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Market Outlooks

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Asset Tokenization in Capital Markets

A Primer

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Contents

Executive Summary

Asset tokenization is a technological leap that is similar to other technological changes that have shaped the financial industry in the past. As with prior technological leaps, asset tokenization also has the potential to transform markets.

In this primer, we explore how this transformation applies to different asset classes and what this shift could mean for the macro economy, the financial industry, and decisions at the level of the individual investor.

We also offer deep dives into individual asset classes to illustrate how adoption of distributed ledger technology, the technology that underpins asset tokenization, could proceed, given the specifics of an asset class and the market in which it trades.

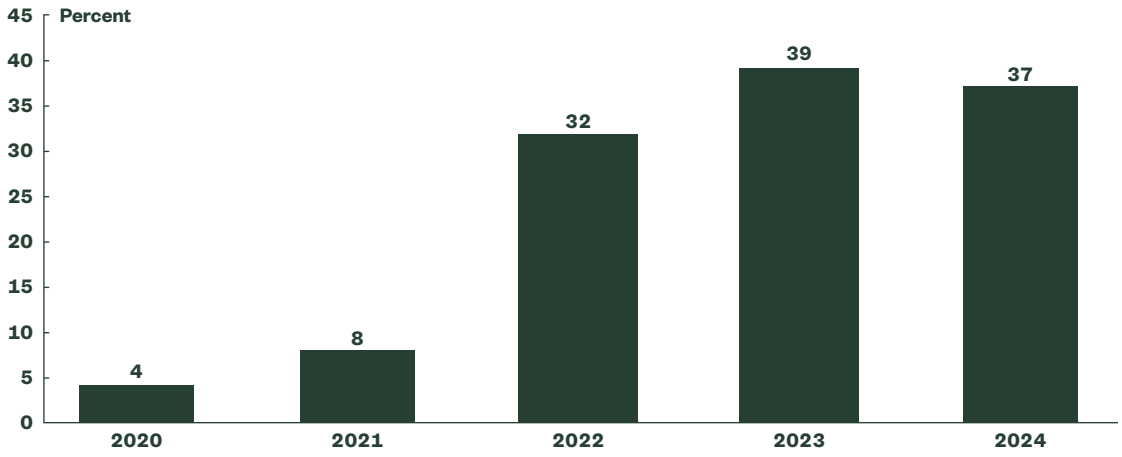
Introduction

In many ways, asset tokenization is just another technological leap, conceptually similar to other technological changes that have shaped the financial industry in the past, such as the change from paper-based securities to digitalized records. It is primarily supply-side driven, with value derived mainly from greater efficiency and lower costs. And, as with prior technological leaps, asset tokenization also has the potential to transform markets.

In this primer, we explore how this transformation applies to different asset classes and what this shift could mean for the macro economy, the financial industry, and decisions at the level of the individual investor. Deep dives into individual asset classes follow this broad overview.

For years digital ledger technology (DLT) such as blockchain has been associated with cryptocurrency. This is no longer true. The technology is making its way into mainstream finance. A multi-year industry survey by the International Securities Services Association suggests a clear trend, with over one-third of respondents saying that they have live DLT and digital assets projects (Figure 1).

Figure 1
Survey Respondents Who Have Live DLT and Digital Asset Projects



Note: Survey conducted in 2Q of each year. The number and distribution of respondents can vary materially from year to year, so the numbers should be treated as directional. The 2024 survey includes views from nearly 350 respondents globally.
Source: International Securities Services Association.

The Technology

Tokenization is the transition from existing market structures where financial instruments remain analogue (even if they have a digital representation) to a world where they are digitally native — i.e. the digital token itself will be the instrument with all legal and financial implications.[1]

A detailed discussion of the technology itself is outside the scope of this paper. However, a brief understanding of how tokens work is essential to understand why it could have an outsized impact on markets.

There are three key ingredients to the technology — distributed ledgers, tokens, and cryptocurrency.

A **distributed ledger** is, as the name implies, a sequential record of transactions. This is the infrastructure (the "rails") for digital assets of all stripes. Blockchain is the best-known distributed ledger.

Tokens, to follow the analogy, are the railcars — the digital "containers" that hold information. In financial markets, these tokens could be deemed as digital twins of a fund share or claim on a commodity.

Two features about tokens are important. First, they are mobile — just as digital containers are easier to move than real containers, digital *financial* containers move easier compared with their real *financial* companions. Second, they can be made "smart" — the logical steps of a process can be automated by programming them into the code of a token. This means tokens can not only move fast, but also self-service, too.

Cryptocurrency is not essential to the mix but can be a catalyst for greater gains. Crypto is simply another type of railcar. What is important is that it rides on the same rails. Ownership and payment legs of a securities transaction can therefore be done in the same place, resulting in huge efficiency gains.

In other words, the financial universe built on the back of DLT will be a much faster and cheaper and more transparent and accessible parallel to the conventional kind.

The Benefits

Today, we are seeing efforts to tether the digital world to real world assets. In doing so, the benefits of digital markets will spill into the mainstream financial world as well. What might those be and who might be the beneficiaries?

