Viable Blockchain Applications: Examples from Financial Services

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Abstract

Blockchain promises substantial impact in many industries, especially in the area of financial services. The timing and impact of each blockchain innovation is a key consideration for business managers. This paper begins with a high-level review of blockchain. Second, a discussion of blockchain components helps explain the nature of product development. Third, impediments to wider implementation are outlined, including limitations of the current technology, and regulatory and governance issues. Finally, we present data to determine which types of blockchain applications are being developed by companies financed by private equity. These products may be among the most important blockchain applications in the years ahead.

Keywords: blockchain, decentralized ledger, financial services, private equity

Introduction

Blockchain promises substantial impact in many industries, especially in the area of financial services. While information technology experts are confident blockchain will bring about dramatic long-run changes, it is not clear which innovations will make the most immediate impact. Some advancements are developed and financed internally by publicly traded big tech and financial corporations, but more may come from the many startups and mid-stage companies aggressively innovating in the blockchain arena. These smaller firms are typically financed by hedge funds, private equity, and/or venture capital. Mid-stage companies that have defined products are attractive to private equity investors, and these products are the furthest along in their development. Thus, determining which products are supported by private equity may show where blockchain will make the most profitable impact in the near term.

This paper begins by providing a high-level view of blockchain. This is followed by a discussion of blockchain components to help in understanding the nature of product development. Next, we discuss some limitations of the current technology. Last, a description of the data and results are presented with an included summary.

Blockchain Explained

The blockchain was invented by Satoshi Nakamoto[1] in his proposal for an electronic cash system which he named Bitcoin (Nakamoto, 2008). At first, blockchain was used exclusively for Bitcoin. As the years went by, other cryptocurrencies and applications were developed, especially in financial services, making blockchain an important part of fintech (Thakor, 2020). While Bitcoin and Ethereum are currently the two most important blockchains, multiple competitive blockchains are in use and under development to provide similar functions or new specific applications.

Blockchain is explained with many analogies and defined according to several characteristic strengths. “Blockchains are distributed ledgers, operated within peer-to-peer

[1] Satoshi Nakamoto’s identity is unknown and may be a pseudonym for an individual or a group.

networks" and are used "for recording transactions and asset ownership" (Biais, Bisiere, Bouvard, & Casamatta, 2019, p. 1662). The distributed ledger, or store of data, is designed to be immutable, transparent, and common to all users. (But, the history of computer security teaches us to expect disadvantageous hacker advances.) The ledger expands when blocks of new information are added through a competitive process commonly observed across users. “Each block, in the blockchain, offers an updated version of the ledger, taking into account recent transactions, and chained to a previous version of the ledger – that is, a previous block” (Biais et al., 2019, p. 1663). The structured and transparent process of adding to the document makes the blockchain very secure and is a key strength of the software. As blockchain operates on a network of nodes or computers, each node has the same version of the blockchain providing an indisputable, identical record of data across all users. The data could be coin ownership, health records (Mackey et al., 2019; Radanovic & Likic, 2018), shipping and payments, and the list goes on.

Although there is general agreement with the characteristics and definitions shown above, some suggest this grossly understates blockchain’s potential. Diedrich (2016) explains how the blockchain’s “guarantee of execution” facilitates the development of smart contracts. “Smart contracts are lines of code that are stored on a blockchain and automatically execute when predetermined terms and conditions are met” (Gopie, 2018, para. 2). (But note, contract law is very jurisdiction specific as are choice of law rules, thus many smart contract provisions are sure to not satisfy the contract law of every jurisdiction.) These smart contracts may include payment streams, investment portfolios, tracking cryptocurrencies, and many others. The Ethereum blockchain network, currently the second largest after Bitcoin, was designed to host very flexible programming needed for smart contracts. Cong and He (2019) develop theoretical models to demonstrate economic benefits of blockchain and smart contracts, noting how decentralized consensus is the core functionality supporting these applications. Although the implications of a common ledger are profound, the inclusion of smart contracts may be the most disruptive application for many industries.

Financial applications such as security trading and settlement, asset and finance management, and other banking functions are currently supported by database systems such as Oracle and MySQL. Dinh et al. (2018) observe that blockchain may disrupt this status quo because it incurs lower infrastructure and human costs.[2] “In particular, blockchain’s immutability and transparency help reduce human errors and the need for manual intervention due to conflicting data” (Dinh et al., 2018, p. 1366). By removing duplicate efforts in data governance, blockchain will streamline business processes, with savings estimated at $6 billion. Regardless of the addition of blockchain to the financial production processes, human decision making will still be required to trigger declaration of completion of some milestones. Do note that blockchain limits the reversibility of some escrow events which will not align with the parties’ desires.

