The Digitalization of Money

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TABLE OF CONTENTS

PREFACE

Everything seems to be changing incredibly fast, the nature of gender, the nature of work, climate change, and, among other changes, the nature of money. There are roughly 12,000 crypto currencies now and blockchain is growing, and at the same time, failing at warp speed. During Crypto Winter there were many crypto firms that went bankrupt followed by the spectacular collapse of the FTX exchange. What is going on? What are we to make of this? The issuers of crypto currencies claim that their currencies are “money”. But you cannot buy lunch with a cryptocurrency—yet.

This book is about these questions.

Some of the material in this book is drawn from:

"Taming Wild Cat Stablecoins," with Jeff Zhang, *University of Chicago Law Review*, forthcoming.

"The Orkney Slew and Central Bank Digital Currencies," with Jeff Zhang, *Harvard National Security Journal*," 14(1), December 2022.

"Protecting the Sovereign's Money Monopoly", with Jeff Zhang, *University of Alabama Law Review*, forthcoming.

"Bank Runs During Crypto Winter," Yale Working Paper.

CHAPTER 1

WHAT IS GOING ON OUT THERE?

What is going on out there—in crypto space? Is crypto space a giant Ponzi scheme? A game? The recent spectacular crashes of some crypto companies suggests that it is. But denizens of crypto land view themselves as being at the forefront of building a libertarian utopia. What? Well, the world is changing and changing fast. Blockchain innovation is bringing far-reaching changes to our lives and to all sectors of the global economy. As is often the case, the important changes are not in the headlines. Instead, they are less sexy and are in the background.

What are all these thousands of cryptocurrencies? We have been through this before. Prior to the U.S. Civil War (1861-1865) there were around 1,500 distinct private bank notes circulating, issued by 1,500 different banks. A private bank note looked like the currency we use today except that it would have the name of the bank engraved on it and usually an engraving of something else, like a railroad engine. The government did not issue money and did not insure these private monies. Banks had been issuing their own monies in the U.S. since 1786. During 1837-1863 some states allowed free entry into banking. It was a free for all. There were numerous bank runs. Is the current crypto currency world like the Free Banking Era? If so, how? (The answer is yes and no.) In this book we will separate the hype from reality and see how innovations in money and payments are undergoing tremendous change. We do this by studying privately produced money generally.

In 1863 the U.S. government entered the money business requiring national bank notes to be backed by U.S. Treasury bonds. Some cryptocurrencies are privately-produced moneys, the first time we have seen privately-produced money since before the U.S. Civil War. They are digital tokens that reside on a blockchain. Blockchain is a new technology. It is a peer-to-peer, non-centralized, anonymous, shared ledger that consists of an immutable set of sequential time-stamped blocks, cryptographically linked together where each block contains transactions data. That's a mouthful. Blockchain and

the cryptocurrency Bitcoin are hyped repeatedly with extravagant claims about decentralization and how this technology will disrupt the entire financial sector. And, indeed, there is this possibility. In this book we will focus on money—cryptocurrencies and learn to what extent these currencies can become money.

The crypto ecosystem is in its earliest stages of development. Computer scientists are working hard to innovate so that blockchain can eventually become the backbone of the financial system and global supply chains. In these early days of blockchain, it is somewhat like these two examples. In 1899 there were thirty American car companies and by the end of the next decade there were 485. But this number dropped to only 49 by 1929 and three companies Ford, General Motors, and Chrysler accounted for 80 percent of cars produced. Much of the activity in crypto space is akin to this type of tournament competition, where only a handful will survive.

Another example has to do with network effects. The internet began in 1969 when ARPANET was started by the Defense Advanced Research Projects Agency ("DARPA"), a part of the Department of Defense. By the 1970s there were many different networks, but they were not interoperable, that is they could not talk to each other, so to speak. Technological progress in the form of packet switching, a way to group data so that it can be transmitted over a digital network, allowed for the networks to be connected. We got the world-wide web. Currently, there are about 1,200 blockchains, which are not (very) interoperable. And blockchains are not very scalable. Nor is crypto space interoperable with the current financial sector, including banks and the payment system. But this too will change.

Cryptocurrencies broadly speaking fall into three types. Coins that the issuers claim are money but are not backed by anything (this is called fiat money). The defining feature of fiat money is that it has no intrinsic value. If it has value, the value comes from the shared belief by enough economic actors that it has value. Cash is accepted as money even though the government does not explicitly back it, it does not pay interest, and it is not convertible into anything. But the government has taxing power and that is implicitly backing cash. Private money, like Bitcoin, is not backed by anything. Later we will look at Bitcoin and discuss whether it is a bubble. Coins like Bitcoin and Doge have very volatile prices and are bubbly, not money. They are speculative objects, seemingly supported by the equivalent of an online gaming community.

Utility tokens are digital means of payment on a specific platform for a specific purpose. For example, an Uber token could be used to pay Uber, but not for anything else. JPM Coin is another example of a utility token. It was designed to enable the instantaneous transfer of value between parties that hold accounts in the bank. The JPM Coin is a stablecoin pegged one-to-one to the US dollar.

