Hearing on Next Generation Infrastructure:
How Tokenization of Real-World Assets Will Facilitate Efficient Markets

Before the U.S. House of Representatives Committee on Financial Services
Subcommittee on Digital Assets, Financial Technology, and Inclusion

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Prepared Statement

Hilary J. Allen, Professor of Law
American University Washington College of Law

Chairman Hill, Ranking Member Lynch, and Members of the Committee:

Thank you for inviting me to testify at today's hearing. My name is Hilary Allen, and I am a Professor of Law at the American University Washington College of Law. I am also a member of the CFTC's Technology Advisory Committee, although I have prepared this testimony on my own behalf and not on behalf of either of these organizations. I teach courses in corporate law and financial regulation, and my research focuses on financial stability regulation and financial technologies. I have authored many articles for law reviews and the popular press about fintech and financial stability, and I have also written a book, *Driverless Finance: Fintech's Impact on Financial Stability*, that explores the threats that fintech innovations pose to our financial system. Prior to entering academia, I spent seven years working in the financial services groups of prominent law firms in London, Sydney, and New York. In 2010, I worked with the Financial Crisis Inquiry Commission, which was appointed by Congress to study the causes of the financial crisis of 2007-2008.

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1. Executive Summary

The goal of today's hearing is to learn about real-world asset tokenization. It is important to clear up the confusion between tokenization and crypto at the outset. Tokenization does not actually require the involvement of the crypto industry or any crypto-specific technologies. As this testimony will explore, tokenization does not require the use of stablecoins, and the tokenization of real-world assets is intended to differ in important respects from faddish NFTs. Tokenization does entail the use of smart contracts (a type of computer program that is often used by the crypto industry), but smart contract technology predates the use of the public permissionless blockchain technology that the crypto industry is built on. Such public permissionless blockchains can be used to record the ownership of tokenized assets, and there has been experimentation to that end. However, tokenization does not actually require the use of public permissionless blockchains technology; token ownership can be recorded on other types of ledgers (private, permissioned, and centralized). This is important, because public permissionless blockchains suffer from insuperable inefficiencies and operational fragilities that render them unsuitable supporting infrastructure for real-world financial markets.

Tokenization of real-world assets can and should be kept separate from crypto. Freed from the limitations of permissionless public blockchain technology, tokenization may be able to promote significant efficiencies in some markets. There is particular interest in tokenizing deposits to improve the speed of interbank payments (particularly cross-border payments), which would require banks to adopt shared ledgers or at least make their ledgers interoperable. Tokenizing deposits would also allow some functions (like making monthly interest payments) to be automated with smart contracts. Tokenized deposits can also serve as the settlement asset in "composed" financial products that involve multiple other tokenized assets. In terms of other tokenized assets, there is significant interest in tokenizing securities as well as physical property like real estate and art. There is also significant interest in creating tokens that allow people to purchase fractional interests in these assets. Transactions in tokenized assets that are hosted on the same ledger can be settled instantaneously: while there are scenarios in which such "atomic settlement" is undesirable, there are also likely to be markets that would benefit from it.

It should be noted that two bills recently passed by the House of Representatives, if they were to become law, could be detrimental to the tokenization of real-world assets. One, the CBDC Anti-Surveillance State Act, would prevent the Federal Reserve from issuing anything like a wholesale CBDC. However, the development of something like a wholesale CBDC is likely to be critical to facilitating the wide-scale adoption of tokenized deposits. The second bill, FIT21, creates an exemption from the securities laws for many tokenized securities. Without the SEC's investor protections, investors may not have the confidence to invest in tokenized securities.

A lack of investor protections would also undermine any financial inclusion benefits associated with tokenization – but realistically, the benefits of tokenization will sound more in efficiency gains than in financial inclusion improvements. When roughly half of all Americans (some surveys say more) are living paycheck-to-paycheck, the problem is not a lack of investment opportunities but a lack of money to invest in the first place. Asset tokenization and fractionalization will therefore have limited financial inclusion benefits. If tokenized deposits allow for faster payment processing, that may help *under*banked communities avoid expensive check cashing services, but tokenized deposits will not bank the *un*banked. Improved efficiencies from tokenization will still be desirable in some contexts, however. We should remain mindful, though, that when systems become more efficient, they also tend to become more fragile. The increased financialization, speed, and automation envisaged by proponents of tokenization all have precedents in the lead-up to the 2008 financial crisis, and there may be circumstances in which tokenization's increased efficiencies ultimately aren't worth the attendant risks.

2. What is Tokenization?

A. Tokenization basics

The Bank for International Settlements has done a significant amount of work exploring tokenization of real-world assets. They define tokenization as "the process of representing claims digitally on a programmable platform."[1] The ownership of many financial assets is already recorded in digital form, so the distinguishing factors here are the programmability of tokenized assets and the shared ledger on which their ownership is noted (as opposed to recording ownership of assets on separate databases, and requiring separate application layers on top of the record of ownership to message and reconcile transactions, which is how things are typically done now).

If more assets are recorded in digital form on the same ledger, then computer programs known as "smart contracts" can be used to automate more transactions, and it is hoped that efficiencies will arise from this programmability. Tokenizing assets also allows for composability: often analogized to building with Lego bricks, composability involves using smart contracts to build bespoke financial products out of multiple tokenized assets, often with different legs of transactions being preprogrammed in sequence.[2] Ownership of a real-world asset can also be split among many different tokens in a process called "fractionalization."

The "ledger" referred to here is a type of database. Even if ownership of digital assets is recorded across different ledgers (rather than a shared ledger), some of the programmability and composability benefits of tokenization may still be achieved by making those ledgers interoperable through the use of application programming interfaces (these "APIs" are a type of computer software that allow two different information technology systems to communicate with one another). Ledgers interconnected in this way may not always be able to support what is known as "atomic settlement," though.[3] Atomic settlement is defined as occurring when "two assets are exchanged simultaneously, such that the transfer of one occurs only upon transfer of the other," and is most easily achieved when ownership of all the assets involved in the transaction is recorded on the same ledger.[4]

Ultimately, the goal of tokenization is to enhance efficiency by allowing contractual rights and obligations to self-execute, minimizing human involvement and processing times, and by allowing transactions to settle atomically 24/7. Although often confused with or associated with the crypto industry, tokenization has important differences from mainstream crypto investments, and can exist separate and apart from the crypto industry. Most obviously, the tokenization we are discussing today relates to real-world assets, whereas many crypto assets are Ponzi-like in the sense that they are not backed by real-world assets and so their value is based entirely on whether another buyer can be found for them. Also, as the next Section will explore, tokenization can be distinguished from crypto because tokenization does not require the use of a blockchain.

