CHAPTER 9: BUILDING A SECURE FUTURE, ONE BLOCKCHAIN AT A TIME

- The *Report* estimates the substantial direct costs and longer-term indirect loss incurred to the economy and critical infrastructure from cyberattacks and threats. The *Report* suggests blockchain as a potential tool for securing America's digital infrastructure.

- Blockchain technology—providing cybersecurity and many other potential benefits—broke into the mainstream in 2017 driven by widespread interest and surging valuations in digital currencies such as Bitcoin and Ethereum.

- These new innovations and markets presented America's regulatory and legislative institutions with unique challenges as well as technology that could revolutionize the world's digital landscape and economy.

INTRODUCTION

The *Report* reviews the new digital threats facing America today. Ensuring the security of computers, the internet, networks, and infrastructure is an enormous task, and the *Report* estimates the costs incurred from cyberattacks. As methods of theft, espionage, and vandalism shift from physical toward virtual—including data and intellectual property—law enforcement's role in fighting property crime remains vital. The economy benefits from protecting private property and contract integrity.

This chapter of the *Response* discusses a particular technology—blockchain—that is not only nearly invulnerable to cyberattack but

is revolutionizing the way the world conducts commerce and shares information.

THE YEAR OF CRYPTOCURRENCIES

Many significant economic events stand out in 2017—passage of tax reform, regulatory reform, the continued drop in unemployment and the emergence of cryptocurrencies should be listed among them. Sensational headlines and intense fascination drove "Bitcoin" to second place as a global news topic in Google's Year in Search 2017.[403] As shown in Figure 9-1, "Bitcoin" searches skyrocketed, and "blockchain" and "Ethereum" moved out of relative obscurity.

Figure 9-1
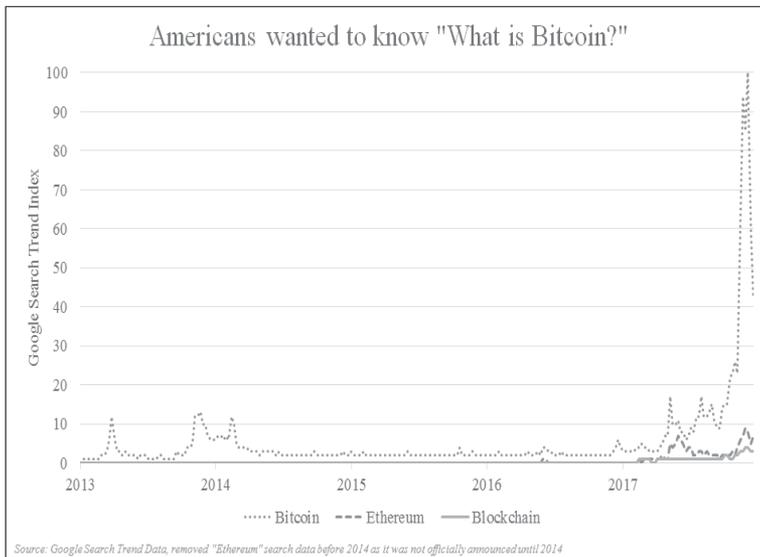
In addition to the surge in searches, the price of many cryptocurrency and blockchain assets skyrocketed. The Dow Jones Industrial Average (DJIA) started 2017 over 19,881 points and grew 24 percent to 24,719; the S&P 500 grew by more than

17 percent.[404] Yet, while both stock market measures experienced strong growth, cryptocurrencies dwarfed their performance.

Bitcoin started 2017 at a price just under $1,000 per bitcoin and finished well over $12,500 per bitcoin, an appreciation of over 1,100 percent. During that period, Bitcoin topped out over $19,000 per bitcoin. The second largest cryptocurrency, Ethereum, did even better. At the beginning of 2017, ether (Ethereum's currency) was worth under $10. By the end of 2017, ether shot up to over $719, an astronomical appreciation of 6,713 percent.[405] Stock market gains seem meager in comparison (Figure 8-2).

The buzz surrounding digital currencies resembles the internet excitement in the late 1990s when people recognized technology companies could change the world. Many internet companies launched and their valuations took off in short order. Many failed, but a few succeeded spectacularly and challenged the conventional ways of doing business. For example, people considered GeoCities the "home page" for individuals and Yahoo bought the company for $3.57 billion in 1999.[406] GeoCities had characteristics similar to Facebook today (or MySpace in the early 2000s), but it never came close to Facebook's reach and remained unprofitable. A company that did eventually succeed is an online book retailer called Amazon.com, but along the way its price gyrated with stock splits and recessions.[407]

Figure 9-2

Cryptocurrencies made stock market gains look insignificant

Source: CoinDesk, St. Louis Federal Reserve, DJIA Stands for "Dow Jones Industrial Average"
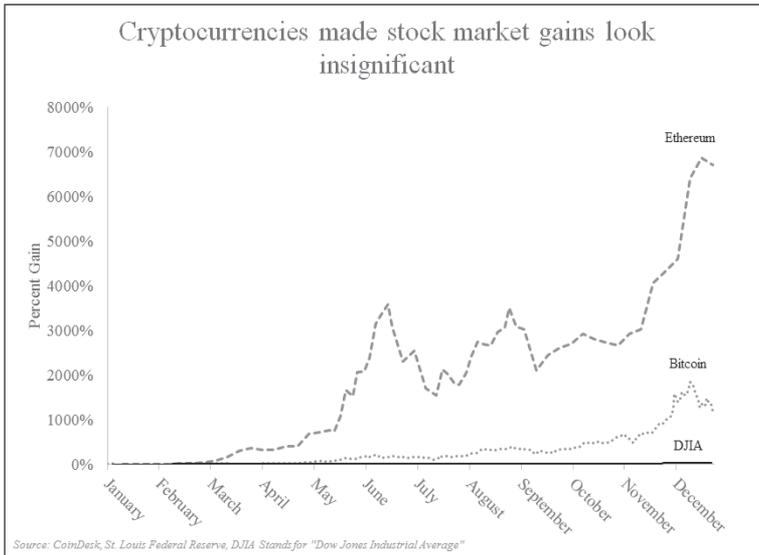
Surging prices also drove up cryptocurrency market capitalization. At the beginning of 2017, the total value of all bitcoin in circulation was almost $15.5 billion, but by year's end it increased almost 14-fold to over $216 billion. Other cryptocurrencies such as Ethereum, Ripple, and Litecoin experienced similar gains. Ether's total circulating value multiplied by 98 from just under $700 million to over $68 billion. Ripple's market cap multiplied by an even larger 342 from $237 million to over $81 billion. Finally, Litecoin lost its position as the third-largest cryptocurrency in 2017. It still grew robustly but increased to just 55 times its original market cap of over $212 million, to well over $11 billion.[408]

