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Blockchain and the decentralization revolution

A CFO's guide to the potential implications of distributed
ledger technology

J.P.Morgan

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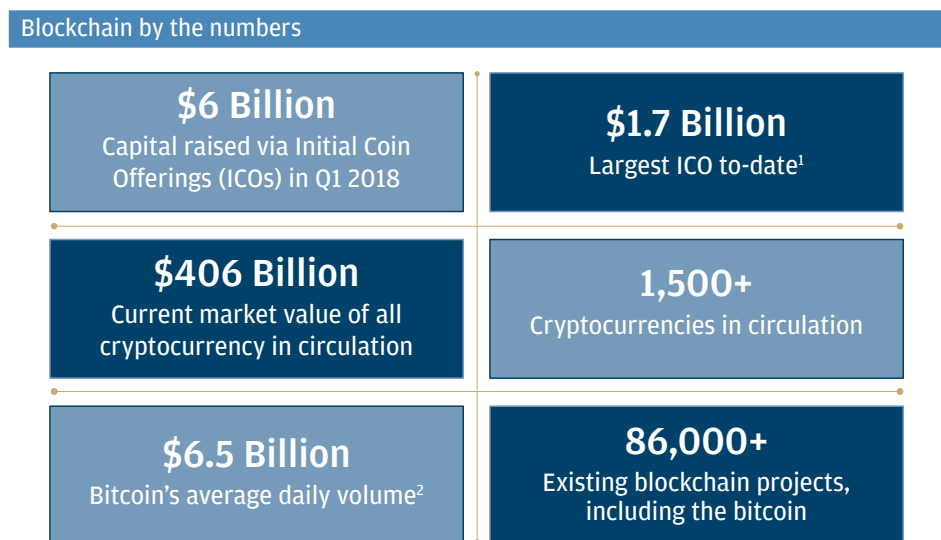
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1. Introduction

A query for “blockchain” on Google’s news aggregator returns 160 matches for the month of April, 2018, alone. The media’s interest in blockchain, or “distributed ledger,” technology and the associated “crypto asset class” over the last 12 to 18 months has mirrored the rapid development of the blockchain ecosystem. The figures are startling (Figure 1):

Figure 1



Source: Coinschedule.com, GitHub, Coinmarketcap.com; market data as of 04/30/2018

¹ According to Form D filings from 02/2018 and 03/2018 (https://www.sec.gov/Archives/edgar/data/1729650/000095017218000030/xslFormDX01/primary_doc.xml, https://www.sec.gov/Archives/edgar/data/1729650/000095017218000060/xslFormDX01/primary_doc.xml) Telegram ICO (pre-sale) dated March 2018

² 30-day average daily traded volume

While a lot has been written about blockchain, and its most media-friendly implementation, bitcoin, there has been less focus on the potential corporate use cases of the blockchain construct. This document will attempt to explain the technology in non-technical terms, provide an update on the current status of blockchain, and summarize an action plan for corporate decision makers to evaluate blockchain’s potential. We will also attempt to clearly outline the potential uses of blockchain while also highlighting the various risks and shortcomings that have been identified to date.

This is not a technical document. Many have filled that need in their white papers and reference materials. Rather, we seek to provide an informed view on the corporate implications of the rapidly changing interplay between finance and blockchain technology.

See a term that
you don’t know?

Check out the [Glossary](#) at
the back of this document.

2. Blockchain basics

Understanding the blockchain basics is crucial to being able to evaluate the technology's more sophisticated potential applications. So what is blockchain? Figure 2 provides a formal definition and a corresponding explanation in “plain English.”

Figure 2

Defining blockchain	
Blockchain characteristics...	...in plain English
A data store holding a log, or ledger, of transactions (events)	A blockchain is a database
Distributed across a public or private network	Multiple identical copies of the database are held by participants in the blockchain network
Using cryptography and hashing techniques to determine valid parties and transactions	Mathematical algorithms create unique electronic “fingerprints” for network participants and any piece of data
Such that everyone agrees on the order and state of the ledger, without having to rely on a trusted third party	A consistent version of the database is maintained using predetermined rules associated with verifying the “fingerprints” of those associated with changes to the database
With a practically immutable, verifiably true audit trail	The entire, unalterable transaction history has become the database itself

Source: J.P. Morgan

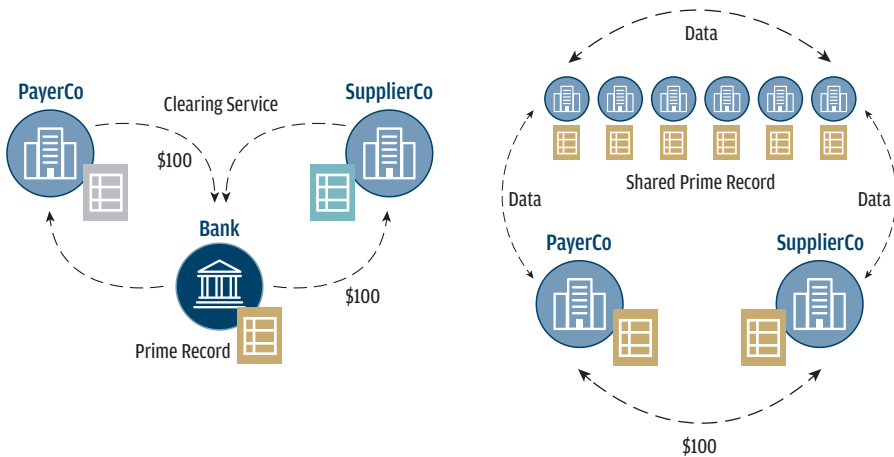
Even in simplified terms, blockchain technology includes some interesting characteristics. The distributed nature of the database means that information in the blockchain system is duplicated and resilient to network attacks. The use of encryption to “fingerprint” and validate data enhances the security of the overall system and also results in the side effect of a comprehensive and immutable audit trail. And perhaps most interesting, the development of algorithms to distribute the responsibility of validating changes to the blockchain's database (or “ledger”) provides a feasible alternative to maintaining a central validating authority.