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[1] Bank for International Settlements ("BIS"), *Blueprint for the future monetary system: improving the old, enabling the new,* BIS ANNUAL ECONOMIC REPORT 2023, 85 (Jun. 25, 2023), available at https://www.bis.org/publ/arpdf/ar2023e3.pdf.
[2] *Id.* at 87.
[3] *Id.* at 94.
[4] *Id.* at 98.

B. Tokenization does not require a blockchain

Much of the discussion of tokenization assumes that a public permissionless blockchain will serve as the supporting infrastructure for tokenization, and some tokenization projects have indeed proceeded in that way (notably, Blackrock's tokenized fund Buidl was launched on the Ethereum blockchain).[5] Importantly, though, tokenization *does not require* the use of a public permissionless blockchain like the Ethereum or Bitcoin blockchain. Other kinds of ledgers can support tokenization's programmability and composability: indeed, smart contracts predate the existence of blockchain technology.[6]

This is a critical point to make, because public permissionless blockchain technology suffers from significant governance and operational fragilities.[7] Public permissionless blockchains also allow for anonymity that can facilitate money laundering and sanctions evasion. It is therefore highly undesirable for public permissionless blockchains to serve as the "plumbing" for any financial services.

To elaborate, permissionless public blockchains are databases that are hosted on multiple different computer servers, each of which is known as a node. Instead of having one centralized entity host and maintain the database, each node runs software that allows it to host a version of the database. "Permissionless" means that any computer running the necessary software can become a node – there is no identification or vetting involved. Transactions are carried out by updating the database, but because it is quite plausible that a node could be a bad actor, nodes need to be discouraged from approving problematic transactions (like double spending, or transferring assets to themselves). Public permissionless blockchains rely on game-theory based consensus mechanisms like proof-of-work or proof-of-stake to discourage such behavior.[8]

These consensus mechanisms make transaction processing on a public permissionless blockchain inefficient and wasteful – this is unavoidable, as without inefficiency and expense it would be far too easy for a bad actor to approve problematic transactions.[9] As a result of this inefficiency, permissionless public blockchains struggle to process large volumes of transactions, and the delays and transaction fees can be significant at peak times. This significantly limits the ability of permissionless public blockchains to scale up.[10] The efficiencies that *can* be achieved using public permissionless blockchains often come from avoiding what can sometimes be time-

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[5] Krisztian Sandor, *BlackRock's BUIDL Becomes Largest Tokenized Treasury Fund Hitting $375M, Toppling Franklin Templeton's*, COINDESK (Apr. 30, 2024), available at https://www.coindesk.com/markets/2024/04/30/blackrocks-buidl-becomes-largest-tokenized-treasury-fund-hitting-375m-toppling-franklin-templetons/

[6] Kelvin F.K. Low & Eliza Mik, *Pause the Blockchain Revolution*, 69 INT'L & COMP. L. Q. 135, 170 (2020).

[7] BIS, *supra* Note 1 at 86; Angela Walch, *The Bitcoin Blockchain as Financial Market Infrastructure: A Consideration of Operational Risk,* 18 NYU J. LEG. & PUB. POL'Y 837, 893 (2015).

[8] For a comprehensive explanation of public permissionless blockchain technology, *see* Primavera De Filippi & Aaron Wright, BLOCKCHAIN AND THE LAW (2018).

[9] Edmund Schuster, *Cloud Crypto Land*, 84 MODERN L. REV. 974, 981 (2020).

[10] Frederic Boissay *et al.*, *Blockchain Scalability and the Fragmentation of Crypto*, BANK FOR INT'L SETTLEMENTS BULLETIN NO. 56 (Jun. 7, 2022), available at https://www.bis.org/publ/bisbull56.pdf.

consuming and expensive regulatory compliance (for example, compliance with KYC/AML requirements). But avoiding these regulatory requirements is not socially desirable.

Another issue with permissionless public blockchains is that each node runs software that, like all software, requires constant monitoring and maintenance to prevent outages and security vulnerabilities. When it comes to their own centralized systems, financial institutions invest heavily in large teams of software engineers to perform maintenance and cybersecurity functions, as do providers of financial infrastructure like the DTCC and CHIPS (who are highly regulated).[11] But who has the economic incentive to invest time and effort in maintaining the resilience of the software supporting a public permissionless blockchain? Certainly not every node in the system. As one point of reference, the Bitcoin blockchain currently depends on a handful of people funded by sponsored grants to maintain its code.[12] The Ethereum blockchain depends heavily on computers running Geth software, and that software is maintained by the Ethereum Foundation, a non-profit which goes to great pains to advertise that "no one person owns or controls the Ethereum protocol."[13]

When it comes to the core software developers for public permissionless blockchains, it is not clear which individuals are involved, what powers they have, or how they are chosen – they are certainly not regulated. If core software developers are compensated by grants or a non-profit, who ultimately funds them (could it be a bad actor?), and what happens if the funding dries up? Who gets to decide when a software update is needed, who ensures that it is developed, and who ensures that the other nodes of the relevant blockchain will accept the update? Can core developers and other nodes be counted on to get the infrastructure up and running in a timely manner after an outage? What if core developers or nodes abandon maintaining a blockchain – could the assets hosted on that blockchain be lost?

