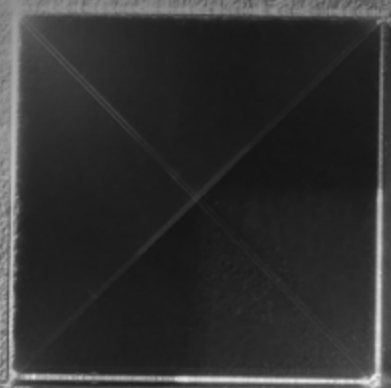
THE CAPCO INSTITUTE
JOURNAL
OF FINANCIAL TRANSFORMATION

ALTERNATIVE MODELS

Bitcoins, cryptocurrencies, and blockchains

JACK CLARK FRANCIS



ALTERNATIVE CAPITAL MARKETS

#49 APRIL 2019

THE CAPCO INSTITUTE

JOURNAL OF FINANCIAL TRANSFORMATION

RECIPIENT OF THE APEX AWARD FOR PUBLICATION EXCELLENCE

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DEAR READER,

Welcome to edition 49 of the Capco Institute Journal of Financial Transformation.

Disruptive business models are re-writing the rules of our industry, placing continuous pressure on financial institutions to innovate. Fresh thinking is needed to break away from business as usual, to embrace the more rewarding, although more complex alternatives.

This edition of the Journal looks at new digital models across our industry. Industry leaders are reaching beyond digital enablement to focus on new emerging technologies to better serve their clients. Capital markets, for example, are witnessing the introduction of alternative reference rates and sources of funding for companies, including digital exchanges that deal with crypto-assets.

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Lance Levy, **Capco CEO**

BITCOINS, CRYPTOCURRENCIES, AND BLOCKCHAINS

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ABSTRACT

The U.S. has approximately 1,600 cryptocurrencies. No cryptocurrency is qualified to be called money because none has been designated by the U.S. government as being legal tender. Cryptocurrencies are called virtual currencies because they possess a few of the qualities of money. In this article, three issues related to cryptocurrencies are analyzed. First, bitcoins are considered, because they are the principal cryptocurrency. Second, an assessment of the processes the Federal Reserve and the central bank of Sweden are going through to evaluate the possibility of issuing some not-yet-fully-defined new form of electronic currency. Third, an examination of the viability of blockchain, which was introduced as an internal component of bitcoin, as a successful stand-alone technology.

1. INTRODUCTION

Bitcoin is the oldest digital currency in the U.S. It was created in 2009 by the mysterious Satoshi Nakamoto, whose true identity has never been verified.[1] Bitcoins are electronic entries in a public ledger that is verified frequently by people called bitcoin "miners." Bitcoins are the most popular of the hundreds of different cryptocurrencies that have recently sprung into existence. Bitcoins and about 1,600 other cryptocurrencies have become so popular that some people have suggested using them as money.

Economics textbooks explain that **money** is used as a means of **payment** that serves three essential purposes: a **medium of exchange**, a **unit of account**, and a **store of value**. Any verifiable record that performs these three functions qualifies to be called money. Thus far, it sounds like cryptocurrencies might qualify.

Most of the monies used around the world are **fiat currencies**. The U.S. dollar, British pound, the euro, and Japanese yen are well-known fiat currencies. **Fiat money** is not backed by any collateral. Cash, checks, and bank notes are also examples of fiat money. Fiat money has value only if the federal government declares it to be legal tender that can be used to make full and final payment of legal debts. The U.S. government has not declared that any cryptocurrency be **legal tender.** So, cryptocurrencies are not qualified to be used as a fiat currency and, thus, should never be called money.

In 2012, the European Central Bank defined a **virtual currency** to be "a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community." In 2013, the U.S. Treasury Department went on to say a virtual currency is "a medium of exchange that operates like a currency in some environments but does not have all the attributes of real currency." Bitcoins meet these requirements.

Economics textbooks tell us that to function effectively, money should possess five qualities. First, it must be portable. Second, its value should be stable. More specifically, the value of money should not fluctuate randomly to any significant extent. Third, it must be

[1] A nine-page paper titled "Bitcoin: a peer-to-peer electronic cash system," by Satoshi Nakamoto in 2009 introduced and explained bitcoin and the initial blockchain database. See http://bitcoin.org/bitcoin.pdf. Also, see Berensten and Schar (2018a).

fungible, or freely interchangeable. Fourth, to prevent counterfeiting, it must be easily identifiable. Fifth, it must be a virtual currency. No cryptocurrency is free from significant random fluctuations, is fungible, and is sufficiently easy to identify to prevent counterfeiting. Once again, it seems that cryptocurrencies are not money. Furthermore, they cannot be called fiat currency because the U.S. government never declared they are legal tender. If cryptocurrencies are not money, not fiat currencies, and not legal tender, what are they? Cryptocurrencies are virtual currencies.

CoinMarketCap.com documents the existence of over 1,600 cryptocurrencies in the U.S. in 2018. Every one of these cryptocurrencies qualifies to be called a virtual currency. But, as mentioned above, none are qualified to be called money.

2. HISTORICAL DEVELOPMENT OF CRYPTOCURRENCIES

Before he passed away in 1814, a German philosopher, Johann Gottlieb Fichte, became a founding figure of the philosophical movement known as German idealism. Of particular interest here, Fichte developed a theory about the ethics of currency. Recently, another philosopher evaluated the extent to which Bitcoin meets Fichte's standards for a just and ethical currency. She concludes that "Bitcoin forsakes the general welfare and is, as such, unethical by Fichtean lights" [Scharding (2018)]. Several financial economists support this negative view of cryptocurrencies [Angel and McCabe (2015)].

