to just increase the chance of getting the solution, which is harder to pull off than hoarding digital coins.

You might say this means its easier to 51% attack Ethereum because its easier to generate a majority compared to Bitcoin. However, a miner can only pull off 51% attacks on proof of stake if they have a 51% stake in a cryptocurrency. However, it is not in a miner's interest to attack a network where they hold a majority share. This would drop the networks value and cause them loss. They would actually be motivated to work to make the network more secure to ensure their holdings value grows and doesnt fall.

Ethereum has finally shifted to POS (The New York Times, 2022c) after having delayed the change for years. It uses up less than 0.1% of the energy it did on the old POW platform. Looking at the above graphs, Ethereum went from estimates 70-80 TwH per year of electricity in all of 2022 to just 0.001 TwH per year. Cardano runs on a proof of stake and is therefore very power efficient and scalable and can manage around 1000 average transactions per second compared to Bitcoins 7. Solana can do 65,000 transactions a second, has scalability, and also uses proof of stake.

Other Consensus Mechanisms

Proof of burn has miners burning coins (sending them to an inaccessible location), and granting them rights to write blocks proportional to their burnt coins. To prevent early adopters from having an advantage with more burnt coins, the coins are programmed to lose value as new blocks are released. This ensures the network is agile and active, countering POSs hoarding issue. Slimcoin is a cryptocurrency that employs the Proof of Burn consensus mechanism.

Proof of capacity pivots on available hard drive capacity by storing potential solutions to cryptographic problems. More storage space means more solutions to a cryptographic problem you can store. Whoever gets the solution in the smallest amount of time (not whoever gets it first) gets to mine the new block. Examples of cryptocurrencies using this consensus mechanism are Chia and Storj.

Block lattice systems give each wallet owner their own personal blockchain with only their wallets transactions recorded. Nano has pre-mined coins and uses such a blocklattice system, and it only involves a small POW calculation for dissuading malicious spammers.

This is to show that the digital quality of a cryptocurrency doesn't have to restrict it to being a guzzler of dirty-energy. Proof of Work cryptocurrencies specifically are the reason behind the high-energy use of some cryptocurrencies. Proof of Stake, as discussed above, does not require a massive race for mining. Some cryptocurrencies even incentivise environmental energy use or energy generation, while others, such as SolarCoin, are based around it and issue coins only through solar energy generation (One SolarCoin for every Megawatt hour).

To conclude, not all cryptocurrencies have significant environmental impacts. Many of them do not use Bitcoin-esque mining at all, such as proof of stake mechanism coins, and some are even eco-focused.

Energy Sources

The other thing to consider, apart from how much energy cryptocurrencies eat, is what kind of energy they consume.

A Cambridge study (CCAF, 2020) is discussed frequently. According to the study, 62% of global Bitcoin miners relied on hydropower for at least some of their electricity; 38% used some coal, and about 39% used at least some combination of solar, wind, or geothermal. In fact, 39% of total energy came from renewables. This is a very high use of green energy in comparison to other much older and matured industries such as manufacturing.

According to an article in the journal Joule, annual global emissions from the Bitcoin network at the time were about equal to the London metro area (Quart Zone, 2021). However, it's crucial to bear in mind that these figures are estimates based on various assumptions and are subject to seasonal fluctuations.

The Sichuan region in China was (China has now banned all cryptocurrency mining) an example of seasonal fluctuation. During the wet season, when the region's hydroelectric dams produced significant surplus energy, there was a notable uptick in local mining activity.

It is argued that Bitcoin miners through their mobile nature, can shift to areas where excess energy is going to waste, thereby saving energy. This ebb and flow happened with Sichuans wet season. However, Bitcoin-like currencies run nonstop 24/7 to remain profitable. Mining is a cutthroat, razor-thin margins field. The blockchain goes on nonstop. Owners cant afford to only turn their miners on during peak green energy hours. This can clash with green energy's infamous unpredictability (hydropower dams are predictable, however.)

That means miners might become a non-stop black hole on the energy grid, both in excess and in low output hours, which only exaggerates the potential issues with the inconsistent nature of many green energies. Wind turbines cant turn nonstop, after all. Mining could become a for-profit leech of sorts on local energy grids, leaving families who need electricity for necessary day-to-day purposes under increased strain. In that case, a local government would have to heed its citizens concerns.

It is clear that power-hungry cryptocurrencies can be powered anywhere due to their mobile nature, freeing them up to green energies, which are often locationrestricted. That does not mean that all is well and good. Although there are no exact measurements of energy usage, it should also be kept in mind that on April 17-18th, 2021, a local Chinese coal mine in Xinjiang faced some issues and stopped producing energy.

One-third of the global Bitcoin computing power shut down due to a single coal mine going down.

Over the weekend, from Friday to Sunday (16th-18th April, 2021), the cost of making a payment with the cryptocurrency or receiving a transfer of Bitcoin jumped from around $16 to $52, according to de Vries. By de Vries's estimates, the "hash rate," the pace at which miners run algorithms to compete for fresh releases of Bitcoin, plummeted by around 35%. Some in the Bitcoin community blamed the upheaval (Fortune, 2021) for the drop in the cryptocurrency price by 14%, from a record $64,000 on Friday, April 16, to $55,000 on Sunday, the 18th.

One-third of the global Bitcoin computing power shut down due to a single coal mine going down.

This incident gives us an excellent insight into what kind of energy is being used by what percentage of Bitcoin miners. The argument that location-flexible cryptocurrency miners are prime candidates for renewable resources is weakened by the argument that in the cryptocurrency mining business, many miner owners will only look at their bottom line.

Cheap power, not green power, is king.

There is a difference in energy and electricity. They are not the same, but the type of electricity Bitcoin buys influences what kind of energy generation method it supports. Bringing it back to cryptocurrencies in general, they run on electricity, and how that electricity is generated is something to keep in mind. Many large bodies in the cryptocurrency space, such as exchanges, recently came together to form the Crypto Climate Accord and vowed to achieve net-zero emissions for all signatories by 2030 and work towards a 100% renewable power blockchain by 2025. It remains to be seen whether this is greenwashing, as environmental effects are a major talking point in critical discussions.

Cheap power, not green power, is king.

The CCAs websites news section has had no new updates since January 2022. For a great visualisation of Bitcoins energy consumption and other details, see the CBECI website (see references).

E-Waste

Although cryptocurrencies are digital and therefore will likely generate some amount of e-waste, the largest producers of e-waste are proof of work cryptocurrencies. They are prone to encouraging a tech arms race, where older hardware is easily dumped in favour of new, improved hardware on a 1.5-year cycle, according to findings from Alex De Vries (2021).

Since transactions in these proof-of-work currencies are validated by solving complex cryptographic problems with random guessing to find the solution (the nonce), the more powerful your miner computers are, the more guesses they can make in a given

period of time. This increases your chances of solving the problem and adding the new block of transactions to the blockchain ledger, which rewards you with coins Mining is a business with razor-thin margins and can be cutthroat. Your miner computers need all the advantages they can get.

Due to this, POW drives miner computer owners to purchase newer, more powerful, and more energy-efficient mining computers and discard older ones. This piling up of discarded components such as CPUs and GPUs was more acceptable when there was a thriving second-hand market for these mining-used parts.
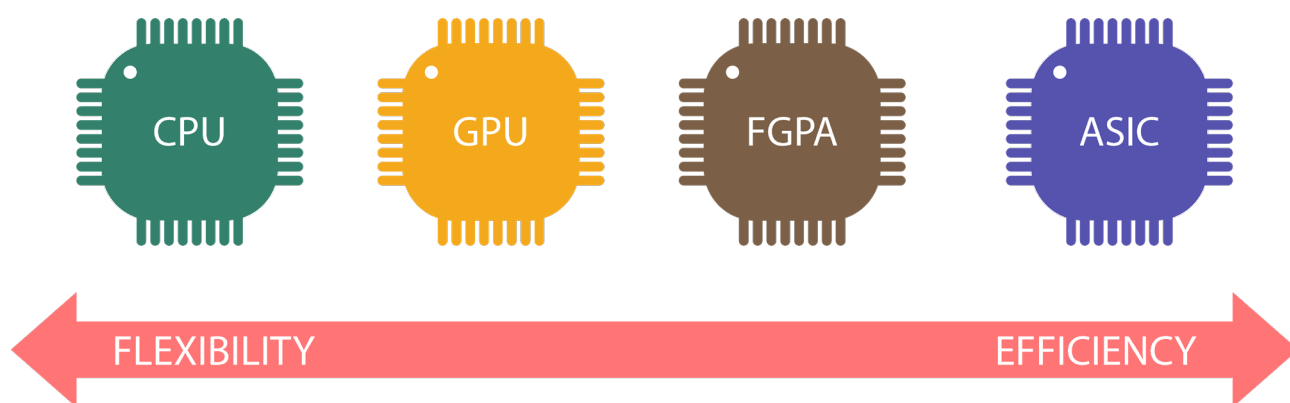
A spectrum of mining hardware sorted from flexibility to efficiency

However, the introduction and subsequent widespread adoption of ASICs (Application Specific Integrated Circuits), which are devices specifically geared to a certain application has changed that. ASIC miners are purpose-built only for mining and have no other use except perhaps for heating your house while mining (some college students in the US (Quartz, 2018) used dorm electricity to mine cryptocurrencies and heated up their dorms at the same time). Some ASIC miners are built only to mine a specific coin, such as Bitcoin, and cannot mine other currencies. This means that older ASIC devices cannot be reused elsewhere, and it is already incredibly difficult to recycle electronic components in general.

