

THE CAPCO INSTITUTE
JOURNAL
OF FINANCIAL TRANSFORMATION

CRYPTO

The evils of cryptocurrencies
JACK CLARK FRANCIS | JOEL RENTZLER

CLOUD

#55 MAY 2022

a wipro company

THE CAPCO INSTITUTE

JOURNAL OF FINANCIAL TRANSFORMATION

RECIPIENT OF THE APEX AWARD FOR PUBLICATION EXCELLENCE

Editor

Shahin Shojai, Global Head, Capco Institute

Advisory Board

Michael Ethelston, Partner, Capco

Michael Pugliese, Partner, Capco

Bodo Schaefer, Partner, Capco

Editorial Board

Franklin Allen, Professor of Finance and Economics and Executive Director of the Brevan Howard Centre, Imperial College London and Professor Emeritus of Finance and Economics, the Wharton School, University of Pennsylvania

Philippe d'Arvisenet, Advisor and former Group Chief Economist, BNP Paribas

Rudi Bogni, former Chief Executive Officer, UBS Private Banking

Bruno Bonati, Former Chairman of the Non-Executive Board, Zuger Kantonalbank, and President, Landis & Gyr Foundation

Dan Breznitz, Munk Chair of Innovation Studies, University of Toronto

Urs Birchler, Professor Emeritus of Banking, University of Zurich

Géry Daeninck, former CEO, Robeco

Jean Dermine, Professor of Banking and Finance, INSEAD

Douglas W. Diamond, Merton H. Miller Distinguished Service Professor of Finance, University of Chicago

Elroy Dimson, Emeritus Professor of Finance, London Business School

Nicholas Economides, Professor of Economics, New York University

Michael Enthoven, Chairman, NL Financial Investments

José Luis Escrivá, President, The Independent Authority for Fiscal Responsibility (AIReF), Spain

George Feiger, Pro-Vice-Chancellor and Executive Dean, Aston Business School

Gregorio de Felice, Head of Research and Chief Economist, Intesa Sanpaolo

Allen Ferrell, Greenfield Professor of Securities Law, Harvard Law School

Peter Gomber, Full Professor, Chair of e-Finance, Goethe University Frankfurt

Wilfried Hauck, Managing Director, Statera Financial Management GmbH

Pierre Hillion, The de Picciotto Professor of Alternative Investments, INSEAD

Andrei A. Kirilenko, Reader in Finance, Cambridge Judge Business School, University of Cambridge

Mitchel Lenson, Former Group Chief Information Officer, Deutsche Bank

David T. Llewellyn, Professor Emeritus of Money and Banking, Loughborough University

Donald A. Marchand, Professor Emeritus of Strategy and Information Management, IMD

Colin Mayer, Peter Moores Professor of Management Studies, Oxford University

Pierpaolo Montana, Group Chief Risk Officer, Mediobanca

John Taysom, Visiting Professor of Computer Science, UCL

D. Sykes Wilford, W. Frank Hipp Distinguished Chair in Business, The Citadel

CONTENTS

CLOUD

08 Cloud's transformation of financial services: How COVID-19 created opportunities for growth across the industry

Peter Kennedy, Partner (UK), Capco

Aniello Bove, Partner (Switzerland), Capco

Vikas Jain, Managing Principal (US), Capco

Chester Matlosz, Managing Principal (US), Capco

Ajaykumar Upadhyay, Managing Principal (US), Capco

Frank Witte, Managing Principal (Germany), Capco

18 Cloud finance: A review and synthesis of cloud computing and cloud security in financial services

Michael B. Imerman, Associate Professor of Finance, Peter F. Drucker and Masatoshi Ito Graduate School of Management, Claremont Graduate University; Visiting Scholar, Federal Reserve Bank of San Francisco

Ryan Patel, Senior Fellow, Peter F. Drucker and Masatoshi Ito Graduate School of Management, Claremont Graduate University

Yoon-Do Kim, Quantitative Analyst, Federal Reserve Bank of Minneapolis; Ph.D. Student in Financial Engineering, Claremont Graduate University

26 Multi-cloud: The why, what, and how of private-public cloud setups and best practice monitoring

Florian Nemling, Senior Consultant (Austria), Capco

Martin Rehker, Managing Principal (Germany), Capco

Alan Benson, Managing Principal (Germany), Capco

CRYPTO

- 32 Digital assets and their use as loan collateral: Headline legal considerations**
Phoebus L. Athanassiou, Senior Lead Legal Counsel, European Central Bank
- 40 Central bank digital currencies and payments: A review of domestic and international implications**
Lilas Demmou, Deputy Head of Division – Structural Policy Analysis Division, Head of Financial Policy, Investment and Growth Workstream, Economics Department, OECD
Quentin Sagot, Junior Advisor, Centre for Tax Policy and Administration, OECD
- 56 Decentralized Finance (DeFi) from the users' perspective**
Udo Milkau, Digital Counsellor
- 68 Central bank digital currencies: Much ado about nothing?**
Jay Cullen, Professor of Financial Regulation and Head of Law, Criminology and Policing, Edge Hill University; Research Professor in Law, University of Oslo
- 76 Bitcoin's impacts on climate and the environment: The cryptocurrency's high value comes at a high cost to the planet**
Renee Cho, Staff Writer, Columbia Climate School, Columbia University
- 82 The evils of cryptocurrencies**
Jack Clark Francis, Professor of Economics and Finance, Bernard Baruch College
Joel Rentzler, Professor of Economics and Finance, Bernard Baruch College
- 94 At last a really socially useful stablecoin: SNUT (the specialized national utility token)**
Stephen Castell, Founder and CEO, Castell Consulting

CYBER

- 102 A semantic framework for analyzing "silent cyber"**
Kelly B. Castriotta, Global Cyber Underwriting Executive, Markel Corporation
- 112 Cyber resilience: 12 key controls to strengthen your security**
Sarah Stephens, Managing Director, International Head of Cyber & FINPRO UK Cyber Practice Leader, Marsh
- 122 Europe's push for digital sovereignty: Threats, E.U. policy solutions, and impact on the financial sector**
Lokke Moerel, Professor of Global ICT Law, Tilburg University
- 136 Construction of massive cyberattack scenarios: Impact of the network structure and protection measures**
Caroline Hillairet, Professor and Director of the Actuarial Science engineering track and Advanced Master, ENSAE and CREST.
Olivier Lopez, Professor of Applied Mathematics (Statistics), Laboratoire de Probabilités, Statistique et Modélisation, Sorbonne Université
- 142 Cyber insurance after the ransomware explosion – how it works, how the market changed, and why it should be compulsory**
Jan Martin Lemnitzer, Department of Digitalization, Copenhagen Business School



DEAR READER,

Welcome to edition 55 of the Capco Institute Journal of Financial Transformation. Our central theme is cloud computing, which has transformed from an efficiency initiative for our clients, to an indispensable growth driver for financial services.

The pandemic has changed consumer expectations, with consumers now demanding 24/7 access to their financial resources from anywhere, as well as hyper-personalized products that reflect their lifestyle choices.

In this edition of the Journal, we explore the power of cloud and its potential applications through the lens of a joint Capco and Wipro global study, and take a deeper look at the financial services data collected in Wipro FullStride Cloud Services' 2021 Global Survey. The survey was focused on perceptions of cloud and its importance to business strategy from over 1,300 C-level executives and key decision-makers across 11 industries.

The study indicates that cloud is becoming ever more intelligent, hyperconnected, and pervasive, and enables companies to offer their end users the personalized, user-centric experience that they have come to expect. It's clear that only the financial services firms that can successfully leverage cloud, will thrive.

