Illinois Blockchain Business Development Final Report

Mandated by 205 ILCS 725/
December 31, 2020

IDFPR
Illinois Financial and Professional Regulation

December 31, 2020

To the Citizens of the State of Illinois,
Honorable J.B. Pritzker, Governor and
Honorable Members of the General Assembly:

In accordance with Public Act 101-0259, also cited as the Blockchain Business Development Act, the Illinois Department of Financial and Professional Regulation has prepared the following report on the application of blockchain technology to the Illinois banking sector. I am pleased by the work the Department has done to outline the dynamic uses of blockchain technology in banking and hope this report can be used as a map for the further exploration of emerging innovations in the financial services space.

Banking has a long history in this state, beginning with the chartering of the Bank of Illinois in Old Shawneetown when Illinois was still a U.S. territory. As banking has evolved nationally and internationally, Illinois has remained on the cutting edge of new trends in financial services while maintaining a strong regulatory presence to ensure Illinois consumers have been adequately protected.

Blockchain technology has the potential to have a significant impact on future developments in investing, accounting, and other critical functions. I believe that as policymakers we must carefully consider new innovations in financial services, encourage beneficial changes in policy that will allow Illinois industries to thrive, and advocate for consumer-oriented provisions that will protect Illinoisans from any negative business practices.

The following report explores the current landscape of blockchain technology in banking and makes policy recommendations that will allow Illinois residents to benefit from such technologies. This report is not intended to be the final verdict on blockchain technology in Illinois. Given the rapidly changing nature of blockchain technology, I encourage policymakers to continue to monitor blockchain innovations that may be beneficial to Illinois residents.

I want to thank my staff, especially lead researcher Jacob Hamilton from the Division of Banking, for compiling this report. Please do not hesitate to reach out to me or the Department around the contents of the report or to discuss further policymaking steps around blockchain technology in banking.

Sincerely,

Secretary Deborah Hagan
Illinois Department of Financial and Professional Regulation

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Executive Summary

Public Act 101-0259, also cited as the Blockchain Business Development Act, provides for the creation of a Blockchain Banking Study. The Act requires the Illinois Department of Financial and Professional Regulation (IDFPR) to "review the potential application of blockchain technology to the provision of banking, and consider areas for potential adoption and any necessary regulatory changes in Illinois." On or before January 1, 2021, this report shall be made available to the Governor and the Illinois General Assembly.

In accordance with this Act, the following report has been prepared by the Acting Director of Banking, Chasse Rehwinkel, for distribution to the Governor and the Illinois General Assembly. This report has been divided into six sections, with the first three sections focusing the makeup of the blockchain industry as well as applications to the banking sector and the last three sections focusing on policy options for consideration.

Section V specifically outlines two major policy recommendations:

- Continue the creation of an innovation unit within IDFPR to assist with monitoring the fintech market place, coordinate with other regulators on changes to policies, and provide feedback to new tech companies looking for technical assistance from IDPFR's regulatory experts. This innovation unit will help blockchain focused companies receive the regulatory guidance they need to adapt their business to meet the needs of the Illinois banking sector.

- The General Assembly should consider legislation that would allow the Division of Banking to charter special purpose institutions as either a bank or a trust company. This measure, similar to legislation in Wyoming, would allow companies to obtain a charter in Illinois and allow the Division of Banking to adopt and enforce consistent standards for companies providing important cryptocurrency asset services to clients within the state. By standardizing cryptocurrency asset services, cryptocurrency businesses in Illinois would have more access to mainstream banking services, allowing for stronger growth potential.

This report is a brief overview of blockchain technology and banking as it exists in Illinois and the United States today. However, the blockchain technology industry is continuously changing, with new applications and innovations being instituted constantly. As with other areas within the fintech space, Illinois policymakers should continue to monitor positive developments within blockchain technology in order to ensure Illinois remains a financial hub.

I. Blockchain Overview

Blockchain technologies, often also called "distributed ledger technologies," have been a major topic of discussion in the financial and banking industries since their creation in 2008. In recent years, blockchain technology has seen large increases in investments into the sector. According to Statista, equity funding and investment in blockchain startup companies worldwide has grown from $1 million in 2012 to $4.15 billion in 2018.[1]

The section that follows contains a brief discussion of the origins of blockchain and the basics of how the technology works. Additionally, this section will discuss the current blockchain industry climate broadly, as well as specifically in the state of Illinois.

Blockchain and Distributed Ledger Technology

Blockchains in the simplest terms are digital ledgers, designed to securely keep track of transactions for any number of assets or information. Blockchain technology originated in 2008 when the anonymous developer(s) Satoshi Nakamoto released the white paper, "Bitcoin: A Peerto-Peer Electronic Cash System". This white paper not only created Bitcoin, now the world's most famous cryptocurrency, but also the underlying technology supporting Bitcoin, the blockchain.[2]

While there is no single agreed upon definition of blockchains, researchers Aaron Wright and Primavera De Filippi have described them in this way:

> A blockchain is simply a chronological database of transactions, a reference to the preceding block in the blockchain, as well as an answer to a complex mathematical puzzle, which is used to validate the data associated with that block. A copy of the blockchain is stored on every computer in the network and these computers periodically synchronize to make sure that all of them have the same shared database.[3]

In this way, blockchains are able to record transactions or information on a decentralized network, validating through consensus mechanisms rather than through a central authority. Because of this function, the ability to confirm transactions on a decentralized network, some experts believe blockchain technology has significant potential to disrupt traditional means of transactions in both private and public sector computing applications.[4]

Blockchains are also often referred to as "distributed ledger technologies" (DLT), although these terms are not necessarily the same thing. Distributed ledgers are databases that exist across multiple locations or among multiple participants, in contrast to a centralized ledger, a database that exists in one location and is manage by a singular entity.[5] It is possible to have a distributed ledger without blockchain technology, although those distributed ledgers would still validate information through a third party or central authority. Blockchains solve a crucial problem for distributed ledgers, the so-called "Byzantine generals problem," which describes how to gain consensus among a

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[1] Liu, Shanhong, "Equity funding and investment of blockchain startup companies worldwide from 2012 to 2019," Statista: September 14, 2020.

[2] Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," White Paper, www.bitcoin.org, 2008.

[3] Aaron Wright and Primavera De Filippi, "Decentralized Blockchain Technology and the Rise of Lex Cryptographia," (March 10, 2015), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664.

[4] P. Treleaven, R. Gendal Brown and D. Yang, "Blockchain Technology in Finance" in *Computer*, vol. 50, no. 09, pp. 14-17, 2017. Accessed at https://www.computer.org/csdl/magazine/co/2017/09/mco2017090014/13rRUyfbwuh.

[5] "The Difference Between Blockchain and Distributed Ledger Technology," *Tradeix*, March 1, 2018. Accessed at https://tradeix.com/distributed-ledger-technology/.

network of nodes when certain actors are unreliable. The Byzantine generals problem sets up a scenario in which a group of generals separately camped outside of an enemy city must coordinate their plan of attack to achieve success. However, there may be traitors among the group of generals and the messengers relaying information may or may not arrive.[6] This problem illustrates the difficulty in gaining consensus within a decentralized network. In the problem, none of the generals can be certain that the information they are receiving about the attack is accurate. In a similar fashion, a node within a distributed network cannot trust the other nodes unless it verifies information with a trusted third party before recording a transaction. Blockchains allow nodes within a distributed network to gain consensus through a cryptographic audit trail that can be maintained and validated by all the nodes in the network and therefore requires no central authority.[7]

Blockchains are complicated cryptographic mechanisms, making it difficult to understand how they work without specific expertise. However, according to a summary published in the Harvard Business Review, five basic principles underlie blockchain technology:[8]

Distributed Database – Every party on a blockchain has access to the entire database, no single party has control of the data, and each party can verify records without a third party.

Peer-to-Peer Transmission – Information is transferred directly between nodes rather than through a central authority.

Transparency and Pseudonymity – Every transaction is visible to any party that has access to the blockchain. Additionally, each party on the blockchain has a unique cryptographic key (identifier) and those users can choose to remain anonymous or provide proof of their identity to other users.

Irreversibility of Records – Because the transactions are recorded and linked together in a chain, the records cannot be altered. Various computational algorithms and approaches are deployed to ensure the recording is permanent, chronologically ordered, and available to each party on the network.

Computational Logic – The digital nature of the ledger means that transactions can be tied to computational logic and in essence programmed. Users can set up algorithms and rules that automatically trigger transactions between nodes.

These qualities of the blockchain lead to a record keeping system that is digital, decentralized, immutable, and transparent. However, there are various ways to structure a blockchain network. Bitcoin, one of the most common cryptocurrencies associated with blockchains, operates a public and permissionless blockchain, meaning that anyone can operate as a node in the network, and anyone can add transactions to the blockchain and view the blockchain. Blockchains can be broken down into 4 different structures shown in the table below.

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[6] Leslie Lamport, Robert Shostak, and Marshall Pease, "The Byzantine Generals Problem," ACM Transactions on Programming Languages and Systems, Vol. 4, No. 3, July 1982: pp 382-401.
[7] Treleaven, et al., "Blockchain Technology in Finance."
[8] A. Tapscott and D. Tapscott, "How Blockchain is Changing Finance," in Harvard Business Review, pp. 2-5, March 02, 2017.

Figure 1: Blockchain Structures

	Permissionless	Permissioned
Public	Anyone can act as a node in the network and anyone can view or add transactions to the blockchain.	Must have permission to act as a node in the network, however anyone can view or add transactions to the blockchain.
Private	Anyone can act as a node in the network, however the information on the blockchain or the ability to add transactions is private.	Closed blockchain. Must have permission to act as a node in the network and the information and the ability to add transactions is private.

Table 1 breaks down the characteristics that determine the structure of a blockchain. A blockchain can either be public or private, as well as permissionless or permissioned. Starting with public vs. private blockchains, this refers to the ability of potential users to access the information on the blockchain and add to it by adding new information or transactions. A public blockchain allows anyone to view the data that is recorded on the blockchain and allows anyone to add transactions to the record. In contrast, private blockchains restrict access to users within an organization or a group of organizations.[9] Blockchains like the Bitcoin blockchain or the Ethereum network are public; anyone in the world can access the data or add transactions to these types of blockchains. R3's Corda Enterprise blockchain platform is a notable private blockchain and restricts access to the businesses that pay to use their services.

Permissionless vs. permissioned blockchains refer to who is able to act as a node within the network. Permissionless blockchains allow any person to participate in the process of validating transactions for the network. Permissioned blockchains limit the number of nodes, which are preselected by a central authority or an associated group that governs the blockchain, like a consortium.[10] Again, Bitcoin and Ethereum are good examples of permissionless blockchains; they allow anyone who has the ability to, to participate in the process of validating transactions without any prior authentication, often called "mining". R3's Corda Enterprise platform also provides a good example of a permissioned blockchain. The R3 consortium governs the blockchain and only allows pre-selected nodes to validate transactions on the network.

Different blockchains also use various types of consensus mechanisms that allow the nodes within a network to validate data. Consensus mechanisms have developed over time, and as blockchain technology progresses, there are sure to be more new and innovative consensus mechanisms that blockchains can operate on. At this time there are three types of consensus mechanisms that are used prominently in the blockchain industry: proof of work

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[9] Gareth W. Peters, and Panayi Efstathios, "Understanding Modern Banking Ledgers through Blockchain Technologies: Future of Transaction Processing and Smart Contracts on the Internet of Money," in Banking Beyond Banks and Money (2016): 239-278.
[10] Peters and Efstathios, "Understanding Modern Banking Ledgers," 243.