This notion of “decentralized trust” is a key attribute of blockchain that excites many of its proponents. Consider a simplified illustration of a common occurrence: A company, PayerCo, wishes to send \$100 to a supplier, SupplierCo. In the centralized model, both PayerCo and SupplierCo would trust a central authority—a bank—to establish that PayerCo and SupplierCo were who they said they were and that PayerCo had \$100 to send to SupplierCo. To the extent the bank deems the transaction valid based on these prerequisites, PayerCo's account is debited by \$100 and SupplierCo's account is credited by \$100. In this model the bank remains the central authority and maintains a single copy of the ledger which reflects past transactions and current account balances.

Now consider a decentralized approach on a blockchain network. In this scenario, PayerCo and SupplierCo would be merely two entities in the broad payment network. PayerCo and SupplierCo each would have identical copies of the ledger and the details of PayerCo's \$100 payment to SupplierCo, which would be broadcast to all entities on the payment network. Other entities on the payment network evaluate their own copies of the ledger to validate the transaction (e.g., does PayerCo have \$100 to send?) and through a consensus algorithm agree on the updated state of the ledger, which in this example results in PayerCo's account being debited \$100 and SupplierCo's account being credited \$100.

Figure 3

Centralized vs. distributed ledger approaches: Finding trust in the network



Source: J.P. Morgan

The implementations of these consensus algorithms vary significantly. In the bitcoin implementation of blockchain, network participants run computationally challenging math problems in order to “vote” on the validity of a proposed transaction (and are rewarded for their efforts via the receipt of bitcoin through a process referred to as “mining”). This approach is required because the bitcoin network is public and trust amongst entities cannot be assumed. Alternative implementations of blockchain would most likely include “trusted” network participants who may validate proposed transactions under any circumstances—effectively a hybrid of a centralized and distributed approach.

While this description glosses over numerous technical details and simplifies many others, hopefully it is clear that blockchain technology has several benefits worthy of close evaluation. However, while some have fallen victim to thinking of blockchain as a panacea to the IT woes of global corporations, blockchain technology comes with several potential hurdles, especially in the near-term (Figure 4).

Figure 4

Blockchain adoption: Short-term hurdles vs. potential long-term benefits

Perceived short-term hurdles	Potential long-term benefits
<ul style="list-style-type: none"> ✘ Investment in new systems infrastructure: Managing a trade-off between short-term investment vs. long-term potential gains ✘ Technical hurdles: Challenges relating to scalability, data privacy, technology standardization, speed of execution, interoperability with existing systems ✘ Security concerns: Well-publicized issues in the cryptocurrency space may drive perception of security risk 	<ul style="list-style-type: none"> ✓ Costs reduction: Infrastructure costs reduced in data management, reconciliations, settlement, administration, etc. ✓ Greater liquidity: Ability to monetize existing assets via “tokenization” ✓ Security enhanced: Cryptography ensures ledger is immutable, and permissioned platform provides added security ✓ Efficiency improved: Speeding up processes by permitting transactions without the need of a trusted third party ✓ Enhanced transparency: Provides greater transparency with an auditable transaction log, and mitigates counter-party risk

Source: J.P. Morgan

It is worth closing this blockchain overview by addressing a common point of confusion. Blockchain is not bitcoin. Bitcoin is a digital currency independent of any central authority. While it is certainly a seminal implementation of blockchain technology, it is only a single use case. Whether bitcoin survives or not, the underlying blockchain technology is likely here to stay. To draw a similar analogy, bitcoin is to blockchain what America Online was to the internet. Bitcoin has been the introduction to blockchain technology for many people just as AOL was an introduction to the internet for many in the 90s. As the complete ramifications of the internet are still being understood, the implications of blockchain are also just beginning to be imagined.

3. Corporate finance implications of blockchain in the enterprise context

Like any emerging technology, the potential implications of blockchain seem both vast and at the same time not fully comprehensible. Many in the popular press have speculated about blockchain-driven notions as diverse as the development of borderless global currencies to the creation of fraud-proof voting tools to help eliminate electoral corruption and fraud. We may not yet even fully comprehend blockchain's "killer app."

For corporate finance professionals, however, the potential implications of blockchain are more tangible. Figure 5 illustrates three primary use cases of blockchain likely to be the most relevant in the corporate finance context:

Figure 5

Primary blockchain opportunities for corporate finance professionals		
Use case	Objective	Observations
Supply chain	<ul style="list-style-type: none"> • Create an auditable and shared transaction log to provide assurance and validate products in the supply chain 	<ul style="list-style-type: none"> • Shared platform lends itself to interoperation between suppliers and customers • Enhanced transparency drives opportunities for optimization and cost reduction • Many individual company and industry pilots underway
Financing	<ul style="list-style-type: none"> • Improve existing capital markets via decentralization and programmatic contract enforcement to further enhance the connectivity of capital issuers and capital providers • Utilize a "digital asset" construct to create new forms of capital with unique characteristics 	<ul style="list-style-type: none"> • Enhancement of existing capital markets offers the potential to reduce costs and counterparty risk • New types of capital (coins/tokens) could offer firms new avenues of liquidity and possibly reduce the overall cost of capital
Payments and settlement	<ul style="list-style-type: none"> • Transparency of transactions over time to all market participants • Reduce settlement time to T+0 	<ul style="list-style-type: none"> • Transparency of transactions allows all participants to view the entire transaction lifecycle and provides an auditable log

Source: J.P. Morgan

4. Supply chain

Today’s supply chain networks have exponentially increased in complexity as companies and markets have become more global and distributed. S&P 500 firms alone have more than 33,000 direct suppliers and more than 26,000 direct customers.¹ These customers and suppliers in turn have their own suppliers and customers, creating a complex but highly interdependent network of relationships.