The third type of cryptocurrency is stablecoins. Stablecoins are a digital form of privately produced money where each coin is proclaimed to be backed one-for-one with "safe" assets like cash or U.S. Treasury securities. "Depositors" buy the stablecoins and for each dollar deposited they receive that number of stablecoins. Supposedly, depositors can redeem coins at will to get their cash back, like demand deposits and money market funds. Issuers of stablecoins are essentially unregulated banks. Stablecoins are a form of privately-produced money. Privately-produced money exists when there are no better alternatives. Before the Civil War there were not enough metallic coins so private bank notes flourished. In crypto space there is no alternative to stablecoins. Such privately-produced money has not existed in over 150 years. To date, market adoption of stablecoins as money has been limited by technology. But initiatives backed by large technology companies and financial institutions could create the potential for wider use.

Stablecoins

Stablecoins raise many questions. Are stablecoins money? Yes, but Bitcoin is not money. Are stablecoin issuers banks? Yes, but not officially. Do stablecoins need to be official banks? Yes, as we will see. Can chartered commercial banks issue stablecoins? Not clear. Will the whole financial structure change? Yes. And there are many other questions. What should the legal infrastructure be for stablecoins? Who owns blockchain or is this question meaningless? Do we need new laws and regulations? What would they be? Your stablecoins would be in a "wallet" on the blockchain (or in a cold wallet, a wallet that is not on the internet but stored in a device you have that can connect to the internet). What happens if your wallet is hacked and your stablecoins are stolen? How is this policed? Who would be liable?

Crypto Winter

In May and June 2022, a crypto crash wiped out roughly $1 trillion in value and scared off many investors., many Crypto banks failed. These were lending platforms where you could deposit cryptocurrencies, like a savings

account—another form of money in crypto space. Subsequently, the large crypto exchange FTX collapsed. This was a systemic event in crypto space, like the 2007-2008 Financial Crisis. But the bank runs and failures in crypto space had little impact on the real world. Nevertheless, in response bank regulators have tried to seal off the real banking system from crypto banks with new regulations. Is this going to work? Or is the technology to powerful to be sealed off? Is "sealing off" the best policy?

E-Money and Financial Inclusion

Aside from cryptocurrencies, there are other perhaps more important developments of new moneys. Less developed countries have been able to provide access to banking services for millions of people with e-Money, another form of digital money. Mobile technology and the internet have combined to offer new more decentralized ways for individuals to make peer-to-peer transactions, micro-payments. E-Money is a mobile phone-based means of payment and a store of value fully backed by government fiat currency. Examples include AliPay and WePay in China, PayTM in India, M-Pesa in Kenya, and Bitt.com in the Caribbean. There are also new developments in cross border digital technologies. Cross border money transfers are currently slow, costly, and inefficient. So, this part of the payments system could potentially benefit greatly from new technology.

Central Bank Digital Currency

Most central banks are taking these questions seriously. Many are actively investigating the possibility of a central bank digital currency (CBDC). This new central bank liability would be a widely accessible digital form of fiat money, intended as legal tender. One day, it could fully replace physical cash. CBDC seems to be a natural next step in the evolution of official coinage (from metal-based money to metal-backed banknotes, to physical fiat money, to digital money). But how exactly would CBDC work? Would you deposit your money in the central bank? In a commercial bank?

There are currently two successful central bank digital currencies, in China and in the Bahamas. These are not blockchain-based CBDC, but digital money—e-Money. These currencies are overseen and run by the respective central banks, so they know the identities of the users. But a hallmark of blockchain is anonymity. Anonymity is a problem for central bank digital currencies, whether e-Money or blockchain-based.

To see the anonymity problem, think about SWIFT, the Society for Worldwide Interbank Financial Telecommunications, a cooperative of banks based in Brussels. SWIFT is the messaging backbone of the international financial system. It has been in the news lately because cutting Russian banks out of SWIFT was a central part of the sanctions imposed on Russia because of its invasion of Ukraine. With a blockchain-based CBDC, such sanctions would not be possible. So, the construction of CBDC by each country and how they interact is a question of national security. What are the standards for blockchains to interact so that CBDC works across border? Who sets these standards? How can data be collected if the CBDCs are anonymous? Should they be anonymous? This another fundamental question that we will examine.

Money and Financial Crises

Money is special because its price is (supposed to be) stable, fixed, and uniform. The idea that money should have a fixed or uniform price is intuitive. It is hard to transact if the price of money is changing and when one side to the transaction may know more about its true value at that moment than the other party. This raises the question of how privately-produced money is designed to achieve a fixed price. Most forms of privately produced money consist of debt backed by debt, like checking accounts backed by bank loans. This structure makes the money information-insensitive. "Information-insensitive" means that no party to a transaction has an incentive to secretly investigate the backing of the money to see if it is sufficient or not because such an investigation is too expensive. So, there can be no insider trading with money if money is information-insensitive. And that is the point.

All successful forms of privately-produced money are vulnerable to a bank run. That is why demand deposits in the U.S. are insured. The Financial Crisis of 2007-2008 was a run on repo and on asset-backed commercial paper, two forms of short-term debt used by large institutions. There was also a run on money market funds. And in March 2020 there was another run-on U.S. money market funds. Note the apparent paradox: Market economies need privately-produced short-term debt, but such debt is always vulnerable to runs. Indeed, bank runs have occurred in all market economies throughout history.