(PoW), proof of stake (PoS), and delegated proof of stake (DPoS).[11] The potential disadvantages of some of these mechanisms will be discussed further in Section II. Brief descriptions of each mechanism are provided here to understand how they work.

Proof of Work – This is the original mechanism that Satoshi Nakamoto used for Bitcoin. This mechanism requires nodes within the network to solve complex mathematical problems to add blocks to the blockchain. Solving this math problem proves to the other nodes that someone has put in the "work" to verify the transactions in the block and has solved the mathematical problem to add the block to the chain. As mentioned earlier, this method is often called "mining" because it takes a substantial amount of computing power to solve the problem and add to the blockchain. Nodes in the network are incentivized to do this work through being rewarded with the digital currency (tokens) of the blockchain. Initially Bitcoin awarded 50 bitcoins for adding to the blockchain; currently it awards 6.5 bitcoins.[12]

Proof of Stake – These mechanisms determine which node creates the block in the chain based on the percentage of tokens a user holds, rather than computing power as in proof of work. The larger the percentage of total tokens that a user holds, the higher the chance they are selected to add the next block to the chain and validate the transactions in that block. The idea is that those who hold more of the tokens for the blockchain have a greater stake in the blockchain's success and are therefore incentivized to keep acting in the best interest of the blockchain.

Delegated Proof of Stake – This mechanism is a more democratic variation of the proof of stake model. Rather than granting the ability to add blocks based on token ownership, all of the nodes vote on a group of delegates to perform this responsibility. In this system, users will theoretically vote for the users who have the best interest in the blockchain performing well.

There are other aspects of blockchain technology that are worth noting, especially in the context of financial applications. Smart contracts pose an interesting use case for financial applications on blockchains. Smart contracts are code-based contracts that are able to be programmed into a blockchain, and then executed once certain conditions are met.[13] This means that users or lawyers or anyone can write a code into the blockchain that will automatically conduct transactions for the participating parties once the set of pre-determined conditions are met. For example, a smart contract could automatically buy or sell a stock once it hits a certain price point, or a smart contract could release loan funds to a borrower once the underwriting process has completed. There are many potential uses for smart contracts on blockchains but there are risks to consider as well such as legal jurisdiction and code correctness. These types of obstacles will be discussed further in Section II.

Finally, it is also important to note that although blockchains are often associated with cryptocurrencies, the potential applications that blockchains provide are separate from the excitement surrounding cryptocurrencies. Blockchain technology is the underlying technology for cryptocurrencies but also poses many use cases outside of being strictly a digital currency.

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11 Aurelia Nick and Lukas Hoenig, "Consensus Mechanisms in Blockchain Technology," Lexology, May 7, 2020. Accessed at https://www.lexology.com/library/detail.aspx?g=e30e7d54-3c7f-4ca0-8a22-478227a9b5ec.
12 Wolfie Zhao, "Bitcoin Halving Arrives: Mining Rewards Drop for Third Time in History," Coindesk, May 11, 2020. Accessed at https://www.coindesk.com/bitcoin-halving-arrives-mining-rewards-drop-for-third-time-in-history.
13 Peters and Efstathios, "Understanding Modern Banking Ledgers," 245.

Blockchain Industry

The blockchain industry has seen enormous growth within the last decade. There are numerous companies offering varying blockchain products within the financial services industry. Recently governments are exploring blockchain based applications as well, for things such as national registries or digital identities.[14] As many as 17 central banks around the world, including the European Central Bank and the People's Bank of China, are exploring uses for blockchain and what the industry is calling "Central Bank Digital Currencies" (CBDC).[15] In the United States, the Federal Reserve Board has also expressed an openness to some type of Federal Reserve digital currency but has not announced any formal exploration of the matter. However, there are a number of legislative and administrative initiatives at both the federal and state level relating to blockchain. The Office of the Comptroller of the Currency (OCC) has issued a guidance letter that would allow banks to hold crypto assets and states like Wyoming and New York have created processes for banks and companies to be specially licensed to deal with crypto assets.

It's clear that blockchain technologies are becoming increasingly popular in both private and public sectors. According to a blockchain market size report published by Grand View Research, the global blockchain technology market was valued at $1.59 billion in 2018 and is expected to have a compound annual growth rate (CAGR) of 69.4% from 2019 to 2025.16 Blockchain applications are varied as well; although this Report focuses on financial services applications, blockchain technology is also being applied to government, healthcare, transportation, logistics, retail, travel and many other industries. In the coming years it is likely that blockchain technologies will be widespread in their use across multiple industries.

Specifically relating to financial services, several major companies are advocating blockchain technology and digital currencies as solutions to issues within the industry. This Report will expand on these applications in Section III, but as an example many believe that the use of blockchains can greatly improve and speed up current payment processing systems as well as clearing and settlement of financial trades.[17] Some of the companies notable in the blockchain and financial services industry are Ethereum, Hyperledger, R3 and the Corda Enterprise Platform. In brief terms, these are blockchain companies that are providing the avenues to explore financial and banking applications on their existing platforms. Ethereum provides a platform that has a Turing-complete scripting language, meaning a computer programming language that can be used by any real world, general purpose computer. This allows any application readable by a computer to be built on the blockchain – many of these applications are in financial services. Hyperledger is a consortium founded by the Linux foundation to "create a free, open-source distributed ledger framework to support business transactions." Finally, R3 and the Corda Enterprise platform is a consortium of some of the largest banks in the world. Through the consortium they aim to create a global ledger that is able to adjust to firm-specific needs and regulations.[18]

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[14] Lesa Moné, "Which Governments are Using Blockchain Right Now?," Consensys, November 18, 2019. Accessed at http://consensys.net/blog/enterprise-blockchain.
[15] António Madeira, "Central Banks are Exploring Blockchain – but for Their Own Reasons," *Cointelegraph*, March 8, 2020. Accessed at https://cointelegraph.com/news/central-banks-are-exploring-blockchain-but-for-their-ownreasons.
[16] "Blockchain Technology Market Size, Share, & Trends Analysis Report By Type, By Component, By Application, By Enterprise Size, By End Use, By Region, and Segment Forecasts, 2019-2025," *Grand View Research*, July 2019.
[17] J. Leon Zhao, Shaokun Fan, and Jiaqi Yan, "Overview of Business Innovations and research Opportunities in Blockchain and Introduction to the Special Issue," *Financial Innovations* 2, no. 1 (2016): 28.
[18] Alejandro Moreno Puertas and Robin Teigland, "Blockchain: The Internet of Value," in *The Rise and Development of Fintech: Accounts of Disruption from Sweden and Beyond*, London: Routledge Press, 2018, pp. 276-308.

In addition to the above companies and consortiums expanding applications of blockchain technology, many large financial institutions are also exploring integrating blockchain technologies into their own business platforms. Some of the largest and most notable banks, such as Goldman Sachs, Bank of America, JPMorgan Chase, Barclays, HSBC and more, have announced blockchain partnerships or programs.[19] Additionally, a 2017 IBM survey of 200 global banks showed that 15 percent of respondents expected to have blockchains in commercial production that year, and 65 percent of respondents expected to have blockchain projects in production within the next three years.[20] According to the same survey, 91 percent of banks were investing in blockchain solutions for deposit-taking to protect against non-bank start-ups entering the industry. Most moderate and large financial institutions are making investments into blockchain technologies as they become more prevalent in the financial services industry.

Blockchain in Illinois

Illinois is a national leader in the financial technology industry, or "fintech", largely driven by the commercial and financial center of the state, Chicago. Chicago counts itself among the world's fintech hub cities, as a new report entitled the Global Fintech Index 2020, released in December 2019, ranks Chicago as the 14th best fintech city in the world and 5th nationally behind San Francisco, New York, Los Angeles, and Boston.21 Additionally, according to the Global Financial Centres Index from 2019, Chicago ranks as the 10th best fintech center in the world.[22] Not all of fintech is blockchain-related technology, although the blockchain industry is a part of the growing fintech industry.

A number of blockchain-focused companies claim residency in Chicago and throughout Illinois. Some of the companies that are headquartered or have offices in Illinois include: Gemini, DigitalMint, ErisX, BRD, Fourkites, Omnium Blockchain, Coinbase, Developcoins, Beaxy Exchange, Tavalor International, Inc., SoluLab, Cubix, and Codiant Software Technologies. Among these companies, Gemini, Digital Mint, ErisX, Omnium, Coinbase, Beaxy, and Tavalor are fintech companies as well, dealing specifically with blockchain financial applications. Others may work on blockchain app development or blockchain software.[23]

In addition, Chicago and Illinois as a whole have a robust talent pipeline for the fintech and blockchain industries. The Chicago metropolitan area has over 3 million working age adults, and 1.2 million of those are ages 18-34.[24] Chicago metropolitan area schools also produce the 4th most engineers in the country and have over 10,000 graduates annually with IT and engineering degrees combined. In addition to the Chicago metro area, the city is within a 2-4 hour drive of 3 of the largest engineering and computer engineering universities in the country: The University of Illinois, University of Michigan, and Purdue University.[25] And the state's flagship University, the University of Illinois at Urbana-Champaign has the fifth best computer science program in the nation according

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[19] Rebecca Campbell, "Which Major Banks Have Adopted or Are Adopting the Blockchain?" *Blockchain Works*, November 27, 2017

[20] IBM, "Leading the pack in blockchain banking: Trailblazers set the pace," *IBM Institute for Business Value*, 2017. Accessed at https://www.ibm.com/downloads/cas/PA8V4RMX.

[21] "The Global Fintech Index 2020," Findexable Limited: Published December 2019, p. 61.

[22] "Global Financial Centres Index 26," Z/Yen Group Limited: September 2019. Accessed at https://www.longfinance.net/media/documents/GFCI_26_Report_v1.0.pdf.

[23] "Top Blockchain Startups& Companies in Chicago," builtin Chicago, November 2020. Accessed at https://www.builtinchicago.org/companies/type/blockchain-companies-chicago.

[24] "You Can Find It In Chicago," World Business Chicago Internal Presentation.

[25] "Find It In Chicago," World Business Chicago.

to U.S. News & World Report.[26] Chicago also provides a competitive salary base for these graduates. Average salaries for software developers and computer programmers are between $103K and $93K respectively.[27] In addition, there is a concerted effort among state universities to offer students in Illinois access to tech programs, such as the I-STEM Education Initiative out of the University of Illinois, the Northern Illinois STEAM initiative, and the Southern Illinois STEM Education Research Center. One of the more notable tech hubs in downstate Illinois, Research Park at the University of Illinois Urbana-Champaign, recently announced that as of 2019 the area has 120 companies with 2,200 employees and 875 student interns. Illinois is an enticing state for blockchain startups and developers with our existing fintech hub and a robust talent pipeline.

The Illinois General Assembly has also been active in exploring blockchain possibilities in Illinois. In addition to enacting Public Act 101-0259, leading to this Report, legislators have also passed the Blockchain Technology Act (P.A. 101-0514), which took effect on January 1, 2020, recognizing the legality of blockchain contracts. This Act gives blockchain contracts the same legal standing as paper contracts, therefore allowing blockchain businesses to operate with legal certainty. In 2017 the State of Illinois also put together the Illinois Blockchain Initiative, a Task Force created by House Joint Resolution 25.[28] It was a consortium of state and county agencies, to collaborate on exploring potential innovations in blockchain technology. Ultimately, they released a report in January 2018 detailing the potential for blockchain applications in Illinois and in Illinois government agencies.[29]

Not only is the blockchain industry growing within the financial sector, Illinois is an important location where blockchain startups and companies can grow their business with every available resource.