Sweden recently voiced an interest in creating a "cryptocurrency" that is managed by its central bank and can be used by the public as legal tender in Sweden. This is a logical proposal about altering Sweden's money supply. It is incorrect to call Sweden's altered money supply a cryptocurrency because it has been and will continue to be controlled by a central bank. To be called a cryptocurrency, a currency must be independent from a central bank; it must be decentralized.

A high-ranking Federal Reserve official indicated that the U.S. government is not favorably disposed toward cryptocurrencies [Derby (2018)]. The Securities and Exchange Commission (SEC) and Commodity Futures Trading Commission (CFTC) displayed similar inclinations [Eaglesham and Michaels (2018)].

The SEC recently rejected nine applications to list and trade various new exchange-traded funds (ETFs) on bitcoins (BTC) from several different applicants. One of these applications was submitted by ProShares in conjunction with the New York Stock Exchange's (NYSE) ETF exchange named Arca. The SEC also rejected other similar proposals that were to be traded on the Chicago Board of Options Exchange (CBOE). The SEC's rejection letter said the Exchange has not demonstrated "that its proposal is consistent with the requirements of the Exchange Act Section 6(b)(5), in particular, the requirement that a national securities exchange's rules must be designed to prevent fraudulent and manipulative acts and practices."

In a similar but different rejection letter, the SEC stated that the bitcoin futures markets lacked "significant size" and the resources needed "to prevent fraudulent and manipulative acts and practices," as evidenced by the fact that the exchange proposed sharing its surveillance responsibilities with ProShares Funds rather than handling the responsibility single-handedly.

The SEC's disapprovals repeated the concerns the agency had already articulated in its March 2017 initial rejection of a high-profile bitcoin ETF application from Cameron and Tyler Winklevoss. A few months later, the SEC issued a final rejection because, among other factors, the Winklevoss' petition claimed that crypto markets are "uniquely resistant to manipulation." In its rejection, the SEC said that "the record before the Commission does not support such a conclusion" [Huillet (2018)]. Several other opinions from high-ranking people in the U.S. government also voiced reservations about the cryptocurrency industry that is currently springing up in the U.S.

3. BITCOINS

Satoshi Nakamoto, the secretive founder of the Bitcoin Blockchain in 2009, worked actively in developing it until 2010. Since then, the bitcoin digital currency and the blockchain technology have continued developing together, as well as along separate paths of their own. These pathways are numerous, and some are so disparate that a complete review of the literature could fill a volume. Consequently, instead of a review of the literature, references are provided in the footnotes and as a list of references at the end of this paper.

3.1 Introduction to bitcoins

Bitcoin is an international decentralized digital virtual currency that works without a financial intermediary, central bank, or third party of any kind. All transactions are handled by direct communications between the counterparties. Each transaction can be verified within a network of nodes using thorough cryptographic records that are maintained in a publicly distributed electronic ledger book called the **bitcoin blockchain**. The bitcoin blockchain is a ledger that is shared, replicated, and frequently re-finalized in order to achieve a continuous consensus among all blockchain users.

From the user's perspective, the bitcoin blockchain is a database management system that facilitates the exchange of bitcoins for other currencies, products, and services. Each entry is cryptographically linked to the entries before and after it. A **bitcoin wallet** is a software that facilitates receiving, storing, and sending bitcoins. In 2017, researchers at the University of Cambridge estimated that there were between 2.9 and 5.8 million unique electronic wallets that contain cryptocurrencies, and most of these were bitcoin wallets [Hileman and Rauchs (2017)].

Manufacturing bitcoins is called **bitcoin mining**. In addition to being used to carry out transactions, 12.5 new bitcoins can also be used to pay any **miner** who completes the electronic computations needed to create a new investment transaction in a bitcoin blockchain.[2] Some people are attracted to bitcoin mining as a source of income.

During 2017 and 2018, bitcoin, ethereum, and ripple were among the most popular cryptocurrencies. These, along with hundreds of other cryptocurrencies, each comprise an independent **decentralized autonomous organization (DAO)**. Each DAO operates according to a set of rules that has been written into a computer program, and they compete against each other to gain investors.

Ethereum permits the construction of more sophisticated DAOs by using **smart contracts**. Smart contracts permit yes or no decisions to be made at some nodes before proceeding to the nodes that follow. Each of these DAOs generate a different price path for its cryptocurrency as they all compete to find speculators or investors who are sufficiently bullish about the currency to buy some.

Cryptocurrency prices are not based on the value of silver, gold, any other collateral, or any significant stream of income. Most, probably all, cryptocurrencies have no intrinsic value.[3] The prices of cryptocurrencies, digital tokens, and other crypto assets are based only on expectations about their future prices. Essentially, the buyer of a cryptocurrency is willing to buy it only because they believe it will sell at a higher price in the future.

The prices of bitcoins and other cryptocurrencies fluctuate freely over a wide range of values in an unconstrained manner. Between their creation in 2009 and 2012 the price of bitcoins fluctuated wildly at prices below U.S.$100. They were new and adequate information about them was unavailable. By 2013, their prices were varying in the U.S.$100 to U.S.$200 range. By 2016, the price bounced around between U.S.$300 and U.S.$600. In early 2017, the price passed through U.S.$1,000 and accelerated up to U.S.$7,500 by the end of that year. This rapid price inflation is not the only striking feature, the prices are also extremely volatile. The price of a bitcoin has sometimes zigzagged up and down by 10% in a single day. The price of bitcoins peaked at an all-time high of U.S.$19,783 in December 2017, and then quickly fell to U.S.$7,178 in February 2018. By early 2019, the prices of bitcoins had collapsed to between U.S.$3,600 and U.S.$3,900. The prices of stocks and bonds virtually never experience this much volatility because they are backed by tangible assets, well-defined streams of income, and significant business contracts.[4]

One reason that some people prefer to use bitcoins or other cryptocurrencies that are based on the blockchain technology is because these instruments are more difficult to hack or counterfeit than cryptocurrencies that are not based on the blockchain technology. The bitcoin blockchain ledger system records every bitcoin transaction electronically. Up-to-date electronic copies of this historical database are continuously circulated among those who own and trade bitcoins. These circulating electronic ledgers are large and, if the cryptocurrency is successful, grow continually. The large and growing

[2] If the creation of new bitcoins continues at the present rate, the number of bitcoins in existence will gradually approach a maximum ceiling value of 21 million bitcoins within the next few years. This ceiling exists because the rewards for bitcoin miners is halved whenever 210,000 blocks are completed. If all the owners of bitcoins in existence at that time can agree on it, it is theoretically possible (but not highly likely) to renegotiate a new bitcoin mining protocol that will permit bitcoin mining to proceed.