In addition, this edition of the Journal examines important topics around digital assets and decentralized finance, including central bank digital currencies, and bitcoin's impact on the environment, and cybersecurity and resilience.

As ever, you can expect the highest calibre of research and practical guidance from our distinguished contributors, and I trust that this will prove useful in informing your own thinking and decision-making.

Thank you to all our contributors and thank you for reading. I look forward to sharing future editions of the Journal with you.

A handwritten signature in black ink, appearing to read 'Lance Levy', with a stylized, flowing script.

Lance Levy, **Capco CEO**

THE EVILS OF CRYPTOCURRENCIES

JACK CLARK FRANCIS | Professor of Economics and Finance, Bernard Baruch College

JOEL RENTZLER | Professor of Economics and Finance, Bernard Baruch College

ABSTRACT

In 2021 Gary Gensler, Chairman of the Securities and Exchange Commission, called cryptocurrency markets the “Wild West” and said they are rife with “fraud, scams, and abuse” [Talley and Volz (2021), Kiernan (2021), CBS News (2021)]. One of the main reasons they cause so many problems is that the U.S. has no laws governing cryptocurrencies. Since cryptocurrencies do not conform to the legal definition of securities, the existing U.S. securities laws do not apply to them. As a result, a complicated multi-billion dollar lawless industry has sprung up in the U.S. in recent decades.

1. INTRODUCTION

Berensten and Schar (2018a) prepared an introduction to cryptocurrencies, which are often called cryptos or digital currencies. Over 10,000 cryptocurrencies were listed on the CoinMarketCap.com website in 2022, and that number keeps increasing. Speculators, investors, and criminals that seek to operate confidentially are attracted to cryptocurrencies.¹ Cryptocurrencies are also of interest to central bankers because some people use them as if they were money. In 2021, Gary Gensler, Chairman of the SEC, called cryptocurrency markets the “Wild West” and said they are rife with “fraud, scams, and abuse” [Talley and Volz (2021), Kiernan (2021), CBS News (2021)]. Popper (2019) reports other cryptocurrency problems. One concern with cryptocurrencies that continues to arise is: are cryptocurrencies money?

1.1 What is money?

Money is:

- 1) a unit of account
- 2) a medium of exchange, and
- 3) widely acceptable as a form of payment.

To be useful, money should also be fungible, difficult to counterfeit, and easily transportable. Cryptocurrencies fail to meet most of these criteria. For example, cryptocurrencies are not a good medium of exchange because commercial banks in the U.S. and China are not allowed to accept them as deposits or execute transactions that involve cryptocurrencies. U.S. banks can allow their depositors to store cryptocurrencies in the bank's safe deposit box for rental fees, the same way a bank might allow depositors to store gold or silver in its safe deposit box. The Federal Reserve treats silver, gold, and cryptocurrencies as illiquid commodities, not as money [Vigna 2019b].

¹ For more about the criminal activities see Lahart and Demos (2021), Osipovich (2021), Vigna (2019b), Popper (2019), Vigna and Jeonmg (2019), Hirtenstein (2021), Talley and Volz (2021), Yaffe-Bellany (2022b), and others.

The U.S. dollar, British pound, the euro, and Japanese yen are established fiat currencies that are not backed by any collateral. Fiat money has value because a sovereign government declares it to be legal tender that can be used to make full and final payment of legal debts. The only currency the U.S. government has designated to be legal tender is the U.S. dollar. Cryptocurrencies are not qualified to be used as a fiat currency in the U.S. and, thus, no cryptocurrency should be called U.S. money. This does not mean that other nation's governments, such as El Salvador in 2021, cannot designate cryptocurrencies to be legal tender in their country.

1.2 Virtual currencies

In 2012, the European Central Bank defined a virtual currency to be an unregulated, digital money that is issued and controlled by its developers. In other words, virtual currencies are used and accepted among the members of a virtual community. In 2013, the U.S. Treasury Department stipulated that a virtual currency is something that operates like a currency in some environments but does not have all the attributes of a real currency. These definitions both describe cryptocurrencies. Some writers have discouraged the U.S. from using cryptocurrencies [Hirtenstein (2021)]. Nevertheless, many private individuals invest in cryptocurrencies in the U.S.

2. BITCOINS

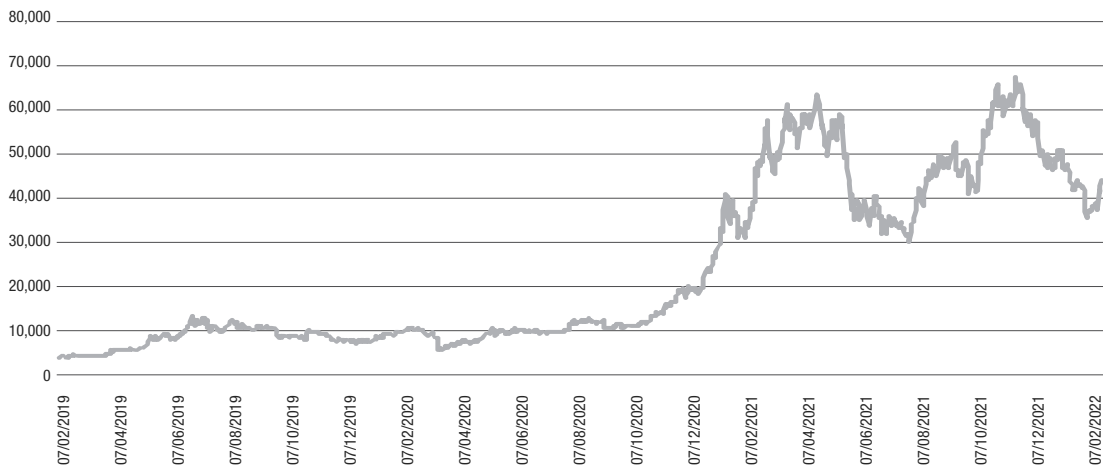
Satoshi Nakamoto introduced the first cryptocurrency in the world, bitcoin, in 2009.²

2.1 Characteristics of bitcoins

Brokers, traders, and exchanges wishing to trade bitcoins will find them listed and traded at approximately 300 cryptocurrency dealers in the U.S. In addition, the Chicago Mercantile Exchange (CME) and the Chicago Board of Options Exchange (CBOE) started selling bitcoin futures and options in 2017. Furthermore, a number of financial executives want to create and distribute exchange traded funds (ETFs) to introduce amateur investors to crypto assets. Financial regulators are reluctant to legitimize cryptocurrencies because most of them have serious issues [as discussed by Osipovich (2019) and Vigna (2019a, b), for example].

Several financial economists have noted that a major complaint against cryptocurrencies is that their market prices fluctuate randomly and sometimes excessively [Jain et al. (2021), Hu et al. (2019)]. For instance, the real sector of the U.S. economy experienced a two-month mini-recession spanning February and March of 2020. Figure 1 shows that the prices of bitcoins acknowledged this mini-recession by experiencing only one single once-and-for-all price drop from March 11th to March 12th. Furthermore, from February 2021

Figure 1: Daily bitcoin prices (U.S.\$)



Source: Federal Reserve Economic Database

² Nakamoto (2009) introduced bitcoins and the blockchain database.

through February 2022 bitcoin prices rose to peak prices and then fell drastically twice for no apparent reason. As various researchers have suggested, it appears that bitcoin prices fluctuate randomly rather than fluctuate closely with (are highly positively correlated with) business activity in the U.S. In addition, Griffin and Shams (2020), Kroeger and Sarkar (2017), and Makorov and Schoar (2021), also reported that bitcoin prices sometimes generate profitable arbitrage opportunities by simultaneously trading at different prices in different markets. Thus, the markets in which cryptocurrencies are traded are not highly efficient.