This complexity and interdependence amongst different counterparties illustrates the challenge of supply chain optimization, but few finance professionals would dispute the potential financial benefits. Let’s consider supply chain optimization in the context of our earlier blockchain definition:

A blockchain is:

A data store holding a log, or ledger, of transactions (events): Managing a supply chain is, at the very least, a management of transactions. Being able to store those transaction details in an accessible database is key to any supply chain optimization

Distributed across a public or private network: The inherently “distributed” nature of any firm’s supply chain would lend itself to a form of distributed network where all participants in the supply chain effectively hold a copy of all the relevant supply chain information (OEM, suppliers, end customers, etc.)

Using cryptography and hashing techniques to determine valid parties and transactions: Blockchain’s embedded security features provide supply chain participants a unique digital “fingerprint” that ensures only authorized participants can make changes to the record of transactions. One tangible impact of this would be reduced concern of counterfeiting

Such that everyone agrees on the order or state of the ledger, without having to rely on a trusted third party: A network of supply chain participants could rely on the network to maintain the state of the database, without relying on a centralized authority who might otherwise use it to extract concessions in the supply chain context

With a practically immutable, verifiably true audit trail: A complete log of all transactions across the entire supply chain would be maintained in an unalterable state, enhancing audit capabilities

So a blockchain solution would fit the supply chain use case very well, potentially increasing transparency and ultimately efficiency, and drive cost savings. Not surprisingly, many firms are actively working towards developing supply chain proof-of-concepts. One crucial aspect of any blockchain solution, however, is mass adoption: Only when the supply chain participants can agree on a common blockchain solution would the full benefits be realized.

Supply chain short-term hurdles vs. potential long-term benefits	
Perceived short-term hurdles	Potential long-term benefits
<ul style="list-style-type: none"> ✗ Getting suppliers to join the network: The idea of sharing data as part of a distributed ledger could hinder participation of suppliers who might worry about competitive implications 	<ul style="list-style-type: none"> ✓ Enhanced capability to manage operations/processes: Complete log of transactions across the entire supply chain would improve audit capabilities ✓ Reduced counterparty risk: Transactions validated by the blockchain network ✓ Improved customer experience: Provide retail consumers of goods more information about the origins of products

¹Source: Bloomberg, J.P. Morgan as of 04/2018

5. Financing

The potential ramifications of blockchain on corporate finance are difficult to understate. Even in its relatively nascent state, blockchain offers numerous potential options for finance professionals to ponder as the technology develops. We evaluate two distinct possible impacts:

Blockchain as capital markets 2.0

Like the supply chain use case, existing financing markets have characteristics that naturally lend themselves to the features of blockchain technology: Numerous participants, seeking to maintain a record of ownership, and reduce friction costs. Let's consider how financing markets might fit the blockchain mold:

A blockchain is:

A data store holding a log, or ledger, of transactions (events): Financing markets are the amalgamation of records of ownership and transfer of value. A ledger is crucial to understanding the state of the market at any moment in time

Distributed across a public or private network: An effective financing market needs to have high resiliency and availability; a distributed database can help to maximize market uptime and mitigate the potential instability of network participants

Using cryptography and hashing techniques to determine valid parties and transactions: Blockchain's cryptographic underpinnings can help ensure the security and validity of asset ownership

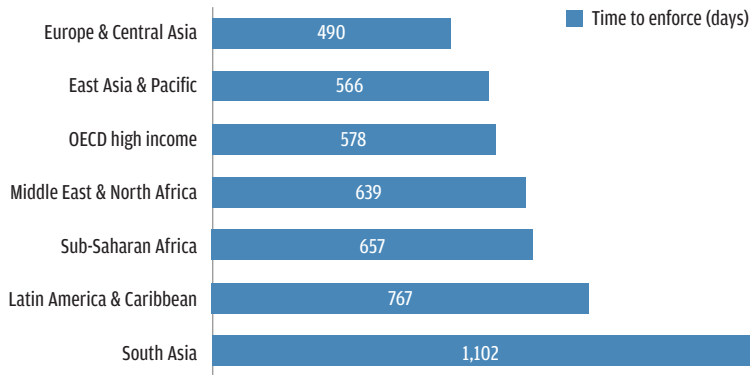
Such that everyone agrees on the order or state of the ledger, without having to rely on a trusted third party: A network of financial market participants could rely on the network to maintain the state of the database, without relying on a centralized authority. Alternatively, a permissioned blockchain could allow a set of trusted market participants (e.g., banks and market makers) to validate transactions and maintain the state of the network

With a practically immutable, verifiably true audit trail: A complete log of all transactions across the entire financial market would be maintained in an unalterable state, enhancing audit capabilities and streamlining the clearing process

Blockchain also has the potential to offer functionality not currently available to capital markets participants. Consider a traditional bond security: An investor buys a bond that has behavior defined in a prospectus (that includes a given maturity date, coupon, payment schedule, etc.). The investor and issuer enter into a contractual arrangement enforced by various legal and regulatory underpinnings that ensure the investor receives interest and principal in all but (hopefully) extreme default scenarios. In a blockchain or distributed ledger implementation, this contractual arrangement could be defined and enforced by the network itself. That is, a "blockchain bond" could make periodic interest payments and ultimately mature programmatically. This notion of a blockchain "smart contract" provides the capabilities to digitally facilitate, verify, and enforce the execution of a contract. Enforcement of contractual agreements is a lengthy and costly process in both developed and underdeveloped markets (Figure 6), and smart contracts could significantly reduce transaction costs, time to enforce, and counterparty risk. The potential benefits of smart contracts aren't limited to the capital markets: To the extent certain kinds of assets (e.g., real estate) are managed on a blockchain framework, there could be implications for M&A, as well.

