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The State of Crypto: How Blockchain Changes the Private Money Debate and the Innovation of Digital Value

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The State of Crypto: How Blockchain Changes the Private
Money Debate and the Innovation of Digital Value

Senior Project Submitted to
The Division of Social Studies
of Bard College

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Abstract

This paper seeks to explore how cryptocurrencies improve on past issues with private currencies and assess where they fit within the broader economic and regulatory context. This paper finds that blockchain technology provides a solid foundation for cryptocurrencies to improve on many of the past issues associated with private currencies, but concludes that, given the infancy of the industry and the lack of an established regulatory framework, we cannot confirm that they are truly infallible, nor that they provide a clear answer to the debate over whether private currencies actually improve the financial system as laid out by Hayek, Ingham, and Selgin. We conclude that cryptoassets are creating a more inclusive and efficient economic system overall by spurring improvements to outdated processes, expanding access to banking and finance, improving transparency within private and government institutions, and forcing regulatory bodies to update and formulate legislation suited to the digital age.

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Introduction

This paper seeks to assess how cryptocurrencies improve on the past issues with private currencies and where they fit within the broader economic and regulatory context. After examining the history of private currencies, we find that private currencies have been limited by a combination of factors related to trust, scale, and redeemability. We then analyze various definitions of money, contrasting Geoffrey Ingham's theory with orthodox definitions. We find that in Ingham's definition, private currencies do not constitute money because they do not serve as a unit of account, whereas in the orthodox definition they can be considered money. We expand on this debate by comparing the arguments of Hayek, Ingham, and Selgin on the role of private money. Hayek's argument for a system of competing private currencies highlights the need for private money to be untethered to any centralized entity. Ingham's arguments highlight the importance of trust in the functioning of any currency and that a decentralized currency must be built on a truly unexploitable technology. Selgin's arguments introduces the possibilities for macroeconomically smart private currencies which we decide would most closely resemble a CBDC. We provide an in-depth explanation of distributed ledger and blockchain technology, the underlying technology on which cryptoassets are built. We then examine the two most successful cryptoassets, Bitcoin and Ethereum, and explain the structural differences between the two. Finally, we explore the ways programmable blockchains like Ethereum, Solana, and Cardano are leading the Web 3.0 movement, the next iteration of the internet which promises to put power back in the hands of users while providing a more secure and efficient system overall. We then explore some notable use-cases of blockchain technology to assess the specific ways the

technology can be utilized to improve current systems. We find that cryptoassets have the potential to decrease transaction costs while simultaneously increasing transaction speeds, in particular for cross border transactions. We then explore the DeFi industry and the benefits of blockchain based smart contracts and find that both financial institutions and customers benefit from the implementation of smart contracts because they cut costs for banks, streamline the process of ensuring regulatory compliance, and provide easier and secure transaction methods for customers. Next we look at the ways blockchain technology can help fight digital piracy and ensure better copyright protection as well as improve the public sector. We then examine the ongoing crypto debate and the current state of crypto regulations in the United States. We assess the arguments surrounding Bitcoin as an inflation hedge and conclude that while it has historically beaten inflation, its extreme price appreciation and high volatility suggests that it is an unreliable short-term inflation hedge in its current state. We then dig into the arguments for and against Bitcoin as a store of value. We conclude that because Bitcoin is the first example of digital property, it will never fulfill some aspects of traditional stores of value. Therefore, if the underlying technology continues to prove its resistance to malpractice, it is in fact a store of value. We then examine the current state of crypto regulations beginning with a discussion on securities law and how this applies to different cryptoassets. We then explain the importance of stablecoins as the lifeblood of the DeFi industry and the key link between the traditional financial systems and the world of DeFi. We contrast this with CBDC's which are proposed government-backed digital currencies. We find that CBDC's can provide some similar, and some added, benefits that stablecoins provide but also pose a potential risk to personal freedoms and privacy if not properly managed. We then examine the PWG's stablecoin report which outlines the U.S. government's plan for stablecoin regulation. We note that the report conveys a sense of

urgency, calling for swift action from existing regulatory bodies to provide supervision while new formal legislation is passed. We note that this sense of urgency stems from the inability of banking regulators to reach all aspects of stablecoin arrangements, even those involving regulated institutions. We conclude that blockchain technology provides a solid foundation for private currencies to improve on past limitations. We find that cryptoassets are an overall net positive for society as they are exposing exploitative practices in the financial sector and in big tech, opening up access for underbanked and unbanked individuals, forcing outdated and inefficient systems across all sectors of the economy to be improved, and galvanizing regulators to update and formulate legislation suited to the digital world.

Chapter 1: Private Money

This chapter will overview the history of privately-issued money in the United States and discuss the needs they fulfilled as well as their weaknesses. It will also summarize economist Geoffrey Ingham's social theory of money. Finally, it will contrast Ingham's views on private money with the perspectives of Fredrich Hayek and George Selgin. This chapter will then wrap up with a brief introduction to cryptocurrencies through Selgin's analysis.

Private Money Historical

When the United States was created, the founding fathers granted Congress the power to issue currency but forbade individual States from doing so. However, private citizens and private companies were allowed to issue their own money for various purposes. Historically, private money issued by individuals or companies can be seen as, "an innovation that arises to fill a void left by the federally provided money of the day" (Champ, 2007). Notable entities that have issued private money include transportation suppliers, coal mines, lumber companies, farms, merchants, and community groups. These private monies arose out of needs that government-provided money could not serve and many of these needs are related to the historical context of the time period. "These purposes include having a currency suited for making small purchases, having a medium of exchange in remote locations, and having a means of exchange during financial panics" (Champ, 2007). The U.S. Treasury allowed private banks to issue notes but put a minimum on the value of the notes (originally \$1 and increased to \$5 in the late 19th century). The reasoning for this was that if the notes were large enough it would encourage

people to redeem them because if the notes were smaller they might pass from hand to hand many times before someone felt the need to redeem them. If this happened, banks might continue to print more money than they could redeem with the gold and silver on reserve which would cause inflation (Champ, 2007). Note that, in 1879 when the minimum value was increased, \$5 adjusted for inflation would be worth around \$133 today (BLS).

In the mid 19th century there was a coin scarcity in the United States and private companies stepped in to fill the void. “From 1820 to 1875, private transportation companies, merchants, and farmers issued a significant amount of small denomination money. This money was denominated in dollars or in goods/services rendered” (Champ, 2007). Companies operating in remote locations, such as mining or lumber companies, would often pay their employees in what is commonly known as ‘scrip’. This was often in the form of paper money and was redeemable in goods and services sold by the issuer of the company. Workers would often exchange scrip at a discount for U.S. dollars. Scrip was useful for companies because they would not have to redeem their bank notes. However, another motivation for companies to issue scrip was as a way to ensure labor remained cheap. This made workers heavily reliant on their job because they would often have little to no money leftover after spending their scrip. This was because scrip was often the only money accepted at company stores, where the company sets the prices. By owning everything in the area where their workers lived, companies could ensure almost total control over their workers. In addition to shopping at the company store, these workers often lived in company-owned housing, resulting in a nearly inescapable and paralyzing state of reliance on that one job (Fishback, 1987).

Private money was also widely used during the Great Depression. During the bank runs of the 1930’s people began to hoard money causing shortages of cash. In response, school

districts, merchants, local relief committees, individuals and even State and local governments issued private money. This has led to more varieties of private money, and today there are more than 4,000 privately issued currencies in more than 35 countries including private gold and silver certificates and barter credits. However, it is difficult to estimate exactly how many different private currencies there are because the question itself is one of definition. For example, should freely transferable airline loyalty program miles be considered money equivalents? (Noam, 2019). This brings us to ask important questions about what constitutes money.

What is Money?

Because what follows is an examination of a debate about money, it will be useful to define exactly what we mean by “money.” For a comprehensive definition of the term we need look no further than British political economist, and author of multiple books on money, Geoffrey Ingham. Ingham defines money as “a social relation of credit and debt denominated in a money of account” (Ingham, 2004). Essentially, this means that the person in possession of money is owed goods or services. Unfortunately, this is where the simplicity ends. Money also represents a claim against the issuer of the money, whether it is the government, a bank, or a monarch. Additionally, because money must be issued, and something can only be issued as money, the money must be capable of canceling any debt taken on by the issuer. However, in economics, even the definition of its most vital tool is up for debate. Orthodox economists would challenge Ingham’s view of money, claiming that in a barter situation anything can then become a form of “IOU-money” by simply exchanging one item for an IOU to be redeemed when their end of the barter is held up. However, Ingham’s definition extends further than this. He says that

for money to be the most exchangeable commodity it must first be constituted by an abstract money of account as transferable debt. For example, the government issues money as payment for goods and services, promising that it will accept that very money as payment for taxes. This also holds true when banks issue notes or allow checks to be drawn against them as they promise to accept it as payment. “Money cannot be said to exist without the simultaneous existence of a debt that it can discharge” (Ingham, 2004). The debt, however, doesn’t just refer to any specific debt, but rather all debts within the defined monetary space. For example, U.S. dollars are accepted to pay off any debt owed to the U.S. government, namely taxes. Another crucial aspect of money according to Ingham is that it does not gain its ability to buy a good based on its equivalence to that good, as measured in a price index. This would disregard the origin of the “power” of money in the promise between issuer and user. The credit must be enforceable by the issuer. In other words, a sovereign power must underpin the entire network of credit and debt relations to enforce the legitimacy of the money being used.

Private Money Problems

The biggest problems with private money in the past have been scale, trust, and redeemability. Historically, private money has been localized to small areas, making them incapable of serving as a national currency. Additionally, private money has often faced the issue of people not trusting the issuing party's word that they will accept it in exchange for what they promised, whether it be U.S. dollars or goods and services. Finally, private money has been limited by its redeemability. If it is difficult to redeem, people will have less incentive to use it and will not be likely to accept it as a form of payment. A private currency that is difficult to

redeem will be worth less than it says it is because of the cost associated with the inconvenience. The last notable problem with private money is that it could be backed by inferior assets, taking advantage of information asymmetry. This results in the classic Lemon Problem, which is when buyers and sellers do not have the same information about the transaction. (Noam, 2019).

Because private money has historically failed to provide a better alternative, government issued fiat currency has dominated despite inflationary and deflationary swings. However, with the coming of the digital age and electronic payment systems, alternative forms of money have become much more promising. The first electronic payment systems were credit and debit cards but were not ideal for small everyday transactions because of high fees. However, new advances in cryptography and distributed networking systems have provided a solid foundation for a transformation of how we complete transactions. We will discuss this further in Chapter 2, but first we must dive deeper into the question of whether or not there is a place for private money in modern economies.

Private Money: Hayek, Ingham, Selgin

There have been extensive debates between economists about whether there is a place for competing private monies within our system, and whether or not their impact or adoption would have a positive effect on the economy. One of the most renowned peddlers of private money is Austrian-British economist Friedrich August von Hayek. He stated that, “money is the one thing competition would not make cheap, because its attractiveness rests on it preserving its ‘dearness’” (Hayek, 1990). Hayek argued that the government has been abusing its monopoly on money through unproductive activities such as financing wars. He believed that if people were

given a viable alternative they would avoid using a government-issued currency and that excessive deficit spending is driving the economy towards inflation. If a government-issued currency was forced into competition with privately issued money that could force it to discipline itself and avoid reckless spending. Hayek considers the “monetary regime” to be a governmental failure and a main source of instability in the economic system (Hayek, 1990). He argued that if money was regulated by the market it would be more stable and welfare would increase.