As compared before, proof of stake can be a viable alternative for some currencies, as it only requires one miner, the staker, to mine the initial block. Subsequent verification by other miners is negligible in energy consumption. Proof of work incentivises using ASIC miners, which are devices that are geared entirely for mining. They have no other purpose and cannot be reused in another field under recycling. According to recent

studies (Alex De Vries, 2019), an average Bitcoin miner causes a total e-waste amount of 30.7 metric kilotons to be cycled out annually by the Bitcoin network and lasts for 1.5 years.

Semiconductor Industry Impact

As cryptocurrencies are digital currencies largely mined and/or maintained as a blockchain through specialised computer hardware, they are inherently linked to the semiconductor industry. Semiconductor chips are found everywhere: in computers, phones, planes, radios, satellites, almost every appliance, every modern automobile, and even smart homes. They elevated us from slow calculators the size of buildings to superfast supercomputers that fit in our pockets. They are the foundation of modern society.

POW cryptocurrencies, which solve difficult calculations using powerful compute parts like GPUs, CPUs and ASIC cards to prove transactions are legitimate, should be huge markets for semiconductor manufacturers. There is even a nonstop drive to purchase newer, more powerful and efficient miner cards in increasing quantities to maintain that competitive edge in POW mining. Because of this intense demand, there has even been upheaval and controversy in the GPU space.

Cryptocurrency mining had been surging for the past few years, and it rose to new heights in 2020-2021. Graphic cards (GPUs) for gaming, content creation and scientific research had all been bought up by miners looking for more hashing power. A once thriving second-hand market was now flooded with generations-old, heavily used GPUs being sold far above original retail prices (The Verge, 2021). Demand was skyhigh, and supply was not, leaving many with no choice but to buy at 2-3x retail price. Due to the cryptocurrency crash in mid-2022, after many years, the GPU market has stabilised and come back to normal.

On the other hand, the manufacturing side of things has, according to industry higherups, faced fewer issues due to cryptocurrency growth than the retail side. Due to COVID-19, supply lines and factories shut down, and the worlds semiconductor industry struggled. Manufacturing could not keep up a decent pace, solely due to the pandemic.

According to a study (Alex De Vries, 2021), to manufacture one million Antminer S19 pro miner cards (used for mining a POW cryptocurrency), one month of 7nm node (the smaller the space between transistors on a semiconductor, the better; 7nm node process was a recent breakthrough at the time) would have to have been booked with TSMC (3rd in sales behind Intel and Samsung in silicon semiconductor chip manufacturing). There was real potential for cryptocurrency to be a massive customer for manufacturers, but it is much more difficult now due to the rocky past semiconductor manufacturers have with POW cryptocurrencies.

For example, cryptocurrency, at one point, represented 10% of TSMCs sales (Fool, 2021). In 2021, at the peak of the pandemic, it only accounted for 1% of sales. The semiconductor industry went from pushing hard for cryptocurrency to all but shutting it out. This comes back to the volatility issues with many cryptocurrencies.

The semiconductor industry went from pushing hard for cryptocurrency to all but shutting it out.

At one point, TSMC even noted the support of rising demand in cryptocurrency as a key factor in their growth as they closed out the 2017 financial year (TSMC, 2018a), and expected more of the same in 2018. In 2018, however, cryptocurrency had a bust period, and TSMC clearly stated cryptocurrency to be the reason for weaker growth (TSMC, 2018b), despite ramp-ups in the mobile industry, a harsh change of tone. When cryptocurrency is up, miners buy new cards at a high rate, but when its down, the miner demands for more hardware flatlines. Other semiconductor companies, such as NVidia, have also reported huge losses from investments (Venture Beat, 2018) into cryptocurrency. Intel shut down its Bitcoin mining chip series (Reuters, 2023), just a year after its introduction.

POW cryptocurrencies are the users of compute units such as GPUs, CPUs and ASIC cards. Ethereum has recently made the major shift from POW to POS, a monumental change in the crypto landscape that has been built up for years. POS networks need

fractions of the computing power needed for POW networks and dont feature GPU and ASIC card-heavy mining like in POW. A shift in consensus mechanisms might mean cryptocurrencies will not need hardware at the level they needed and became famous for so far. But although they might need less hardware to run, their volatility is still a major issue. Semiconductor giants bet big on cryptocurrency and faced heavy losses due to this volatility.

VISA Comparison

There is a common comparison between VISA and Bitcoin used to illustrate Bitcoins scaling flaws, i.e. its low rate of transactions, high energy per transaction rate, and need for a large network of independent and distinct miners all running on expensive components.

The argument usually centres around the transaction per second (Tps) rate. VISA's rate? 24,000 tps. Bitcoin? 7. Ethereum? 15. (data by VISA; Kyle et al, 2016; Ray Neiheiser et al, 2021)

VISA's rate? 24k tps
Bitcoin? 7 tps
Ethereum? 15 tps

Some Bitcoin advocates rue this argument, as they reason that VISA is part of a dollar economy, whereas Bitcoin is a fully formed financial system relatively free (but do note that one mine supplying energy to Bitcoin miners in China shut down and Bitcoins value tanked, so this view of a fully formed independent system is not entirely correct) of external influence. One argument even called on US military imperialism and interventionism as a factor in considering VISAs energy usage, citing the effect of the US military on the economic presence of the dollar worldwide.

This sort of comparison is very tricky to make and almost impossible to make objective. The challenge in this comparison lies in defining the boundaries for energy usage and operational scope for both systems. For example, lets say all of VISAs computers eat energy. Which computers are VISAs, though? Where does this system start and end? How much energy do VISAs office workers use, as they are part of the payment providers system? What about the office buildings, which make up the physical side of VISAs infrastructure? Or do the physical buildings not count, as we are talking about ideal situations and only looking at the digital systems working? Where do you lay down the boundaries on VISA and Bitcoin? It varies from person to person.

This is clearly not an apples-to-apples comparison. Both these financial systems move to solve different problems in different ways. But one thing we should remember is that in the end, to the common person, Bitcoin and VISA are both just ways to buy things. In that light, Bitcoin falls flat due to its difficulty scaling and energy efficiency problems. Other cryptocurrencies are huge generational improvements, yet none are currently near the level of VISA, though they are getting there. This industry has only been around for a decade or so and is already making massive bounds.

Environmental Policy

Its tricky for a government to push cryptocurrency towards being greener. Regulating a particular organisation or field is relatively more straightforward when an oil company has an oil spill disaster. There are also rather set conventions, methods and practices in oil fracking. Cryptocurrency is decentralised, almost entirely digital, and has infinite variations; each cryptocurrency is different from other currencies. That makes it hard to regulate and penalise/incentivise environmentally compared to traditional industries with centralised companies. Those companies often follow similar conventional methods found throughout the industry.

The developers creating currencies must be incentivised to develop or update preexisting coins to be more energy-efficient and more environmentally friendly in the first place for a widespread effect. Can you realistically ban the infinite number of variations of polluting cryptocurrencies? You could try blanket bans, but you might cut off innovations in the field. It is also hard to enforce blanket bans, as even after the mining ban, China has bounced back up to tenth on Chainalysis Global Crypto Adoption Index (Chainalysis, 2022d).

Too much pressure from carbon taxes and miners (the main sources of pollution) will leave for other jurisdictions, similar to China, where miners then shifted to the USA (NPR, 2022).

Cryptocurrency is almost entirely digital, so an unwelcome environment is relatively easy to fix. While miners are the primary source of pollution and high energy use by cryptocurrency in a single country, developers and investors of the currency are worldwide. How to regulate their activities, which might affect local regions?

Even if you impose higher taxes, many countries wont have a significant percentage of a specific currencys miners. This means local governments with hot pockets of mining activity will face the brunt of any changes or consequences of mining presence. Local governments might place carbon taxes on cryptocurrencies using dirty energy mixes or call for higher electricity prices for mining operations that run constantly, creating a constant load on local power grids. Local grids dependent on renewables such as solar or wind might struggle with balancing the unreliability of some renewables with the constant heavy demand of mining operations.

Cryptocurrencies might also create new business for cheap but dirty energy manufacturers, such as in the ancestral homeland of the Onondaga Nation (White House, 2022) in upstate New York, where a Bitcoin mining operation re-started the previously closed Greenidge coal-fired power plant.

There have also been cases of mining operations using gas flares (CNBC, 2022c), a byproduct from oil wells to power their rigs. Gas flares are composed of high amounts of methane, which is a very potent greenhouse gas. It traps 80x as much heat as CO2. To reduce its contribution to global warming, the gas is normally burnt to carbon dioxide, a much milder GFG. But these gas flares can be converted to electricity by cryptocurrency miners to power their rigs that are kept on-site, negating the need for gas pipelines and infrastructure. However, there is criticism that this would further incentivise energy companies to invest more (The Verge, 2022) in oil, as they can now sell their waste flares to miners.

Cryptocurrencies might also create new business for cheap but dirty energy manufacturers.

Countries can set environment and local community-friendly standards and regulations for mining operations, such as low water use, low energy use, and prioritisation of lower intensity consensus mechanisms. Governments could subsidise miners who submit transparent reports of their energy mix and heavily use clean renewables powering their machines. Miners will likely periodically upgrade their machinery themselves to more efficient models, as they depend on speed and efficiency to increase profit and lower electricity costs in their business models. Countries can also encourage further transparency in mining operations, as clearer data will only help optimise and lower costs, electricity use and pollution.

If regulations are too intense, miners costs will rise in that region, and they will shift elsewhere. In any case, developers will be the ones making new projects. If a government is welcoming and encourages more eco-friendly projects, they can attract developers and, therefore foster innovation while also ensuring environmental concerns are considered. Countries must also consider the value of investing in cryptocurrency innovation by supporting ventures and start-ups. Governments can even support start-ups that are environmentally friendly. Striking a balance between innovation and sustainability will be key as the cryptocurrency sector continues to evolve.