II. Blockchain Obstacles

Although many in the blockchain industry are bullish on the potential of this technology, there remain obstacles to its widespread implementation and growth. Section II of this Report explores some of the different types of impediments that the blockchain industry faces as it becomes more prevalent. This section will look at technological issues that blockchains might face, from concerns over energy consumption and hacking to human error. It will also look at the ability of blockchains to see widespread market adoption and scalability and finally the regulatory environment for blockchains and some of the potential regulatory challenges for blockchain startups.

Technological Risks

Blockchain technology has many benefits over existing traditional financial technologies; however, it is not without risks and downsides. As the technology evolves and becomes more innovative, many of these issues with blockchain technology may be mitigated over time. It is important to consider that blockchain technology is still a relatively new technology and, as with all technological innovations, it will improve over time.

Despite the existing benefits of blockchain technology, there are problems with how some of the world's largest blockchains currently operate. One of the most pressing concerns is the amount of energy consumption that

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[26] "Best Computer Science Schools," *U.S. News & World Report*, 2018. Accessed at https://www.usnews.com/bestgraduate-schools/top-science-schools/computer-science-rankings.
[27] "Find It In Chicago," WBC, 63-64.
[28] "Blockchain Task Force," 100th Ill. Gen. Assem., House Joint Resolution 25, 2017 Sess.
[29] The 2018 Illinois Blockchain and Distributed Ledger Task Force Final Report can be found at the following link: https://www2.illinois.gov/sites/doit/Strategy/Documents/BlockchainTaskForceFinalReport020518.pdf.

blockchains require. Bitcoin, the world's first and one of its largest blockchains, operates on a proof of work consensus mechanism, as described in Section I above, which requires nodes to solve complex mathematical problems to confirm transactions. This "mining" process requires the nodes within the network to use very large amounts of computational power and because of this is extremely energy intensive. According to the Bitcoin Energy Consumption Index, the digital currency platform currently uses roughly 77.5 terawatthours of electricity per year. This is a small portion of the global electricity consumption, but it is still greater than the amount of electricity that countries such as Colombia, Austria, and Bangladesh consume.[30] By comparison, Ethereum, which also currently runs on a proof of work mechanism, consumes roughly 11.7 terawatt-hours of electricity per year.[31]

Another issue with Bitcoin's energy consumption is that a large portion of that consumption comes from fossil fuels. According to a 2019 report from the digital asset management firm CoinShares, 65 percent of the mining activity on the Bitcoin blockchain comes from large Bitcoin mining facilities in China where electricity and resources are relatively cheap, but also rely primarily on fossil fuel sources such as coal.[32] Additionally, Bitcoin transactions have a large carbon footprint: a single Bitcoin transaction has a carbon footprint of 357.98 kgCO2. That is the equivalent of almost 800,000 Visa transactions, or almost 60,000 hours of watching YouTube.[33]

As climate change is becoming a more immediate threat, there is concern that blockchains using proof of work consensus mechanisms have the potential to be energy intensive and leave large carbon footprints. The Bitcoin mining process will also only become more energy and resource intensive over time as the blockchain grows and the computing power needed to confirm transactions increases. There are solutions, however. Ethereum has announced plans to switch from a proof of work mechanism to a proof of stake mechanism in the future to curb energy consumption and costs.[34] Because proof of stake mechanisms rely on the percentage of tokens that a user holds, rather than the computing power of a node to confirm transactions, these mechanisms use significantly less electricity and resources. Proof of stake mechanisms are more widely used in smaller, private blockchains but they could be scaled to larger operations like Ethereum is attempting to do. Other consensus mechanisms such as the delegated proof of stake voting model are also significantly less energy intensive. Currently other major blockchain platforms, such as Hyperledger and R3's Corda Enterprise, operate under this model.

Another concern with blockchain technology is susceptibility to hacking and other security risks. Blockchain advocates consider the strengths of blockchains to be their transparency, security, and immutability; for the most part, blockchains are tamper-resistant. However, attacks can still occur and there are security risks to consider. The most prominent types of attacks and security risks that blockchains have been susceptible to are:

Eclipse Attacks
This is an attack on a peer-to-peer network, or more specifically a certain user within a network. It occurs when an attacker isolates a specific user from the decentralized network rather than attacking the whole network. Once

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[30] See "Bitcoin Energy Consumption Index," Digiconomist. Accessed November 5, 2020, https://digiconomist.net/bitcoin-energy-consumption/.

[31] See "Ethereum Energy Consumption Index," Digiconomist. Accessed November 5, 2020, https://digiconomist.net/ethereum-energy-consumption.

[32] Joseph Young, "New Report Shows China Dominates Bitcoin Mining, Is This a Sign of Worry?" *Forbes*, December 12, 2019.

[33] "Bitcoin Energy Consumption," Digiconomist.

[34] Christine Kim, "Everything You Need to Know About Ethereum 2.0" *Coindesk*, July 24, 2020.

[35] "What is an Eclipse Attack," Radix, June 7, 2018, accessed November 6, 2020. https://www.radixdlt.com/post/what-is-an-eclipse-attack/.

isolated, the attackers can prevent the target from getting a true picture of the network and an accurate reading of the current ledger.

This method allows attackers to commit fraudulent transactions through the isolated node, such as a double spend transaction. On a normal blockchain, a user wouldn't be able to double spend because all the nodes have an accurate copy of the ledger; however, an isolated node could be manipulated to confirm a transaction even if the funds had previously been sent to another node. Eclipse attacks are limited in their ability to affect the whole network.[35]

51 Percent Attacks

This type of attack occurs when a malicious actor takes over 51 percent of the mining power on a proof of work blockchain. When this happens, the actor can retroactively make changes to the digital ledger, alter the history of transactions, and even double spend as well. This type of attack was once considered to be too resource intensive to succeed. However, in 2018, a Bitcoin spinoff, Bitcoin Gold, fell victim to this kind of attack and lost $18 million worth of Bitcoin Gold in the process.[36]

This kind of attack can destabilize an entire blockchain and undermine confidence in the blockchain, leading to a crisis. However, as blockchains begin to grow in size, a 51 percent attack becomes less likely. Realistically, the amount of resources and computing power necessary to perform this type of attack on the Bitcoin blockchain is not practical, but smaller blockchains could be susceptible to this kind of attack.

Attacks on Applications Using Blockchains

Hackers don't need to attack the blockchain itself to compromise user funds; they can also target applications and software that use the blockchain and work tangentially to the blockchain. The most notable example of this attack is the hacking of the Mt. Gox cryptocurrency exchange in 2011 and 2014, the second of which was the largest hack on a cryptocurrency ever seen. In 2014, hackers were able to compromise a computer of a Mt. Gox auditor and artificially change the trading price of Bitcoin to a single cent and were also able to obtain the private keys of users' digital wallets. The attackers were able to steal 850,000 bitcoins, 750,000 of which came from users, with the total coins worth $460 million at the time. At Bitcoin's peak, those stolen coins were worth approximately $17 billion.[37]

A smaller exchange called Bitpoint experienced a similar wallet hack in July 2019, in which attackers were able to steal $28 million.[38] Currency exchanges and the digital wallets where users hold cryptocurrencies are always going to be susceptible to hacker attacks just like accounts with any other financial institution or company that holds a user's data. In the analysis of the Mt. Gox hack, it was found that lax security protocols led to such a large hack, and since then digital wallets have become much more secure.[39] As with any institution that holds valuable information or funds, they must make sure security protocols are in place to prevent against hacking attacks.

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[36] Jeff John Roberts, "Bitcoin Spinoff Hacked in Rare '51% Attack'," *Yahoo! Finance*, May 29, 2018. Accessed November 6, 2020
[37] "Hack Flashback: The Mt.Gox Hack – The Most Iconic Exchange Hack," *Ledger*, February 18, 2019. Accessed at https://www.ledger.com/hack-flasback-the-mt-gox-hack-the-most-iconic-exchange-hack.
[38] Heena Vinayak, "Crypto Under Attack: The Five Worst Hacks That Shook the Crypto World," *Cointelegraph*, November 4, 2019. Accessed at https://cointelegraph.com/news/crypto-under-attack-the-five-worst-hacks-thatshook-the-crypto-world.
[39] "Hack Flashback," *Ledger*.

Due to the anonymous nature of blockchain transactions, there is also concern about money laundering and other illicit activities carried out with cryptocurrencies. To counter the risk of this kind of activity institutions must have in place strict monitoring and anti-money laundering (AML) protocols. In 2019 The Financial Crimes Enforcement Network (FinCEN) issued an advisory about the illicit use of cryptocurrencies. They note that "Without sufficient controls in place, financial institutions cannot reasonably assess and mitigate the potential risks posed by a customers' source of funds or a customers' counterparty, and criminals can exploit the U.S. financial system by engaging in illicit transactions."[40] Financial systems are always at risk of being exploited by criminals, but the use of strict controls and reporting can reduce the risk of illicit activity and money laundering.

A final technological risk involved with blockchains is human error. Although the technology itself is theoretically sound, it still must be programmed by a person who can make a mistake as in any industry. The Bitcoin blockchain itself has experienced bugs and errors in its coding. In 2018, developers discovered a bug that would allow attackers to artificially create new Bitcoins and inflate the supply of the digital currency.[41] Other blockchains have experienced similar bugs as well. Human error also looms large in smart contracts deployed on a blockchain. If a smart contract is written incorrectly or even has a small error, the implications could be significant. Contracts could be executed incorrectly and then it would be difficult to reverse errors due to the immutability of blockchains. Even in 2016, hackers were able to exploit an unforeseen weakness on Ethereum's blockchain to steal around $80 million worth of Ether, the blockchain's token.[42] Fortunately, Ethereum was able to later correct this problem.

Blockchains are a promising technological innovation, but there are still risks with the technology for the industry to address. First, the blockchain industry must address energy consumption concerns to be viable in a sustainable world. Second, as is the case with any technology, the industry must ensure that robust security protocols are in place to protect users and consumers against dangerous hacks. Finally, although human error will always exist, dedicated quality checks can help reduce the prevalence and impact of those issues on blockchain users.

Market Adoption

Proponents of blockchain technologies have described the technology as a potential disrupter to the banking industry. In fact, when Satoshi Nakamoto first created Bitcoin and blockchain, the creator(s) intended that the technology could replace traditional financial institutions as trusted third-party intermediaries since the technology does not require them.[43] This outcome has not yet come to pass. Although blockchain technology is being used more broadly in our financial systems, it has not replaced traditional financial institutions as a medium of exchange. Digital currencies also have not replaced government-backed fiat currencies in any meaningful way. Currently they are treated more like tradeable securities or commodities, rather than a currency that we use for everyday purchases. This is not to say that these technologies will not continue to have a greater impact on current financial systems, but they are still in the early stages of development and adoption.

40 "Advisory on Illicit Activity Involving Convertible Virtual Currency," Financial Crimes Enforcement Network, May 9, 2019. Accessed at https://www.fincen.gov/sites/default/files/advisory/2019-05-10/FinCEN%20Advisory%20CVC%20FINAL%20508.pdf.
41 Alyssa, Hertig, "The Latest Bitcoin Bug Was So Bad, Developers Kept Its Fell Details a Secret," *CoinDesk*, September 21, 2018.
42 Mike Orcutt, "How Secure is Blockchain Really?" *MIT Technology Review*, April 25, 2018. Accessed at https://www.technologyreview.com/2018/04/25/143246/how-secure-is-blockchain-really/.
43 Nakamoto, "Bitcoin," 1.