Hayek believed that inflation could be tamed through the competition between currencies. He argued that with competition between private money, forces would tend to promote the emergence of a single global money, but it would take time, especially as conditions differ between regions. He believed that as long as local monies could be freely exchanged against one another, transaction costs would be significantly reduced with the help of computers. However, as American economist Robert Murphy states in a critique of Hayek’s ideas, “we cannot say that the benefits of a single money outweigh all other considerations” (Murphy, 2020). Murphy specifically critiques the viability of a single global money, because if the firm issuing the new global money were a monopoly, its owners would be incentivized to spend it themselves. The monopoly issuing firm would have to periodically increase the supply of the currency to maintain its purchasing power. The firms would then need to give new units of currency to its customers and would therefore end up acting as a bank, paying dividends on deposits (Murphy, 2020). Murphy’s critique of Hayek’s argument exhibits a need for private currencies to be untethered to any centralized entity in order to overcome the problems associated with past examples.

Geoffrey Ingham shares an opposing view to Hayek’s when it comes to private money. He has written extensively on the topic focusing much of his argument on the failure of

proponents of private money to consider the core functions of money. As we transitioned into the internet age, along with it came a flood of sentiment that internet barter-credit transactions might mean the end of money, rendering central banks redundant. Ingham notes that the possibility of this is not unfounded but warns of further problems that could arise. He argues that denationalized money could evade tax authorities and monetary regulation which would harm social welfare programs and stifle macroeconomic management. He sees the debate about the future of money as just a single element of broader “economic liberal and social communitarian” hopes that the internet could provide emancipation from the state (Ingham, 2002). Ingham’s criticism here highlights the need for transparency within a system that is not directly managed by a central authority.

Ingham’s main conflict with many who speculate about a future with this type of money is that he believes they are either ignoring, or lack an understanding of, the fundamental nature of money. As we discussed previously, Ingham defines money in terms of its functions as a medium of exchange, a means of payment, a money of account, and a store of value. However, many of the arguments for internet based private money are based on Orthodox economic theories which regard the medium of exchange as the most important of these functions. Ingham argues that ignoring or putting less weight on the other functions of money is a mistake. He warns that there is a tendency in this debate to confuse specific forms of money such as paper, metal, or electronic signals with the “generic properties of money as measure and bearer of abstract value” (Ingham, 2002). He writes, “some [...] have a vision of a truly transcendental global order: a vast “moneyless” market, made a reality by a vast barter credit clearing system based on a fabulously more powerful successor to the Internet” (Ingham, 2002). These people tend to brush off the importance of sovereign backing of money, essentially putting all of their faith into the internet

of the future technology that such a money would be built on. Therefore any new system of private digital money could only hold as much integrity as the computer systems that verify the creditworthiness of each party's assets. Here, Ingham warns that trust lies at the core of any strong currency and for people to put their trust in "a fabulously more powerful successor to the Internet", the technology must be truly resistant to malpractice.

Ingham's final argument considers the function of money as a unit of account. He points to the economy of mid-18th century Boston which had issued no currency. Instead, debts for farmers and traders were recorded in money of account which was based on the English currency. While this seems like a moneyless system of abstract credits and debits it was actually a cashless system. While there was no physical cash being exchanged, it still required one thing that all true money needs, a unit of account, which in this case was the English pound sterling. He argues that this is a prime example of why the Orthodox economic theory doesn't hold up. Orthodox economists argue that a commodity standard, based on prices for baskets of commodities, could both produce a benchmark value and a unit of account. Furthermore, constructing a money of account would simply be a matter of public choice and regulation would be more difficult. Ingham believes that this is a dangerous oversimplification of the problem, highlighting a misunderstanding of money as the value of commodities without commodities. For example, even with the gold standard, by buying gold at a fixed price, the central bank was stabilizing the market because their promises to pay were essentially a market order that fixed gold to a dollar value (Ingham, 2002).

Despite his criticisms, Ingham notes that doubts about the possibilities of new private money do not mean there is no merit in their consideration. In fact, he argues that it means we need to pay more attention. In the end it all boils down to the ability of the new form of digital

money to build trust. Trust in the security and viability of the cyberspace in which the money operates ultimately controls the money's potential. To connect this sentiment with what we are seeing today, there has been a rapid increase in the investment in and adoption of cryptocurrencies. Whether the trust in these assets is well-founded remains to be seen, but if the trends continue it will be crucial to truly consider the possibilities and consequences cryptocurrency adoption poses.

Another economist who has written extensively on the subject of private currencies, but with particular focus on cryptocurrencies is George Selgin. In an article, *Bitcoin: Problems and Prospects*, Selgin opens by highlighting that according to Carl Menger, the founder of the Austrian School of economics, any ordinary good can become money if it is accepted as a medium of exchange. Because this would require no action by the government it would appear to be a positive for Bitcoin or other cryptocurrencies becoming the dominant medium of exchange. Given the rapid acceleration and adoption of Bitcoin, it would seem that it isn't out of the question that Bitcoin or another cryptocurrency becomes a truly viable currency. However, he notes that the first problem cryptocurrencies face in this regard is that Bitcoin, for example, doesn't fit the economist definition of money and therefore cannot serve as a unit of account. Menger's theory "suggests that it is highly unlikely, if not impossible, that something like Bitcoin should ever become employed, let alone generally, as a medium of exchange" (Selgin, 2014).

However, because Bitcoin's adoption has accelerated so quickly and hasn't shown signs of slowing, it isn't out of the question that Bitcoin could eventually qualify as money. Similar to Hayek's sentiments, Selgin argues that if Bitcoin (or some other cryptocurrency) were to become the preferred currency "we would no longer have to worry about the Fed mismanaging the

money stock. Instead we'd have a Bitcoin supply that's strictly regulated—predetermined, in fact—with the supply rising at a gradually declining rate toward a limit of 21 million Bitcoins. Hyperinflation, or even inflation at more modest rates, would therefore be highly unlikely” (Selgin, 2014). Selgin admits that there is no undeniable reason to assume that it would be stable, especially because Bitcoin has been characterized by extreme volatility since its inception in 2009. However, it must be considered that even in its short lifetime, Bitcoin has become significantly less volatile as its adoption rate has increased. As Bloomberg's Crystal Kim points out, “it appears the gyrations [of Bitcoin] are diminishing if you take a longer view, which Bloomberg Intelligence commodity strategist Mike McGlone attributes to a natural maturation and greater institutional adoption” (Kim, 2021). Regardless, a key detail to note when considering this is that the value of Bitcoin that is fluctuating refers to its exchange rate with the U.S. dollar. Theoretically, in an economy where Bitcoin is the dominant money the only sort of stability that would matter would be Bitcoin's value relative to goods and services. “For that reason Bitcoins' purchasing power in a fully ‘Bitcoined’ economy would almost certainly be considerably less volatile than the present Bitcoin-dollar rate” (Selgin, 2014). Selgin argues that because of Bitcoins steadily declining supply, there would be deflation at least equal to the rate of economic growth “with occasional bouts of more severe deflation occurring with every cyclical increase in the demand for money” (Selgin, 2014). Further, he notes that deflation doesn't necessarily have to coincide with recessions and depressions as long as the deflation rate reflects the total factor productivity growth rate. For example, the gold standard permitted some deflation but it wasn't severe enough to impede economic growth. Bitcoin cannot be sure to be better than the gold standard, or even better than the dollar. In fact Selgin believes it to be more likely that a new modified version of Bitcoin would be. This could be Bitcoin itself or an alt-coin

(any other cryptocurrency), that is currently in its infancy or yet to be created that is built on a superior technology making it more efficient, scalable, and/or cheaper.

The last aspect of private money that we must address regards the topic of inflation, which is central to many debates concerning the adoption of cryptocurrencies. The Federal Reserve insists on treating a 2% inflation rate as the absolute floor. Selgin notes that a 2% inflation rate means halving the value of the U.S. dollar every 36 years. However, in practice this means we can expect the dollar to lose value significantly faster than that with booms and busts along the way. He believes that in the same way its creators were able to come up with Bitcoin's programmed supply protocol, they could also come up with what he refers to as a more "macroeconomically smart" protocol. This could provide the basis for an exceptionally stable and well-behaved cybermoney" (Selgin, 2014). There are many possibilities for such a protocol. For example it could allow for long-run growth of the money stock that is consistent with output or other factors such as increasing labor and capital input. It could also allow feedback-based for cyclical adjustments based on transaction volumes. Because of the implementation of a smart protocol like this, the cryptocurrency would be beyond anyone's power to manipulate and would remain elastic in a "macro-economically desirable way" (Selgin, 2014). However, with all of this said, because the currency would be both competitive and deflationary, currency consumers could still be incentivized by profits to choose the cryptocurrency that brings about the most severe deflation, which could pose real problems for the economy. Therefore, Selgin's hypothesized macroeconomically smart cryptocurrency would likely need to be directly managed and enforced by a central authority in order to ensure economic stability. Mass adoption of a currency like this in free competition with other cryptocurrencies would be very unlikely.

Instead, this would likely take the form of a Central Bank Digital Currency (CBDC) which we will discuss more in Chapter 4.

Chapter 2: Crypto-Assets

In this chapter we will dive deeper into the world of cryptoassets. We will discuss a variety of cryptoassets as well as the underlying technology that makes them possible. This will include technical explanations of how blockchains work and how they are, for the first time, revolutionizing the back-end infrastructure of the internet. Note, that while the term cryptocurrency is commonly used to describe everything within the crypto space, cryptocurrencies are really just one piece of what has evolved into a dynamic and diverse industry. Cryptocurrencies, utility coins, and security tokens, all fall under the umbrella of “cryptoassets”. As such, we will use the term cryptoasset when speaking generally about the industry, and the term cryptocurrency when talking about non-security cryptoassets such as Bitcoin and Ethereum.

DLT and Blockchain

To understand cryptoassets we first have to understand the technology on which they are built, the blockchain. However, to understand the blockchain we must dig even deeper by introducing the foundation of it all, distributed ledger technology (DLT). Because these topics are so technical, it is often difficult to understand them without using equally technical terms, so let's break this down as simply as possible before we get into the weeds.

We use physical cash everyday to exchange goods and services. One way to keep track of this would be to use a book containing everyone's name and the amount of cash they have between transactions. When cash is exchanged between two individuals, the total amount of cash each of them has would be updated in the book. This of course requires someone to keep track of the transactions that are taking place by continuously updating the book. Consequently, if the transactions of everyone in the world were recorded in the book, there would technically be no need for cash in the first place. Of course, this brings up the question of who controls the book. If someone were to have control over the book they could manipulate it for their own benefit. Today we entrust the control of the book to our governments who in turn promise to manage it fairly. The alternative to this is to simply not untrust control of the book to any one individual or entity. In the case of distributed ledger technology, the book, or "ledger" is not controlled by any one entity but instead is stored on millions of individual computers around the world. Hence, distributed-ledger-technology (DLT). These computers all communicate with one another and must continuously agree on the contents of the ledger. If any computers try to manipulate the ledger, their work is rejected by the millions of other computers who have together reached a common consensus. This is the essence of DLT.