[3] The U.S. dollar, the euro, the Canadian dollar, the Swiss franc, and many other well-known currencies have no intrinsic value either. These fiat currencies are created by government decree.

[4] Three independent discussions of these points are: Popper (2018a), Russolillo (2018a), and Vigna and Michaels (2018).

ledger that accompanies a successful cryptocurrency makes it difficult to manipulate. The IBM Corporation and several other respected organizations foresee sufficient value in the blockchain electric ledger system to motivate them to develop and sell blockchain computer software for purposes that are unrelated to cryptocurrencies [Marr (2018)].

Although police can track every transaction through a bitcoin blockchain ledger, unfortunately the design of the blockchain system does not require the blockchain users to associate their identity with their bitcoin address (also known as their "hash," as explained below). This information gap has stymied more than one police investigation of bitcoin thefts [Popper (2018a)]. In other words, the blockchain ledger system does not make the cryptocurrencies that use them as safe as many people think.

> "The digital-currency exchanges bear little resemblance to the well-financed, well-regulated places where stock and bond investors trade and where people do their banking."

3.2 Advantages of cryptocurrencies over the U.S. banking system

Those who obtain cash by conducting initial coin offerings (ICOs), such as owners of cryptocurrency exchanges, owners of cryptocurrencies, and others that might benefit from cryptocurrency trading, tend to argue that cryptocurrency markets are superior to the U.S. financial system for the following reasons:

- **Simplicity:** no financial intermediaries or other third parties facilitate trading in cryptocurrencies. All counterparties only deal directly with each other.
- **Privacy:** a blockchain ledger contains a different node for each different person or organization. Each of these nodes is represented by a long and complicated alpha-numeric called a "**hash**." A hash is a computer function that converts alpha-numeric input into an encrypted output of a fixed length. The counterparties in a bitcoin transaction never learn the name, address, or anything else about each other. Thus, all bitcoin transactions and all bitcoin users remain anonymous. This complete privacy attracts criminals and scares away law-abiding investors who would like to have their transactions audited.
- **Inexpensive:** the bitcoin blockchain is costly to maintain, but it is much cheaper to operate than a monetary system made up of numerous commercial banks and a central bank that verifies every transaction and stands ready to correct errors.
- **Robust:** no central point or any system relevant nodes exist that could cause the blockchain system to collapse.

The bitcoin blockchain system verifies transactions by operating as a **consensus building mechanism**. Anyone who wishes may download the bitcoin blockchain software and become a new bitcoin miner. Bitcoin miners collect one or more pending bitcoin transactions, verify their legitimacy, and assemble them into what is called a **block candidate**. If a bitcoin miner can convince all the existing network participants to add their new block candidate to the latest existing version of the bitcoin blockchain, that bitcoin miner will receive a fixed **block reward** payment of 12.5 new bitcoins. Although some cryptocurrency traders hope to earn their living by mining bitcoins, not a large number seem to be successful in that endeavor.

One of the world's largest cryptocurrency miners is a Hong Kong based company named Bitmain Technologies Ltd. In 2018, Bitmain was discussing having an initial public offering (IPO) in Hong Kong, rather than having an initial coin offering (ICO) [Russolillo (2018b)]. Bitmain's major competitors include two other Hong Kong companies, Canaan Inc. and Ebang International Holdings Inc., and a company named Bitfury in the country of Georgia [Alderman (2019)].

Bitcoin miners that successfully process a block of transactions are paid the sum of the block reward and the **transaction fees** that are attached to each transaction in the block. The size of the block reward is set by the bitcoin protocol and cannot depend on anything the miners do. It is a different story for the transaction fees, as they are set by the investors who send the transactions to the miners. The tradeoff the investors face is simple; the higher the fee you offer, the faster the miners will process your transaction. The essence of this economic competition is that the miners must not only participate in a hashing race, but they must also compete to process those that have the highest transaction fees attached.

The idealistic promise of blockchain is, essentially, to replace a reputation-based consensus between regulated banks with a trustless algorithm that is free from human foibles. Unfortunately, this promise of blockchain overlooks standard technology like Microsoft's SQL Server, which is a well-known computer software that has been achieving reputation-based consensuses quickly and efficiently for decades.[5]

3.3 The scaling problem

One of the most stubborn problems facing bitcoin, blockchain, and every other cryptocurrency is the slow speed at which they can handle transactions. For example, when more than a few different computer systems are mining bitcoins at the same time, there are limits on how many transactions they can share and store at the same time. This is called the **scaling problem**. More specifically, bitcoin can handle no more than about seven transactions per second. Ethereum is faster than bitcoin; it can handle about fourteen transactions per second. However, no cryptocurrency comes close to the 50,000 transactions per second that VISA handles routinely. This technical constraint seriously limits the potential growth of all cryptocurrencies [Sorkin (2018), Vigna (2018a)].

Law et al. (1997) concluded that the potential risks in electronic commerce are magnified when the users are anonymous. In particular, they point out that false advertising and fraud are encouraged when anonymity is widespread. These problems are evident in the cryptocurrency industry.