When it comes to permissionless public blockchains, there are no ready answers to these critically important governance questions – and the stakes are high. Bugs have been found in the code of the Bitcoin blockchain, for example, that could have been exploited to allow major Bitcoin thefts: in one early instance, a bug *was* exploited in this way but core developers were able to patch the bug and then undo the problematic transaction by forking the ledger;[14] in another instance, a friendly developer reported the bug to core developers for patching before it could be exploited.[15] Just last month, the Department of Justice indicted two brothers "who studied computer science and math at one of the most prestigious universities in the world, [and] allegedly used their specialized skills and education to tamper with and manipulate the protocols relied upon by

[11] See, for example, Dodd-Frank Title VIII and the Principles for Financial Market Infrastructures.
[12] Paul Kiernan, *Bitcoin's Future Depends on a Handful of Mysterious Coders*, WALL ST. JOURNAL (Feb. 16, 2023).
[13] https://ethereum.org/en/governance/
[14] Robert Stevens, *The Day Someone Created 184 Billion Bitcoin*, DECRYPT (Aug. 26, 2020), available at https://decrypt.co/39750/184-billion-bitcoin-anonymous-creator
[15] Joseph Young, *Bitcoin Core Dev Takes Responsibility for Critical Bug: "I'm Embarrassed and Sorry"*, CRYPTOSLATE (Sept. 24, 2018), https://cryptoslate.com/bitcoin-core-dev-takes-responsibility-for-critical-bug-im-embarrassed-and-sorry/

millions of Ethereum users across the globe."[16] Software bugs have also caused outages in the Nethermind and Besu software that some nodes rely upon to support the Ethereum blockchain. No critical bugs have yet been reported with regard to the Geth software that most nodes use to support the Ethereum blockchain, but smaller bugs have been reported, and experts have raised concerns that a bigger glitch in this software could cause a major Ethereum outage.[17]

Given these stakes, the absence of accountability for permissionless public blockchain core software developers is disqualifying, as are the aforementioned inefficiencies. Public permissionless blockchains simply should not be used as infrastructure for real-world asset transfers.[18]

As an alternative, tokenized assets could be recorded on permissioned or private distributed ledgers. For these ledgers, permission is needed before a computer can serve as a node supporting the ledger, and so the people supporting the ledger can be identified and subjected to regulation and oversight.[19] These kinds of distributed ledgers also don't need to rely on expensive and inefficient consensus mechanisms to authorize nodes to validate transactions, because the permissioned nodes can be trusted to authorize transactions appropriately (and there are legal remedies available if they fail to do so). Permissioned and private distributed ledgers are therefore more efficient and scalable than more technologically decentralized permissionless public blockchains. Permissioned and private distributed ledgers may still sometimes be referred to colloquially as "blockchains," but they avoid lots of the problems associated with public permissionless ledgers.

To be sure, private and permissioned distributed ledgers may not be suitable for all tasks. There are several high-profile examples of enterprise distributed ledger projects that were abandoned as unworkable, including the Australian Stock Exchange's blockchain project,[20] and a proposed IBM/Maersk logistics blockchain.[21] In some circumstances, a ledger controlled by a single centralized entity may be the preferable underlying infrastructure for asset tokenization (the centralization solves many efficiency and scalability challenges, provides an obvious candidate for legal obligations, and ensures that there are not any disparate competing versions of the ledger). However, I do not intended to express any preference for centralized ledgers or private or

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[16] Department of Justice, *Two Brothers Arrested for Attacking Ethereum Blockchain and Stealing $25M in Cryptocurrency* (May 15, 2024), available at https://www.justice.gov/opa/pr/two-brothers-arrested-attacking-ethereum-blockchain-and-stealing-25m-cryptocurrency

[17] Sam Kessler, *Bug That Took Down 8% of Ethereum's Validators Sparks Worries About Even Bigger Outage*, COINDESK (Jan. 22, 2024), available at https://www.coindesk.com/tech/2024/01/22/bug-on-ethereums-nethermind-software-sparks-discussion-of-client-diversity-risks/

[18] Walch, *supra* Note 7 at 893.

[19] Low & Mik, *supra* Note 6 at 143 ("permissioned blockchains may give certain nodes the right to retrospectively edit the contents of a block, reverse transactions or, as part of formalised system upgrades, amend the underlying code").

[20] Jesse Coghlan, *Aussie stock exchange abandons blockchain plans, leaving $170M hole*, COINTELEGRAPH (Nov. 17, 2022), available at https://cointelegraph.com/news/aussie-stock-exchange-abandons-blockchain-plans-leaving-170m-hole.

[21] Danny Nelson, IBM and Maersk Abandon Ship on Tradelens Logistics Blockchain, COINDESK (Nov. 29, 2022), available at https://www.coindesk.com/business/2022/11/30/ibm-and-maersk-abandon-ship-on-tradelens-logistics-blockchain/

permissioned distributed ledgers: the broader point is that they can all support all the benefits of tokenization and they are all preferable to the use of permissionless public blockchains.

The remainder of this testimony's assessment of tokenization of real-world assets is predicated on the assumption that such tokenization will be performed *without* a public permissionless blockchain.

3. Selected Tokenization Use Cases

This portion of the testimony will consider some of the use cases and benefits of tokenizing real-world assets, and strip out some of the unsubstantiated hype.

A. Tokenized deposits

One regularly discussed use case is the tokenization of bank deposits.[22] There is, however, some confusion between stablecoins and tokenized deposits, which are two very different things. Most stablecoins seek to maintain their peg to the dollar by investing in a segregated reserve of safe assets like treasuries, whereas tokenized deposits represent debts owed to customers by a bank. Banks can invest the funds they borrow from their deposit customers in a broader range of permitted assets (including loans, which facilitates the provision of credit). Tokenized deposits are a technological upgrade, but not a fundamental change to the bank business model, whereas stablecoins look more like a money market mutual fund, or the narrow bank model.

Tokenizing deposits would facilitate composability, because composability can only work if there is some kind of tokenized money on the ledger to serve as a settlement asset for the other parts of the transaction.[23] Tokenization would also allow for programmability of deposits. To give one basic example of a potential programmability use case, a deposit token could be preprogrammed to make periodic interest payments, eliminating the need for back office employees to make payments each month. To give another, more complicated example, the BIS has suggested that tokenized deposits could be preprogrammed to eliminate depositors' early mover advantage in some circumstances, which, if effective, could prevent future bank runs.[24]

If a tokenized deposit operates on a single bank's ledger, then it will only be useful for settling transactions among that bank's customers.[25] Much of the excitement about tokenized deposits, though, derives from the hope that this technology upgrade will speed up payments processing across the banking system. There is particular interest in speeding up cross-border payments (which typically take several days to settle because the current process requires the reconciliation of multiple accounts after the exchange of messages among a chain of correspondent banks, many of which are in different time zones and therefore have different operating hours).[26]

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[22] Oliver Wyman and Onyx by J.P.Morgan, DEPOSIT TOKENS: A FOUNDATION FOR STABLE DIGITAL MONEY (Feb. 2023), available at https://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2023/feb/oliver-wyman-jp--morgan-deposit-tokens-report-final.pdf

[23] BIS, *supra* Note 1 at 86.