Chapter 5

Governments and Policy

The Intersection of Political Governance, Taxation and Cryptocurrencies

Cryptocurrency is a multifaceted field. Governments will write policies on miners, exchanges, investors, developers, security, privacy and criminal elements, all in political, financial, diplomatic, and environmental contexts. Most governments will, at the very least, implement some form of policy regarding cryptocurrencies, and some will be very welcoming towards crypto.

On September 7, 2021, El Salvador (Livemint, 2021) made Bitcoin legal tender and launched a Bitcoin wallet, Chivo. It even announced plans to build a Bitcoin city off of a 1 billion dollar Bitcoin bond (Business Standard, 2021). Not all governments will follow El Salvadors footsteps, but they will most likely not leave cryptocurrency to grow and evolve unchecked.

As discussed above in the Developing Countries section, even if a country is welcoming to crypto, that does not mean it will only reap pure benefits. El Salvadors Chivo wallet has been a massive failure. Identity theft (Yahoo, 2021) was present on launch, sign-up bonuses were stolen, and a majority of users (NBER, 2022b) stopped using the service after spending their sign-up bonus of 30 USD. The 2300 bitcoins the government purchased (106 million USD (Bloomberg, 2022c) have since lost major value (Bloomberg, 2022d).

So clearly, cryptocurrency regulation is just as tricky and high stakes as other areas under regulation. In fact, due to cryptocurrencies volatility issues, its even more so. And there are some regions of the cryptocurrency field that are in dire need of regulation.

Take Initial Coin Offerings (ICOs), for example. Initial Coin Offerings are the blockchainbased cryptocurrency version of IPOs. Investors in the venture generally receive tokens, a kind of share issued on a blockchain (remember, it's a record/ ledger). These tokens often allow the holder access to some future service provided by the company but can vary in purpose. However, ICOs are currently unregulated, which has given rise to numerous scams and corrupt practices. An investor has to essentially trust that whatever ICO he invests in is not fraudulent, as there is no framework in place.

The Bitconnect scam cost investors $3.45 Billion. The team behind the Vietnamese Pincoin disappeared with the $870 million of funding its ICO raised after giving its 32,000 investors a token named iFan. An ICO by the maker of Telegram (SEC, 2019) raised $1.7 billion, but US courts forced Telegram to return $1.2 billion to their investors and fined them $18.5 million after SEC intervention.

It's very easy for a company to launch an ICO and create tokens. There are online services that allow for the generation of cryptocurrency tokens in a matter of seconds. This is not the case with IPOs, which can take several months to navigate requirements, regulations and due diligence.

ICOs are like IPOs but unregulated and without oversight.

ICOs are like IPOs but unregulated and without oversight.

ICOs arent inherently corrupt. Some organisations are thriving today (NEO and Ethereum) because of their successful ICO funding. But their unregulated state would inevitably leave investors open to scams and create an unlawful culture. Many governments would want regulations in place to protect public investors from fraud and prevent corrupt and unlawfully sold coins from entering their economy. In the same way, countless other areas of cryptocurrency will face regulation. We will now outline some of the key topics linked to cryptocurrencies and the complexities of regulating them.

Taxation Policy

Taxation (and regulations in general) depend on how a government defines a cryptocurrency, which will depend on that nation. In the US, there is disagreement on whether crypto coins should be specifically defined as assets, commodities, securities or currencies. (Please note that different countries may have different legal definitions of these financial concepts.)

ASSETS (CFI, 2019) are any economic goods bought, traded, or owned by an individual/party with the intention of it providing a future profit.

COMMODITIES (Merriam-Webster, 2023) are a type of asset that is fungible, i.e. interchangeable with others of the same type. One kilogram of copper is interchangeable with another kilogram in the eyes of the market. They both have the same value, but a house, though valuable, is not interchangeable with another; therefore, it is not fungible.

SECURITIES (CFI, 2023) are a type of asset that is fungible (one stock in Apple Inc. is the same as another), a financial contract between two parties that holds some monetary value. Theyre usually in the form of a stock, bond or option.

In the US, different federal financial agencies disagree on how to regulate cryptocurrencies due to differences in their definition of cryptocurrencies, namely the CFTC and the SEC. Both agencies want to bring cryptocurrencies under their oversight. According to the CFTC (Commodity Futures Trading Commission), virtual currencies are a commodity and so are subject to oversight under its authority.

The SEC (Securities and Exchange Commission) regulates securities and has been pushing hard to take charge on cryptocurrencies. SEC Chairman Gary Gensler (Kennedy and Crypto, SEC Speaks, SEC, 2022) said that most cryptocurrencies are securities and that the SEC would be policing cryptocurrencies and tokens (Bloomberg Law, 2022). The SEC has even moved to assume jurisdiction over Ethereum.

(Previously, the SEC stated Bitcoin (Wired, 2018) and Ethereum (Reuters, 2018a) are not securities and instead declared ICOs under their jurisdiction.)

It should be noted that the District Court of Massachusetts in 2018 ruled that digital assets, including cryptocurrencies, were commodities and that the CFTC would have jurisdiction. There is currently a bill in the American Legislature (PYMNTS, 2022a) that would give jurisdiction to the CFTC, but it is not law yet (at the time of writing).

There is a real difference between a currency and a financial asset like a commodity or security, which is what Bitcoin is primarily treated as. A currency must ideally have a stable value; otherwise, it is not usable as a reliable store of value (Remarks Before the Aspen Security Forum, SEC Speaks, SEC, 2021). Simply take a look at the hyperinflated Venezuelan bolivar. Some cryptocurrencies are currently too volatile to pass as currency. Additionally, if a government makes a cryptocurrency legal tender, a currency they dont control is taking market share. This will be a deal breaker for central banks, which will have to lose their monetary sovereignty over the country's economy.

So, what is the current situation?

From a taxation standpoint, the IRS currently treats cryptocurrencies as assets and applies either short or long-term capital gains tax on profit made from selling coins. Any income from crypto coins through mining and staking is considered under income tax, not capital gains. You pay your regular income tax rate using the value of the coin at the time of mining. Being paid in cryptocurrency also applies as income under income tax. As for trading one cryptocurrency for another, that is, selling the first cryptocurrency and buying the second so that the selling transaction will be taxed under capital gains.

> **If a cryptocurrency coin is legally made an asset, there are certain consequences.**

If a cryptocurrency coin is legally made an asset, there are certain consequences. For example, if you buy coffee with Bitcoin valued at $1200, then if you initially purchased the bitcoin at $1000, youll be taxed on the amount of bitcoin you spent according to capital gains rules. That is to say, if you had a profit of $200 on that bitcoin at the moment of buying that coffee, you would be taxed on that $200 increase. This only applies to gains. Tax deductions on declared losses do not apply. If one buys

Bitcoin at a higher price and then purchases food with the Bitcoin at a lower price, they cant declare a loss on their tax forms.

Currently, in the US, one has to report all transactions with cryptocurrency, although a bipartisan bill (introduced in Jul 2022 in the Senate (US Congress, 2022)) changes the tax code to exclude a transaction in your tax report if the value of the exchange or gains on the bitcoin used in that exchange are less than $50 per transaction (US Congress, 2022). But this is still not ideal if one wants to use cryptocurrency to buy goods and services for everyday life.

Another issue is that if a cryptocurrency is ruled as property, as by English courts (Orrick, 2019) and several others, then even if someone unknowingly acquires stolen bitcoins that have been laundered through legal means (Chainalysis, 2022a), a court can seize those bitcoins (River) by civil forfeiture (Skadden, 2022) or forcibly return them to the rightful owner without financially compensating (Forbes, 2021) the person who innocently acquitted the bitcoins. To make it easy to understand, the same thing happens with cars. If you legally buy a stolen car, law enforcement can seize that car and return it to the rightful owner. If Bitcoin (or other cryptocurrencies) wish to be taken as currency, it is a serious drawback for any investor or banker who might find their cryptocurrency assets seized due to their illegal origin.

It should be noted that India has not even waited for laws to define what cryptocurrencies are to start taxing profits (Forbes, 2023) made on cryptocurrencies According to Indian Finance Minister Nirmala Sitharaman, "...I don't wait till regulation comes in for taxing people who are making profits." (NDTV, 2022)

In summary, these definition issues seriously hold back any cryptocurrency from being accepted as a legitimate currency. The lack of a clear definition for cryptocurrencies makes the regulatory landscape complex, and it has specific implications for how these digital assets are taxed. The situation is still in flux, with ongoing debates and pending legislation aiming to clarify these issues.