Longfin Corporation, an alleged cryptocurrency firm, provides a good case study of such risks. LongFin Corporation, whose shares were listed on Nasdaq in December 2017, saw its share price skyrocket after launch, such that within weeks the firm had a market value of U.S.$5.5 billion. However, LongFin was headquartered in a shared Manhattan office that had only three desks and no computer when the Wall Street Journal investigated the office. Much of LongFin's fast gain occurred on December 18, 2017, when its share price rose over 500% after acquiring Ziddu, a smaller firm focused on blockchain-technology solutions and micro-lending. But LongFin's stock price then went on a downhill roller coaster ride after the Wall Street Journal reported that LongFin had failed to disclose important information and had misstated some facts. LongFin's founder and CEO, Venkat Meenavalli, had issued over two million shares to three acquaintances as payment for their consulting services. Then, after the corporation's share price had risen sharply, those individuals illegally sold large blocks of their new shares even though the shares were not registered for sale. In response, the SEC obtained a court order to freeze U.S.$27 million of the sales proceeds to prevent the funds from being transferred outside the U.S. The websites for LongFin and Ziddu contained enticing promises, but no historical or pro forma financial statements [Back and Eaglesham (2018)].

4. CRYPTOCURRENCY EXCHANGES

Risks associated with investing in cryptocurrencies extend beyond the coins to include the markets where the cryptocurrencies are traded. Within the U.S., cryptocurrencies are bought and sold through approximately 190 cryptocurrency exchanges, which can be tracked through coinmarket-cap.com. Many other cryptocurrency exchanges exist outside of the U.S. Very few of these digital-currency exchanges are regulated by any laws or government agencies. Cryptocurrency traders who go to a cryptocurrency exchange expecting to find convenience and safety will not usually find what they were expecting. The digital-currency exchanges bear little resemblance to the well-financed, well-regulated places where stock and bond investors trade and where people do their banking. Cryptocurrency exchanges match buyers and sellers for a fee, and if the trader desires, stores the trader's coins in that cryptocurrency exchange's electronic wallet.

Most cryptocurrency exchanges are modest websites that sprung up during 2016-2017. Cryptocurrency hackers pursue cryptocurrency traders, electronic wallets, and cryptocurrency exchanges. Some of the largest cryptocurrency exchanges have lost millions of dollars of their clients' money. The following losses, for example, have been reported by cryptocurrency exchanges: Youbit lost U.S.$35 million in 2017, DAO lost U.S.$55 million in 2016, Bitfinex lost U.S.$77 million in 2017, BitGrail lost U.S.$170 million in 2018, Mt. Gox lost U.S.$450 million in 2014, and Coincheck lost U.S.$534 million in 2018 [Vigna (2018b, 2019a)]. Initially, there were no reports of any cryptocurrency exchanges reimbursing their customers for their losses. However, in March 2018, Coincheck set a new precedent by spending hundreds of millions of dollars

[5] Microsoft's SQL Server is a relational database management system (RDBMS) that supports a wide variety of transaction processing, business intelligence, and analytic applications in corporate IT environments. Oracle's Database and IBM's DB2 are two other competing database management technologies that are also popular because they have been performing very well for years.

to compensate 260,000 of its customers whose currency holdings had been stolen while held in trust by Coincheck [Bhattacharya and Russolillo (2018)]. Similar refunds by the other cryptocurrency exchanges have not yet been reported.

Most cryptocurrencies are not designed to be tax friendly. The cryptocurrency exchanges are no better. Some "fly-by-night cryptocurrency exchanges" have vanished suddenly, wiping out all records of the clients' taxable transactions [Roose (2018), Vigna (2019b)].

Nothing requires any cryptocurrency exchange to submit to any regulations, and most of them do not submit to any regulations. However, a few ethical cryptocurrency exchanges exist. For example, Cameron and Tyler Winklevoss's Gemini Trust, which owns and operates Gemini, Coinbase's GDAX, and Japan's BitFlyer have voluntarily registered with the New York State's Department of Financial Services. This New York state agency seeks to detect and prevent fraud and market manipulation. In addition, the few cryptocurrency exchanges that also trade stocks, options, or futures within the U.S. come under federal legislation governing trading in those securities. Stock trading is governed by the SEC, futures trading is governed by the CFTC, and options trading is governed by both the SEC and the CFTC. Many states have also Secretaries of State that enforce securities trading laws. However, few cryptocurrency exchanges are legally required to submit to strict federal standards to prevent fraud, provide fair access, and to regulate securities trading [Michaels (2018)]. The few unusually ethical cryptocurrency exchanges discussed in this paragraph provide operations for cryptocurrency traders that are less risky than the typical cryptocurrency exchange, but none are likely to be as safe as the thousands of commercial banks that are governed by and audited periodically by the Federal Reserve, Office of the Comptroller of the Currency, and, in some states, the Secretary of State.

5. MOB PSYCHOLOGY

Mob psychology is a branch of social psychology that deals with the psychology of crowds and the psychologies of the individuals that comprise those crowds. Mob psychologists have highlighted three commonalities that characterize the members of a frenzied crowd: (1) members of the crowd have the impression that everyone in the crowd has the same feelings they do; (2) each individual in a crowd has the erroneous feeling that they are not personally responsible for the actions of the crowd in which they are a participant; and (3) the intensity of the two previous beliefs increases with the size of the crowd.