Howell et al. (2019) investigated another common problem that plagues cryptocurrency buyers; their new investment becomes illiquid not long after it is introduced at its initial coin offering (ICO). Numerous issues of cryptocurrencies appreciate in the first few days after their ICO, but after a few months buyers can no longer be found. Since most cryptocurrencies have no assets, income, or collateral, rational buyers lose interest quickly.

2.2. The Bitcoin blockchain

Bitcoin is an international decentralized digital virtual currency that works without a central bank, financial intermediary, or other third party to handle its transactions. Every transaction is verified in an electronic network of nodes using cryptographic records that are maintained in a publicly distributed electronic ledger called the Bitcoin blockchain. The Bitcoin blockchain is shared, replicated, and re-finalized every time a bitcoin transaction occurs; this process results in what bitcoin users like to call a “continuous consensus” among the blockchain users. This “continuous consensus” does not prevent millions of other people, the U.S. government, and the Chinese federal government from disapproving of the use of bitcoins and other cryptocurrencies.

Bitcoin computer technicians called miners compete to validate every bitcoin transaction. Miners are paid 6.25 new bitcoins for the proof of work they provide by verifying transactions in the Bitcoin blockchain. In addition to 6.25 bitcoins for their proof of work, the miners can also receive a negotiated “transaction fee” from the bitcoin buyer [it should be noted that the blockchain itself has value apart from bitcoin, see Francis (2019)].

A problem with the Bitcoin blockchain is that it can handle a maximum of only about seven transactions per second. No cryptocurrency comes close to the 50,000 transactions per second that VISA credit card handles routinely. This scaling problem poses one of the fundamental limitations on the growth of cryptocurrencies [Andolfano (2018), Vigna (2018a)].

2.3 Halving

When bitcoins were created in 2009, Satoshi Nakamoto stipulated that a total of no more than 21 million bitcoins could ever be issued [Nakamoto (2009)]. Also in 2009, Satoshi Nakamoto declared that each time another 210,000 blocks of bitcoin were mined, the block reward given to bitcoin miners for validating transactions would be cut in half. These halvings took place in 2013, 2017, and 2021 – about every four years. Each halving is significant because it marks a significant drop in the total remaining supply of bitcoins. On May 11, 2021, after halving reduced the block reward to 6.25 bitcoins, approximately 18,715,050 million bitcoins had been released into circulation. Thus, on May 11, 2020, only about 2,284,950 million bitcoins remained to become future mining rewards.

When the number of unissued bitcoins falls to zero, if all the owners of bitcoins in existence can agree, it is theoretically possible to renegotiate a new bitcoin mining protocol. But, perhaps, it will be quicker, cheaper, and easier for bitcoin owners to abandon bitcoin and shift their activities to a more user-friendly investment. This potential internal problem is evidence that the oldest and most popular cryptocurrency in the world is built on a shaky foundation.

2.4 Competing cryptocurrencies

Every cryptocurrency is a decentralized autonomous organization (DAO). Each cryptocurrency's DAO operates according to the rules written into the computer program that handles its transactions.³ The different DAOs are designed to compete against each other in order to maintain and augment their customer list. About half the DAOs traded in the U.S. are bitcoins; no other cryptocurrency is as popular as bitcoin.

A cryptocurrency named Ethereum has a DAO that handles “smart contracts”. The smart contract permits transactions to advance in Ethereum only after certain conditions are fulfilled. Decisions made by Ethereum buyers can generate different

³ Decentralized finance (DeFi) applications permit users to lend, borrow, earn interest, trade assets, and perform other transactions with various decentralized autonomous organizations (DAOs). See Vigna (2021a) and Hirtenstein (2021). DeFi is a newer, more complex system than cryptocurrencies [Economist (2021c)].

price paths for the cryptocurrency. Ethereum was launched in 2015; it is a system that resembles Bitcoin in two respects. First, Ethereum has its own unique blockchain. Second, it has miners that create Ethereum's cryptocurrency, which is called ether. Ethereum's blockchain miners are paid in ethers.

Ethereum is more complicated than bitcoin. For example, when a shipment of widgets is delivered, the recipient can be notified. This notification of arrival can activate the recipient's (widget buyer's) computer to send the appropriate payment to the widget seller. Most older computer systems were less flexible, they could only communicate simpler messages between the members of their uniquely established list of counterparties. In contrast, Ethereum allows new and different counterparties in its blockchain to transact. Furthermore, Ethereum permits unrelated parties to interact. Ethereum can also transfer money between wallets after a specific event is completed. This additional flexibility can result in new business transactions. The market capitalization of Bitcoin greatly exceeds that of Ethereum, but at this time the volume of transactions at Ethereum is increasing more rapidly than the growth in Bitcoin. Ethereum has become central in the budding field of decentralized finance (DeFi), where smart contracts make sophisticated decisions, such as whether or not to make a loan without the aid of a human decision-maker [Economist (2021a)].

Ripple XRP is a blockchain-based digital payment network that has its own cryptocurrency, named XRP. Instead of using blockchain mining, Ripple uses a consensus-gaining mechanism installed in a group of bank-owned servers to confirm transactions between the bank's clients. Ripple provides a system for making direct transfers of financial assets.

Binance Coin, Cardano, Dogecoin, Litecoin, Tron, Monero, NEO, and IOTA are other cryptocurrencies that are currently traded actively. As mentioned above, all are significantly less popular than bitcoin and ether.

3. CRYPTOCURRENCY MARKETS

The price of a bitcoin went from a penny for a single coin in 2009 to over U.S.\$68,000 per coin in November 2021. Gains like these stimulate interest from buyers who have FOMO (fear of missing out). But bitcoin's price does not always rise smoothly. Unfortunately, bitcoin's price fell rapidly from U.S.\$68,000 in November 2021 to U.S.\$35,000 in January 2022. During that period the number of bitcoin trades per day

ranged from a high of 56 million per day when bitcoin's price was near U.S.\$68,000 to a low of around 21 million per day when bitcoin's price was down to U.S.\$35,000 in January 2022. In spite of these wild gyrations, the market for bitcoins is flourishing [Easley et al. (2019)]. Bitcoin is the oldest and by far the most frequently traded cryptocurrency in the U.S., it is listed and traded at many cryptocurrency exchanges. Some of the most noteworthy cryptocurrency exchanges are discussed below.

3.1 Cryptocurrency exchanges

Some of the most noteworthy cryptocurrency exchanges are:

Binance: the largest cryptocurrency exchange in the world is named Binance. The founder of Binance, Changpeng Zhao, says this international company has no headquarters office because, in his opinion, having a corporate headquarters is "an antiquated concept." Unfortunately, for those who have a problem with Binance, this ambiguity could complicate settling their claim [Ostroff et al. (2022), Kowsmann and Ostroff (2021)].

Gemini: as discussed later, the Gemini Trust is a candidate to be the most ethical cryptocurrency exchange in the world. Gemini is a small operation in New York City that was founded and managed by identical twins named Cameron and Tyler Winklevoss. The brothers sued Mark Zuckerberg, founder of Facebook, in 2004, claiming he stole their ConnectU idea to create the popular social networking site Facebook.

