Drew University

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Revolutionizing Central Banking: Demystifying Decentralized Finance Technology and its Integration within the Federal Reserve System

A Thesis in Business

by

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Abstract:

This thesis explores the topic of decentralized finance, with a focus on demystifying relevant technologies and exposing their potential uses. It argues that Blockchain, cryptography, and smart contracts can offer the potential for increased security, traceability, and efficiency in financial transactions compared to traditional methods. The thesis also highlights how the Federal Reserve functions in stable environments and during economic crises. By understanding the Federal Reserve's critical role in stabilizing the economy, demonstrates that the FED's current infrastructure has limitations, and explores the potential integration of DeFi technologies into the Federal Reserve's operation. It examines how Fedcoin and citizen Fed accounts could offer beneficial applications, acting as a distributed ledger system. The thesis concludes that the introduction of DeFi technology to America's central bank could create significant economic efficiencies and provide many social benefits. With the support of the Federal Reserve in the implementation of efficient DeFi technology, the economy and marketplace could have the opportunity to flourish in the future. Ultimately, the thesis argues that the integration of DeFi technology can create a more secure, transparent, and efficient financial system, ultimately benefiting the nation and potentially the global economy as a whole. By embracing and leveraging DeFi technology, the Federal Reserve can position itself as a leader in innovation and ensure that it remains at the forefront of financial technology development.

Chapter 1: The Demystification of Decentralized Finance Technology:

Non-Fungible Tokens (NFTs) and crypto-currencies, decentralization, blockchain technology, and cryptography have emerged as controversial topics in recent years. Advocates of these so-called libertarian technologies and products have been perceived as opponents of centralized, bureaucratic, and overly powerful governments who seek to steer away from traditional asset classes. However, this thesis aims to counter the myth that decentralized financial technologies cannot live harmoniously within centralized organizations. Although decentralized governance and financial systems have existed for decades, only recently has technological innovation allowed for more secure, effective, and decentralized versions of governmental institutions and private finance. Blockchain technology, for example, is rapidly disturbing traditional centralized systems as it facilitates greater efficiencies of scale, enhanced security, asset tracking, and user protection. Authors such as Marcella Atzori (2015) and Lev Menand (2022) argue there are reasons both for and against supporting these developments in Decentralized Finance (DeFi). Accompanied by Robert Hockett (2019), they also note that the historical records illustrate how decentralized organizational frameworks in finance have both failed and succeeded in the past.

This thesis argues that decentralized methods of finance, cryptography, and blockchain technologies should be adopted, developed, and integrated by central banks with specific guidelines on how they will most effectively be implemented. It will also examine some of the more successful instances in which decentralized approaches to finance and governance can be deployed by governing bodies.

In order to identify the benefits of DeFi, it is important to first have a concrete understanding of what cryptography, blockchain, smart contracts, and cryptocurrencies are.

Accordingly, the first chapter of this thesis will examine the basic components of Decentralized Finance and the benefits of DeFi technology separately from the scandals of crypto schemes.

What is decentralization?

Decentralization in itself is no new phenomenon in the realms of governments or technology. The term *decentralization* refers to "the act or process of giving some of the power of a central government, organization, etc. to smaller parts or organizations around the country" (Oxford Dictionary, 2023). Decentralization can be used as a successful tool for dispersing power and granting individuals more control and responsibility. Such a strategy can be implemented to enforce resiliency and redundancy across systems and compete against the fundamental flaws of centralized designs.

Decentralization in a Financial Technology (Fintech) closely relates to three major components: Blockchain, Cryptography, and Smart Contracts. Although these technologies are currently associated with crashing cryptocurrencies and pump-and-dump schemes, the technologies that facilitate such systems are entirely transparent and functionally useful. Ultimately, they are not inherently bad or corrupt but have come to be viewed as such because of the recent scandals associated with their uses. In the cases of NFT projects being dropped or crypto scammers siphoning money from users, it has most commonly been the fault of individuals who have operated such programs rather than the technology failing to be fit for purpose.

Why is there a negative stigma?

Recent examples of malicious activity within the crypto spaces have significantly crippled the trust and acceptance of such technologies. Cryptocurrency and NFTs are relatively new and rapidly evolving technologies that have been met with both excitement and skepticism. In addition to the fact that these technologies are so new, they face little to no regulation from the government.

Cryptocurrencies, the most prominent of which are Bitcoin and Ethereum, are digital or virtual currencies that use cryptography methods for security. They have been created and are operated privately and independently of central banks and governments. Their advocates have argued that they've allowed for more financial freedom and privacy. Their critics contend that such digital assets have created regulatory concerns. They have not been regulated by governments and have been used for illegal and illicit activities (Lennon, p.1, 2021). As of 2019, "criminal activity represented 2.1% of all cryptocurrency transaction volume," or around $21.4 billion worth of worldwide transfers (Lennon, p.1, 2021).

Additionally, the value of cryptocurrencies has been extremely volatile, leading some investors to gain or lose significant sums of money in extremely short periods (Gobler, p1, 2021). For example, in 2017 "Bitcoin prices soared from a little under $800 in January to more than $20,000 in December, before crashing [...] to $3,300 in February 2019" (Gobler, p.1, 2021). This is significant as Bitcoin is considered to be one of, if not the most, liquid cryptocurrencies on the market with immense trading volume. An even more extreme example, the $SHIB coin posted incredible gains, having increased just short of 112,000,000% in coin value from January to its peak in October of 2021, having opened in 2021 for $0.000000000077 and rising to an all-time high of $0.00008616 (CoinMarketCap, 2023). However, as of January 27, 2023, $SHIB

traded at $0.000012 which is an 86% drop from its all-time high in 2021 (CoinMarketCap, 2023). It's not surprising that risk-averse traders would want to steer clear of the crypto scene. But such examples don't fully illustrate the range of potential negative outcomes associated with cryptocurrency and DeFi technologies.

A more significant and recent controversy can be found with the FTX debacle. FTX was a cryptocurrency exchange that allowed users to trade a variety of cryptocurrencies and other digital assets. FTX, founded and led by Sam Bankman-Fried in 2019, quickly became one of the leading crypto exchanges between 2020 and 2022, accumulating a $32 billion valuation. However, FTX quickly collapsed in November 2022 and was forced to file for bankruptcy, leaving many investors confused and empty-handed. Along with crypto's rising popularity, Mr. Bankman-Fried hired celebrities such as Tom Brady, Stephen Curry, Shaquille O'Neal, and Larry David to endorse FTX (Q.ai, p.1, 2022). In a round of funding in January of 2022, "FTX raised $400 million to an aggregate funding" of $2 billion in total capital (Q.ai, p.1, 2022). After rumors were leaked that FTX did not hold the reserves to repay account holders for their balances, the company suffered a massive liquidity squeeze as their account holders demanded withdrawals. Sam Bankman-Fried and FTX currently face significant lawsuits as "U.S. based customers suffered $11 billion in damages" - many of whom will likely never recover those funds (Q.ai, p.1, 2022). As a result, there is serious skepticism surrounding crypto exchanges and cryptocurrencies in general. Arguably, because there was no regulatory enforcement from any public or government entity, the collapse of FTX resulted in its complete liquidation and dissolution.

In the recent past, we have seen the Federal Reserve and the U.S. Treasury step in to support sinking companies with emergency loans and capital injections (e.g. Citi, AIG, and Bear

Stearns). However, because neither the Fed the Securities and Exchange Commission (SEC) nor the Federal Deposit Insurance Corporation (FDIC) recognized, monitored, and regulated crypto at the time, none felt responsible to grant loans, capital injections, and depositor guarantees to the company and its investors. Because of a loud public outcry from the public about failing crypto-related projects, the SEC has declared that it intends to become the "lead regulator of US crypto markets" in the near future (Bini, p.1, 2022). On Sept. 8, SEC chair Gary Gensler stated that the "SEC will be aggressively policing crypto tokens and intermediaries" (Bini, p.1, 2022). Ultimately, while various scandals have called cryptocurrency into question, the underlying technology that allows such transactions to remain private and secure has been robust. Therefore, in the right hands, the technology could perhaps be used in a more fiscally responsible manner. This thesis argues that the technology itself is not faulty nor evil; it has just been abused and manipulated by bad actors not subject to public regulations and oversight.

In conclusion, there is a negative perception of cryptocurrencies and their exchanges like FTX. Because of the highly volatile of their markets and the unregulated nature of their exchanges, crypto is quickly being abandoned by average investors. Cryptocurrencies offer high returns with accompanying extremely high risks. While crypto-related technologies have the potential to change the way we think about money and ownership in a decentralized way, their function and utility are being overlooked because of recent events and scandals. Therefore, although crypto assets are risky, the technology behind them can be reconfigured to have a positive impact on other sectors and financial instruments.

Crypto-related technologies:

Arguably, the three most transferable components of decentralized finance technology deriving from crypto assets, markets, and exchanges are the Blockchain, Cryptography security measures, and Smart Contracts. When utilized in the right settings, these technologies can have hugely positive impacts on financial markets and other sectors regarding security, integrity, traceability, and efficiency. Below, I briefly describe each of these technologies and their functions, providing insight into their potential uses and implementation by and integration into central banking.

Blockchain

The Blockchain is an innovative memory or database system used to track the movements and record the transfer of digital assets such as cryptocurrencies. The decentralized component becomes significant as it removes the single point of failure flaw by spreading nodes across the Internet to track transactions between users. A single point of failure (SPOF) exists when a product or entity can be maliciously targeted, harmed, or destroyed at one single source. This is inherently problematic for transactions and security as individuals or malicious parties can destroy a whole infrastructure at one source or location. An analogy is to think of a house and its foundation - a centralized system would collapse from only targeting one pillar of its foundation, whereas a decentralized system would allow for other supports to prop up the building even if one was compromised. This ultimately makes the blockchain system more robust compared to centralized digital systems because of its decentralized nature, protecting against attacks at one source and preventing them from altering the memory of the entire system.