Figure 2
Potential Benefits of DLT to Mainstream Financial Markets

Faster	• Shorter Settlement Time (including 'atomic')
Cheaper	• Lower Issuance and Trading Costs • Automation of Backoffice Services via Smart Contracts
More Transparent	• Permanent Record of Transactions • Realtime Pricing
More Accessible	• Access to Exclusive Asset Classes (such as real estate, commodities, and private markets) • 24/7 Trading

Source: State Street Global Advisors.

Adoption of DLT will mainly transform the *supply side* of the market, whereby value is derived from savings for issuers and service providers. For example, once an asset is tokenized, the settlement of transactions can be undertaken instantaneously (or nearly so), compared with the current multi-day settlement process. Efficiency gains can be extended to the processes that underpin securities issuance and servicing. For example, DLT can be adapted to coordinate the information flow among parties involved in issuance. Equally, it can speed up asset servicing by automating corporate actions, such as dividend and coupon payments. Greater efficiency generates savings for the intermediaries involved in respective processes.

And while there are *demand-side* drivers as well, they are clearly secondary. One such driver is demand for traditional assets among crypto investors. Another is demand for ultra-short maturities in markets such as repo and swaps, where current settlement times impose a hard minimum limit on maturity (i.e. overnight). Yet another demand is for private market assets among retail investors who are locked out of the asset class due to high minimum investment amounts. These pockets of latent demand should help to accelerate the transition in some asset classes, and especially in bonds.

Box 1 Digital Ledger

The world of digital assets is broad, and terminology can at times be confusing. The simplified schemata below provide an overview.