The pace at which blockchain technologies are being adopted and widely used is a reason for pause on the immediate impact of blockchain. In recent years the technology has become more widely adopted, however, there are many businesses and individuals that are still considering the technology. According to Deloitte's 2020 Global Blockchain study, 39% of respondents have brought blockchain projects into production in 2020, compared to 23% of respondents in 2019.[44] This is a large year over year increase, and the same study also showed that 81% of respondents believed that blockchain was either critical or important to their strategic priorities.[45] There is a gap between the actual launch of blockchain products and use cases for companies and their positive sentiment about the technology.

This is not abnormal for new technologies, as companies can often be slow to adopt new innovations, particularly when those innovations can be viewed in part as competition. Iansiti and Lakhani, professors at the Harvard Business School, have compared blockchain technology and its framework for adoption to TCP/IP (transmission control protocol/internet protocol) technology in the early 1970s – the technology that the Internet is built on. TCP/IP technology eventually revolutionized the way in which we connect with each other and subsequently global economies, but at first businesses and the public at large were skeptical of its broad uses. TCP/IP gained traction with a single use case, email, similar to how blockchain technology has become notable through a single use case, Bitcoin.[46] Eventually blockchain may be the technology that revolutionizes the way in which we transact with each other, but adoption takes time.

Iansiti and Lakhani posit a four-phase adoption model for both TCP/IP and blockchain technologies based on a scale of novelty and cooperation required: single use, localization, substitution and transformation.[47] Figure 2 depicts the four stages of the adoption process. In the first stage, the technology is deployed in a simple, single use application, such as email or sending money back and forth with Bitcoin tokens. In the second stage, localization, businesses begin to use the technology for private and internal applications, like banks using blockchain ledgers for processing internal transactions. Substitution is the third stage, where common, simple products are replaced with applications on the new technology. Finally, in the fourth stage, transformation, the technology has achieved widespread institutional and public adoption. In this last stage, complex applications of the technology are used both privately and publicly, for blockchain that might entail banks using smart contracts to release funds for a loan once underwriting conditions have been met. The researchers argue that blockchain is currently in the localization stage, where it is being adopted more for private uses than widescale public uses .[48] Bitcoin itself has a wide reaching platform and has grown tremendously. However, Bitcoin is far from being a usable global currency.

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[44] "Deloitte's 2020 Global Blockchain Survey: From Promise to Reality," 2020. Accessed at https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain-survey/DI_CIR%202020%20global%20blockchain%20survey.pdf.
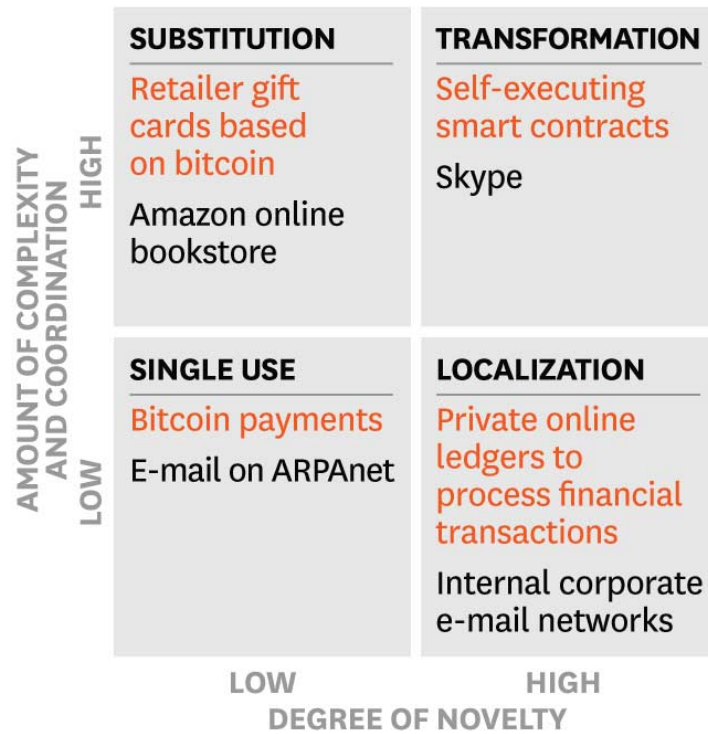[45] Ibid.
[46] Marco Iansiti and Karim R. Lakhani, "The Truth About Blockchain," *Harvard Business Review: Technology*, January 2017. Accessed at https://hbr.org/2017/01/the-truth-about-blockchain.
[47] Ibid.
[48] Ibid.

Figure 2: Blockchain Adoption Model

FROM "THE TRUTH ABOUT BLOCKCHAIN,"
BY MARCO IANSITI AND KARIM R. LAKHANI,
JANUARY–FEBRUARY 2017   © HBR.ORG

This is not the only adoption model for blockchain. Other researchers have put forth ideas about how the technology will grow and be accepted among public and private industries. Wang, Chen, and Xu evaluate blockchain along a technology maturity model from the ACM Computing Classification System. This maturation model gives five stages: initial, repeatable, defined, managed, and optimizing. The authors conclude that "With reference to adoption, businesses should realize that the blockchain system is not yet at an optimum maturity level and should conduct extensive feasibility studies before implementation."[49]

Similarly, researchers have used the methodology of the research company Gartner's hype cycle to evaluate the maturity of blockchain technologies. The hype cycle provides a graphical view of how a technology or application will evolve over time,[50] moving from the initial phases of peak excitement into eventually a steady and productive technology. In 2016 Buitenhek said of blockchain, "the blockchain is right at the Peak of Inflated Expectations…. Now it is set to slide into the Trough of Disillusionment, which will see the possibilities narrowed down and a new realism return to the discussion."[51] Figure 3 shows various blockchain technologies along the Gartner Hype Cycle in 2019 for reference. At this point, blockchain is squarely in the "Trough of Disillusionment," meaning that interest is waning, and more targeted applications are being sought by investors.

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[49] Huaiqing Wang, Kun Chen, and Dongming Xu, "A Maturity Model for Blockchain Adoption," *Financial Innovation* 2, no. 1 (2016): 12.
[50] "Gartner Hype Cycle," *Gartner*. Accessed at https://www.gartner.com/en/research/methodologies/gartner-hypecycle.
[51] Mark Buitenhek, "Understanding and applying Blockchain technology in banking: Evolution or revolution?," *Journal of Digital Banking* 1, no. 2 (2016): 113.

Figure 3: Hype Cycle for Blockchain Technologies, 2019
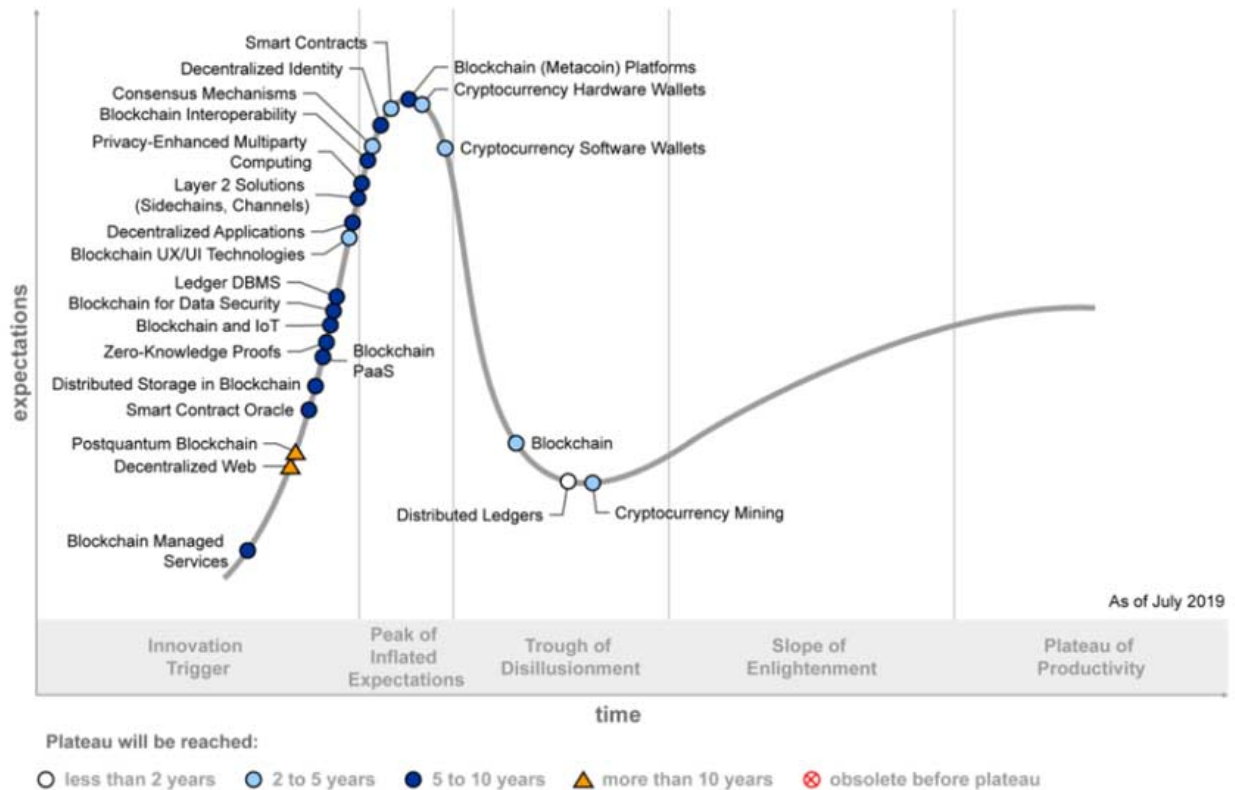
There is a consensus among blockchain researchers that while the technology is promising, it is still in the early stages of its development and adoption. In the short term, this technology may be more useful in small scale developments to advance transactions, rather than as a major disrupter to the financial services industry. Over time, blockchain technology is sure to improve and the use cases for this technology will grow as developers create applications as innovative solutions in the financial sector. However, researchers believe that widespread blockchain adoption is still years away from being realized. Therefore, legislators and regulators should be cautious as they work with this growing industry.

Regulations

Regulatory considerations are an important part of the discussion surrounding new technologies. It is necessary to strike a balance between regulating new products and industries to make sure they are safe and consumers are protected, while also encouraging technological growth and innovation. Blockchain and the fintech industry more broadly are currently going through the process of figuring out how they might fit within existing regulations and seeing what potential regulatory regimes may come into place for their industry. As it stands, there is no general consensus among regulators, either in the U.S. or across the world, on how to regulate the fintech industry and blockchain technologies. Bitcoin for example, is an entirely peer-to-peer platform that is run and governed by users. Apart from the example of Bitcoin, there are blockchain and cryptocurrency companies that are more in line with traditional financial services and thus more easily regulated. Different regulatory bodies have made efforts to establish guidelines for the blockchain and fintech industries, but there have been obstacles for both regulators and innovators as they try to navigate this relationship.