DLT is a database that is both shared and managed in a decentralized format. This means that there is no central controlling authority, but rather the database is managed by many independent nodes across the network. This allows for a decentralized and secure database because everything is verified through consensus across these nodes, making tampering and hacking vastly more difficult than in a centralized system. Instead of relying on trust, DLT relies on verification. While DLT is central to cryptocurrencies and the decentralized finance movement, it has many potentially revolutionary applications outside of this such as for personal

identification, deeds, birth records, and anything else requiring secure data storage (Noam, 2019).

The biggest implication of DLT technology is that it can remove the need for putting trust in intermediaries such as real estate agents, lawyers, companies, or in the most extreme case, central banks. Instead of trusting a central authority, DLT allows for trust to be put into the hands of the network's protocol which cannot be altered in any way without majority consensus. This allows for progressive changes and innovations to be made to the network while still being resistant to manipulation. The bigger the network, the more nodes, and the more secure. Hacking a large decentralized system is virtually impossible because of the sheer computer power required to bypass so many independent nodes on the network.

Within DLT there are varying types of networks. There are permissionless-public networks in which anyone can become a node and view every action taking place. Permissioned-public networks, where you must go through an admittance process to become a node, enabling everyone to view actions but also allowing for private channels within the network. Finally, there are permissioned-private networks which require users to both apply to become a node and attain permission to view actions (Noam, 2019). Bitcoin is an example of a permissionless-public network, allowing anyone to become a node and anyone to view all transactions that occur. The permissionless and transparent nature of the Bitcoin network is what makes it the most secure public database ever created because malpractice of any kind is so easily detected and rejected. Additionally, its permissionless nature has allowed for indiscriminate and exponential network growth, making it even more resilient.

Blockchain technology is an application of DLT and is responsible for the introduction of cryptoassets. Blockchain technology is what allows cryptoassets to operate in a decentralized

fashion without financial intermediaries like banks. Transactions on blockchain networks are shared in real-time among all network participants. Information such as transaction amount, sender, and receiver is all stored and shared on the blockchain. Put simply, the blockchain is an ordered chain of blocks. Each block holds information about a list of transactions, and every node in the blockchain holds a copy of the entire chain of blocks which represent the history of every transaction ever executed on that blockchain. The system continuously updates and each participant's copy of the blockchain is kept synchronized with the other copies. This distributed record of all transactions prevents malpractice because attempted changes to any blocks can easily be cross-checked and rejected (Noam, 2019), (Burniske and Tater, 2018).

Now to go more in depth on exactly what is going on within these blocks. Each block in a blockchain consists of three sets of information. First, each block references the previous block to maintain the order the block was added. Second, each block contains details about the transactions such as amount, sender, and receiver. Third, each block holds a randomly generated number which is referred to as a “cryptographic nonce.”¹ The blocks are linked together in a chain using the cryptographic equivalent of fingerprints which are called “hashes.” Each block contains both its own distinctive “hash” and the “hash” of the previous block which ensures the order cannot be confused and any attempt to alter a set block in the chain will result in easily identifiable inconsistencies. All participants in the blockchain can see the addresses of all the transactions that take place and access to the blockchain is secured with public key cryptography. Essentially, every participant in the blockchain has a public key, which serves as their address, and a private key which they use to sign transactions, similar to a bank personal identification number or PIN (Noam, 2019), (Burniske and Tater, 2018).

¹ A nonce in cryptography is a number used to protect private communications by preventing replay attacks. Via Security Encyclopedia

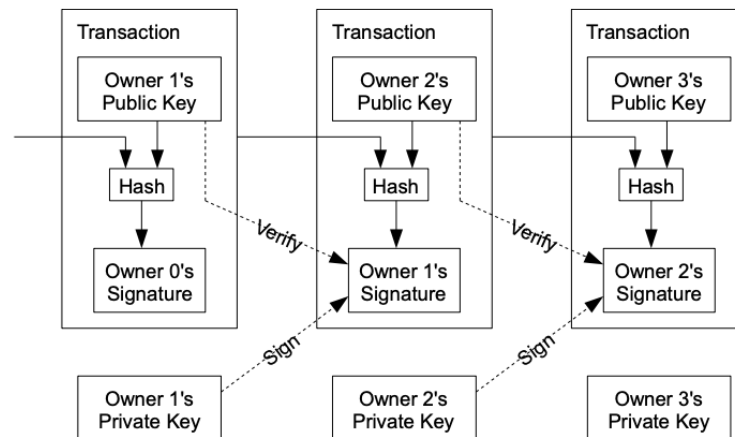


Figure 1.0 is an illustration of how this process works with Bitcoin.²

Bitcoin

Just like we did with DLT and blockchain, it will also be helpful to explain Bitcoin using these same simple terms. In our example, we have a book (ledger) that is stored on millions of computers all around the world (nodes), and contains information about how much cash individuals have. From this, two more questions arise. How do you convince people to store the book on their computers, and how do you convince governments to use the book instead of cash? While the simple answer is you can't, Satoshi Nakamoto tried with Bitcoin. Nakamoto created a new book, called Bitcoin. Instead of cash, this book uses a new currency called bitcoin, and instead of individuals' names, this book contains anonymous IDs. The only way to earn bitcoin is to store the book on your computer. When people send each other bitcoin, the computers that are storing the book on them do the work required to verify the transaction. These computers receive a reward for their work. This is the process we mentioned in Chapter 1 called mining.

² Via Bitcoin Whitepaper - bitcoin.org

Bitcoin is the most well-known and widely adopted cryptocurrency. Introduced in 2008 by the anonymous person or group, Satoshi Nakamoto, Bitcoin was the first cryptocurrency to be created, and the first known use of what would come to be known as blockchain technology. According to Bitcoin's white paper, it is "a chain of digital signatures. Each owner transfers the coin to the next by digitally signing a hash of the previous transaction and the public key of the next owner and adding these to the end of the coin. A payee can verify the signatures to verify the chain of ownership."³ In January of 2009 the Bitcoin network went live when the first block on the blockchain was mined.

Mining is also the process by which new coins are introduced into supply. Instead of an intermediary or broker verifying transactions, bitcoin transactions are verified by thousands of computers all around the world. Each computer contributes power to the network and in addition to receiving payment for this work in the form of fees collected from senders, miners receive periodic payouts in new coins that have yet to be introduced into circulation. The new bitcoins are rewarded to miners according to the network's set protocol, and the amount paid out continues to be halved every 210,000 blocks until essentially all 21 millions bitcoins are in circulation (Noam, 2019).

The first block of the Bitcoin blockchain, known as the genesis block, contained text that read "Chancellor on Brink of Second Bailout for Banks." This was a reference to a London Times article regarding the 2008-2009 bank bailouts and sparked the reputation of Bitcoin, and cryptoassets in general, as anti-establishment and a solution tailored to the growing anti-big bank sentiment (Nibley, 2021). Since its inception, Bitcoin has unleashed a wave of disruption across the financial and technology industries. Additionally, Bitcoin's open source code has allowed for the creation of many derivations of Bitcoin such as Ethereum, Litecoin, and Monero. In the

³ bitcoin.org

following years, countless more cryptoassets and projects have emerged, seizing the attention of retail and institutional investors across the globe.

Ethereum and Web 3.0

You cannot write about blockchain and cryptoassets without mentioning Ethereum. It is through understanding Ethereum that we can begin to grasp the true potential of blockchain technology and the impact cryptoassets are having on the financial industry. Before we enter the weeds once again, let's apply the same explanation from before to Ethereum.

Besides simple transactions, there are countless other activities that we can engage in with our money such as borrowing and lending. To keep things as simple as possible, if one person wants to borrow money from someone else, they will likely sign a contract that holds them to their agreement. This would be a contract that includes the amount borrowed (the loan), the cost of borrowing (the interest rate), and how long they have to pay the money back (the term). Ethereum allows these contracts to be digitally created and self-executed, opening up crypto markets to a variety of financial practices. These are called “smart contracts” and these arrangements are collectively referred to as decentralized finance (DeFi).

Co-founder, Joseph Lubin, describes Ethereum as “a platform on which you can build, deploy and use decentralized applications” (Frankenfield, 2022). Ethereum was the first programmable blockchain, allowing users to build their own projects on top of the broader network. Today, there are over 3,000 decentralized apps (Dapps) running on the Ethereum blockchain itself and many more being built on newer programmable blockchains (Shah, 2021). While functions can be similar, apps on a blockchain like Ethereum are not managed by a central

authority like Google, Facebook, or Robinhood which ultimately control all customer data. The purpose of decentralized apps is to put the control back in the hands of users. The DeFi industry exploded in 2020 and is seen by many as the next iteration of the internet. However, because the technology is still in its relative infancy, many dapps are experimental and sometimes outright scams.

DeFi is the most revolutionary use case of programmable blockchains such as Ethereum, Solana, and Cardano. DeFi's purpose is to expand the utility of cryptoassets to more complex financial use cases beyond simple peer-to-peer transactions. DeFi dapps and smart-contracts, are much like everyday financial contracts but are digital and programmable. Beyond our simple lending/borrowing example, another more complex example of a smart contract would be one user agreeing to sell an asset to another user at a set price on a set date, just like a traditional futures contract. Once that date comes around the smart-contract would automatically execute and verify the transaction. This allows for complex financial activity to take place on blockchains, such as loans and derivatives. Some notable examples of Ethereum's Dapps include Compound, a decentralized lending platform (compound.finance), WBTC, a 1:1 bitcoin backed token intended to bring Bitcoin's liquidity to the Ethereum network (wbtc.network), Status, a wallet and private messaging app (status.im), Unstoppable Domains, which allows for the creation of decentralized domains (unstoppabledomains.com), OpenSea, a marketplace for non-fungible tokens (NFT's) such as digital art (opensea.io), Livepeer, a decentralized live-streaming network (livepeer.org), and Decentraland, a virtual reality video game with digital real-estate (decentraland.org), (ethereum.org).

All of these dapps are a part of a broader transition of the internet known as Web 3.0. The first iteration of the internet, known as Web 1.0, was a "read-only web" in which users could

search for and read information from largely non interactive websites. This revolutionized the spread of information, allowing for seemingly infinite and free distribution to anywhere in the world. Web 1.0 was largely a decentralized internet, with information being freely and equally accessible and uncontrolled by any large centralized entities. However, the internet slowly evolved into the internet we use today, known as Web 2.0. Sites like Youtube and MySpace epitomize the transition to Web 2.0, with the introduction of user generated content, interoperability across different services, and an explosion in participation levels. While nothing significant changed at the core, or back end, of the internet as a technology, the front-end changed dramatically. The pillars of Web 2.0 are mobile technology, social media, and the cloud (Kenton, 2022). The exponential growth of internet users attracted massive investments and resulted in the rise of tech giants such as Google and Facebook. These tech companies have become some of the most valuable companies because of the control they have over their users' data. With the rise of ecommerce in particular, user data became a valuable commodity and tech giants became monopolies through data extraction and exploitative advertising and marketing practices. Companies like Facebook, now Meta, have continuously come under fire for mis-using user data and selling it to third parties without the knowledge or consent of the individuals themselves. Unfortunately, before now there has been no reliable way for users to protect their own data from these companies. When a company like Google plays such an integral role in the entire user experience it is virtually impossible to avoid giving up your data anytime you engage in activity on the internet.