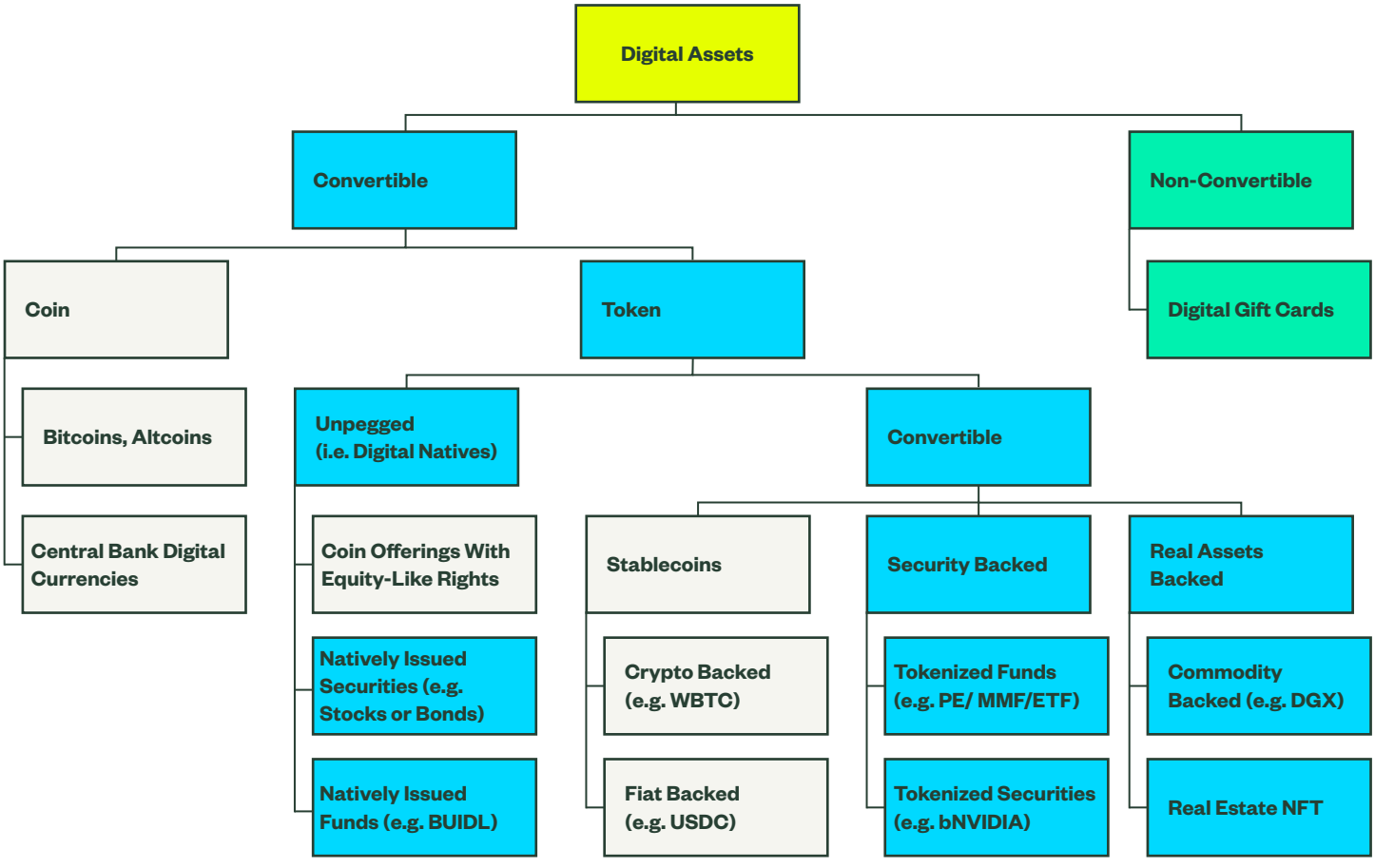
Coins Versus Tokens

- **Coins** can be thought of as low-level codes that run the operating system of a device, whereas **tokens** are higher-level codes that run individual applications. Some unregulated coins, such as bitcoin, have developed as an investment asset in their own right, but most are utilities, including central bank digital currencies (CBDC). Tokens, much like software, have a broader set of uses.

Pegged Versus Unpegged Tokens

- **Pegged** tokens are "digital twins" of assets that reside off-chain. This can be almost anything from financial assets such as bonds to real assets such as commodities. The value of a token is pegged to that of an underlying asset. In digital form, an asset becomes more tradeable, and this can drive additional investor demand. Pegged tokens are also used to bridge structural gaps, for instance by enabling fiat-backed stablecoins (e.g. USDC) to move between traditional and crypto markets, and crypto-backed stablecoins (e.g. WBTC) to move between different blockchains. All coins are unpegged.

- **Unpegged** tokens are digital natives — i.e. issued on-chain and have no analogous "twins". There is some conceptual overlap between these and coins. The difference lies in the inherent economic value that exists behind tokens, which does not exist for coins. For example, natively issued bonds are backed by contractually obligated future cash flows, which can be enforced legally.



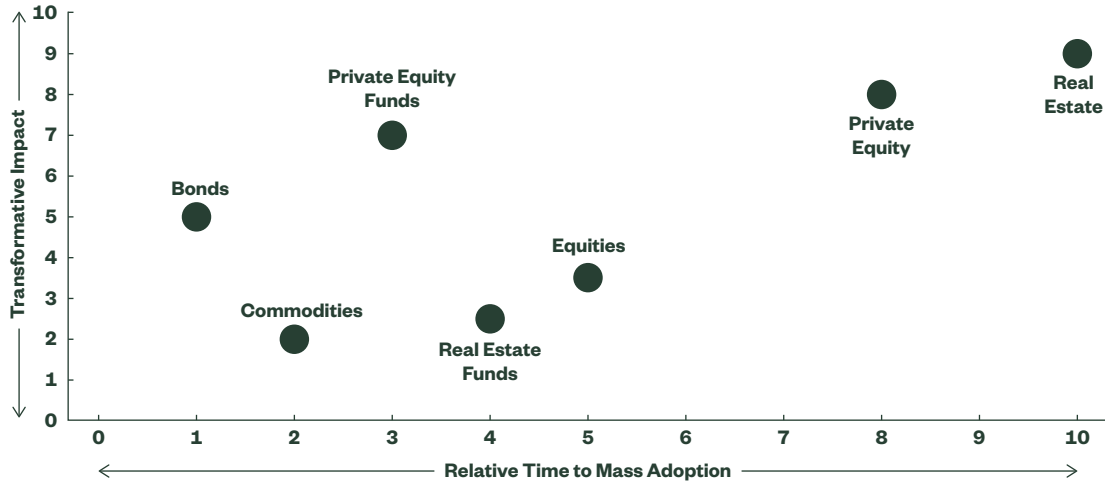
Source: Milken Institute, State Street Global Advisors.

Impact of Tokenization on Various Asset Classes

Tokenization of traditional financial markets will not be equally quick or impactful across all asset classes. Within financial markets, each asset class has defining features — from the nature of the product, the process by which it is issued, traded, and serviced to the nature of competition, and the regulatory environment. These differences make some markets better positioned for DLT adoption than others.

Figure 3 illustrates how we think uptake will proceed for different asset classes. We see mass adoption being led by bond markets, with the most transformative impact being shared by private equity funds as well in the near term. The prospect of tokenization of illiquid individual real assets would be revolutionary. But outside of the fund structure, it is likely to be very far in the future.

Figure 3
Time to Mass Adoption and Transformative Impact on Market



Source: State Street Global Advisors.

The bond market is ripe for adoption. The complex nature of the instruments, repeated nature of issuance costs, and high competition among intermediaries support both a rapid pace of adoption and room for significant impact. DLT can play an important role in markets that prize velocity of trading, such as repos and swaps.

In **public equities,** where the current representations of ownership already work well and the market itself is relatively efficient and transparent, the impetus for adoption is low and potential benefits are moderate.

In **private market funds,** DLT can materially reduce barriers to entry by streamlining the relationship between funds and their limited partners. The lack of meaningful automation is one reason why these markets have such high minimum investment amounts. However, ultimately, consumer protection regulations may limit "democratization" to high-net-worth individuals, limiting the promise of DLT.

In **commodity** markets, tokenization seems to finally offer the possibility of direct ownership (as opposed to indirect exposure via derivatives), especially since this can be fractional. However, what is possible is often legally unrealistic — for instance, retail ownership of uranium.