Studying the history of privately-produced money is useful because the technological form of money may change but the inherent nature of money does not change. Consequently, we can learn from history. This is

particularly important when we come to public policy questions. Rather than guess at what policies will work, we can refer to the lessons of history. If policymakers do not learn from history, what do they learn from?

Blockchain

To understand these issues, we need to know about blockchain and we need to know some cryptography, which makes blockchain possible. So, we will ask: What is a "block"? And what is the "chain"? How is it decided to add a block to the chain? This decision is informed by the "consensus mechanism" and this is what replaces trust. There is no central decision-maker, like a bank or the government, instead everyone (or a majority) on the chain follows the rules of the consensus mechanism.

Blockchain is an example of a distributed ledger. The ledger is shared across thousands of computers around the world. Blockchains (there are many of them) can be permissioned, which means it is only shared with a specified group; or it can be permissionless, which means that anyone can have access to it. One can download the entire Bitcoin blockchain. A blockchain provides a record of transactions and ownership that is immutable and final. But identities are hidden. It works by consensus, a set of rules followed by participants which replaces trust in a central authority.

Blockchain is anonymous, so when you download the entire history of Bitcoin you see transactions and the time at which they were executed. But you do not see the identities of the parties to the transactions. Anonymity is a hallmark of blockchains. It is championed as such as a reaction to Big Tech tracking you online and collecting all your personal data to be produced, targeted, automated, ads. But anonymity has obvious disadvantages, such as terrorists and other bad actors from moving money around. CBDC would not be entirely anonymous. How this would work is another important question.

Current payment systems consist of sets of institutions, rules, and laws that agents can trust. These are record-keepers in the current system. Blockchain is revolutionary in that the notion of "trust" is replaced by a set of anonymous agents drawn from a broader community that, according to some mechanism, essentially "vote" on whether a given transaction should be added to the blockchain. To understand cryptocurrencies, we need to know about distributed ledger technology and blockchain. We will study this in more detail later, but for now here is a summary.

A distributed ledger is a database that can be used for keeping track of assets and information and the ledger is shared by multiple participants. Blockchain is a specific kind of distributed ledger. It is a shared, replicated, record-keeping system that forms a consensus among the blocks (or nodes) to ensure the validity of transactions, and provide finality of the transaction. Blockchain is a system which is also used for exchanges, storage, and for tracking assets without going through any intermediaries like banks or the government. What is new is the mechanism for providing consensus, i.e., creating trust. Forming consensus is what allows for the system to be independent of banks and governments. Later we will look at different consensus mechanisms.

Stablecoins

Of the cryptocurrency types, only stablecoins are money. A stablecoin is a digital currency that its issuers claim is backed one-for-one with some country's fiat money, like dollars or euros, or government securities. This backing, if believable, is the mechanism for maintaining a uniform, unvarying, value. The backing assets have a physical location. Issuers also say that stablecoins are redeemable for the underlying currency, just like withdrawing money from your checking account. This redeemability feature has been tested in a bank run, which we will look at later.

Stablecoins currently only circulate in a very limited way. They are used on different crypto exchanges and platforms, mainly to buy other coins or to use as collateral for financial transactions that are on a chain. You cannot, however, buy coffee with a stablecoin. And stablecoins are not yet used for payments in global supply chains. However, there are signs that use of these coins as a means of payments is developing. For example, Visa has announced that transactions can be settled using a stablecoin.

Stablecoin issuers recognize that the credibility of their one-to-one backing is an issue since they are not regulated or examined. They strive to convince coin holders that the backing exists. For example, this is what Circle, the issuer of USDC, says on its website: "Every month, the US dollar reserves for USDC [the Circle stablecoin] are attested to by top 5 accounting services firm, Grant Thornton LLP. We publish those reports so that you can be confident that USDC is always 100% redeemable for dollars" (as of May 25, 2021). We will discuss later whether this type of representation is sufficient and credible.

Will stablecoins evolve into a useful form of money? For that to happen a lot of infrastructure must be built. A sound legal basis is required in all relevant jurisdictions concerning the nature of such a claim for holders and issuers. Without legal clarity stablecoins will be even more vulnerable to bank runs, a risk that either will limit their "moneyness" or create financial instability if their use becomes widespread.

Payment Systems

Blockchain and stablecoins hold out the promise of revolutionizing payments systems, which are currently slow and inefficient. Use of "money" (in whatever form) is inextricably linked to a payment system. When you "pay" someone with something other than cash, it is the payment system which carries through the transaction. A payment system is the physical, technological, and legal infrastructure used to settle financial transactions through the transfer of monetary value. Money itself is a payment system because it cannot function without a set of rules and arrangements which facilitate the transfer of value in a credible way. All forms of money have an associated payment system. Different countries have different payment systems. Currently in the United States, payments are cleared and settled using a variety of systems.