As previously noted, there has not been any widespread consensus on how to regulate the fintech sector and by extension blockchain technology. This has been an issue of particular interest in the banking industry, because in the United States different regulatory bodies have issued different guidelines for blockchain and fintech companies. The Office of the Comptroller of the Currency (OCC), which charters national banks, has in recent years pushed for a special-purpose national bank charter for nonbank fintech companies. However, this effort was struck down in federal court after a suit was brought by the New York Department of Financial Services (NYDFS), with the court concluding that only depository institutions can be chartered under the National Bank Act.[52] NYDFS was also supported in its effort to invalidate the OCC's special-purpose charter by several consumer advocacy, state regulatory, and banking and credit union advocacy groups.[53] The OCC, however, has recently issued interpretive letters concluding that national banks and federal savings associations (1) may provide cryptocurrency custody services for customers; and (2) may hold deposits serving as reserves for certain stable coin issuers when the stable coins are held in a hosted wallet.[54]

Other federal agencies have had little to say that is definitive about blockchain technologies and cryptocurrencies. The Financial Stability Oversight Council (FSOC) in its annual report included one brief section in a 152-page long document, observing, "The ultimate success of the technology, including applications in the financial sector, is not yet certain."[55] The Securities and Exchange Commission (SEC) also has not yet taken a definitive stance on whether cryptocurrencies are investment contracts and subject to federal securities laws. Rather, the SEC has issued guidance on cryptocurrencies that the specific facts and circumstances related to a particular cryptocurrency are important, stating that "A digital asset should be analyzed to determine whether it has the characteristics of any product that meets the definition of 'security' under the federal securities laws."[56]

Federal officials have also exhibited skepticism of cryptocurrencies, citing their use for illicit purposes. One notable example was the response to the rollout of the Libra Association. The Libra Association is a consortium originally made up of 28 businesses including a subsidiary of Facebook, the platform the currency is proposed to launch on. Libra is set to be a stable coin digital currency, backed by various fiat currencies and holding a stable value, in contrast to digital assets like Bitcoin and Ether, which can rapidly fluctuate in value.[57] The announcement of Libra sparked a backlash from regulators and legislators in the U.S. Hours after the announcement of Libra, Chair of the House Financial Services Committee, Representative Maxine Waters wrote to Facebook, "Given the company's troubled past, I am requesting that Facebook agree to a moratorium on any movement forward on developing a cryptocurrency until Congress and regulators have the opportunity to examine these issues and take action."[58] U.S.

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[52] *Vullo v. Office of Comptroller of Currency*, 378 F. Supp. 3d 271, 298 (S.D.N.Y.), *appeal docketed sub nom. Lacewell v. Office of Comptroller of Currency*, No. 19-4271 (2d Cir. 2019).

[53] John Ryan, "Congress, Not the OCC, decides what is and isn't a bank," *American Banker*, August 19, 2020.

[54] OCC Interpretive Letter No. 1170 (July 22, 2020); OCC Interpretive Letter No. 1172 (Sept. 21, 2020).

[55] "FSOC 2019 Annual Report," *Financial Stability Oversight Council*, p. 96. Accessed at https://home.treasury.gov/system/files/261/FSOC2019AnnualReport.pdf.

[56] "Framework for 'Investment Contract' Analysis of Digital Assets," U.S. Securities and Exchange Commission, April 3, 2019. Accessed at https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets.

[57] At the time of writing, the value of Bitcoin has increased from approximately $5,000 to $18,000 from March to November of 2020. "Bitcoin," *Coindesk*, November 18, 2020. Accessed at https://www.coindesk.com/price/bitcoin.

[58] Salvador Rodriguez, "Rep. Maxine Waters asks Facebook to pause work on cryptocurrency Libra," CNBC, June 18, 2019. Accessed at https://www.cnbc.com/2020/12/01/facebook-backed-libra-digital-currency-has-been-renamed-diem.html?&qsearchterm=libra%20renamed html. As of December 1, 2020, the Libra Association has transitioned to the name "Diem." Jessica Bursztynsky, "Facebook-Backed Libra Association has been renamed Diem," *CNBC*, December 1, 2020. Accessed at https://www.cnbc.com/2020/12/01/facebook-backed-libra-digital-currency-has-been-renamed-diem.html.

Treasury Secretary Steven Mnuchin also said of Libra, "Treasury has been very clear to Facebook, Bitcoin users, and other providers of digital financial services that they must implement the same anti-money laundering and countering financing of terrorism — known as AML/CFT — safeguards as traditional financial institutions."[59]

The backlash to Facebook's Libra shows at least in part the caution with which federal officials are treating blockchain technology and digital currencies. There are concerns among regulators that these new technologies may threaten consumer safety and disrupt traditional financial markets. Treasury Secretary Mnuchin has also said that "Money transmitters of cryptocurrency must comply with the relevant Bank Secrecy Act obligations, known as BSA, and register with the Financial Crimes Enforcement Network, known as FinCEN."[60] Consumer advocacy groups have voiced concerns as well. The National Consumer Law Center (NCLC) released a report in 2019 on fintech and consumer protection. Regarding blockchain, the NCLC cites concerns about wide fluctuations in virtual currency values, minimal to no fraud or error protections for virtual currencies, security vulnerabilities with blockchain technology, inaccuracies and inability to correct errors, Fair Credit Reporting Act (FCRA) compliance, and "one-sided" smart contracts that could enforce fraud and deception.[61] Among U.S. authorities there is general skepticism and uncertainty about digital currencies and blockchain technologies that could restrict widespread adoption of the technology.

Ultimately, the scope of potential federal regulations surrounding blockchain and cryptocurrency companies has been unclear. This regulatory uncertainty has been seen as a barrier to adoption in the blockchain industry. A 2018 PwC Global Blockchain survey showed that regulatory uncertainty was the biggest impediment to blockchain among respondents. 48 percent viewed regulatory uncertainty as either the first, second, or third largest barrier to adoption.[62] There are regulatory avenues for blockchain and cryptocurrencies businesses, but greater regulatory certainty could help the industry grow and become more widely adopted.

III. Banking Applications

Blockchain technology has promising applications in many different industries, but perhaps none more so than the banking and financial services industry. The technology is built to be able to allow users to transact with one another without the use of a third-party authority. This has the potential to significantly reduce transaction costs and times across the financial industry. This section of the Report will examine some of the most prominent applications for blockchain technology for banks and the financial sector.

Payment Applications

Trade Settlement and Clearing Processes

One of the most promising applications for blockchain technology is in the process of clearing and settling trades. Currently the process for buying and selling securities in major markets can take two or three days depending on

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[59] Steven Mnuchin, "White House Press Briefing by Treasury Secretary Steven Mnuchin on Regulatory Issues associated with Cryptocurrency," U.S. Department of the Treasury, July 15, 2019. Accessed at https://home.treasury.gov/news/featured-stories/white-house-press-briefing-by-treasury-secretary-steven-mnuchinon-regulatory-issues-associated-with-cryptocurrency.

[60] Ibid.

[61] Lauren Saunders, "Fintech and Consumer Protection: A Snapshot," *National Consumer Law Center*, March 2019, p. 20.

[62] PwC, "PwC's Global Blockchain Survey 2018," 2018. Accessed at https://www.pwccn.com/en/research-andinsights/publications/global-blockchain-survey-2018/global-blockchain-survey-2018-report.pdf.

where you are. The U.S., Canada, and Japan have a 3-day settlement cycle, while the EU, Hong Kong, and South Korea have a 2-day settlement cycle.[63] Considering that today a user can make a trade in just a few clicks on their smart phone, the settlement process lags behind the fast-paced technology that most trade on.

Blockchain technology can streamline this process by effectively "cutting out the middleman." Currently the trade settlement process relies on trusted intermediaries, clearing houses, to manage the risk associated with trading by confirming that the funds are sufficient from the buying party and the selling party will be able to fulfill the contract. The clearing house holds the ledger for both parties and confirms all of the needed information before settling the trade. A blockchain can be used in place of the clearing house to do that work for the buying and selling parties — and it can do it more rapidly and at a lower cost. In this scenario, all parties to the trade have access to the blockchain platform and the ledger, allowing settlement to be done by the system almost instantaneously. Researchers have estimated that blockchain settlement process could reduce the time needed from days to minutes or less.[64] Additionally, a 2016 Goldman Sachs report estimated that adopting blockchain technology in the trade settlement process could save U.S. capital markets $2 billion and global capital markets $6 billion on an annual basis.[65]

The benefits for clearing and settlements of trades using blockchain are clear. This technology could substantially increase efficiency and reduce costs in this process. This can be seen in the way the many cryptocurrency exchanges operate, like Coinbase or Kraken. These companies allow users to trade digital currencies all on a blockchain. Other companies like TZero, Symbiont, Chain, and SETL are leveraging blockchain technology to improve trading in traditional financial markets.[66] Widespread use of blockchains in the trade settlement and clearing process has not yet been realized, however. It will take widespread adoption before large benefits are seen. All parties in the trade process must commit to using a blockchain-based clearing house if they are going to make a trade on that platform.

Global Remittance

Similar to the settlement of trades, sending payments from one country to another and across the globe is currently a lengthy process. The processes and clearing procedures vary from country to country, but a remittance across national borders can require nearly three days to arrive and incur numerous fees.[67] In the conventional funds transferring system, most banks rely on the Society for Worldwide Interbank Financial Telecommunications (SWIFT) to facilitate international fund transfers. The SWIFT system currently has over 11,000 banks and facilitates trillions of dollars in payments annually.[68] SWIFT acts as a trusted third-party intermediary for the banks. In this system the banks use pre-funded transactional accounts to reduce the risk of funds being insufficient. Smaller and medium sized banks that don't have these accounts may rely on larger banks to access the accounts and transfer funds. This process involves numerous steps, participants, and procedures, and therefore can be expensive and time consuming, with the fees and costs often passed on to consumers.

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[63] Peters and Efstathios, "Understanding Modern Banking Ledgers," 265.

[64] Ibid, 266.

[65] Pete Rizzo, "Goldman Sachs: Blockchain Tech Could Save Capital Markets $6 Billion a Year," Coindesk, May 26, 2016. Accessed at https://www.coindesk.com/goldman-sachs-blockchain-tech-save-capital-markets-12-billion.

[66] Peters and Efstathios, "Understanding Modern Banking Ledgers," 266.

[67] Ye Guo and Chen Liang, "Blockchain application and outlook in the banking industry," *Financial Innovation* (2016) 2:24, p. 6.

[68] Mike Faden, "The Future of Cross-Border Payments: Ripple versus SWIFT," *American Express*. Accessed at https://www.americanexpress.com/us/foreign-exchange/articles/ripple-vs-swift-gpi-cross-border-payments/.

Blockchain technology once again can simplify the global transfer process by allowing banks to communicate directly with each other without the use of an intermediary. Further, because all parties will have a copy of the ledger, the use of blockchain will reduce risk as well as the cost and time of the transfer of funds. One blockchain company in particular, Ripple Labs, has aimed to fix the international payments process. Ripple Labs operates a blockchain platform that allows banks to communicate via blockchain and transfer funds at a lower cost and almost instantaneously. According to the company, the settlement process can be completed within seconds and requires no pre-funding.[69] As of November 2019, Ripple announced that it has over 300 customers, which is a low number of users compared to SWIFT, but does show growth for the company against an established intermediary.[70]

In recent years, SWIFT has also made improvements in the global remittance market. In 2017 SWIFT released its SWIFT GPI (Global Payments Initiative) platform. This platform has been able to reduce fund transfer times to less than 24 hours, and in 50 percent of transactions, to as little as 30 minutes. The platform also claims to provide end-to-end tracking and greater fee transparency. SWIFT GPI represents a dramatic improvement over traditional international payment systems, but still lags behind the cost and speed of blockchain based payment systems. Of course, Ripple Labs' network still faces some of the same problems that other blockchains have experienced: scalability, adoption, and regulatory uncertainty.