Figure 9-3

Cryptocurrencies hit a growth spurt

Source: Coinmarketcap.com — Coin Market Cap from January 1, 2017 to December 31, 2017
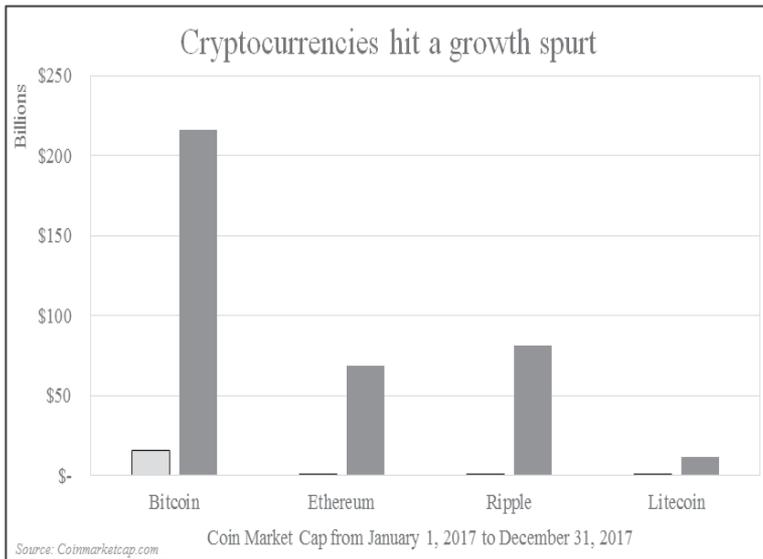
WHAT ARE CRYPTOCURRENCIES AND BLOCKCHAIN?

Blockchain is the distributed ledger technology that underlies digital currencies such as Bitcoin. A ledger is the accounting tool that tracks the movement of money from one person or account to another. Conventionally, such records are stored in central locations like banks, headquarters, and Paypal servers. Blockchain revolutionizes ledger technology with a network of distributed ledgers. Instead of one central, authoritative record of all transactions or information, blockchain creates potentially thousands of identical ledgers in computers and servers all over the world.

In "permissionless" proof-of-work blockchain, people compete to validate each transaction in return for a reward. The protocol rewards users for creating and validating entries into the ledger. This reward creates an incentive for competition and gives these validators ("miners" see Box 9-1) new tokens to use in the system. Users who do not earn tokens by performing verifications, i.e., not

"miners," must buy the tokens. This interplay between miners and purchasers create an ecosystem where people have clear incentives and rewards to maintain the distributed ledger for everyone.[409]

Bitcoin was the first blockchain. Bitcoin's network creates a new record of verified transactions approximately every ten minutes and packages the records into a so-called "block". Ethereum is the second-largest cryptocurrency in the world, and though it uses the same blockchain technology as Bitcoin, it serves different purposes. While Bitcoin's blockchain records each transaction in its currency, Ethereum records results from the programs users upload to its network. It allows programmers to create applications and "smart contracts" that utilize computing power from Ethereum's network to execute them.[410] This brings the decentralized security of blockchain to computing power, while allowing developers to build applications, smart contracts, and other digital coins on top of Ethereum. Additionally, it uses the same proof-of-work mining that Bitcoin does, but its network produces a block every 12 to 15 seconds and rewards its miners three ethers per block, with additional rewards for solutions found but not included.[411]

Box 9-1: Bitcoin Mining (Proof-of-Work)

Each block contains data related to Bitcoins sent and received, as well as digital signatures using cryptographic keys, by which each party confirms its agreement to a transaction. Each block is chained to the previous block, as computers throughout the network confirm its validity and solve a complex cryptographic proof. Solving this proof requires immense energy consumption, deterring other computers from spamming the Bitcoin network.[412] Once a block is in the chain, it can never be removed or altered and will be there for everyone on the network to see. The protocol then begins working on the next block in the chain.

The process is called mining using a proof-of-work method.[413] Essentially, users on the network have to prove that they constructed a block and solved the cryptographic proof. The Bitcoin protocol adjusts the difficulty of the proof to ensure a new block approximately every ten minutes. The users who successfully mine a new block are allowed to reward themselves with new bitcoins. The rewards dwindle based on the number of blocks in the chain. Thus, the only revenue miners can earn will come from the transaction fees.[414] The mining process varies among cryptocurrencies.

Are Digital Currencies Actual Currencies?

Blockchain technology could compete with existing mechanisms, goods, and services. Its initial application as a payment medium prompted questions about whether it might replace national currencies and challenge the U.S. dollar. While skyrocketing cryptocurrency prices impress, economists question whether these new digital technologies should be considered currencies. Currencies serve three functions: medium of exchange, unit of account, and store of value. A medium of exchange is something people willingly accept for goods and services. People willingly accept the medium of exchange because they believe it can be used for other transactions. A unit of account is a measure people use to post prices. A currency provides a common measurement unit of pricing, enabling direct comparisons across different products or services. Finally, a store of value is something that individuals can use to transfer purchasing power over time. A currency will not be the only store of value in an economy. Many items can potentially store value, but money normally maintains relatively stable purchasing power over time and individuals expect it to remain an acceptable medium of exchange in the future.[415]

At this point, many prominent economists do not believe cryptocurrencies fit the standard definition of money. Former Federal Reserve Chair Janet Yellen considered Bitcoin a "highly speculative asset" that is not considered legal tender.[416] Bitcoin itself has technical and economic limitations that hinder its use as a medium of exchange. Transaction processing time and fees on the Bitcoin network keep increasing and render Bitcoin uneconomical for common purchases. According to one report, Bitcoin transaction fees averaged $28 in December 2017 and processing time reached an average of 19.8 hours.[417] This was at the height of Bitcoin's popularity in 2017 and highlighted the limitations of its underlying protocol. Bitcoin's current design can only process about seven transactions per second, while Visa or Mastercard can process thousands. The debate over scalability deeply divides the Bitcoin community. Ethereum experienced similar problems, but underwent a planned and substantial upgrade in October of 2017 that improved its processing time.[418] If Bitcoin or other digital currencies can improve their underlying protocols or find off- chain solutions, they could speed up processing time and reduce transaction fees.

Extreme volatility in the dollar price of cryptocurrencies also impairs their use as money because people price goods and services in dollars and thus their purchasing power fluctuates wildly. For example, the price of pizza could move from a fraction of a bitcoin to thousands of them in a short time.[419] In order to value items in terms of bitcoin, ether, or ripple, the dollar exchange values of these units would have to stabilize. The dollar loses about two percent of its value per year due to inflation, but its purchasing power loss is modest and predictable so people can incorporate it in their decisions. If digital currencies become less volatile in the future, valuing items in those denominations could become easier and individuals might begin using them more frequently as a medium of exchange.

Some critics of currencies controlled by government fiat welcome cryptocurrencies because their supply is preprogrammed and perceived as unchangeable.[420] For example, only 21 million bitcoins will ever be issued and the last fraction of a bitcoin will be issued in approximately 2140.[421] Additionally, the creator of Ethereum designed its mining reward to decline exponentially as more miners create blocks, and according to his calculations the supply will be just over 100 million ether.[422] The volatility of digital currency values has not resulted from variability of their supply,[423] as was the case with the Venezuelan bolivar, which lost essentially all its value in less than a year;[424] rather, the value fluctuations of digital currencies stem from the demand side.