At its core, the most groundbreaking feature of blockchain technology is that, for the first time, value can be securely transmitted as data across the internet without relying on any third party. The broader significance of the incorporation of cryptography, blockchain technology, and

dapps, is that it is pioneering a new era of the internet. With web 3.0, the back-end infrastructure of the internet is finally going through a much needed transformation. This new iteration of the internet, built on blockchain technology, has introduced an advanced metadata system that structures and arranges data to be readable by both machines and humans. Consequently, the pillars of Web 3.0 are artificial intelligence (AI) and decentralized networks. The AI-friendly component of Web 3.0 is an overall improvement to the internet back-end, which enables machine-to-machine interaction, advanced analytics, and other smart operations that were previously not possible. However, the more impactful pillar is the use of decentralized networks, which puts data back in the hands of the entities who actually own it. In this way, Web 3.0 empowers users to own their own data and be self-determinant in how their data can be shared. This decentralized back-end also encrypts user data, allowing for unprecedented improvements in privacy and security, which would have been unimaginable in previous iterations of the internet. With Web 3.0, trusting third parties such as Google to act responsibly with user data can become a thing of the past as the internet transitions to a more secure and efficient system that puts power back in the hands of users (Allyn, 2021).

Another important use-case of Ethereum's blockchain is its ability to host stablecoins, which are essential to the trading of cryptoassets in the fiat world. According to ethereum.org, the most widely used stablecoins are Tether and USDC, both of which are 1:1 pegged and backed by the U.S. dollar. This allows users to convert US dollars into a USD-backed stablecoin, and use them to purchase other cryptoassets and participate in the DeFi ecosystem. Conversely, cryptoassets can be converted back into USD through this same process. Finally, stablecoins allow for US dollars to be transferred in the form of stablecoins without the use of centralized

authorities or banks without being converted into other un-pegged cryptoassets (Burniske and Tater, 2018).

While Ethereum is a cryptocurrency, it also falls under the category of “alt-coins” which is a blanket term commonly used to refer to any cryptoassets that are not Bitcoin. Notable alt-coins include Tether, Cardano, BNB, Solana, XRP, and Terra, which are the largest by market capitalization as of January 2022 according to CoinMarketCap, but are only a few of the thousands in existence. Many of these alt-coins are themselves built on the Ethereum blockchain, meaning despite having their own use-cases and tokens, they still rely on the Ethereum network to run. While companies like Cardano and Solana hope to one day surpass Ethereum as the leading programmable blockchain, it is still solidly at the top.

Chapter 3: Blockchain Use-Cases

Since Bitcoin's inception, blockchain technology and cryptoassets have been touted as the solution to almost every problem imaginable. From privacy concerns and issues with payment systems, to supply-chain inefficiencies, there is a blockchain project for everything. But how real are the problems they are trying to solve, and how well does this new technology address these problems? In a letter included in cryptocurrency exchange Coinbase's public filing documents, CEO Brian Armstrong wrote, “trading and speculation were the first major use cases to take off in cryptocurrency, just like people rushed to buy domain names in the early days of the internet. But we're now seeing cryptocurrency evolve into something much more important” (Webber, 2021). This chapter will dive into some promising blockchain use-cases and assess the viability of the solutions they offer.

Cross-Border Payments

One of the widely touted benefits of cryptoassets is their ability to facilitate fast and cost-effective cross-border payments. According to the World Bank, the global average transaction fee for worldwide payments is 6.3%. There are a variety of methods for cross-border payments, all of which have benefits and drawbacks. International Wire-Transfers are the fastest method of cross-border payment but come with hefty transaction fees that can exceed \$50 dollars depending on the bank dollars, making them not suitable for small transactions. Another option is Global ACH payments which have lower transaction fees but can take days to be processed. Additionally, this requires the payee's International Bank Account Number as well as other account information. The next option for cross-border payments is PayPal. International PayPal transactions are notoriously inconsistent in terms of speed and come with high fees. Prepaid debit cards are another option for cross-border payments. This is a good option for quick payments but fees are charged to both payers and payees. These transactions are also not covered by federal consumer protection laws, but are good for payments to underbanked countries. The final option is paper checks. This method is very cost-effective and the only information required is the payee's name and address. However, this is also the slowest method of cross-border payment, often taking weeks for the check to arrive and be cashed. Paper checks are also at risk of fraudulent activity because of their physical nature.

The final method for cross-border payments is cryptoassets. Cryptoassets provide an alternative to the trade-off between cost and transaction speeds associated with traditional

methods. In recent years, more and more companies have begun using cryptoassets to facilitate cross-border payments, and international crypto payment providers like BitPay cite high transaction speeds and low friction as key benefits over other methods. Today, major companies including Microsoft, Tesla, Expedia, and WeWork have begun accepting payments in cryptoassets and even established card networks, Visa and Mastercard have announced moves into the space. Interestingly, even one of the previously mentioned international payment methods, PayPal, has begun to support crypto as a cross-border payment method which suggests that they view it as one of the best solutions to the issues that plague other methods. Ahead of this announcement, CEO of PayPal, Dan Shulman stated, “We think it is a transitional point where cryptocurrencies move from being predominantly an asset class that you buy, hold and or sell to now becoming a legitimate funding source to make transactions in the real world at millions of merchants” (Irrera, 2021).

A study by PYMNTS and Stellar Development Foundation titled, “Digital Currency Shift: The Cross-Border Remittances Report,” found that 70% of US consumers pay some kind of fee when making international payments with average percentage fees of 6.2% and fixed fees of \$14.8. The study also found that nearly 25% of these US senders use crypto and that, for over half of those that do, crypto was their main method for making these payments.

TABLE 2:

Most common method for recipients to receive cross-border payments

Most common method by which recipients receive these payments, by payment method used

	Directly into their bank account	Directly into a mobile wallet	Cash from an agent or retail location	Not sure	Other
Average	46.8%	30.1%	14.0%	8.5%	0.7
Bank transfer	52.3%	30.4%	11.2%	5.9%	0.1
Debit card	45.6%	33.1%	15.9%	5.3%	0.1
Credit card	45.3%	34.5%	14.1%	6.1%	0.1
PayPal	42.9%	36.9%	11.8%	7.6%	0.8
Mobile wallet	39.9%	41.4%	12.4%	6.2%	0.1
Cash	39.4%	32.3%	22.8%	5.3%	0.2
Cryptocurrency	34.9%	46.2%	12.3%	5.9%	0.7

Source: PYMNTS.com

While bank transfers, credit/debit cards, and PayPal remain the most common methods of cross-border payments, cryptoassets are becoming an increasingly common method for these remittances. Low transaction fees are one of the primary incentives for using cryptoasset as a method of payment (Fonda, 2022). At the time of writing this, the average transaction fee on the Bitcoin blockchain is \$1.948 while other more efficient blockchains like Solana have an average fee of just \$0.00025 (ycharts.com). However, because cryptoassets are still in their relative infancy, proof-of-work blockchains like Bitcoin in particular cannot handle extremely high transaction volumes and are prone to congestion which has driven average fees as high as \$62.79 in April of 2021 (ycharts.com). Blockchains like Solana utilize a more efficient and scalable proof-of-stake model for verifying transactions. However, many people argue that using proof-of-stake is inherently less secure than proof-of-work and gives more influence and power to those who can afford to hold a large allocation of the asset. This means that while blockchains undoubtedly provide a viable solution to some of the issues with traditional methods of cross-border payment, given the current state of mining technology, not all blockchain's can

currently support the transaction volumes of the traditional methods. Conversely, between different blockchains there emerges another trade-off as those that support higher volumes while still keeping fees low may be sacrificing security, privacy, or inclusivity.

Accountability in Traditional Contracts

Currently financial contracts are generally reliant on some form of intermediary or third party to ensure that the conditions laid out in the contracts are met and that all parties are held to their end of the agreement. Blockchains like Ethereum allow for the creation of smart contracts which offer a safe way to bypass these intermediaries without sacrificing the security of the deal. IBM defines smart contracts as “programs stored on a blockchain that run when predetermined conditions are met. They typically are used to automate the execution of an agreement so that all participants can be immediately certain of the outcome, without any intermediary's involvement or time loss.” Additionally, smart contracts can “automate a workflow, triggering the next action when conditions are met.”⁴ There are three different types of self-executing smart contracts, smart legal contracts, decentralized autonomous organizations (DAOs), and application logic contracts (ALCs) (Rupareliya, 2021). Smart legal contracts are legally enforceable and require all parties to satisfy the obligations as laid out in the contract. Examples of smart legal contracts include everything from automated financial trading, automatic document creation and filing, and immediate and automatic insurance payouts. DAO's are transparent, open-source, and incorruptible contracts in which any action taken by community members is replaced by self-enforcing code. DAO's are bound to specific rules and governance mechanisms that are coded into its blockchain contracts. Bitcoin is the earliest example of a DAO. ALC's are smart

⁴ Via ibm.com

contracts which allow devices to function autonomously which facilitates cheaper transactions and increased scalability. ALC's are the foundational piece of any multi-function smart contract and are usually overseen by a managing program.⁵ Because smart contracts are built on the blockchain, they are tamper-resistant and can guarantee more security than traditional contracts without relying on intermediaries. With everything on the blockchain being completely transparent, smart contracts remove the need for trust while also offering faster resolution than traditional manual processes, saving time for all parties involved.

With the rise of DeFi, smart contracts have exposed inefficiencies within the financial services industry and provided an alternative to how business is done. A great example of how blockchain smart contracts can improve the financial services industry is in the processing of insurance claims. Traditionally, assessing the legitimacy of an insurance claim is a tedious process. Manually counter-checking the terms of traditional contracts and validating claims can take a long time. Blockchain-driven smart contracts offer a secure way to automate insurance claim processing by allowing claims to easily be filed and validated through the decentralized ledger of the blockchain network with limited oversight. This reduces the risk of financial institutions having to compensate fraudulent claims. Additionally, because transactions governed by smart contracts are self-regulatory, they significantly lower costs in the long run by facilitating low-cost record-keeping with little to no need for manual intervention.

Another application of smart contracts in the financial services industry is in auditing. Record-keeping is essential to facilitate audits, meaning traditional contracts involve a lot of paperwork (physical and digital), requiring banks to invest in people or other resources to manage and process them. Blockchain-powered smart contracts support advanced bookkeeping tools which are based on incorruptible distributed codes on the network. This not only enhances

⁵ Via ostechnix.com

the transparency of stored records, but also eliminates the possibility of infiltration (Rupareliya, 2021).

Smart contracts also allow for a more streamlined know-your-customer (KYC) process, which is a crucial function in the financial services industry and often required by regulatory bodies. Before offering loans or engaging in any type of transaction with individuals, banks and financial institutions must verify the identities of their customers. This is made much easier with smart contracts systems which can verify identities and other more specific information like credit scores or tax returns instantly (Rupareliya, 2021). This is tied to another application of blockchain technology, digital identities, which we will discuss later in this chapter. Both financial institutions and customers benefit from the implementation of smart contracts because they cut costs for banks while streamlining the process of ensuring regulatory compliance and providing easier and secure transaction methods for customers.