Security and Criminal Concerns

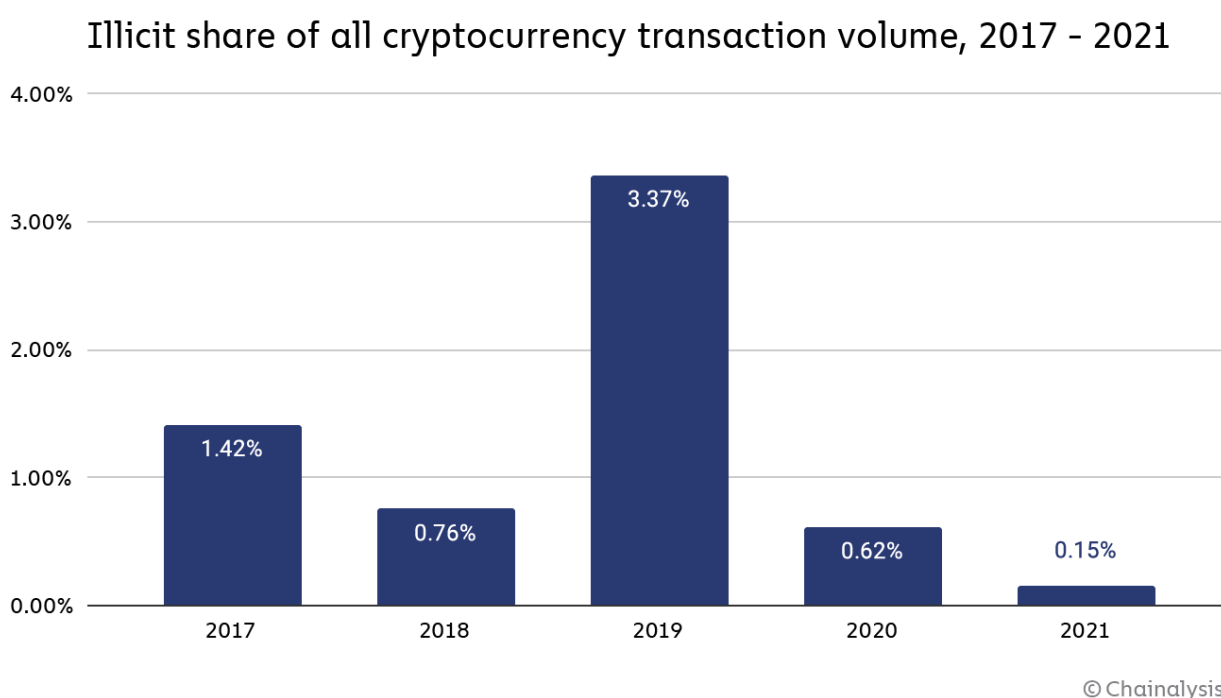## Accessing Security Risks in the Cryptocurrency Sector

There is a perception that only criminals use cryptocurrencies or that a majority of the

users are criminals. This is not true. According to industry crime forensics reports by Chainalysis, only a small percentage of transactions are illicit.

It is also true that fiat currency-based money laundering and illegal activity dwarfs cryptocurrency-based counterparts by orders of magnitude: According to the UN, it is estimated that between 2% and 5% of global GDP ($1.6 to $4 trillion) annually is connected with money laundering and illicit activity.

The number of funds received by illicit cryptocurrency addresses per year:

Illicit share of all cryptocurrency transaction volume, 2017 – 2021

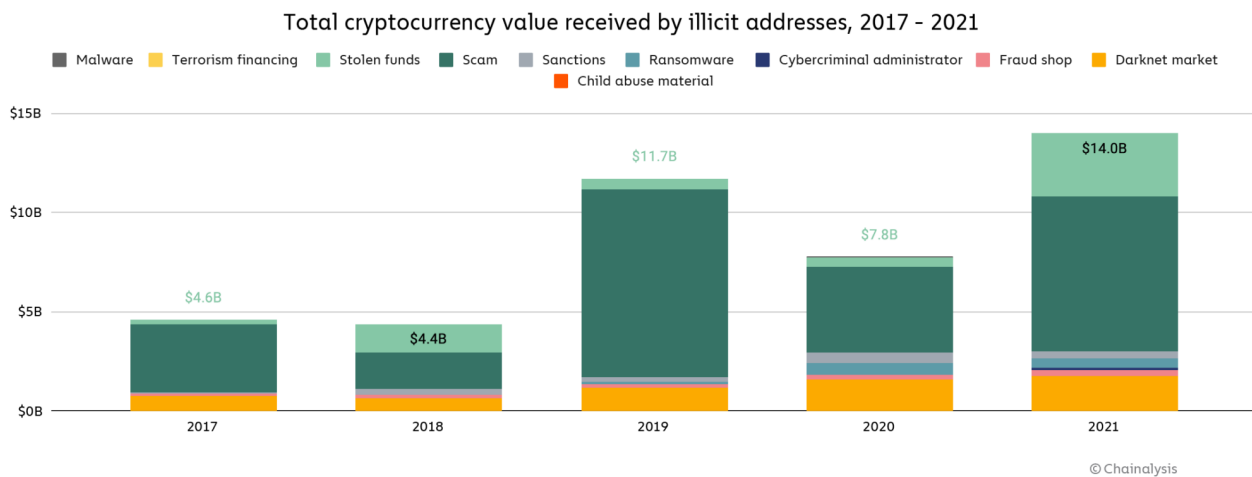|	2017	2018	2019	2020	2021
	1.42%	0.76%	3.37%	0.62%	0.15%

© Chainalysis

Illicit transactions as a percentage of total of volume of transactions.

Source: (Chainalysis, 2022b)

Although cryptocurrency crime hit an all-time high of $14 billion in 2021, there was an incredible 550% increase in total transaction volume to $15.5 trillion and only a 79% increase in funds received by illicit addresses. This meant an astounding low of 0.15% illicit transaction volume compared to 2-5% of global GDP for fiat.

2019s high (3.37%) can be traced to the $3 billion-plus token scam and the $4 billion One Coin scam (one of the largest scams in history, according to The Times).

Although there was a significant lowering in crimes from 2019 to 2020 due to a high number of scam addresses being identified, in 2021, the rug pull scam soared in popularity and accounted for 37% of scam revenue (Chainalysis, 2022) compared to 1% in 2020, at $2.8 billion. A rug pull is like an IPO scam for cryptocurrency.

Total cryptocurrency value received by illicit addresses, 2017 - 2021

Legend: ■ Malware ■ Terrorism financing ■ Stolen funds ■ Scam ■ Sanctions ■ Ransomware ■ Cybercriminal administrator ■ Fraud shop ■ Darknet market ■ Child abuse material

© Chainalysis

Total value received annually by illicit cryptocurrency addresses in USD

Source: (Chainalysis, 2022b)

A rug pull is when developers create the front of a legitimate cryptocurrency project (i.e., a new token or a coin) to stir up investor interest but then take the investors funds and disappear. Code audits of the project would prevent this, but they are not currently prevalent or enforced by regulations. It is currently very easy to create a new token and have it listed on a decentralised exchange without a code audit. This is why Decentralised Finance rug pulls became so prevalent in 2022.

Although criminal activity might be a very low portion of the cryptocurrency network currently, and though the fiat situation may be worse, cryptocurrency crime is poised to rise as time goes on. It is still a facet of crime worldwide worth billions of dollars, although most of those billions are usually attributed to a handful of major scams.

As researchers and law enforcement work to study and detect illicit transactions, criminals work to outpace and defeat their methods. A big feature in this back-and-forth fight is privacy coins.

This meant an astounding low of 0.15% illicit transaction volume compared to 2-5% of global GDP for fiat.

Privacy Coins

Cryptocurrencies can grant anonymity and be untraceable, but they dont always do that. They can be categorised (roughly) into privacy coins, non-privacy coins, and everything in between. Bitcoin is a pseudo-anonymous coin and is non-private, meaning there are no direct identifications on the blockchain, but the blockchain is public. This makes it possible to tie a real-world identity to the address by its transactions, something authorities are increasingly capable of doing.

A privacy coin is a cryptocurrency that provides private, anonymous and/or untraceable transactions. Anonymity hides the identity behind a transaction, while untraceability makes it virtually impossible for third parties to follow the trail of transactions using services such as blockchain analysis.

This is done through several strategies and technologies. For example, the origin and destination of the funds can be obscured. Transactions can be mixed to make analysis difficult (CoinJoin), new addresses can be generated for every transaction to impair recording the history of transactions (Stealth Addresses), and a type of digital signature with multiple different public signatures can be added to a transaction, meaning outside observers dont know who made the transaction originally from that ring of signatures (ring signatures) etc.

The three largest privacy coins are Monero, Dash, and Zcash.

A report (Rand Corporation, 2020, commissioned by Zcash developers) found that the Zcash coin was currently overlooked on darknet places (0.23% forum mentions of the coin) as compared to Bitcoin and Monero, but also admitted there was not enough research conducted into privacy coins in general, and that absence of evidence does not equal evidence of absence.

This also points to the difficulties with researching criminal use of privacy coins. It means we might not know how much we are missing due to the obscuring nature of the technology.Monero, on the other hand, was used in approximately 44% of ransomware attacks as of 2018. Bitcoin was at 10%, and Ethereum was at 11% in ransomware usage. Monero is now accepted on most dark marketplaces, and victims paying in Bitcoin now have to pay a 10 to 20% premium to ransomware groups because of the reduced security disadvantage the criminals suffer.

Monero   Dash   Zcash

Monero and other privacy coins can also be used as an intermediary (Fool, 2021a) for Bitcoin transactions. Users can buy Monero with Bitcoin and then use the privacy coin in transactions, ensuring anonymity and untraceability. The IRS (United States IRS) even established a bounty (Forbes, 2020) of up to $625,000 for cracking and tracing transactions for Monero or other anonymity-enhanced currencies (AEC). Additionally, atomic swaps between Bitcoin and Monero do away with the need for a third-party exchange to mediate the currency swap, which is an essential point of KYC and AML. With atomic swaps, one can simply directly swap currencies with another party without the need for exchanges or middlemen.

Bitcoin is The Default

Bitcoin is still the go-to by far for illegal activities. There are many reasons:

1. A critical mass effect, where the high volume of transactions on the Bitcoin blockchain have a lost in the noise effect. It is harder to find a specific transaction in the massive wave of constant transactions using Bitcoin.

2. As the most popular cryptocurrency, it is easily accessed through exchanges that do not comply with KYC. This can balance out the lack of privacy features relative to privacy coins.

3. Due to its popularity, a network effect occurs, where a service is more useful to all users if more people use it.

4. Additionally, a minor coin has far less liquidity than a behemoth like Bitcoin. Simply purchasing or selling a smaller coin in large quantities would have some impact on its price.