In 2017, demand for these assets spiked, leading to the significant price appreciation. Whether digital currencies hold their value will depend upon whether they offer benefits in terms of ease of use and accessibility, low transaction costs, security, anonymity, and other considerations in sufficient degree relative to conventional currencies and other stores of value such as gold. Venezuelans bought Bitcoin in increasing amounts recently, presumably because their national currency lost value and the government imposed capital controls. In this sense, cryptocurrencies resemble real assets or commodities more than currencies, though their future role could expand to include functioning as mediums of exchange.

Initial Coin Offerings

A new market formed around blockchain startups, called Initial Coin Offerings (ICO). An ICO allows developers to raise funds for a project by issuing tokens to use on that project. For example, if a group of economists wants to exchange papers, research, analysis, and review or editing services, developers would create an online platform to allow each person to have an account for

conducting these activities. Before blockchain, such a site would usually use outside payment systems such as Paypal or Visa to process transactions, but in this example, users could transact with hypothetical scarce tokens called EconoCoins.[425]

The second element would be a "smart contract." While smart contracts might sound new, the concept is rooted in basic contract law. Usually the judicial system adjudicates contractual disputes and enforces terms, but it is also common to have another arbitration method, especially for international transactions. With smart contracts, a program enforces the contract built into the code. Using the EconoCoin example above, if economist A wants economist B to edit her paper, economist B agrees and both create a smart contract that will reward economist B with EconoCoins from economist A's wallet upon delivery of edits. The network will enforce the contract without a third party, but the two economists can also build in a provision that would enlist others in the network to resolve disputes for a fee.

The developers and economists in this example do not need an influx of outside capital to begin the project. With an ICO, the creators explain the concept to potential users and offer for purchase initial coins that can be used in the network. Platform users would utilize the coins on the network to obtain the services or goods listed above.

An ICO consolidates two important elements of building a new economic ecosystem, obtaining funding and creating a network. ICOs do not offer equity and are much less expensive than an Initial Public Offering (IPO). PricewaterhouseCoopers estimated that an IPO costs companies between four to seven percent of the capital raised and an additional $4.2 million in accounting costs. Further, after surveying chief financial officers, PricewaterhouseCoopers found that companies spend between $1 million and $2 million annually on maintaining their status as a

publicly listed entity.[426] These costs help explain why only the largest of companies go public.

In contrast, developer Merunas Grincalaitis estimated that an ICO would take three months and cost approximately $60,000. A third of this cost comes from legal fees to ensure the ICO complies with relevant laws.[427] Once up and running, these platforms continue to raise funding for upgrades and maintenance through either transaction fees for verification, appreciation of the tokens, or donations. During 2017, developers launched hundreds of ICOs and investors realized their potential. Most new tokens utilized the Ethereum blockchain to launch their tokens and execute their code.

As shown in Figure 9-4 below, the enthusiasm led to an explosion in capital flowing into the ICO market. Before 2017, developers raised just under $300 million in funding for ICO projects. Although this number may seem high, it is misleading. Approximately $152 million of these funds went into the infamous Decentralized Autonomous Organization (DAO) which eventually shut down and returned a portion of those funds (more details below). During 2017, developers raised over $5.3 billion for new token companies. Such capital includes a plethora of projects and ideas. For example, FileCoin, a blockchain intended to decentralize cloud storage away from Amazon and Google, raised $262 million to move forward with its vision. Many of these projects will likely fail, as most startups do, but the ones that do survive could transform the way the internet and technology works for decades to come.

Figure 9-4

Capital Raised through ICOs exploded in 2017

Source: CoinDesk ICO Tracker
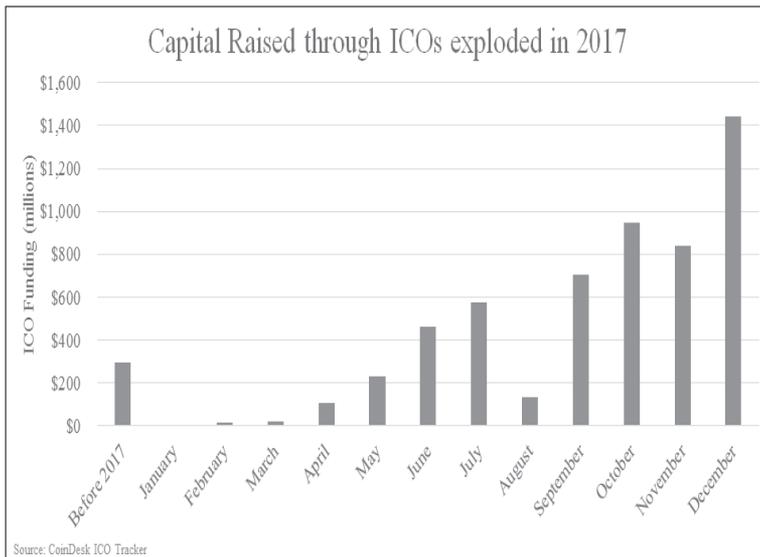
Blockchain Innovations

Cryptocurrencies and ICOs create headlines, and the pace of financial innovation in the blockchain space amazes skeptics. Yet, with all the headlines focusing on the financial applications, people may miss the digital revolution now happening with other blockchain applications. Even worse, people could be frightened about new developments with the technology as they associate blockchains with the negative headlines. Blockchain technology offers a decentralized, secure, and efficient way to store almost any form of data across multiple platforms. Developers, companies, and governments recognize the potential and have already starting to implement blockchains for many different uses.

For instance, health care providers, patients, and policymakers continue searching for portable and secure ways to store medical records digitally. On a Joint Economic Committee podcast, Committee member Representative David Schweikert described

how health care companies are already researching blockchains as a secure way to keep medical records on personal smartphones or within provider networks, and what this advance could mean for America's future:[428]

> [M]edical records have no value if they don't move with you. So think of if I could put my medical records on a blockchain where just like on many phones, I could use my thumbprint and a password and with a certain type of encryption…It would be HIPAA [Health Insurance Portability and Accountability Act, which includes patient privacy protections] compliant. Now all of a sudden you and I and the rest of society can carry their medical records on their phone.[429]

Unlike many innovations that attempt to skirt laws or regulations and become associated with the underground, these new blockchain products attempt to comply with the current system and even work together with regulators. The new products range from coordinating payment (healthnexus),[430] monitoring and rewarding patients for following clinical recommendations (RoboMed Network),[431] tracking pharmaceuticals along the supply chain (MediLedger),[432] and even identifying specific supply chain problems such as those associated with the opioid crisis (BlockMedx).[433]

On the regulatory side, Representative Schweikert currently coordinates with institutions like the Massachusetts Institute of Technology and the National Institute of Standards and Technology (NIST) to develop encryption standards that would protect Americans' private medical data.[434] Further, in 2016 the United States Department of Health and Human Services (HHS) announced the "Use of Blockchain in Health IT and Health-Related Research" Ideation Challenge.[435] The initiative requested

white papers examining how blockchain technology could change health information technology. Researchers submitted 77 papers and 15 won awards from their work.[436]

From applications ranging from management of the electrical grid and utilities to how companies manage global supply chains, the potential for blockchain is truly revolutionary. For example, power plants could record the electricity they generates on a blockchain as available for purchase. Utilities could then purchase the power, and the blockchain would record the purchase and the transfer. Finally, the meters of end users would communicate with the utility to purchase portions of the power. These steps occur now but using a distributed ledger would streamline and speed up delivery, lowering costs and saving power.