All payment systems are in part ledgers and are constructed to be tamperproof. Blockchain is a ledger that is tamperproof. In the modern era, the payment system is designed to safeguard stores of value, allow for the value to moved quickly over long distances and cross-border, ensuring that payments are made to the correct parties, and achieving settlement finality. The infrastructure—legal and technological—to achieve this is complicated. The question we want to consider is whether blockchain-based on stablecoins can work to simplify and speed this up.

Central Bank Digital Currency

Should central banks issue a digital currency? What would a central bank digital currency (CBDC) look like? CBDC is inevitable because of technological change. Money has always evolved, from metallic coins to paper money, to digital (but not blockchain-based), money. The private production of stablecoins will force central banks to take the idea of CBDC seriously. And, indeed, many central banks are well-along in studying CBDC through cross-border experiments with other central banks.

There are many public policy questions raised by cryptocurrencies and stablecoins. Should cryptocurrencies be regulated? Only regulate stablecoins? How should they be regulated? Should stablecoins be outlawed? Should central banks issue digital currencies? Exactly how? The goal of this book is to understand these developments and their significance. To do this we will first study money in (almost) all its forms to determine what characteristics money needs to have to be a medium of exchange and a store of value. We will then be able to measure various crypto currencies against these standards. Of the 12,000 or so such crypto currencies, only a few—maybe none in their current form—will survive.

CHAPTER 2

WHAT IS SPECIAL ABOUT MONEY?

On July 4, 1964, Leicester ("Lester") Hemingway, the younger brother of Ernest Hemingway (winner of the Nobel Prize in literature in 1954) anchored an eight by thirty-foot raft off the coast of Jamaica and declared it a sovereign country called New Atlantis. He then issued a currency called "the Scruple", apparently believing that rich people should have scruples. It is not clear whether the Scruple really was a sovereign currency or a privately-produced money. In any case, it does not seem that it had any backing; if it was money, it was only because Leicester Hemingway declared it to be "money". It shows that anyone can privately-produce money, but getting it accepted is another matter.

Can something become "money" just because someone says it is "money"—like Bitcoin? This confusion about money exists today. What characteristics are needed for something, digital or not, to become money? First, I will state some fundamental issues and principles about money. In the next chapter we will look at some historical examples.

The No Questions Asked Principle (NQA)

The essential problem with privately-produced money was stated by David Ricardo, the famous English economist:

> In the use of money, everyone is a trader; those whose habits and pursuits are little suited to explore the mechanism of trade are obliged to make use of money, and are no way qualified to ascertain the solidity of different banks whose paper is in circulation; accordingly, we find that men living on limited incomes, women, laborers, and mechanics of all descriptions, are often severe sufferers by the failure of country banks . . . Ricardo (1876, p. 409)

Ricardo is referring to the problem of adverse selection, a situation in which one side of a transaction secretly has inside or better information than the other side and can take advantage of this insider knowledge. In other words, there is asymmetric information. Suppose people are transacting with

privately-produced bank notes. If the buyer, for example, secretly knows the true value of the bank note, then that information can be used to cheat the seller. Say the note has $10 printed on the front, but it is only worth $9 and this is secretly known by the buyer while the seller is unsure what the note is worth. You can see how the buyer can take advantage of the seller. If the seller accepts the note as worth $10, then he loses $1. In other words, everyone is a trader because they need to transact with something and there may be this problem of asymmetric information.

You can imagine the difficulties if every time you are offered privately-produced money the two sides to the transaction must stop and do due diligence, credit analysis, before accepting or rejecting the money. Hard to buy lunch in that world. The solution? Ricardo put it this way: “All writers on the subject of money have agreed that uniformity in the value of the circulating medium is an object greatly to be desired”. “Uniformity in the value” means a $10 private bank note should always be accepted as $10. The problem is how to achieve this. Money must be designed to achieve this. If uniformity can be achieved, then there is confidence in the money. Confidence is not a state of mind, it is the knowledge that both parties to a transaction have no private information. Confidence in money means that the design of the money makes it such that no one has incentive to produce the secret information, and everyone knows this. It is information-insensitive.

If there is confidence, then when you are offered the $10, you accept it without question. This is the Principle of No Questions Asked (NQA). Accepting a money NQA means that the backing for the money is believed to be sufficient without producing information about it (no due diligence) before you accept the money.

This raises the issue of money’s backing. What backs it? If the money is fiat money like government-issued currency, then the money is implicitly backed by the government’s taxing power. Bitcoin is not backed by anything and Bitcoin adherents simply assert that it is fiat money. In general, privately-produced money must be backed by something. Your checking account is backed by the bank’s loans, which are periodically examined by the government. Checks satisfy NQA because of government deposit insurance. Stablecoins claim that each coin is backed one-for-one with dollars or euros. But it is not clear that this is true or that we can be convinced that it is true. Stablecoins are not regulated and their backing is not examined by the government.

What are the designs of private money that can achieve NQA? We know that one mechanism is government deposit insurance. There are different types of backing that have been tried over the years. Later we will look at some examples.

Imagine a world where every person and every firm were completely honest and had perfect recall. Then we would not need money. You would always be able to remember how much you have spent in the past and how much you have received, and will receive, in various forms of income. You would know your net position (what you have minus what you have spent or owe), which is hopefully positive. You would be able to calculate whether you are within your budget constraint; the idea that you cannot spend more than you are receiving.

