SPECIAL SECTION

What's the Real Deal on Web3?

Examining the revenue potential and potential risks of blockchain and cryptocurrencies for local governments

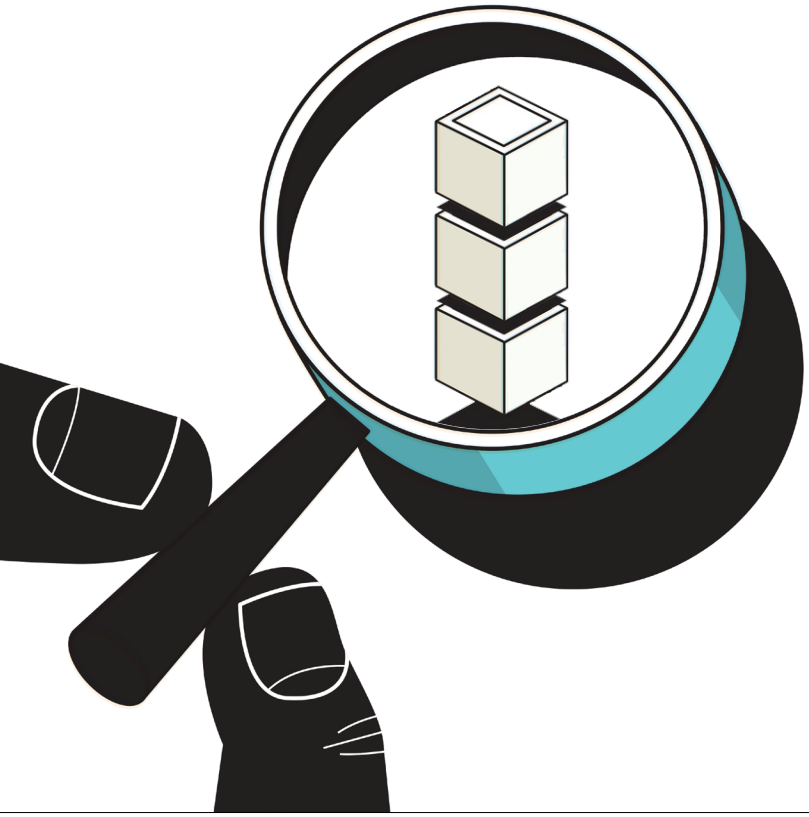
BY THEO COX AND SHAYNE KAVANAGH

Cryptocurrency and blockchain are part of the latest iteration of Internet technologies, broadly referred to as "Web3." Web3 includes cryptocurrency but also other technologies that are characterized by decentralized, blockchain-based architectures. Non-fungible tokens (NFTs) are another example of a Web3 technology that has gotten widespread attention. A brief Internet search on "Bored Ape Yacht Club" gives an idea of the fervor NFTs have created.

Web3 and cryptocurrency have led to much excitement and investment beyond what we see in popular culture. Many sectors are experimenting with these technologies, including some local governments. Initiatives such as CityCoins have made headlines but are not without controversy. Questions persist about the potential of these technologies for public finance.

This series aims to help local governments think about the revenue potential of Web3, as well as potential risks. Web3 technologies are complex, and their implications are not well understood. Though we would not expect local governments to invest directly in cryptocurrencies, and GFOA has an advisory that recommends governments abstain from using and investing in cryptocurrency, their wild swings in value illustrate the uncertainty surrounding Web3 technologies.

In March 2022, GFOA approved an advisory that advises governments to abstain from accepting cryptocurrency for receivables, using cryptocurrency for payables, and investing in these products. More information is available at **gfoa.org/materials/cryptocurrency-advisory**.



Understanding Web3 and Blockchain Technology

The term "Web3" lacks a precise definition. It is often used as an umbrella term for various blockchain-based technologies and activities. Most famously these include cryptocurrencies and non-fungible tokens (NFTs), but there are many others. A more detailed outline of these is given in section 2. Web3 also evokes a future version of the Internet based on these technologies. A good way to begin understanding Web3 is to compare it to its predecessors, Web2 and Web1.

Venture capitalist Marc Andreesen formulated a simple typology:

- **Web1 = read.** The earliest Internet applications published information online in formats like blogs for people to read.
- **Web2 = read and write.** The next iteration of the Internet allowed users to publish their content much more easily, with social media being a prime example.
- **Web3 = read, write, and own.** Web3 allows users to exercise ownership rights over Internet content, using technology native to the Internet rather than relying on external forces to enforce ownership rights (such as copyright laws). One of the implications is that scarcity can be introduced to the Internet. A finite supply (of a certain cryptocurrency, for example) introduces a pricing dynamic that has not existed before on the Internet.

Introducing ownership rights as native to the Internet isn't the only exciting aspect of Web3. Proponents also cite decentralization and alternative economic models, with cryptocurrencies being the most famous but far from only example.

This isn't just a result of technological innovation—social narratives fuel excitement around Web3. For example, trust in institutions has been decreasing dramatically for years. By supporting decentralization, Web3 promises to reduce reliance on institutions. The creation of Bitcoin was partially inspired by distrust in established banking institutions, as the first Bitcoin references the 2008 financial crisis in its code.[1] Another obvious social narrative is that Web3 is a bold new frontier, capable of generating fantastic wealth.

Because "blockchain" technologies are the basis for Web3 technologies (and the associated social narratives) let's see what this technology is, and how it works.

What is blockchain technology?

Blockchain technology is an example of an "append-only distributed ledger." The "append-only" ledger means that data can only be added to it, but not edited or removed. "Distributed" ledgers are databases where data is stored across many different actors in a network rather than in a single location. These actors are referred to as "nodes" in the network. In a blockchain, each node stores a full copy of the database. As all nodes have equal permissions within the network—they all have the power to do the same actions—these are known as "peer-to-peer" (P2P) networks, and it's this feature that leads people to describe blockchains as decentralized technologies. The fact that all participants have full access to the entire database and are equally empowered[2] within the network is one of the key technical features that fuels the excitement around blockchain technologies, as this is said to build in transparency and more participatory dynamics.

Blockchains can be categorized as either public or private. This distinction is similar to the differences between the Internet and intranets. Public blockchains are publicly visible and accessible to anyone. They are

"permissionless," meaning anyone can participate in transacting (adding data to the ledger) or validating transactions. Private blockchains are used internally by private actors such as businesses to manage their data. But almost all discussions around Web3 and blockchain in popular culture today refer to public, permissionless blockchains—although much of the excitement exhibited by private companies refers to private blockchain. Some of the potential applications for local government might also rely on private blockchains.

How do blockchains work?

Exhibit 1 outlines the way in which data is added to a blockchain.

Step 1: Creating a new block. A node must create a new block for data to be added to a blockchain. Any node can create new blocks of data. These "blocks" contain the data itself (for example, the sender, recipient, and amount of a transaction), a unique identifier for the block, and a unique identifier for the previous block.

Step 2: Broadcast and validation. For the new block to be added to the blockchain, it must be broadcast to all other nodes on the network so that they can validate it. The other nodes must approve and add it to their local copies of the database. This approval requires a "consensus mechanism."