Coinbase: on April 14, 2021, the Coinbase Exchange became the first cryptocurrency exchange in the U.S. to have its shares listed on NASDAQ (ticker: COIN). Shares in Coinbase began trading at U.S.\$328 per share, but that price was reduced to U.S.\$274 by May 4, 2021, as investors investigated Coinbase. First, the founder of Coinbase and one of his executives were inappropriately assigned to be on the corporation's internal Audit Committee [Eaglesham (2021)]. In other words, the managers were auditing themselves. Second, some Coinbase investors reported unfair losses and at least one filed fraud charges against the exchange [Browning (2021)].

The Coinbase Exchange typically charges its retail traders several transactions fees. If you buy U.S.\$1,000 worth of a cryptocurrency in the U.S., for instance, you will pay a flat fee of 2.99 percent, or \$29.90. In addition, Coinbase adds a fee of one-half of one percent to the transaction to bring the sub-total to 3.49 percent, or U.S.\$34.90. Furthermore, if you pay with a credit card a one percent fee, or U.S.\$10 will be added

to bring the total fee to 4.49 percent, or U.S.\$44.90. If you both buy and sell a cryptocurrency, Coinbase will double the one-way fee to U.S.\$89.80 for your “round-trip” transaction. These transaction fees are much higher than the NYSE’s fees for trading shares of stock, but lower than the small, privately owned cryptocurrency dealers would charge.

Other centralized cryptocurrency exchanges: BlockFi, Crypto.com, eToro, Kraken, and Robinhood Crypto are the names of other large cryptocurrency exchanges in the U.S. In 2020, these centralized cryptocurrency exchanges began facing new competition from the first decentralized cryptocurrency exchange.

DEXs emerge: decentralized cryptocurrency exchanges are often called DEXs. Decentralized exchanges enable users to buy and sell cryptocurrencies without the aid of a commission-hungry broker acting as their middleman. The crypto buyer and seller begin to transact by simply connecting their crypto wallets to a DEX, which temporarily acts as their middleman. Then the traders select the crypto they want to trade and enter the amount they wish to transact. The DEX endeavors to bring together two like-minded traders to consummate the transaction.

Uniswap: the first DEX is named Uniswap, it was created in 2020 by 27-year-old Hayden Adams while he was between jobs [Osipovich (2021a)]. Uniswap provides a way for computers to talk to each other. No central bank or other third party decides who will be allowed to trade or what tokens may be traded. Furthermore, DEXs do not require their traders to give their digital tokens to the DEX before they can trade. Traders find this last feature appealing because they worry about losing their digital tokens when they trade through the system of loosely managed private cryptocurrency exchanges used by many traders. Coinbase sometimes uses a DEX to act as an interface with public cryptocurrency traders.

Coinbase provides user-friendly websites but, behind the scenes, Uniswap sometimes performs the trading for some cryptocurrency dealers [Vuilleme (2020)].

3.2 Large central banks

The Federal Reserve, or, the Fed, is the monetary authority for the U.S. It controls the U.S. money supply, interest rates, inflation, and the credit markets. The Fed also routinely clears thousands of checks per day from banks around the world. These checks are all cleared through the Federal Reserve Bank of Cleveland.

The Fed does not allow any U.S. banks to accept deposits or execute transactions involving silver, gold, cryptocurrencies, or any other commodities. As explained above, the Federal Reserve treats silver, gold, and cryptocurrencies as illiquid commodities, not as a type of money. In October 2021, the Fed did permit MasterCard credit card company and a Georgia-based digital wallet company named Bakkt Holdings Inc. to join forces to create a cryptocurrency credit card in the U.S. [Andriotis (2021)].

The Peoples Bank of China (PBOC) is the Chinese government’s monetary authority. In 2021, the PBOC outlawed all cryptocurrencies and any activities related to cryptocurrencies. Most businesses in the U.S. and China will not accept cryptocurrencies as payment. The Russian government has opposed cryptocurrencies for years, saying it could be used in money laundering or to finance terrorism. The Russian government gave cryptocurrencies legal status in 2020 but banned their use for payments. It is difficult to see how cryptocurrencies will ever become as liquid as some suggest as long as large industrialized nations like the U.S., China, and Russia continue to place crippling restrictions on their transactions.

4. THE HISTORY OF STABLECOINS

Stablecoins are cryptocurrencies with prices that are pegged to a cryptocurrency, fiat money, or to an exchange traded commodity like silver or gold. The advantage of these asset-backed cryptocurrencies is that the stablecoin prices are stabilized by their connections to assets that have prices which fluctuate outside of the cryptocurrency space. These uncorrelated connections are supposed to reduce the financial risk of the stablecoins. The disadvantage of stablecoins is that their underlying collateral is typically inadequate or simply nonexistent.

The first stablecoin in the U.S., nubits, was introduced in 2014. Initially, Nubits (ticker: NBT) was considered safe and its prices hardly fluctuated. People thought every nubits was safe because stories and advertisements said every nubits was fully collateralized by one U.S. dollar. Unfortunately, a reputable audit never verified that nubits had any collateral. As a result, investors’ trust faded away and a nubits with a face value of one U.S. dollar was selling for 32 cents in early 2022.

If a cryptocurrency has a U.S. dollar backing that can be authenticated by a respectable auditor, that cryptocurrency will have a market price that fluctuates in a narrow range around the value of its collateral. But, if the existence of a cryptocurrency's collateral cannot be confirmed, then the collateral backing is questionable, and the cryptocurrency's market price will fluctuate towards zero. Almost all cryptocurrencies that were ever introduced in the U.S. and are not still actively traded today have market values of zero. This worthless and inactive segment of the population of cryptocurrencies equals the vast majority of all U.S. cryptocurrencies.

Not all collateralized cryptocurrencies are backed by U.S. dollars. Some claim to be backed by other fiat monies, actively traded commodities like gold or silver, cryptocurrencies, or ingenious computer software that is claimed to promote the price of the stablecoin.

4.1 Tether

Tether (ticker: USDT) is the most popular blockchain-based stablecoin. Tether's initial coin offering (ICO) was a crowdfunding issue of tokens that was managed by its issuer, Tether Limited. Tether Limited claimed that every tether token was backed by one U.S. dollar [Ackermann et al. (2020)]. At the same time, Tether Limited announced that tether buyers had no contractual rights to their underlying collateral of U.S. dollars. Surprisingly, this latter declaration did not cause the initial market price of tethers to plunge below U.S.\$1. The market price of tethers remained very close to U.S.\$1 for about a year after they were issued. But, in 2016 the market price of the tether began to wobble. More recently tether's market price fluctuated between U.S.\$1.06 and 92 cents [Lyons and Viswanath-Natraj (2020)]. Tether Limited could have probably kept the market price of the stablecoin closer to U.S.\$1 if it had opened its books to a public audit that verified Tether was fully collateralized by the promised number of U.S. dollars. Tether Limited provided no such public assurance. To make the situation more tenuous, in March 2019 Tether Limited announced that it was expanding tether's collateral beyond the U.S. dollar to also include loans to affiliate companies, a much riskier type of collateral than the U.S. dollar. Furthermore, on April 30, 2019, the cryptocurrency market was disappointed when Tether Limited announced that each tether was backed by only 74 cents in cash and cash equivalents, less than was promised at Tether's ICO. In other

words, if Tether went bankrupt when it was backed by only 74 cents worth of U.S. dollars, the tether owner could expect to receive less than 74 cents for each tether.⁴ Investing in tether is obviously much riskier than investing in U.S. dollars.