Cryptocurrencies are not backed by any tangible assets, and they are traded in unregulated markets. Without any tangible price determinants, the unbridled forces of supply and demand determine cryptocurrency prices. Supply and demand are largely determined by the feelings and emotions of the crowd of people trading the cryptocurrency. In other words, the emotions and feelings of a group of cryptocurrency traders determines the market price of a cryptocurrency. This is not a rational economic process. Mob psychology explains more about the behavior of cryptocurrency traders than economics. People conducting initial coin offerings (ICOs) can and have enriched themselves by selling cryptocurrencies to not-so-clever cryptocurrency buyers who have unrealistic expectations about getting rich [Popper and Lee (2018), Economist (2018)].

6. BUSINESS OPPORTUNITIES IN THE CRYPTOCURRENCY INDUSTRY

The cryptocurrency industry provides many profitable business opportunities. Unfortunately, many of these activities are unethical, illegal, and/or dangerous. Harmful activities that are facilitated by the cryptocurrency industry include the following:

Fraudulent divorces: dividing the family wealth is a bone of contention in many divorces. This source of contention can be diminished if one or both spouses secretly hides wealth in a cryptocurrency prior to entering the divorce process. Such divorce fraud would be difficult to detect because anonymity is a characteristic of cryptocurrencies.

Tax evasion: some cryptocurrency transactions avoid the use of U.S. dollars by swapping cryptocurrency for goods and/or services instead of selling them for money. Cryptocurrency transactions can be opened in one country and liquidated in another country. And, some "fly-by-night cryptocurrency exchanges" have vanished suddenly, which wipes out all records of the clients' taxable transactions [Roose (2018)]. If appropriate planning precedes these transactions, they can be conducted without the knowledge of the U.S. Government's Internal Revenue Service (IRS). The existence of cryptocurrencies facilitates such illegal tax evasion schemes.

Money laundering: some drug, gambling, and prostitution rings, and some cryptocurrency manipulators generate cash flows that criminals want to conceal from the police and IRS. A cryptocurrency can be purchased with "dirty money" and liquidated later to obtain "clean money." These simple transactions facilitate and encourage criminal activities by laundering criminals' ill-gotten gains [Michaels et al. (2018)].

ICOs: an ICO is an online crowdfunding technique used to introduce a new cryptocurrency to the market. A new cryptocurrency was born almost every day during 2017. The founders of many of these ICOs create digital tokens that are like bitcoins and sell them to the public before they have even developed a clear plan for a product. When buyers pay for their new digital tokens those transactions provide immediate income for the ICOs founders. Unfortunately, the cryptocurrencies purchased with U.S. dollars are not as liquid as the U.S. dollars that financed the purchase. Each transaction involves fees that are more expensive than the commissions charged by U.S. government registered securities brokers. Furthermore, large random fluctuations in the conversion rate between a cryptocurrency and U.S. dollars creates substantial additional risk. Finally, not all cryptocurrency promoters are truth tellers.[6]

Valueless investments: during 2017, the market prices of many cryptocurrencies shot up and then fell by half while stock market investors enjoyed a bull market throughout that year. The random price volatility of virtual currencies occurs because the prices of cryptocurrencies and digital tokens are based on irrational supply and demand forces rather than on tangible collateral, contractual income, or meaningful contracts. Some cryptocurrencies become worthless because the ICO founder was a criminal who spent their investors' money selfishly on themselves. Furthermore, even if the investors' money remains invested in the cryptocurrency, mob psychology is a better way to determine cryptocurrency prices than rational economic analysis [Vigna (2018c), Andolfatto and Spewak (2019)].

Cryptocurrency exchanges: most cryptocurrencies are not traded on organized security exchanges that are supervised by the SEC or any other reputable governmental body. Nearly all cryptocurrencies are traded over-the-counter at opaque and unregulated exchanges that are not well-protected from cyber-attacks. In 2016, for example, the Commodity Futures Trading Commission (CFTC) reached a U.S.$75,000 settlement against a cryptocurrency exchange named Bitfinex for offering leveraged trading without the CFTC's advanced approval [Vigna and Michaels (2018)]. Furthermore, in 2018, computer programs written to manipulate the prices

[6] For example, the SEC halted a Dallas-based ICO by AriseBank in 2018 because the advertisement made fraudulent claims, https://bit.ly/2DVU3An

of cryptocurrencies in their unregulated markets were criticized by the office of New York Attorney General Barbara D. Underwood [Vigna and Osipovich (2018)].

Theft: it turns out that the well-publicized electronic blockchain ledger system that is supposed to make bitcoin burglarproof can, unfortunately, attract thieves instead of discouraging them. While police can track every transaction through Bitcoin's blockchain ledger, the design of the blockchain system permits its users to omit providing any information about themselves or their address. This information gap has made some bitcoin thefts unsolvable [Popper (2018b)]. More specifically, the police may be able to use the blockchain ledger system to track transactions to the criminal's computer but if the criminals are using someone else's computer the task becomes impossible.

Counterfeiting: unlike the U.S. dollar, most cryptocurrencies are easy to counterfeit. Section 8.1 below provides facts about how and why cryptocurrencies attract counterfeiters.

None of the activities listed above earn large tax revenues for the government, enrich ethical business enterprises, increase commercial activity, or provide transparency for the cryptocurrency's investors. Nevertheless, some U.S. futures exchanges and options exchanges are creating derivatives on bitcoins that increase their liquidity and enable the not-so-liquid cryptocurrency markets to become more liquid by trading derivatives based on them [Rubin (2018)]. Different nations are dealing with cryptocurrencies in different ways.

7. THE ACCEPTANCE OF CRYPTOCURRENCIES BY NATIONAL GOVERNMENTS

Consider a few national governments' vastly different assessments of cryptocurrencies. By 2018, China, Bolivia, Lebanon, and Iceland banned cryptocurrencies. India enacted restrictions on cryptocurrency transactions [Russolillo and Hunter (2018)]. In contrast, Canada recognized bitcoins as a form of barter. And, Japan and Australia both defined bitcoins to be legal tender.