[24] *Id.* at 101.

[25] Oliver Wyman and Onyx by J.P.Morgan, *supra* Note 22.

[26] BIS, *supra* Note 1 at 98. The BIS, IIF, and several central banks recently announced that their Project Agora, which is designed to explore how tokenization can enhance the functioning of the wholesale cross-border payments,

Improving efficiencies in cross-border payment processing would be a highly desirable outcome, but shared or interoperable ledgers would be needed to allow tokenized deposits to be used in transactions between customers of different banking institutions. Steps would also need to be taken to ensure that a deposit token issued by Bank A is considered to be as good as, and therefore fungible with, a deposit token issued by Bank B, C, or D.[27] One way to do this would be for banks to settle exposure to one another's tokenized deposits in central bank money. Wholesale central bank digital currencies ("CBDCs") are issued only to banks, and could serve as a digitally native settlement asset for this purpose: a report authored by Oliver Wyman and JPMorgan has noted that:

> *deposit tokens can have a symbiotic relationship with blockchain-based wholesale CBDCs, helping to further the two-tier banking system in place today and providing a natural bridge for the integration of CBDCs into the banking system.*[28]

The implementation of tokenized deposits could be compromised if the CBDC Anti-Surveillance State Act passed by the House of Representatives in May 2024 were to become law. While it is not clear to me that central bank digital currencies are necessary or desirable *for retail customers*, the language of that bill goes far beyond precluding the Federal Reserve from issuing a retail CBDC. For example, Section 3 of that bill provides that:

> *A Federal reserve bank shall not offer a central bank digital currency, or any digital asset that is substantially similar under any other name or label, indirectly to an individual through a financial institution or other intermediary.*[29]

This would preclude the Federal Reserve from supporting private banks' issuance of tokenized deposits with a wholesale CBDC (the statutory language might even be broad enough to preclude other innovative improvements to the Federal Reserve's interbank settlement systems). The CBDC Anti-Surveillance State Act expressly preserves a role for privately-issued stablecoins, so perhaps the supporters of that bill assume that privately-issued stablecoins will perform the role of money in programmed/composed transactions, and that tokenized deposits will therefore be unnecessary. Replacing fiat currency with privately-issued stablecoins is a dangerous path to go down, however.

If significant amounts of funds flow into stablecoins, then that will disrupt the provision of credit (because funds will be tied up in safe assets instead of loans), limit the available supply of safe assets, and potentially disrupt the implementation of monetary policy.[30] Stablecoins also

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is ready to open up to private sector participation. BIS, *Project Agorá moves to next phase and opens up call for private sector participation* (May 14, 2024), available at https://www.bis.org/about/bisih/topics/fmis/agora.htm.

[27] *Id.*

[28] *Id.*

[29] H.R. 5403.

[30] Rod Garratt, Michael Lee, Antoine Martin, and Joseph Torregrossa, *The Future of Payments is Not Stablecoins*, LIBERTY STREET ECONOMICS (Feb. 7, 2022), available at https://libertystreeteconomics.newyorkfed.org/2022/02/the-future-of-payments-is-not-stablecoins/#:~:text=Stablecoins%20tie%20up%20liquidity%20unnecessarily.&text=On%20the%20other%20hand%2C%20tying,maintain%20sufficient%20liquidity%2C%20for%20example.

aren't protected by deposit insurance, are vulnerable to depegging and runs, and aren't currently subject to prudential regulation. Stablecoin-specific legislative proposals have been advanced in the United States, but these envisage prudential regulation for stablecoins that is "lighter touch" than bank regulation. Stablecoins also run on the highly problematic public permissionless blockchains discussed in Section 2.B, and the legislative proposals we've seen so far do nothing to address the operational and governance problems that plague this underlying infrastructure. It is possible that some of these problems could be solved if banks themselves issue stablecoins on permissioned or centralized ledgers, but those stablecoins won't be protected by deposit insurance while the banks' deposits (tokenized or otherwise) will be. This seems sure to cause massive confusion among bank customers. Given these factors, tokenized deposits, rather than stablecoins, should be the settlement asset for other tokenized assets, to which this testimony will now turn.

B. Tokenized securities

As with cross-border payments, securities settlement currently tends to involve lots of communications and reconciliations among many different intermediaries. The hope is that tokenization of securities can eliminate some of these intermediaries, making the settlement of securities trades quicker and more efficient. Another goal is to reduce settlement risk by having securities transactions settle atomically (i.e. the securities will be transferred at the precise moment of payment, and so there's no concern that something will go awry after payment has been made but before the securities are received, or that securities will be transferred without receiving payment).[31] Finally, fractionalization aims to increase liquidity by allowing investors to buy a piece of an asset, rather than requiring them to commit to purchasing the whole asset.

Achieving these goals may require steps towards adopting shared or interoperable ledgers, as discussed in the previous Section. An important point to note is that existing delays in securities settlement are not necessarily due to technological limitations.[32] In some instances, technology already exists that can speed up settlement, but market participants consider immediate settlement undesirable. For example, more transactions are likely to fail if the trade can only occur if all assets and payments are on hand and available at the exact moment the trade is executed – non-instantaneous settlement, on the other hand, allows more grace and also frees up assets a little more, increasing liquidity. Also, if transactions settle instantly, netting of multiple transactions will not be possible, and it may not be desirable in some markets to eliminate the benefits of netting (netting can reduce some kinds of credit, settlement, liquidity, and systemic risks).[33] These kinds of considerations should factor into whether tokenization and atomic settlement are desirable in a particular market. But it is highly likely that there will be some securities markets that will benefit from advances in tokenization.

However, another bill passed by the House of Representatives in May 2024 may prove detrimental to the development of the tokenized securities market, were it to become law, by

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[31] BIS, *supra* Note 1 at 100.