Law-abiding, risk-averse businesspeople have little incentive to buy tethers or other stablecoins. The features that motivate people to buy stablecoins are the absence of binding laws, the absence of records, and the complete lack of transparency that exists throughout the stablecoin market. As a result of these features, the so-called "privacy" that exists throughout the cryptocurrency markets makes them a particularly attractive place for swindlers and criminals to conduct business. In an early attempt toward regulation, in October 2021, the U.S. Commodity Futures Trading Commission (CFTC) fined Tether U.S.\$41 million for misrepresenting itself to be fully backed by assets during 2016 and 2019.⁵ Since SEC Chairman Gary Gensler stated publicly in 2021 that the U.S. cryptocurrency markets are rife with "fraud, scams, and abuse" [CBS News (2021), Talley and Volz (2021), Kiernan (2021)], the likelihood that the SEC will issue similar fines in the future increased.

4.2 Problems with Tether

An additional problem for Tether Limited occurred in 2018-2019. Two different cryptocurrency exchanges named Bitfinex and Tether Limited were both owned and operated by iFinex Inc. Although tether was issued in the U.S., iFinex is headquartered in Hong Kong and registered in the British Virgin Islands. Many people were confused by these complicated international arrangements. In 2019, the New York Attorney General's office alleged that in mid-2018 Bitfinex lost U.S.\$850 million and secretly used funds taken from Tether to cover the resulting shortfall. This well-documented allegation further tainted Tether's reputation [Griffin and Shams (2019) Vigna (2019a), Ostroff (2021), Michaels (2021)]. Customers' money has been stolen or lost in several incidents and, as a result, like the other uncollateralized cryptocurrencies, Bitfinex, Tether, and iFinex have never been permitted to transact with any U.S. commercial bank.

While Tether Limited's reputation is not spotless, tethers have much better collateral than uncollateralized cryptocurrencies like bitcoin and ether. In spite of anything they might advertise, most, or all, of the uncollateralized cryptocurrencies in the U.S. have zero collateral. It appears that the founders of thousands

⁴ In February 2021, Tether was fined U.S.\$18.5 million by New York State for overstating the size of its collateral backing of U.S. dollars [Economist (2021b)].

⁵ Unfortunately, the U.S. has not yet enacted any laws regulating cryptocurrencies to furnish a legal basis for this fine.

of uncollateralized cryptocurrencies disappeared with the cash proceeds from their initial coin offering (ICO) soon after the ICO was completed. Such frauds occur repetitively in the U.S. because the Securities and Exchange Commission (SEC), the Federal Reserve, the Comptroller of the Currency, the U.S. Treasury, the Federal Bureau of Investigation (FBI), or some other arm of the U.S. federal government have never officially recognized that cryptocurrencies are securities. As mentioned above, the Federal Reserve treats cryptocurrencies as if they were commodities, not legal tender. Since cryptocurrencies are not legally defined to be securities, they cannot be regulated under the existing U.S. securities laws [Macintosh (2021), Smialek (2021)].

4.3 Gemini Trust

An entertaining and informative 2010 movie named *The Social Network* reported the interesting 2004 campus activities of several Harvard undergraduates. The focus of the movie is Mark Zuckerberg's formation of Facebook and his interactions with the identical twins named Cameron and Tyler Winklevoss (portrayed by actors) when they were all Harvard students. The twins are of interest here because in 2015 they founded and still run a New York City cryptocurrency broker-dealer firm named Gemini Trust.

Gemini Trust brokers and deals in selected cryptocurrencies. In addition to making markets in various cryptocurrencies, the Gemini Trust also issues a stablecoin of its own called the Gemini dollar. The Gemini Trust seems to operate at a higher level of security and professionalism than most other cryptocurrency exchanges. Gemini complies with both the New York state and the U.S. digital asset regulations and consumer protection laws. As a result of these legal operating standards, Gemini Trust was able to obtain Federal Deposit Insurance Corporation (FDIC) insurance for the U.S. dollar (but not Gemini dollar) accounts of its clients.⁶

The collateral for the Gemini dollar is kept with a highly reputable third party, the State Street Trust in Chicago. Unlike Tether, both Gemini Trust and State Street Trust have audited financial statements to confirm that Gemini's collateral actually exists. The Gemini dollar runs on an Ethereum-based blockchain system. Unlike many other cryptocurrency operations, the Gemini Trust appears to manage the Gemini dollar ethically [Jain et al. (2019)]. As a result, the market price of the Gemini dollar floats within the narrow range between

U.S.\$1 and \$1.06. No U.S. commercial bank is allowed to accept Gemini dollar deposits. Thus, Gemini dollars are no more liquid than bitcoins or ethers.

Although tether is financially riskier than the fully collateralized Gemini dollar, tether is much more well-known within the cryptocurrency markets. One reason for this popularity is because tether enjoys a first-mover's advantage. Tether is an older stablecoin and its average daily trading volume of several billion exceeds the volume of the Gemini dollar. As a result, more cryptocurrency buyers are accustomed to dealing with the tether than with the Gemini dollar. In addition, many tether users are probably unaware of Tether Limited's unsavory past.

4.4. Three types of stablecoins

In this section, we describe three categories of stablecoins, each of which define their collateral differently.

4.4.1 STABLECOINS COLLATERALIZED BY FIAT MONEY

Many stablecoins claim to be backed by a fiat currency. The safest fiat-backed cryptocurrencies are collateralized by the U.S. dollar. Some of the most popular stablecoins that claim to be collateralized by U.S. dollars are tether (USDT), U.S. Dollar Coin (USDC), TrueUSD (TUSD), StableUSD, Dai (DAI), and the Gemini dollar (GUSD). Unfortunately, the Gemini dollar (GUSD) seems to be the only stablecoin that has verified the existence of some appropriate amount of collateral by allowing itself to be audited by a respectable auditor. Similar claims by competing stablecoins are unaudited and, as a result, are highly dubious.

4.4.2 CRYPTOCURRENCIES COLLATERALIZED BY OTHER CRYPTOCURRENCIES

Each BitShares coin, issued by BitUSD, claims to be worth one U.S. dollar. In fact, the BitUSD has at least 100 percent of its own outstanding cryptocurrency backed by BitShares core currency, BTS. This circular relationship provides no valuable collateral.

Havven issues nomin, which is a stablecoin backed by a portfolio of havvens. The value of havvens comes from transaction fees generated from nomin transactions that are paid into the portfolio of havvens. The value of nomin is supposed to be kept stable by the havven owners, who are supposed to be incentivized to manage the supply of

⁶ The FDIC is an independent federal agency of the U.S. government that insures U.S. dollar deposits in U.S. banks and thrift institutions if the bank fails. FDIC insurance covers checking and savings accounts, CDs, money market accounts, IRAs, trust accounts, and employee benefit plans up to a maximum of U.S.\$250,000 per client. But the FDIC does not insure any cryptocurrency deposits.



havens propitiously [Brooks et al. (2018)]. These claims have not been verified by a reputable auditor and are, therefore, suspect. Essentially, all cryptocurrencies collateralized by cryptocurrencies that have no fundamental value have no fundamental value either.

4.4.3 STABLECOINS COLLATERALIZED BY SOFTWARE

Instead of being backed by monetary collateral, some uncollateralized stablecoins are backed by a computer algorithm that makes dubious claims that it can execute transactions that will stabilize the stablecoins price fluctuations.

- **Basis:** after a short run, Basis shut down in December 2018. The market price of basis was supposed to be kept stable by a trading algorithm. When demand was rising, the blockchain was supposed to create more basis. This expanded supply was supposed to meet the rising demand and reduce the rising price. When demand for basis was falling, the blockchain was supposed to buy basis. The resulting contraction in supply was supposed to bid up the market price of basis [Reuters (2018)]. These claims were never demonstrated.
- **Carbon:** Carbon is supposed to operate like Basis. Carbon uses an algorithm named Hedera Hashgraph, which is significantly faster than the system used by Basis. The passage of time should reveal if the cryptocurrency market finds any value in Carbon.