[2] However, “lower infrastructure and human costs” is true only when ignoring externalities. Blockchain calculations for Bitcoin alone consumes as much electricity as the entire country of Sweden, and since such mining primarily (has been) done in China, the greenhouse gas emissions are vast. The ‘savings’ solely are internal to the firm using blockchain but at the expense of the rest of the Earth.

Blockchain Components

Blockchain software operates on a network of computers, often pre-existing, and requires complementary software and applications to complete product delivery. Blockchain is explained in the preceding section. In contrast to other software which operates on a single personal computer or at a centralized location on the internet (e.g., the cloud), blockchain uses the computing power of multiple computers on a network, making it essentially an “internet computer.” Blockchains may be specific, such as Bitcoin, or general, for example Ethereum, to allow applications with various uses. The Bitcoin network specified nodes must meet minimum requirements including amount of free disk space, memory, and internet upload speed (see bitcoin.org/en/full-node#minimum-requirements). Singhal, Dhameja, and Panda (2018) give a technical perspective on blockchain concepts and uses. The network could be a general public network, it may also be limited by some criteria to make the network private or to improve the performance in one or more key blockchain characteristics.

Sidechains, working interoperably with blockchain, may handle subsets of calculations to improve speed, connect blockchains to other blockchains, or communicate with other technology (Singh et al., 2020). Based on the review of the investments presented later in our paper, blockchains, networks, and sidechains constitute the most common innovations in basic blockchain function. Although the focus of these products may be general or specific, they serve as basic building blocks.

Innovation in applications may be specific to one particular blockchain, work on multiple blockchains, or focus on a specific industry. Most current applications refrain from using excess complexity as blockchains are new and fundamentally changing through innovation and formation of standard processes. As Bitcoin has driven great interest and progress, many applications are cryptocurrency-related such as initial coin offerings (ICOs), exchanges, or wallets. Almost every blockchain includes a coin or token as part of the basic software, but ICOs can be written to create coins traded on third-party blockchains. Often the coins have a specific purpose; for example, several new coins trade for green energy (Andoni et al., 2019). Exchanges allow one coin to be traded for another coin or asset, including cryptocurrencies, real currencies, digital assets and hard assets. Digital wallets store coins or digital assets. Finally, as the financial services industry is a key area of innovation and a focus of this research, applications may focus on payment systems, wealth management, storage of data or asset ownership, and lending. Guo and Liang (2016) discuss some of the initial applications in the banking industry. Stulz (2019) discusses how blockchain and other technology advancements will affect traditional banks.

Impediments to Blockchain Success

Blockchain is new, and a new class of software. As such, there are many aspects of best practices and standardization that have not yet been resolved. Implementation and development of the software will undoubtedly improve. Current impediments to implementation include dependence on the internet for execution, lack of standardization, uneven adoption across companies and industries, technical limitations, lack of regulatory structure, and unclear governance.

Blockchain runs on the internet with some describing it as an internet computer. The internet is robust and substantial, but anything affecting regions of the internet (for example, electricity blackouts, limitations on bandwidth, or viruses) can disturb blockchain. While blockchain by design is decentralized and can operate even when the internet has non-functional regions, this will create lags in affected nodes to update and accurately reflect the blockchain. Two dimensions of time requirements can be disrupted by impairments of internet functionalities. First, lags in transaction completion can disrupt specifically sought attributes of smart contracts. Second, lags can be locally pronounced relative the entire internet's health, and if those localities are associated with the localities of transacting parties, then it might not be feasible to timely initiate or complete the requisite blockchain transaction. A crucial feature of blockchain is that all nodes have an identical version of the ledger or have run an identical version of the software. This could be violated during internet breakdowns. Limiting the network to specific nodes that meet robust criteria would reduce failures due to breakdowns of the internet but may reduce transparency.

Bitcoin and Ethereum are two benchmarks in blockchain development, but innovations in blockchain occur rapidly. Multiple blockchains have been developed that vary in many characteristics. Although innovation is key at the current phase, standardization will be required for widespread use and full utilization of blockchain functionality to allow more complex applications with broader delivery. Despite Ethereum's flexibility in serving as a host for multiple different software, the complexity of apps is limited. Although some decentralized applications (dApps) are written to run on different blockchains, the applications can be more complex – and more effective – if the underlying software is more consistent.