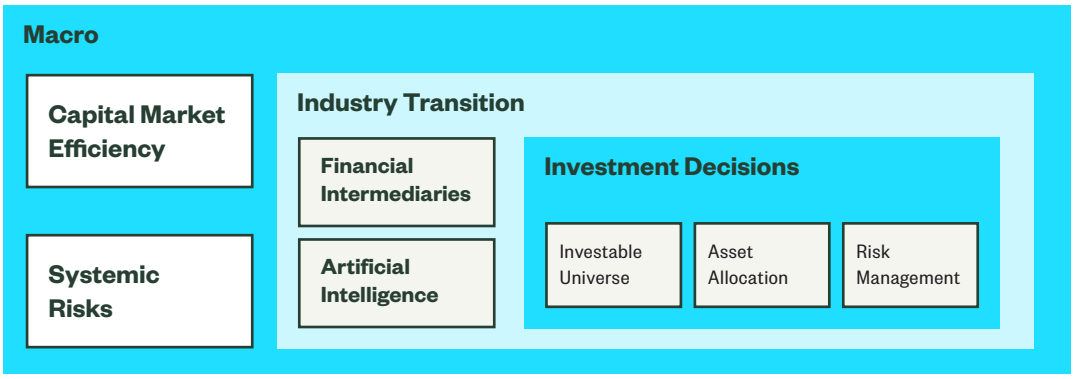
Finally, tokenization of **real estate and private equity outside of the fund structure,** for all its promise, is a distant dream due to high informational asymmetries for which DLT does nothing. However, incremental short-term benefits may come from efficiency gains to tangential processes, such as property registration (in real estate).

Recent data on native digital issuance support a multi-speed thesis. Tokenization of bonds and related products, such as commercial paper and derivatives, is well ahead of the rest.

Outlook and Conclusion

If we zoom out and consider these changes from a broader perspective, how should investors be thinking about this transition? Below we draw out some emerging themes and offer some examples of how those apply.

Figure 4
Impact of DLT Adoption



Source: State Street Global Advisors.

Macro Environment

At the broadest level, tokenization simplifies cross-asset allocation and trading. In reducing the friction inherent in financial intermediation, tokenization should lead to greater efficiency in capital allocation. Given the impact on barriers to market entry, we expect it to benefit *smaller* economic actors, such as borrowers (e.g. small and medium-sized enterprises (SMEs)) and savers (e.g. retail investors, including high-net-worth), drawing them into the market and amplifying their impact.

In a general economic sense this is good. However, it does also raise new challenges for consumer protection and financial stability. All else being equal, faster, nimbler, and more interconnected financial markets carry greater risk of market abuse and market contagion. This is a risk that can be managed by updating regulations to reflect technological advances and global alignment on standards. But regulations are also by definition political. In the current political climate, reaching consensus may be challenging, both domestically and internationally, creating vulnerabilities.

Industry Transition

The technology will disrupt the financial industry. Simply put, DLT threatens the market position of companies that make money by bridging existing market inefficiencies, chief among them custodians, payment agents, and depositories. The new technology will not eliminate the need for their services, but it will change and possibly narrow their scope. Control over the technology will be key, which supports a trend towards acquisitions within that part of the sector.

Disruption from DLT coincides with the rise of artificial intelligence related technologies (AI). The interaction between the two could be transformative. As the industry builds AI into various processes, a rising share of portfolios will be constituted by digital assets with built-in automative programming. This means, AI-guided portfolio management will have machine readable digital assets as a counterpart, allowing software to drive the less strategic parts of portfolio management and trading. The potential productivity gains appear enormous, especially as these technologies could automate the costliest, least-productive work within the financial industry.

DLT will disrupt business models in other industries as well, including entertainment services (relationship between artist and label) and healthcare (relationship between patient and provider). These changes will certainly be relevant for investors, but they are outside the scope of this paper.

Investment Decisions

Tokenization of assets expands both the breadth and depth of capital markets, which should expand the investable universe, make asset allocation nimbler, and help to precisely manage risk.

Investable Universe

An immediate example is a transformation of the repo market, with *intraday* repos and swaps (allowing deal maturities in hours or even minutes) becoming the norm, whereas overnight is the shortest timeframe today.

In the longer term, we see a broadening and deepening of the bond market. This would include more options for SMEs, for which the current cost of bond issuance is a strong disincentive, as well as greater frequency of issuance in line with demand and market conditions. The programmability of securities will transform the structured finance space, leading potentially to new forms of securitization.

Meanwhile, the ability to fractionalize ownership should make it possible to explore more granular investment theses more cheaply, particularly if paired with AI-backed advisory. This could be a powerful force, particularly in the retail space.

Asset Allocation

Tokenization should make access to each asset class easier, with effects more pronounced for some asset classes versus others. In turn, this should make global asset allocation nimbler, with reduced friction and costs when shifting assets between markets, asset classes, and geographies. The practical effect of this should be greater correlation in cross-asset returns. We expect this to be felt most notably between alternative markets (e.g. private equity) and public markets, a trend that has assumed prominence in recent decades.