- **USDVault:** the USDVault stablecoin is pegged one-to-one to the U.S. dollar. It is supposed to be backed by either gold bullion stored in Swiss vaults or U.S. dollars. USDVault takes a novel approach to maintaining stability. This stablecoin is supposed to stay gold-price neutral while maintaining a one-to-one peg to the U.S. dollar through a sophisticated gold hedging process that is administered by fiduciaries and financial partners. Since the ambitious claims supporting the USDVault stablecoin have not been supported by a respectable auditor they are considered to be doubtful.

The founders of many stablecoins and almost all cryptocurrencies do not provide any clear, audited proof that their collateral exists. Examination of whatever plans may be provided reveals they are exaggerated and unclear.

Various writers have evaluated the characteristics of cryptocurrencies [Cheun and Guo (2018)]. One favorable feature that cryptocurrencies provide is a structure that facilitates the creation of non-fungible tokens (NFTs) [Ostroff (2021a)]. However, few people have any desire to invest in this tiny new market segment. A second favorable feature is wealth creation. Some speculators have quickly accumulated significant wealth from a cryptocurrency and they like to brag about that. Numerous losers that do not brag about their outcomes also exist.

5. EVIL ASPECTS OF CRYPTOCURRENCIES

In its original form, the bitcoin is an ingenious concept. But some unethical developers have reconstituted cryptocurrencies in ways that are harmful. Unfortunately, the U.S. government has been painfully slow in regulating the development of cryptocurrencies.⁷

5.1 Inadequate collateral

The Gemini dollar appears more likely than the average stablecoin to actually be worth its face value. Tethers appear to have some value, but their collateral is likely to be worth significantly less than their face value. The majority of other stablecoins are worth significantly less than they claim too. And some stablecoins are worthless.

All cryptocurrencies that are not stablecoins are totally void of collateral. Popular cryptocurrencies like bitcoin achieve and maintain their positive market prices because many investors have FOMO (fear of missing out) and, as explained in the next paragraph, some bitcoin traders are unethical.

Schoar and Makarov (2021) have recently mapped and analyzed every transaction in bitcoin's 13 years of transactions and reported that only 0.01 percent of the bitcoin owners own 27 percent of the outstanding bitcoins [Vigna (2021b)]. Concentrated holdings like this might be called cornering the market, which is illegal in regulated commodity and security markets in the U.S. However, since the U.S. securities laws have not yet been applied to the cryptocurrencies, these unseemly behaviors in the crypto markets continue to go unpunished. Furthermore, Schoar and Makarov (2021) report that about 90 percent of all bitcoin transactions have no actual economic function that can be determined from the publicly available bitcoin transactions records. These research findings are troublesome.

5.2 A fundamentally flawed governance plan

A fundamental problem underlying stablecoins involves bad governance. Consider the fact that if a private party issues stablecoins and is responsible for providing collateral for these stablecoins, that manager has continual economic incentives to under-collateralize the stablecoins. In addition, the stablecoin issuer has an incentive to invest the collateral in risky assets that have higher expected returns. Thus, stablecoins are a fundamentally flawed, unstable arrangements that encourage some bad management practices.

5.3 “Privacy” attracts criminals

Cryptocurrencies offer “privacy” that criminals find essential for survival. For example, if a kidnapper, computer ransomware seeker, tax cheat, divorce settlement cheater, bank robber, or other criminal wants to hide U.S. dollars obtained illegally, the criminal's “dirty money” could easily be hidden by investing it in a cryptocurrency that keeps their identity private [for criminal aspects of cryptocurrency trading, see Lahart and Demos (2021), Osipovich (2021b), Vigna (2019b), Popper (2019), Vigna and Jeonmg (2019), Hirtenstein (2021), Yaffe-Bellany (2022b), Talley and Volz (2021)]. Income from cryptocurrencies is taxable in the U.S. But the U.S. government cannot collect taxes on “private” transactions if it cannot discover them.

5.4 Money records provide a valuable memory

The privacy of cryptocurrency transactions conceals much valuable information that should be made legally available to beneficiaries, creditors and other interested third parties.⁸ Law-abiding citizens prefer to transact in U.S. dollars because the U.S. check clearing system and related paper trails provide valuable information for police, regulators, and other interested third parties. In addition, a frequently cited research by Narayana Kocherlakota, former President of the Federal Reserve Bank of Minneapolis and a former Stanford University professor, argues that using U.S. dollars creates an audit trail [Kocherlakota (1998)]. This paper trail of money transactions provides a valuable chronological history of accessible records that can be used to determine causes and effects if a legal dispute or criminal investigation arises.

5.5 Significant environmental damage

As explained above, bitcoins, ethers, and many other cryptocurrencies are based on blockchain technologies that employ miners to verify every transaction. The mining process that accompanies most cryptocurrency transactions uses a massive amount of electricity to power the computers that verify every transaction. Electric generators that burn oxygen and create carbon dioxide are used to generate much of the electricity. The Cambridge Center for Alternative Finance (CCAF), for example, estimates the amount of electricity used by cryptocurrency miners to process only the world's bitcoin transactions has a market value approximately equal to the “energy draw of small countries like Malaysia or Sweden.” [Carter (2021), Ostroff and Yu (2021)] When the aggregate electrical cost of simply verifying and reverifying the world's

⁷ F. A. Hayek, a Nobel Prize winning economist, argued in favor of competing national currencies. He did not address most of the problems discussed herein.

⁸ Regulators have succeeded in uncovering crooked cryptocurrency transactions. For information about a recent U.S.\$2.3 million illegal bitcoin transaction that was uncovered and corrected see Volz et al. (2021). But most crooked transactions are not identified.

bitcoin transactions is considered, the negative impact that bitcoin mining has on the world's climate is troubling [Huang et al. (2021)].

5.6 Centralized mining

Bitcoins, ethers, and many other cryptocurrencies are based on a blockchain system that requires verification and re-verification of every transaction by a computer called a “miner” each time another cryptocurrency transaction occurs. Thousands of specialized computers (miners) compete to finish each verification process first and win the reward of 6.25 bitcoins, which has a current market value of roughly U.S.\$250,000 at current market prices. Over the years, this mining competition has evolved to the point where a few big “pools” of computers do most of the mining. The costs of this mining have become so high that only a small group of large firms can afford to do it [Economist (2022)]. These mining operations tend to centralize their locations in a few spots around the world where large amounts of electricity can be purchased cheaply. In 2022, these mining operations became such a problem in Russia that the government passed a law making cryptocurrency mining in Russia illegal. Some of the Russian bitcoin miners are now in the process of moving to Rockdale, Texas (population 5,600), where electricity is cheap and plentiful and the mayor welcomes new cryptocurrency businesses.

Two bitcoin mining firms named Bitdeer and Riot Blockchain are currently Rockdale's only miners, and they are both growing as fast as they can. While additional new cryptocurrency miners relocate to Rockdale, Riot Blockchain currently claims to be the largest so far with 100,000 computers on site. The electric grid for the state of Texas is deregulated and has ample power to sell, which makes electricity inexpensive in Texas. The state of Texas is a strong candidate to becoming the new central headquarters of the world's cryptocurrency mining industry.