Figure 6

Enforcing contract law programmatically may have significant benefits globally



Source: The World Bank

Note: The enforcing contracts indicator measures the time and cost for resolving a commercial dispute through a local first-instance court, and the quality of judicial processes index, evaluating whether each economy has adopted a series of good practices that promote quality and efficiency in the court system. The most recent round of data collection was completed in June 2017

Work is already underway to improve existing capital markets by extending them onto blockchain implementations. These changes are likely to be transparent to existing capital users and providers since they will rely on developing solutions in the context of existing forms of capital. This is not to say you'll be day trading on the blockchain anytime soon. Blockchain technology today still suffers from significant limitations around scalability and transaction processing speed. However, financing markets that ultimately depend less on centralized market authorities and more on a distributed framework of ownership have, at the very least, the potential to increase efficiency, improve market transparency, and lower costs (Figure 6).

Over the past 18 months, J.P. Morgan's Debt Capital Markets business has spent considerable time evaluating how distributed ledgers can be an opportunity for both industry thought leadership and capital markets transformation. Dromaius (J.P. Morgan's Capital Markets Blockchain Proof of Concept Platform) is creating a decentralized market for digital assets, designed to allow direct transacting between issuers and buyers and to provide analytics-driven, frictionless, rules-driven liquidity management solutions. In this evolving capital markets environment, blockchain technology should ultimately be able to help connect borrowers and lenders and facilitate an enhanced and more secure marketplace where transactions are recorded and validated by network participants and corporates can achieve ongoing access to capital markets.

In April 2018, National Bank of Canada, with the support of J.P. Morgan, issued a \$150 million, one-year floating-rate Yankee certificate of deposit, with a parallel simulation of the issuance using blockchain technology. The blockchain debt issuance application was designed to incorporate functions across the entire debt instrument transaction lifecycle, including origination, distribution, execution, settlement, interest rate payments, and maturity repayments. This transaction demonstrates the technology's capabilities and capital markets implications.

Financing short-term hurdles vs. potential long-term benefits

Perceived short-term hurdles	Potential long-term benefits
<ul style="list-style-type: none"> ✗ Getting regulators on board: IRS/SEC to approve issuance and trading ✗ Incremental capital structure complexity: New definitions for fit in the capital structure and impact on existing securities would need to be evaluated by accountants/lawyers; CFOs and treasurers might be reluctant to add capital structure complexity 	<ul style="list-style-type: none"> ✓ Ongoing and easy access to capital markets: Enhanced liquidity and ability to raise capital in a streamlined process via crowdfunding ✓ Greater liquidity: Ability to monetize existing assets via tokenization ✓ Lower cost of capital: Reduced transactions costs

Source: J.P. Morgan

Blockchain as a facilitator of new forms of capital

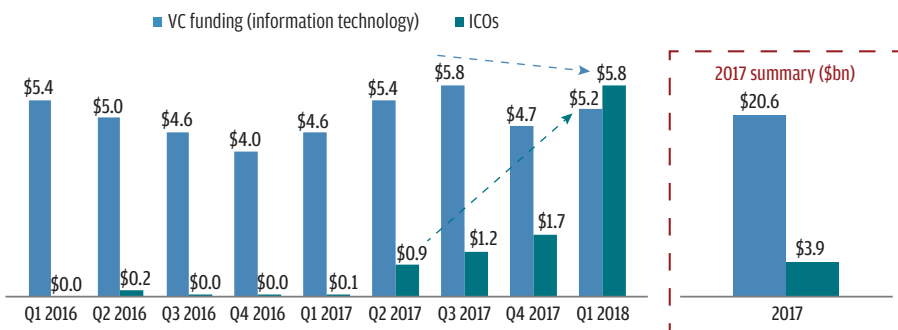
Perhaps one of the most visible aspects of the rapid development of blockchain technology has been the emergence of so-called “Initial Coin Offerings” or ICOs. These structures have allowed firms to raise money in exchange for digital “coins” or “tokens” to be traded on blockchain networks. So what is this new form of “coin” capital? In short, just about anything you can think of. It is a digital representation of value. This value could reflect something physical (e.g., real property) or more conceptual (e.g., copyright ownership). If that construct isn’t abstract enough, consider that a coin doesn’t have to simply be a static representation of value but rather can also have dynamic characteristics as defined by smart contracts, as discussed above.

Amazingly, many firms have accomplished these fundraising objectives before the development of the digital coin or associated marketplace has even taken place. This form of industrial-strength crowdfunding raised almost \$4 billion in 2017 and almost \$6 billion in the first quarter of 2018 alone (Figure 7), outpacing the capital raised in the first quarter by VCs for information technology start-ups!