Domestic Payment Processes

Although domestic payment rails are faster than international payment rails, many consider the systems used in the U.S. to be outdated and inefficient. Payment rails are the networks that transmit payment information between necessary parties in a transaction. Consumers don't typically interact with this side of the domestic payment system. When someone makes a purchase with a debit card at a store, there is no waiting or settlement process. This is known as "end-user" services, which allows us to spend accessible funds directly and quickly. However, behind what the end user sees, there is an additional process involving the payer's bank settling a transaction with the recipient's bank, in what is referred to as the wholesale portion of payments.71 In the U.S., the Federal Reserve typically manages this bank-to-bank payment process. Currently, the settlements are completed within the same day or on the next business day.72 The Federal Reserve has committed to creating a "real time payments" system (RTP) called FedNow by 2023 or 2024. This system would "process individual payments within seconds ... [and] would incorporate clearing functionality with messages containing information required to complete end-to-end payments, such as account information for the sender and receiver, in addition to interbank settlement information."73 This would be available to all banks that have a Federal Reserve account and could enable real time payments throughout the U.S.

It appears that the Federal Reserve plans to use blockchain technology to enable this system and allow member banks to act as permissioned nodes entering transactions onto the decentralized ledger.74 This would be a major adoption of blockchain technology by a government entity, and would likely lead to greater regulatory certainty if the U.S.

[69] "The Financial Network of the Future," *Ripple*. Accessed at https://ripple.com/ripplenet.
[70] "RippleNet Growth: Announcing More than 300 Customers," *Ripple Insights*, November 6, 2019. Accessed at https://ripple.com/insights/ripplenet-growth-announcing-more-than-300-customers/.
[71] "U.S. Payment System Policy Issues: Faster Payments and Innovation," Congressional Research Service, September 23, 2019, p. 1. Accessed at https://fas.org/sgp/crs/misc/R45927.pdf.
[72] Ibid, 12.
[73] Federal Reserve, "Federal Reserve Actions to Support Interbank Settlement of Faster Payments," August 5, 2019, Docket No. OP-1670, pp. 72-73.
[74] Sky Guo, "BankThink FedNow service and blockchain closely linked," *American Banker*, August 26, 2019.
Accessed at https://www.americanbanker.com/opinion/fednow-service-and-blockchain-closely-linked.

central bank is using the technology. A U.S. real time payments system could have large benefits for consumers, too. According to a New York Times report, large banks collected $11.68 billion in overdraft fees in 2019. Moreover, 84 percent of overdraft fees were collected from only 8 percent of users[75]–who typically had a low balance of $350 or less in their accounts. Overdrafts often occur when account holders believe they have access to funds that haven't settled yet, amplifying problems for low-income customers. A real time payments system would certainly help many customers who currently incur overdraft fees due to lags in our payments system.

Administrative Applications

Internal Bank Ledgers

Modern day banks have to maintain numerous ledgers to track the various expenses, transactions, and crediting that occur on a given day. In the digital age, these ledgers are automated, but a bank may have a separate ledger to track numerous different types of transactions. For example, a bankmay have different ledgers for credit purchases, credit sales, bank transactions, small cash transactions, and a general ledger for expenses such as wages, insurance, rent, utilities, etc. Maintaining these ledgers requires strict protocols to ensure data integrity. A blockchain based internal ledger can automate all of these processes and track the numerous transactions in one integrated system. All of the different ledgers that a bank may have can be recorded on a single interconnected blockchain, simplifying the process. This has the potential to reduce costs and increase efficiency for banking institutions in their internal accounting processes.

Additionally, internal blockchain ledgers can increase security for banking institutions. Traditional bank ledgers are kept on a centralized database that requires frequent technological and security updates to reduce the risks of fraud and cybersecurity attacks.[76] Blockchains in contrast are decentralized and less susceptible to these kinds of cyberattacks. A bank could install a blockchain ledger system that has multiple permissioned nodes within its own private network to make the data more secure. A potential hacker would have to access all of the nodes to compromise the data in the blockchain rather than targeting a single centralized database. Of course, one potential downside of blockchain ledgers is the immutable nature of the technology. If a bank needs to reverse a transaction or fix any potential mistakes in the data, that could be more difficult to do on a blockchain than on a traditional centralized ledger.

Cost Savings

As noted above, there are significant projected cost savings from the use of blockchain technology in the financial sector. The Goldman Sachs study referenced above projected that blockchain technology would save $2 billion in the U.S. and $6 billion around the world annually in the settlement and clearing of trades. But the cost savings measures apply to more than just the settlement of trades. According to a Santander Fintech study, "distributed ledger technology could reduce banks' infrastructure costs attributable to cross-border payments, securities trading and regulatory compliance by between $15-20 billion per annum by 2022."[77] For banking institutions, blockchain

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[75] Mary Williams Walsh, "Banks Took $11 Billion in Overdraft Fees, Group Says," *New York Times*, June 3, 2020. Accessed at https://www.nytimes.com/2020/06/03/business/banks-overdraft-fees.html.

[76] Paul Shumsky, "Blockchain Use Cases for Banks in 2020," *Finextra*, September 10, 2019. Accessed at https://www.finextra.com/blogposting/17857/blockchain-use-cases-for-banks-in-2020.

[77] "The Fintech 2.0 Paper: Rebooting Financial Services," Santander Innoventures, 2015. Accessed at https://www.finextra.com/finextra-downloads/newsdocs/the%20fintech%202%200%20paper.pdf.

technology can be a new and more efficient infrastructure system, enabling faster and cheaper payments and accounting. The financial services and banking sector is a multi-trillion dollar industry, but the potential cost reductions from blockchain technology are still significant. Potentially, these cost savings could either be leveraged into further innovation within the sector or used to accomplish other goals such as a more sustainable and equitable banking sector.

Based on the blockchain investment seen in recent years, banking institutions are clearly interested in exploring how the technology can save on costs and increase efficiency. According to the Deloitte 2020 "C-Suite Briefing" on blockchain, in the financial services sector, 38 percent of respondents planned on spending at least $5 million on blockchain initiatives in the next 12 months.[78] This was a 5 percent increase from the prior year's survey. It's important to note, however, that most of this investment is being made by large banks and institutions. It is more difficult for small and mid-sized community banks to commit this kind of investment to a technology that may only achieve minimal savings for their institution.

Compliance Applications

Automated Accounting and Auditing
One of the important ways that blockchain technology can achieve cost savings is by reducing regulatory compliance costs. As discussed above regarding the use of blockchain for internal banking ledgers, if a bank were to keep its transactions and balances on a blockchain, then the blockchain could perform automated accounting and auditing services for the bank, reducing the need for outside auditors. Traditionally banks prepare financial statements and reports at regular intervals (typically mandated by the bank's regulators), after which an auditor will assess the validity of the bank's financial statements, and then government regulators can use the financial statements to conduct examinations of the financial institution. This process is time consuming and involves significant costs for banks. However, a bank using a blockchain for its internal ledger would be able to automatically generate financial statements that would be verifiable and transparent.[79]

The use of blockchain for ledgers and financial statements process would help increase efficiency in auditing and accounting process in two ways: by being more trustworthy, and by being faster than traditional financial processes. Currently, auditors must be trusted to confirm the accounting of the bank or financial institution, acting as a third party to verify the bank's ledgers. With blockchain, however, "the blockchain itself could, to a large extent, replace the auditor in confirming the accuracy of the firm's accounting."[80] If a bank records all of its transactions on a blockchain, that information would be available to any viewing party in real time, and also be trusted as accurate because of the blockchain consensus mechanism. To extend this to the regulatory process, any permissioned bank examiner could also access the information on the blockchain to pull and verify financial statements and balance sheets in a timely and orderly fashion. The adoption of blockchain could therefore greatly reduce the traditional costs and time associated with financial audits and examinations.

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[78] "C-Suite Briefing, 5 Blockchain Trends for 2020," Deloitte, March 2020. Accessed at
 https://www2.deloitte.com/content/dam/Deloitte/ie/Documents/Consulting/Blockchain-Trends-2020-report.pdf.
[79] Hans Byström, "Blockchains, Real-time Accounting, and the Future of Credit Risk Modeling," *Ledger* 4 (2019).
[80] Ibid, 41.

Digital Identity and Know Your Customer Laws

In 2014, the U.S. Financial Crimes Enforcement Network (FinCEN) proposed Know Your Customer (KYC) requirements as a part of a broader initiative to modernize and increase focus on BSA and AML regulations seeking to prevent fraud and other illicit activities in banking. KYC, which was adopted in 2016, requires that banks have a due diligence program in place to assess the risk of doing business with a potential customer. These measures help to ensure that banks are not unknowingly engaging in business with customers who may want to commit fraud, finance terrorism, or other illegal practices. KYC is important in maintaining the integrity of the banking industry; however these requirements can complicate the account opening process for individuals who may have to provide multiple forms of identity and various documents to verify information about themselves. This process is also costly for banks. Financial institutions spend an average of $48 million per year per institution on KYC compliance.[81]

Many advocates believe that blockchain technology can help reduce the cost and streamline the process associated with KYC by allowing banks to share identity verification information with one another. For example, Spring Labs is a blockchain company focused on promoting data exchange between financial institutions. The Spring Network allows banks to share information anonymously while remaining compliant with KYC and privacy laws. In addition, due to its anonymous nature, this network avoids bank concerns about sharing data with a competitor.[82] In this system, a customer who has opened a checking account will have already been verified by Bank A. When that customer seeks a separate loan product from Bank B, Bank B can use the Spring Network to obtain the prior verification information for the customer without doing additional due diligence, but while still being able to comply with KYC and trust that the customer is not a risk. These types of systems will rely on widespread adoption of blockchain within the banking world in order to see the mutual benefits of the decentralized network data sharing.

Additionally, there is another way to solve digital identity issues. Some governments have instituted programs to allow individuals to take greater control of their own digital identity. India started a digital identity initiative in 2009 called Aadhar, a biometric digital ID system in which 99 percent of the country is enrolled.[84] The Aadhar program has widely been considered a success for digital identity programs. This universal, government run digital ID program allows individuals to enroll themselves and verify their personal information, which is then used to verify them with a financial institution. So far, the program has helped Indian banks reduce KYC costs from approximately $5 to $10 per customer to approximately 10 cents, all while greatly reducing fraud.[85] Digital identity programs like this can also increase access to financial services, allowing many people to open a bank account who ordinarily lack the proper documentation, and overcoming a barrier to accessing basic financial products. Of course, any digital identity program has to be designed with privacy and equity concerns in mind to protect individuals' personal information.

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[81] John Callahan, "Know Your Customer (KYC) Will Be A Great Thing When It Works," *Forbes*, July 10, 2018.
Accessed at https://www.forbes.com/sites/forbestechcouncil/2018/07/10/know-your-customer-kyc-will-be-a-greatthing-when-it-works/?sh=1940b6738dbb.
[82] Bryan Yurcan, "Can Blockchain Ease Banks' Digital-Identity Concerns?" American Banker, March 27, 2018.
Accessed at https://www.americanbanker.com/news/can-blockchain-ease-banks-digital-identity-concerns.
[83] Ibid.
[84] Bryan Yurcan, "Banks Can Profit from Digital ID Movement (Even if They Don't Control It)," American Banker,
May 17, 2017. Accessed at https://www.americanbanker.com/news/banks-can-profit-from-digital-id-movementeven-if-they-dont-control-it.
[85] Ibid.