Sweden's central bank, the Riksbank, is preparing to switch to a new digital currency called the e-krona. The e-krona will perform all the tasks of the krona but in a digitized fashion [Alderman (2018)]. Sweden welcomed bitcoins to compete with the e-krona. The e-krona resembles a new electronic currency that Berensten and Schar (2018a), two Federal Reserve research economists, suggest for the U.S.

In 2018, a group of scheming entrepreneurs met in Puerto Rico to establish a cryptocurrency industry for that U.S. territory. Puerto Rico offers the unparalleled tax incentives of no federal income taxes, no federal capital gains taxes, low local taxes, and no requirement to be an American citizen to obtain these valuable tax benefits. A member of this group, Mr. Brock Pierce, who has been sued for fraud in the past [Mora et al. (2014)], established himself as a director of the Bitcoin Foundation and co-founded a block-chain-for-business company named Block.One. Block.One had an ICO that brought in U.S.$1.5 billion during several months of 2017 and 2018. This U.S.$1.5 billion may become personal income for Mr. Brock Pierce or it may be invested in the cryptocurrency. The privacy and anonymity that characterize the cryptocurrency industry make it extremely difficult for the investors to find out what happened to their investments [Bowles (2018)]. As of yet, no reactions from the U.S. or Puerto Rican authorities have been reported.

8. WILL HISTORY REPEAT ITSELF?

The preceding list of unethical and illegal activities is troubling. Bitcoins were first launched in the U.S. in 2009. Since then, the U.S. has not developed any new laws to govern them. To understand the implications of the cryptocurrency industry for the U.S., this section reviews the history of free banking in the U.S. from 1836 to 1862. The next section discusses a well-documented historical crisis in the U.S. financial system that may unfold similarly in the U.S. cryptocurrency industry.

8.1 Lessons from the "free banking era" of 1837-1862

A total of 1,600 state-chartered private banks were issuing their own unique paper money in the U.S. in 1836.[7] The money issued by each bank had a special color and a unique design. Furthermore, every denomination of each bank's money also had a different color and a distinctive design. As a result, over 30,000 varieties of paper money, called bank notes, were issued by state banks with a minimum of bank regulation. The profusion of color and design differences in this paper money created

[7] Video entitled: U.S. money history, U.S. Treasury Department, Bureau of Engraving and Printing, viewed March 2018

lucrative opportunities for counterfeiters to profit. It was estimated that one-third of all the money in circulation was counterfeit in 1836.[8] This was the beginning of what the economic history books call the "free banking era" – it began in 1837 and lasted until 1862. During this period, hundreds of loosely regulated state-chartered banks could legally issue bank notes (that is, their own unique paper money) that was backed by the bank's gold and silver coin deposits. But few regulators checked to see if the issuing banks actually owned the collateral that was supposed to support the value of the money they issued. These state banks were also permitted to offer checking account services.

During the "free banking era," each state was allowed to regulate their own banks' reserve requirements, interest rates for loans and deposits, and the required capital reserve ratio.[9] This largely unregulated situation grew even riskier in 1837 when the Michigan Act authorized a Michigan state bank charter for any U.S. bank that could fulfill the Michigan Act's reserve requirements. Unfortunately, Michigan's state legislature provided inadequate resources to verify that the rapidly growing number of banks chartered in Michigan were meeting the state's reserve requirements. As a result, many thinly capitalized non-Michigan bankers found Michigan's bank chartering system to be an attractive launch pad. The Michigan Act made creating unstable banks easier in all states and lowered state supervision in the states that allowed entry by banks chartered in Michigan. As a result of these remarkably loose bank regulations, the real value of a bank note was often lower than its face value. And, to make the system even more troublesome, the day-to-day news about each issuing bank's financial strength caused continuously fluctuating and always negotiable exchange rates between the bank notes issued by different banks. For example, it might take three $1 bills printed by a small-town bank to buy two $1 bills issued by a nearby large city bank. Situations like this meant that if someone traveled from a small town to a large city they might have to take 50% additional small-town cash because of the unfavorable exchange rate differences.

Between 1837 and 1862, the free banking era shrunk the length of the average bank's life to a mere five years. About half of the banks failed, and about a third went out of business because they could not redeem their notes for gold and silver as they had advertised. The widespread fraud and uncertainty that resulted from inadequate bank regulation depressed the nation's economy and slowed economic growth between 1837 and 1862.

8.2 The beginning of the cryptocurrency industry, 2016-2018

The National Banking Act of 1863 brought an end to the Free Banking Era of 1837-1862. Among other things, the National Banking Act created:

- A system of national banks that had higher reserve standards and more ethical business practices than the numerous state banks, many of which were chartered in Michigan.
- A uniform national currency, which required all national banks to accept the national currency at its full par (face) value.
- The Comptroller of the Currency. The money printed by the Comptroller of the Currency was manufactured using uniformly high quality standards that greatly reduced the widespread use of cheaply printed counterfeit money.

Not surprisingly, some problems like those the U.S. banking industry experienced between 1837 and 1862 are found in the cryptocurrency markets of 2019.

Between 2016 and 2018, the U.S. cryptocurrency industry added over 1,000 new cryptocurrencies without any government regulations to guide the ICOs. These new cryptocurrencies operate under less regulation than the under-regulated banking industry during the free banking era of 1837 to 1862. Section 6 above lists eight illegal activities that offer profitable opportunities that the unregulated cryptocurrency industry facilitates.

9. MONETARY ECONOMICS

Although virtually anyone can become a bitcoin miner and create new bitcoins by simply downloading the software and working within the system, this process of mining is not working out as well as planned [Cong et al. (2018)]. In fact, a small number of large miners with expensive high-speed hardware sprung up in 2018 and they tend to dominate bitcoin mining. Creating cryptocurrencies in these somewhat centralized "bitfarms" threatens to further restrict the transparency of the cryptocurrency industry.