5.7 Facilitating criminal activity

If a criminal has a large amount of cash or cryptocurrency in their electronic wallet, they can transfer this “dirty money” long distances to a recipient electronic wallet about as quickly and confidentially as the Federal Reserve could conduct a similar wire transfer between the bank accounts of non-criminals. The existence of cryptocurrencies and these developments in the cryptocurrency industry engenders criminal activity by facilitating electronic transfers of “dirty money.”

5.8 Law-abiding investors are scared away

Satoshi Nakamoto, who created the bitcoin in 2009, said that bitcoin was created to allow anyone to open a digital bank account and hold digital money in a way that no government could regulate [Nakamoto (2009)]. This innocent sounding goal overlooks some inconvenient realities. Actually, the privacy surrounding cryptocurrencies may entice criminals and scare away law-abiding investors who would prefer to have transparent transactions that generate paper trails that can be audited and policed.

Most cryptocurrency exchanges are only modest websites that sprung up in someone's home during 2016-2017. Some of these cryptocurrency exchanges have lost millions of dollars of their clients' money. For example, the following losses 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
- Coincheck lost U.S.\$534 million in 2018.

More recently, in February 2022, the U.S. government seized U.S.\$3.6 billion of cryptocurrency linked to the U.S.\$4.5 billion 2016 hack of the cryptocurrency exchange, Bitfinex.⁹ A married couple was arrested in this huge financial seizure. This arrest suggests law enforcement officers are sometimes able to recover stolen cryptocurrency. A Deputy Attorney General said the authorities captured the married couple by following the stolen funds as they were deposited and withdrawn in rapid succession while jumping between multiple forms of virtual currency exchanges and dark markets. When Satoshi Nakamoto was designing bitcoins in 2009 terrible events like these were probably never imagined.

5.9 Misleading transaction prices

Through no fault of the researchers, some of the cryptocurrency trades that researchers study and report do not always involve actual trades. For example, consider a hypothetical small sample of empirical data that has a mean daily return that is calculated from a sample of 132 large, frequently traded cryptocurrencies. If this sample of 132 selected observations

⁹ As discussed above in Section 4.2, in 2018-2019 two different cryptocurrency exchanges named Bitfinex and Tether Limited were both owned and operated by iFinex Inc. Tether (ticker: USDT) is a stablecoin that has become popular in spite of being inadequately collateralized.

happens to equal a small percent of the total population of cryptocurrencies, the sample mean statistic is very likely to be an unrepresentative estimate of the underlying population parameter. Fake transactions have also been reported [Vigna (2019b)].

In the more fool-proof research methodology mentioned above, Schoar and Makarov (2021) analyzed every transaction in Bitcoin's 13 years of transactions and reported that only 0.01 percent of the bitcoin owners own 27 percent of the outstanding bitcoins [Makarov and Schoar (2021), Vigna (2019b)]. Schoar and Makarov (2021) also report that about 90 percent of all bitcoin transactions have no actual economic function that can be determined from the publicly available bitcoin transactions records. These facts suggest that a few large bitcoin traders could be in a position that would make it possible for them to profit from manipulating bitcoin prices.

5.10 Essential governmental functions

Milton Friedman (1960) made a statement that is still relevant today. "Something like a moderately stable monetary framework seems an essential prerequisite for the effective operation of a private market economy. It is dubious that the market can by itself provide such a framework. Hence, the function of providing one is an essential governmental function on a par with provision of a stable legal framework."

6. CONCLUSION

Cryptocurrencies, as explained in Section 1, have only a small resemblance to the popular fiat currencies. Since they do not attempt to duplicate any of the popular fiat currencies, cryptocurrencies cannot be called counterfeit currencies. The two aspects of cryptocurrencies that make them unique are, first, they are a medium of exchange that operates through a computer network and second, that they are not reliant on a central authority. These are the qualities that were innocently stressed by Satoshi Nakamoto when the bitcoin was introduced in 2009.

Since 2009, unethically greedy people and criminals have, unfortunately, reconstituted and adapted bitcoins in ways Satoshi Nakamoto might not appreciate. Although bitcoins are still the predominant cryptocurrency, over 10,000 other cryptocurrencies have been developed in the U.S. The developers of over 90 percent of these newer cryptocurrencies took the proceeds from their initial coin offering (ICO) and disappeared. Several get-rich-quick stories are told and retold while numerous losers remain silent.¹⁰

¹⁰ For one of the few accounts of losses from cryptocurrency trading, see Yaffe-Bellany (2022a). The last half of the article discusses various problems cryptocurrency traders encounter.