Since the world is complicated and people are not completely honest and do not have perfect recall, we need a method of keeping track of all the transactions in the economy so that people are within their budget constraints. Money is a substitute for memory. So, we need infrastructure that is trustworthy. One example is bank checks. When you write a check to someone, that person must believe that you have the requisite amount of money in your checking account. If you do not, then the check bounces, which is a reminder that the bank is keeping track of your net checking account position.

Checks are an example of account-based or identity-based, money as opposed to token money. Account-based money refers to money in a specific bank account. Or, more generally, to a specific person or firm. Person X writing a check to Person Y, for example, links the payment to X's bank account. That money will be deposited in Y's bank account when the check clears (*i.e.*, when the money is drawn from X's account and put into Y's account). Account-based money does not circulate. It does not pass hand-to-hand in a chain of transactions that are separate from the check-clearing process, because the identity of the check writer matters. Consequently, endorsing a check that was written to you and using the endorsed check to buy groceries does not happen because the grocery store does not know the identity of the check writer.[1]

[1] Some may point out that bank deposits do circulate via platforms like PayPal, Venmo, or Zelle. While these platforms certainly allow for increased transactions, they do not deviate from the account-based model described here. Money transferred through these services still go from one account to another. This is simply another form of check writing, account-based money.

With checks, the bank supplies the ledger. The bank keeps track of whether your account is overdrawn. Checks are account-based, but cash is a token. Digital money on a blockchain has memory because every transaction is recorded on the blockchain. The blockchain ledger replaces the bank. The trust supplied by a regulated bank is replaced by the trust generated through the consensus protocol of the blockchain. Whether this means that blockchain-based banking can replace the current banking system is a question we will address later.

Cash does not pay interest and so cash must be valued for its use as money. Money is convenient as a transaction medium and as a store of value over short periods of time. Money has a convenience yield, the part of the return earned due to the money's convenience of use. Money is most convenient when the principle of NQA is satisfied. That is the same as saying that there is no adverse selection.

The Principle of Debt-on-Debt

How can NQA be achieved? Most of the examples above were forms of money backed by debt. Money too is a debt contract. The structure of debt backed by debt is intended to make the money information-insensitive. This means that it is too costly for anyone to investigate the debt that is backing the money and everyone knows this. So, in a transaction the money can be exchanged for goods or services NQA.

Money is supposed to be information-insensitive. In other words, money is special because its price is not supposed to change. The price adjustments that occur because of changes in supply and demand—like the price adjustments for bananas—do not apply to money. A one-dollar bill is to always transact for one dollar without question. This is the NQA principle. However, if the price does not change, then the laws of supply and demand require that the quantity must change. These adjustments occur most dramatically during a bank run when the outstanding quantity of the privately-produced money is severely reduced.

Information-insensitivity can be enhanced if the money's backing debt is hard to value. For example, banks make loans to consumers and small businesses. These loans are very expensive for an outsider to value. There are synergies between the liability side and the asset side of banks. The asset side should consist of loans *that are opaque* and costly to produce information about, like loans to small businesses and home mortgages. In that case the money that these assets back is information-insensitive. But

this opacity necessitates bank examiners, and their examination reports are kept confidential. This has always been the case. The bottom line is that opacity is necessary in banking and thus so too is regulation.

Why is Money Special?

In your first Economics course you learn about how markets for goods and services work. They work through the forces of supply and demand and the market price is the price at which supply equals demand. This is how prices are determined. If some force increases demand while not affecting supply, then the price goes up and vice versa. This is the fundamental idea that, in a competitive economy, resources are allocated by the price system.

But there are some subtleties. Fredrich Hayek, an economics Nobel Prize winner, posed the "problem of the division of knowledge". Markets are fundamentally a "mechanism for communicating information," but unlike, social media or newspapers, prices aggregate information so that we can "avail ourselves . . . of the knowledge which individually we do not possess. Prices coordinate economic decisions. Hayek:

> Fundamentally, in a system in which the knowledge of the relevant facts is dispersed among many people, prices can act to coordinate the separate actions of different people in the same way as subjective values help the individual to coordinate the parts of his plan. — Friedrich Hayek, *The Use of Knowledge in Society*

But the NQA Principle says the money should have a price that does not change. One dollar is always one dollar. So, money cannot work via the price system the way markets work for goods and services. If prices do not change, then only the quantity can adjust. But if the price of the debt does not change and no one really knows the value of the backing collateral, there is a potential problem, namely a bank run or financial crisis. The price does not change, but the quantity can change. It can shrink in a bank run when people demand their cash back from their banks.

This is what makes money special.