Figure 7

Initial Coin Offerings (ICOs) are increasingly being adopted as a mechanism for raising capital but regulatory uncertainty remains a hurdle for wider adoption

VC funding (information technology) vs. ICOs over time (\$mm)



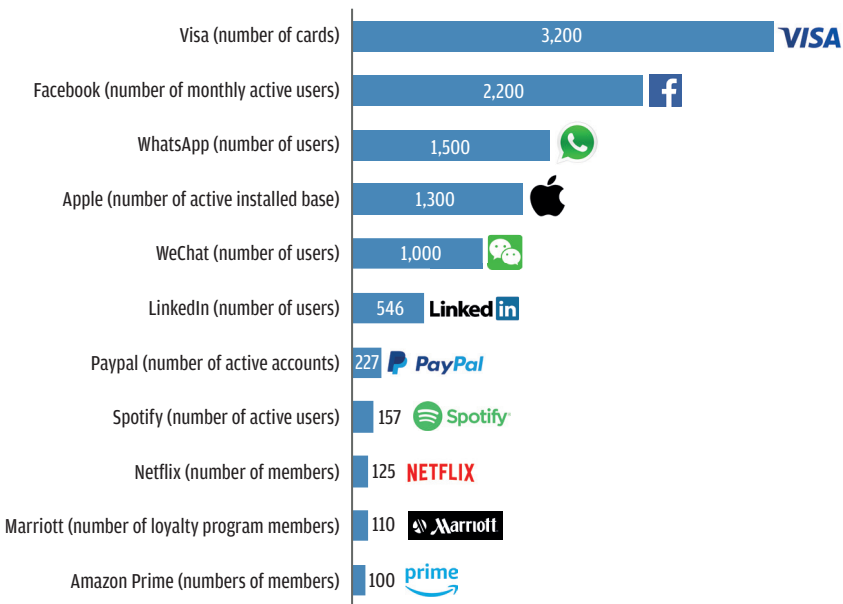
Source: PitchBook, Coinschedule.com; Note: VC funding includes Seed, Series A and Series B funding stages
 Note: Market data as 03/31/2018

Many of the ICOs described above have been issued without any future promise of return of principal or rights to interest (so they are clearly not debt) but they also have avoided offering voting rights or rights to cash flow typical of equity. This suggests that blockchain technology has facilitated the creation of a new asset class, and potentially a new form of capital. But it also raises the question of where investors see value in these structures. One possible answer is in the potential network effect of a successful coin, whereby current investors seek the opportunity to get in early on a technical solution that becomes a de facto standard for the emerging digital asset class.

While mostly start-ups have been quick to seek ICO monetization opportunities based on this network effect potential, incumbents with large existing user bases (Figure 8) may be even better positioned to be the new standard-bearers. For example, companies could issue “utility” tokens that users would purchase and use to pay for services; leveraging a blockchain platform to connect billions of customers could eliminate traditional intermediaries, reduce transaction costs, and expand the customer base.

Figure 8

ICOs might be interesting for companies with large user-based networks; selected current networks (in millions)



Source: Company filings, company presentations, Techcrunch.com, brokers estimates

For more traditional capital issuers let’s consider how blockchain “coins” might challenge the conventional corporate finance perspectives:

Debt or equity? Precedent ICOs suggest there is an investor base for capital that possesses neither explicit debt nor equity characteristics. This has significant ramifications for those seeking to raise capital, since it potentially offers enhanced financial flexibility, possible credit rating flexibility, and limited dilution. For existing capital providers, the addition of coins to the capital structure offer both benefits and pitfalls: A coin issuance might diversify funding sources and enhance credit quality, or it might subordinate a capital provider’s right to cash flows. The inherent flexibility of the coin construct means that different structures may have different impacts on the rest of the capital stack.

Accounting treatment? For all the uncertainty of how coin offerings might be viewed economically, accountants have only so many options for reflecting a coin issuance on the balance sheet. While treatment differs subject to the exact circumstances, most have been accounted for as debt, equity, or deferred revenue.

Speed to market? Unlike IPOs or even debt offerings that typically require extensive regulatory filings, investor marketing, and execution timelines, ICOs have been rapid turn-around exercises. Many have used techniques similar to popular “crowdfunding” websites to raise funds from anyone with an internet connection. Heightened scrutiny from the SEC has definitively slowed the process and increased scrutiny, particularly for those who hoped to avoid securities registration, but the process illustrates the potential for disruption in the more traditional capital raising venues.

Regulatory hurdles? Coins as a capital raising tool remain very much new technology. All ICOs transacted to date were done by start-up stage companies seeking to raise money from venture capitalists and other early-stage investors who may more fully appreciate the future potential of a given coin. In a statement made by SEC Chairman Jay Clayton in December 2017, it was noted that no ICOs to date had been SEC-approved or registered offerings.² Chairman Clayton also emphasized that “the structures of [ICOs] that [he] has seen promoted involve the offer and sale of securities.” While the SEC’s comments emphasize their commitment to promoting capital formation, this commentary suggests that ICOs and other strategies involving “crypto” assets are likely to receive additional scrutiny. More recent comments by the SEC clarifying that online platforms that facilitate the trading of digital assets (e.g., coins or tokens sold in ICOs) must register with the SEC as national securities exchanges (or be deemed exempt) also underscore the incremental regulatory scrutiny, but also the speed at which the market may mature.³ Legal definitions, accounting standards, and tax treatment will all need to be determined to provide comfort for large corporations to utilize this new source of capital.

Should you contemplate raising capital through an ICO? It is tempting to look at the amount of capital recently raised through ICO processes and ponder the opportunities for raising capital via one’s own coin issuance. In practice, the potential for a successful coin issuance is very fact-specific. A potential coin issuer requires the technical prowess to implement a public technology solution and manage the associated challenges and risks. An issuer would also have to navigate what is currently a highly complex but navigable regulatory environment while also ensuring that such a capital raising endeavor didn’t have negative consequences for other capital providers. While these challenges are surmountable, and are likely to become more so as the technology develops, firms considering raising capital via ICOs today are very much early adopters and are likely to encounter numerous hurdles, accordingly. The rapid rise of the ICO market, however, serves to illustrate the potential impact of new technology, and blockchain, specifically, applied to old corporate finance problems.