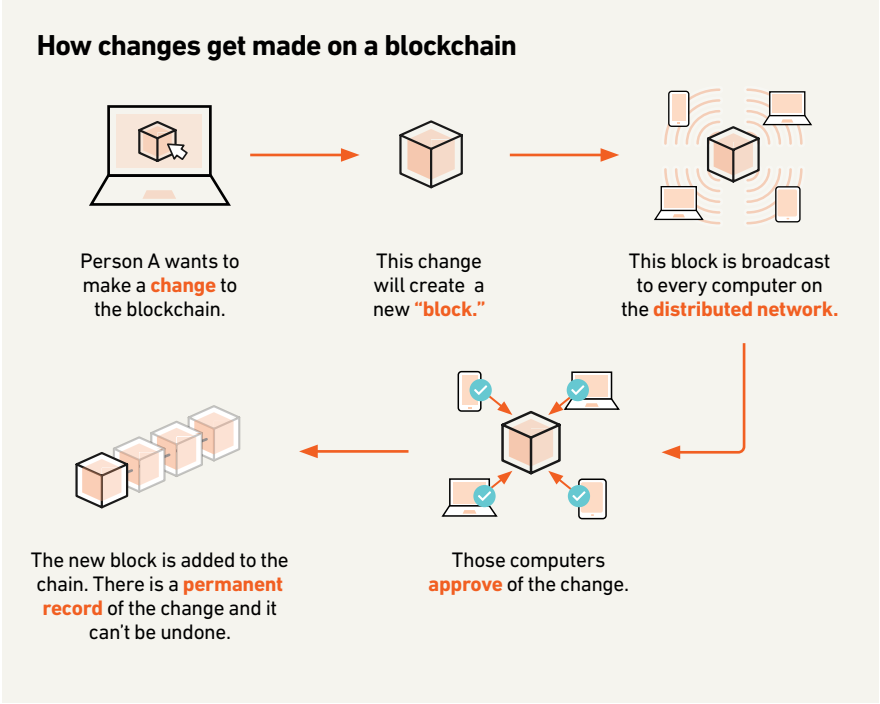
Consensus mechanisms are required as the database has no central administrator. Rather than a central actor deciding what is added, the nodes must "agree" to update their own database copies. Subsequently, the newly created block is added to all local copies of the database and becomes immutably part of the blockchain. Consensus mechanisms create incentives for nodes to validate transactions by rewarding validators with the blockchain's native cryptocurrency.

The most common consensus mechanisms in blockchain are "proof-of-work" (PoW) and "proof-of-stake" (PoS). PoW is the mechanism used by Bitcoin and is known for its vast energy consumption and environmental impact.[3] Validating transactions under PoW is referred to as "mining," while under PoS it is referred to as "staking."

The combination of consensus-based validation for new additions to the chain and the linking of blocks via their unique identifiers in a way that can't be easily tampered with is why people are interested in blockchain security. Consensus mechanisms support security in two related ways. First, since the network must agree to a change, it can remain secure even if an individual node is compromised. In a centralized database, the entire database is compromised if one part of it is hacked. Second, consensus mechanisms defend against the network being taken over by a malicious actor accumulating many economic resources to grant majority consensus to itself (known as a 51 percent attack). This is because the act of granting blockchain consensus is very costly (either in terms of energy in PoW or assets in PoS) and thus not feasible for an individual actor. While these features have historically made the consensus layer of the blockchain resistant to hacks, Web3 is far from hack-proof because secondary infrastructure like wallet holders' keys and middleware connecting blockchains with human interfaces get compromised quite frequently.

Step 3: The new block is added to the chain. Once the consensus mechanism has been used to approve the block, it is added to the chain. The name "blockchain" refers to this structuring of the database. When the database is updated, a new block is created and added to the prior one. The two are linked by their unique identifiers, as the new block refers to the one before. This way, blocks are connected in a referential sequence, forming a chain.

EXHIBIT 1 | MAKING CHANGES ON A BLOCKCHAIN

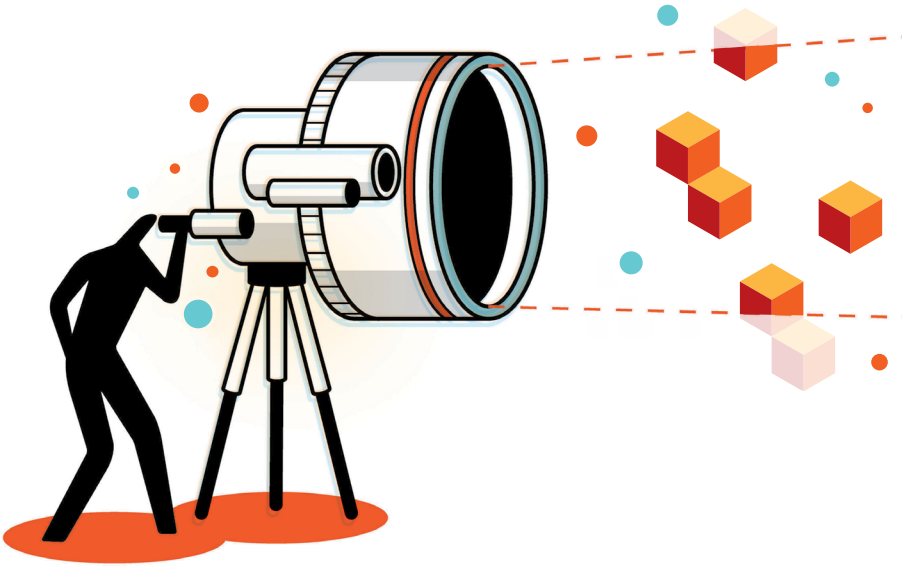


Credit: Business Insider, 2021

[1] Because the creator of Bitcoin is anonymous, it is impossible to know what their motives were, but the first block on the Bitcoin blockchain, in early January 2009, included the text, "The Times 03/Jan/2009 Chancellor on brink of second bailout for banks."

[2] Anyone who wants to send a transaction or mine/validate the next block and is willing to pay a high enough fee or set up the required crypto-economic infrastructure can send the transaction or mine/validate the next block.

[3] While Bitcoin's emissions remain extremely high, proponents argue that more efficient mining hardware, combined with supplementary software protocols, mean Bitcoin has the potential to be far less environmentally damaging.



Typology of Web3 Technologies and Potential Applications to Local Government Revenues

There are many concepts and technologies under the umbrella term of Web3. Exhibit 1 breaks down how these relate to one another.

Exhibit 1 breaks down Web3 into a series of nested concepts, each based on the one above it in some way. For example, "blockchain technology" sits below "Web3" because Web3 is based on blockchain technology. Alternatively, "cryptocurrency" sits below "crypto asset" because it is a subcategory of this general concept.

Crypto assets appear to be the most relevant technologies in the context of local government revenue, so this section will focus on them for detailed explanation.

Blockchain platform

A blockchain platform is a particular instantiation (creating a real instance or realization of an abstraction or template) of a blockchain-based distributed ledger. There are many distinct blockchain platforms, which can also be called blockchain networks because of their distributed nature.