Bank Runs

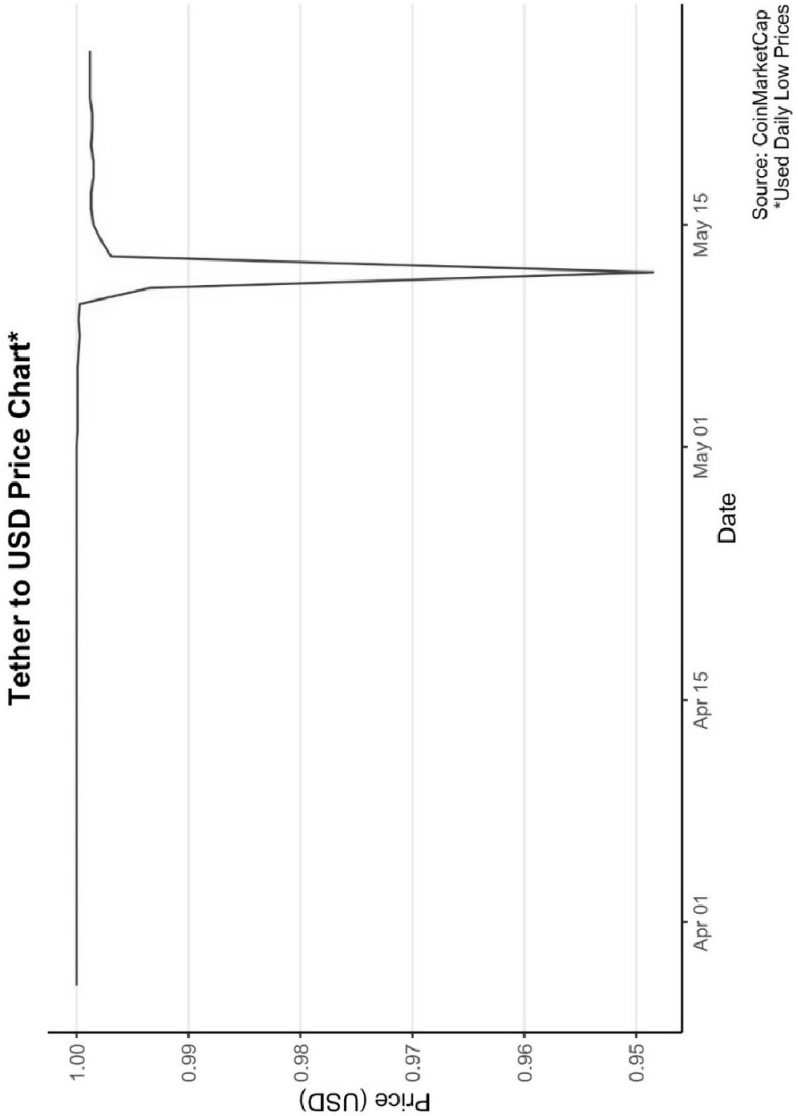
What is a bank run? A bank run occurs when there is bad news for the macro economy such that the backing collateral of the private money becomes suspect. In 2007-2008 bad news about the subprime mortgage market

appeared when house prices began to fall. A form of wholesale short-term debt, known as repo, was sometimes backed by mortgages in the form of mortgage-backed securities. The repo depositors came to mistrust the collateral, the mortgages, and en masse demanded their money back—a bank run.

When the holders of short-term bank debt do not want the debt anymore and instead want their cash, this is a massive problem for the banking system because the banks don't have the cash. Their assets are illiquid, meaning that they cannot easily be sold unless it is a very low price. The entire banking system is then technically insolvent because it can't return the cash. The central bank has to step in with emergency lending programs in order to save the banking system.

While countries have had different experiences with respect to financial crises, financial crises have plagued all market economies and have throughout history. In the modern era, Laeven and Valencia (2012) count 147 banking crises over the period 1970-2011. And developed economies have crises too. A World Bank report found 62 percent of the crises in their modern era sample had bank runs. Some countries have more frequent crises than others. Some countries go for long periods with no crisis. Nevertheless, financial crises plague all market economies.

There have already been stablecoin bank runs. For example, Tether, the largest stablecoin at over $75 billion in market capitalization, dipped below $0.97, as shown below. Tether holders withdrew $7 billion from Tether during the panic.


Tether to USD Price Chart*
Price (USD)
1.00
0.99
0.98
0.97
0.96
0.95
Apr 01
Apr 15
May 01
May 15
Date
Source: CoinMarketCap
*Used Daily Low Prices

CHAPTER 3

SOME HISTORICAL MONEY EXAMPLES

Now we will look at some historical examples to see how different forms of money tried to satisfy the NQA principle. We will see that constructing NQA money is very hard.

Scottish Free Bank Notes and Bills of Exchange

There are two forms of early money where there was unlimited liability. The partners of Scottish banks were liable for the bank's free bank notes. All their wealth backed the money. This system existed in Scotland in the period 1717-1845. The other money form is inland bills of exchange, these bills were somewhat like checks and circulated via endorsement in the industrial North of England around the same time. Every endorser faced unlimited liability. These two forms of money were information-sensitive because the identities of the people who backed the notes or bills mattered and had to be known. Consequently, these moneys could only circulate in geographical areas where these identities were known. These two forms of money were identity-based, like checks.