Bitcoin also has a mainstream reputation for anonymity, so less tech-savvy criminals would simply stop there and go no further for ways to hide their transactions. Criminals will usually stick to tried and tested methods, but as they become more familiar with cryptocurrency, an uptick in illicit activities involving cryptocurrencies is to be expected, along with an increase in the use of more advanced privacyensuring transaction options such as privacy coins. Europol, in a 2020 report (Internet Organised Crime Threat Assessment (IOCTA) 2020, Europol 2020), placed privacy coins among the factors that had rendered cryptocurrency investigations more challenging and [that] we can expect these to feature more prominently in future investigations (Financial Times, 2021b).

Cryptocurrency in International Finance

Cryptocurrency has made a splash at many of the worlds most esteemed institutions. It is being discussed in legislatures and summits around the world. One of the most influential organisations in finance has also been quietly making impactful changes in the world of finance in response to cryptocurrencies' breakthrough into the mainstream. This organisation is FATF, the Financial Action Task Force.

What is FATF?

FATF is an international finance watchdog. Most nations are members of it. It has immense influence in the finance sector worldwide but can only recommend regulations. AML (Anti Money Laundering) and KYC (Know Your Customer) regulations, the foundation for safeguarding and policing traditional finance and trading, are drawn up and distributed by FATF.

FATF has recently released updates to its recommended regulations that have a lot of impact on cryptocurrencies.

The FATF Cryptocurrency Regulations

The updated FATF guidelines have many effects. Most importantly, we must discuss the new definitions of virtual assets and Virtual Asset Service Providers (VASPs), and also the changes to Recommendation 16.

The new FATF definition of virtual assets is any digital representation of value that can be digitally traded, transferred or used for payment. (This does not include CBDCs).

And a VASP (Virtual Asset Service Provider) could be for example a cryptocurrency exchange, a crypto ATM, a shop that allows payment in cryptocurrency, essentially any organisation or person that offers services involving cryptocurrency. To be precise:

VASPs are any individual or entity that have a business model providing transfer of, safekeeping and issuing of virtual assets and exchange fiat with virtual assets and/or virtual assets with virtual assets.

Then there is the FATF Travel Rule (Recommendation 16). It states that for transactions exceeding USD/EUR 1000, a country should ensure that VASPs make records of transaction information and make them available on request to the government authorities.

The Travel specifies conducting due diligence of the other party before sharing data. It has guidelines for originating VASPs and beneficiary VASPs.

Originating VASPs should obtain and hold information of originator clients using their service for virtual asset transfer, share the information with the beneficiary VASP, and also make it available on request to appropriate authorities.

Beneficiary VASPs should obtain and hold required originator and beneficiary client information and make it available on request to appropriate authorities. Both must monitor transactions and report when they notice suspicious activity. These guidelines also apply to financial institutions carrying out virtual asset transfers on behalf of a customer.

Obstacles

There are obstacles to a comprehensive, robust implementation of Recommendation 16:

1. Blockchains do not have an inbuilt protocol that can securely transfer sensitive transaction data and stop a data breach.

   a. Data is not safely centralised in a blockchain; it is stored in many locations. This additional complexity must not hinder VASP services.

   b. VASPs also vary greatly in many ways (No two cryptocurrency exchanges are the same), and there is a need for a comprehensive interconnecting system that ensures cross-VASP transaction data is secure. Even a single weakly enforced exchange could corrupt traffic.

   c. Many cryptocurrencies, like Bitcoin, need a majority vote to implement any changes necessary for compliance. After all, they are decentralised. That means there is no centralised entity to be held responsible by regulators.

2. This system must also be flexible and easily scalable in accommodating newer, experimental technologies and VASPs to ensure innovation is not stifled.

3. Cryptocurrency is a worldwide industry spanning countless cultures, languages, and regions. There must be cooperation and agreement amongst these groups. Any comprehensive and effective regulatory solution will require international cooperation to ensure cross-jurisdiction compatibility.

4. Cryptocurrency is also infamous for its anti-government ideologies and belief bases. Many VASPs will not even be willing to play along with each other, let alone the government.

Current Progress

FATF releases a yearly review on member implementations of its guidelines. In 2021, the review found that there had not been sufficient progress in the global implementation of the travel rule. This has caused the sunrise issue, a transition

period where a VASP following regulations might be at a disadvantage against another operating freely. Also, contradicting regulations in different jurisdictions is another issue that necessitates cooperation. The 2022 review found the situation much the same, with only limited progress in the implementation of the Travel Rule. Only 11 of 98 responding jurisdictions had enforced regulations and measures of the Travel Rule, and a third had not introduced the Travel Rule even in legislation. There is still a continuing trend of ransomware groups using VASPs for ransom payments, relying on privacy coins and non-compliant VASPs. FATFs recommendations are of immense importance in the finance sector, and they will undoubtedly have an effect on cryptocurrencies, regardless of how the cryptocurrency industry feels about them.

Current Government Policies on Cryptocurrencies

India

In India, the government has historically either been quite hostile or vague and unclear on crypto. In 2018, the Finance Minister (FM) and RBI banned rendering services connected to virtual currencies (Indian Express, 2021a), but the Supreme Court set aside the ban in March 2020.

The RBI (Indias central bank) is anti-crypto and favours a complete ban (Economic Times, 2021) on cryptocurrencies. It believes them to be a serious threat to macroeconomic and financial stability. Under the RBI, a digital rupee CBDC has been announced. The wholesale pilot was launched on 1st Dec 2022, and a retail version has been tested with thousands of merchants and customers.

Parliament shelved (Business Insider, 2021a) for the second time since Feb 2021, a cryptocurrency bill reportedly focused on regulating exchanges and trading for its next session on February 23. A previous 2019 draft bill aimed to ban all cryptocurrency-related activities.

In the absence of clear law, the government should tax gains and income on transactions, irrespective of current legality, according to an RBI senior official (Indian Express, 2021b).

On 1st Feb 2022, the FM announced a 30% tax on gains (Livemint, 2022) in parliaments budget session but also maintained that taxation still did not lend legitimacy to private crypto coins. On 2nd Feb 2022 (Business Today, 2022a), she said, "Bitcoin, Ethereum or NFT will never become legal tender."

The FM also said on March 5th (CNBCTV18, 2021) that she wanted to ensure innovation was possible in the field and that "...we are not closing our minds..."

This taxation was not the clear indication that cryptocurrencies are legal in India that industry insiders and users wanted. Government officials said the new proposals do not mean cryptocurrency is legal. The FM also said, "...I don't wait till regulation comes in for taxing people who are making profits." (NDTV, 2022)

The community most wanted to know whether cryptocurrency would be considered legal, but they were still just as uncertain.

A government committee (Business Today, 2021) suggested banning all virtual currencies except those released by the states. The Standing Committee on Finance (Indian Express, 2022a) concluded that cryptocurrencies should not be prohibited but regulated. The FM has said in the Rajya Sabha (Zee News, 2021) that the aspects of the old bill that banned all virtual currencies other than CBDCs had to be modified and that a new bill is being worked on.

These two taxes caused a 90% drop in trading volumes over three months, and many cryptocurrency entities moved out of India.

It was not certain what direction regulations would take. The only bill actually available to the public is the 2019 draft bill banning cryptocurrency. Some industry insider consultants to the deferred bill stated (Business Insider, 2021b) that the bill would focus on the regulation of exchanges and trading and clarify the definition of a cryptocurrency asset, although other publications have disputed this.

However, in recent times, a shift seems to have occurred.

The government has been implementing clear regulations on cryptocurrency. On April 1st, 2022, the Indian governments first cryptocurrency law came into effect. A 30% tax on any income generated from cryptocurrency transactions and a second tax of 1%

at source on all transactions (TDS). In the same announcement, the RBIs digital rupee was declared to be introduced within the financial year (this is the first reference to a time frame for the digital rupee). These two taxes caused a 90% drop in trading volumes over three months, and many cryptocurrency entities moved out of India That might mean India loses out on innovations in the cryptocurrency space.

Finally, on March 7th, 2023, the government brought cryptocurrency transactions under anti-money laundering laws and enforced Know Your Client (KYC) regulations on all exchanges and entities dealing with cryptocurrency. Many industry insiders (X (Formerly Twitter), 2023, Nischal Shetty, WazirX Founder) welcomed the move, as it brings clarity.

These steps indicate that cryptocurrency is being accommodated and accepted into the Indian economy, but whether it will be elevated to a currency definition is something else entirely. The worry of a full ban is mostly gone now. Industry insiders want clarity, and despite the new taxation regulations, there is still much that is unanswered.

United States

The consequences of defining a cryptocurrency as an asset, currency, or security. A recent US bill focused on the definition of a broker and had a controversial clause that faced intense pushback from the cryptocurrency industry. The bill (sec 80603) proposed that brokers servicing cryptocurrency transactions report transactions greater than $10,000 to the IRS. But the $10,000 threshold is not the issue. The bill broadened the definition of a broker to any person (for consideration) who is responsible for regularly providing any service effectuating transfers of digital assets on behalf of another person and made them responsible for recording KYC info. This definition could cover POW miners, who by design have no access to users' information whose transactions they verify (i.e., provide service) on POW blockchains In fact, the language is broad enough to even include hardware (ASIC miner card manufacture), software (wallet developers) developers, and blockchain protocol developers, who themselves might not even be involved in trading crypto Amendments were proposed, but none were passed. In the end, the bill passed into law with the initial sec 80603 unchanged. The new recording requirements are to apply to transactions post-January 1, 2023 (Leechtisman, 2022).

There have also been more recent efforts at regulation, but all seem to be stalled currently. One example is a bill aiming to provide regulation of cryptocurrencies to the CFTC (Commodity Futures Trading Commission) over the SEC (Securities and Exchange Commission). The bill categorises Bitcoin and Ether as commodities. The CFTC has jurisdiction over commodities, but the SECs chairman has claimed jurisdiction over the power to regulate most tokens, which are, in fact, securities under the SECs jurisdiction.