Blockchain requires widespread adoption for many applications, which some have suggested could impede initiation and growth of blockchain application use. However, many firms in many different industries are eagerly adopting existing blockchains and developing expertise and experience. Casino, Dasaklis, and Patsakis (2019) outline the immense range of applications already in use. Thus, there appears to be a broad consensus that adopting blockchain applications, in some spheres of activity, are the best business practice.

In discussing impediments to blockchain success, a variety of technical difficulties can be cited. Of course, innovation can eventually address technical issues until they are no longer key concerns. As noted by Casey et al. (2018), current technical concerns include performance, scalability, privacy and security, interoperability, and governance. These are discussed further below.

Performance is a substantial problem as blockchain processes transactions slower than competitive software. The transaction speed of Bitcoin is three to seven transactions per second and for Ethereum, 15 to 25 transactions per second (Hazari & Mahmoud, 2020). In contrast, the centralized models of Mastercard and Visa can settle 5,000 credit card transactions per second. Bitcoin's slow processing speed can cause several-hour delays before transactions are processed, resulting in blockchain information which is not current. These processing delays lead to preferential treatment for orders with larger fees as miners can choose among multiple orders submitted at different times. Processing delays for Bitcoin are caused by the effort required by its Proof of Work (PoW) verification model. Proof of Stake (PoS) is an alternate mechanism for achieving consensus, but risks centralizing control in the hands of parties who accumulate large ownership positions as well as still other concerns. Cao et al. (2020) compare the performance of PoW, PoS, and a third mechanism. Other verification models may be less time- and resource-intensive but have additional challenges. While transactions with smaller fees could be directed to other software, they would eventually require integration into the 'primary' blockchain which is currently not a reliable process. Scalability is linked to performance. As blockchain becomes more widespread, total transactions will increase, exacerbating the performance issues from processing delays. Kaur and Gandhi (2020) provide additional insights on scalability.

Privacy and security, two strengths of the blockchain technology, may be challenges with some applications. Blockchain includes transparent transactions and pseudonymous participants. For some applications, it is better if transaction details are not disclosed (so think ransomware hackers). Even more common are complications around participant privacy. A key issue for regulators is that anonymity makes it easier to participate in illegal activities such as money laundering (e.g., from sex trafficking, drug dealers, etc.) and tax evasion (Sanchez, 2017). Also, repeated transactions by the same pseudonyms may allow hackers to discover participant identity or demographics. Additional security concerns are motivated by the supporting technologies and software operating with blockchain, which may not be as secure or private as blockchain itself. Although blockchain has been resistant to hacks, 90% of Bitcoin transactions occur in exchanges and with other providers outside of Bitcoin that may be vulnerable to security breaches.

Interoperability is key for blockchain adoption and a key challenge to widespread use. Almost every application will require blockchain to be paired with other software and systems. Moving smaller transactions 'off-chain' or allowing 'cross-chain' operability is a previously stated example. Interledger is a promising protocol for moving payments across different systems both centralized and decentralized, allowing integration with the existing financial system (see interledger.org).

Blockchain regulation, non-existent ten years ago, has moved very quickly and now covers many areas (Hacker, Lianos, Dimitropolous, & Eich, 2019). In the financial arena, bank regulators are taking proactive positions toward innovation, allowing more rapid changes than any previous period. National governments are concerned about money laundering, tax evasion, financial stability and a litany of other potential disruptors. Applying existing regulations to blockchain applications is an ongoing challenge, for example the determination of what constitutes a 'security' under securities laws. Some suggest these uncertainties may slow development, and indeed some products have been found to violate regulation and been terminated. Nevertheless, the vast majority of innovation has moved forward, with regulators scrambling to keep up.

Governance will become increasingly complex as technology advances and blockchain grows in scope. Blockchain promises to handle financial transactions potentially worth trillions of dollars. As this transpires, who controls the software will be crucially important, perhaps even inspiring plotlines for Hollywood movies. Maintaining each blockchain will likely require updates to the coding. In 2016, a loophole in Ethereum's coding allowed hackers to steal funds worth over $50 million. Ethereum was rewritten to eliminate the loophole and restore the funds. This created a 'hard fork' in the Ethereum blockchain, with some participants following the new coding and some following the original coding. Mehar et al. (2019) provide a detailed discussion of this 2016 event.

Beyond how blockchains and cryptocurrencies are themselves governed, these new technologies will create challenges and opportunities for many aspects of corporate governance. Yermack (2017) outlines how the balance of power may be altered among stakeholders including managers, shareholders, and regulators.