In the 18th century Scottish banks issued their own distinctive monies, a form of free banking. Banks were partnerships with unlimited liability. For example, the Dundee Banking Company, which began in Glasgow in 1763, had 36 partners, including merchants and eight partners who were landed gentlemen of the region. According to Scottish banking historian Sydney Checkland (1975), "The intention was to involve a major part of the town's business community in the bank. It was to be a town's affair in the most complete sense" (p. 112). The Banking Company of Aberdeen, formed in 1767, had 297 partners. "Indeed, by taking into account the unlimited liability of so large and wealthy a group of partners, the Banking Company of Aberdeen flattered itself that 'their Security will be allowed nothing inferior to any Bank or Company in Europe'" (p. 115).

Scottish bank notes were successful because the identities of the bank partners, who faced unlimited liability, were known to be substantive,

typically, rich people. These notes were accepted only if users of the notes knew who the bank partners were. But there was a problem: The notes could not circulate very far away because at a distant location people would not know the identities of the bank partners.

In England in the 17th and most of the 18th centuries banks were limited to no more than six partners. Though the partners faced unlimited liability, the banks were weak and often failed. Instead, inland bills of exchange were used as money. Inland bills of exchange, where all parties to the bill were in England, were a unique form of private money that predominantly circulated in the industrial north of England. While debt, such bills were not produced by banks (though banks sometimes backed such bills) and differed from bank debt, such as banknotes or deposits, in fundamental ways. Bills of exchange circulated via indorsement, putting each indorsers' wealth at risk if the borrower failed.

There are three parties to a bill of exchange. The drawer (lender) is the person who makes the bill and the person to whom the bill is addressed is called the drawee (borrower). The drawee accepts the bill by signing the front of the bill, becoming the acceptor, and is then obligated to pay a specified person (the payee) or to order at a specified date. Once the bill is accepted it can be used as money by indorsing it over to a third party. The new holder of the bill can similarly use it by endorsing it to still another party.

Here is one example of how bills worked as money. A shopkeeper, needing to pay a supplier, draws a bill on himself for £10 maturing in one month. The shopkeeper accepts the bill by endorsing it, thereby providing evidence of his indebtedness, and pays the supplier with it. The supplier may then use it to pay another shopkeeper or, needing cash, discount it with a merchant acting as a bill broker. Often the bill would be honored by the shopkeeper's London broker, where he had an account. Further, in some cases the acceptor, the party obligated to pay, was in fact a bank.

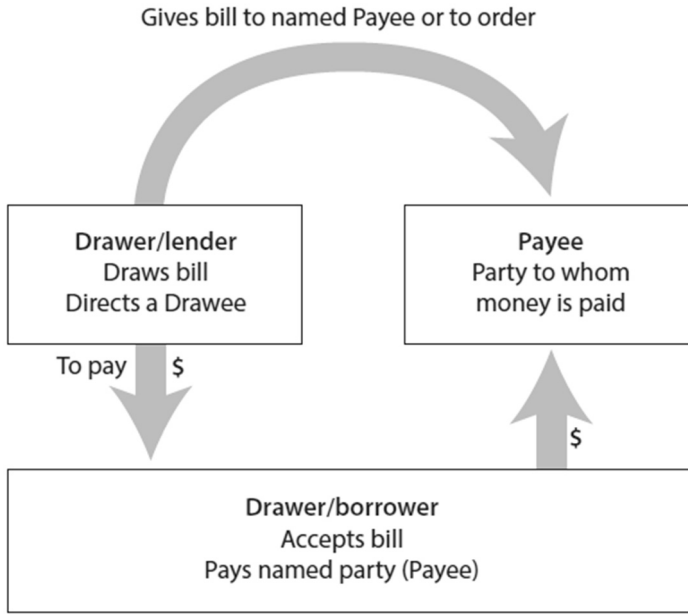
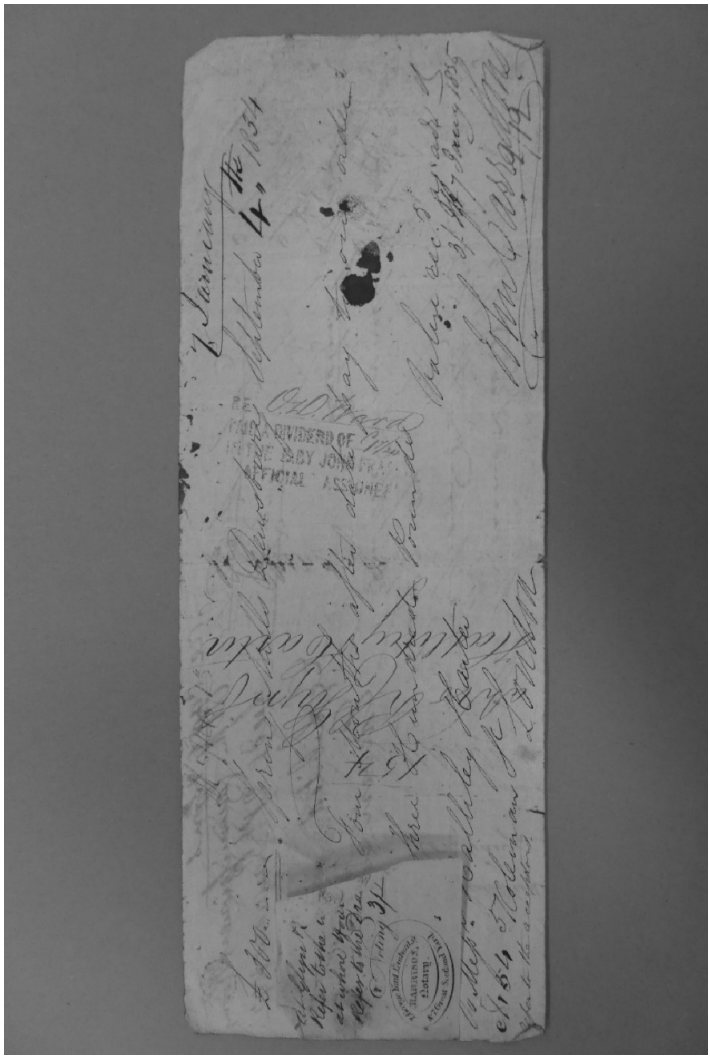