Supply Chain Management

One of the most directly applicable implementations of blockchain technology is its potential to increase efficiency in the complex industry of supply chain management. Blockchain technology has shown great potential to eliminate fraud within the supply chain while simultaneously increasing revenues. Blockchain-driven supply chains can “increase traceability of material supply chains to ensure corporate standards are met; lower losses from counterfeit/gray market trading; improve visibility and compliance over outsourced contract manufacturing; reduce paperwork and administrative costs” (Laaper 2021). Additionally, by using blockchain technology, companies can strengthen their reputation by being truly

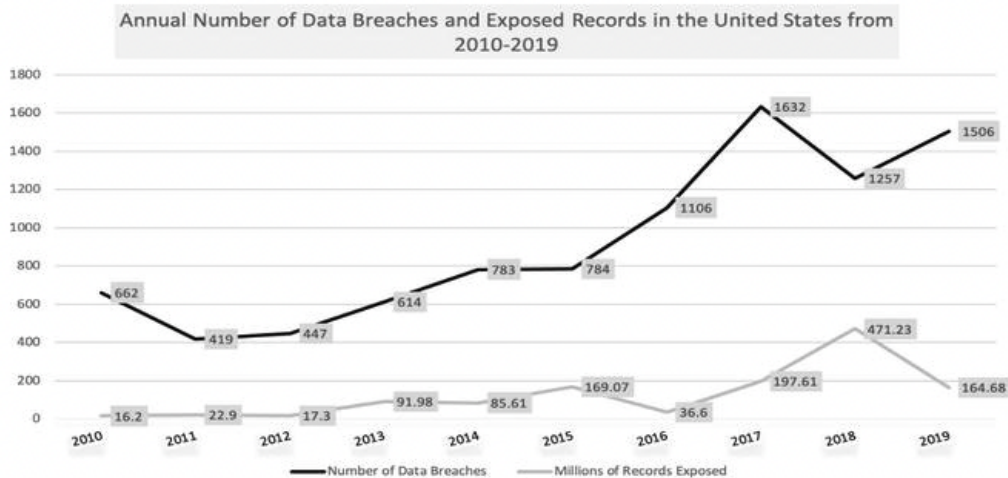
transparent about the materials used in their products. Blockchain technology has the potential to improve overall trust between buyer and sellers within supply chains and force companies to improve their standards and provide safer products to consumers.

Personal Identification, Data, and Privacy

In our current identification system we use physical documents such as driver's licenses, passports, and social security cards to verify our personal identity. While this works fairly well in the physical world, it has not translated very well to the digital world, and with an ever-increasing amount of highly personal activity taking place on the internet it has become more important than ever to be able to accurately and securely verify our identities online. Currently, identity verification on the internet relies on phone numbers and email addresses to prove our identities in a sufficient time frame. KYC requirements for more important internet-base activity such as online banking often rely on a combination of phone numbers, emails, ssn's, or even photo-proof of a physical ID resulting in long delays while still not absolutely guaranteeing a safe and secure identification process. With frequent cybersecurity failures and increasing regulation, maintaining the privacy of personal information has become an important issue for individuals, and a strategic concern for many organizations. Additionally, personal data is constantly gathered and stored by organizations and used or sold for profit at the expense of their customers' privacy. Blockchain technology has the potential to offer safe and secure solutions to issues related to identification, data-use, and privacy.

In our increasingly online world, cybersecurity has become increasingly important for governments and businesses. In particular, information security, which focuses on protecting the

integrity and privacy of data, can make or break businesses that fail to keep up with the rapid innovation in the practices used by those with malicious intentions. Despite advances in security protocols and software, according to a 2020 report by Risk Based Security, “the total number of records compromised in 2020 exceeded 37 billion, a 141% increase compared to 2019” (Heister, and Yuthas). Data breaches by cyber-hackers leads to sensitive information being stolen such as passwords, credit card information, and even ssn’s, leading to credit card fraud and identity theft which can result in negative effects on personal credit that can take months or even years to remedy.



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The right to privacy is considered to be a basic human right in many parts of the world, and with the rise of the internet, this right has become increasingly compromised. In response to this, states and governments are actively passing increasingly strict regulations to ensure institutions are adequately protecting the personal data that they collect. Blockchain technology is uniquely positioned to both help companies comply with these regulations and provide individuals with secure alternatives to centralized data storage.

⁶ Via [statista.com](https://www.statista.com)

One of the biggest blockchain-based solutions to the problem of personal data is the implementation of decentralized digital identities. Proponents of blockchain technology widely believe that self-sovereign identities provide the best solution to these security challenges. This would allow individuals to have control over their own identities and control how facets of their identity are shared with others. “Currently, our identity and all our digital interactions are owned and controlled by other parties, some of whom we aren’t even aware of” (Heister, and Yuthas). Returning ownership of individual data can benefit both those individuals and the organizations that would otherwise be responsible for protecting the data themselves. Decentralized identities (DIDs) are owned and controlled by individuals and stored on the blockchain and can instantly verify the validity of claims a user makes about their personal information. A DID can be created by anyone and initially has no information associated with it. The owner of the DID can attach information to it such as driver’s license or other identifying information. Just like a confirmation code is sent to the email address of someone attempting to sign into an account associated with that address, the owner of the DID would verify that it is them by providing a private key (password). However, unlike an email account, the DID is securely stored on the blockchain and owned by a person rather than an email service provider. This allows users an enhanced level of security while still being the only party with access to their private key. DID’s solve what is referred to as the “correlation problem”, which is when common identifiers such as email addresses or phone numbers are used on different sites. This allows entities to associate information about a single identity across multiple systems without the user's consent. Tracking cookies and web clicks enable identities to be linked across websites allowing outsiders to gain a full picture of user identities including location, gender, age, interests and more (Heister, and Yuthas). The privacy of DID’s is ensured by zero-knowledge proofs which are cryptographic

algorithms that enable a prover to mathematically demonstrate to a verifier that a statement is correct without actually revealing any of the sensitive data. A simple example of how this works is when an individual must provide proof of age when attempting to buy an age-restricted item online. Instead of providing the seller with a driver's license containing unnecessary information such as exact age, appearance, home address, etc.. a DID would allow an individual to prove that they meet the age requirement without actually revealing any of the specifics of their information. While this is a somewhat trivial example, this innovation would allow streamlined and secure identity verification for more critical functions, such as medical or insurance purposes, without compromising or exposing personal data.

Digital Copyright and Piracy

According to a study by the Global Innovation Policy Center for the U.S. Chamber of Commerce, global online piracy costs the U.S economy between \$29.2 and \$71 billion in lost domestic revenue annually. Additionally, it was estimated that digital video piracy results in \$47.5-\$115.3 billion in reduced U.S. GDP and a loss of 230,000-560,000 jobs per year (Blackburn, Eisenach, and Harrison, 2019). With media companies unable to successfully curtail these losses, many see blockchain technology as a potential solution to combat digital piracy. Digital piracy is extremely difficult to combat because it is virtually impossible to track or keep pace with the internet's boundless capacity to duplicate and spread information. Blockchain technology is positioned as the best solution to this problem primarily because it allows unlawful actions to be easily and accurately tracked through irreversible digital footprints embedded in the blockchain. However, a fool-proof implementation of this technology would require the entire

internet to be built on the blockchain which limits the full potential of this solution until Web 3.0 becomes commonplace.

Despite this limitation, there are still two main ways that blockchain technology can immediately be utilized to combat digital privacy. The first method is through content surveillance. Vevue is a blockchain streaming service which is developing a technology that tracks the life cycle of digital media content. Founder, Thomas Olsen stated that “if someone copies content tracked by our technology by any possible means, including videoing or recording a screen, our platform will be able to identify the owner of the device/system where the content was last played (Reiff, 2021).” In this case blockchain would provide a way to efficiently store, secure, and share the surveillance data.

The second immediate method through which blockchain can help is through “digital watermarking”. A company called CustosTech is using the blockchain to build a digital watermarking technology that allows monetary rewards in bitcoin to be embedded in media files. The embedded bitcoin is irremovable and imperceptible to the receiver of the content. This allows CustosTech to analyze the watermark to determine who the legal recipient of the file was (Reiff, 2021). As more companies and users adopt blockchain technology, the potential for blockchain-based anti-piracy tools will continue to expand, opening up new possibilities for decentralized copyright, piracy tracking and content validation.

Slow Public Sector

Blockchain technology has the potential to transform government activities by offering more efficient alternatives for organizing, processing, and handling information. Governments in

several countries have already been experimenting with blockchain technology across a variety of applications including healthcare, land registration, educational credentialing, procurement, supply chains, and identity management (Lemieux and Dener, 2021). One of the most fundamental roles of governments is storing and managing sensitive information, a historically complex and cost intensive process. As we discussed, online security is becoming increasingly important, and data hacks have become more common in recent years. This has had devastating effects on the companies that are exploited and the individuals whose data they secure. However, data hacks of government systems are even more dangerous and can have potentially catastrophic consequences. Because of this, governments are exploring different applications of blockchain technology to improve their existing centralized systems, which themselves are inherently inefficient, costly, and insecure.

As we outlined before, blockchain technology allows for the elimination of intermediaries, which could help combat corruption in many e-government services. Blockchains would allow governments to adopt a decentralized approach to appropriate functions, fostering real-time transparency, auditability, and functionality. This could allow for improved public sector efficiency and citizen engagement while streamlining the management of public affairs (CoinTelegraph, 2021). Additionally, governments could utilize blockchains to provide more secure identity management for their citizens through government issued digital identities. Because funding varies across federal, state, and local governments, and between different initiatives and agencies, blockchains can offer a way to reduce costs and improve efficiency when operating with scarce resources. This can help state actors budget more efficiently and more effectively track government transactions. Another important function of government entities is the disbursement of funds for social assistance, education, or for various humanitarian

aid programs. Unfortunately, grant disbursement processes tend to be slow, opaque, and convoluted, often subject to fees from banks or other third parties. With blockchains, government agencies could provide grants and other fund disbursements directly to their recipients while mitigating corruption or illicit financial siphoning and building public trust.

Another potential public sector application of blockchain technology is in electronic voting, an essential process for the functioning of democracy in the digital age. Election security has been a growing concern in the internet age and blockchain-based voting solutions could help eliminate election tampering while boosting efficiency and accessibility. Such a system could also work in tandem with government issued blockchain digital identities to maximize the efficiency of the voting process while protecting citizens and eliminating election fraud.

The next public sector application of blockchain technology that shows great potential is in the real estate industry. The US real estate industry in particular, has notoriously low levels of transparency as well as multiple dislocated parties that rely on manual processing. Additionally, high barriers to entry have resulted in fewer investors, predatory practices, and expensive underlying assets. This opens up various opportunities for the application of blockchain technology within the US land registry department for property registration, transaction processing and administrative purposes. A blockchain-based land registry system would provide all parties with exact, real-time, copies of the system, increasing transparency and efficiency by removing layers of cost and friction. This would also open up the real estate industry to a variety of new innovations including easy fractional property purchases.

The final potential public sector application of blockchain technology pertains to improving our healthcare system, for which 19% of U.S. GDP was spent in 2020 (Peterson-KFF). With healthcare costs continuing to rise along with health data breaches,

blockchain could prove to be a valuable innovation to improve the healthcare system. Blockchain technology could be applied across several key areas of healthcare including, “personal health record data management, point-of-care genomics management, electronic medical records (EMR), data management, healthcare data protection, and electronic health record data management” (CoinTelegraph, 2021). This could eliminate data breaches in doctor-patient confidentiality as well as streamline the management and deployment of medical supplies while also empowering patients through the ownership of their personal health data.