²Source: SEC Chairman Jay Clayton, Statement on Cryptocurrencies and Initial Coin Offerings (December 11, 2017, <https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11>)

³Source: Statement on Potentially Unlawful Online Platforms for Trading Digital Assets – Divisions of Enforcement and Trading and Markets (March 7, 2018, <https://www.sec.gov/news/public-statement/enforcement-tm-statement-potentially-unlawful-online-platforms-trading>)

6. Payments

As a bank, we are keenly aware of some of the inefficiencies and redundancies in our own core businesses. The process of making cross-border payments through networks of correspondent banks is an area admittedly rife with such inefficiencies. Figure 9 illustrates a typical cross-border payment facilitated through a correspondent banking network. In short, a local remitter bank might work through several intermediaries and related correspondent banks to facilitate such a transaction. Each bank in this network must replicate risk management functions, meet liquidity requirements, and facilitate clearing and settlement, all while maintaining compatibility with the relevant interbank messaging technologies.

The consequences of these various redundancies are numerous: Payments are slow (sometimes taking days to complete), reconciliation between various parties is often manual, and the process is generally opaque and costly.

Now consider the problem of payments via correspondent banking networks through the lens of blockchain technology, once again using that initial blockchain definition to guide the applicability of the technology to the problem:

A blockchain is:

A data store holding a log, or ledger, of transactions (events): The correspondent banking system manages payments through records of asset ownership and the associated transactions

Distributed across a public or private network: A system where each bank in the network would maintain a copy of the record of assets and transactions would reduce duplication of effort, particularly with respect to tasks like sanctions screening, AML/KYC requirements, and record keeping. A distributed ledger would also help to eliminate intermediaries, increasing the speed of transaction processing and lowering cost

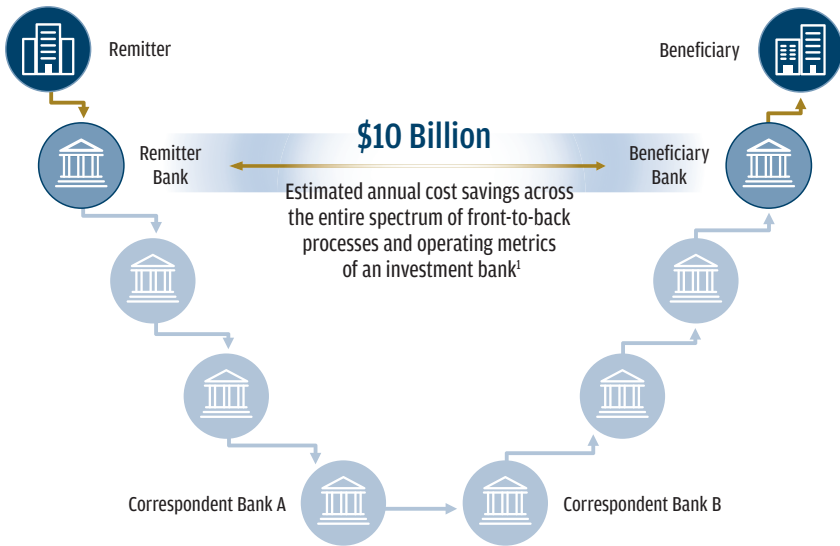
Using cryptography and hashing techniques to determine valid parties and transactions: Blockchain's cryptographic underpinnings can help ensure the authenticity and security of potential transactions

Such that everyone agrees on the order or state of the ledger, without having to rely on a trusted third party: Given the well-established nature of the current correspondent banking network, a permissioned blockchain network could allow the order and state of the ledger to be determined without the need for costly computational overhead (i.e., "mining")

With a practically immutable, verifiably true audit trail: A complete log of all transactions across the entire correspondent network would be maintained, establishing a comprehensive audit trail of all transactions

Figure 9

Blockchain could significantly simplify the correspondent banking structure



Source: J.P. Morgan

¹ Based on Accenture's estimates from the article "Banking on Blockchain" (2017) that the annual savings for investment banks as a result of implementation of blockchain technologies range between \$8-\$12 billion

The correspondent banking system is an important and well-established aspect of the global financial system ripe for renovation and technological change. It is by no means the only way in which funds flow between counterparties, however, and this illustration brings into stark relief the disruptive influence of blockchain in the context of financial payments, broadly.

In October 2017, J.P. Morgan, along with Royal Bank of Canada and Australia and New Zealand Banking Group, announced the launch of the Interbank Information Network (IIN). This new initiative will seek to use blockchain technology to streamline and improve the efficiency of the global payments process. Consistent with the correspondent banking case described herein, the IIN will seek to reduce the number of parties currently needed to maintain the various compliance and data-related requirements that slow payments.