[8] Video entitled: A history of central banking in the U.S., Federal Reserve Bank of Minneapolis, viewed March 2018

[9] Video entitled: History of central banking in the United States, Wikipedia.org, viewed in March 2018

9.1 Contrasting different forms of currency

Several monetary economic issues can be addressed by contrasting the characteristics of various types of money.

9.1.1 CASH

U.S. dollars have an economic value that is inseparable from the coin or the note. Whoever has physical possession of the cash owns the corresponding value; no third party is keeping track of who is holding the cash. Cash money circulates freely and conveniently with no need for records documenting each transaction. Using cash creates no credit relationships. Furthermore, cash spenders do not need to open a bank account nor seek any permissions and, if desired, they can even remain anonymous. A central bank and the federal government's U.S. Treasury are the monopolistic issuers of cash. Cash is a productive asset that is used to increase the nation's income, and the demand for cash holdings is growing [Bates et al. (2009, 2018)]. The disadvantage of using cash is that the buyer and seller must both be present to complete a transaction. Consequently, very few cash transactions involving large sums can occur between distant counterparties.

9.1.2 DIGITAL CASH

Digital cash provides all the advantages of cash without the disadvantages. In addition, it can be copied and transferred electronically. Unfortunately, copying and transferring digital cash electronically facilitates fraud and thievery, which is lightly referred to as the "double spending problem" in the cryptocurrency industry.

9.1.3 COMMODITY MONEY

Gold and silver are popular examples of commodity money. Commodity money has most of the same characteristics as cash, with the main exception being how it is created. Most governments do not issue significant amounts of gold or silver. Miners must either work or pay cash to obtain gold, silver, or some other form of commodity money.

9.1.4 BANK DEPOSITS

Bank deposits exist in an accounting system instead of as tangible cash. Bank deposits are transferred by writing paper checks, with credit cards, and through various online transactions. Commercial banks compete to obtain bank deposits from both short-term depositors and long-term savers. Commercial banks and central banks keep records of every bank deposit and transfer. These financial intermediaries work to prevent fraud and they correct any errors soon after they are detected. In particular, bank deposits are very useful for paying large debts to distant creditors. Unfortunately, bank deposits are vulnerable to electronic failures, hackers, and incompetent politicians that can manage their nation's monetary system capriciously.

9.1.5 BITCOINS

Bitcoins are virtual monetary units. One bitcoin unit can be divided into 100 million **Satoshis**. Bitcoins do not circulate freely and conveniently like cash. And, unlike bank deposits, bitcoins cannot be used to pay bills unless a gracious counterparty agrees in advance to accept them as full and final payment. Bitcoins cannot pass through the Federal Reserve or any other audited centralizing system. Bitcoins are a virtual currency that can only be transferred through about 190 decentralized cryptocurrency exchanges in the U.S. These cryptocurrency exchanges are not transparent and do not operate for free, but they are significantly simpler and less costly to maintain than a central bank and the accompanying system of commercial banks that must undergo periodic audits. The bitcoin blockchain verifies transactions by using a consensus building mechanism that is operated and maintained by bitcoin miners. The problem that seems to be emerging with this consensus building mechanism is that a small number of wealthy bitcoin miners in China seem to be gaining control of the bitcoin mining business by buying larger computer systems and more electricity than most bitcoin miners can afford [Berensten and Schar (2018a)].

9.2 Acceptance of bitcoins

Bitcoins are a virtual currency that is managed by a decentralized network that was inconvenient to use for paying bills during 2016 through 2018. But, while most businesses still refuse to deal in cryptocurrencies, a slightly larger number of businesses adapted to cryptocurrencies in 2018. And in 2018, some cryptocurrency exchanges began actively trading one cryptocurrency for another at fluctuating exchange ratios. If the liquidity of bitcoins continues to increase (which seems possible), this development has the potential to disrupt the current payments infrastructure and financial system in the U.S. The questions that arise here are: can bitcoins and/or some other cryptocurrency become sufficiently liquid to displace cash money and bank deposits in the U.S.

financial system? Are such changes helpful or harmful to the U.S. economy?

10. DISCUSSIONS OF A NEW FEDERAL RESERVE ELECTRONIC MONEY SYSTEM

Two Federal Reserve research economists, Aleksander Berensten and Fabian Schar, proposed improvements in the current U.S. monetary system that will, among other things, prevent the kind of problems that arise with the 1,600 decentralized cryptocurrencies. Berensten and Schar suggest the Federal Reserve develop and operate a new form of central bank controlled electronic money that is based on the U.S. dollar [Berensten and Schar (2018b)]. Let us call this hypothetical new currency the e-dollar.

The Federal Reserve, or, the Fed, has been transferring money between the twelve Federal Reserve Banks in the U.S. for decades to prevent local money panics from developing. Berensten and Schar (2018b) suggest extending the present monetary system to become a larger and more centralized bank electronic money system that provides more services. They suggest enlarging the Fed's current interbank electronic system so that every adult, business, and governmental agency could have its own private bank account at the Fed. The existing 6,500 centralized commercial banks and the 1,600 decentralized cryptocurrencies could all continue to operate beside one another and compete with the Fed's hypothetical new e-dollar system.