Platforms are the base layer on which other objects and technologies are built. By analogy, blockchain platforms are like computer operating systems such as MS Windows or Mac OS. Operating systems use base technologies (for example, programming languages) to build environments where programs (such as word processors, Internet browsers, and more) are run to perform different activities. Similarly, blockchain platforms act as environments where users can undertake activities.[1] The difference is that an operating system is a piece of software stored on a single computer, while a blockchain platform is a distributed network of actors (nodes) comprising many machines.

The two largest and best-known platforms are Bitcoin and Ethereum. Bitcoin was the first blockchain platform. Its standalone functionality—the things you can do on the platform—has historically been limited, and it is now primarily associated with its native cryptocurrency (bitcoin).

Ethereum is more advanced as it has a built-in, fully fledged, Turing-complete programming language, which allows the platform to run programs in the same way that a computer operating system does. This means that Ethereum can run "smart contracts," or computer programs that execute actions as programmed (for example, when certain predefined conditions are met). Smart contracts form the basis for a whole host of more complex programs, known as "decentralized applications" (dapps). These encompass everything from decentralized finance (DeFi) applications to play-to-earn games.

While the Bitcoin platform's scripting language has critical limitations, particularly the lack of Turing-completeness, some applications have since been created on top of it to provide additional functions.

Crypto assets

Crypto assets are the most prominent class of "objects" built on top of blockchain platforms. The concept is an umbrella for digital representations of value or contractual rights built on a blockchain. These are analogous to other assets, such as financial products or even physical assets such as paintings. Crypto assets can be broadly split into cryptocurrencies and crypto tokens.

Cryptocurrency

Cryptocurrencies are the best-known type of crypto asset. They are digital assets that are "native" to a particular platform. For example, the Bitcoin platform has bitcoin cryptocurrency, the Ethereum platform has ether cryptocurrency,

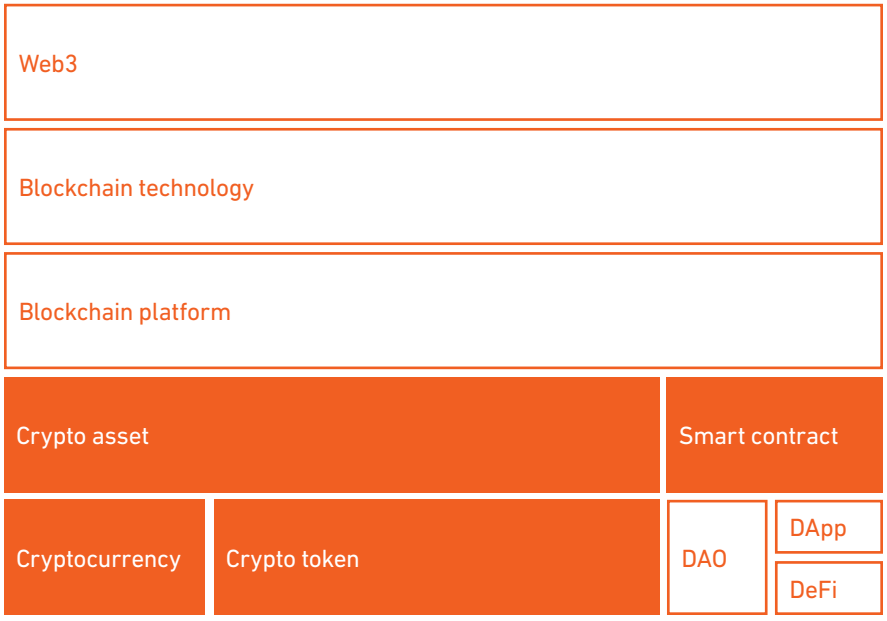
and so on. All public blockchains have native cryptocurrencies. These function as rewards for miners/validators to create incentives for them to validate transactions.

The first cryptocurrency, and with that crypto asset, was bitcoin. Bitcoin was initially intended to function as a digital currency, designed to act as a medium of exchange through a decentralized, blockchain-based network—giving rise to the term "cryptocurrency." As Bitcoin was the first cryptocurrency, it has become a foundational concept against which all others are compared. Cryptocurrencies today are generally divided into bitcoin and the umbrella term "altcoins," which references all non-bitcoin cryptocurrencies. Prominent altcoins include Ethereum's ether,[2] Litecoin, XRP, and Dogecoin.

Despite their name, cryptocurrencies are far from challenging legal tender status. In fact, as an asset class, cryptocurrencies may not meet the criteria for currency at all (for example, functioning as a unit of account, a store of value, and a medium of exchange). Cryptocurrencies are divisible and so can be a unit of account, but they seem less suited to acting as a store of value due to their generally high price volatility.[3] Finally, even the latest technologies have yet to show they can reliably process transaction volumes at a similar level to traditional payment rails, which undermines their ability to function as an effective medium of exchange.[4]

The conclusions that can be drawn from on-the-ground activity regarding the adoption of cryptocurrency as a medium of exchange are mixed. Let's start with bitcoin as an example. In 2021 the number of payments[5] on the bitcoin network was estimated to have peaked at around 770,000 per day.[6] This was also the three-year peak across 2020 to 2022. In the same year, the Visa network alone processed 164.7 billion transactions, equating to an average of 451,232,877 transactions per day.[7] So, Bitcoin's share of total financial activity still appears incredibly low. It is also not the case that daily payments have been rising dramatically over time. The 2021 peak was approximately 100,000 daily transactions more than the 2019 peak, and just short of 200,000 transactions more than the 2018 peak[8]—hardly an exponential growth rate. Since a significant drop at the end of 2021, daily payments also appear to be plateauing. The daily transaction data for the Ethereum blockchain shows a similar trend of moderate growth giving way to plateau.[9]

EXHIBIT 1 | THE COMPONENTS OF WEB3



On the other hand, the number of vendors now accepting or intending to accept cryptocurrency has increased. As we discuss below, some US cities and even states are also starting to accept cryptocurrencies for tax and utility payments, albeit via third party conversion services. These developments persist despite a relatively small proportion of Americans—just shy of 13 percent of the population—owning cryptocurrency now.

Cryptocurrencies and local government revenue

Experiments are underway with incorporating cryptocurrencies into local government revenue systems. At the most basic level, cities such as Chandler, Arizona, allow residents to pay their utility bills in cryptocurrency. The State of Colorado also accepts cryptocurrencies for tax payments. But this is mainly intended as a customer service option, and the potential to actually raise additional revenue appears limited. In both cases, all payments are converted to U.S. dollars by a third party before the government receives payment, shielding the government from the significant price volatility of the crypto markets. For example, the payment service used by Chandler does not charge the city extra processing fees for accepting cryptocurrency. While data on the volume of crypto payments made isn't available, there is anecdotal evidence that at least some people are using the service.

Offering the option to pay taxes in crypto does not increase revenue directly. Nevertheless, officials may still hope for indirect benefits, and those who believe that cryptocurrency has a future in mainstream America may seek to get ahead of the curve. Such offerings serve a signaling function, indicating an openness to the Web3 industry that could attract Web3 businesses, with implications for tax and other revenue streams. Such benefits rely on positive assessments of Web3's future coming true, however.