Blockchain technology is already being deployed by many governments for some of these very reasons. Denmark has rolled out a blockchain-based e-voting solution which has improved access to voting while improving security.⁷ Estonia has rolled out the “e-Estonia project”, which has helped to integrate government services, secure sensitive documents, and streamline public sector related experiences for citizens.⁸ Finally, Venezuela and China have issued digital currencies which have shown promise but have also raised a lot of questions, particularly with the digital yuan, about privacy and government overreach. We will explore central bank digital currencies (CBDC) further in Chapter 5.

Chapter 4: The Crypto Debate

Cryptoassets and Bitcoin in particular have become the focal point of an intense debate between investors, economists, and academics alike. This debate revolves around one essential question; does Bitcoin have value beyond its capacity to facilitate peer-to-peer transactions? Beyond its application as a method of payment, proponents tout Bitcoin as a store of value and

⁷ Denmark Liberal Alliance

⁸ e-Estonia.com

an inflation hedge. Conversely, Bitcoin's critics argue that it is both fundamentally worthless and too volatile to serve as either. In this brief chapter we will examine both sides of this debate to assess the claims made for and against the cryptocurrency.

Inflation Hedge

One of the major ideas pushed by crypto-enthusiasts, and Bitcoin advocates in particular, is its value as an inflation hedge. However, this is arguably one of the least relevant uses to consider for a couple of reasons. But first let's examine the argument for Bitcoin as a hedge against inflation.

In February 2022, The Bureau of Labor Statistics reported that U.S. inflation increased 7.5% year-to-date.⁹ This is the biggest drop in purchasing power in 40 years, an inauspicious sign for the economy and U.S. citizens, but potential vindication for believers in and holders of Bitcoin. However, since inflation really started to climb in early 2021, Bitcoin plunged and has remained down around 18% for the year, significantly underperforming the S&P 500 and traditional inflation hedges like gold. Bitcoin's immutable supply cap of 21 million bitcoins is what legitimized it in the eyes of investors as a store of value, a claim that is highly disputed across the investment and academic communities. This is of course because store of value claims rely on the intrinsic value of an asset which suggests its ability to sustain value in the long run. This is a heavily debated topic, one that is ultimately somewhat irrelevant when analyzing Bitcoin as an inflation hedge. The reality is that an asset like Bitcoin that is still in its relative infancy can not be deemed an 'inflation hedge' when it has only been around for 13 years. Therefore, even when putting aside the extremely volatile nature of Bitcoin, its price has

⁹ CPI, bls.gov

increased over 2,919% in the last 5 years (as of 2022).¹⁰ Calling Bitcoin an inflation hedge simply because it has appreciated more than the dollar almost makes the use of the term inflation hedge meaningless. Consider the most traditional inflation hedge, gold, which has returned roughly 30% in that same time frame.¹¹ Bitcoin's incredible price increase can not be attributed solely to its value as a store of value, but rather to other much more influential factors such as its adoption rate and heavily sentiment-driven speculation. This means that, for the time being, making an argument for Bitcoin's value as an inflation hedge is somewhat extraneous given the infancy of the asset and the multitude of other driving factors at play. This is not to say that Bitcoin cannot hedge against inflation, or that it cannot be a consistent hedge in the future, but for now Bitcoin's volatility remains a red flag for anyone seeking a consistent short term hedge against inflation.

Store of Value

Despite questioning Bitcoin's current practicality as an inflation hedge, the store of value argument is one that is much more interesting to consider. To accurately assess Bitcoin's function as a store of value we will put forth the main arguments for and against this claim, beginning with the pro-store of value stance.

The pro Bitcoin store of value argument revolves around three fundamental characteristics of Bitcoin, scarcity, trust, decentralization, and the impact of network effects. As we have mentioned, there can only ever be 21 million bitcoins, around 83% of which are currently in circulation. The Bitcoin protocol awards new bitcoins to miners on a decreasing

¹⁰ Via [statista.com](https://www.statista.com)

¹¹ Via [gold.org](https://www.gold.org)

basis, with the bitcoins rewards programmed to half every 210,000 blocks. With this schedule, it is projected that virtually all bitcoins will have entered circulation by the year 2140 (Lim, 2021). Because there is a fixed and unalterable supply, bitcoins are inherently rendered digitally scarce. Scarcity is a fundamental characteristic of most stores of value with the exception of fiat currencies, which, while stable when properly managed, slowly decrease in value over time. Fiat currencies highlight the importance of demand on value. In their case, demand is the primary driver of value which shows that scarcity alone cannot deem something valuable without complementary demand. While Bitcoin's perfect scarcity is crucial, the increasing demand for the asset is what is driving its adoption and in turn causing it to appreciate.

The significance of Bitcoin's ability to create digital scarcity cannot be overstated. The digital revolution and the rise of the internet allowed for unprecedented digital abundance because the marginal cost of data replication is essentially zero. For example, an image can be copy-pasted and sent anywhere in the world for free. However, because of this digital information is relatively worthless because there was no way to impose true scarcity without centralized private servers or completely offline data storage. Bitcoin's cryptography allows for value, in the form of immutable data, to be transmitted across the internet without sacrificing the web's permissionless and transparent nature. The key determinant of any digital asset's ability to store value lies in how difficult it is to replicate or alter, which in a blockchain network as large as Bitcoin's is impossible. Therefore, Bitcoin's digital scarcity makes it, at its core, a true store of value. Before blockchain technology allowed value to be publicly and securely transferred across the internet in a permissionless manner, existing methods had merely given the impression that value is being transferred, when in reality transactions were simply verified by third parties and completed through simple debits and credits on the accounts of participants. It is essential to

understand the difference between these two methods of value interaction because only one is actually moving real value in the form of data between parties. This means that the only aspect of Bitcoin as a store of value that can actually be contested is how much value is being stored, and whether it can serve as a stable store of value with a fiat currency as the unit of account.

The second point of argument for Bitcoin as a store of value is that it is a trust-less system that doesn't rely on any centralized authority to legitimize and enforce its value. The U.S. dollar relies on the U.S. government and politicians to act in the best interest of the country and its citizens. This opens up the currency to the potential for corruption, fraud, and conflicts of interest associated with human nature as a whole, not to mention politics and banking. This argument highlights the core influences behind Bitcoin's inception as a response to the 2008 financial crisis where citizens were burdened with the negative consequences of political conflicts of interest and reckless profit seeking. Bitcoin's founder(s) launched the project as a response to this, with the intention of providing trustless and secure methods for exchanging value digitally without relying on any centralized entity or government. The proof-of-work mining algorithm allows transactions to be verified through consensus by distributed independent nodes that are properly incentivized to accurately secure the network. While manipulating the blockchain itself is impossible, Bitcoin's public blockchain also provides full transparency which adds another layer of security for anyone using it. For example, even if an individual exchange or an entity hosting non-custodial wallets were to be hacked, which wouldn't require hacking the blockchain itself, it has been shown to be virtually impossible to wash the stolen bitcoins because every transaction that is made can be easily traceable. This makes it extremely difficult to spend or transfer any stolen bitcoins without exposing yourself and having your wallet flagged. A great example of this is the infamous 2016 hack of the

Bitfinex exchange, where hackers were able to exploit flaws in the exchanges security and steal \$4.5 billion worth of bitcoin. However, the hackers were never able to launder the bitcoins without risking exposure and 7 years later were arrested when they tried to do so (US Department of Justice, 2022). This highlights the added security that a transparent public blockchain provides in discouraging bad actors. Examples like the Bitfinex hack provide an insight into the viability of Bitcoin as a store of value because of the security they provide users without the need for trust in intermediaries or governments.

The next characteristic that Bitcoin advocates point to for its viability as a store of value is its decentralization. Economist and University of Columbia professor and Saifedean Ammous wrote, “for as long as the money was controlled by anyone other than the owner, whoever controlled it would always face too strong an incentive to pilfer the value of the money through inflation of confiscation and to use it as a political tool to achieve their political goals at the expense of the holders” (Ammous, 2018). Ammous’ statement highlights the core of Bitcoin’s value as a fair and trustless method of value exchange, and points to its potential as a store of value. The essence of this argument is that no one controls the Bitcoin network. Its decentralized nature means that it is not reliant on any one actor, computer, or datacenter, meaning that if any nodes shut down, others will take their place without affecting the security of the network. This was exemplified when China banned all Bitcoin mining operations in July of 2021, despite being home to the vast majority of bitcoin miners and accounting for 75% of the total Bitcoin hashrate (O’Farrell, 2021). Hashrate is a measure of the network's computational power contributed by miners, which determines the speed at which transactions are verified. The graph below shows



the Bitcoin hashrate from 2019 to 2022. As a result of the crackdown, Bitcoin's hashrate was cut in half, a seemingly devastating blow. However, with Chinese mining companies packing up and setting up shop in other countries, and miners outside of China taking advantage of the opportunity to start or increase their own mining operations, the hashrate bounced back to pre-crackdown levels within 3 months, hitting an all-time high just three months after that.¹² It is also worth noting that today China is estimated to still be home to nearly 20% of Bitcoin's hashrate despite the nationwide mining ban (Sigalos, 2021). Many believed that China's crackdown would serve as a catastrophic blow to the future of the Bitcoin network, but instead it only served to highlight the system's durability. Even the attempts of a global superpower that was also home to the majority of the network's nodes were unable to create any significant impact on the efficiency or security of the blockchain. This cemented Bitcoin's status in the minds of many as a store of value untouchable by even the world's largest governments.

Finally, advocates point to the significant role of network effects in creating value. A network effect is the phenomenon in which new users joining a network alters the value of that network for other users. Network effects are commonly seen in social media platforms and serve as the main determinant of value and competitiveness for many of today's tech giants. What is so

¹² Via ycharts.com

powerful about network effects is that they can allow established user networks to crush emerging networks even if they provide superior technology. The network effect happens exponentially, with each new user making the network more valuable and attractive to other potential users, incentivizing more and more people to join. This effect can give significant and compounding value to any network once the process is started. The most common example of the power of network effects can be seen by looking no farther than language itself. Like a blockchain network, languages can theoretically be created by anyone, but the success of either type of network depends on how many users it can attract. Today it would be virtually impossible to create a language that could compete in any way with English or Chinese. Not because they are easier to learn or sound sweeter rolling off the tongue, but because their networks are already so established. Billions of people all around the world already speak English and Chinese, and so the marginal benefit of converting to any new language would be zero regardless of its vernacular improvements. Social media platforms epitomize the value network effects create, leading to massive valuations for companies that control established social networks. Network effects have allowed companies like Facebook to monopolize their industry and remain resistant to competing platforms with more innovative features.

Bitcoin's decentralized, permissionless, public network has grown at an exponential rate since its inception. Network effects are having massive impacts on its utility as both a currency and a store of value. Like any currency, Bitcoin's value is reliant on the willingness of others to accept it as payment or purchase it as an investment. While it has continuously beat out alternative cryptoassets and other payment methods in growth, the challenge it faces when going up against the US dollar cannot be overstated. As the global reserve currency, the US dollar constitutes over \$17 trillion in economic activity (River Financial, 2021). The currency's

domestic network alone is some 350 million users strong and it is also issued and backed by the reputation of the most influential economic power in the world, the US government (Adkins, 2022). While Bitcoin has provided unprecedented innovations in digital value interaction, and blockchain technology is an overall superior underlying financial framework, even with its own rapidly growing user base, it cannot be certain that any of this will be enough to compete with the established strength of the US dollar. Additionally, the introduction of a U.S. CBDC could also arguably cancel out some of the innovations that set Bitcoin apart, though any centralized currency is still vastly different from a network like Bitcoin, blockchain or not. However, the founding intention of Bitcoin was to provide an alternative to fiat currencies, and having surpassed the initial hurdles of early adoption, and finally tapped into the institutional sphere, its network effects will only continue to gain momentum. Whether this will be enough to truly challenge the reign of the US dollar, only time will tell, but Bitcoin's growth so far has cemented its value in the eyes of many as a robust and efficient network, free from many of the problems associated with fiat currencies.