The benefits extend not only to strategic decisions, but tactical ones as well. One immediate example is the ability to use shares in tokenized money market funds as collateral (normally only cash is accepted). In a world where interest rates are meaningfully above zero, this gives investors greater balance sheet flexibility.

Risk Management

Most of what has been said above applies to risk management, insofar as greater depth, breadth, and efficiency of financial markets allow greater precision in tailoring exposure to risk preference. For instance, when ownership of assets is used to mitigate certain risks, as is the case with interest rate risk in liability-driven investment, the ability to purchase fractions of an asset will make the process more precise. DLT can also make management of certain non-financial risks easier — for instance, in the case of know your customer (KYC) processes, screening criteria can be programmed into the assets themselves.

Deep Dives

In the sections that follow, we offer deep dives into individual asset classes to illustrate how adoption of DLT could proceed, given the specifics of an asset class and the market in which it trades. Each section explains how benefits of DLT apply to the asset class, discusses existing tokenization trends, suggests broader market implications, and offers specific examples of tokenization.

Deep Dive: Bonds

To understand the dynamic of DLT adoption in the bond market, consider the nature of bonds themselves. First, they have finite maturities — this is important because it makes issuance costs a recurring feature. Second, they are relatively complex instruments, which make them relatively labor-intensive to service, especially in structured finance. Last, they make good collateral, which makes the ease of moving them valuable to market participants.

Figure 5
Bonds — Benefits of Tokenization

For Bond Issuers	For Investors
Lower Issuance Costs	Possibility of Instantaneous Settlement
Programmability Simplifies Bond Servicing	Lower Transaction Costs
More Repo Options Increase Appeal of Bonds	Improved Collateralization Options
	Programmability Simplifies Bond Ownership

Source: State Street Global Advisors.

DLT speaks well to these structural features and can transform all stages of a bond's lifecycle as well the instruments themselves. Some of these transformations are as follows. One is the ability to merge the cash and securities legs of a transaction — on-chain bonds can settle instantaneously (T+0). Another is the ability to streamline bond servicing with smart-contracts — i.e. programming the logic of bonds into bonds themselves, thus narrowing the amount of human intervention needed.

In a competitive environment, greater efficiency creates incentives to lower costs for customers. For bond markets, this is transformative, especially if we were to consider issuance, as costs are an important constraint of supply (not just because they are high, but because they are both high *and* recurring). This double whammy deters potential issuers, especially smaller and less creditworthy borrowers.

But the benefits go further. The moveability of digital bonds used as collateral could transform liquidity management. For example, it makes *intra-day* repos and swaps possible, such that participants can lend/borrow funds just for a few hours, if not for a few minutes. This is valuable when interest rates are materially above zero. Moreover, smart contracts, besides speeding up servicing, create opportunities for new economic linkages, including new types of securitizations. Various attractive features of DLT, including lower costs and looser technical constraints, should combine to create multiple push and pull factors that drive its adoption.

Progress of Tokenization in this Asset Class

The bond market is where tokenization is already visible (Figure 6).

Figure 6
Digital Asset Issuance
USD Million

Note: Through end-2023. New native issuance only, excluding tokenization of existing assets and crypto currency.
Source: International Securities Services Association.

We See Three Broad Trends

1) Experimentation by International Banks The bond market is large, and competition among intermediaries is strong. This has two consequences:

- There is a first-mover advantage to adopting the technology
- Companies have the scale to test it

For example, international banks initially used DLT to manage cash flows among their own international subsidiaries. With time, these networks included other banks and non-financial clients. As they did so, they created the foundation of a blockchain-based repo market and a market for bond-based derivatives, such as swaps.

2) Experimentation by Bond Issuers A growing number of issuers are experimenting with onchain bonds. These bonds are not yet competitive on cost or speed of issuance, but there are other motivations. They range from demonstration and testing in-house technology to using blockchain tools to back sustainability credentials, or some combination of the above.

3) A Bridge from Crypto Currency to Traditional Assets In crypto, there are few options between ultra-safe (e.g. fiat-backed stablecoins) and highly speculative investments. This has led to the creation of "digital twins" of traditional assets, both single-name and portfolio ETFs, with a variety of strategies. Relevant to the bond market has been a proliferation of tokenized money market ETFs, which invest in bonds (e.g. Blackrock's BUIDL) and have increased demand for bonds. As of May 2024, these held over US$1 billion in assets. Many fiat-backed stablecoins are also partly invested in short-term government bonds.

Implications

Blockchain technology clearly creates a tailwind for the bond market in terms of breadth and depth. On the supply side, lower transaction costs will facilitate market entry, benefitting in particular those that bear high costs, among them smaller businesses, high-yield issuers, and issuers of highly structured products. Lower costs likewise incentivize more *frequent* issuance, such that companies can issue in smaller amounts but in a way that is better tailored to their funding needs and changes in market conditions.

These drivers will have positive knock-on effects on market liquidity and transparency. And, in a broader sense, this also implies greater competition for banks and private lenders, which today are an important source of non-public funding.