Many other bills, many bipartisan, showed promise but are now held up, mostly stalled in contentions and discussion. Progress has also been elusive on efforts in the Senate (Lummis-Gillibrand Responsible Financial Innovation Act) that aim to bolster the CFTCs ability to directly oversee trading in Bitcoin and any other cryptocurrencies that arent subject to US securities laws. A stablecoin bill by the House Finances Committee, which had some input from the Biden administration, has also faltered in discussions.

This definition could cover POW miners, who by design have no access to users' information whose transactions they verify.

Additionally, the US Congress will also be preoccupied to some extent with its November re-elections. Any chance of legislation from the US Congress regarding this issue for this year is slim. This is amidst a dire need for stabilising and clarity by providing regulation for cryptocurrencies in the country. Bitcoins price of 19,853 USD is down from a record 68,000 USD just last November. Trust in cryptocurrencies is shallow right now.

El Salvador

El Salvador is most known for its adoption of Bitcoin as a legal currency. This controversial decision by the nations president, Nayib Bukele, put the small nation in the spotlight. The country has been struggling terribly with gang wars (see New American Story in references) and economic issues for years. Bukele has pushed forward Bitcoin adoption as the way to stability and prosperity. El Salvadors adoption has made waves for Bitcoin and cryptocurrency worldwide. Lets discuss it. El Salvador, on September 7th (Livemint, 2021), was the first country to make Bitcoin legal tender. The government also launched Chivo, a cryptocurrency wallet, on the same day.

However, the IMF (International Monetary Fund), the financial branch of the UN, has criticised this move repeatedly (BBC News, 2022b), stating it would make acquiring a loan (Bloomberg, 2022b) from the IMF difficult for the country.

The launch of Chivo was not smooth (Foreign Policy, 2021), and the app was temporarily removed (Newsweek, 2021) shortly after the launch to increase its platforms server capacities. The system was hit with the theft (Coindesk, 2021b) of sign-up bonuses. Chivo was largely unsuccessful (NBER, 2022b) in pushing Bitcoin to the mainstream in El Salvador, and it was not even used widely (PYMNTS, 2022b) for transactions.

Between Sept 2021 and Jan 2022, El Salvadors government under Bukele purchased around 86 million USD of Bitcoin (Bloomberg, 2022), bringing it up to 106 million USD by July 2022 (Bloomberg, 2022c). Bitcoins value dropped 45% (Bloomberg, 2022a) from Nov 2021 to Jan 2022, causing a loss of 56 million USD (Bloomberg, 2022d) on their purchases of Bitcoin. After the 2021-22 crash, Bitcoins value had dropped 60% (CNBC, 2022a). El Salvadors 800 million USD debt (Bloomberg, 2022d) was due in Jan 2023. He responded to the crash by tweeting he was "buying the dip." (Bloomberg, 2022e) In July 2022, he bought an additional 80 bitcoins (CoinDesk, 2022).

In Nov 2021, Bukele announced plans for a "Bitcoin City" at the base of Conchagua volcano (Business Standard, 2021) in the circular shape of a coin. The city was to use sustainable geothermal energy from the volcano to mine Bitcoin, and no income tax would be collected in the city. In 2022, the government drafted legislation for the creation of 1 billion USD in Volcano Bonds, half of which would fund the Bitcoin City, and the remaining half would be used to buy Bitcoin after a five-year lock-up period.

61% of users stopped using the service (NBER, 2022b) after spending their bonus.

These are all massive, widespread and newsworthy plans. However, just because a country is intensely welcoming to crypto, that does not mean it will only reap pure benefits Despite such a massive and controversial push for Bitcoin adoption, a year after the launch day in Sep 2021, results have been comparatively lacklustre.

As discussed previously, El Salvadors Chivo wallet has not accomplished what it proclaimed it would or even come close. Even at launch, there were cases (Coindesk, 2021b) of identity theft where people installed the service and found their 30$ sign-up bonus had already been redeemed. User's funds are disappearing (CoinDesk, 2021a from their accounts. 20% have yet to spend the sign-up bonus. 61% of users stopped using the service (NBER, 2022b) after spending their bonus. In March, the Salvadoran Chamber of Commerce (The New York Times, 2022a) found

Only a meagre 3% felt that being able to use Bitcoin was valuable.

only 14% of businesses had conducted Bitcoin transactions between September 2021 and July 2022, and only a meagre 3% felt that being able to use Bitcoin was valuable. Despite being heralded as a Bitcoin-centric government scheme, by July 2022, only 9% of Chivo users used Bitcoin in the app (NBER, 2022b).

That is just the Chivo wallet service. In June 2022, around 2300 bitcoins (BBC, 2022a) President Bukele bought for 106 million USD (Bloomberg, 2022c) from Sep 2021 till then, had lost 70% of their value. El Salvador's overseas bonds dropped by 30% by Dec 2021 (Bloomberg, 2021). This means foreign investors, including other nations, elected to sell their investments and pull out, similar to stockholders selling their shares in a company when they feel the company is not performing well.

In March 2022, the Salvadoran government announced a delay (Reuters, 2022a) of the "Volcano Bonds", giving global economic conditions and the war in Ukraine as the reasons. It has since drafted new legislation (Decrypt, 2022) for the bonds in Jan 2023.

It should also be noted, that Bukeles reign has been condemned (The New Yorker, 2022) as authoritarian (Journal Of Democracy, 2021). On 9th Feb 2021, in a move now known as the 2020 Salvadoran Political Crisis (aka 9F), he sent military forces into the legislative houses (LA Times, 2020) to pressure legislators to vote in favour of a 109 million USD loan from the United States that would contribute to his Territorial Control Plan, an anti-crime law enforcement measure in El Salvador (Murder rate has dropped significantly (Reuters, 2023a) under him in the nation). He also executed what is considered a self-coup (Washington Post, 2021) in May 2021, where he ousted several judges (Conectas, 2021) from the Salvadoran Supreme Court and the Attorney General of El Salvador. He is still popular amongst the people (NBC, 2023), with 8 out of 10 citizens approving of him in Jan 2023.

The World Bank initially rejected a request (BBC, 2021) from El Salvador to help with the implementation of Bitcoin as a legal tender, as they stated this is not something the World Bank can support given the environmental and transparency shortcomings Many countries facing similar social and economic problems today might learn from El Salvador's Bitcoin struggles to see if the process of supporting cryptocurrencies should be implemented differently.

The Chinese Cryptocurrency Ban

In September 2019, China held 75.5% of the hash rate, which dropped to 34.2% in May 2021. Then in September 2021, China banned cryptocurrency in all forms.

Since 2013, China has been restricting and opposing cryptocurrency activity within its borders. In May 2021, the first financial institutions were prohibited from engaging in cryptocurrency transactions; then domestic mining was banned in June, finally culminating in a wholesale ban on cryptocurrency mining activities, transactions, and services in late Sept 2021.

China has declared its reasons are environmental, as it was home to the majority of Bitcoins notoriously energy-hungry mining activity. Banning cryptocurrencies is allegedly in line with their 2060 carbon neutrality goal. It is true that China has been making serious moves towards its goal. However, it does not make sense to ban the entire industry for these reasons, considering the existence of environmentally focused coins such as solar.

China is well aware that it is the mining of POW currencies that is so energy-hungry, and it is this mining activity that is highly prone to energy mixes of non-renewable energy sources such as coal (Xinjiang (CCAF, 2021) and Sichuan (CNBC, 2021) regions were major hotspots for mining in the wet seasons, data also from CCAF). Banning POW mining would have largely the same result. More likely, the Chinese government doesn't want competition against its in-house, monitorable, centralised Digital Yuan and wants to retain control over payment systems.

Cryptocurrency often experiences speculative investment hype and subsequent crashes in value. It can potentially have destabilising effects on an economy. It is also widely discussed that the partial reason is that China is not favourable towards cryptocurrencies decentralised, transparent, difficult-to-survey and monitor tendencies and roots. However, the cryptocurrency industry has since bounced back

after the devastating ban. The US now has the highest hash rate share at 37.84% (CBECI, Jan 2022), Russia (4.88%), Canada (6.48%), and even Kazakhstan (13.22%) are other formidable cryptocurrency adopters.

Tough regulations and outright bans only shift miners to other locations around the world, and there are already countries such as El Salvador that are highly welcoming regulatory environments towards cryptocurrencies. Regardless, China is in the race for a CBDC (in fact, it can be argued it is the furthest along).

It should also be noted that there is still a strong volume (NIKKEI Asia, 2022) of cryptocurrency transactions occurring in the country some months after the ban was implemented. China is at 10th on Chainalysis Global Crypto Adoption Index (Chainalysis, 2022c).

Other Jurisdictions

In other news, Egypt, Iraq, Qatar, Oman, Morocco, Algeria, Tunisia, and Bangladesh have all (Fortune, 2022) banned cryptocurrency. Forty-two others have implicit bans (banks/exchange restrictions). In Nov 2021 (Library Of Congress, 2021), a total of 1.8 billion people live in 51 countries where cryptocurrencies are at least partially banned. The number of countries and jurisdictions that have banned cryptocurrency either completely or implicitly has more than doubled since 2018, when the organisation first published a report on the subject.

> **Tough regulations and outright bans only shift miners to other locations around the world.**

Regarding Government Adoption

Here, sourced from a paper by Philipp Sander (2020), we have a general flow for how cryptocurrencies may be accepted politically and legislatively.
Many governments are hostile to cryptocurrencies, and without political support, cryptocurrencies will not become widespread. And political support will most likely only come with regulatory frameworks and laws. This accountability from a national government is often ideologically opposed by cryptocurrency advocates. It is not

necessarily regulations that are contested, as much as the source of those regulations. Tough regulations and outright bans only shift miners to other locations around the world.