In summary, Bitcoin advocates argue that there is nothing eternal or natural about our current monetary system and that monetary status is a product of human action influenced by technology. Money is therefore not a rational product of human design and the same characteristics that led to gold's adoption as a store of value will cause Bitcoin to become the next. Through immutable digital scarcity, decentralization, and increasing adoption, Bitcoin is positioning itself as the next global store of value.

The argument against Bitcoin as a store of value is based on three main points. Bitcoin critics highlight the lack of a unit of account, volatility, and questionable intrinsic value, as fundamental pitfalls. Bitcoin is a historically volatile asset whose value can halve in a matter of

weeks. A store of value is an “asset, commodity, or currency that maintains its value without depreciating.”¹³ Therefore, by definition this makes Bitcoin today a poor store of value. Bitcoin’s price volatility is largely due to its relatively low market cap making it highly sensitive to market sentiment. A study by Bukovina and Martiček examined the impacts of market sentiment on Bitcoin and found that the impact of sentiment, and in particularly bullish (positive) sentiment, was especially effectual during high volatility and bubble periods. However, they also found that Bitcoins volatility has been significantly stabilizing over time (Kayal and Rohilla, 2021). While the volatility problem is the simplest argument against Bitcoin it is not the strongest with Bitcoin advocates pointing to the network's relative infancy in terms of adoption. The more powerful extension of this argument is that Bitcoin has little or no intrinsic value like other assets, commodities, or currencies. Some stores of value are more objective, like real estate, or gold, and some are more subjective such as art. Assets with objective value are typically better stores of value because they are more widely accepted as valuable and can therefore be more easily exchanged for other assets, goods or services. Anything can store some objective or subjective value and be exchanged with anything else through some kind of value exchange rate. Gold has long served as an objective store of value because it is scarce and indestructible as well as having many real world applications such as in electronics. This means that gold has intrinsic value and can serve as a store of value on multiple objective and subjective fronts. Critics argue that Bitcoin on the other hand, has no intrinsic value. It is not backed by any assets and it does not have any collectible value. Furthermore, it is not tangible in the real world but rather exists in a digital network as code. Therefore, Bitcoin’s only store of value is the value the market assigns to it in U.S. dollars (FFI, 2020).

¹³ Via investopedia.com

Another big concern lies in the economics behind Bitcoin. Fixed supply currencies pose some major problems that can create macroeconomic imbalances if transaction volume continuously increases (Kayal and Rohilla, 2021). As Stern School of Business professor David Yermack notes, Bitcoin's fixed supply will lead to deflation, causing high welfare destroying volatility. It would be very difficult to match this variation in demand and a more flexible system could likely be required to respond to varying demand. One solution is to have an adjustable supply growth rate. Another is to have a decentralized voting mechanism. However, concerns about deflation are contrasted with the possibility of hyperinflation caused by central banks oversupplying currency. Others argue that the only real negative effects of Bitcoin's fixed supply are the long term impacts of mining profitability, which could itself be mitigated or eliminated with improvements in mining efficiency through hardware improvements (Yermack, 2015) (Iwamura, Kitamura, Mastumoto, and Saito, 2014).

The final piece of the anti-Bitcoin argument considers the difference between a store of value and a means of exchange. Since the U.S. dollar was detached from gold it is no longer a true store of value due to inflation, but rather a means of exchange. This suggests that the only argument for Bitcoin's value is its function as a means of exchange, which critics point to as average at best. The store of value debate is hotly contested but ultimately comes down to Bitcoin's ability to continue its hyperbolic adoption rate. While it is difficult to accept the value of an asset that you cannot touch or even see, Bitcoin's subjective value as a trustless value exchange system free from bad actors or governments continues to increase in the eyes of many. Bitcoin is a heavily polarizing topic as many arguments take an absolute either-or stance. However, there are also those who believe that Bitcoin is not a substitute for fiat currency but rather a complement. Professor Jon Carrick of Stetson University argues that Bitcoin can work in

conjunction with fiat currencies, balanced as both a medium of exchange and a speculative investment depending on the risk-profiles of users (Kayal and Rohilla, 2021). However, many of the key arguments for and against Bitcoin as a store of value could be verified, rectified, or rendered invalid as the traditionally wild and unfettered crypto industry becomes legitimized through regulation. In this next chapter we will examine the current state of cryptocurrency regulations as well as the impacts of government issued CBDC's.

Chapter 5: The State of Crypto

This chapter will explore the current state of crypto regulation. It will briefly examine securities law and why some cryptoassets are considered securities when others are not. It will provide an in-depth introduction to stablecoins and CBDC's and contrast the benefits and dangers associated with them. It will then explore the current state of stablecoin regulation with a particular focus on the PWG's stablecoin report. Finally, we will conclude with a summary of the entire paper and assess the implication of the findings on the stated thesis.

Securities

The rise of cryptoassets and DeFi activities has attracted the attention of policymakers and regulators across the globe. Because of the relative infancy of the industry and its rapidly evolving nature, regulatory attempts have been inconsistent when faced with the challenge of keeping up with the seemingly infinite number of blockchain use-cases. Proper regulation is essential to the safe use of these new digital assets and vital to the application of many projects

that make use of blockchain technology. Policymakers are met with the challenge of trying to foster innovation while still protecting the public interest and the stability of existing political and economic systems.

While Bitcoin's decentralization allows it to be isolated from regulatory intervention, standard currencies like the US dollar still hold more liquidity and trust with people. This, combined with the need to convert into a fiat currency for most purchases, subjects Bitcoin to regulatory bodies who can tax profits realized once the conversion is made. While some countries have made attempts to ban Bitcoin, most academics do not recommend this as it could hinder technological progress. Instead, concerns about illicit crypto-related activities can be addressed through proper regulations that make use of the highly transparent nature of the Bitcoin blockchain (Kayal and Rohilla, 2021).

The SEC's existing approach entails a law framework for both securities and commodities. The securities framework makes use of the Howey Test which is designed to determine if an asset is an investment contract which would put the asset under the regulatory framework that exists for securities. If an asset is deemed a security it is regulated as such regardless of whether or not the asset is speculative or if it has intrinsic value. In 2017 the SEC determined that DAO tokens should be offered and sold in compliance with the existing securities laws. However, a key part of the Howey Test states that expectations of profits are derived from the managerial efforts of others, something that is not true for all cryptoassets prompting more discussion on the topic (Concannon, Valdez, Wink, 2021). "Cryptocurrencies (sometimes called tokens or digital assets) are a lawful means of storing or transferring value and may fluctuate in value as any commodity would. In the abstract, an investment of money in a cryptocurrency utilized by members of a decentralized community connected via blockchain

technology, which itself is administered by this community of users rather than by a common enterprise, is not likely to be deemed a security under the familiar test laid out in [Howey]. The SEC, for example, does not contend that Bitcoins transferred on the Bitcoin blockchain are securities” (Concannon, Valdez, Wink, 2021). While the SEC contends that nearly all cryptoassets are securities they have since ruled that Bitcoin is not a security. SEC Chair Jay Clayton stated that, “cryptocurrencies are replacements for sovereign currencies...[they] replace the yen, the dollar, the euro with bitcoin. That type of currency is not a security” (Sharma, 2019). Bitcoin has never sought public funds to develop its technology and does not pass the Howey Test meaning it should not be regulated under securities law. While policymakers are seemingly reaching consensus on how to deal with Bitcoin and some other cryptoassets, the biggest regulatory questions lie in how stablecoins will be regulated, which will have critical consequences for the crypto industry.

Stablecoins

The regulation that matters the most for the crypto industry is how policymakers and regulatory agencies will deal with stablecoins. As we noted in chapter 2, stablecoins are a class of cryptocurrencies that offer price stability by being backed by a reserve asset and are crucial because they provide liquidity to crypto markets. There are stablecoins backed by gold, real-estate, and even other cryptoassets. The stablecoins with the highest market value and greatest trading volume are USD-backed tokens whose value is pegged 1-1 to the US dollar. The most notable USD-backed stablecoins are Tether (USDT), USD Coin (USDC), Binance USD

(BUSD), and Dai (DAI).¹⁴ For this paper when we refer to stablecoins we are specifically talking about those backed by the US dollar.

Stablecoins allow users to buy or sell cryptoassets without directly converting back into fiat currencies. They also allow users to store value without price volatility while still not converting back into a fiat currency. Stablecoins are especially vital to DeFi activities because the price volatility would hinder blockchain-based loans, derivatives, and other long term smart contracts (Liao and Charamicheal, 2022). Stablecoins are a bridge between the crypto industry and the traditional system, seen by many to be the best of both worlds by serving as a stable store of value untouched by financial institutions and other third parties. However, in recent years this has also caught the eyes of the Federal Reserve who have begun investigating stablecoins and developing a regulatory framework for them. Additionally, this has led governments to consider introducing stablecoins of their own known as central bank digital currencies (CBDC).

Central Bank Digital Currencies

CBDC's are stablecoins that are issued by a governing body and pegged to the reserve currency of that country. CBDC's have all of the qualities of fiat-backed stablecoins with the exception that they are centralized. The main benefit of CBDC's is that they would allow central banks to quickly increase financial inclusion in their country, allowing unbanked and underbanked citizens access to the financial system. CBDC's could also help to streamline and increase the effectiveness of monetary policy by speeding up the process of interest rate adjustments. An added benefit is that this would also force private companies to become more transparent, reducing corruption and other illicit activities. This would also allow large bills to be

¹⁴ Via. CoinMarketCap

removed from circulation, potentially reducing other illegal activity, money laundering, and tax evasion (Auer, Frost, Gambacorta, Monnet, Rice and Shin). CBDC's could also provide a cheaper, more efficient and transparent alternative to existing payment systems which could reduce monopolistic and usurious practices (Jackson, 2021).

The potential problems that CBDC's could create are centered around what sets them apart from stablecoins, the fact that they are centralized. CBDC's would essentially give central banks and governments full control over the monetary system. The rise of cryptoassets and in particular stablecoins has caused financial regulators to worry about losing control over the money supply and being unable to properly maintain economic stability. Thus CBDC's would not only ensure central banks remain in control but would give them complete control. Complete government control of the financial system is both a utopian dream and a dystopian nightmare depending on who you ask. But putting aside the extremest, and anti-government opinions that inevitably comes to the surface when the topic of CBDC's and cryptoassets are discussed, it is worth assessing the impact of putting a governing tool as powerful as this in the hands of politicians.

The original purpose of cryptocurrencies was to democratize and decentralize the financial system because of the pain centralized financial practices and policymaking have caused everyday people in the past. Bitcoin itself was born out of the 2008 financial crisis in which over 6 million Americans lost their homes and resulted in over \$3.4 trillion in retirement savings being lost. The increased transparency and potential reduction in monopolistic and usurious behavior that a CBDC could provide may well have prevented much of the private activities that caused the Great Recession. However, skeptics would point out the intertwined nature of big banks and those in charge of regulating them. This alone gives some credence to

the skepticism of giving more financial power to the government but ultimately, like any other government program, the results are dependent on the ability of the officials behind it to act in the best interests of the public.