For example, under a centralized system, if a malicious user was able to alter a transaction record within a database management system to show that the assets of a trade were never received, the system would have nothing to cross-reference the exchange. The memory or record of the transaction would be lost and overwritten. However, under a decentralized database system, when a malicious user tries to alter a transaction record, the database can cross-reference millions of other records (nodes) around the world. The system is able to verify whether a transaction was performed or was maliciously edited and the database would be able to deny the falsified system entry. In short, the decentralized Blockchain system technology secures the legitimacy and transparency of transactions.

In addition, the Blockchain is not a mysterious database with backdoor access to a private company that developed it. The Blockchain is an open-source system - meaning that all code, algorithms, and program files are open for viewing by the public. The Blockchain "collects information together in groups, known as blocks, that hold sets of information" regarding the location or address key of a certain asset (Hayes, p.1, 2021). Once these "blocks" of data reach a certain storage capacity, they "are closed and linked to the previously filled block, forming a chain of data known as the blockchain" (Hayes, p.1, 2021). This is crucial to ensure that the memory structure of transactions is stored indefinitely and cannot be altered - unlike a traditional database that stores information in a table. The Blockchain's "data structure inherently makes an irreversible timeline of data when implemented in a decentralized nature," because once the block is added to the chain, [it makes] available [the transaction's] verification (Hayes, p.1, 2021). This demonstrates that the Blockchain provides an accurate record of all data that flows through the system, and through the unique linkage of a decentralized network, the database is protected against a Single Point of Failure (SPOF).

The inherent data-logging and exchange traceability that the Blockchain offers could plausibly eliminate the need for financial intermediaries, as well as financial fiduciaries, to oversee transactions. Streamlining the process by utilizing a free open-source robust database management system offers a cheaper and more autonomous method for financial transfer oversight but may not be appropriate as a solution for a national payment and security system. However, the structure of Blockchain creates efficiencies for financial transfers and interactions once they are deemed legitimate. Data entries or transactions are deemed legitimate only if they are referenced exactly the same across an array of nodes within the decentralized network. The beauty of this process is that if data entries are tampered with on a local node or mismatch across the decentralized network, external nodes can cross-reference the manipulated data and render the transaction illegitimate - protecting users and securing the legitimacy of the Blockchain (Hayes, p.1, 2022). Therefore, if implemented in a privatized manner with consistent oversight from the Fed or another entity within the Fed, a private Blockchain database system could grant incredible transaction recording efficiency.

Cryptography and Cryptocurrency

Cryptography is a technique used to secure communication between two parties. It involves the use of mathematical algorithms to transform information into an unrecognizable cipher that can only be decrypted by an authorized party with a translation key. Cryptography is a crucial element in modern-day communication, especially in electronic transactions where security is a priority. Therefore, cryptography has become especially relevant in the cryptocurrency space, primarily for securing digitized currency transactions.

In the simplest terms, *cryptography* is the process of converting plaintext, or unencrypted text, into ciphertext, or encrypted text, using an algorithm (Bernard, p.1, 2016). The resulting ciphertext can then be safely transmitted over any network or stored securely without fear of unauthorized access (Bernard, p.1, 2016). The two main types of cryptography are symmetric key cryptography and public key cryptography. *Symmetric key cryptography* uses a single key to both encrypt and decrypt messages. The sender and receiver must both possess the same key, which must be kept secret from anyone else. For cryptocurrency, private keys are used to authorize transactions and prove ownership of any blockchain asset. Consequently, private keys are integral parts of cryptocurrency, and their encrypted properties help protect users from theft and unauthorized access to their assets. *Public key cryptography*, on the other hand, uses two keys, a public key, and a private key (Bernard, p.1, 2016). The sender encrypts the message using the recipient's public key, and the recipient decrypts it using their private key. Some popular systems that use public key cryptography methods are password-authenticated key agreements and messaging applications.

Cryptography is used closely alongside the blockchain to ensure that each transaction is encrypted using a unique cryptographic hash. This makes it nearly impossible for anyone to tamper with the blockchain. Although nearly impossible, there will always be an arms race between security advances and hackers attempting system break-ins, where unfortunately, sometimes the hackers win too. However, the Blockchain is currently the most advanced record system to trace transactions in a publicly accessible way. Any change to the ledger would require the attacker to modify every subsequent block, which would be computationally infeasible because of the complexity of the cryptographic hash. As previously mentioned, the technology behind cryptography grants confidence in the transfer and security of assets. Cryptography has

become an exponentially growing field in terms of protecting company IP, secured telecommunications, and also within the financing world of transactions. Most recently, cryptography supports the secure transactions of cryptocurrencies.

Cryptocurrency is a digital asset that is secured through hash cryptography methods and is traced through the Blockchain. Because of such strict encryption and tracing methods, this "makes it nearly impossible to counterfeit [, duplicate,] or double-spend" cryptocurrency (Frankenfield, p.1, 2022). One of the defining features of cryptocurrencies is that they are "generally not issued by any central authority, rendering them theoretically immune to government interference or manipulation" - granting full non-disclosed usage for any owner of the asset (Frankenfield, p.1, 2022.). Unlike modern currencies such as the US dollar, there are a finite number of coins per cryptocurrency, and the currency circulation is dictated by miners rather than a central bank's printing rate. Mining Bitcoin for example is a "painstaking, costly, and sporadically rewarding" process in which a computer "solves an extremely complex computational math problem" and is rewarded with a coin if correct (Frankenfield, p.1, 2022). With 21 million total coins available for minting (creation), the value behind the currency is a product of scarcity, demand, and security. In theory, the scarcity of cryptocurrency was supposed to build intrinsic value in the coins whilst also making them stable enough to be utilized as a medium of exchange. However, as depicted in the example of the SHIB coin and Bitcoin prices, the stable asset theory has collapsed. Although cryptography, security, and protection of these assets have for the most part prevented the creation of illegitimate currency, cryptocurrency scarcity is no longer a measure to secure value. With the development of thousands of new micro and small-cap cryptocurrencies, the crypto market investment pool has broadened significantly, and the price of large-cap coins dropped correspondingly. Ultimately, this showcases a

counter-example as to why private crypto market advocates have overlooked the inherent value of the assets are becoming diluted in a pool of more and more private digital assets. Therefore, there is a consistency to indicate that the private crypto market will remain extremely in time to come.

However, another concern for cryptocurrency is that if the integrity of its hash function, blockchain, or encryption is broken, the coin's value may sustain extreme losses (Frankenfield, p.1, 2022).

Cryptocurrency advocates claim that they are trying to combat the current system of central banks' currency printing. In modern times, the paper dollar that we use daily or the digital number that we see within our bank accounts are backed by the assets on the FED's balance sheet, including government and private securities. Government securities are backed by the US government's ability to tax back the money the FED issues and the fact that contracts can be settled in dollars. Bank deposits, which make up most of the US money supply, are private liabilities of commercial banks, backed by the assets of those banks, including loans, securities, cash in vaults, and reserves at the FED. The US Monetary Settlement system allows commercial banks to create money by making loans and converting cash inflows into bank deposits. Unlike the gold standard, the value tied to the physical bill or numeric digits found in bank accounts is the ability to repay a promise. Cryptocurrency offers a tangible asset to store value, but would not act the same as the gold standard because it is not a scarce asset. Although the private crypto market could theoretically reshape the modern realm of financing, because of the assets' extreme market volatility, it is unlikely to foresee these privatized assets taking any significant hold in replacing the government-backed currency. As a result, for there to be any true value for a digital asset to take precedence over the national economic system, it would need to hold the same

repayment ability as the U.S. government provides, offering a stable and trustworthy asset. Therefore, by today's standards, the only entity that can permit such opportunity is the U.S. government itself, granting the FED the possibility to facilitate such assets. Cryptocurrency has not shown true resistance against inflation, never mind being able to store its own inherent value. Once again, cryptocurrencies offer an opportunity to expand currencies into utilizing the protection of digital traceability and protection with hash functions, however, without a secured backing of a government-like entity, their value will remain too volatile to be adopted by an entire economic system.

Smart contracts

The last foundation that enables DeFi to be a legitimate system that eliminates the demand for financial intermediaries and third-party personnel is the smart contract. The definition of a *smart contract* is a "self-executing contract with the terms of the agreement between buyer and seller being directly written into lines of code" (Frankenfield, p.1, 2022). Thus, the intermediary between buyer and seller is an unbiased stream of logic that will execute a command determined by conditional activities made by the party. Therefore, smart contracts permit trust among transactions across "anonymous parties without the need for a central authority, legal system, or external enforcement mechanism" to support the transaction (Frankenfield, p.1, 2022). The utilization of smart contracts, in combination with blockchain and cryptocurrency, grants a much more autonomous, transparent, and credible transaction-making in the finance realm. As a result of making these processes more autonomous, the need for human capital and intermediaries could diminish, and service costs for transactions significantly drop. This places pressure on intermediary banks for the future as such technologies slash the price of

overseeing transactions. Therefore, traditional banking strategies and services may be forced to adopt the evolving system or be outperformed by its efficiency.

Competition against the flaws of centralization

With incredible innovation of technology and service to streamline the processing and protection of financial assets, there are clear benefits and consequences to discuss in terms of the adoption of DeFi. Although there is strong evidence to show that cryptocurrencies and other digital assets have fluctuated in value significantly within the last few quarters, the technology behind these assets and operations is highly functional compared to traditional security, data logging, and contractual committing technologies. However, in order to justify that it is the asset itself and the overall market driving such instability in asset value, there is a historical correlation between the implementation of cryptocurrencies as experienced during the implementation of the fiscal U.S. dollar.

Cryptocurrency volatility and correlation with the history of the U.S. dollar

Although it is important to reflect on the negative stigmas of DeFi and the volatile returns of digital currencies, it is also important to differentiate between risky crypto schemes and the effective technology behind such systems. In many instances, the projects that failed investors were not a result of the infrastructure they are supported by, but more so the lack of regulation around the system and lack of faith in new systems.