[32] Michael Lee, Antoine Martin, and Benjamin Müller, *What is Atomic Settlement?*, LIBERTY STREET ECONOMICS (Nov. 7, 2022), available at https://libertystreeteconomics.newyorkfed.org/2022/11/what-is-atomic-settlement/; Dirk Bullmann, *Atomic Settlement: Counting Down to Zero,* CLS (2023), available at https://www.cls-group.com/media/jw2pzuaq/cls_shaping-fx_opinion-piece_-01_counting_down_to_zero.pdf

[33] https://www.newyorkfed.org/medialibrary/microsites/fmlg/files/Millerspresentationonnetting.pdf

creating regulatory uncertainty and undermining investor protections. Section 202 of the FIT21 Act expressly carves "investment contract assets" out of the definition of "security," with the result that the SEC would have no jurisdiction over an "investment contract asset."[34] That term is defined to mean:

> *a fungible digital representation of value—*
> *(A) that can be exclusively possessed and transferred, person to person, without necessary reliance on an intermediary, and is recorded on a cryptographically secured public distributed ledger;*
> *(B) sold or otherwise transferred, or intended to be sold or otherwise transferred, pursuant to an investment contract; and*
> *(C) that is not otherwise a security pursuant to the first sentence of paragraph (1).''*

If enacted, this loophole would likely be very attractive to issuers in the short term, as it would allow them to avoid SEC oversight by recording the asset on a permissioned (or permissionless) public blockchain. We should expect to see a glut of tokenized "investment contracts assets" that look surprisingly like traditional kinds of securities (although subsection (C) provides that tokens representing traditional securities like "stock" and "notes" aren't investment contract assets, there will inevitably be definitional fights as issuers try to litigate their way out of these categories and into the investment contract asset definition). In addition to this regulatory uncertainty, the absence of investor protections is likely to undermine confidence in the tokenized securities markets in the longer term.

Even without the passage of the FIT21 Act, investors could lose some protections if tokenization eliminates the role of regulated intermediaries (e.g. brokers) who are legally required to provide some investor protection functions. The flip side of this is that some regulated intermediaries are ill-intentioned and take advantage of investors: there could therefore be some investor protection benefits, as well as efficiency benefits, from eliminating intermediaries. It is important to note, though, that using technological tools instead of human intermediaries does not guarantee neutrality or good behavior. Technological tools cannot exist or function without human beings to create and deploy them, and it is important to consider the incentives of those who develop, sell, and deploy those tools.

C. Tokenized physical assets

There has also been interest in using tokens to create greater liquidity for real world assets like real estate and art, either in whole or fractionalized form. The logic behind this kind of tokenization bears some resemblance to the logic behind asset securitization, which seeks to make illiquid real-world assets into liquid financial assets by pooling them and then selling claims on the pool.

Assets like real estate and art can indeed be represented by a token on a ledger, but they exist separate and apart from the ledger in the real world. This can lead to complications, because

[34] H.R. 4763.

the real-world assets can change hands without updating the ledger, leading to significant confusion regarding ownership.[35] As the Congressional Research Service has noted:

> *The ability to record transactions of real estate (for example, on a ledger) does not necessarily confer legal rights. Moreover, while tokenization offers an avenue for "owning" or conveying real estate or art, such physical assets may still be traded offline (i.e., in real life). This would require a system that reconciles blockchain and physical realities so that a tokenized property that has been sold on the blockchain cannot also be sold via traditional methods and vice versa.*[36]

Tokenization is meant to achieve efficiencies through automated self-enforcement (in the sense that monitoring and uncertainty should be eliminated if breach all but impossible), but uncertainty about the alignment between ownership of the token and ownership of the real-world asset will undermine these kind of efficiencies unless there are mechanisms to bring the real-world assets into compliance with the record on the register.[37]

Disputes over ownership will ultimately play out in the courts pursuant to established law, and it is the ledger that will need to follow the courts rather than vice versa – unless the law endorses a particular ledger as the final word on who owns a particular asset. Some countries, like Australia, have adopted such a "title by registration" approach to real estate transactions (this system was first implemented in 1858, and so title by registration long predates the use of databases and smart contracts). Title by registration can provide certainty, but it is not without its drawbacks: for example, it can sometimes be easy for bad actors to convince those who maintain the ledger to record and therefore validate their claims to a particular asset.[38] Conversations about facilitating tokenization of real world assets therefore raise important property law policy questions, and property law experts should be involved in those conversations.

Finally, it should be noted that these examples of tokenized real-world assets are very different from the faddish non-fungible tokens or "NFTs" that have been popular in the crypto markets in recent years. The examples discussed here assume that tokens will confer an actual ownership right in the underlying asset, whereas many of the NFTs sold in the crypto market do not convey any such right.[39] For example, you might buy an NFT relating to a digital artwork, but that does not mean you own the copyright associated with that artwork (although many NFT purchasers seem to misunderstand this). Instead, purchasers typically acquire a token that serves as a digital signature (similar to owning a copy of a book that is autographed by the author).

D. Financial inclusion

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[35] Low & Mik, *supra* Note 6 at 145 ("But "traditional" assets, such as houses or cars and (less obviously) even copyright and carbon credits, do not exist solely on the pages of ledgers – ledgers reflect a state of the world outside of them").

[36] Paul Tierno, *Tokenized Assets*, CONGRESSIONAL RESEARCH SERVICE (May 20, 2024), available at https://crsreports.congress.gov/product/pdf/IF/IF12670#:~:text=Tokenization%20refers%20to%20a%20form,platform%2C%20such%20as%20a%20blockchain.

[37] Low & Mik, *supra* Note 6 at 166-67.

[38] *Id.* at 154-56.

[39] Juliet M. Moringiello & Christopher K. Odinet, *The Property Law of Tokens*, 74 FL. L. REV. 607, 642 (2022).

There has been some discussion of tokenization as a path to financial inclusion, banking the unbanked and opening up investment opportunities to those who have traditionally been excluded from them. In reality, though, tokenization has quite limited prospects for facilitating meaningful financial inclusion.