Blockchains could also enable microgrids from local power sources. The company LO3 Energy currently runs a pilot program for trading power from solar panels on Brooklyn roofs. Smart meters throughout the neighborhood would buy and sell power generated from these alternative sources as it enters the grid.[437] With these developments and countless possibilities, it is no surprise that governments around the world started working with energy providers to explore blockchain's use.[438] Even the Department of Energy partnered with BlockCypher to demonstrate how blockchains could facilitate a smarter energy grid.[439]

Shipping a product from a supplier to retail creates mountains of paperwork or computer records that are rarely compatible across differing systems, especially a when distributor acts as a middle-man between the two. The paperwork and data tracking multiplies when sending said product overseas or importing. Not only will multiple parties need to ship the product, but the supplier and customer will have to deal with customs agency paper work. Recognizing blockchain's potential, IBM teamed up with the

world's largest shipping company, Maersk, to develop a consensus distributed ledger that would allow all companies and government agencies along the chain to record, track, and verify products throughout their journey.[440]

Walmart and other grocers started testing blockchains for their supply chains. In testimony before the House Science and Technology Committee, Frank Yiannas, Walmart's Vice President of Food Safety, described how tracking E. coli and other contaminated food took companies and regulators weeks, which left Americans at risk and incurring large costs in food waste. Walmart tested a blockchain platform to track sliced mangos from farm to shelves and reduced the tracking time from 7 days to 2.2 seconds. Walmart and ten of the largest grocers in America formed a coalition to implement this technology throughout their supply chains.[441]

Growing Pains and Misuses

The potential for theft remains a problem but not due to the structure of blockchain. No evidence exists of anyone hacking blockchain's underlying protocol, but digital currencies are still vulnerable to theft. Users keep their currencies on digital "wallets" stored as files on a computer. For many, this could be a technical barrier deterring them from directly using the tokens. Centralized exchanges and internet services emerged to solve this hurdle where users could buy, sell, and store their virtual currency on that site. The most well-known American example is the site Coinbase. However, using an exchange to store ones' digital assets increases the risk of theft. When individuals keep their digital asset in a single "wallet," the only way to access it is by knowing their private key. But with online exchanges that pool multiple assets into much larger "wallets" to facilitate trading, many people will have access to those funds.

Although Coinbase and other exchanges earned reputations for security, a few early exchanges did not. The most infamous theft occurred on the Mt. Gox exchange. This early Japanese exchange allowed users to create accounts and store Bitcoin. In 2014, bad actors gained access to Mt. Gox's main wallet and transferred hundreds of millions of dollars' worth of Bitcoin to their account. Mt. Gox's system was so flawed that a user accidently entered a negative symbol under payment and the site credited him with extra bitcoin. After multiple thefts and the arrest of the owner, the site was shut down.[442] Users in a cryptocurrency exchange must remember that they are putting their trust in the security of that entity in a manner similar to depositors in early banks.

In July 2017, YouGov polled internet users about what they believed people mainly used cryptocurrencies to do. While just under 40 percent said they did not know, almost a quarter said these currencies were used for illegal transactions. Anecdotal reports furthered this sentiment as sites such as Silk Road, an online marketplace for illicit drugs, publicized Bitcoin's use for the transactions.[443] Recently economists estimated that approximately 25 percent of all users conduct illegal transactions on Bitcoin, and while the proportion of transactions for illegal purposes fell, the absolute level remained at an all-time high in April 2017.[444]

The rapid appreciation in value of cryptocurrencies and ICOs contributed to the doubt and unease about blockchain technology. *The New Palgrave Dictionary of Economics* defines price bubbles as "asset prices that exceed an asset's fundamental value because current owners believe they can resell the asset at an even higher price."[445] Nobel Prize Winners Eugene Fama and Robert Shiller disagree on the reasons for an asset's value.[446] The former maintains that markets always set efficient prices based on the information available. The latter claims that, at times, irrational

decisions can determine prices. With new kinds of investments, detailed information about the product will likely be hard to find or could be manipulated. This makes establishing the fundamental value difficult. Investors will estimate the possible future value, but with only unreliable and changing information to go on, their valuations fluctuate. Market participants will rationally speculate to varying degrees and the price reflects the "best guess" of future value. Still, Robert Shiller would note that "irrational exuberance" could take hold and drive up asset prices beyond reasonable estimations of fundamental value, which eventually leads to a rapid downward correction. "Bubble" sceptics will point out that no one can identify bubbles *a priori* with any consistency.[447]

Blockchain's market reception fits the pattern of a new, not fully understood technology. Within the financial community, it is a running joke that adding "blockchain" to a company's name, prospectus, or business plan will drive up the stock price. A recent example of this phenomenon is the unprofitable New York-based Long Island Iced Tea Corporation, which specialized in selling non-alcoholic beverages. With the NASDAQ threatening to delist the publicly traded company, it changed the name to Long Blockchain Corporation.[448] As Figure 9-5 shows, the stock price skyrocketed after the announcement and closed at a price three times the higher value.

Figure 9-5

"What's in a name?" Try "Blockchain"
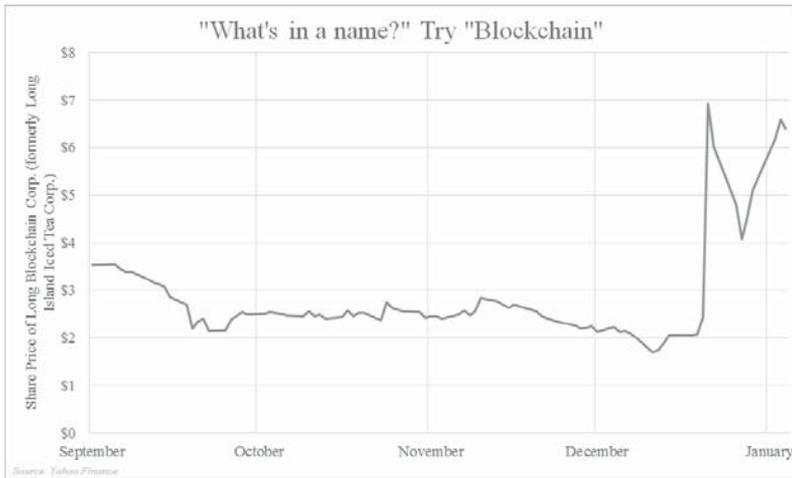
Outside what may seem an obvious attempt at cash grabs, observers will point to other warning signs such as Useless Ethereum Token (UET) and DogeCoin. The creator of UET advertised the coin with the following: "The UET ICO transparently offers no value" and "Might be secure, definitely not audited."[449] The ICO still raised $336,038 and issued almost 4 million tokens. DogeCoin's recent rise raises similar concerns. In 2013, Jackson Palmer created a "joke" cryptocurrency called DogeCoin as a parody of many alternative currencies started at that time and to raise awareness about cryptocurrencies generally. A year later, scammers fleeced millions from the DogeCoin community, and users including Jackson Palmer left as enthusiasm and good will evaporated.[450] Prior to 2017, the highest market capitalization was just over $89 million in February of 2014. As enthusiasm grew, DogeCoin expanded to almost $2 billion in market capitalization.[451]