In a similar event of history, the green bills that are connected so deeply to the U.S. and global economy also had a controversial beginning. Through Robert C. Hockett's *Money's past is fintech's future: wild cat crypto, the digital dollar, and citizen central banking* (2019), Hockett showcases how physical currency also faced a turbulent beginning before it was adopted as the

official currency of the U.S. This also justifies as to why cryptocurrency could act so volatile and face little regulation - matching the adoption of paper money in the American colonies until the late 1700s and the United States after it was created with the signing and ratifying of the U.S. Constitution after 1787. As Hockett notes, the U.S. has undergone periods of instability. One of the most volatile periods was "the wildcat banking era" between 1836 and 1865. As a result, Hockett argues that this historical period resembles the current era of Cryptocurrencies.

The historical comparison of cryptocurrencies and the start of the U.S. currency notes (the greenback) stems from 1860. Private institutions initiated a new system, issuing paper bills to represent the value of gold in the promise of a banknote. Each banknote was individually backed by a private institution by which it was issued - notes were not backed by a single sovereign or Federal entity as experienced today. As a result, "different issuers, for their part, were differently reliable" because, "two banks might both promise redeemability of their notes," but the two banks may have very different abilities to fulfill those promises (Hockett, p.3, 2019). Consequently, because some private firms were more inapt to repay dues for issued notes, each note carried its value as a percentage of par value. For example, a one "dollar note issued by Billy the Kid Bank or Sidewinder Bank might trade at 50% of par," whereas a "dollar note issued by Wyatt Earp Bank or Bald Eagle Bank [would] […] go for 90% of par" (Hockett, p.3, 2019). Several significant factors led to the discrepancies among issuers including limited bank regulation and independent backing. This is similar to the modern situation faced with the introduction of digital currencies. Because there was no governing central authority to regulate or certify note values, differing note values spread across currencies issued in different states and regions (Hockett, p.3, 2019). This is the same way we experience different digital currencies

holding different value - value stemming from the credibility of the private issuer and as a derivative of scarcity.

Just as the dollar bill had its struggle with stability during its wildcat era, crypto is facing the same issues because of its early stages of adoption, regulation, and implementation. However, the technological elements of blockchain and cryptography are effective in isolation to transform the efficiency of global transactions, national currency control and enhanced security measures to a more satisfactory level. In a similar progression as supporting fiscal money for the first time, by regulating, supporting, and recognizing blockchain and cryptography, we can develop enhanced and efficient monetary systems. Through a repeat of history, the one way that the green dollar bills we use today gain more stability was through the regulation and adoption of cash by a central entity. If digital currencies are to follow the same trajectory as the implementation of fiscal currency, then a governing entity needs to enforce stricter regulation around the marketplace at large. Only then will digital currency values hit more stable levels and become successfully implemented as a standard medium of exchange.

What are the benefits of DeFi and digital currencies?

One of the most prominent benefits of DeFi is the elimination of SPOF. As previously discussed, centralization installs Single Points Of Failure which creates risk for organizations and governments. Decentralization eradicates this risk by offloading information and service across a global network - increasing range, functionality, and protection against local service blackouts. In addition to protecting the structure of financial services, cryptography is also improving the physical security of holding assets and recording the transactions that occur. This is due to the transparent nature of the Blockchain and publicly declaring all transactions. Because

smart contracts and cryptography are successfully securing digital assets, “DeFi applications have the potential to deliver important efficiencies through the transfer of value without the need for trusted [private] intermediaries;” proving that “decentralized applications may result in faster, potentially cheaper and frictionless transactions driven by [...] automation” (OECD, p. 41, 2022). Ultimately, there are significant benefits for the public if decentralized methods are adopted among financial service providers. However, hesitation from such governing bodies and financial issuers is preventing the public from experiencing the potential efficiencies.

The hesitation to implement DeFi systems.

There are many reasons to integrate DeFi systems into our society, but there is much hesitation from governing bodies. Three major arguments cause resistance to decentralized systems. Firstly, the “Security problems and technical weakness of currently distributed blockchains” (Atzori, p. 16, 2015). Under a decentralized public network, “blockchain is inherently volatile and it can be forked or dismissed by the community at any time” which means that there is no guarantee that these processes will exist or be relied upon in the future (Atzori, p. 17, 2015). This is a concern if the Fed integrates its systems with the open-source Blockchain that already exists because there is no certainty that the large capital investment it would take to connect and adopt these systems will even be utilized in the future. There is further concern that “if the electronic network were shut off, or if everyone moved on to a new system, there is no paper-based backup archiving the existence (or execution) of these contracts” (DuPont, p.1, 2015). However, if the Fed were to invest in creating its own decentralized and private Blockchain, it would grant them transparency and traceability of transactions from the inside but would not be accessible from the outside. Therefore, in this case, the Fed would not be

concerned whether a public domain Blockchain exists or survives, as the entity would rely on its own private network.

Secondly, although there are many advocates for the security of blockchain and cryptography hash functions, there is a lot of trust being placed on an immature, highly vulnerable, and volatile exchange storing trillions of dollars of wealth. The scientific community is also corroborating the idea that these "systems are too immature to be fully trusted" (Atzori, p. 17, 2015). One major area of concern, for instance, is that "a colluding, minority group of 'selfish miners', consisting of 1/3 of all [Bitcoin] miners of the network, may in fact be able to strategically control the system and break its decentralized nature. The research has therefore concluded that services and data built on the top of the Bitcoin blockchain, such as virtual notaries, are currently at risk" (Atzori, p. 17, 2015). Ultimately, it goes against the logic of the governing body of a nation or large corporate entities to invest heavily into strategies prone to risk; justifying the decision to avoid such technological enhancements.

Lastly, Atzori argues that "central coordination of public institutions was originally created [...] to protect common good and collective rights in the long term from transitory individual interests and from any reckless logic of profit" (Atzori, p. 21, 2015). In a perfect world, it would be great to have a decentralized financial structure in which we would all benefit. However, the nature of decentralization inherently restricts the command of law, policy, and governance, and individuals gain greater freedom. If there were no evil or opportunists in the world, decentralization would be an idyllic system, however, with the current state of humanity, it is even difficult for the public (never mind government) to place complete trust in the structure. As a result, the only viable option for the Fed to implement any DeFi related structure to its

operation would be in a privatized, heavily monitored, yet technologically decentralized framework - combatting the issues of security, lack of monitoring, and open-source exposure.

In conclusion, this chapter has covered an array of topics. Firstly, it has shown just why it is appropriate for investors to feel skeptical about cryptocurrency, especially in such volatile markets. Although it is appropriate to be wary as investors, it is not necessary to be as worried about the infrastructure surrounding cryptocurrencies. Because the DeFi systems that are integrated with cryptocurrencies are practical and effective, they will support drastic improvements and efficiencies within macroeconomic systems in the future. In addition, an overview of DeFi technologies and their function in isolation of cryptocurrency including Blockchain, Cryptography, and Smart Contracts was provided to give an understanding of how these technologies are simultaneously integrated but also fully autonomous systems. Lastly, a critical comparison was made between cryptocurrency and the introduction of fiat money in the late 1700s and the early 1800s. Although there is hesitation for entities to adopt DeFi, the remainder of this thesis will directly portray how and where DeFi can be most effectively introduced in a macro setting and identify whose responsibility it will be to regulate such technology and assets created.

Chapter 2: The Operation and Organizational Structure of the Federal Reserve

In the United States the Federal Reserve System and the Securities and Exchange Commission are the government agencies most involved in monitoring and regulating the evolution of DeFi technologies. As mentioned in chapter 1, DeFi assets and technologies are in dire need of regulation to mitigate extreme digital asset value fluctuations and to stabilize the governance of crypto schemes. To understand how both agencies can most effectively perform these tasks, it is important to understand their regulatory powers and functions.

The U.S. Federal System

The Federal Reserve System (Fed) is empowered and obligated to conduct monetary policy, supervise and regulate nationally chartered banks, manage the US Interbank and Automated Clearinghouse (ACH) payment system, and provide a variety of services to the U.S government and private financial institutions. It does so in order to maintain the economic integrity and stability of the American financial system. During the recent economic crises of 2008-2009 and 2020-2022, the Fed deployed non-traditionally authorized functions to preserve the national and global economic system, in particular, to contain the systemic risks that arose and spread throughout global financial markets (Board of Governors of the Federal Reserve System, p.1, 2023).

The Fed conducts monetary policy to achieve maximum employment, stable prices, and moderate long-term interest rates. It does this by conducting open market operations, setting reserve requirements, and adjusting its discount rate. The Fed also supervises and regulates banks and other financial institutions, and monitors and analyzes the functioning of financial markets to ensure the safety and soundness of the banking system. It sets standards for banking practices, conducts examinations, and takes corrective action when necessary. It takes action to

prevent or mitigate systemic risks that could threaten the stability of the system. Through monitoring and addressing systemic risks that arise in financial markets, such as those related to credit, liquidity, and market functioning, it works alongside other regulators and central banks to address these macro-related risks.

The Fed also plays a major role in the operations of the US payment systems, including the US Interbank Payment System (Fedwire) and the Automated Clearing House (ACH) system. The management of this payment infrastructure offers an opportunity for the Fed to implement DeFi methods to increase the operational security and efficiency of commercial transactions. Fedwire payment systems facilitate the transfer of funds between all types of banks and other financial institutions.

Finally, the Fed provides a range of services to the US government and financial institutions, such as issuing currency, providing loans to banks, and processing payments on behalf of the government. The Fed has a rather complex structure but its continuous cooperation and support are crucial for the functioning of the national and global economy. (Board of Governors of the Federal Reserve System, p.1, 2023)

The Securities and Exchange Commission:

The Securities and Exchange Commission (SEC) is a regulatory agency that monitors and enforces all legal procedures relating to securities markets. It was created in 1934 as a response to the stock market crash of 1929, its primary function being to protect investors and maintain fair and efficient markets (U.S. Securities and Exchange Commission, p.1 2023). Over time, the SEC's mandate has expanded to include the oversight of financial reporting and corporate governance, the enforcement of securities laws, and the regulation of investment advisors and

brokers. The SEC plays a significant role in the financial industry and will play an even more crucial role in overseeing and regulating decentralized digital currencies in the future.

The SEC's enforces the laws that require companies to disclose their financial conditions to the public, such as making available for scrutiny their financial statements and their executive compensation systems. The SEC also sets rules for the registration of securities, including "stocks, bonds, and mutual funds, to ensure that they are legitimate" and meet specific standards (U.S. Securities and Exchange Commission, p.1 2023). It also enforces securities laws and has the power to bring civil actions against individuals or entities who violate them, including engaging in insider trading, market manipulation, and fraud.