Separately, blockchain based universal digital ID programs can be applied to a variety of nonfinancial services industries. These programs could also be used to verify college degrees, employment histories, credit histories, insurance histories, and much more. The applications in the banking industry are numerous, but there are potentially much broader implications for blockchain-based digital identity innovations.

IV. Other States' Actions on Blockchain and Cryptocurrency

In the absence of comprehensive federal regulation, various state regulators have taken their own steps to regulate the digital currency and blockchain industry. States like Wyoming, New York, California, Texas, and South Dakota have all taken steps to regulate or create more access to the cryptocurrency market in some way. Wyoming has created a new charter for cryptocurrency companies; New York has developed a virtual currency license; California is modernizing and expanding the scope of authority of its state financial regulator, including adding resources to monitor blockchain companies and other fintech companies; Texas, similar to Illinois, has announced guidance on cryptocurrencies and money transmission; and both New York and South Dakota have allowed cryptocurrency companies to be regulated as trust companies.

Wyoming – Special Purpose Depository Institution (SPDI) Charter

In 2019, the Wyoming legislature passed House Bill 74, authorizing the Wyoming Division of Banking (Wyoming DOB) to charter, regulate, and supervise Special Purpose Depository Institutions (SPDIs). Wyoming DOB has suggested that "many SPDIs will focus heavily on digital assets, such as virtual currencies, digital securities and utility tokens,"[86] but SPDIs may provide banking services to other legitimate businesses and hold other assets as well. In addition, Wyoming state officials have said that their model can provide blockchain businesses a way to access customers in New York without having to comply with that state's stringent regulations, which are discussed further below.

The authorizing legislation for SPDIs indicates that these banks are designed to have a more limited scope of business than traditional banks and will be subject to heightened liquidity requirements — the list below highlights some of their key characteristics:[87]

- *Scope of Business*: SPDIs may provide deposit and payment services, apply to become member banks of the Federal Reserve System, and engage in other activities usual or incidental to the business of banking, subject to the approval of Wyoming DOB, including providing custody of digital assets pursuant to applicable rules, as discussed below. SPDIs may not make loans, including temporary credit related to overdrafts.
- *FDIC Insurance:* SPDIs are not required to obtain FDIC insurance, but are permitted to do so.
- *Customers:* Generally, only institutions, not natural persons, may open deposit accounts at SPDIs, though Wyoming DOB may make limited exceptions. These institutions must be engaged in a lawful business and maintain minimum deposits of $5000. Customers must also provide sufficient evidence to the SPDI to allow it to comply with anti-money laundering, customer identification, and beneficial ownership requirements.

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[86] "Special Purpose Depository Institutions," Wyoming Division of Banking, 2019. Accessed at http://wyomingbankingdivision.wyo.gov/home/areas-of-regulation/laws-and-regulation/special-purpose-depository-institution.
[87] Wyo. Stat. 13-12-101 – 13-12-126.

- *Liquid Assets:* SPDIs must maintain at all times "liquid assets" of at least 100% of deposit liabilities. "Liquid assets" include cash held at the bank, Federal Reserve, or a federally-insured financial institution, U.S. Treasury and federal agency debt, and other highly liquid investments, as determined by the Wyoming DOB.
- *Contingency Account:* SPDIs must also maintain a contingency account of at least 2% of deposit liabilities for unexpected losses and expenses. SPDIs may require depositors to make contributions to the contingency account.
- *Place of Business:* SPDIs must maintain their principal headquarters and the primary office of their CEO in Wyoming.

Wyoming DOB began accepting SPDI applications on October 1, 2019. Currently, two companies, Kraken and Avanti, have been granted a SPDI charter and others have also applied for the charter.[88] On November 8, 2019, new regulations went into effect allowing Wyoming state-chartered banks to opt in to enhanced regulatory requirements for digital asset custody. Wyoming state-chartered banks, including SPDIs, seeking to provide custody of digital assets must apply to the Wyoming DOB for approval at least 60 days prior to engaging in such activity. These banks must provide the following information to Wyoming DOB:[89]

- an outline of the proposed custodial services and risk mitigation activities;
- an agreement with an independent public accountant to conduct an audit pursuant to asset custody regulations promulgated by the U.S. Securities and Exchange Commission (SEC); and
- an explanation why the proposed custodial services will not impair the solvency or safety and soundness of the bank.

Following Wyoming DOB's approval, banks must comply with a detailed set of substantive requirements. Briefly, these requirements address the following areas, among others:[90]

- *Storage of Assets:* Banks must comply with specific requirements regarding the storage of clients' "private keys" (i.e., the encryption keys which allow them to make blockchain transactions), technology controls, and cyber and physical security.
- *Best execution:* Banks have a duty to obtain best execution and seek the most favorable terms for contemplated transactions that are reasonably available under the circumstances.
- *Block Source Code:* Banks must agree with their clients "on the protocols for maintenance and application of block source code in the event of 'forks' of digital assets (any temporary or permanent divergence in blockchain)."

The Wyoming SPDI charter and digital asset custody legislation provide an avenue for certain cryptocurrency businesses to be banked and regulated that is not common in other parts of the U.S. These measures are a significant step in creating more avenues for regulation within the blockchain and cryptocurrency sector.

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[88] Michael del Castillo, "Avanti Unanimously Wins Bitcoin Banking Charter," *Forbes*, October 28, 2020. Accessed at https://www.forbes.com/sites/michaeldelcastillo/2020/10/28/avanti-unanimously-wins-bitcoin-bankingcharter/?sh=1425440416aa.
[89] Wyo. Stat. 34-29-104.
[90] Ibid.; Wyo. Rules, Dept. of Audit, Banking Division, Ch. 19, Enhanced Digital Custody Opt-in Regime, §§ 8(a), 4(k), 5.

<u>New York – BitLicense</u>

In 2015 the New York Department of Financial Services (NYDFS) promulgated new rules to regulate the conduct of virtual currency businesses. These rules created a new Virtual Currency License (BitLicense) that require any company engaging in financial virtual currency business in New York to acquire a license to conduct business. According to the NYDFS BitLicense Frequently Asked Questions, anyone engaging in virtual currency transmission, custody or control of virtual currency on behalf of others, buying and selling virtual currency as a customer business, performing exchange services as a customer business, or controlling, administering, or issuing a virtual currency affecting New York residents must obtain a BitLicense.[91]

The BitLicense creates a framework for regulation of virtual currency companies that is not common in the U.S. As noted in Section II, the Office of the Comptroller of the Currency (OCC) has promoted a special-purpose fintech charter for non-traditional fintech banking institutions. However, that charter was struck down by the United States District Court for the Southern District of New York. Currently, 24 companies have been granted a BitLicense by the NYDFS,[92] the most notable being Gemini, Ripple, Square, BitPay, Coinsource, and Robinhood. However, other companies, such as ShapeShift and Kraken, have opted to cease business in New York due to these regulations.[93] Kraken has since been licensed as a SPDI in Wyoming.

Within the framework of the BitLicense, companies have to comply with regulations that are similar in nature to those applicable to traditional depository institutions. In order to receive a BitLicense, a company must have written compliance policies and keep cryptocurrency transaction records for up to seven years. In addition, a customer's sensitive information must be recorded and be made available to NYDFS upon request. These same requirements also apply to the company's books and records. Companies also must inform NYDFS and obtain approval for any material changes, changes in control, or mergers and acquisitions. The BitLicense also includes capital requirements (which are specific to individual licensees), surety bond requirements to protect customer assets, quarterly financial statements and annual financial statements, and biannual examinations.[94] There are also security requirements included in the BitLicense. Companies must maintain a cybersecurity program and have business continuity and disaster recovery plans. In relation to consumer protections, there are advertising and marketing requirements that all marketing materials include the phrase, "Licensed to engage in Virtual Currency Business Activity by the New York State Department of Financial Services." [95] Companies must also disclose all material risks associated with virtual currency prior to any transaction with a consumer. There are many specific disclosures included in the rules, but one example is, "Virtual Currency is not legal tender, is not backed by the government, and accounts and value balances are not subject to Federal Deposit Insurance Corporation or Securities Investor Protection Corporation protections."[96]

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[91] New York Department of Financial Services, "BitLicense Frequently Asked Questions". Accessed at https://www.dfs.ny.gov/apps_and_licensing/virtual_currency_businesses/bitlicense_faqs.
[92] New York Department of Financial Services, "Regulated Entities," October 26, 2020. Accessed at https://www.dfs.ny.gov/apps_and_licensing/virtual_currency_businesses/regulated_entities.
[93] Klein, Jessica, "New York Just Granted Its 18th BitLicense," *BreakerMag*, Published March 28, 2019. Accessed at https://breakermag.com/new-york-grants-its-13th-bitlicense-since-last-may/
[94] JJ, "Everything You Need to Know About NYSDF BitLicense," *CipherTrace*: Published June 25, 2019. Accessed at https://ciphertrace.com/new-york-bitlicense/.
[95] Ibid.
[96] N.Y. Comp. Codes R. & Regs., Title 23, Chapter 1, Part 200, Virtual Currencies, § 200.19 (August 8, 2015).

California – Office of Financial Innovation

In July 2020, California created its own version of the Consumer Financial Protection Bureau, the Department of Financial Protection and Innovation. The California Consumer Financial Protection Law (CCFPL) was included in Governor Newsom's proposed 2020-2021 state budget and will revamp the Department of Business Oversight (DBO) as the Department of Financial Protection and Innovation and "empower the department to provide consumers greater protection from predatory practices while facilitating innovation and ensuring a level playing field for all companies operating responsibly in California."[97] This proposal would also create an Office of Financial Innovation as a part of the restructured Department to engage with California companies developing new financial products and services, including blockchain and cryptocurrency companies. This unit would interact with the fintech sector, conduct research to anticipate trends in assessing new financial products, and would create a consumer protection ombudsperson to monitor the industry.[98]

The revamped agency is expected to expand its workforce over the course of three years and be funded by $44.3 million in existing DBO funds. The Office of Financial Innovation would initially start with four employees and would be based in San Francisco to be in the center of fintech innovation in California.[99] The shift in agency powers seeks to expand consumer protections in California, as the Newsom administration has argued that federal regulators are scaling back protections for consumers. Illinois has created a similar initiative within the Department of Financial and Professional Regulation (IDFPR), to create an in-house Innovation Unit, but that project has been delayed due to the COVID-19 pandemic.[100]

Texas – Cryptocurrency Regulatory Guidance

In April 2019, the Texas Department of Banking issued guidance on the "Regulatory Treatment of Virtual Currencies Under the Texas Money Services Act." Under this guidance, the Department of Banking states that it does not consider decentralized virtual currencies to be money or to have intrinsic value under Texas law. However, the Department does consider centralized virtual currencies, particularly stable coins such as Tether or Facebook's Libra, to be money in certain situations, since these may be considered a claim that can be converted into currency.[101]

Under this analysis, the Texas Department of Banking has determined that in most exchange scenarios, cryptocurrency companies do not meet the definition of money transmitters and do not need a money transmitter license to conduct business in Texas. Only in some scenarios, where a third-party exchanger is present in transactions, does Texas consider the movement of cryptocurrencies as money transmission. For example, Bitcoin exchange sites that hold a buyer's sovereign currency before remitting it to the seller would be considered money transmission.