A more ambitious approach is to establish government-owned validating infrastructure, which

would enable municipalities to earn cryptocurrency through validating transactions on blockchain networks—often referred to as "mining" cryptocurrency. Mined cryptocurrency can then be exchanged for real dollars. For example, the City of Fort Worth, Texas, has started its own bitcoin mining operation. Many blockchain platforms, including Bitcoin, use a proof-of-work validation mechanism. Nodes on the blockchain network race to solve complex math problems, and the first to complete this "work" validates the new transaction. Validators gain cryptocurrency as a reward. More computing power to solve these problems means greater potential gains.

There are many potential drawbacks to local governments engaging in cryptocurrency mining. Most obvious is the vast price volatility in crypto markets, which has implications for the U.S. dollar value of any earnings. Securing validations is also not guaranteed, even using high levels of computing power. These factors mean returns are likely to be inconsistent and difficult to predict.

Cryptocurrency mining is also infamously energy intensive. For example, the energy spent globally on bitcoin mining has been estimated to exceed Argentina's total energy use over a year.[10] Further, mining carries high upfront investment costs because of the computing power required. Given these factors, cryptocurrency mining could result in a net loss. Finally, it is notable that the most popular cryptocurrency, bitcoin, is deflationary. Only 21 million bitcoins can ever be mined, with no more produced when this limit is reached. The Bitcoin platform also has an algorithm built in that halves the number of bitcoins yielded by mining every four years, on average. Combined with (1) persistently high energy prices in the short-to medium-term and high price uncertainty in the long term[11] and (2) long-term stagnation in the value of cryptocurrency caused by the recent popping of the speculative bubble and the ensuing "crypto winter," as even the most ardent crypto currency supporters have started calling it, mining cryptocurrency does not appear to have a lot of potential for local governments.

OUR USE OF THE TERM "ASSET"

We refer to tokens as digital assets because they are intended to represent some ownership right that has economic value. We are not suggesting that this intention will come to fruition in real life or that tokens are sound investments.

Crypto token

Crypto tokens are the other major form of crypto asset. Both cryptocurrency and tokens are derived from a blockchain. Cryptocurrencies are intended as stores of economic value and can be earned by participating in the validation of a blockchain (for example, proof of work). Tokens are created by software developers, using blockchain technology, and are intended to represent ownership of some asset, with creative art assets being a particularly high-profile use. Tokens cannot be "earned," like cryptocurrencies; instead, they are bought and sold, more akin to traditional financial securities. Much of the excitement around tokens is because they can represent ownership of assets that don't have firm physical form. This can include digital images but might also include other examples such as decision-rights in an organization, where each token represents a "vote."

NFT

NFT stands for "non-fungible token." These are unique digital assets stored on the blockchain. Most tokens are fungible, meaning one token is the same as the next. They're interchangeable. NFTs, however, have a unique digital signature cryptographically encoded into them—so even two qualitatively identical NFTs will not be numerically identical. Two identical images can become distinct digital assets, for example.

NFTs are best known for their use in creating tradeable digital artwork. For example, digital artist Beeple famously sold an NFT called "Everydays" for more than $69 million. They have also seen applications in other areas like event tickets.[12] These use cases focus on areas where uniqueness is good. For example, art is an area in which owning the original means something; originals are worth more than copies, even if they can't be told apart by the naked eye. The same is true of tickets to a concert.

There are two primary potential use cases for NFTs in the context of government revenue-raising. The first and most apparent is that municipalities can sell them to earn money. The City of Miami, Florida, for example, had plans to sell 5,000 digital art NFTs to raise funds for the city.[13] Similarly, the City of Reno, Nevada, intended to offer NFTs of a piece of public art.[14] The idea of creating NFTs of well-known public landmarks and other features has also been raised.[15]

The crashes that have occurred in the NFT market in the first half of 2023 should make anyone pause for thought here. Many purchasers of municipal NFTs may not be trying to invest to get a return. They may simply wish to support their community or feel ownership of a part of it. This may mean market volatility is less of a concern—but we should note that this rationale is largely hypothetical, and in practice, most investors do seek to profit when buying NFTs. Whether price volatility is a problem unto itself or not, it does speak to deeper worries about what exactly people are buying when they buy an NFT.

NFTs are in fact lines of code on a blockchain, linked to a digital asset such as an image or animation. It is this code that creates their uniqueness, not the assets themselves. The media comprising a typical NFT can be copied and distributed endlessly, for free. The addition of blockchain-based code is thus an imposition of artificial scarcity. It builds scarcity (the non-fungible token) into a fundamentally non-scarce resource (digital artwork). Municipal NFTs that imply the opportunity to own a piece of a public artwork or landmark carry the risk of reputational harm. The rise of NFTs may turn out to be a bubble, leading to a shift in public perception against them. NFTs could be confused for actual ownership of physical artwork itself, rather than ownership of an image of the artwork. Either way, purchasers may be left dissatisfied if they feel they

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have been short-changed. If NFTs start to be viewed as more akin to gift shop trinkets, buyers may feel cheated by having been sold them as "real" art.

NFTs do have potential outside of speculation, though. For example, they could help increase the efficiency of tax systems and reduce tax evasion. Goods such as cigarettes and alcohol still use physical stamps to track excise tax, a system that carries significant administration costs. There are also security risks from the theft or counterfeiting of stamps. Blockchain-based solutions to this problem are already being explored, involving a "digital twin" of a physical good being stored on the blockchain. This twin would be directly linked to its physical counterpart via packaging, potentially reducing both administration costs of tax systems and tax leakage.[16] While this system could take many forms, the uniqueness of NFTs makes them well suited to acting as digital twins. (Such a system would likely also rely on smart contracts, which we will discuss later.) An interesting feature of such a system is that it could be enacted on either a public or private blockchain. Whether governments develop their own blockchain networks or use existing ones will depend on various factors including costs—as public chains will carry far fewer development costs—and desired levels of publicity.

Security token

NFTs aren't the only kind of crypto token. The other form of token most relevant to government revenue are security tokens, which are simply tokens that are also financial securities.

The criteria for securities is laid out in the *Howey Test*.[17] Tokens meeting these criteria are subject to the same regulation as other securities. But the crypto industry is still in its infancy, so the law will lag behind it. The recent U.S. Securities and Exchange Commission (SEC) probe of CoinBase, one of the world's largest crypto exchanges, provides an example. CoinBase is alleged to have listed unregulated securities on its platform.[18] We should define security tokens as all tokens meeting the criteria for a security, even if they're not (yet) regulated as such.

A potential use case for securities tokens is the sale of government debt. Municipal bonds are a potentially fruitful source of revenue for local governments, but they can be relatively costly to issue, particularly on smaller scales.[19] High- and low-denomination bonds often cost almost the same amount to issue because of regulatory and administration costs. This makes the latter relatively unattractive, and the market is dominated by large institutional investors. Citizens may not be able to afford to invest in their own cities, even if they would like to—meaning there is apparently inefficiency in the traditional municipal bond market.