One downside to the current path of DLT adoption in the bond market is assets ending up on multiple unconnected and permissioned blockchains. This speaks to the conservative nature of the industry but impedes secondary trading and prevents efficient use of collaterals. An important challenge for the industry, therefore, is to connect them to each other and to public permissionless blockchains, so that network effects in the market can take hold. This is partly a question of technology and partly of risk management.

A further critical step in tokenization of bonds would be tokenization of traditional bonds. Unless we run two parallel infrastructures indefinitely, there must be a program for immobilizing and tokenizing existing instruments. It is as yet unclear how this will proceed, though central securities depositories or exchanges might be well-placed to do this.

As of August 2024, over US$15 billion in digital bonds have been issued.[2] These come from a variety of borrowers of which some are listed below.

Examples	Comments
European Investment Bank	Supra National. Multiple Issuances Between 2022 and 2023. Pioneered New Processes, Including Use of CBDC as a Settlement Currency.
Hong Kong Monetary Authority	Sovereign. Two Issuances in 2023 and 2024, the Latest Being the Largest Ever Digital Bond Issue, Raising About US$750 Million.
Quincy, Massachusetts	Municipal. 2024. 7-year, US$10 Million. First US Blockchain Native Municipal Bond.
Société Générale (France)	Financial Institution. 2023. 3-year, €10 Million in Digital Green Bonds.
Hitachi (Japan/Conglomerate)	Corporate. 2023. 5-year, ¥10 Billion in Digital Green Bonds.
UBS (Switzerland), SBI (Singapore), and DBS (Japan)	2023. World's First Live Cross Border Repo with a Natively Issued Digital Bond on a Public Blockchain.
UBS (Switzerland) and CIBC (Canada)	2024. USD-EUR Intraday FX Swap.

Deep Dive: Commodities

The oldest of all financial markets resides in commodities trading, with metals trading dating back thousands of years and modern commodity trading established in the 19th century. Depending on the commodity, much depends on standardization and oversight of adherence to set standards, which is why centralized exchanges have been critical for commodity markets.

In addition, commodities trading is divided into soft (i.e. perishable agriculture) and hard (i.e. energy or metals) commodities. For each group, trading is either conducted in spot or derivatives markets. In particular, derivatives trading is attractive for a narrow set of professional investors who want to hedge real economy commodity exposure. For this reason, tokenization is likely to be less disruptive here even if some of the core benefits apply to commodity trading as well.

Figure 7
Commodities — Benefits of Tokenization

For Commodity Producers	For Investors
Greater Access to Capital Through Additional Collateralization Opportunities	Legal Claim to Underlying Commodity; Stronger Investor Protection
	Possibility of Instantaneous Settlement
	Lower Costs
	Improved Collateralization Options
	Fractionalization
	Securitization

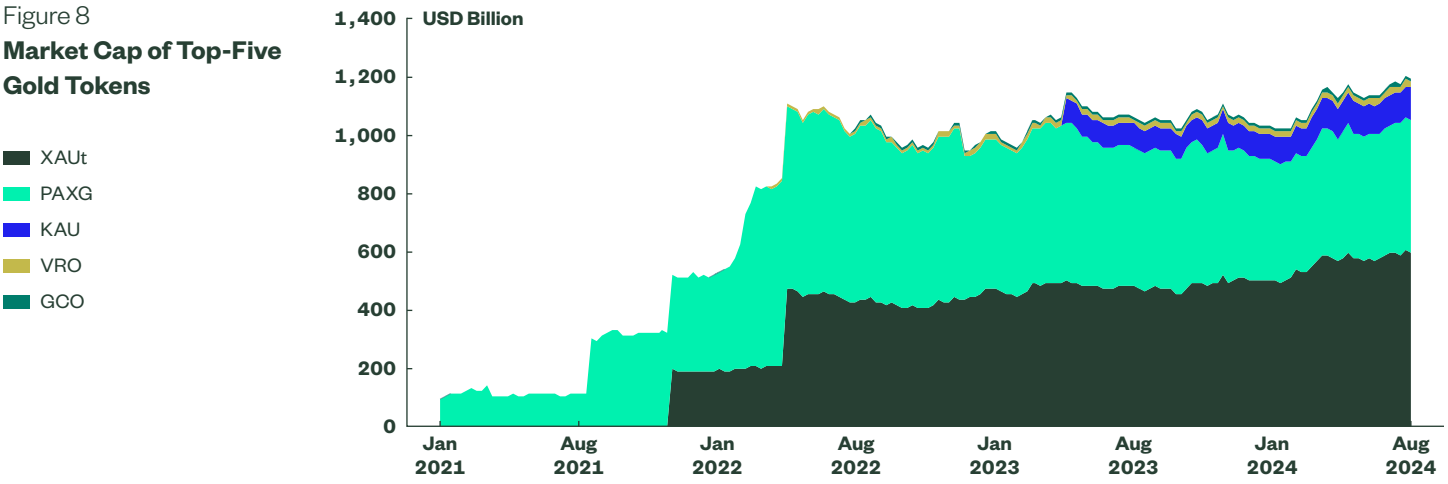
Source: State Street Global Advisors.