Such authority and actions have become extremely relevant as cryptocurrencies have been recognized as securities by the SEC and have come under the scope of its regulatory powers. As argued in chapter 1, the main criticism of crypto-assets is from the fraudulent and illegal uses to which they are deployed by bad actors, rather than from the inherent nature of their technology. With a designated regulator, these digital asset markets can operate in a more transparent and orderly manner, reducing fraudulent crypto schemes and restricting illegitimate players. Through its enforcement actions, the SEC's overarching goal is to maintain financial integrity within markets and protect investors from unlawful activities (U.S. Securities and Exchange Commission, p.1 2023). Regarding the SEC's oversight of financial reporting, the SEC also ensures that companies comply with accounting standards and report accurate financial information to investors. This helps individuals make informed investment decisions.

The SEC's regulatory oversight helps ensure that companies operate ethically and transparently and that investors are protected from fraud and other illegal activities. It's role in investigating and enforcing securities laws helps to maintain the integrity of the financial

markets, while its oversight of financial reporting and corporate governance ensures that investors have access to accurate and reliable information. Finally, because the SEC has openly stated that it is willing to directly oversee and regulate cryptocurrencies and other digital assets, it is important to explore how it will do this.

The Federal Reserve System and the Securities and Exchange Commission will have to work in tandem to implement and recognize DeFi systems at the heart of the American Economy. Although both have traditionally functioned within centralized frameworks, digitalizing operations with enhanced security and efficiency measures could help bolster their functioning to the benefit of local, national, and global financial systems. There is room to implement digitized DeFi technologies within their respective infrastructures to make operations more efficient. Consequently, DeFi promoters assert that an alternative DeFi structure can assist in autonomously preserving the economy as a whole - both during crises and stable periods. Through analyzing the historical behaviors of the Fed, it is possible to see where such technology can be implemented.

Decentralized Financial Governance and the History of Federal Reserve:

The structure of America's Central Bank has evolved over the years, becoming an increasingly centralized organization. Lev Menand's book, *The Fed Unbound,* describes the organizational shifts that the Fed and its historical predecessors have undergone through time, the extent to which its powers and obligations have evolved, and how effective it's been in meeting the challenges it has confronted. Menand notes that the Fed has always been pressured to operate within a uniform framework to effectively regulate, manage, and support private

financial institutions. But, Menand advocates and supports the idea that the Fed should adopt a more digitalized and decentralized framework in its operation.

The history of the Federal Reserve is relatively short, having only been established in 1913 following the chronic currency crises of the nineteenth century. An early predecessor was the Bank of North America chartered in 1781 before the United States won its independence from Great Britain. The Continental Congress printed "the new nation's first paper money-known as continentals. This was followed by the creation of the First Bank of the United States (1791-1811) and then the Second Bank of the United States (1816-1836) (Hill, p.1, 2015). However, the Federal Reserve, the entity which we know today, was formed after Congress passed the 1913 Federal Reserve Act; legislation that created the current Federal Reserve System (Hill, p.1, 2015). The Federal Reserve was developed as an entity that "act[s] as a bank for bankers, issu[es] a common currency, clear[s] payments, regulate[s] banks, and act[s] as a 'lender of last resort' for banks in financial trouble" (The Fed Explained p.58, 2021). However, the Fed has been the subject of much dispute over its organizational structure, its lending policies, and its freedom when it comes to printing money.

Federal Reserve Organizational Structure:

The Fed was originally established by Congress to contend with three main challenges: currency deflation, currency maldistribution, and insufficient political legitimacy (Menand, p. 86, 2022). It was designed to combat these threats and to manage economic and financial instability via a decentralized governance framework. The Fed's organizational structure is unique. It was and still is both a private and public entity and comprised of 12 Federally chartered Reserve Banks spread throughout the country. Each of the Reserve Banks was initially authorized to

produce a gold-backed currency marked by a seal indicating its bank of origin (The Fed Explained, p.11, 2021). Each Reserve Bank was and is currently owned by the commercial banks within the district over which they are empowered to regulate. Originally, all the Reserve Banks were required to finance themselves.

At its origin, the Fed was designed to perform public tasks. Strongly tied to government operations, its most important body is the Federal Reserve Board - a political body of seven representatives that are nominated by the President of the United States and confirmed by the U.S. Senate. It is this dichotomy of being organized as both a public and private entity that makes the Fed unique among most corporations and governmental agencies. Although it is most common to reference the Fed as a central entity, its organizational structure is decentralized across a range of institutions (public and private) working together.

Historical Powers and Functions of the Federal Reserve:

The Fed was mainly established to bring stability to the U.S. economy. Headquartered in Washington, DC, along with its 7 Governors, the Fed has transitioned to take on many different functions to support America's consumers and businesses. The Fed has the responsibility of creating and managing the U.S. currency, i.e., it has the "power of the printing press" (Menand, p. 16, 2022). The Fed holds operational independence and control over money, allowing it to print as much money as it deems necessary to support economic activity in the United States. The Fed does so to "regulate the money supply [and] to make sure there is enough money in the economy for everyone else to use" (Menand, p. 17, 2022). It is authorized to regulate commercial banks to ensure that the deposits they create are always interchangeable one-to-one with the cash and reserves the Fed creates. It is especially important to analyze how the Fed acts

during stable times and crises to adequately discuss its potential for implementing DeFi technology within its infrastructure.

The Fed and Bank Runs:

A bank run occurs when large numbers of its account holders simultaneously attempt to withdraw their deposits with the expectation of converting them to cash, but the deposit balances being withdrawn are greater than a bank's reserves. (Barone, p1, 2023). Such events can occur for many reasons, but most commonly occur from the public's fear over a bank's collapse or systematic unease in the economy. Under either situation, this fear drives individuals to withdraw as much of their balances as possible. As concern over the bank's illiquidity or insolvency grows, more individuals attempt to retrieve their cash. As this cycle continues, a compounding cycle of fear, deposit withdrawal, and a further reduction in liquidity will develop. Consequently, if one firm loses all liquidity and is unable to repay its depositors, the fear and demand for cash spreads further to individuals at neighboring banks, causing a catastrophic collapse of the banking system.

An examination of the Fed's reaction and management of the financial crisis of 2008, offers an excellent example of its power and importance during bank runs. The crisis featured a dramatic bank run on several large financial institutions as their creditors and depositors panicked when one of them suffered huge losses on its loans and investments. The run drained liquidity from the banking system, as deposit withdrawals exceeded bank reserves. One by one, large commercial banks and other financial institutions faced huge liquidity shortages and each one feared that all others were on the verge of insolvency. As interbank lending collapsed, the Fed was required to come to the rescue as the "lender of last resort". The 2008 financial crisis

was a perfect storm of lax loan issuance criteria, cheap credit allowances, and a burst in alternative asset prices. The Fed was compelled into action.

Federal Reserve Bailouts:

Ultimately, the Fed is responsible for ensuring that financial crises are averted and/or managed. It does so by expanding bank reserves and the total cash supply to reduce depositor fear and satisfy account withdrawals. It is important to remember, however, that the Fed creates and maintains bank reserves and issues paper money to banks, but does not create deposit money (Menand, p.26, 2022). The US government outsources the power of issuing deposits purely to "publicly chartered, privately owned banks-banks like Wells Fargo, JPMorgan Chase, and Bank of America," and leaves the Fed solely responsible for supporting these institutions when its depositors draw down their bank accounts (Menand, p.26, 2022). Bank deposits are what are used by firms and households for trade and services daily including paying salaries, purchasing goods, and paying credit card bills.

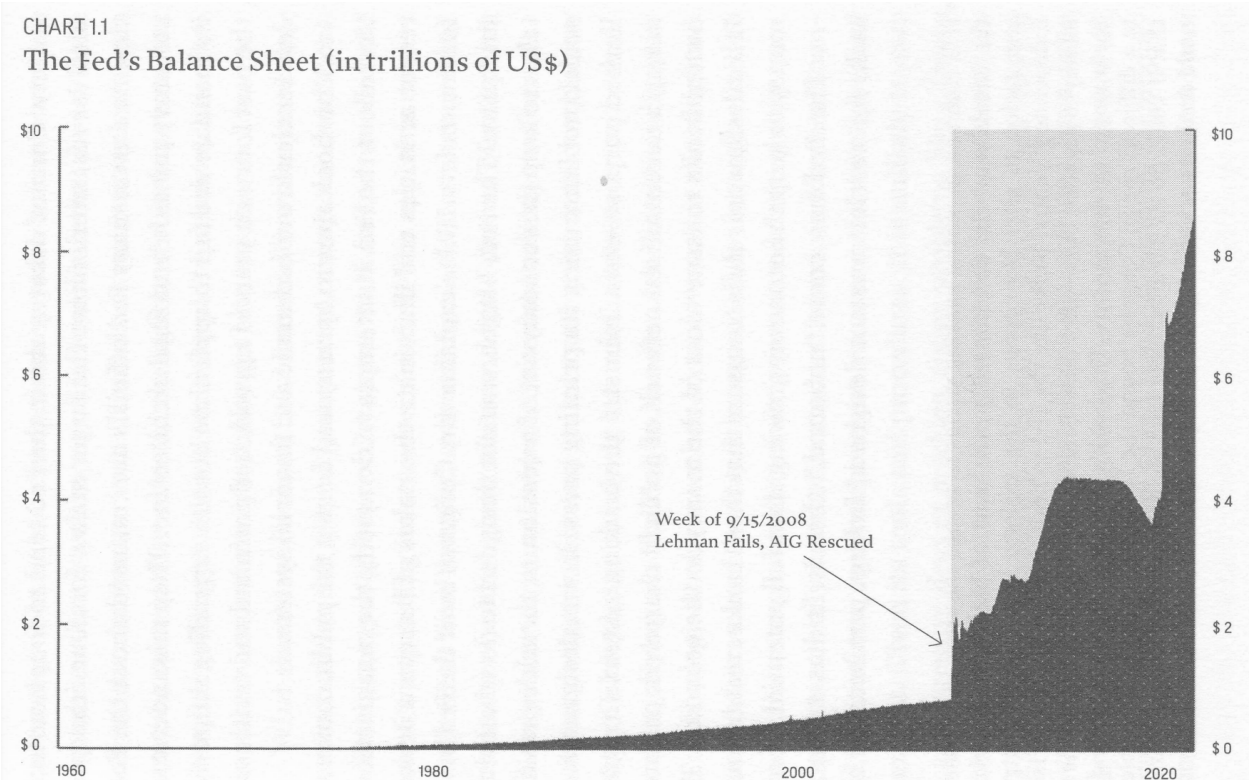
During 2008, the Fed provided massive injections of liquidity to support large financial institutions. Several large investment and commercial banks struggled to manage the housing market crash and its effect on the billions of dollars of Mortgage Backed Securities (MBS) they'd invested in. These firms had financed those investments with their retail deposit accounts and with very short wholesale funding. At the time these securities were viewed as an alternative to U.S. government bonds as they were considered safe and highly liquid. However, as the housing market crashed, the financial firms that held many of them found their market values plummeting and the securities they held rapidly losing their liquidity. As their depositors went to withdraw their accounts and their creditors refused to roll over their short-term loans reinvested

into MBS deals, several large financial institutions were unable to redeem them. The Fed kept globally and economically significant institutions from failing by buying these increasingly illiquid assets and lending reserves to them through its discount window.