REGULATORY QUESTIONS

Cryptocurrencies, ICOs, and their exchanges present novel regulatory challenges. Their rapid ascension led to instances of

new products running afoul of America's current regulatory framework. This demonstrated how certain regulatory environments are simply out of touch with the internet age. The market expanded with a light regulatory touch, but its explosion in 2017 and the well-publicized nefarious actions in this space prompted regulators to act. Further, American regulators spent years convening working groups, watching developments, and conducting research to ensure they understood how these technologies operated and how they could be regulated. Rather than covering the plethora of regulatory challenges cryptocurrencies and blockchain present, this *Response* will focus on securities regulations, money transmission laws, taxation definitions, and possible future regulatory action.

Securities Regulation

ICOs developed so rapidly, as shown in the above in Figure 9-4, that many innovators did not ask the question, "Is this a security that would need to be registered with the Securities and Exchange Commission (SEC) or other regulators?" The most well-known example is Ethereum's Decentralized Autonomous Organization (DAO). The DAO was a digital organization that allowed users to contribute ether to a pool that would be invested in proposed projects based on a vote. The amount contributed would determine how many votes a user had. The DAO launched its tokens on Ethereum's blockchain as an open source program in May 2016 and attracted 14 percent of all ether created at that point.[452] Within a month, someone exploited a flaw in the code and stole over $50 million in ether.[453] This caused Ethereum's value to drop and eventually led to shutting down the DAO and a splitting of the currency to return the ether to its original owners before the DAO.[454]

The DAO represented amazing innovation in democratized finance, but its operation certainly seemed as if it were similar to a mutual or hedge fund. If so, then it should have registered as a security with the SEC. The SEC launched an investigation into the DAO to determine if it should have been defined as a security subject to SEC regulation. The normal test for this purpose is considered the Howey Test, named for a case the SEC brought against a 1946 orange grove.[455] Peter Van Valkenburgh summarizes the test as four prongs:

> *A [security] for the purposes of the Securities Act means a contract, transaction or scheme whereby a person…*
>
> - *invests his money in*
> - *a common enterprise and is led to*
> - *expect profits*
> - *solely from the efforts of the promoter or a third party*[456]

The SEC found the DAO should have been defined as a security under this test.[457] Since this ruling, the SEC started pursuing more enforcement actions against new tokens for both securities registration issues[458] and fraud.[459] Additionally, SEC Chairman Clayton started warning against unregistered securities offerings, fraud, and pursuit of superficial name changes such as the one undertaken by Long Island Iced Tea.[460]

Market innovators knew securities regulators would scrutinize both the potential fraud and securities registration. A group of participants joined in brainstorming an industry standard for future token launches.[461] The agreement they launched was called the Simple Agreement for Future Tokens (SAFT).[462] The SAFT acknowledges that presale tokens before a network operates should be considered a security available for accredited investors.

Once the network is running, the tokens would be available to the public as utility tokens and not classified as securities. Using the EconoCoin example, the token sales to raise funds for the project would be considered a security. Once the project was up and running, those tokens would then be available to the public and not a security. SEC Chairman Clayton has yet to comment on the SAFT proposal, but it exemplifies the good actors within a market working to root out fraud and ensure that new innovations comply with existing regulations.

Taxation

Securities regulations are not the only federal rules challenged by the innovation of cryptocurrencies challenge. Bitcoin's rise introduced an ever-growing question about how these assets should be taxed. For example, dollar fluctuations are not taxed. If a person held cash for a number of years and the purchasing power went up relative to other currencies, the appreciation would not be considered taxable if the dollar is later exchanged for foreign currency. However, the tax code treats foreign currency as property rather than currency.

If foreign currency is received as part of a business transaction, it is considered ordinary income and must be reported as a dollar value at the time it is received. If the currency then appreciates before the foreign currency is actually exchanged for dollars, the appreciation is treated as a capital gain and subject to capital gains taxes. If the taxpayer is an individual and not a business and holds foreign currency for an investment, the gains when the currency is converted to dollars are considered capital gains. However, if an individual is not holding foreign currency as part of a business or an investment—as often occurs in foreign travel—then up to $200 in appreciation is exempt from taxes and any additional amount is capital gain.

This distinction made participants wonder if cryptocurrencies receive the same treatment. In 2014, the IRS recognized the need for clarity and issued a guidance document to answer frequently asked questions and request further comments on the issue. Like foreign currency, the IRS classified virtual currencies as property and not currency, but noted they should not be considered foreign currency for tax purposes. Similar to foreign currency, taxpayers who receive digital currency as payment for goods and services must treat it as ordinary income and report the fair market value in dollars, and any appreciation after that point as capital gain when exchanged for dollars. Additionally, taxpayers who hold virtual currency as an investment must treat appreciation like capital gain. However, the $200 exemption that applies to personal foreign currency transactions does not appear to apply to virtual currency. Hypothetically, if a person paid a coffee shop for a cup of espresso with a virtual currency, that person would need to track the basis and fair market value of each small transaction like this to determine gain or loss in the virtual currency. Additionally, the IRS clarified that mining awards should be included in users' gross income.[463]

While the guidance provided some clarity, it left many unanswered questions that prompted comments requesting clarification. For example, the American Institute for Certified Public Accountants (AICPA) noted that while the IRS indicated fair market value could be obtained from exchanges, it did not specify which exchanges should be used. Further, AICPA pointed out that tracking basis and fair market value in very small transactions would create an enormous compliance burden for users without significantly affecting the total gain or loss in virtual currencies.[464] The IRS has agreed to better coordinate virtual currency.[465]

The larger issue for virtual currency market participants is that the absence of guidance could expose them to enforcement actions later if rules are applied retroactively. Such a situation could freeze investment and exploration into new virtual currencies, especially for smaller transactions such as coffee purchases. Representative Schweikert, along with Colorado Representative Jared Polis, introduced the Cryptocurrency Tax Fairness Act of 2017.[466] The bill would essentially create a *de minimis* reporting exemption for virtual currency purchases under $600.[467] The bill has yet to become law, but as virtual currencies' popularity and technical abilities improve, more bills on this topic will likely be introduced.