Tokenized deposits could offer some consumer benefits, for example, if they speed up individuals' access to their paychecks and other payments. This could help limit underbanked populations' need for expensive services like check cashing, earned wage access programs, and payday loans. But although they might help the *under*banked (meaning those who have a bank account, but still rely on expensive alternative providers of financial services), tokenized deposits will not help bank the *un*banked. Many who are unbanked identify the primary reason as either insufficient wealth to meet minimum balance requirements or lack of trust in banks, and tokenization is not responsive to either of these problems.[40] (For the avoidance of doubt, stablecoins also won't bank those who are unbanked because they don't trust banks. Because most people are not paid in stablecoins, the predominant path for acquiring stablecoins, and for cashing out stablecoins to transact in the real economy, is through a crypto exchange. But crypto exchanges typically require users to have a bank account in order to open an exchange account, and so the unbanked are largely precluded from using stablecoins).

The creation of other kinds of tokenized assets (even fractionalized ones) is unlikely to meaningfully increase financial inclusion, because the real problem is not a lack of investment opportunities but a lack of wealth to invest in the first place. The Federal Reserve's report on the Economic Well-Being of U.S. Households in 2023 states that "54 percent of adults said they had set aside money for three months of expenses in an emergency savings or "rainy day" fund."[41] That means that 46 percent of U.S. adults *do not* have enough savings to get through a three month emergency period. The survey also revealed that 51% of U.S. adults had spent all of or more than their income in the month prior to taking the survey.[42] In other words, roughly half of all American adults are living paycheck to paycheck and do not have any spare money to invest.

As Professors Lindsay Sain Jones and Goldburn Maynard have explored, many of fintech's claims about building wealth for traditionally excluded groups do not bear out, and in fact often disguise predatory practices that disproportionately harm vulnerable members of society.[43] Real solutions for traditionally excluded populations will require policies that directly provide wealth to those populations. For example, proposals have been made for the issuance of "baby bonds," which would allow children in need to build wealth by the time they become adults.[44] While technology might play a minor role in creating the infrastructure for delivering this kind of wealth-building, it will not come close to providing the whole solution.

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[40] Federal Deposit Insurance Corporation, 2021 FDIC National Survey of Unbanked and Underbanked Households Executive Summary, 2, https://www.fdic.gov/analysis/household-survey/2021execsum.pdf.

[41] Board of Governors of the Federal Reserve System, *Economic Well-Being of U.S. Households in 2023*, 33 (May 2024), available at https://www.federalreserve.gov/publications/files/2023-report-economic-well-being-us-households-202405.pdf

[42] *Id.* at 15.

[43] Lindsay Sain Jones & Goldburn Maynard, *Unfulfilled Promises of the FinTech Revolution*, 111 CAL L. REV. 801 (2023).

[44] Darrick Hamilton & William Darty, Jr., *Can 'Baby Bonds' Eliminate the Racial Wealth Gap in Putative Post-Racial America?*, 37 REV. BLACK POLITICAL ECON. (2010).

Ultimately, tokenization is not a response to the lack of wealth and trust that creates disparities in financial inclusion in the United States. Although quicker payments may benefit underbanked population, advances in tokenization are primarily likely to benefit relatively wealthy and institutional users of financial services by improving efficiencies. As we have already explored these efficiencies may be well worth pursuing – but financial inclusion is not the driving force.

4. Risks to Consider

We should be careful to avoid getting swept up in tokenization hype, but there certainly appear to be use cases in which tokenization can improve efficiencies. Those efficiencies will sometimes come at the expense of making the financial system more fragile, though, and so it is important to be thoughtful about where tokenization is deployed: sometimes, increased fragilities will outweigh the efficiency gains. If we think back to 2020 and the beginning of the Covid pandemic, we learned the hard way that steps that had been taken to make supply chains more efficient in normal times left those supply chains brittle when changes occurred. Now, there is more and more interest in making components closer to home – which is often less efficient, but more resilient.[45] We should ask the same question about tokenization: "when is something efficient enough, such that making it more efficient will introduce too many fragilities and be counterproductive in the long run?"

A. Increased financialization of assets

Tokenization has the potential to bring more real-world assets into the financial markets, and to split those assets into many tradable pieces through fractionalization. While doing so may unlock liquidity and efficiencies in good times, we learned from our experience with securitization in the lead up to 2008 that an increasing supply of financial assets can precipitate increasingly speculative financial markets and pose financial stability risks. We also learned that the more complex and bespoke financial assets generated much of the uncertainty, and were more likely to become illiquid, during a panic.

Like the mortgage-backed securities that contributed to the 2008 crisis, the tokenized assets discussed in this testimony must ultimately be linked to a real-world asset somewhere. In that sense, they may pose less of a financial stability threat than crypto assets that can be created out of thin air and therefore proliferate indefinitely. Still, if tokenization takes off, it is undeniable that it will result in the creation of more financial assets that can be traded speculatively, and that can serve as collateral for leveraged transactions. From a financial stability perspective, too much leverage is problematic both because of its ability to multiply exposure to assets (which can inflate bubbles on the upswing), and also because the deleveraging process once the market turns south generates significant "fire sale externalities" as the borrower is forced to sell assets at a discount

[45] Rana Foroohar, HOMECOMING: THE PATH TO PROSPERITY IN A POST-GLOBAL WORLD (2022). Kathryn Judge, DIRECT (2022).

in order to satisfy their lender.[46] The bigger the supply of available financial assets, the greater the opportunities for asset bubbles to grow, and then for assets to be dumped during fire sales.

Deleveraging and fire sales create greater problems for financial stability if the assets involved are illiquid, because their illiquidity requires assets to be sold at even steeper discount in a panic. Reserve, capital, margin, and liquidity regulations can and should be used to limit leverage and ensure liquidity buffers, but they are unlikely to fully blunt the impact of a huge increase in the supply of financial assets (it is also possible that composability will enable new ways of creating leverage in transactions involving tokens, and these new types of leverage may evade some existing regulations).

Furthermore, the more bespoke and unfamiliar the assets are, the more likely they are to become illiquid in a panic, because valuing complex contractual arrangements in a crisis is subject to significant uncertainty.[47] Unique financial products composed of multiple tokenized assets are therefore particularly likely to become illiquid. There is also a real risk that markets for fractionalized assets will become less liquid than the markets for the whole versions of those assets. In both instances, illiquidity will only be worsened if there are legal uncertainties about how ownership of the token is mapped to ownership of assets in the real world: in bankruptcy situations determining ownership is critical and can be contentious, and potential buyers of these assets will factor that into the price that they are willing to pay.