This is where tokens come in. Token-based experiments with debt issuance may hold potential for local governments by reducing their administrative burden.[20] Governments can simply mint and issue tokens themselves without going through the complex process of registering and issuing other forms of bonds, making it more affordable to issue smaller denomination bonds—although relying on Web3's lack of regulation for this benefit is likely an unsound strategy. Further, tokenization can cut out brokers by enabling the government to sell directly to individuals, which can also increase bond affordability. Supporters argue that tokenization can thus democratize municipal financing.[21] Smaller investors may like the idea of investing in their cities, and tokenized debt may be a means of doing so. This opening of the market has the potential to increase demand for government debt. Further, tokens are more easily divisible into smaller units than traditional financial assets. This may support growing secondary markets for tokenized debt, further increasing demand. Tokenization could hold the potential to increase municipal borrowing potential.

Like all potential Web3 applications, there are many practical issues to consider. For example, wealthy investors traditionally favor municipal debt because of its tax advantages. These investors are unlikely to struggle to access the existing municipal debt market. Civic pride or responsibility may still attract less-wealthy investors who would not enjoy these tax advantages. But it is unclear whether or not civic mindedness would be enough to have an impact on the $4 trillion municipal debt market, so tokenization may be of limited material financial benefit. These limits will be more pronounced if municipal debt has to compete against other securities that offer superior returns.

Hailed as a potential game-changer since making its debut in 2021, MiamiCoin has lost more than 95% of its value from its peak price.

CityCoins' crucial vulnerability is the system's detachment from traditional, productive economic activity. The value of the tokens is not tied to anything in the outside economy. This feature is shared by the vast majority of other crypto token projects.

Another relevant case study in security tokens is CityCoins. The CityCoin project, and MiamiCoin in particular, is one of the best-known examples of municipal adoption of crypto tokens. We should start by making the point that MiamiCoin has already attracted controversy for skirting securities regulation,[22] so this discussion should not be interpreted as an endorsement of CityCoins or a position on their status as regulated securities. We aim only to describe a prominent, actual local government use of security tokens.

CityCoins, including MiamiCoin, are presented as a "community-driven revenue stream" for cities. CityCoins are programmable crypto tokens. They are built on top of the Bitcoin network using a third-party protocol called Stacks, which carries its own tokens called Stacks (STX). CityCoins' creators intend for their programmability to lead to a variety of future uses, although their launch functionality is limited to producing more CityCoins or earning STX.

Mining CityCoins uses a "proof-of-transfer" (PoX) mechanism to validate the blockchain. PoX is a much less common validation method than proof-of-work (PoW) or proof-of-stake (PoS). In essence, the CityCoins PoX is a lottery system where miners exchange STX for a chance to win a newly minted CityCoin. STX can be purchased via exchanges like CoinBase, like other crypto tokens and cryptocurrencies. They can also be earned by participating in the CityCoin platform in other ways. Most of the STX transferred by miners are eventually paid back out to these other CityCoins users. Some—30 percent—are distributed to the city government. Cities can cash out their STX into U.S. dollars or use them to earn bitcoin. In essence, the revenue-raising mechanism for local government is like a local lottery, where the government keeps some portion of the currency that participants paid to enter the lottery.

CityCoin Inc. has stressed that CityCoins are simply an experiment rather than a complete financial solution.[23] Still, the results so far cast doubt on their viability as a source of government revenue. Since MiamiCoin's launch, the token has lost more than 95 percent of its value from its peak price. This has led to investor losses and potential regulatory scrutiny.[24]

CityCoins' crucial vulnerability is the system's detachment from traditional, productive economic activity. The value of the tokens is not tied to anything in the outside economy. This feature is shared by the vast majority of other crypto token projects. It contrasts with financial products such as stocks, which derive their value from the issuing company's performance. As a result, the value of such tokens is purely a matter of consumer perception. People buy tokens because they believe they are valuable. This belief is based on the activity of other buyers, in a way that can be subject to bandwagon bias.[25] For this reason crypto assets have been accused of being speculative assets,[26] subject to Greater Fool Theory.[27] Whatever one makes of these accusations, it is evident that the crypto economy is particularly vulnerable to shifts in the Keynesian "animal spirits" of investors.[28] Changes in outlook or other psychological factors can lead to huge swings in prices.

Whether projects like CityCoin hold potential as a sustainable, long-term source of municipal revenue remains to be seen; significant changes will have to be made if they are to show real promise. The programmability of such tokens may play a role here. They may become promising investments if they can be embedded into the wider economy through new uses. This potential does depend on practical applications of the technology being developed, to underpin the value of related tokens. Finding such applications is by no means an easy task.

Smart contract

A smart contract is a program stored on the blockchain which runs when some set of predefined conditions are met. They can automate agreements without the need for third parties. This automation is the primary source of excitement around smart contracts. Proponents argue that they can increase speed and efficiency in areas such as conveyancing. More radically, some see them as holding the potential to transform governance. They argue that immutable and automated rules reduce the potential for dispute, corruption, or abuses of power.

Smart contracts may play a role in tracing tax liability. The use of smart contracts could potentially increase government revenue by reducing the administrative costs of tax systems and by reducing tax leakage. Smart contracts have been proposed as a means of automating the collection of sales taxes when products change hands,[29] allowing governments to collect taxes in real time and removing the need for intermediaries. This quality has the potential to strip costly steps from the taxation process and limit the opportunities for tax evasion and avoidance between the time of sale and tax declaration.

It should be noted that smart contract-based systems come with their own difficulties. First and foremost, obviously, is that they are highly complex to design and implement effectively, carrying significant upfront investment costs. Real world use cases remain limited and are predominantly being considered at national rather than local scales.[30] Second, smart contract-based payments can present other tax difficulties. Regulators are already guarded about the prospect of automated and anonymized smart contract-based transactions happening at larger scales for private transactions; transactions of this kind make it hard to identify the parties that have tax obligations and the jurisdictions they fall under.[31]

If state and local governments accelerate the use of smart contracts for some purposes, they may run the risk of accelerating adoption in other areas, which in fact make revenue collection harder. For example, if digital asset transfers, assisted by smart contracts, become a more common means of securing payment for freelance work, this might make income taxation difficult. Customer and contractor could make direct, automated, peer-to-peer payments through anonymized crypto wallets. There are ways for regulators to catch up, but these will take time to develop and implement.

The key will be to ensure that private use of such methods does not outrun the government's ability to regulate them. While it is uncertain that government adoption in one area would accelerate their spread in this way, the risk is not trivial. As with all emerging technologies, smart contracts can act as a double-edged sword, and the law of unintended consequences should give pause to those rushing to adopt them without fully understanding their complexities.

1 The most basic of these activities for most public blockchains is transacting cryptocurrencies; however, increasing numbers of alternative applications also feature on many platforms.

2 Given Etherum's scale, some people now refer to Altcoins as all non-bitcoin and ether cryptocurrencies. For simplicity, we are using the original definition here.

3 It should be noted, however, that this level of volatility is in some sense circumstantial and could at least in theory change.

4 Daren Fonda, "Solana Could Be the Visa of Crypto Networks. Not So Fast, Says Visa," *Barrons*. January 2022.

5 We use payments per day as a more accurate measure of activity than transactions per day. This is because a single transaction can contain a number of payments.