Money Transmission

One of the more vexing questions cryptocurrencies created involve money transmission laws. Money transmitters are entities that take money from one customer and give it to another; common examples include Western Union and MoneyGram. As explained by Peter Van Valkenburgh, historically, States regulated and licensed money transmitters. These licensure regimes were intended to protect customers if the funds were lost or stolen. However, State licensing requires those operating across State lines to obtain a license to operate in all States and territories except Montana.[468] Normally, many take the federalist view on state laws and regulations.[469] From this perspective, States can experiment with new and novel policies and if citizens do not like it, they can move to another State. It also gives State policymakers flexibility to craft new policies that might better fit their circumstances than a uniform national policy.

Cryptocurrency and ICO emergence challenged the "states as laboratories" view on these licensing regimes. Every cryptocurrency exchange or ICO is "global on day one." This means once launched, anyone around the world can access the site and potentially use its services. Using the example of EconoCoin

above, when the new token launches the sites that traded the token for money—including the launch site itself—might theoretically have needed a license in every State. This would deter investment and research into new innovative products.

Market participants and organizations proposed multiple ways for a path forward. The Uniform Law Commission, a nonpartisan commission focused on creating consistent state laws, drafted and approved legislative text that would clearly define what virtual currency businesses need to file as money transmitters.[470] States would still need to enact the proposed legislation, which would likely take years. This delay caused others to recommend Federal alternatives. Peter Van Valkenburg listed various options, including creating a "passporting" regime similar to the European Union or Federal preemption of State transmission laws.[471] None of these solutions would be perfect, and all should undergo rigorous cost-benefit analysis.

Future Regulatory Questions

Solving the challenges cryptocurrencies and blockchains present will require unique solutions that balance the needs of consumer protection, security, and entrepreneurship. While it is impossible to determine precisely which rules, regulations, and guidance will result from this process, one thing is certain. Regulatory agencies will need to coordinate to ensure they do not work at cross purposes. America is already subject to a complex set of regulatory institutions governing financial products and transactions. As Perianne Boring of the Chamber of Digital Commerce highlighted, this regulatory web produced four different classifications of digital assets (commodity, security, currency, and property),[472] which is not conducive an environment where entrepreneurs are enthusiastic about launching a startup.

Regulators recognized the need for coordination. In the *Wall Street Journal*, SEC Chairman Jay Clayton and Commodities Futures Trading Commission Chairman J. Christopher Ginacarlo noted:

> *The CFTC and SEC, along with other federal and state regulators and criminal authorities, will continue to work together to bring transparency and integrity to these markets and, importantly, to deter and prosecute fraud and abuse.*[473]

Outside the financial space, as noted above, other executive agencies such as NIST and HHS continue working towards standards that promote compliance without needlessly halting innovation. For cryptocurrencies and blockchain to further thrive, policymakers will need collaborative and innovative solutions that set the rules of the game without overly prescriptive regulations that constrain this emerging technology from reaching its full potential

CONCLUSION

Technology presents evolving challenges and generates new solutions. Blockchain technology essentially stores and transmits data securely, in large volume, and at high speeds. So far, the technology has proved largely resistant to hacking, and given this feature, developers first applied it to digital currencies. Yet blockchain has many more potential applications, such as portable medical records and securing the critical financial and energy infrastructure that the *Report* identified.

Recommendations

➢ Policymakers and the public should become more familiar with digital currencies and other uses of blockchain

technology, which have a wide range of applications in the future.

➢ Regulators should continue to coordinate among each other to guarantee coherent policy frameworks, definitions, and jurisdiction.

➢ Policymakers, regulators, and entrepreneurs should continue to work together to ensure developers can deploy these new blockchain technologies quickly and in a manner that protects Americans from fraud, theft, and abuse, while ensuring compliance with relevant regulations.

➢ Government agencies at all levels should consider and examine new uses for this technology that could make the government more efficient in performing its functions.

https://paulsen.house.gov/press-releases/paulsen-welch-introduce-legislation-to-improve-chronic-care-lower-costs-for-patients/

[395] ERP 2018, p. 290.

[396] "Background: The American Medical Technology Industry and International Competitiveness," Advanced Medical Technology Association, August 15, 2011. https://www.advamed.org/sites/default/files/resource/32_10_2011_Final_Study_CAgenda_Backgrounder.pdf.

[397] ERP 2018, Box 6-4, p. 306.

[398] *Ibid*.

[399] "A Better Way: Our Vision for a Confident America, Health Care," Speaker Paul Ryan, pp 28-29, June 22, 2016. https://abetterway.speaker.gov/_assets/pdf/ABetterWay-HealthCare-PolicyPaper.pdf

[400] ERP 2018, p. 314.

[401] ERP 2018, p. 307.

[402] Pomerleau, "Analysis of the 2016 House Republican Tax Plan."

[403] "Year in Search 2017," Google, https://trends.google.com/trends/yis/2017/GLOBAL/

[404] Data from the Federal Reserve Economic Data (FRED), Federal Reserve Bank of St. Louis: Dow Jones Industrial Average: https://fred.stlouisfed.org/series/DJIA, S&P 500: https://fred.stlouisfed.org/series/SP500

[405] Data from CoinDesk: Bitcoin: https://www.coindesk.com/price/, Ethereum: https://www.coindesk.com/ethereum-price/

[406] http://www.businessinsider.com/where-are-the-kings-of-the-1990s-dot-com-bubble-bust-2016-12

[407] Yahoo Finance Data, https://finance.yahoo.com/quote/AMZN?p=AMZN

[408] Data from CoinMarket Cap: https://coinmarketcap.com/coins/

[409] Catalini, Christian and Joshua Gans, "Some Simple Economics of the Blockchain," NBER Working Paper 22952, http://www.nber.org/papers/w22952

[410] Buterin, Vitalik, "What is Ethereum?", Coin Center, March 9, 2016, https://coincenter.org/entry/what-is-ethereum

[411] "What is Either?", Ethereum Project, https://www.ethereum.org/ether

[412] Lee, Timothy, "Bitcoin's insane energy consumption, explained," Ars Technica, December 6, 2017, https://arstechnica.com/tech-policy/2017/12/bitcoins-insane-energy-consumption-explained/

[413] There is another method called proof of stake, but due to space constraints it is not discussed here.