One of the most significant of these Fed "bailouts" occurred in support of Bear Stearns - a highly leveraged investment bank that owned several hedge funds that held billions of dollars worth of MBS. This action was controversial because it was the first time that the Fed had stepped outside its traditional legal authority to serve as a lender of last resort for commercial banks. Bear Stearns was an investment bank. The Fed supported Bear Stearns as its creditors refused to roll over their short-term loans. It was the "fifth-largest investment bank in the U.S. and held approximately $18 billion in assets" (Chen, p1, 2023). Consequently, the Fed had to step in to prevent a default of a firm this size, which could have had detrimental effects on the entire American and global financial system. Over 24 hours, many of Bear's lenders were pulling out their positions and asking for cash. Bear responded quickly to appear financially stable, but it no longer had the loan inflows to fund operations or repay its lenders. The Fed stepped in to fulfill its duties and rescue the shadow bank. As the economic climate worsened, the Fed supported more traditional banks and shadow banks as well as buying collapsing Mortgage-Backed Securities (Menand, p.106, 2022). However, such support from the Fed in bolstering struggling firms came with a cost. Although the Fed can theoretically print unlimited amounts of money, its actions had unintended consequences. An example of this is the extreme pressure that issuing billions and, in some cases, trillions of dollars in loans are accruing on the Fed's balance sheet.

Cost of Fed Bailouts

The process by which the Fed allocates its loans and supports financial firms is relatively simple. The Fed's Board of Governors determines the number of new reserves and currency that needs to be created to satisfy deposit withdrawals and to meet the demands of liquidity-distressed firms. The Fed issues loans to these struggling firms, especially those that are deemed too large to fail, i.e., those whose default will have consequential negative national and global impacts. As the Fed offers such bailouts, it will increase the total Fed balance sheet. Additionally, during times of crisis, the Fed buys government securities or depreciating assets such as MBS securities as in 2008, which will also be added to the total treasury balance sheet. After 2008, the Fed helped to reignite the economy and stimulate spending once again. Through several rounds of quantitative easing, the Fed had amassed an asset portfolio of over $2 Trillion. Between the 2008 crisis and the pre-pandemic market crash, the Fed continued to support institutions that continued to struggle and maintained its promise to buy MBS securities. As a result of the Fed's quantitative easing practices, the Fed's balance sheet continued to grow until a plateau of around $4T - double the summation of 2008 (Menand, p.23, 2022).



(Menand, p.23, 2022)

The Covid Panic:

Unfortunately, as the United States economy began to stabilize and grow, the globe faced an unprecedented health threat in 2020. The Covid-19 pandemic sparked chaos as businesses and households faced critical conditions in a world that went into physical lockdown. Index funds "crashed 20% within a couple of weeks" and, once again, the U.S. economy was confronted with massive financial instability (Menand, p. 20, 2022). Workers were forced to stay at home to avoid the threat of the new deadly Coronavirus. There was less concern for a liquidity crisis, but an unparalleled fear of a catastrophic collapse in real economic activity. The Fed had learned from its mistakes in '08 and transitioned rapidly into supporting the quickly crashing economy. As GDP and the prices of all asset classes began to plunge, the Fed stepped in.

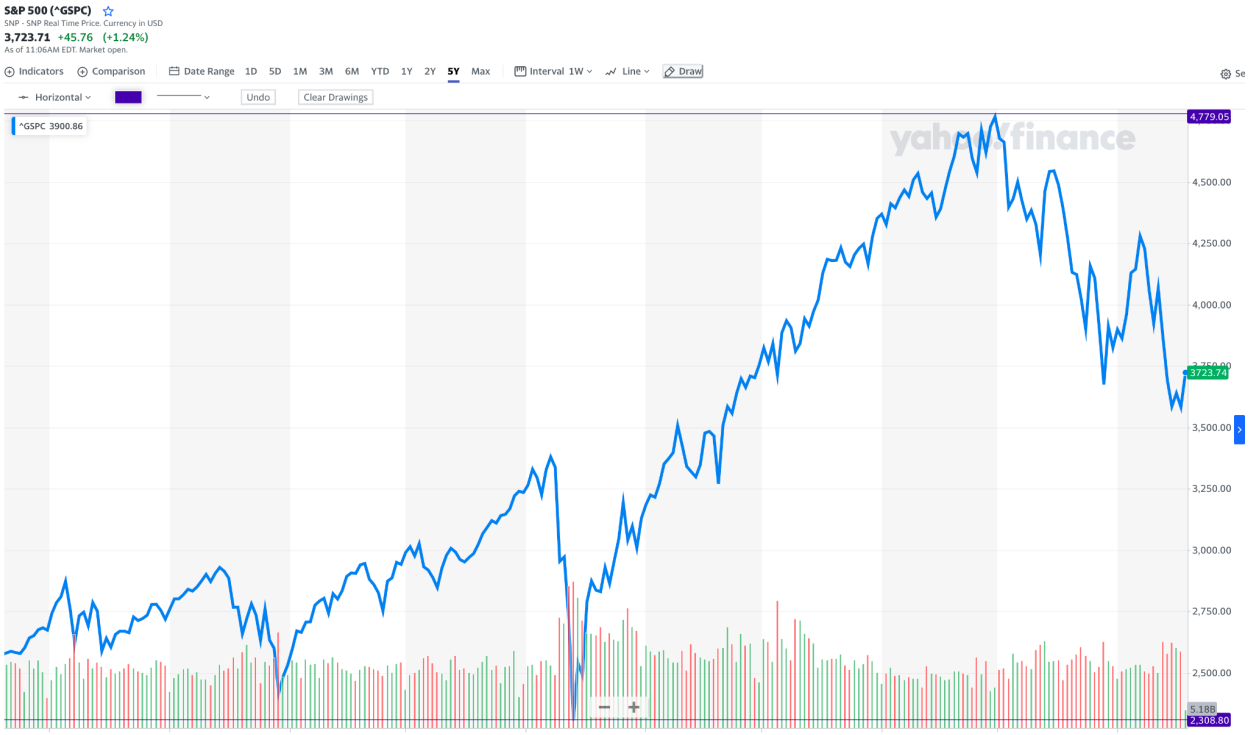
Through the early stages of 2020, the Fed provided a $3 trillion backstop of loans to prevent an ongoing economic collapse (Menand, p.106, 2022). One-third of those loans were issued to financial firms that were not government-chartered banks (Menand, p.20, 2022). It used the remaining two-thirds to buy government bonds and mortgage-backed securities (MBS) through further rounds of quantitative easing (Menand, p.20, 2022). In just one month, Fed officials deployed almost as much money as Congress allocates in a year (Menand, p.20, 2022). The Fed also worked with the U.S. Treasury to facilitate its federal government's fiscal operations, especially in its delivery of covid relief funds. As economic tensions dragged on throughout 2020 and 2021, congress passed "the Coronavirus Aid, Relief, and Economic Security (CARES) Act, authorizing the Fed to set up facilities to lend to medium-sized enterprises, state and local governments, and large corporations-the sorts of entities that usually receive government loans from agencies like the Small Business Administration and Treasury Department" (Menand, p.21, 2022). The Fed expanded its remit from solely supporting large systemically important financial firms with loans and purchasing Treasury debt and Mortgage-Backed Securities backstopped by Federal agencies to supporting markets in a myriad of non-government issued assets and lending to many non-financial businesses.

Amidst fears that its actions were not enough to keep the financial system afloat, the Fed moved to restart its quantitative easing policy. Through 2020 and into October 2021, the Fed purchased over $120 billion worth of financial assets per month. (Menand, p.21, 2022). The astounding flood of supporting funds and quantitative easing propped up countless companies, ultimately heightening company performance and causing dramatic rises in equity markets. Additionally, the lowering of interest rates encouraged companies and individuals to take out

loans, further stimulating consumption and investment spending and improving market sentiment and confidence.

Effects of QE and Company Bailouts:

Although US economy activity rebounded quickly from its collapse in mid-2020 it underperformed compared to its trends and projections before the pandemic. However, stocks, bonds, and real estate prices all recorded historically high valuations as a consequence of the strong Fed initiatives (Menand, p.21, 2022). The S&P alone soared 107% above its low in 2020 after the initial covid crash of 41.2% in December (Yahoo! Finance, 29 Mar. 2023). This signifies the truly impactful consequence of Fed actions. However, there is a growing among many observers regarding the legitimacy and long-term consequence of the Fed's policy on commerce and asset prices. Between late 2020 and 2021, as the Fed aggressively supported desperate firms and plunging markets, it prevented an economic collapse, however, there is doubt over equity market performance and asset values. Some believe that such markets should not have trended as positively as they did through the year of infinite support. As a result, the Crypto boom occurred as speculators turned against government-backed assets, securities, and traditional valuation methods to enter an untapped market, sending record-high performances in many cryptocurrencies.