6 "Confirmed Payments per Day," Blockchain.com.

7 "Reports Fiscal Fourth Quarter and Full-Year 2021 Results". Visa Inc., October 2021.

8 "Confirmed Payments Per Day," Blockchain.com.

9 "Ethereum Daily Transactions Chart," Etherscan.

10 Jeremy Hinsdale "Cryptocurrency's Dirty Secret: Energy Consumption," *Columbia Climate School*, May 2022.

11 "Global Energy Perspective 2022," McKinsey & Company, April 2022. 14 For example, see: "NFT Tickets—Create, Mint and Sell Online," Oveit.com.

12 For example, see: "NFT Tickets—Create, Mint and Sell Online," Oveit.com.

13 Ornella Hernandez, "Miami Collabs With TIME, Mastercard, Salesforce to Sell 5K NFTs," *Blockworks*, July 2022.

14 The Biggest Little City in the World series, "The Space Whale, CityKey, citykey.art/.

15 Mahesh Singarap, "NFTs offer means for governments to find solutions," *Mint*, September 2021.

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Assessing the Viability of Web3 Applications

While we have explored many potential applications of Web3 technologies to municipal revenue-raising, the utility of most existing Web3 applications remains unclear,[1] and the application of Web3 to local government revenue thus remains largely speculative. Present contributions should therefore focus on ways of evaluating such applications. The questions below can help assess the viability of potential Web3 revenue applications.

To what extent does the application rely on speculative bubble dynamics versus real-world value?

Bubble dynamics mean that asset prices exceed real-world value. Speculation drives bubble growth, as investors assume that prices will continue to increase. Speculation is fundamental to the current value attached to Web3 "digital goods," demonstrated by the 2022 crypto asset crash.[2] Potential local government applications should therefore have their reliance on speculative value questioned. Mining cryptocurrency relies heavily on speculative valuations. The value of mined cryptocurrency depends on investor perceptions, and the same seems true of CityCoins and selling NFTs of public art.

When considering any Web3 revenue-raising proposal, a local government should make sure it understands what it is that grounds a Web3 application's earning potential. If the answer seems to come down to the value perceived by others rather than solid underlying social or economic value, the application may rely on bubble dynamics.

What real-world problem does Web3 solve that existing technology cannot?

Specifically, the question should be, "What problem does Web3 solve that more established technologies can't?" To start, we may consider the efficacy of existing "analogues" to a Web3 innovation. The closest analogue in our CityCoins example appears to be a lottery. In general, lotteries work well enough as they are—which should call the need for technological innovation around them into question.

In many areas, innovative technology can add significant value. The next step should interrogate the merit of blockchain technology, specifically, over other possibilities. Many technologists have observed that existing technologies are often already perfectly capable of delivering some of the same benefits that blockchain is purported to provide. For example, leading computer scientist Professor Jorge Stolfi has commented:[3] "It [blockchain] promises a decentralized ledger where multiple organizations can contribute input data and supposedly it will be tamper-proof in the sense that you can't delete or change the data, only add to it. But this has been used forever. Any large bank or a critical system has to have such a log for several reasons: if the system crashes, you have to go back and see what happened and rebuild the databases. So, this is nothing new, people have known how to do distributed databases in a reliable manner for years."

Governments considering blockchain solutions should clarify the unique added value of this particular technology. Blockchain's standout feature is that it removes the need for a central, managing authority. This may be valuable in certain contexts. For example, it may hold symbolic value where there is low trust in certain authorities. It may also enable secondary markets to emerge more easily. In the municipal debt example, the initial sale of tokenized bonds is only the beginning. These assets could then be traded peer-to-peer without the

need for third parties like brokers. Such secondary markets may help drive demand for municipal debt in a unique way.

Considering a Web3 application then requires three steps: 1) asking what problem the application is supposed to solve; 2) asking whether the application will be able to solve it; and 3) asking why, or if, the Web3 solution will work better than more established technologies. Engaging qualified experts who work with other, related technologies can help clarify this.

Is the mechanism something I can explain to the public?

Local governments should have a clear general understanding of how prospective Web3 applications generate social and economic value. Technological complexity should not justify neglecting this comprehension. A practical test here is to imagine explaining the mechanism of an application to a citizen who is informed but not an expert. This test is realistic, given the growing regulatory scrutiny, as government officials may be on the spot to explain Web3 innovations to a skeptical public or media. CityCoins, the most complex use case described in this series, may offer a cautionary tale. Perhaps not coincidentally, it is the one that also appears set to run afoul of regulatory scrutiny.[4] So, for any Web3 application, if a simple explanation cannot be given, this should be a matter of concern. The same goes for descriptions that must be carefully framed to avoid regulatory attention.

To what extent does the application rely on value as a "collectable"?

Because of their technical novelty and the powerful social narratives surrounding Web3, much of the economic value of early crypto assets might be due to the "collector's value" of owning the earliest ones. For example, Twitter founder Jack Dorsey sold an NFT of his first tweet for almost $3 million to a Web3 entrepreneur.[5]

Local governments must ask if any potential Web3 revenue application relies on novelty and collection value to raise revenue. For example, if we understand NFTs of public art in this way, we might expect diminishing returns from NFT sales. The first city to do so may well find success because of its first-mover status. The first NFTs of public artworks or landmarks will hold historic significance through being the first of something. This significance is lessened in later issuances by other cities joining the trend. Our initial example also shows that even the first movers may not be immune—the very same tweet NFT that sold for $2.9 million was recently valued at a little more than $100.[6]

A local government should make sure it understands what it is that grounds a Web3 application's earning potential. If the answer seems to come down to the value perceived by others rather than solid underlying social or economic value, the application may rely on bubble dynamics.

WHY NOT SPECULATE?

Economic theory shows that it is possible to make money even in a speculative bubble. And many people have become vastly wealthy through Web3 activities. So, what is wrong with government officials engaging in speculation? The answer is that the benefits of speculation generally accrue only to a small number of market participants. Governments will probably not end up on the winning side. A traditional goal of government investment has been to protect investment principal, which is composed of taxpayer money accumulated over multiple generations of taxpayers for the long-term benefit of the community. For a single generation of officials to essentially "bet" this principle on a high-risk/high-reward proposition will probably not be consistent with the long-term interests of a majority of citizens.

Consider the actual benefit of a blockchain application as a remainder. Once we have subtracted the benefits of regulatory arbitrage, what is left? This should give a more realistic picture of the value Web3 can generate in the longer term.

To what extent does the application rely on "regulatory arbitrage"?

"Regulatory arbitrage" means using the lack of regulation around Web3 to do things that are difficult or impossible to do through more established channels. The sale of unregulated security tokens is one example of regulatory arbitrage.

Blockchain is still an emerging and poorly understood technology, contributing to the current lack of regulation—but this context will not last forever. The future will bring increased regulation, evidence of which is already mounting.[7]

Local governments should consider how much a Web3 application relies on regulatory arbitrage. If this is one of the significant benefits of a blockchain solution, it is at risk from regulatory expansion.