[414] Van Valkenburgh, Peter, "What is Bitcoin Mining, and Why is it Necessary?" Coin Center, December 15, 2014, https://coincenter.org/entry/what-is-bitcoin-mining-and-why-is-it-necessary

[415] Mankiw, N. Gregory, "Principles of Macroeconomics, Fifth Edition," Cengage Learning, 2008, p. 338-341

[416] Torres, Craig, "Yellen Says Bitcoin Is a 'Highly Speculative Asset'," Bloomberg Technology, December 13, 2017, https://www.bloomberg.com/news/articles/2017-12-13/yellen-says-cryptocurrency-bitcoin-is-highly-speculative-asset

[417] Browne, Ryan, "Big transaction fees are a problem for bitcoin – but there could be a solution," CNBC, December 19, 2017, https://www.cnbc.com/2017/12/19/big-transactions-fees-are-a-problem-for-bitcoin.html

[418] O'Leary, Rachel Rose, "Ethereum Executes Byzantium Blockchain Software Upgrade," CoinDesk, October 16, 2017, https://www.coindesk.com/ethereum-executes-blockchain-hard-fork-byzantium/

[419] Price, Rob, "Someone in 2010 bought 2 pizzas with 10,000 bitcoins – which today would be worth $100 million," Business Insider, November 28, 2017, http://www.businessinsider.com/bitcoin-pizza-10000-100-million-2017-11, ironically this process usually happens the other way with fiat currencies as central banks inflate away their value during crises (see Venezuela and Zimbabwe for modern examples)

[420] "Tech Visionary George Gilder: 'Bitcoin is the Libertarian Solution to the Money Enigma'," ReasonTV, August 14, 2014, https://www.youtube.com/watch?v=V9hb0EKAcro

[421] Brito, Jerry and Andrea Castillo, "Bitcoin: A Primer for Policymakers 2nd edition," Mercatus Center, 2016 https://coincenter.org/wp-content/uploads/2013/08/Bitcoin-Primer-2ndEd.pdf, p. 9

[422] Buterin, Vitalik, "Let's talk about the projected coin supply over the coming years," Reddit, https://www.reddit.com/r/ethereum/comments/5izcf5/lets_talk_about_the_projected_coin_supply_over/dbc66rd/

[423] Although "hard forks" could arguably increase the supply of a cryptocurrency. The nature of a hard fork creates a separate currency all to its own. For example, Bitcoin will only have 21 million tokens and the fact that Bitcoin Cash exists and shares part of the Bitcoin blockchain does not change that.

[424] Zerpa, Fabiola, "Venezuelan Hyperinflation Explodes, Soaring Over 440,000 Percent," Bloomberg, January 18, 2018, https://www.bloomberg.com/news/articles/2018-01-18/venezuelan-hyperinflation-explodes-soaring-over-440-000-percent

[425] Can't you feel the creativity?

[426] "Considering an IPO to fuel your company's future?", PriceWaterhouseCoopers, https://www.pwc.com/us/en/deals/publications/cost-of-an-ipo.html

[427] Grincalaitis, Merunas, "What it takes to create a successful ICO? How expensive it is? Your complete guide," Medium, September 29, 2017, https://medium.com/@merunasgrincalaitis/what-it-takes-to-create-a-successful-ico-how-expensive-it-is-your-complete-guide-35912722351e

[428] For podcast: Joint Economic Committee Republicans, "Main Street Economics" August 17, 2017: https://www.jec.senate.gov/public/index.cfm/republicans/podcasts/, For example, Miliard, Mike, "How does blockchain actually work for healthcare?", Healthcare IT News, April 13, 2017, http://www.healthcareitnews.com/news/how-does-blockchain-actually-work-healthcare

[429] Joint Economic Committee Republicans, "Main Street Economics" August 17, 2017: https://www.jec.senate.gov/public/index.cfm/republicans/podcasts/

[430] Healthnexus, https://token.simplyvitalhealth.com/

[431] Robomed Network, https://robomed.io/

[432] MediLedger, https://www.mediledger.com/

[433] BlockMedx, http://blockmedx.com/index.html

[434] O'Leary, Rachel Rose, "Congressional Group Pushes for Blockchain Security Standards," CoinDesk, August 22, 2017, https://www.coindesk.com/congressional-blockchain-group-pushes-medical-security-standards/

[435] "Announcing the Blockchain Challenge," HealthIT.gov, https://www.healthit.gov/newsroom/blockchain-challenge

[436] For more details see, "Blockchain Healthcare & Policy Synopsis," Chamber of Digital Commerce, October 2016, https://digitalchamber.org/assets/blockchain_healthcare_policy_synopsis_chamber_2016.pdf, and "Winners Announced!" CCC Innovation Center, http://www.cccinnovationcenter.com/challenges/block-chain-challenge/view-winners/

[437] Bruno, Debra, "Brooklyn's Latest Craze: Making Your Own Electric Grid," Politico, June 15, 2017, https://www.politico.com/magazine/story/2017/06/15/how-a-street-in-brooklyn-is-changing-the-energy-grid-215268

[438] For Australia: Sundararajan, Sujha, "Australian Government Grants $8 Million for Blockchain Energy Pilot," CoinDesk, November 20, 2017, https://www.coindesk.com/australian-government-grants-8-million-for-blockchain-energy-pilot/, For Europe: Milano, Annaliese, "European Energy Firms Trial Blockchain Trading Marketplace," CoinDesk, October 26, 2017, https://www.coindesk.com/european-energy-firms-trial-blockchain-trading-marketplace/, For Japan: del Castillo, Michael, "No More Nuclear: Japan's Biggest Utility Turns to Blockchain in Power Pivot," CoinDesk, October 10, 2017, https://www.coindesk.com/no-nuclear-japans-biggest-utility-turns-blockchain-power-pivot/

[439] "BlockCypher And U.S. Department Of Energy's National Renewable Energy Laboratory To Provide Blockchain Agnostic Distributed Energy Solution," January 23, 2018, http://www.prweb.com/releases/2018/01/prweb15117801.htm

[440] Cuomo, Gennaro, Testimony before the United States House Committee on Science, Space and Technology, Subcommittee on Oversight & Subcommittee on Research and Technology on "Beyond Bitcoin: Emerging Applications for

Blockchain Technology," February 14, 2018, http://docs.house.gov/meetings/SY/SY21/20180214/106862/HHRG-115-SY21-Wstate-CuomoG-20180214.pdf, p. 3

[441] Yiannas, Frank, Testimony before the United States House Committee on Science, Space and Technology, Subcommittee on Oversight & Subcommittee on Research and Technology on "Beyond Bitcoin: Emerging Applications for Blockchain Technology," February 14, 2018, http://docs.house.gov/meetings/SY/SY21/20180214/106862/HHRG-115-SY21-Wstate-YiannasF-20180214.pdf, p. 3-5

[442] "Kim Nilsson – Cracking MtGox," TheBitcoinArmy, September 10, 2017, https://www.youtube.com/watch?v=l70iRcSxqzo&t=3s

[443] For more details on Silk Road, see Bearman, Joshuah, "The Rise & Fall of Silk Road", Wired, April 2015, https://www.wired.com/2015/04/silk-road-1/ & https://www.wired.com/2015/05/silk-road-2/

[444] Foley, Sean, Jonathan Karlsen, and Talis j. Putnins, "Sex, Drugs, and Bitcoin: How Much Illegal Activity is Financed Through Cryptocurrencies?", January 15, 2018, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3102645

[445] The New Palgrave Dictionary of Economics, Palgrave Macmillan, London, 2008 http://www.dictionaryofeconomics.com/article?id=pde2008_S000278&edition=current, there are more sentences to this but it captures the thoughts

[446] Fox, Justin, "What's That You're Calling a Bubble," Harvard Business Review, January 8, 2014, https://hbr.org/2014/01/whats-that-youre-calling-a-bubble

[447] Steimetz, Seiji, "Bubbles," The Concise Encyclopedia of Economics, Library of Economics and Liberty, http://www.econlib.org/library/Enc/Bubbles.html

[448] Shapira, Arie and Kailey Leinz, "Long Island Iced Tea Soars After Changing Its Name to Long Blockchain," Bloomberg Markets, December 21, 2017, https://www.bloomberg.com/news/articles/2017-12-21/crypto-craze-sees-long-island-iced-tea-rename-as-long-blockchain

[449] Useless Ethereum Token, "The world's first 100% honest Ethereum ICO," https://uetoken.com/, other entertaining quotes from this ICO includes "If I don't make enough money to buy at least one flat-screen television, I'll probably keep the ICO open longer than initially stated." and "You're literally giving your money to someone on the internet and getting completely useless tokens in return."