The suggestion by Berensten and Schar (2018b) can be implemented in many different forms. For example, the central bank electronic money system could either be secretive and restrictive or transparent and available to everyone. More specifically, the system could handle direct transfers between individuals, like private payments of cash, or, alternatively, every transaction could be routed through something like the Federal Reserve check clearing system, which presently clears 50 million checks per day from banks around the world. If all the proposed new electronic bank accounts at the Fed were identified by a 50-digit alpha-numeric hashtag instead of the account owner's name, then everyone's privacy could be maintained and each transfer would resemble an anonymous cash payment that took place secretly. Alternatively, every transaction could carry the payer's and the recipient's names, and every transaction could be recorded electronically so that all transactions would be cheap and easy to audit as often as desired. If the Fed acts as a check-clearing middleman between electronic check writers and electronic check recipients, then the e-dollar would be a centralized currency rather than a decentralized cryptocurrency that encourages illegal behavior by carrying out undisclosed transactions that cannot be audited.[10]

The new central bank electronic money system currently under discussion by research economists at the Fed could be designed to be very useful and convenient. To encourage competition between the 1,600 cryptocurrencies, the existing centralized banking system, and the Fed's hypothetical e-dollar system, people could be allowed to ignore the Fed's new system and bank through their present commercial bank with paper checks and/or maintain a cryptocurrency account, if they wished. Thus, for instance, one individual person or company could have three separate accounts at a cryptocurrency organization, one of the traditional commercial banks that exist today, and the Fed's new electronic banking system. Economic theory suggests that this competition would most likely foster improvements in all three systems.

The Fed would probably pay interest on its millions of new e-bank accounts. And as one of its monetary policy tools, the Fed could adjust this one most-important interest rate from time to time. If a new central bank electronic money system paid interest to its depositors, the same interest rate should be paid to every account to keep from getting the nation's monetary policies (like controlling the level of interest rates) entangled with the nation's fiscal policies (such as the enforcing the structure of the federal income taxes). If the Fed paid a uniform single interest rate on every Fed account, the level of that interest rate would affect the demand for the new accounts at the Fed, the amount of cash held in every bank account in the U.S., and the prices of government bonds. This hypothetical introduction of numerous new interest-bearing checking accounts would strengthen the linkages between the Fed's monetary policies and every aspect of the U.S. economy [Halaburda and Haeringer (2018)].

[10] Hayek's (1976) views about concurrent currencies become relevant when considering how the current system of thousands of U.S. commercial banks, hundreds of cryptocurrencies, and the contemplated e-dollar system might compete with each other.

11. DIFFERENT BLOCKCHAIN APPLICATIONS

Bitcoin and ethereum are two competing cryptocurrencies that both use the blockchain technology. However, not all cryptocurrencies employ the blockchain technology. If we take an even broader perspective, we can find other uses for the blockchain technology that are unrelated to cryptocurrencies. For instance, IBM, Microsoft, and other software manufacturers sell blockchain software for non-cryptocurrency applications. Stated differently, blockchains and cryptocurrencies are separate products that can be purchased either separately or together. Some of these new non-cryptocurrency applications seem to be blossoming.

11.1 The IBM Corporation

IBM's Blockchain group has 1,500 employees. During the past 25 years IBM has worked with over 500 different clients to create and install blockchain technology in their organizations. One ambitious Blockchain project IBM has undertaken recently was the creation of a European trade consortium named we.trade. IBM helped Deutsche Bank, HSBC, and seven other banks go live with we.trade in June 2018 [Salzman (2018a)]. Similarly, IBM is working with Maersk to develop a blockchain named TradeLens that tracks important shipping documents through over 100 different organizations. Buyers, sellers, shipping companies, port authorities, and other participants are working together to develop TradeLens into an effective joint decision-making platform.

11.2 Microsoft

After Microsoft developed the well-known videogame console named Xbox, it built a blockchain that calculates the royalties due to Xbox game publishers almost instantly. Before this blockchain application was completed, Microsoft's Xbox publishers had to wait 45 days past the end of the month to find out how much they earned from the sales of their game. Working with Accenture and Mercy Corps, Microsoft built a blockchain system called ID2020 that can record data for up to 1.1 billion people. ID2020 can imbed identity documents and biometric information like fingerprints and retina scans into software that is both immutable and encrypted. The state of West Virginia used similar blockchain software to facilitate voting by veterans residing in foreign countries.

11.3 Medical records

A new medical records company named MedRec is an MIT-backed initiative designed to digitize family's medical records. Blockchain creates a family medical history that can be passed down from generation

to generation. It uses ethereum blockchain's smart contracts to execute scripts on the blockchain. MedRec uses metadata to protect the integrity of the data but still allows records to be accessed securely by patients across different providers.[11]

Despite such initiatives to apply blockchain in the non-cryptocurrency space, Gartner group's survey of chief information officers found that only 3.3% had deployed blockchain software [Salzman (2018b)].

12. CONCLUSION

A respected 19th century German philosopher, Johann G. Fichte, advocated that the nations of the world abolish world currencies that can be traded between nations and, instead, work to develop national currencies that can only be traded between citizens and within national borders. Fichte argued that using national currencies ensures that the currency's value is more likely to remain constant and that will help the nation's citizens maintain a level of welfare that will never decline: "All individuals are guaranteed that their present state of existence will continue into the future, and, through this, the whole is guaranteed its own quiet, steady continuity" [Fichte (2012)]. Fichte went on to propose a systematic account of the ethics for currencies. Professor Tobey Scharding employs Fichte's ethical philosophy to show that bitcoin forsakes the general welfare and is unethical [Scharding (2018)]. Following the philosophical suggestions of Fichte and Scharding, this paper reviews recent developments to show that the privacy provided by bitcoin and the other cryptocurrencies attracts criminals and facilitates illegal activities that are counterproductive to the maintenance of a peace-seeking, prosperous society. These findings have been supported by economics professors who take cognizance of the ethics involved in a nation's monetary system [Gray (2003), Angel and McCabe (2015)].

While the blockchain technology is not experiencing the ethics problems that are crippling the cryptocurrency industry, it is developing at only a modest pace. The blockchain technology has yet to experience a breakthrough of major proportions.

[11] For more information see: https://bit.ly/2Ns8rlv

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