REFERENCES

- Ackermann, E., C. Bock, and R. Bürger, 2020, "Democratising entrepreneurial finance: the impact of crowdfunding and initial coin offerings (ICOs)," in Moritz A., J. Block, S. Golla, and A. Werner (eds.), *Contemporary developments in entrepreneurial finance. FGF studies in small business and entrepreneurship*, Springer
- Alderman, A., 2018, "Sweden's push to get rid of cash has some saying, 'not so fast'," *New York Times*, November 21, <https://nyti.ms/3LXXDdj>
- Alderman, L., 2019, "Despite bitcoin's dive, a former Soviet Republic is still betting big on it," *New York Times*, January 22, <https://nyti.ms/3hbpafF>
- Andolfano, D., 2018, "Blockchain: What it is, what it does and why you probably don't need one," *Review*, Federal Reserve Bank of St. Louis 100, 2, 87-95
- Andriotis, A. M., 2021, "Crypto payment coming to credit cards," *Wall Street Journal*, October 26, p. B1
- Berensten, A., and F. Schar, 2018a, "A short introduction to the world of cryptocurrencies," *Review*, Federal Reserve Bank of St. Louis 100:1, 1-16
- Berensten, A., and F. Schar, 2018b, "The case for central bank electronic money and the non-case for central bank cryptocurrencies," *Review*, Federal Reserve Bank of St. Louis 100:2, 97-106
- Brooks, S., A. Jurisevic, M. Spain, and K. Warwick, 2018, *Haven: a decentralised payment network and stablecoin*, Version 0.8
- Browning, K., 2021, "Coinbase users got hacked. Then they got stonewalled," *New York Times*, March 27, p. B7
- Carter, N., 2021, "How much energy does bitcoin annually consume?" *Harvard Business Review*, May 5, pp. 1-6
- CBS News, 2021, "Crypto market 'rife with fraud, scams and abuse,' SEC chief says," August 3, <https://cbsn.ws/3LxQdLL>
- Cheun, D. K. K., and L. Guo, 2018, "A new investment opportunity?" *Journal of Alternative Investments*, 20:3, 16-40
- Eaglesham, J., 2021, "Coinbase insiders get roles guarding investors," *Wall Street Journal*, April 6, 2021, page B1
- Easley, D., M. O'Hara, and S. Basu, 2019, "From mining to markets: the evolution of bitcoin transaction fees," *Journal of Financial Economics* 134:1, 91-109
- Economist, 2021a, "The future of Banking," *Special report*, May 8, <https://econ.st/36sFUKC>
- Economist, 2021b, "Beating bitcoin: cryptocoins are proliferating wildly. What are they all for?" June 12, <https://econ.st/3LWKUYg>
- Economist, 2021c, "Decentralized finance," September 18-24, pp. 17-20
- Economist, 2022, "Build block better: is a greener, faster and more decentralised alternative to Bitcoin possible?" January 1, <https://econ.st/3pe7TEu>
- Francis, J. C., 2019, "Bitcoin, blockchain and cryptocurrencies," *Journal of Financial Transformation*, 49, 8-21
- Friedman, M., 1960, *A program for monetary stability*, Fordham University Press
- Griffin, J. M., and A. Shams, 2019, "Is bitcoin really un-tethered?," *Journal of Finance* 75:4, 1913-1964
- Hayek, F. A., 1976, *Denationalism of money*, The Institute of Economic Affairs
- Hirtenstein, A., 2021, "Hackers steal and return crypto," *Wall Street Journal*, August 12, pp. B1 and B4
- Howell, S., M. Niessner, and D. Yermack, 2019, "Initial coin offerings: financing growth with cryptocurrency sales," *Review of Financial Studies* 33, 3925-3974
- Hu, A. S., C. A. Parlour, and U. Rajan, 2019, "Cryptocurrencies: stylized facts on a new investible instrument," *Financial Management* 48:4, 1049-1068
- Huang, J., C. O'Neill and H. Tabuchi, 2021, "Bitcoin uses more electricity than many countries. How is that possible?" *New York Times*, September 3, <https://nyti.ms/3hgoYJs>
- Jain, P. K., T. H. McInish, and J. L. Miller, 2019, "Insights From bitcoin trading," *Financial Management* 48:4, 1049-1068
- Kiernan, P., 2021, "Crypto executives defend industry as Congress considers oversight," *Wall Street Journal*, December 8, <https://on.wsj.com/3lft5Qn>
- Kocherlakota, N., 1998, "Money is memory," *Journal of Economic Theory* 81:2, 232-251
- Kowmann, P., and C. Ostroff, 2021, "Traders want bitcoin losses back," *Wall Street Journal*, July 12, pp. 1-2
- Kroeger, and A. Sarkar, 2017, "The law of one price?" *Federal Reserve Bank of Philadelphia*, <https://bit.ly/3vEVVHX>
- Kuhn, T. S., 1962, *The structure of scientific revolutions*, University of Chicago Press
- Lahart, J., and T. Demos, 2021, "How crime is haunting bitcoin," *Wall Street Journal*, June 19-20, p. B14
- Lyons, R. K., and G. Viswanath-Natraj, 2020, "What keeps stablecoins stable?" *NBER working paper no. 27136*
- Macintosh, J., 2021, "Stable coins hark back to wild west of finance," *Wall Street Journal*, 28 May, pp. B1 and B11
- Makarov, I., and A. Schoar, 2021, "Blockchain analysis of the bitcoin market," *NBER working paper no. 29396*
- Michaels, D., 2021, "Digital-coin exchange penalized \$100 million," *Wall Street Journal*, August 11, pp. B10-11
- Nakamoto, S., 2009, "Bitcoin: a peer-to-peer electronic cash system," Nakamoto introduced bitcoins and the blockchain database, <https://bit.ly/33MtTPg>
- Ospovich, A., 2021a, "Peer trading rises in crypto sector," *Wall Street Journal*, May 25, p. B11
- Ospovich, A., 2021b, "Crypto scams target newbies, market pros," *Wall Street Journal*, June 8, pp. B1 & B11
- Ostroff, C., 2021a, "The cats that created the NFT explosion," *Wall Street Journal*, May 8-9, p. B8
- Ostroff, C., 2021b, "Tether lays out details about assets," *Wall Street Journal*, August 11, pp. B10-B11
- Ostroff, C., and E. Yu, 2021, "Cryptocurrency miners move out of China," *Wall Street Journal*, August 23, pp. B3-B4
- Ostroff, C., P. Kowmann, and D. Michaels, 2022, "SEC probes Binance's US Arm, affiliates of crypto exchange," *Wall Street Journal*, February 16, pp. A1-A2
- Popper, N., 2019, "Terrorists are turning to bitcoin to raise funds discretely," *New York Times*, August 19, pp. B1 and B2.
- Popper, N., and C. Li, 2021 "China is charging ahead with its digital currency," *New York Times*, March 2, pp. B1 and B5
- Rappeport, A., and J. Smialek, 2020, "Treasury to introduce rules on cryptocurrencies," *New York Times*, February 13, p. B6
- Reuters, 2018, "Cryptocurrency project Basis to shut down and return funding to investors," December 13, <https://reut.rs/3pfl7w6>
- Schoar, A., and I. Makarov, 2021, "Bitcoin's ultra-elite dominate its wealth," *Wall Street Journal*, December 21, pp. B1 and B4
- Smialek, J., 2021, "In a rush to rein in stablecoins," *New York Times*, September 18, pp. B1 and B4
- Talley, I., and D. Volz, 2021, "U.S. to target crypto use in random cyberattacks," *Wall Street Journal*, September 18, pp. A1 and A4
- Vigna, P., 2019a, "Two groups likely stole a billion dollars of crypto," *Wall Street Journal*, January 29, pp. B1-B2
- Vigna, P., 2019b, "Most bitcoin trading is faked, study finds," *Wall Street Journal*, March 23-24, p. B13
- Vigna, P., and E.-Y. Jeonmg, 2019, "Cryptocurrency scams took in \$4 billion in 2019," *Wall Street Journal*, February 10, p. B4
- Vigna, P., 2021a, "DeFi adds to crypto boom and volatility," *Wall Street Journal*, June 4, pp. B1 and B2
- Vigna, P., 2021b, "Bitcoin's 'one percent' controls lion's share of the cryptocurrency's wealth," *Wall Street Journal*, December 20, <https://on.wsj.com/3BLxpWG>
- Volz, D., S. Gurman, and D. Uberti, 2021, "Pipeline ransom money seized by US," *Wall Street Journal*, June 8, p. A4
- Vuillemey, G., 2020, "The value of central clearing," *Journal of Finance* 75:4, 2021-2053
- Yaffe-Bellany, D., 2022a, "Coin boom is drawing new traders and tokens," *New York Times*, February 7, pp. B1 and B3
- Yaffe-Bellany, D., 2022b, "No real names in crypto, please," *New York Times*, March 3, pp. B1 and B6

© 2022 The Capital Markets Company (UK) Limited. All rights reserved.

This document was produced for information purposes only and is for the exclusive use of the recipient.

This publication has been prepared for general guidance purposes, and is indicative and subject to change. It does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (whether express or implied) is given as to the accuracy or completeness of the information contained in this publication and The Capital Markets Company BVBA and its affiliated companies globally (collectively "Capco") does not, to the extent permissible by law, assume any liability or duty of care for any consequences of the acts or omissions of those relying on information contained in this publication, or for any decision taken based upon it.

ABOUT CAPCO

Capco, a Wipro company, is a global technology and management consultancy specializing in driving digital transformation in the financial services industry. With a growing client portfolio comprising of over 100 global organizations, Capco operates at the intersection of business and technology by combining innovative thinking with unrivalled industry knowledge to deliver end-to-end data-driven solutions and fast-track digital initiatives for banking and payments, capital markets, wealth and asset management, insurance, and the energy sector. Capco's cutting-edge ingenuity is brought to life through its Innovation Labs and award-winning Be Yourself At Work culture and diverse talent.

To learn more, visit www.capco.com or follow us on Twitter, Facebook, YouTube, LinkedIn, Instagram, and Xing.

WORLDWIDE OFFICES

APAC

Bangalore
Bangkok
Gurgaon
Hong Kong
Kuala Lumpur
Mumbai
Pune
Singapore

EUROPE

Berlin
Bratislava
Brussels
Dusseldorf
Edinburgh
Frankfurt
Geneva
London
Munich
Paris
Vienna
Warsaw
Zurich

NORTH AMERICA

Charlotte
Chicago
Dallas
Hartford
Houston
New York
Orlando
Toronto
Tysons Corner
Washington, DC

SOUTH AMERICA

São Paulo



WWW.CAPCO.COM



CAPCO
a wipro company