Take the example of tokenized municipal debt. Officials should question where the efficiency and accessibility gains from tokenization come from. How much derives from technological benefits versus bypassing costly regulatory bureaucracy? The regulatory scrutiny that CityCoins attracted should spark a similar question. Consider the actual benefit of a blockchain application as a remainder. Once we have subtracted the benefits of regulatory arbitrage, what is left? This should give a more realistic picture of the value Web3 can generate in the longer term.

What unintended consequences or real-world problems might a Web3 application run into, or even create?

Even if a local government application passes the tests above, it may not be viable because of real-world problems and unintended consequences that can still stand in the way. Take our municipal debt example. Even tokenized bonds will carry a price disadvantage relative to many other securities. This is because its tax advantages have no value to investors below a certain level of wealth. This problem can prove fatal to an innovation like this. Another real-world problem may be found in potential tax applications of Web3. A foundational premise of many Web3 applications is that participants in the application are given a financial incentive to participate (for example, they can earn cryptocurrency). But imagine a Web3 application that attempts to use a blockchain to assign tax liability. In this case, participants face a *financial disincentive* to be part of the blockchain! This attempt may give rise to resistance and attempted circumvention, making implementation difficult.

Uses of Web3 may also create an unexpected issue—Web3 applications risk technological acceleration that undermines the utility of existing regulation.

Another example is the potential for worsening existing economic and social inequalities. Web3 is sometimes positioned as a great leveler that will democratize access to power, but the reality has not matched the promise. Not only does a small portion of people participate in Web3 currently, but among those who do, the actual power is held by a small subset of those people. For example, as of the end of 2021, fewer than 1 percent of bitcoin holders held more than 90 percent of total bitcoin wealth.[8] So it seems that Web3 economies may be subject to many of the same wealth-concentrating features of other economies. It is reasonable to question whether local government support for some kinds of Web3 applications might exacerbate these forces. For example, let's imagine NFTs of public art were to experience the popularity their proponents hope for. There would likely be a secondary market where NFTs would be bought and sold at high prices. High-price art markets are generally not known for their wealth-distributing features! This same concern would apply to any Web3 application where participants stand to benefit financially from participation in the application, and financial incentives are a fundamental feature of many Web3 applications.

Even if all the other questions above are addressed, there is still cause for caution. Municipalities are complex social systems, meaning they can respond unpredictably to new interventions, with consequences and failure modes that may not be immediately apparent. This reality should temper optimism about the potential of new technologies and leave officials with a degree of skepticism.

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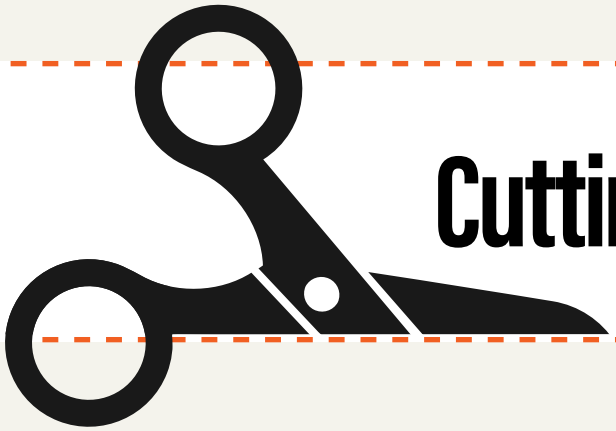


Cutting through the hype

Like many new technologies, Web3 has generated a lot of excitement—but it's difficult to tell how much of that excitement is justified. Following are a few more points to further demystify Web3 technology, help you evaluate potential use cases and pose questions that can help local officials assess other potential use cases.

Governments are not tech companies, so they don't face the same incentives.

Tech companies often face a phenomenon known as "first mover" advantage—meaning the first company to offer a particular service or product will dominate the market. Amazon.com is a leading example of a firm that was one of the first in its category (online retail) and has gone on to dominate that category. Information technologies have features that tend to result in monopolistic or oligopolistic markets. "Metcalfe's Law" describes the most important of these features. The implication is that there are often very high stakes for taking a leading position in a market. Local governments are not subject to these same incentives because no local government will "dominate" Web3 revenue, just like local governments in Silicon Valley don't "dominate" the benefits that have accrued to local governments from Web 2.0. (These local governments have enjoyed more property and sales taxes from economic activity of the firms within their boundaries, but this pales in comparison with the total revenue generated by online sales taxes generally, for example.)

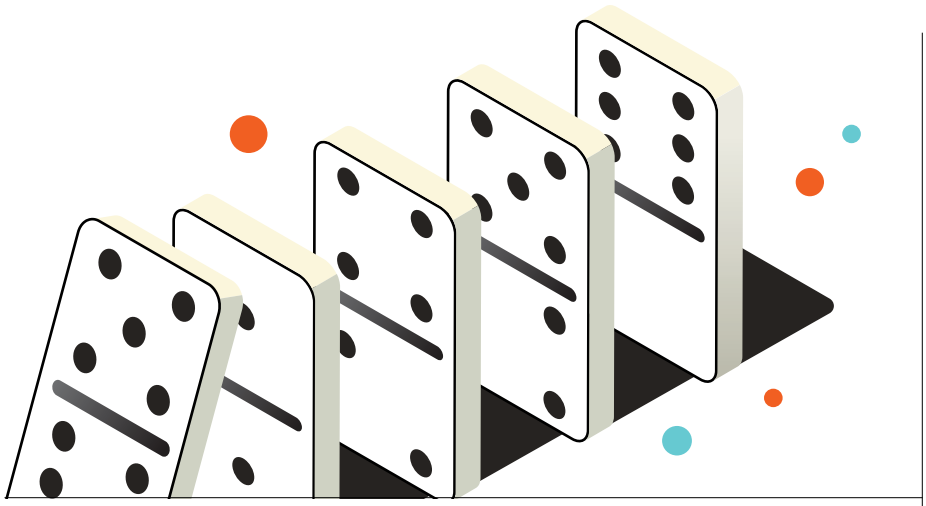
There is a second-mover advantage.

Second mover advantage is when a firm benefits by learning from the mistakes of the first mover and offering a product or service that capitalizes on those mistakes. This concept is more akin to the situation local governments are in. It will be a better use of the government's (and hence taxpayers') time and energy to let private entrepreneurs work out the most practical applications of Web3. Government can then apply those lessons.

That said, the first governments to commit to Web3 may be more successful in attracting new Web3 firms to their communities (a common justification for government forays into Web3). Tech firms' employment and physical footprints are usually much smaller than traditional firms of comparable annual revenue, though. For example, in 2021, Google (Alphabet)'s revenue was $256 billion, with about 150,000 employees, and Facebook (Meta) had revenues of $115 billion, with about 45,000 employees. General Motors had revenues of $127 billion, with 157,000 employees, and General Electric had 168,000 employees, with $74 billion in revenue. For local governments that derive most of their income from property and sales taxes, the actual revenue benefit from attracting Web3 firms may be relatively modest.

There are opportunity costs to spending time and energy on Web3 innovation.