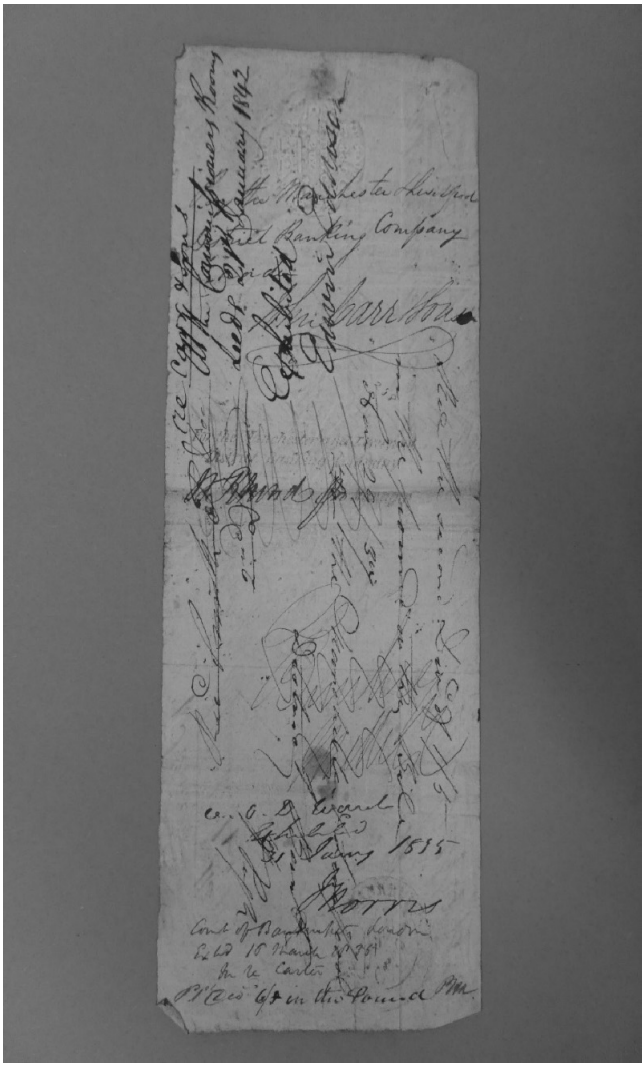
Illustration: Bill Nelson

Bills functioned as a medium of exchange via indorsement. The key feature of a bill was that *all* parties to a bill were liable (including all indorsers). This joint liability rule meant that the receiver of a bill in payment needed to know the identities of the parties indorsing the bill and then know that at least one of the indorsers was substantive. As well, knowledge of the identities of the other indorsers in the chain would further make the bill credible.

So, an inland bill of exchange was very different from short-term debt issued by a bank (e.g., a banknote or check). Unlike all other forms of private money, bills of exchange depended on the two transacting parties knowing each other (and the indorsers). No more information needed to be produced other than the identity of the indorser (meaning how wealthy that person was). Personal knowledge of the counterparty, essential for a bill to be used as money, meant that there was likely a prior relationship. These bills were not information-insensitive.



Front of a bill of exchange



Back of the same bill.

Scottish free bank notes and English inland bills of exchange did not have the NQA property. Scottish free bank notes and inland bills of exchange were backed by unlimited liability. Consequently, the identities of the bank owners in Scotland mattered to a person offered a bill or note in exchange for goods. The back of the bill had to be examined for evidence that some of the endorsers were wealthy.

The identities of the endorsers of an inland bill of exchange mattered for the bill to function as a medium of exchange. We say that these two forms of money were information-sensitive because their acceptability depended on the identities of the people backing the money. Information had to be produced about the identities (if only be looking at the note or the endorsers). *But they circulated only within a limited geographical area*, where those identities were well-known.

U.S. Free Banking

Stablecoins perhaps most resemble the period of free banking in the United States. In U.S. history banks could issue their own distinct money, banknotes, until 1863 when the National Bank Act was passed. The period 1837-1863 is called the Free Banking Era because some states passed laws to allow free entry into banking, while the other states required that banks be voted a bank charter by the state legislature. But even in banks that were in charter systems issued their own distinct monies. All these banks issued their own private money. The picture below shows a ten-dollar bill issued by the Mechanics Bank of Memphis, Tennessee.