[450] Palmer, Jackson, "My Joke Cryptocurrency Hit $2 Billion and Something Is Very Wrong," Vice Motherboard, January 11, 2018, https://motherboard.vice.com/en_us/article/9kng57/dogecoin-my-joke-cryptocurrency-hit-2-billion-jackson-palmer-opinion

[451] Data from CoinMarketCap, https://coinmarketcap.com/coins/

[452] "The DAO of accrue," The Economist, May 19, 2016, https://www.economist.com/news/finance-and-economics/21699159-new-automated-investment-fund-has-attracted-stacks-digital-money-dao

[453] Price, Rob, "Digital currency Ethereum is cratering because of a $50 million hack," Business Insider, June 17, 2016, http://www.businessinsider.com/dao-hacked-ethereum-crashing-in-value-tens-of-millions-allegedly-stolen-2016-6?r=UK&IR=T

[454] del Castillo, Michael, "Ethereum Executes Blockchain Hard Fork to Return DAO Funds," CoinDesk, July 20, 2016, https://www.coindesk.com/ethereum-executes-blockchain-hard-fork-return-dao-investor-funds/

[455] Securities and Exchange Commission v. Howey Co., 328 U.S. 283, 1946, https://supreme.justia.com/cases/federal/us/328/293/case.html

[456] Van Valkenburgh, Peter "Is Bitcoin a Security?", Coin Center, January 25, 2017, https://coincenter.org/entry/is-bitcoin-a-security

[457] "SEC Issues Investigative Report Concluding DAO Tokens, a Digital Asset, Were Securities," Securities and Exchange Commission, July 25, 2017, https://www.sec.gov/news/press-release/2017-131

[458] "Company Halts ICO After SEC Raises Registration Concerns," Securities and Exchange Commission, December 11, 2017, https://www.sec.gov/news/press-release/2017-227

[459] "SEC Emergency Action Halts ICO Scam," Securities and Exchange Commission, December 4, 2017, https://www.sec.gov/news/press-release/2017-219, "SEC Halts Alleged Initial Coin Offering Scam," Securities and Exchange Commission, January 30, 2018, https://www.sec.gov/news/press-release/2018-8

[460] Clayton, John, Testimony before the United States Senate Committee on Banking, Housing, and Urban Affairs on "Virtual Currencies: The Oversight Role of the U.S. Securities and Exchange Commission and the U.S. Commodity Futures Trading Commission," Securities and Exchange Commission, February 6, 2018, https://www.banking.senate.gov/public/_cache/files/a5e72ac6-4f8a-473f-9c9c-e2894573d57d/BF62433A09A9B95A269A29E1FF13D2BA.clayton-testimony-2-6-18.pdf

[461] "Consensus 2017: New Regulatory Challenges for Blockchain Technology," Coindesk, August 7, 2017, https://youtu.be/YTlfXxs5rUY?t=16m17s

[462] Batiz-Bent, Juan, Marco Santori, and Jesse Clayburgh "The SAFT Project: Toward a Compliant Token Sale Framework," Protocol Labs and Cooly, October 2, 2017, https://saftproject.com/static/SAFT-Project-Whitepaper.pdf

[463] Internal Revenue Service, Notice 2014-21, April 14, 2014, https://www.irs.gov/pub/irs-drop/n-14-21.pdf

[464] Lewis, Troy, "Re: Comments on Notice 2014-21: Virtual Currency Guidance," American Institute of CPAs, June 10 2016, https://www.aicpa.org/advocacy/tax/downloadabledocuments/aicpa-comment-letter-on-notice-2014-21-virtual-currency-6-10-16.pdf

[465] Treasury Inspector General for Tax Administration, "As the Use of Virtual Currencies in Taxable Transactions Becomes More Common, Additional Actions Are Needed To Ensure Taxpayer Compliance," September 21, 2016, https://www.treasury.gov/tigta/auditreports/2016reports/201630083fr.pdf

[466] "Creating tax parity for cryptocurrencies," Representative David Schweikert, September 7, 2017, https://schweikert.house.gov/media-center/press-releases/creating-tax-parity-cryptocurrencies

[467] Schweikert, David, "H.R. 3708 To amend the Internal Revenue Code of 1986 to exclude from gross income de minimis gains from certain sales or exchanges of virtual currency, and for other purposes," Congress.gov, https://www.congress.gov/bill/115th-congress/house-bill/3708?r=4

[468] Van Valkenburgh, Peter, "The Need for a Federal Alternative to State Money Transmission Licensing," Coin Center, January 30, 2018, https://coincenter.org/entry/federal-alternative-to-state-money-transmission

[469] "Laboratories of democracy," Wikipedia, https://en.wikipedia.org/wiki/Laboratories_of_democracy

[470] "Regulation of Virtual Currency Businesses Act," Uniform Law Commission, http://www.uniformlaws.org/Committee.aspx?title=Regulation%20of%20Virtual%20Currency%20Businesses%20Act , Van Valkenburgh, Peter, "The Uniform Law Commission Has Given States a Clear Path to Approach Bitcoin," Coin Desk, July 27, 2017, https://www.coindesk.com/uniform-law-commission-given-states-clear-path-approach-bitcoin/http://www.uniformlaws.org/Committee.aspx?title=Regulation%20of%20Virtual%20Currency%20Businesses%20Act

[471] Van Valkenburgh, Peter, "The Need for a Federal Alternative to State Money Transmission Licensing," Coin Center, January 30, 2018, https://coincenter.org/entry/federal-alternative-to-state-money-transmission

[472] Boring, Perianne, "Protecting blockchain from 'Mad Hatter' treatment," *The Hill*, November 21, 2017, http://thehill.com/opinion/technology/361220-protecting-blockchain-from-mad-hatter-treatment

[473] Clayton, Jay and J. Christopher Giancarlo, "Regulators Are Looking at Cryptocurrency," *Wall Street Journal*, January 24, 2018, https://www.wsj.com/articles/regulators-are-looking-at-cryptocurrency-1516836363