Additionally, many industries, including finance, are hesitant to interact with cryptocurrencies due to the lack of regulation or even a general outlook on the field from regulators. This is a point of contention by many industry insiders as well, who are hoping for regulators to bring clarity. A halfway situation might lose the benefit of both approaches.

A total of 1.8 billion people live in 51 countries where cryptocurrencies are at least partially banned.
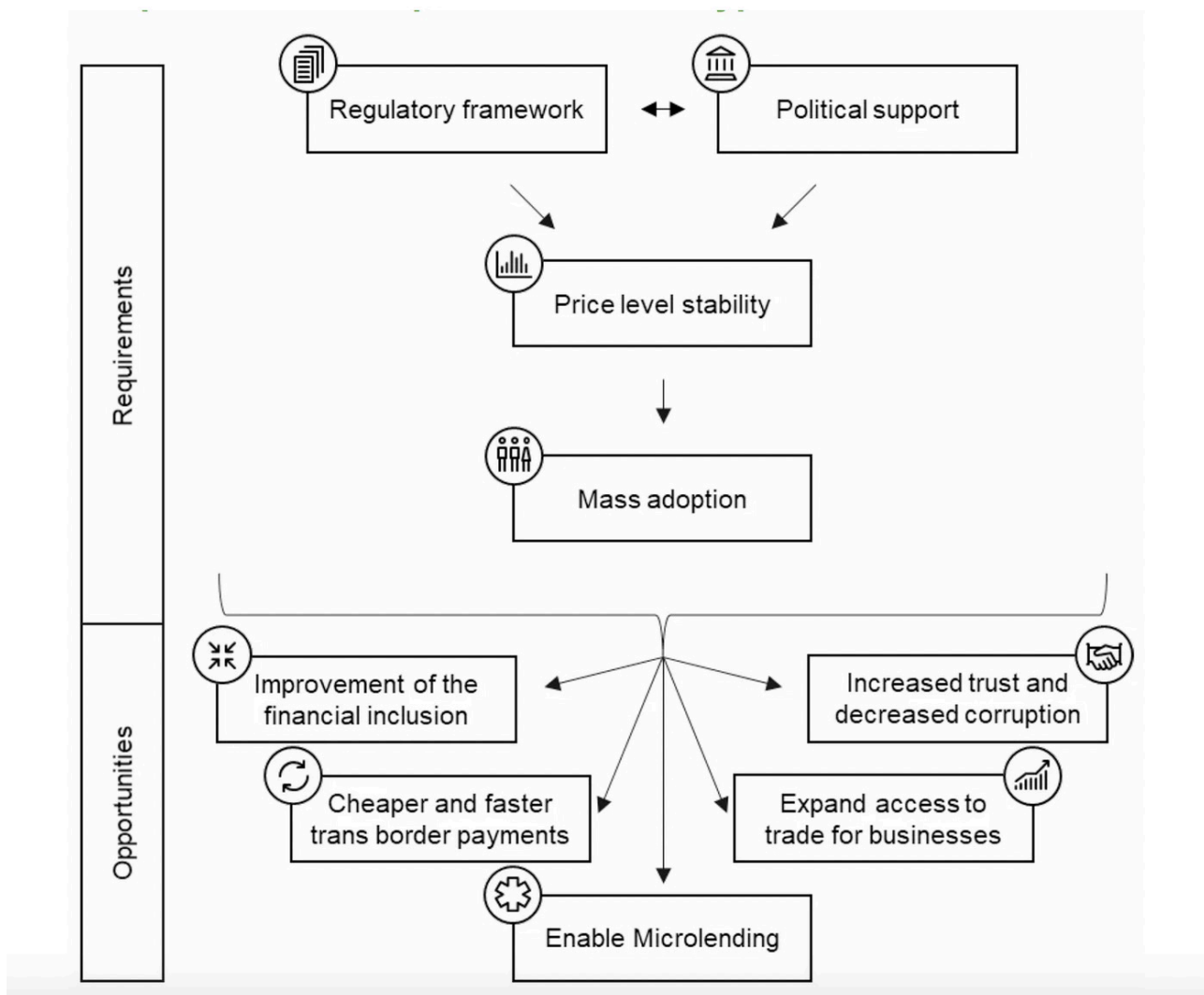
A flowchart graphic depicting the requirements for and consequences of govt adoption of cryptocurrency

Chapter 6

Conclusion

A Brief Recap.

Over the course of this report, we have discussed the varied facets and qualities of cryptocurrencies. They are rapidly changing people's ideas of money. Money is not just a physical fiat note in your hand. It can be anything that has enough belief keeping its value afloat and stable. Even e-payment systems had not done that; they were based on the same familiar notes.

Cryptocurrencies are a tool, not a saviour or a magic bullet. They are a type of ledger that, in some ways, are harder to defeat than traditional ledgers.

Cryptocurrencies are also famously anti-government. The world is ruled by governments They decide the way of life for almost all people. Cryptocurrencies will have to choose whether to beat them or join them, though joining might go against the ideologies of core supporters.

Cryptocurrency crimes are noted to be barely a drop in the ocean, orders of magnitude less than fiat-based. But technologies like privacy coins can allow transactions of unknown sizes in unknown numbers between unknown parties. This is not acceptable. As criminal elements are more and more familiarised with cryptocurrencies, things may worsen. There might be solutions that are currently being developed in the industry that could provide benefits, and those should be explored. Government-backed regulations (e.g. FATF) are a battleground of sorts Some proposed regulations wipe away the inherent nature of cryptocurrencies. Cryptocurrencies are also too volatile for use as a currency in struggling national economies. In El Salvador, the Bitcoin-based government payment service Chivo is

used only by a fraction of users post-launch, and Bitcoin remittances through the service are very low (NBER, 2022c), at less than 2% of all remittances throughout 2022.

The issue with financial exclusion is not as much with lack of services as it is with lack of funds. A bank account for $2 a month is not worth it when you make $21 a month. Some groups might only have one member hold a bank account and use that account to pool resources for the whole group (aka rotating savings; in Sub-Saharan Africa, 48% of savers use these informal clubs, and in Nigeria, 69% of savers, sourced from World Bank, 2012). Those without bank accounts in low income nations such as Venezuela or El Salvador aren't really struggling because they don't have a bank account as much as they are because they don't have a living wage, don't have a stable economy, prices are high, inflation is terrible etc.

Cryptocurrencies will most likely not fix struggling economies in the way often advertised, but they can likely find use as part of a greater movement. If one has issues with wealth inequality, cryptocurrencies already struggle with signs of wealth inequalities, with many popular currencies depending on a few whales (BitInfoCharts, 2023) to not tank their value by selling out.

Also, cryptocurrencies will not be used as currencies if nations aren't willing to give up their economic sovereignty. Asset designation will bring cryptocurrencies under asset taxation, severely hampering their use. If a country is not accepting of cryptocurrency, it is usually not realistic for a citizen to use it as a currency.

Currently, many popular cryptocurrencies run off a sizable amount of energy, but this is changing. Bitcoin runs off on the proof of work mechanism, which cannot scale in terms of energy or transaction rate (VISA allows orders of magnitudes more transactions per second). Ethereum, the second largest cryptocurrency, has shifted to proof of stake.

What is just as important as the amount of energy used is where the electricity is from. Is it coal or hydro? Is it from repurposed gas flares that would go to waste, or might it also contribute to an increase in market demand for fossil fuels?

These same proof-of-work currencies are also the main (by far) cause behind the massive increase in e-waste. Cards that can only be used for mining a specific currency are obsolete in less than two years.

Cryptocurrencies have also affected the semiconductor industry with their large demand and volatility. Semiconductor giants invested in meeting cryptocurrency miner demands during a surge in prices, and faced heavy losses when cryptocurrencies crashed yet again. With Ethereum shifting away from POW to POS mechanisms, there might be less need for powerful hardware to mine cryptocurrencies.

Many governments have banned cryptocurrency, such as China, which experts consider to have been done to ensure government control over payment systems. The progress of different countries on their individual CBDC projects is as varied as the types of cryptocurrencies. Some have partially functional systems. Others are only considering the prospect, and still others, such as China, are well on their way to a fully functioning CBDC. Any arrival of a CBDC will almost certainly cause severe shifts in the position of a central bank in the economy.

Lawmakers should first learn more about this burgeoning industry before passing laws that seem to fundamentally misunderstand the working of these cryptocurrencies, potentially making things worse. If non-specialists are considering investing in cryptocurrencies, they should be aware that this is probably an unregulated industry in their region and that scams are common. However, some banks are offering cryptocurrency consultancy services and will even hold your wallet and password safely for you so you are at least free from the human error of losing your wallet key.

This is a complex and nuanced field, with potential in many directions. Some of those directions can lead to misconstrued and unnuanced representations and discussions, and yet others can lead to real positive change in the world.

Appendices

Appendix 1: Value Network Mapping

Value Network Mapping is an open-source (non-proprietary) methodology developed by Verna Allee, a consultant and knowledge management expert. It maps networks of value exchange between individuals, organisations and other entities. The value exchanges mapped include tangible and intangible assets such as knowledge, expertise, and reputation.

Our co-author and advisor, Kaliya Young introduced this method to us. We applied it in the Transaction Mapping at the end of the Introduction section. We used it to map value flows in a transaction between a customer buying a commodity and a vendor receiving payment. We compared three different pathways: 1) Using cash as a payment method, 2) using KYC-regulated systems (digital payments and conventional banks), and 3) using Bitcoin via a blockchain.

There are several mapping elements in VNMs.