Although the potential impact of blockchain is immense, the immediate problems discussed above are serious. It may not be clear where effective implementation will happen next. Upcoming blockchain innovations can be tracked by following the money, to see where financing is being directed. This is the focus of our next section.

Data and Results

One approach to understanding the state of blockchain development is to examine those companies which have received investment capital. At this time, there are few publicly traded companies[3] primarily focused on any aspect of blockchain technology. However, there are many new firms developing and applying blockchain in innovative and extremely useful ways.

New firms raising capital typically rely on hedge funds, private equity, and/or venture capital. Investment motivations differ among the three groups of capital providers. Hedge funds have a short-run perspective, often using derivatives and leverage. Venture capital investors take small ownership stakes in firms that are often at the earliest stage of development. Private equity generally targets more mature firms and takes a larger ownership stake. Furthermore, private equity firms are themselves supported by the most sophisticated institutional investors. Thus, important insights can be gained from determining which types of blockchain applications are being developed by companies financed by private equity. These products may be among the most important blockchain applications in the years ahead.

Our data are obtained from the Crypto Fund Research database of crypto and blockchain investments by hedge funds, private equity, and venture capital. There are 20 private equity firms making 115 investments, distributed across 88 companies in the blockchain industry. Table 1 lists the 20 private equity firms. Table 2 categorizes the 88 blockchain companies by their primary product.

[3] Examples include Coinbase (ticker symbol COIN), HIVE Blockchain Technologies (HIVE), Canaan Inc. (CAN), VMWare Inc. (VMW), and Riot Blockchain (RIOT).

Table 1
Private Equity Firm Names and Number of Blockchain Investments

Firm Name	Blockchain Investments
Accolade Partners	1
All Blue Capital	7
Aquiline Technology Growth	1
Bain Capital	5
Calibrate Management	4
Canaan Partners	19
Fin Lab AG	3
GreenHouse Capital	2
GSR Capital	6
Idealab	3
InvestX	1
JD Capital	7
LUN Partners Capital	3
Mangrove Capital Partners	3
Scalar Capital	4
Sequoia Capital	13
Smartblock Capital	3
TokenStack Partners	16
Valor Equity Partners	2
Venrock	12

As the data in Table 2 suggest, there is very strong investment in the building blocks of blockchain including blockchain software (16), networks of hardware (8), and sidechain software (5), giving a total of 29 investments. Although some of these core products are targeted at very specific industries or services, they would still be categorized as a basic product.

Table 2
The Primary Product of Blockchain-Related Companies Supported by Private Equity Investments

Primary Product	Number of Companies
Blockchain	16
Coins/Tokens	13
Applications in financial services	11
Networks	8
Other applications	8
Exchange	6
Investments in venture capital firms	6
IT consulting	6
Sidechains	5
Wallet	5
Authentication	2
Misc.	2

The second area of extensive investment is cryptocurrencies including ICOs (13), exchanges (6), and digital wallets (5), giving a total of 24 investments. A third area of substantial innovation is applications in financial services (11), the emphasis of this paper. A fourth area is support including IT consulting, fundraising and marketing.

As noted near the beginning of this paper, blockchain applications in financial services are part of the growing arena of fintech. “At its core, fintech is the use of technology to provide new and improved financial services” (Thakor, 2020, p. 1). To further examine the 11 private equity investments in financial services shown in Table 2, we classify each into one of four categories presented by Stulz (2019): 1) payments; 2) digital lending; 3) digital banking; and 4) digital investment management and personal finance. For clarity and ease of exposition, we rename these as 1) payment systems; 2) lending; 3) banking; and 4) wealth management.

Table 3
Applications in Financial Services

Applications in Financial Services	Number of Firms Receiving Private Equity Funds
Payment Systems	4
Wealth Management	3
Lending	2
Banking	2

Das (2019) describes fintech as “primarily a disintermediation force where disruptive technologies are the drivers” (p. 981). This is supported by the evidence from Table 3. Payment systems, lending platforms, and banks themselves have always been fundamental to the banking sector, and wealth management has become increasingly important in recent years.

Conclusion

In the years ahead, technological innovation will increase blockchain’s roles in financial services and many other industries. However, the technology to exploit and disrupt blockchain will also continuously evolve. Additionally, increasing the influence of blockchain will make governance and regulation key issues as applications mature. Private equity investments suggest blockchain infrastructure is a key area of development and potential profitability, as exchanges, wallets, sidechains and blockchains were the most common investments. In the area of financial services, key investments include payment systems, wealth management, lending, and banking. Although there is a great deal of hype around blockchain, private equity investors are typically prudent, emphasizing high-probability first steps for the technology.

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