All of the risks discussed in this Section will be exacerbated if tokens become widely used to create *synthetic* exposure to real-world assets. With synthetic exposures, holders do not actually have any rights to the real-world asset; instead, the real-world asset would just be a reference point for the rights and obligations associated with the token, allowing for a much greater speculation, multiplication of assets in the financial system, and complexity. Naked credit default swaps were used in this way in the lead up to 2008; the DeFi Mirror Protocol already allows crypto investors to invest in synthetic tokens.

B. Speed and automation

There is no avoiding the fact that the speed and automation associated with preprogrammed tokens and composed transactions will create new fragilities in our financial markets if tokenization takes off. At the most general level, increased transaction speed and "always on" 24/7 trading is likely to increase the volatility of, and therefore speculative interest in, the affected financial markets,[48] and faster payments are widely understood to have increased the incidence of

[46] Anil K. Kashyap, Richard Berner & Charles A.E. Goodhart, *The Macroprudential Toolkit*, 59 IMF ECONOMIC REVIEW 145 (2011).
[47] Nicola Gennaioli, Andrei Shleifer & Robert Vishny, *Financial Innovation and Financial Fragility*, FONDAZIONE ENI ENRICO MATTEI NOTA DI LAVORO 114.2010, 2 (May, 2010).
[48] Saule T. Omarova, *Technology v Technocracy: Fintech as a Regulatory Challenge*, 6 J. FIN. REG. 75, 98-99 (2020). To illustrate with a practical example, it has been reported that the securities brokerage Robinhood briefly suspended 24 hour trading in April 2024 to mitigate increased uncertainty and market volatility caused by geopolitical events. Steve Goldstein, *Users say Robinhood's overnight trading service went down after Israeli attack*, MARKETWATCH (Apr. 19, 2024).

fraud.[49] Ultimately, there are some benefits associated with slower operations and downtime that we may not wish to lose. For example, one problem with the automated 24/7 clearing model that FTX proposed (before its demise) was that retail investors would receive notifications of margin calls while they slept, and could find their holdings automatically liquidated by morning.[50] Confining trades to waking hours would avoid this. To offer another example, bank runs could become faster if tokenized deposits were to allow for quicker and more frictionless transfers of large amounts of uninsured deposits. Right now, such withdrawals are conducted via wire transfers to other financial institutions, and weekends and overnight bank closures can provide a natural pause in these wire transfer requests.[51]

Speed and automation can make financial markets very rigid, precluding opportunities for intervention, discretion and flexibility that can be needed in unexpected circumstances.[52] For example, when critical parts of the financial system are overleveraged, flexibility may be needed during the bust cycle to release the largest entities from obligations to respond to margin calls or repay loans – otherwise the failures of intermediaries and fire sales will have ripple effects that can drag down the whole system. But the use of smart contracts to preprogram tokenized assets could deprive the financial markets of intervention points to an even greater degree than the rigid contractual terms that turned mortgage-backed securities into "suicide pacts" in 2008.[53] Smart contracts are designed to execute their preprogrammed instructions instantly, without waiting for input from the parties (or a regulator, or a court). In good times, this makes things more efficient – but smart contracts will execute just as quickly in bad situations, even if everyone would be better off if they didn't. Sometimes, automatic execution is problematic because flaws in smart contracts can be exploited by hackers to steal tokenized assets. During a panic, though, even the normal execution of smart contracts could be problematic.

Just like legal contracts, computer programs cannot anticipate all future states of the world, and the speed and automation of self-execution can cause problems when the world has changed in ways that were not contemplated by the token's programmers.[54] When we're talking about financial stability, low-probability high-consequence events are the events we're most concerned about, and smart contract programmers are unlikely to have programmed the code to deal with such events. Once such an event occurs, the parties might have agreed to negotiate or extend some grace to one another – had they had the opportunity – to prevent temporary liquidity problems from metastasizing into something worse. But automated self-execution cuts off that opportunity. Automated self-execution may also limit opportunities for emergency government intervention. Although reversal of undesired transactions may be possible (something that is very difficult to

[49] The Federal Reserve, *Fraud and instant payments: the basics*, available at https://www.frbservices.org/financial-services/fednow/instant-payments-education/fraud-and-instant-payments-the-basics.html.
[50] Hilary J. Allen, Lee Reiners & Ryan Clements, *Comment Letter to the CFTC regarding LedgerX LLC d/b/a FTX US Derivatives ("FTX") Request to Amend DCO Order of Registration (IF 22-001)* (May 11, 2022).

[51] Hilary J. Allen, *Digital Bank Holidays*, forthcoming YALE J. REG., draft available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4756871.
[52] Katharina Pistor, *A Legal Theory of Finance*, 41 J. COMPARATIVE ECON. 315, 321 (2013).
[53] Anna Gelpern & Adam Levitin, *Rewriting Frankenstein Contracts: The Workout Prohibition in Residential Mortgage-Backed Securities*, 82 S. CAL. L. REV. 1077, 1079 (2009).
[54] For an overview of the literature on incomplete contracts, *see* Cathy Hwang, *Collaborative Intent*, 108 VA. L. REV. 657, 665-67 (2022).

achieve with permissionless public blockchains – yet another reason why they shouldn't be used), given the interconnectedness of the financial system, the initial execution may already have caused harmful spillovers like runs and fire sales by the time reversal can occur.

There are steps that can be taken to better equip a smart contract to adapt to unexpected events (for example, a smart contract can be programmed to consult an external data source known as an "oracle" that is controlled by a trusted party, before executing). Taking these kinds of steps might limit efficiencies to some degree, but are well-worth pursuing for financial stability and consumer/investor protection purposes.

C. Operational risks

Section 2.B of this testimony noted the inevitability of software bugs and vulnerabilities in public permissionless blockchains. Other kinds of ledgers are not immune from software problems. Skilled software engineers and cybersecurity professionals will therefore be critical to maintaining a private, permissioned, or centralized ledger's software, but it is widely accepted that it is impossible to craft perfectly safe and error-free computer code. While the efficiencies of tokenization will be maximized by using a single, shared ledger, the software of this ledger – and the data stored upon it – will become particularly attractive targets for hackers and other cybercriminals. As the BIS acknowledges, "the more comprehensive the ledger, the bigger the risks of a single point of failure and therefore the larger the potential associated costs."[55] Thought should therefore be given to whether the financial system will be safer (albeit less efficient) if more, smaller ledgers are used.