Progress of Tokenization in this Asset Class

For spot trade, the financial structure of tokenized commodities is relatively straightforward. Each token would represent the nominal amount of a physical commodity. This is already widely done for gold, where several gold tokens represent a claim to physical gold in a secured location, sometimes even inclusive of an identifiable specific gold bar number. The token price therefore should simply track the spot price, though the market remains imperfect and arbitrage opportunities persist due to low market capitalization (Figure 8).

The same principle would hold for other hard commodities, too, namely a reserve-backed token tracking the spot price. On the margins, this pathway to investment exposure is potentially advantageous to existing publicly traded alternatives (mainly ETFs) by enabling greater transparency and possibly 24/7 trading.

Figure 8
Market Cap of Top-Five Gold Tokens



Source: CoinGecko, Coinmarketcap, as of July 2024.

For soft commodities, this is not appealing. Instead, there we find examples of transforming agricultural products or assets into digital tokens that are then pledged as collateral in exchange for loans or other forms of credit. This is less relevant for financial markets but could improve capital and liquidity conditions for agricultural producers, especially in lower-income countries with underdeveloped or strained banking systems. Tokenization also promotes digitization of the agricultural value chain and should therefore boost overall efficiencies.

Implications

Replicating and scaling gold-like tokens across precious metals is just a question of time, though the economics of spot pricing and physical custody diminish with lower-value industrial metals. Similarly, for energy, tokenization would mean reserve-backed tokens tracking the spot price.

This is all feasible, but the question is how to mimic derivatives contracts that make up the bulk of commodity trading. Tokenization could easily embed derivative features into smart contracts, but the fundamental utility of commodity derivatives stems from standardization, which in turn is driven by a centralized authority. Commodity exchanges were created for that very purpose, namely, to help build a standardized market where the various needs of sellers and buyers can coalesce into common instruments (typically futures). In this regard, tokenization only offers a marginal improvement versus the digital tools used today on exchanges. In other words, tokenized futures are unlikely to draw in new buyers or transform the market.

However, the rise of spot-price tokens is likely to boost 'financial' (versus real economy) demand for the underlying commodities, especially as an additional inflation-hedging option for retail investors. In theory, spot-price tokens could enable the build-out of derivative contracts for a wider audience. Regulation is unlikely to be forthcoming though, and therefore the overall magnitude of additional commodity demand will presumably be modest given that commodities lack yield-bearing features.

A bigger change could herald from the ability to tokenize soft (agricultural) commodities. The ability to digitize claims to production should allow for collateralization and securitization in a more efficient form for agricultural producers. Initial prototypes of such tokens were basically geared to facilitate lending to producers. Regulatory standardization and wider acceptance could eventually lead to broader securitization, akin to what occurred in the US for mortgage owners. This could offer easier access to capital and possibly lower cost too but raises systemic risk as well.

Examples		Comments
Metal	Paxos Gold, Tether Gold, Perth Mint Gold Token	Physically Backed 1:1 in Ounces.
Metal	DigixGlobal, GoldCoin, Meld Gold	Physically Backed 1:1 in Grams or Fraction of Ounce.
Metal	Kinesis Silver, tSilver	Physically Backed 1:1 Either in Grams or Ounces.
Metal	sXAG	Not Physically Backed, but a Derivative Digital Tracker of the Silver Spot Price.
Energy	OILR	Oil Reserve Backed Token, Conceived in 2018 but Still Not Live.
Agriculture	Agrotoken	Agro-Commodity Token Usable as Collateral or as Means of Payment for Goods or Services Among Participant Networks.

Deep Dive: Public Equity

To understand the dynamic of DLT adoption in public equities, recall some key features of the instrument and the market where it trades. Equity is a relatively simple financial instrument with indefinite maturity, and it trades on centralized exchanges, which are relatively transparent and efficient. Blockchain technology does offer benefits to public equities — for example, lower cost of issuance, T+0 settlement, and 24/7 trading expand the market, and programmability of tokens makes it cheaper and easier to service equity securities. However, these benefits are incremental rather than transformative.

Figure 9
Public Equity — Benefits of Tokenization

For Equity Issuers	For Investors
Lower Cost of Issuance	Broader Trading Ability
Programmability Offers Easier Equity Servicing	Instant Settlement
	Programmability Offers Easier Equity Ownership

Source: State Street Global Advisors.

Progress of Tokenization in this Asset Class

There is currently little by way of tokenization in public equity, with most developments related to its links with crypto markets. Some of those developments are illustrated below.

Bridging Traditional Assets to Crypto

A major development in the crypto space was the creation of ETFs that track crypto prices. These trade like equity on traditional exchanges and serve as a bridge for traditional investors into the crypto space. In other words, investors can get exposure to crypto's price fluctuations without holding the crypto themselves. These ETFs track individual coins as well as coin baskets.