Payments short-term hurdles vs. potential long-term benefits

Perceived short-term hurdles	Potential long-term benefits
<ul style="list-style-type: none"> ✘ Regulatory & jurisdictional compliance standards: New standards and processes would need to be determined ✘ Anti-Money Laundering (AML): Creation of AML standards within decentralized networks 	<ul style="list-style-type: none"> ✓ Speed of execution: Reduce settlement time to T+0 ✓ Significantly reduce counterparty risk: Transactions validated by the blockchain network ✓ Lower transaction costs: Ability to execute the process without intermediaries

Source: J.P. Morgan

7. Where blockchain comes up short

Blockchain has captured the imagination and interest of entrepreneurs, financial professionals, and the media. This interest risks making blockchain appear almost as some form of technological panacea, offering potential solutions for everything from the line at the DMV to global warming. Blockchain's optimal use cases are relatively more nuanced and specific, as illustrated in the previous examples. Any evaluation of a potential blockchain-based solution should consider the following questions:

Is a decentralized system required? A decentralized system, like blockchain, may be appropriate where numerous independent parties wish to maintain a centralized database, particularly if there is a concern about a single party “owning” the data. In many cases, however, it is natural for a central authority (a government, bank, healthcare provider, etc.) to maintain and secure information. While decentralization offers other benefits, such as redundancy and resilience against certain forms of cyberattacks, there are numerous technical solutions that offer these benefits without the use of a blockchain.

Do the business case requirements align with the current state of blockchain development? While the promise of blockchain is appealing, the development of robust, enterprise-ready blockchain tools remains in its early days. Furthermore, current blockchain implementations still suffer from a number of basic limitations (in particular, limited speed and scalability). A project requiring a rapid development cycle may not be currently well-suited to blockchain.

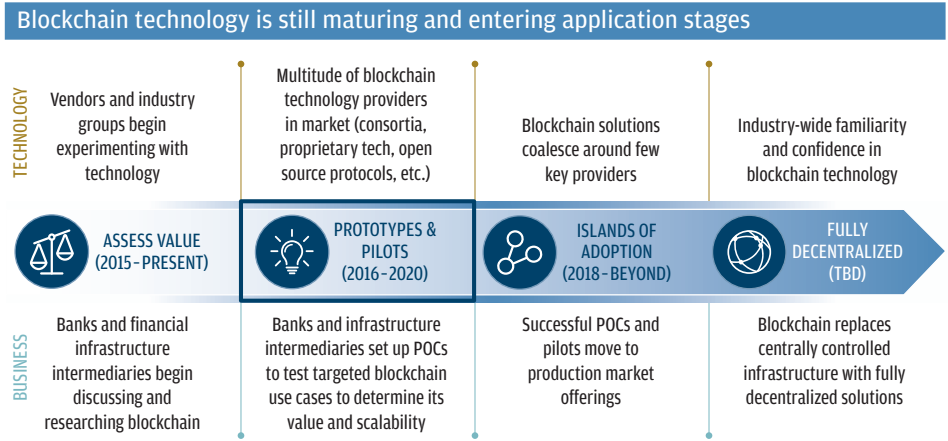
Is the technical problem well-defined? The far-reaching implications of blockchain technology have sparked conversations amongst management teams and boards about how technology, broadly, is changing the day-to-day corporate landscape. While appealing to contemplate in the abstract, it is critical to understand what problems are well-defined enough to have technical solutions. A process involving multiple sophisticated counterparties (e.g., banks) might be something to be codified and automated. In contrast, a complex network of on-the-ground relationships (e.g., between local suppliers in foreign jurisdictions, for example) may simply not lend itself to a feasible automated solution.

Blockchain is just the latest technology to invigorate the ever-changing dialogue surrounding business and technology, following on the heels of hot topics, such as “the cloud,” “big data,” and “AI (Artificial Intelligence).” Like all these technologies, blockchain remains a tool with incredible promise yet to be fully realized, but also one with natural limitations and applications.

8. Seeing blockchain move from theory to practice

Blockchain and distributed ledger technology continues to develop at a rapid pace, but the technology is still maturing. While the cryptocurrency asset class is becoming more established, with asset managers increasingly considering investment, for enterprise technology purposes, the use of blockchain remains very much in the proof-of-concept (“POC”) stage. As summarized in Figure 10, 2018 is likely to be a watershed year as proof of concepts transition to production stage offerings.

Figure 10



Source: J.P. Morgan

At the same time, a large ecosystem has developed around blockchain with developers starting to coalesce around a few “fabric” blockchain or distributed ledger platforms. Ethereum is one notable example that has gained notoriety as being the second largest cryptocurrency behind bitcoin, but the ethereum network and code base are increasingly being used as the basis for other blockchain implementations and applications. As illustrated in Figure 11, well-known aspects of blockchain universe are just individual components of an increasingly large scope of ongoing tools being developed.

Figure 11

The blockchain ecosystem is far broader than just “cryptocurrencies”

Stack	Core focus	Market participants
Data	<ul style="list-style-type: none"> Provide data and content for decentralized applications 	<ul style="list-style-type: none"> Data providers, such as Bloomberg, Thomson Reuters
Applications	<ul style="list-style-type: none"> Tend to have domain and industry focus, providing specific utilities 	<ul style="list-style-type: none"> Cryptocurrency tokens and digital assets, such as Cobalt, Hijo
Distributed ledger - implementations	<ul style="list-style-type: none"> Public or private, generally have unique protocols, consensus, privacy considerations 	<ul style="list-style-type: none"> Distributed ledger applications, such as Quorum
Distributed ledger - fabric platform		<ul style="list-style-type: none"> “Fabric” blockchain platforms, such as bitcoin, ethereum, ripple
Development platform	<ul style="list-style-type: none"> Cloud development platform for blockchain/infrastructure 	<ul style="list-style-type: none"> Large-cap tech companies (e.g., Amazon, IBM, Microsoft)

Source: J.P. Morgan

9. Action plan

Even though blockchain remains in its early days, it is not difficult to see how wider adoption of the technology could have far-reaching implications for corporate finance. CFOs and financial executives should continue to periodically evaluate both the latest blockchain developments, but also how those developments could directly impact their business and financial objectives. Senior decision-makers should also continue to evaluate their growth investment opportunities as technology continues to drive the risk of business disruption ever higher. Finally, firms may wish to evaluate strategic blockchain partnership opportunities—either within their own industries or with blockchain thought leaders like financial institutions and start-ups.