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[97] Mark Anderson, "Newsom proposes increased power for consumer financial protection," *Sacramento Business Journal* January 10, 2020. Accessed at https://www.bizjournals.com/sacramento/news/2020/01/10/newsom-proposesincreased-power-for-consumer.html.
[98] California Department of Financial Protection and Innovation, "Monthly Bulletin," January 2020. Accessed at https://dfpi.ca.gov/2020/01/15/january-2020-monthly-bulletin/.
[99] Lydia Beyoud and Evan Weinberger , "California seeks New Fintech regulation in Agency Overhaul (Corrected)," *Bloomberg Law* (January 10, 2020). Accessed at https://news.bloomberglaw.com/banking-law/califgovernor-seeks-new-fintech-regulation-in-agency-overhaul.
[100] "Illinois Department of Financial and Professional Regulation Announces Creation of Office of Innovation," Press Release, Dec. 10, 2019. Accessed at https://www.idfpr.com/News/2019/IDFPR%20Office%20of%20Innovation%2012%2010%2019.pdf.
[101] "Supervisory Memorandum – 1037," Texas Department of Banking (April 1, 2019). Accessed at https://www.dob.texas.gov/public/uploads/files/consumer-information/sm1037.pdf.

Additionally, automated machines like Bitcoin ATMs are generally considered money transmission because most of these machines act as an intermediary between a buyer and seller.[102] In relation to stable coins, Texas has stated in its guidance that the need for a money transmitter license will depend on a licensing analysis for individual companies.[103]

Similarly, in June 2017, IDFPR announced guidance to establish the regulatory treatment of digital currency under the Illinois Transmitters of Money Act (205 ILCS 657) ("TOMA").[104] IDFPR's guidance focuses primarily on decentralized digital currencies, which are considered electronic mediums of exchange that are not created or issued by a central authority, are not legal tender, and can be used to purchase goods and services or to exchange for other currencies.[105] IDFPR's guidance followed a commentary period that concluded in January 2017 and considered responses received from the public. The guidance makes clear that transactions involving both fiat currency and digital currency may be governed by TOMA under some circumstances.

New York and South Dakota – Cryptocurrency Trust Companies
Several states have taken an alternative route to licensing specialized cryptocurrency businesses that focus on providing asset custody services. Both South Dakota and New York have chartered such cryptocurrency businesses as trust companies in their states. Trust companies act slightly differently than traditional banking institutions: a trust company is a legal entity that acts as a custodian or a fiduciary on behalf of a person or business to manage the assets that are entrusted to it. For cryptocurrency businesses, designation as a trust company means that the company can act as a fiduciary for the crypto assets that are entrusted to them. A trust company does not own the assets it manages but can perform custodial and safekeeping services and may manage and/or invest the assets on behalf of the customer.

Two prominent cryptocurrency companies are licensed as trusts: Gemini, a cryptocurrency trust chartered in New York; and Anchorage Trust Company chartered in South Dakota. Gemini was first chartered as a trust company by NYDFS in 2015. In a press release issued by the Department, officials observed that, "Gemini applied to NYDFS for a charter to operate as a trust under that process for virtual currency exchanges in July 2015…. As a chartered limited purpose trust company with fiduciary powers under the Banking Law, Gemini can begin operating immediately and is subject to ongoing supervision by the NYDFS." This charter allowed the exchange to legally operate in the state of New York, by allowing clients to trade cryptocurrencies such as Bitcoin. Gemini has since also obtained a BitLicense from NYDFS allowing it to act as a fiduciary for a greater range of cryptocurrencies, specifically Zcash, Litecoin, and Bitcoin Cash.[107]

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[102] Ibid at 4-5.
[103] Ibid at 5.
[104] *See* "Digital Currency Regulatory Guidance," IDFPR (June 13, 2017). Accessed at
https://www.idfpr.com/Forms/DFI/CCD/IDFPR%20-%20Digital%20Currency%20Regulatory%20Guidance.pdf.
[105] However, TOMA differs from Texas and other states' money transmission laws by defining "money" as a medium of exchange that is authorized or adopted by a domestic or foreign government as a part of its currency and that is customarily used and accepted as a medium of exchange in the country of issuance and not encompassing "monetary value." While the Texas Money Services Act has a similar definition of "money," that Act also expressly encompasses "monetary value," which is defined as a claim that can be converted into currency through a financial institution, electronic payments network, or other formal or informal payment system. Other states' money transmission laws also encompass "monetary value" with varying definitions.
[106] "NYDFS Grants Charter to 'Gemini' Bitcoin Exchange Founded By Tyler and Cameron Winklevoss," New York Department of Financial Services, Press Release (October 5, 2015). Accessed at https://www.dfs.ny.gov/reports_and_publications/press_releases/pr1510051.
[107] "DFS Authorizes Gemini Trust Company to Provide Additional Virtual Currency Products and Services," New York Department of Financial Services, Press Release (May 14, 2018). Accessed at https://www.dfs.ny.gov/reports_and_publications/press_releases/pr1805141.

Anchorage Trust Company was licensed as a trust company in South Dakota in July 2019, allowing it to act as a fiduciary for institutional investors looking to safeguard large amounts of crypto assets. The company has said that it chose South Dakota to establish itself as a trust company due to the state's established record in chartering trusts.[108] Two other smaller cryptocurrency companies, BitGo and Kingdom Trust, are also licensed as trusts in South Dakota.[109]

Clearly one potential regulatory avenue to license and monitor certain cryptocurrency businesses focused on custody services is to charter them as a trust, allowing them to manage digital assets and perform custodial services. These limited purpose charters that have been seen in New York and South Dakota as limited purpose trust companies, or Wyoming in the form of a SPDI, may be a potential avenue for Illinois as well.

V. Recommendations

Several states have acted on crypto and blockchain regulation in recent years. Illinois can also be a leader in this growing industry, consistent with its existing resources, markets, and talent to attract blockchain-based companies. By facilitating a structure that allows these companies to operate with regulatory certainty, Illinois can be a place where established and new crypto companies can grow. This section will discuss some potential avenues for Illinois to engage with the blockchain and cryptocurrency communities and allow them to conduct business safely within Illinois.

IDFPR Innovation Unit

There are various initiatives that Illinois regulators have been working on to promote innovation in this sector within the state. As noted above, IDFPR announced plans to create an in-house innovation unit with the dual goals of protecting Illinois consumers from new and unregulated financial products and services, and to respond to emerging marketplace trends to provide a fertile ground for innovation in Illinois. In IDFPR's announcement, the agency outlined new financial products and technologies that the unit will review, including applications of blockchain and distributed ledgers and virtual currencies like Bitcoin, Ethereum, and Litecoin.[110] The Department has also emphasized that start-up companies and current licensees with innovative ideas should seek IDFPR's guidance on the applicability of current laws to their proposed products and services.

Therefore, IDFPR's new innovation unit will work to accomplish the following goals:

- Monitor the fintech marketplace, meet and provide feedback to companies with proposed innovative products and services, and make policy determinations regarding the regulation of innovative products and services in Illinois;
- Coordinate with federal and state regulators to maximize consumer protections for innovative products and services; and
- Provide feedback to companies, including through interpretive letters and technical assistance from the Department's subject matter experts.

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[108] Nathan McCauley, "Anchorage: A Qualified Custodian That's Safer than Cold Storage," Medium.com, July 16, 2019. Accessed at https://medium.com/anchorage/anchorage-a-qualified-custodian-thats-safer-than-cold-storage-b4646e3578e8.
[109] Martine Paris, "Anchorage Chose South Dakota for Its Crypto Custody – Here's Why," Coindesk, July 20, 2019. Accessed at https://www.coindesk.com/a16z-backed-libra-member-anchorage-on-why-it-chose-south-dakota-for-crypto-custody-office.
[110] "Illinois Department of Financial and Professional Regulation Announces Creation of Office of Innovation," Press Release, Dec. 10, 2019. Accessed at https://www.idfpr.com/News/2019/IDFPR%20Office%20of%20Innovation%2012%2010%2019.pdf.

This new unit will help IDFPR explore other areas of interest within the fintech space, including areas such as blockchain and cryptocurrencies. Illinois legislators should work with IDFPR and the innovation unit to craft potential legislation that fosters innovation in these sectors while ensuring consumer protections are maintained.

Special-Purpose Depository Charters

In addition to preparing this Report, IDFPR's Division of Banking has been actively researching regulatory initiatives in other states to determine which ones could best be applied in Illinois. In October 2020, the Division of Banking hosted a Fintech Roundtable discussion panel on the Wyoming SPDI charter. The panel included Wyoming's Banking Commissioner as well as experts in both the banking and cryptocurrency industries. Feedback on the event from the banking and crypto communities was positive. Panelists and attendees alike are enthusiastic about the prospect of special purpose charters in Illinois. This step would allow both new businesses and existing state-chartered financial institutions to participate in the growing digital asset custody space without having to leave the state.

The Department recommends that the General Assembly enact legislation that would allow the Division of Banking to charter special purpose institutions as either a bank or a trust company. This measure would potentially look similar to the SPDI charter in Wyoming. Allowing companies to obtain a charter in Illinois would allow the Division of Banking to adopt and enforce consistent standards for companies to provide important crypto asset services to clients within the state.

Regulatory Sandboxes

Another regulatory initiative that certain states and the federal Consumer Protection Financial Bureau have adopted as a pilot program are fintech "regulatory sandboxes". IDFPR does not recommend that the legislature pursue this type of program in Illinois. Regulatory sandboxes are often touted because they allow new and innovative companies to operate and test their products with less fear of regulatory action. However, consumer advocates such as the National Consumer Law Center have raised concerns with sandboxes, such as their elimination of important consumer protections, decreased regulatory scrutiny, potential promotion of risky innovations that may harm consumers, and their frequent low levels of transparency.[111] In addition, it is possible for such pilot programs to continue indefinitely and cover entire markets with little to no regulation. Finally, regulatory sandboxes also may give an unfair advantage to companies that adopt into the program over companies that are already chartered within the state.

There are many potential benefits for blockchain technology in banking. As the industry continues to evolve, regulators and lawmakers will have to continue to adapt to these new technologies. The Illinois General Assembly should continue to work with IDFPR and other state agencies to build a regulatory structure in Illinois that promotes growth and innovation while also maintaining strong consumer protections.

VI. Conclusions

Blockchain and distributed ledger technologies have the potential to change the banking industry. They can be the infrastructure for the next generation of payment systems, fundamentally change how consumers control their own digital identity and data, and streamline regulatory and compliance processes. All of these developments can occur while lowering costs and increasing efficiency in the financial services sector. Of course, as this new industry and its

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[111] Saunders, "Fintech and Consumer Protection," p. 8.

associated technologies have grown over the last decade, there has been significant debate about how to regulate blockchains and cryptocurrencies. There is no general consensus among domestic regulatory bodies at either the state or federal level. However, certain states are making inroads in how to regulate this industry. Allowing banks and financial institutions to act as legal custodians for crypto asset clients seems to be the regulatory path that both industry advocates and regulators want to pursue.

The State of Illinois has the ability to facilitate new and innovative businesses in this major financial hub. State legislators and regulators can work together with industry stakeholders and consumer advocates to promote blockchain in banking in a safe and sound manner. Taking these initial steps has the potential to increase access to financial services for Illinoisans who may be unbanked or underbanked and to reduce costs for financial institutions and consumers as systems become cheaper and more efficient. As the financial sector becomes increasingly digitized, blockchain is one part of industry growth. Illinois will be a leader when it comes to embracing a modern digital banking sector.