(Yahoo! Finance, 29 Mar. 2023)

The Fed Unbound

The Fed has often acted in response to financial and economic crises, most recently with nearly unlimited lending support. Beginning in 2008, the Fed extended its lending power outside the scope of traditional financial institutions and its purchases beyond government securities. Through the 2008-2009 housing crisis, non-commercial shadow banks were bailed and the Fed purchased billions of dollars of Mortgage-Backed Securities. As the effects of the covid pandemic threatened the stability of the national economy again, the Fed unbound its traditional lending facilities yet again, offering seemingly unlimited support to all firms and repurchasing many forms of mixed fixed-income securities. The Fed broadened its support to sectors and asset classes beyond its normal remit, and there is no indication that this trend will slow or be reversed. Therefore, as future economic crises occur, the Fed may see the need to support future

asset classes and securities that become economically significant. Consequently, if cryptocurrencies become more popular, comprise a greater market share of alternative assets, and are increasingly used in national and global trade and commerce, the Fed may be required to recognize and support their markets during crises.

Fed efficiency and transition

Undoubtedly, the Fed acts as a critical player in mitigating economic instability and volatility. The Fed's most effective tool is monetary policy. It offsets liquidity shortages and stimulates business investment and consumer spending. However, through the 2008 housing crisis and covid crash, monetary policy was accompanied by unlimited financial support, including support for asset markets outside its orthodox remit. Although the Fed has responded in unorthodox ways, its actions to bolster the economy were entirely necessary to prevent a catastrophic economic collapse. By analyzing them carefully, it is possible to understand why the Fed had to take such severe actions.

During the 2008 housing crisis, the Fed confronted systemic liquidity shortages that plagued large financial institutions and shadow banks. Such firms were unable to meet depositor withdrawals and retain the confidence of their short-term creditors. The Fed was faced with the responsibility of offsetting such shortages. It was forced to bail out private firms. As a result, the Fed has and continues to add to its balance sheet to support systemically important financial institutions. Menand suggests an innovative alternative. He argues that all checking deposits be held directly with the Fed rather than private commercial bank intermediaries. As a result of the Fed's support during the 2008-2009 housing crisis and the 2020 pandemic, the rise in its balance sheet is concerning - breaching $8 Trillion (Menand, p.23, 2022). Therefore, Menand asks

whether it is less efficient for private financial intermediaries than the Federal Reserve to hold individual bank accounts. The transition to holding individual accounts at the Fed would remove the liability of having to support failing firms (where bankruptcy would collapse the global economy) and would cut the intermediary deposit system entirely. The idea of holding individual accounts at the Fed was never permissible in the past because of the lack of security measures and ineffective technology. However, the last chapter of this thesis will discuss how decentralized technology and cryptography can grant access to a more efficient digital system and enable the Fed to be the key account holder. This system would offer positive long-term externalities and limit the infinite support regime the Fed has been obliged to undertake to support private institutions.

How the Fed works as a clearing house:

Finally, advances in DeFi technology can be adopted to enhance the efficiency with which the Fed operates its central clearing house system for private banks. Fedwire is a real-time gross settlement (RTGS) system that enables banks to transfer funds electronically and securely. To use Fedwire, financial institutions must be members of the Federal Reserve System and have access to the Federal Reserve's settlement accounts. The Fed acts as an intermediary bank to private banks. Due to the massive number of bank accounts shared by investment banks, corporate banks, and consumer banks, the Fed is responsible for clearing all of its inter-bank exchanges on a net-sum basis. For instance, the Fed adjusts “deposit account records to reflect all the transactions from customers of … different banks” (Menand, p.95, 2022). Once a transaction is initiated, the sending bank's account is debited and the receiving bank's account is credited simultaneously. For example, exchanges of deposits and credits between account holders of Bank

of America and Chase are handled by Fedwire. The Fed "stitch[es] together bank balance sheets so that customers of one bank can seamlessly interact with customers of another bank-the Fed operates as a bank for banks" (Menand, p.95, 2022). Thus, the Fed effectively integrates all banks in the United States, allowing them to operate like one big bank. Fedwire works as a complex algorithm that allows the Fed to determine the amount a bank owes or is indebted to another bank. In calculating the net sum through the Fedwire, "the Fed runs a nationwide check-clearing system, which adds up all the check transfers, and an electronic service known as FedACH, which processes electronic payments drawn on banks by depositors of other banks" (Menand, p.96, 2022). The Fed then either deposits or withdraws the amount from a Bank's master account; accounts held at one of the twelve Federal Reserve Banks called reserve accounts. Although this operation does not have the same macroeconomic impact as altering interest rates through monetary policy, the Fedwire operation is a crucial utility for interbank connectivity and infrastructure for the whole economic system.

In closing, the Fed is responsible for maintaining a stable and well-functioning financial system. It does this by conducting effective monetary policy and managing the interbank payments. The Fed has expanded its tool kit in an ever-evolving economy to meet new challenges. The nature and increasing size of its bailout and quantitative easing operations have been necessary because systemically significant institutions have misjudged their exposure to certain assets and markets. Their failure put accounts of their household and business depositors as well as their creditors at risk. As a result, the Fed rescue policies have expanded its balance sheet to historically high levels. The next chapter will explore how Defi technology can be deployed to limit the damage to the public of the misjudgments of bankers, by creating a system

of private bank deposit accounts directly at the Federal Reserve. If done well, the need for massive Fed rescue operations of the banking system may be less necessary.

Chapter 3: What are DeFi integrations - an introduction to CBDCs

In recent years, the world of finance has undergone significant changes thanks to the emergence of new technologies such as Blockchain, smart contracts, and cryptography. These technologies have the potential to revolutionize the way financial transactions are conducted and to create more efficient, secure, and accessible payment systems. At the same time, there is a growing need for regulation in the expanding crypto space to prevent fraudulent and illegal activities and to improve the overall sentiment related to the digital asset space. There are clear opportunities for the Fed to introduce DeFi-related technologies within its infrastructure to streamline its processes and to heighten the security and improve the traceability of local and global commercial transactions. Some of the most promising opportunities being discussed regarding the Fed and DeFi are the possibilities of introducing a Fedcoin (a digital currency issued by the Federal Reserve), a more efficient Fedwire system, and a system of personal Fed accounts that could potentially eliminate the need for intermediary banks. Ultimately, implementing such systems will require huge investments in infrastructure development and maintenance, a large and competent regulatory workforce, and lastly, faith in and compatibility across local and global economies to ensure the functionality and acceptance of the new systems and currencies.

For the Federal Reserve to improve the efficiency and effectiveness of its operations and financial systems, it may be interested in utilizing decentralized finance (DeFi) related technologies such as Blockchain, smart contracts, and cryptography. These three technologies can enhance the efficiency, security, and traceability of the American and global financial systems. The first significant advantage of implementing a Fed Blockchain is its transparency and immutability. Blockchain - the distributed ledger - records all transactions and allows all parties involved to verify and authenticate them. It would oblige public and private business

entities to be more transparent in their financial reporting and more accountable for their actions. The Fed could develop its own Blockchain database to track and verify the movement of funds between different financial institutions, making it easier to detect and prevent fraud or money laundering. Digital currencies in combination with Blockchain transactions could also be processed more quickly and securely without the need for intermediaries, reducing the time and cost of processing financial transactions. This could help the Fed to improve the speed and efficiency of its payment systems, including the Fedwire, and also make it easier for individuals and businesses to access and transfer funds. Smart contracts, which are self-executing contracts with their terms embedded and programmed into computer code, can be used to automate financial transactions, reducing the need for intermediaries within a financial setting. Addressing technologies such as smart contracts will require the necessity for lawyers and programmers to collaborate to ensure such systems are implemented accurately, or professional consultants will act as new legal intermediaries. Smart contracts can also facilitate the settling of trades and net transfers through the Fedwire in the Federal Reserves' clearing house operations. Smart Contracts can automate commercial transactions, making them more efficient and autonomous. It will also require the expansion of legislative action to ensure that the contracts conform to existing laws and that the courts to adjudicate different interpretations. Lastly, cryptography, which is the use of mathematical algorithms to secure and verify transactions, could be of interest to the Fed. It can be used to secure financial transactions, protect personal information, and prevent fraud. If the Fed were to implement a fully digital financial system or issue its own central bank digital currency, the records of financial transactions and the storage of digital assets would have to use cryptography to secure payment systems and to protect the personal and financial information of the public. As a result, the Fed should be interested in utilizing

DeFi-related technologies such as Blockchain, smart contracts, and cryptography to improve the efficiency and effectiveness of its operations and financial systems. By leveraging these technologies, the Fed could improve the transparency and accountability of its operations, reduce the time and cost of processing financial transactions, automate processes, and secure financial transactions and personal information.

The current chapter analyzes the effectiveness of DeFi technology on a case-by-case basis. Each element of this technology ultimately has its own distinct use. In the following discussion of how the Fed can best implement DeFi technology, it's most significant application is in the adoption of a Central Bank Digital Currency. Although its capabilities are impressive, prior skepticism from crypto markets makes critics of DeFi worried about the effectiveness of a possible digital currency. However, it will become apparent that the technology behind such systems will be able to effectively operate securely.

The Fed's Implementation of Digital Currencies:

The emergence and proliferation of cryptocurrencies such as Bitcoin and Ethereum have sparked a growing interest in digital currencies among private investors, government authorities, and central bankers. Alongside private institutions, governments worldwide have started exploring the possibility of issuing their own centralized digital currencies (CBDCs), with the US Federal Reserve being no exception. The Fed is currently studying the feasibility of introducing a CBDC, a Fedcoin, and considering its potential benefits and drawbacks.

What sorts of factors is the Fed considering?