Finally, local governments have limited time and energy. If the goal is to find new sources of revenue, Web3 is just one option. GFOA's Rethinking Revenue program (gfoa.org/rethinking-revenue) has identified many opportunities for new local revenues that are far less speculative than Web3 at its current stage of development. Most local governments would be better off spending their time and energy on these more promising avenues.



What Happened to FTX

(and why government finance officers should care)

FTX was one of the world's largest cryptocurrency exchanges. Such exchanges are the locations where users can trade crypto assets such as cryptocurrencies and crypto tokens, either for other crypto assets or fiat money. They form the financial backbone of the mainstream Web3 ecosystem.

FTX had a partner company, Alameda Research, which operated as a crypto hedge fund. Reports surfaced that Alameda's main holding was FTT, the native token issued by the FTX exchange.[1] Given these were meant to be two separate entities, the value of Alameda being propped up by a token created by FTX caused significant concern. In response, Binance, the world's largest crypto exchange, liquidated its holdings of the FTT token. What ensued was akin to a bank run—investors scrambled to withdraw their holdings, leaving FTX in a liquidity crunch, without the necessary funds to fulfill all the withdrawal requests. Binance briefly announced that it would buy out FTX to ease this liquidity crunch, but it pulled out after completing due diligence checks. FTX filed for bankruptcy soon after.

The implications of the collapse

Government finance officials can learn a lot from the collapse of FTX, along with anyone who is interested in the future of Web3. Most apparently, the days of lax regulation that have characterized the Web3 boom appear to be coming to an end, and rightly so. Alameda was accused of using FTX customer deposits without consent to make highly risky investments, to an extent that its activities were described as "old-fashioned embezzlement."[2] The CEO brought in to oversee FTX's bankruptcy described it as suffering a "complete failure of corporate controls" to a degree that he had never before seen in his career.[3] Coming from the man who managed the fallout from the collapse of Enron, this statement speaks volumes. A litany of severe crises swept the Web3 ecosystem in 2022,[4] with huge numbers of everyday retail investors losing everything because of gross misconduct that often resulted in serious criminal allegations.[5]

Not only should this make any reasonable public official pause before considering engaging with Web3 projects in any capacity, but it also has implications for what is often the main attraction of the ecosystem. The so-called "regulatory arbitrage" opportunities of Web3 are the source of many of its purported speed, efficiency, and cost-saving benefits—and this window of opportunity appears to be closing.

Second, the collapse is a damning reality check to one of the most significant and alluring narratives of Web3, that of decentralization. The decentralized nature of the Web3 ecosystem is a source of great excitement, lauded as the central feature that sets it apart from, and above, Web 2.0.[6] But FTX shows that the technical potential for decentralization does not amount to decentralization in practice.

The reason that FTX was able to allegedly conduct such nefarious mixing of funds with Alameda, and why so many investors were locked out from their funds when FTX froze withdrawals, was because it was a centralized exchange. Users deposited funds in accounts owned by FTX to conduct trades and often kept their assets stored in these centrally owned accounts. In other words, FTX operated just like a centralized private bank. The fact that this crisis took the shape and reached the scale it did was due to centralization, the feature Web3 is purported to bypass. That much of the Web3 ecosystem is in fact not very decentralized at all has been a longstanding critique, subject to rigorous supporting analysis from academia.[7]

There are many critics of centralized exchanges even within the Web3 community.[8] Critics argue that such centralization contravenes the core principles of Web3 and that the only valuable path forward lies with decentralized finance (DeFi), which facilitates peer-to-peer transactions between those holding their own, private cryptocurrency wallets. This critique rings true on one level, but the continuing hope that "true" decentralization is possible overlooks two things. First, human beings generally don't like effort. Second, marketplaces are subject to network effects.

On the first point, all of us regularly settle for suboptimal but easier options in all realms of our lives. Consider password security. Despite an awareness of its importance, recent data shows the five most common passwords globally are still 123456, Password, 12345678, qwerty, and 123456789, and a staggering 59 percent of Americans still use their name or birthdate in their passwords.[9] Similarly, while it is possible to hold all of one's crypto assets in an entirely private wallet and participate in the Web3 ecosystem in a significantly more decentralized way, this is a lot more work. The height of good practice even goes so far as engraving one's key identifying information into metal and then hiding it for safekeeping.[10]

It is not just effort that makes the world of DeFi unattractive to many. Using these services requires significant technical expertise and leaves users at risk of losing the entirety of their assets at the click of a button through scams, bugs, and user errors.[11] DeFi systems can also carry prohibitively high transaction costs, particularly at higher levels of use. This is because of the inbuilt dynamics of the Ethereum cryptocurrency network where most DeFi platforms exist, which increases transaction costs (known as "gas fees") at times of high demand. This has further led to doubts as to the scalability of DeFi.[12] Finally, the need for centralized governance structures for DeFi platforms have led to accusations that the ecosystem is not in fact as decentralized as it claims,[13] and it has been identified as carrying severe and systemic financial vulnerability to boot. Inconvenience aside, none of this bodes well for DeFi's status as a serious contender to centralized exchanges.

Centralized exchanges fill a gap in the market and meet consumer needs. They make the exchange process easier and protect users from risks by overseeing their transactions, although the value proposition around risk reduction is not without irony in the present moment. Given the choice, it's likely that many everyday users of Web3 technology will gravitate to centralized solutions if they require less effort and expertise.

The second compounding factor for this tendency toward centralization is the economic concept of network effects,[14] the phenomena whereby the value of certain goods or services is affected by the number of actors using them. They're often positively correlated, with more existing users making the network more valuable. The hegemonic dominance of many of today's tech giants is a result of these effects. Facebook, for example, dominates because everyone else using its products makes them more attractive to other users. Nobody wants to use a social network that others aren't also using. Marketplaces are one of the prototypical examples of network effects; there is a reason there was a single, central Agora in ancient Greek societies. Marketplaces are most valuable if others are also using them, otherwise I might have to look elsewhere to buy what I want or find a seller for my product or service. Being able to go to one place alone provides massive gains. Crypto exchanges will also be subject to network effects, meaning they will likely tend toward a few major players dominating the market.

Combining the attractive convenience of centralized exchanges with the phenomenon of network effects creates an incredibly strong tendency toward centralization within the Web3 ecosystem. This tendency has visibly borne out, with the evidence showing both that the five largest cryptocurrency exchanges, by trading volume, are all centralized,[15] and the centralized finance portion of crypto holding a market capitalization that is estimated at more than 20 times the size of the DeFi ecosystem.[16]

Conclusions

Regulation can remove some of the more severe risks from using centralized exchanges and stop a disaster like FTX happening again. But then if the majority of the crypto ecosystem becomes people using large, regulated, centralized institutions to trade financial products, there seems to be very little to set this apart from the world of traditional finance. The major difference appears to be a larger role for speculation and greater detachment from productive economic activity in the real economy than trading traditional assets such as stocks and bonds.[17] Such a vision of the future should pose questions as to where the value of blockchain technology really lies.

If the majority of the crypto ecosystem becomes people using large, regulated, centralized institutions to trade financial products, there seems to be very little to set this apart from the world of traditional finance.

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