A visualisation of the basic structure of a VNM
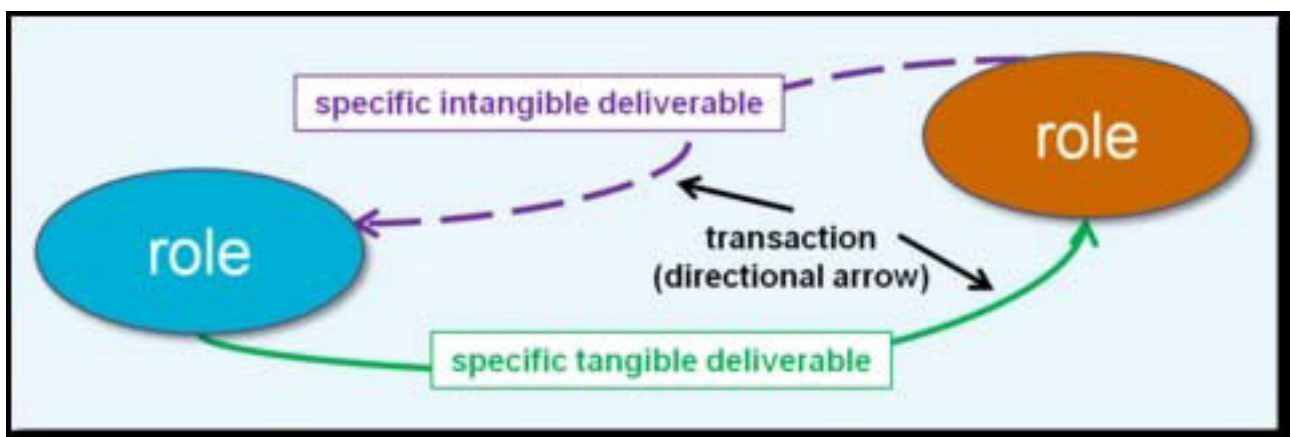
A visualisation of the basic structure of a VNM

Roles are represented as a node in the network by an oval or circle marked with the name of the Role. Roles represent real people or groups of people (organisations and entities) who can generate transactions, send messages, engage in interactions, add value, and make decisions.

Transactions are represented by a one-directional arrow that originates at one Role and ends at another. The arrow represents direction and denotes the movement of a Deliverable from one Role to another. Transactions are transitory in nature. They have a start, middle, and completion.

Solid lines show Tangible (formal, contractual) Deliverables being provided

Dashed lines show Intangible or informal Deliverables being provided.

Step 1: Define Boundaries: The starting point for any value network map is to define the boundaries and to decide what level of detail to go into.

Step 2: Identify Key Stakeholders: Stakeholders include customers, vendors, suppliers, regulators, energy providers, computation providers, and payment infrastructure providers.

Step 3: Map Value Flows: This involves identifying the various goods, services, information, and other resources that are exchanged between the stakeholders.

Step 4: Analyse the Value Network: We do provide a written explanation of the map, but our purpose here was not to improve the system but rather to provide a comparison between the three different pathways for payment that are possible.

THE VILLAGE EXAMPLE: A METAPHOR FOR BITCOIN

www.cryptopolicyforthepeople.com

Appendix 3: Do You Need A Blockchain?

Blockchain technology, often surrounded by much excitement, is not always the universal solution it's sometimes made out to be. It's a specialised tool that works best for specific needs. For instance, when several groups need to record transactions collectively without a central leader, blockchain implementations can be quite suitable. They ensure that once information is entered, it can't be altered, which is crucial for maintaining a transparent and consistent historical record. Blockchain is well-suited when immutable records are essential and where trust is distributed among stakeholders rather than centralised. Conversely, for situations that demand data confidentiality, the flexibility of modifications, or centralised control, then traditional databases can be preferable.
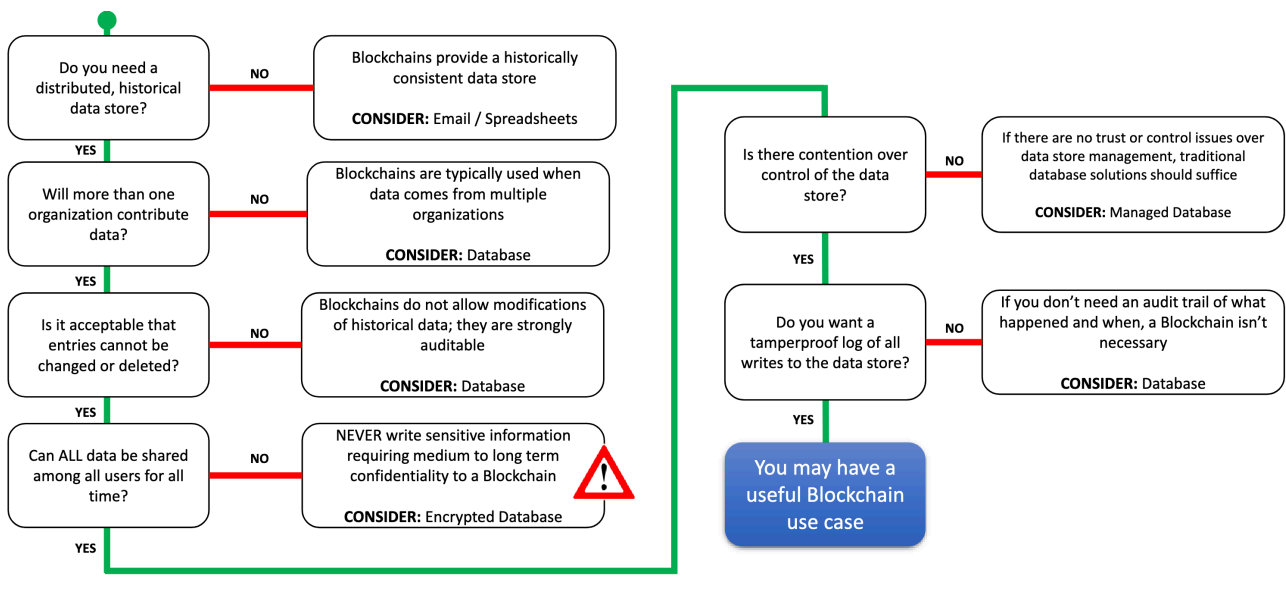
A flowchart depicting use cases where Blockchains may or may not be useful

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Author Biographies

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Heramb Podar is a 5th year student at the Indian Institute of Technology, Roorkee. He is interested in technology as a lever to raise the expected well-being of society and is concerned about the risks different forms of emerging technology bring with them. He does AI policy research with the Center for AI and Digital Policy, a Washington DC-based think tank focusing on national AI policy assessments. He is the co-executive director of Policy for the People, a youth policy non-profit organisation incubated under Harvard Innovation Labs that aims to bring youth voices into policy discussions. He has also been involved as a mentor at the Clinton Global Initiative University, helping young changemakers set up local initiatives to solve community problems. Previously, he also helped run ElfDAO, which raised $37,000 in less than a month to support toy drives for underprivileged children and Reach4Help, a student-run non profit which dropshipped critical aid resources to communities in need in India and Bangladesh during the peak of COVID-19.

Yash Bohra

Yash Bohra is a full-stack software developer and data analyst working at DavaNinja, a pharmaceutical tech startup based in Mumbai. He graduated in 2024 from SRM Institute of Science And Technology with a Bachelors in Computer Science with a Specialization in Artificial Intelligence and Machine Learning. He is passionate about digital privacy and protection of user data. Beyond this, he's an avid reader and occasional poet.

Kaliya Young

Kaliya Young is a public interest technologist, widely known as Identity Woman. She has spent the last 20 years of her career focused on one thing: supporting the emergence of an identity layer of the Internet that works for people so they can build thriving communities. In 2005, she co-founded the Internet Identity Workshop (IIW), where OpenID Connect and OAuth were created. She has also led the facilitation of IIW-inspired regional events, such as the Digital Identity unConference Europe, APAC Digital Identity Unconference.

Kaliya has been playing a critical role in developing the next generation of standards for decentralized identity, which is in the process of being adopted by institutions like the European Union via the eIDAS2 initiative, the Government of Bhutan, and the U.S. Department of Homeland Security. Kaliya's boutique consultancy, Identity Woman in Business, is working at the forefront of empowering organizations of all sizes and types to succeed in investing in the new generation of secure, privacy-preserving, and interoperable identity infrastructure.

Kaliya graduated from the first cohort of the Masters of Science in Identity Management and Security program at the University of Texas at Austin in 2017. Her master's report, Domains of Identity: A Comprehensive Framework for Understanding Contemporary Identity Systems, became a book and is a comprehensive framework explaining all the domains of identity where individuals personal data ends up in databases. She also co-authored A Comprehensive Guide to Self-Sovereign Identity and the online course of Getting Started with Self-Sovereign Identity.

Denise Lochtenbergh, M.A. Philosophy

With a purpose to inspire and uplift the world since childhood, Denise began as an explorer of thoughts, ideas, spaces, and places, aiming to share her findings. Along her journey, she pioneered digital community software, earning a title of "The First Women of the Web." She continued digital product design in startups and incubators, briefly serving as a CEO before declaring herself "CEO of Myself" where she upgraded her own life. Driven by a profound desire for inner harmony and balance in her mind and body, Denise explores music, dance, fitness and mindful embodiment practices. She integrates these into her workshops, talks and offerings, which are a fusion of her findings. Denise crafts her vision of harmony in life on earth where individuals become intentionally purposeful and engaged in embodied and mindful coherence. She is a Life Coach and Hypnotist with Lotus Love Dreams, hosts the Technology of Self™ podcast, is developing a mindful media platform, UPDREAM™, and has a book coming too.

Thank you.

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