Another big concern with CBDC's is its impact on privacy. Central banks could be able to monitor, record, and tax every single transaction ever made as well as easily dictate a citizen's access to the financial system. Concerns about personal privacy, freedom, and liberty are central to the CBDC debate and many of these concerns are being highlighted through China's introduction of the digital yuan. In January 2022, China launched a pilot version of their own digital currency also known as the e-yuan. The Chinese government cites fighting corruption, money laundering, illegal cash flows, tax evasion and economic data collection as potential benefits of the digital currency. Program officer and regional expert for China at the National Endowment for Democracy, Akram Keram suggests that these are just some of the real incentives behind the e-yuan (Keram, 2021). Keram notes that China already employs a social credit system to reward and punish individuals depending on if they are seen as unloyal or untrustworthy by the Chinese Communist Party (CCP). The CCP also continuously collects other personal data and information and monitors Chinese citizens with artificial intelligence technology, which according to Keram, "is used to ethnically profile and repress the Uighurs and other ethnic and religious groups" (Keram, 2021). The e-yuan could serve as a valuable tool to increase the CCP's control over Chinese citizens, suggesting that the technology could be attractive to other autocratic regimes. Keram warns of the e-yuan becoming yet another censorship or filtering tool to monitor people's financial activity in other countries. "China may be ahead of the curve — its central bank has filed more than 80 patent rights on digital currency — but the United States and other democracies should accelerate research for their own digital

currencies, so that international standards and regulations are set under democratic norms to protect citizens and data privacy” (Keram, 2021). Despite the dangers that the misuse of a CBDC poses, it may be a vital step for countries like the United States to take in order to protect its citizens and ensure the upholding of democratic values. While a decentralized cryptocurrency like Bitcoin could theoretically provide the ultimate form of freedom, it could also serve to weaken democracies around the world.

The President's Working Group

The President’s Working Group (PWG) has been tasked with identifying the risks associated with the increased use of stablecoins and developing a regulatory framework to address these concerns. The PWG is led by Secretary of the Treasury Janet Yellen, Chairman of the Federal Reserve Jerome Powell, SEC Chair Gary Gensler, and CFTC chair Rostin Behnam. The PWG was originally formed in 1988 in response to the black monday stock market crash and has since worked to prevent other crashes by advising the US president in times of economic and stock market turbulence. Since its formation, critics have suggested that the PWG actively intervenes to prop up stocks, resulting in the group being commonly referred to as the “Plunge Protection Team” (Fromson, 1997).

The PWG released their stablecoin report in November 2021 which provides a background on stablecoins, the major risks and regulatory gaps associated with them, as well as legislative recommendations. The first major risk the PWG identifies is the potential for loss of confidence in a stablecoin leading to bank-run scenarios and fire sales of reserve assets. This loss of confidence could be due to a drop in the price or liquidity of reserve assets, failure to

safeguard reserve assets, a lack of clarity regarding redemption rights, and other operational risks regarding cybersecurity and the management of data. The more widely adopted stablecoins become, the greater the threat these risks pose to the broader financial system.

The second major risk highlighted in the report are similar to those that already apply to existing centralized payment systems which the PWG warns could manifest in new ways on a DLT network. This includes operational risks such as deficiencies in information systems or internal processes, human errors and management failures, or external disruptions resulting in the weakening or breakdown of services. This also includes settlement risk, where payment systems do not work as expected, which is a worry for stablecoins as they sometimes do not clearly define some aspects of the settlement process. The final payment system risk the PWG notes is liquidity risk, which can arise from the misalignment of settlement timing and other arrangements.

The final major risk noted in the report is the risk of scale which could pose threats to both individual stablecoins and lead to systemic risk and the concentration of economic power. The failure of a large stablecoin issuer could threaten the stability of the financial system and the real economy. Additionally, the wide adoption of a particular stablecoin could have anti-competitive effects leading to added friction or costs being forced onto users should they choose to switch to another product or service.

The next section of the PWG's stablecoin report addresses the existing regulatory gaps. They note that current stablecoin arrangements are not subject to consistent regulatory standards that adequately address the risks outlined in this report. The complexity of stablecoin arrangements and the number of key parties involved in them poses challenges for oversight. To address these regulatory gaps, a comprehensive regulatory framework is needed to ensure the

functionality of stablecoins in all market conditions while also increasing transparency in stablecoin arrangements.

This leads to the final section of the report which lays out the PWG's recommendations for stablecoin regulation. The proposed legislation focuses on limiting stablecoin issuance to insured depository institutions and establishing a federal framework that reaches other participants in stablecoin arrangements. This would broaden the scope of regulation beyond the insured depository institutions which are already subject to substantial supervision and regulation. This proposed regulation would subject custodial wallets to federal oversight and risk management standards. Note, custodial wallets are managed by third parties which provides users with backup security in the case of lost keys where non-custodial wallets give users full control of their keys. This means users of non-custodial wallets do not have a backup option for recovering lost keys but their assets are free from regulation or malpractice because they are not connected in any way to a third party.

This section of the report also references which existing agencies can be used to address these risks in the meantime. The PWG points to the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTF) as possessing the authority necessary to regulate stablecoin arrangements that are consistent with securities, commodities, or derivatives activities. Additionally, they call on the Financial Stability Oversight Council (FSOC) to use available tools to supervise certain stablecoin arrangements. They state that the FSOC could do so by designating certain stablecoin activities as “systemically important, clearing, and settlement activities.”¹⁵ Additionally, they note the Department of Justice's authority, granted by

¹⁵ President's Working Group on Financial Markets, the Federal Deposit Insurance Corporation, and the Office of the Controller of the Currency. “Report on Stablecoins.” U.S. Department of the Treasury, 2021.

the Glass-Steagall Act, to consider issues as they relate to the affiliation between commercial entities and stablecoin activities. Finally, they note the power of the Consumer Financial Protection Bureau (CFPB) and the Financial Crimes Enforcement Network (FinCEN) to enforce safety safeguards and anti-money laundering and anti-terrorist financing (AML/CFT) obligations.

The PWG's stablecoin report conveyed a sense of urgency, calling for swift action from existing regulatory bodies to provide supervision while new formal legislation is passed. This urgency comes from the inability of banking regulators to reach all aspects of stablecoin arrangements, even those involving regulated institutions. This is echoed by SEC chairman Gary Gensler who stressed the SEC's and CFTC's commitment to "deploy the full protections" of the law "to these products and arrangements, where applicable" (Gensler, 2021).

Conclusion

In this paper we sought to establish how cryptocurrencies improve on the past issues with private currencies and where they fit within the broader economic and regulatory context. First established how private currencies have historically emerged to fill voids in the economy that government issued currencies could not. We found that private currencies were not able to achieve wide adoption for a number of reasons but ultimately because they were not able to provide the security and trust this would require. We then analyzed various definitions of money, contrasting Geoffrey Ingham's theory with the neoclassical definitions. We found that in Ingham's definition, private currencies do not constitute money because they do not serve as a unit of account, whereas in the orthodox definition they can be considered money. We expanded

on this debate by comparing the arguments of Hayek, Ingham, and Selgin on the role of private money. Hayek's arguments for a system of competing private money highlighted the need for private money to be untethered to any centralized entity. Ingham's arguments highlighted the importance of trust in the functioning of any currency and that a decentralized digital currency must be built on a truly unexploitable technology. Selgin's arguments introduced the possibilities for macroeconomically smart private currencies which we decided would have to take the form of a CBDC, which would be backed, issued, and enforced by a government.

Next, we provided an in-depth explanation of distributed ledger and blockchain technology, the underlying technology on which cryptoassets are built. We addressed the differences between public and private blockchains as well as the differences between proof-of-work and proof-of-stake consensus mechanisms. We then dove into the birth of the two most successful cryptoassets, Bitcoin and Ethereum and explained the structural differences between the two. Finally, we explored the ways in which programmable blockchains like Ethereum, Solana, and Cardano are leading the Web 3.0 movement, the next iteration of the internet which promises to put power back in the hands of users while providing a more secure and efficient system overall.

We then explored some notable use-cases of blockchain technology to assess the specific ways it can be utilized to improve current systems. We found that cryptoassets have the potential to decrease transaction costs while simultaneously increasing transaction speeds, specifically for cross border transactions. We then analyzed the DeFi industry and the benefits of blockchain based smart contracts. We found that both financial institutions and customers benefit from the implementation of smart contracts because they cut costs for banks while streamlining the process of ensuring regulatory compliance and providing easier and secure transaction methods

for customers. Next we looked at the ways blockchain technology can help fight digital piracy and ensure better copyright protection in both the current state of the internet and in Web 3.0. Finally, we looked at the ways that blockchain technology can be utilized to help improve efficiency across the public sector and help fight corruption by improving transparency.

Next, we examined the ongoing crypto debate and the current state of crypto regulations in the United States. We assessed the arguments surrounding Bitcoin as an inflation hedge and concluded that while it has historically beaten inflation significantly, its extreme price appreciation and high volatility suggests that it is an unreliable short-term inflation hedge in its current state. We then dug into the arguments surrounding Bitcoin as a store of value, which is at the heart of the Bitcoin debate. We found that critics highlight the lack of a unit of account, volatility, and questionable intrinsic value as the reasons Bitcoin is not a store of value. We contrasted this with the points of Bitcoin advocates who cite Bitcoin's scarcity, decentralization and trustless verification process as key determinants of value. We concluded that because Bitcoin is the first example of digital property, it will never fulfill some of the aspects of traditional stores of value. Therefore, if the underlying technology continues to prove its resistance to malpractice, it is in fact a store of value. We conclude that many of the arguments for and against Bitcoin as a store of value could be verified, rectified, or rendered invalid as the crypto industry becomes legitimized through regulation.

Finally, we examined the current state of crypto regulations. We briefly dug into securities law and the reasons Bitcoin cannot be regulated as a security. We then explained the importance of stablecoins as the lifeblood of the DeFi industry and the link between the traditional financial systems and the world of DeFi by allowing fiat currencies to serve as a unit of account and provide price stability. We contrasted this with CBDC's which are proposed

government-backed digital currencies and have been tested in countries like China. We found that CBDC's can provide some similar, and some added benefits, that stablecoins provide but also pose risks to personal freedoms and privacy if not properly managed. We found an example of this in the use of the Chinese government's CBDC as a tool for increased control over Chinese citizens. We then examine the PWG's stablecoin report which outlines the U.S. government's plan for stablecoin regulation. We note that the report conveys a sense of urgency, calling for swift action from existing regulatory bodies to provide supervision while new formal legislation is passed. We noted that this urgency seems to come from the current inability of banking regulators to reach all aspects of stablecoin arrangements, even those involving regulated institutions.

In conclusion, we found that blockchain technology provides a solid foundation for private currencies to improve on past limitations. However, the industry is still in its infancy and despite its brief yet infallible history, even Bitcoin, the king of crypto itself, has yet to prove its worth in the long run. But with debates and definitions aside, cryptoassets are an overall net positive for society. They are exposing exploitative practices in the financial sector and in big tech, providing access for unbanked and underbanked individuals, forcing outdated and inefficient systems across all sectors of the economy to be improved, and galvanizing regulators to update and formulate legislation suited to the digital world.

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