A Federal Reserve digital currency could improve the speed, efficiency, and safety of its payment systems and provide greater financial inclusion to those who are currently unbanked or underbanked. Using distributed ledger technology (DLT), the new currency would allow for the almost instantaneous transfer of funds, 24 hours a day, 365 days a year, with much lower fees and much greater transparency and security (Nover, p.1, 2021). Ultimately, this is in the best interest of consumers and businesses alike. Secondly, the rise of cryptocurrencies like Bitcoin and Ethereum has encouraged some central banks to create their own digital currency to displace these alternative private forms of money. As Tommaso Mancini-Griffoli explains in an International Monetary Fund paper, "E-money backed by central bank reserves can eliminate liquidity and market risk, and thus attenuate default risk," granting the central bank greater security and control of money circulation (Mancini-Griffoli, p. 13, 2019). This would preclude the undermining of the authority of central banks. In addition, it would protect the wealth of digital coin users from the scandals, turbulence, and bankruptcies observed recently among private exchanges and issuers of private digital currencies. Therefore, it is anticipated that investors and users would not experience the same type of crypto crashes if a CBDC was issued backed by the Fed and other Central Banks and backed by the full faith and credit of the U.S. and any other sovereign government. Lastly, it would address the issue of illicit activities such as money laundering and terrorist financing by providing greater transparency and traceability in transactions. The Blockchain, closely associated with digital currency for recording transactions and storing them in a public decentralized database, effectively stores and secures data on transaction history. As Mancini-Griffoli argues, CBDCs have the potential to improve

compliance and help prevent financial crime by “granting appropriate transaction monitoring in accordance with anti-money-laundering regulation” (Mancini-Griffoli, p. 14, 2019).

Ultimately, however, the concern for the users of CBDC is the lack of anonymity when making purchases. Having all purchases stored and available indefinitely on a Fed Blockchain is concerning for the public as they are worried about their privacy rights. While a government-issued digital currency like Fedcoin does not afford the anonymity that cash provides, its users in fact would actually enjoy greater privacy. Depositors at the Fed would experience enhanced privacy because current private financial institutions have motives to sell transaction data on depositor spending habits to companies to utilize for fees, as they enjoy insights into consumption and locating a target market. The Fed on the other hand acts for the benefit of the nation and not for profit, so would not be subject to selling depositor transaction data for consumer metrics and advertising strategy. Therefore, because the Fed or any other Central Bank has no profit-maximization incentive, it will have no reason to sell consumer spending data to private corporations for revenue, as banks do. Additionally, the privacy protections offered by Blockchain technology will extend to all “Citizen Accounts” (Hocket, p.9, 2019). Direct central banking is likely to be more effective, consumer-friendly, and offer more privacy than current private payment systems.

There are many reasons why the Federal Reserve has been exploring the possibility of creating a digital currency, including improving payment systems, maintaining monetary sovereignty, and eradicating hidden illicit activities. Although such systems may restrict the anonymity of spending, it does create a highly advanced and efficient system for future generations. Therefore, considering the many benefits and the few concerns of implementing a

CBDC (such as infrastructure cost and potential electronic failure), it is useful to explore how the Fed may want to develop a CBDC in the future.

How would a CBDC be implemented at the Fed:

The first step for the Fed to implement a CBDC would be to define its objectives and uses. Will it serve as a digital version of physical cash and/or as a tool to enhance the efficiency of the payments system? If the Fed considers adopting a digital currency, it needs to decide whether to create a wholesale or retail version of it. Wholesale CBDCs would be limited to large non-financial and all financial varieties institutions and used for large-value transactions. Retail CBDCs, on the other hand, would be available to the general public and used for day-to-day transactions. If the Fed was to choose a wholesale CBDC solution, the digital currency would solely be issued to large institutions and used only for large-value transactions. Its implementation would significantly improve the efficiency and security of interbank settlements through "reduc[ing] transaction costs[…], financial inclusion[...], real-time transaction settlement[...], and reduced counterparty risk" (Geroni, p.1, 2021). This option would also reduce the cost of transactions by eliminating the need for commercial bank intermediaries. However, a wholesale CBDC would not be available to the general public, which could lead to concerns over financial inclusion. In contrast, a retail CBDC would be available to the general public and used for day-to-day transactions. It would provide the benefits of financial inclusion by allowing unbanked and underbanked individuals to access digital payment systems. Additionally, a retail CBDC would be "more efficient and secure than traditional payment systems", reducing transaction costs and increasing transparency among transactions and transfers (Geroni, p.1,

2021). However, the implementation of a retail CBDC would require significant investment in infrastructure and could raise concerns over privacy and security for users.

Implementation of a Wholesale Fed Coin and its Impact on Fed Deposits

It is essential to explore how the implementation of a wholesale Fed Coin could have major implications on the global and local economies. Who would benefit and who would we be hurt? How would individuals hold accounts at the Fed, and equally as important, what impact would the creation of Fed accounts have on bank intermediaries? It is clearly difficult to discuss how the Fed would manage the transition to such a system.

The introduction of a wholesale Fed Coin could have major impacts on global and local economies. The primary benefit of a wholesale Fed Coin would be its potential to eliminate the need for commercial bank intermediaries which would allow non-financial institutions to transfer funds instantaneously and at a lower cost. This could significantly reduce the cost of cross-border payments by global businesses but also could have catastrophic impacts on intermediary banks. A Fed coin could potentially reduce the need for correspondent banks and payment processors that currently facilitate cross-border transactions between institutions. According to Ekberg, correspondent banks facilitate cross-border payments and typically act as "intermediaries between the sending and receiving banks [in different countries], often resulting in high transaction costs, long settlement times, and lack of transparency" (Ekberg, p.1, 2021). If such non-bank firms were able to hold accounts directly at the Fed and transfer funds using a wholesale Fedcoin, they would not need to rely on correspondent banks or payment processors for cross-border payments. Although a Fedcoin reduces the cost and time involved in cross-border transactions, it could potentially harm the business operations of these banks and

have negative effects going forward. One real-world example of a bank that could potentially be affected by the implementation is JPMorgan Chase. JPMorgan Chase is one of the largest correspondent banks in the world and facilitates cross-border transactions for other financial institutions (Ekberg, p.1, 2021). In 2020, the bank processed "approximately 26 million transactions per day worth between $6-8 trillion. Losing such business and potential fees to the Fed would clearly have significant detrimental impacts on its operations and revenue streams (Ekberg, p.1, 2021). If large non-commercial banking institutions were able to hold accounts directly at the Fed and use a wholesale Fedcoin for cross-border payments, they would simply bypass JPMorgan's and other correspondent banks' services. Evidently, if the Fed holds and transfers cash deposits more efficiently than commercial banks, which often impose fees for such services, it could potentially generate a net positive impact on the economy. By relieving commercial banks of this function, they could concentrate on their primary role of intermediating between long-term savers (issuing bonds, CDs, savings deposits, and raising funds through equity) and long-term investors (such as industrial firms, service companies, and technology companies). This could lead to a more efficient allocation of capital and resources, potentially benefiting the overall economy. Furthermore, if we were to reduce our reliance on large commercial banks and avoid false assumptions that the Fed guarantees to bail them out in case of bad investment decisions, we could reduce the risk of a collapse of the overall payment system. However, such a shift would require careful consideration of potential risks and benefits, and the Federal Reserve would need to be well-equipped to take on the added responsibility of maintenance.

However, there are also some potential concerns to the implementation of a wholesale Fedcoin. It could lead to a decrease in the demand for traditional banking services, as individuals

and businesses could hold accounts at the Fed directly. If a large number of customers were to switch to using digital currencies issued by the Fed, traditional banking firms could experience a decline in profitability. Banks generate revenue from a range of services such as interest on loans, fees charged for various banking services, and commissions from investment activities. If the Fed is able to serve as the sole provider for payment systems, there would be decreased demand for intermediary services, and banks may experience a decline in revenue and profitability. The contraction in bank profitability from holding deposits and payment transfers could, in turn, lead banks to become more prudent in their lending decisions and other revenue generating operations. Banks would become more cautious in their lending practices and may be less willing to extend credit to customers. Shareholders and creditors would force banks to be more careful when making loans and become more conscious of the risks they take in doing so. They would bear the equivalent business risks like the private companies they claim to be. Because the private banks will still remain relevant, but not integral for economic survival, the Fed would no longer have to support them as systemically important parts of the payment system and they will in turn act more responsibly in extending credit and in making investments. This could result in a decline in bank lending and real investment.

Another concern of implementing either a wholesale or retail CBDC is the potential for disintermediation, further centralizing the financial industry and setting up the potential for a Single Point of Failure (SPOF). A CBDC would allow individuals and businesses to bypass traditional financial institutions to cut costs and conduct transactions directly with the central bank-- in the U.S., it would be the Fed. This could reduce the profitability of financial institutions and their operations at large as they would lose the fees associated with transaction processing. Additionally, the implementation of a CBDC could threaten the necessity for

physical cash, again leading to a loss of privacy and financial independence because of the recording processes of Blockchain or other database technologies.

However, concerns over declining bank profits and disintermediation may be offset by the net benefits to the overall economy. The gains from adopting a more efficient payments system at the Fed would benefit households and non-bank firms because the cost to households and non-bank firms paying the fees required to support an enhanced Fed payment system would be much less than the costs they currently pay to commercial banks for running less efficient systems and doing so for profit. Also, the adoption of a CBDC would not preclude the existence of physical cash, just as digital checking deposits have not made the need for cash redundant either.

Ultimately, the implementation of a CBDC comes with both benefits and concerns. The choice between a wholesale or retail CBDC would depend on its objectives and purposes, whether a CBDC would be best suited for institutional transactional purposes or for the public as a whole. A Fed digital currency would provide benefits such as increased efficiency, security, transparency, and financial inclusion. However, under either implementation, there would be no immediate solution provided as this would be a step by step process in which then FED needs to integrate layers at a time rather than a full scaled product. This would simultaneously allow for private institutions to adjust to the disintermediation being created and prepare them to search for new revenue streams. On the other hand, the FED would also assess the efficacy of new systems being developed in a rolling release to enhance security and ensure effective development. As of now, the likelihood of the Fed implementing any sort of digital currency is uncertain and its initial capital expenditure will be steep. Also, it would likely be opposed by powerful lobbyists like the American Bankers Association, as commercial banks would fear the loss of privilege in

controlling and running inefficient yet profitable transaction systems. However, the implementation of a CBDC would have significant positive implications for the financial system and society as a whole.