If more, smaller ledgers are used, some efficiency gains could still be achieved by making those ledgers interoperable through APIs. Again though, there are trade-offs, as APIs carry their own operational risks. APIs are increasingly becoming an attack surface: the crypto "bridges" that connect different public permissionless blockchains are a type of API, and a popular target for hacks.[56] In addition to being a target themselves, we should also consider whether APIs could transmit problems among connected ledgers: "shortcuts" like APIs that allow data and tokens to be transmitted more directly and quickly between ledgers may similarly allow technological problems to be transmitted between those ledgers more directly and quickly.[57] Increased interoperability may, for example, provide channels that magnify the damage caused by a cyberattack – by targeting one bank that has made its ledger interoperable with other banks' ledgers, the attack could compromise multiple banks.

Other operational risks will no doubt arise. For example, if the tokenized securities operate on a permissioned distributed ledger, there is the possibility that different nodes will have competing versions of the ledger, raising confusion about which is the authoritative version and therefore who owns the security.[58] (This would not be an issue if a centralized ledger were used). Another potential issue is that if a ledger detailing the movements of tokenized deposits were visible to the public, that would publicly reveal all of the payments associated with a particular

[55] BIS, *supra* Note 1 at 108.
[56] Boissay *et al*., *supra* Note 10.
[57] Hilary J. Allen, *Payments Failure*, 62 B.C. L. Rev. 453, 466; 473 (2021).
[58] Low & Mik, *supra* Note 6 at 163.

account number. Anyone (law enforcement, an estranged partner) who knows the account number of an individual would therefore automatically have access to enormous amounts of information about the individual, including what they're buying and where they're going. This is one reason to avoid making any ledger supporting tokenized deposits visible to the public; another is that transparency can sometimes exacerbate bank runs and other panics. As the Oliver Wyman/J.P. Morgan report noted "real-time transparency of on-chain activity, such as redemptions, may exacerbate the perception of redemption risks by displaying the activity of users who redeem in significant amounts, triggering the same fear and redemption activity in others."[59]

5. Looking Forward

As explored in this testimony, tokenization is best conceived of as a technological upgrade for existing financial services. When tokenized, the rights and obligations associated with deposits and securities do not fundamentally change, although many of them are memorialized in computer code. Such a technological upgrade may create new kinds of financial stability, consumer/investor protection, and operational risks that may require regulators to think a little differently about their supervisory and regulatory approaches, but by and large these risks can be addressed within regulators' existing mandates and statutory authorities (as already mentioned, however, if the FIT21 Act were to become law, there would be a problematic gap in investor protections for some tokenized securities). If important new financial market utilities are created to facilitate tokenization (for example, a provider of a shared ledger), then Title VIII of Dodd-Frank and the Principles for Financial Market Infrastructure already provide a framework within which to regulate them.

It is usually bad policy to tie legislation or administrative rulemakings to the state of a technology at a particular moment in time (this is a mistake that the FIT21 Act makes). Doing so opens up all kinds of opportunities to exploit loopholes by tweaking the technology itself, as well as guaranteeing that the legislation or rule will soon be rendered obsolete by technological evolution. It is typically better policy to eschew technology-specific laws and embraced the adage of "same activity, same risk, same rules" (meaning that law works best when it focuses at a higher level on the activity being carried out, rather than being granularly tailored to the technology being used to carry out that activity). Trust in tokenized deposits will flow from the application of traditional bank regulation (including deposit insurance) to the banks that issue them; investor confidence in tokenized capital markets will flow from the application of traditional securities laws. There are, however, some changes that may need to be explored outside of the boundaries of US financial regulation to accommodate the tokenization of physical real-world assets and to facilitate cross-border transactions. For example, there may need to be changes in private law to address potential discrepancies between ledger-recorded and physical ownership of assets like real estate and art;[60] for ledgers to operate cross-border, that may require the harmonization of laws between countries.[61]

Finally, this testimony has examined tokenization as a phenomenon separate and apart from crypto. With that said, much tokenization experimentation uses public permissionless

[59] Oliver Wyman and Onyx by J.P.Morgan, *supra* Note 22.
[60] On these private law issues, *see* Moringiello & Odinet, *supra* Note 39.
[61] BIS, *supra* Note 1 at 105-6.

blockchains, and seems designed to facilitate interconnections between crypto and traditional finance. As one Financial Times journalist noted, "in time, [BlackRock's tokenized fund] Buidl and others may lead to more efficient and exciting new ways to buy and sell shares…but its first use case may be to feed into the perpetual motion machine that is crypto trading."[62] Regulators around the world have sounded the alarm that greater integration of crypto and traditional finance could undermine the stability of our financial system.[63] Tokenization should not be used to facilitate this integration.

[62] Philip Stafford, *BlackRock adds heft to tokenisation push,* FINANCIAL TIMES (Apr. 12, 2024).

[63] Financial Stability Board, ASSESSMENT OF RISKS TO FINANCIAL STABILITY FROM CRYPTO-ASSETS (Feb. 16, 2022). The FSOC has noted that "financial stability vulnerabilities may arise from crypto-asset price volatility…, the market's high use of leverage, the level of interconnectedness within the industry, operational risks, and the risk of runs on crypto-asset platforms and stablecoins. Vulnerabilities may also arise from token ownership concentration, cybersecurity risks, and the proliferation of platforms acting outside of or out of compliance with applicable laws and regulations." FSOC, ANNUAL REPORT 2023, 41 (2023), available at https://home.treasury.gov/system/files/261/FSOC2023AnnualReport.pdf. For my work exploring crypto's potential financial stability risks, *see* Hilary J. Allen, DRIVERLESS FINANCE: FINTECH'S IMPACT ON FINANCIAL STABILITY, Oxford University Press (2022); Hilary J. Allen, *DeFi: Shadow Banking 2.0?*, 64 WM. & MARY L. REV. 919 (2023).