Ultimately blockchain is just the latest in a line of technology developments that will require the focus and understanding of the entire C-suite as business models and markets evolve.

Figure 12

CxO playbook	
<p>Chief Executive Officer (CEO)</p> <ul style="list-style-type: none"> • Assess and understand the potential impact of blockchain on your organization • Outline the longer term vision and the ambition for your organization • Determine where blockchain falls on the priority scale for your leadership team, especially vis-à-vis other innovative technologies • Encourage open and transformative thinking, particularly among young tech teams • Develop an external engagement approach 	<p>Chief Financial Officer (CFO)</p> <ul style="list-style-type: none"> • Evaluate growth investments in blockchain-related projects for internal development or through acquisitions • Learn about new banking platforms and solutions that utilize blockchain technology (e.g., Quorum) that could provide new sources of capital and liquidity going forward • Identify strategic partnership opportunities for potential blockchain applications, inside and outside your organization
<p>Chief Operating Officer (COO)</p> <ul style="list-style-type: none"> • Bring the business process and controls view to potential blockchain applications • Partner with the CTO on determining if/when a blockchain lab makes sense for your organization • Future-proof, long-term operating model decisions that may be impacted by blockchain • Identify partners across the ecosystem that are active and engage them • Prioritize use cases to follow/monitor vs. ones to lead and develop yourself 	<p>Chief Technology Officer (CTO)</p> <ul style="list-style-type: none"> • Lead internal understanding and an awareness campaign around blockchain • Identify emerging experts across the organization • Determine if/when the creation of a blockchain lab makes sense • Review long-term technology decisions that may be impacted by blockchain • Engage with external vendors and follow technology advancements in the space

Source: J.P. Morgan

BLOCKCHAIN GLOSSARY

Bitcoin: A cryptocurrency and worldwide payment system. Bitcoin is the first decentralized digital currency, as the system works without a central bank or single administrator. Bitcoin is underpinned by a peer-to-peer network where transactions take place between users directly, without an intermediary

Block: A package of data that contains zero or more transactions, the hash of the previous block, and optionally other data. Because each block points to the previous block, the data structure that they form is called a “blockchain”

Blockchain: A type of distributed digital ledger to which data is recorded sequentially and permanently in “blocks.” Each new block is linked to the immediately previous block with a cryptographic signature, forming a “chain.” This tamper-proof self-validation of the data allows transactions to be processed and recorded to the chain without recourse to a third party certification agent. The ledger is not hosted in one location or managed by a single owner, but is shared and accessed by anyone with the appropriate permissions—hence “distributed”

Cryptography: The branch of mathematics that enables the creation of mathematical proofs that provide high levels of security. Online commerce and banking applications already use cryptography

Encryption: The process of converting information or data into a code, especially to prevent unauthorized access and hide its meaning

Ethereum: Ethereum is an open-source, public, blockchain-based distributed computing platform and operating system. Ethereum’s implementation of “smart contracts” is a differentiating feature relative to other blockchain-based platforms (including bitcoin)

Fork: A situation when a blockchain diverges into two potential paths forward, with regards to transaction history or a new rule about valid transactions. As different parties need to use common rules to maintain the history of the blockchain, users of the blockchain must support one or the other. As a result of a rule fork, a blockchain can split (i.e., diverge into two separate paths forward)

Hash: The result of applying an algorithmic function to data to convert it to a fixed-size string of numbers and letters, also called a “checksum.” This acts as a digital fingerprint of that data, allowing it to be locked in place within the blockchain

Initial Coin Offering (ICO): An ICO is a means of financing centered on crypto assets, which can be a source of capital for start-up companies. In an ICO, a quantity of the crypto asset is sold to investors in the form of “tokens” or “coins,” in exchange for legal tender or other cryptocurrencies

Key: A key is a small amount of information that allows its holder to convert plaintext data into encrypted data (ciphertext) and vice versa

Mining: A process where transactions are verified and added to a blockchain. For example, bitcoin mining is the process of making computer hardware do mathematical calculations for the bitcoin network to confirm transactions and increase security. As a reward for their services, bitcoin miners can collect transaction fees for the transactions they confirm, along with newly created bitcoins

Node: A copy of the ledger operated by a participant with a blockchain network

Proof of work: An algorithm that rewards the first person who solves a computational problem (i.e., mining) to achieve distributed consensus. Miners compete to solve difficult cryptographic puzzles in order to add the next block on the blockchain. It prevents spam and cyberattacks as it requires work from the service requester

Quorum: Quorum is an enterprise-focused, open-source version of Ethereum created by J.P. Morgan. Quorum is designed to address specific challenges to blockchain technology adoption within the financial industry and supports blockchain transactions amongst a permissioned group of known participants

Smart contract: A computer program intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract. Smart contracts allow the performance of credible transactions without third parties. These transactions are trackable and irreversible

FURTHER READING

J.P. Morgan Perspectives - Decrypting Cryptocurrencies: Technology, Applications and Challenges - <https://www.jpmm.com/research/content/GPS-2559049-0>

Unlocking Economic Advantage with Blockchain - A guide for asset managers - <https://www.jpmorgan.com/jmpdf/1320706695973.pdf>

Bitcoin white paper - Bitcoin: A Peer-to-Peer Electronic Cash System - <https://bitcoin.org/bitcoin.pdf>

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