Digital currencies and Blockchain compatibility for the Fed

The Fed plays a crucial role in the US monetary system by influencing the size and composition of bank balance sheets through its control over the issuance of reserves. As the intermediary for settling payments between banks, the Fed has the power to create reserves and cash out of thin air, which it uses to stimulate monetary expansion through quantitative easing. During the Covid-19 pandemic, it facilitated the U.S. Treasury's issue of stimulus checks, a powerful illustration of the coordination between monetary and fiscal policy. By leveraging its position at the pivot point of the monetary system, the Fed effectively managed the flow of government spending to stabilize and support the U.S. economy. Throughout the Covid-19 pandemic, there were several instances in which a digitalized asset and a Blockchain system could have prevented instances of "fraud and system manipulation" (Ackerman, p.1, 2021). Some individuals were able to receive multiple stimulus checks by using fake identities or fraudulently claiming dependent children, thus "amassing over $100 billion of stolen income" (Ackerman, p.1, 2021). The utilization of a Blockchain, digital assets, and smart contracts, could have prevented such fraud. The Fed would already have had access to all individuals with bank accounts in the U.S. It would only have needed to increase the account totals for each individual in their database, that fit the agreed-upon criteria. In this way, the Treasury's stimulus checks would have been delivered instantaneously and accurately.

A payment system more fully controlled by the Fed can also be utilized in the disbursement of tax returns from the IRS. In combination with smart contracts, the code behind filtering individuals on assessment criteria would grant an accurate list of individuals who qualify for the checks as well as the amount they are due to receive. Once this is completed, the Fed can alter the registered account number with the additional funds. Lastly, all transactions would be registered within the Blockchain. Updated account amounts will be registered within the Blockchain for historical record and verification purposes. This would provide a far more efficient and robust system to benefit the security of the economy and the integrity of the system.

Regulating a CBDC - who's responsible?

The role of the Securities and Exchange Commission is also changing with the transition towards digital transactions and assets. The SEC is already beginning to recognize private crypto and digital assets and taking on regulation across crypto markets. As the digital space continues to grow, so will the scope of the SEC's regulation. Just as the SEC regulates a broad range of securities in the current financial system, it will have to take significant steps to ensure the regulation of such digital currency securities. Learning from the era when bank notes were originally released in the U.S. in the 19th century, their valuations fluctuating wildly and their issuers failing to redeem them, modern regulators can craft legal tools to ensure that history does not repeat itself. The SEC can use the lessons of that time to effectively regulate private crypto and digital assets, managing any legal loopholes and blocking fraudulent and overly risk strategies developed by their creators.

What is the SEC's function and responsibility?

The Securities and Exchange Commission (SEC) is the government agency responsible for regulating and enforcing securities laws. Its prime function is to protect investors and maintain fair and efficient markets. The SEC plays a critical role in promoting confidence in the financial system, ensuring that companies follow its rules and procedures when raising money from the public. The SEC requires companies to provide accurate information to all investors. Companies file reports to the SEC, disclosing all necessary financial, business, and operational information. In addition, the SEC also plays an important role in establishing accounting and auditing standards. The SEC works closely with the Financial Accounting Standards Board (FASB) to develop and maintain accounting standards when preparing financial statements. The SEC oversees all public company accounting statements and audits. Investors most commonly utilize company 10-K or 10-Q documents filed by public companies that "disclose significant financial information so investors have the timely, accurate, and complete information." These give investors insight into company financials, risks, and relevant operational notes (U.S. Securities and Exchange Commission, p.1, 2023). The SEC also has the authority to investigate and prosecute individuals or companies that violate securities laws. For example, the SEC may investigate insider trading deals and has the authority to take legal action against "wrongdoers[, holding them] accountable and deterr[ing] future misconduct" (U.S. Securities and Exchange Commission, p.1, 2023). In modern times, the SEC's scope has shifted toward the digital landscape. As of March 2022, the SEC has taken responsibility for regulating and taking actionable cases for Crypto asset offerings, Crypto asset exchanges, Crypto asset lending, and staking products, Decentralized finance ("DeFi") platforms, Non-Fungible Tokens ("NFTs"), and Stablecoins (U.S. Securities and Exchange Commission - Crypto, p.1, 2022). Consequently, the

SEC's DeFi regulatory teams have had to grow just as rapidly as the market itself to protect investors and maintain fair play in the marketplace. The SEC has extended its regulatory gaze in recent years. It currently regulates digital assets to protect those who invest in them, allowing it to gain experience in this market before the Fed considers releasing its own digital currency. Therefore, the SEC's critical function of protecting investors, maintaining fair and efficient markets, and promoting confidence in the financial system will not be altered in the future regardless of whether the Fed creates and adopts a CBDC. Through its regulatory, enforcement, and standard-setting functions, the SEC will remain an important regulator in the space and its role will become more relevant in the digital world as the market continues to grow too.

Undoubtedly, the digital asset space has grown exponentially over the last decade, stemming from incredible technological advancements. The SEC has updated its scope of regulation as securities have changed over time. On the positive side, having the SEC regulate Crypto-securities would increase investor confidence in them and likely stabilize their values. This could lead to a quicker adoption of a Fedcoin as digital currency users become more aware of such assets, removing the negative stigma associated with them, and stabilizing their prices. Ultimately, the SEC's support would make Fedcoin more widely accepted, and generate the possibility for it to develop into an effective payment method.

What is the best course of implementation?

Evidently, we are in the earliest stages of figuring out the most functional way to implement DeFi systems. As shown in chapter two, crypto markets are risky and investors are skeptical about any digital currency's ability to sustain its value. The Fed as well as other government agencies would have to regulate, monitor, and support any privately issued currency

to secure its value and usefulness. If the Fed issues Fedcoin, there will be little use for privately created Cryptocurrencies as means of exchange or units of account (Hocket, p.8). It is assumed that such assets will simply fade out of circulation as more stable currencies become available; undoubtedly, the speculating risk traders will still explore the crypto marketplace.

As Hockett argues, a Fed-issued digital dollar will be uniform and elastic, enhancing and making more effective the stabilization and regulatory policies of U.S. monetary and fiscal authorities. Because of the speed, reliability, and tractability of distributed ledger-tracked credits and debits, “markets should be able to cut out the intermediary commercial banks as middlemen between citizens and central banks” (Hocket, p.9, 2019). As a result, during deep recessions when monetary policies have become ineffective in the face of liquidity trap scenarios, the Fed would no longer need to supply private banks with cheap money, nor need to bail them out when they're in poor standing. Similarly, when inflationary pressures emerge, the Fed can raise interest payments on Citizen Accounts and not rely on the transmission mechanism through the banking system. Removing the necessity for intermediaries would make for better private-sector lending practices, allow greater access to banking for all citizens, and permit cheaper, more secure, instantaneous, and more traceable transactions. Not only will this allow all citizens to be banked, but Hockett concludes that the “Fed will also have the ability to have more secure and impactful monetary policy instruments”, limiting the amount of fraud and illegitimate collection of state checks, and enabling more effective support over the economy (Hocket, p.9, 2019). Evidently, Hockett showcases the undeniable benefits that a DeFi-implemented central banking framework would offer to the United States and acts as a true advocate for our transition.

Unfortunately, although the prospect of a digital Fedcoin is viable, it is unclear whether we will see it in the future. The Fed has been studying the possibility of a Fedcoin for several

years, but many intricacies in finding the most effective way to implement a coin are delaying the process in which one is established. In addition to the difficulties of designing a plan to implement a digital currency, the current economic landscape is not best suited to promote an entirely new and digital system. With the recent collapse of Silicon Valley Bank (SVB) and the tightening balance between raising interest rates to combat inflation and not raising rates in fear of having more banks collapse, it is difficult for the Fed to focus on implementing a Fedcoin or considering DeFi technology applications. The implementation of a Fedcoin would require significant coordination and collaboration between various government agencies, which in turn would significantly slow progress toward its adoption. In conclusion, if the Fed were to release a Fedcoin, the SEC would first need to play a role in regulating private digital assets' issuance and trading in order to shift the public consensus regarding these assets. The prospect of a Fedcoin is clear on paper, but its implementation would require a rolling installment to ensure its delivery is met. The private banking sector will perceive a public digitalasset as a threat becasue the system will eat into its prifits. Therefore, it will take time to give such private institutions the space and influence to push them into new revenue streams and focus. In this way, the integration of DeFi technologies can be developed at a steady rate and the finance sector will not be overwhelmed with an immediate nation-wide system change. Hockett, Menand, and other advocates make it evident that implementing a digital-based currency associated with DeFi technology integration will support economic growth in the coming years.

Conclusion:

The topic of decentralized finance or DeFi has been explored in this essay, with a focus on demystifying its technology and exploring its potential uses. Through discussions on Blockchain, cryptography, and smart contracts, the essay has shown that these technologies offer the potential for increased security, traceability, and efficiency, and should be considered in isolation from controversial crypto schemes. The thesis has also highlighted the role of the Federal Reserve in managing economic crises. It was demonstrated that while the Fed has played a critical role in stabilizing the economy, its current infrastructure has its limitations, and there is room for digital advancement in the future. The essay then explored the probability of integrating DeFi technologies into the Federal Reserve's operations and demonstrated that the benefits of a central bank digital currency outweigh its possible costs. Piggybacking on the ideas of Hockett, Menand, and other authors, it argued that the most practical way to improve the overall efficiency of the economy is by implementing DeFi technology at the Fed. With the introduction of Fedcoin and Citizen Fed accounts using distributed ledger technology and Blockchain, DeFi advocates have showcased the true effectiveness of these new applications. The thesis concluded that the introduction of DeFi technology by America's central bank could create significant efficiencies for the economy, offering many benefits. With the SEC regulating the crypto marketplace and the implementation of efficient DeFi technology, the economy, crypto assets, and central banking systems will become less volatile and more secure. Ultimately, the integration of DeFi technology holds the potential to create a more secure, transparent, and efficient financial system, benefiting the nation and the globe as a whole. By leveraging DeFi technology, the Federal Reserve can position itself as a leader in innovation and ensure that it remains at the forefront of financial technology development.

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