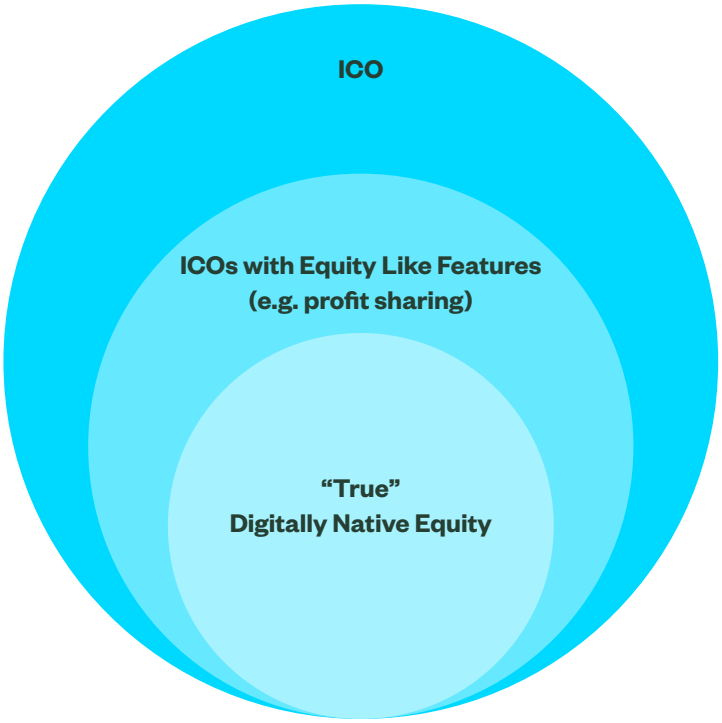
Bridging Crypto to Traditional Assets

In parallel, there are efforts to create a bridge going in the other direction. This is driven by a lack of investment opportunities in crypto that fall between the ultra-safe (e.g. fiat-backed stablecoins) and the highly speculative (free-floating coins). The result was a proliferation of "digital twins" of traditional assets, both single-name and portfolio ETFs, with a variety of strategies. Relevant to the equity market are "twins" of single-name equities (e.g. bNVIDIA, which tracks the NVIDIA stock) and equity ETFs. They make it possible to buy traditional equities (and other assets) with crypto coins.

Digitally Native Equity

Another trend is "true" tokenized equity — i.e. digitally native equity shares that convey legal ownership rights to the token holder and trade on a crypto exchange. Despite the preponderance of initial coin offerings (ICO), tokenized equity is very rare. To qualify as such, the issued tokens need to convey ownership rights to the underlying firm, including right to receive dividends and take part in governance. The overwhelming majority of coin offerings do not. To summarize, all tokenized shares are "coin offerings", but not all coin offerings are tokenized shares (Figure 10).

Figure 10
Initial Coin Offerings Versus Digitally Native Equity



Source: State Street Global Advisors.

Implications

We expect adoption of DLT in public equities to proceed slowly, driven more by external drivers than intrinsic ones. These could include spillovers from other markets, where intermediaries as such are developing DLT capabilities (e.g. bonds or publicly traded funds), or regulation, for instance, in the form of a mandate to move to T+0 settlement.

The impact of adoption on supply/demand dynamics will likewise be modest. The supply of public equities is driven more by the regulatory burden of financial disclosure and listing requirements of the different exchanges than by efficiency constraints. For its part, investor barriers to entry are already low, with even retail investors easily able to access the markets (including via fractional shares). The only exception, perhaps, is slightly greater supply of equity from smaller companies for whom cost of issuance is a material barrier to entry.

In short, since large stock markets work relatively well in the current format, tokenization will not be transformative. However, on the smaller end of market cap, tokenization could create a new path to raising equity capital. Instead of being constrained to private equity funds or conventional private markets, tokenized public equity could be an affordable alternative for smaller companies. The technology makes this a potential option, provided regulators design a suitable framework — the latter being the formidable hurdle for now.

Examples	Comments
IBIT	Bitcoin Exchange Traded Product. Bridge to Crypto Market for Traditional Investors.
bNVIDIA	Tokenized Public Equity. Bridge to Traditional Markets for Crypto Investors. Essentially an Equity-Backed "Stablecoin".
WisdomTree	Tokenized Funds. Bridge to Traditional Markets for Crypto Investors.
Enegra	Digitally Native Equity. Enegra Issued its Equity-Backed EGX Security Tokens via Tokeny's T-REX Platform. Enegra has Been Managing its Security Tokens and Investors Through the Same Platform.

Deep Dive: Alternative/ Private Market Funds

Tokenization in private markets is mainly a story of democratization of an asset class that is traditionally the preserve of institutional or high-net-worth investors. Greater back-office efficiency will allow it to tap into large, latent demand.

Figure 11
Alternative/Private Market Funds — Benefits of Tokenization

For Equity Issuers	For Investors
Potential Expansion of Investor Base	Access to an Exclusive Asset Class
Lower Expenses (in the medium- to long-term)	

Source: State Street Global Advisors.

Alternatives is a catch-all category, capturing a large number of products and strategies, among them private equity, venture capital, hedge funds, and private credit. However, the products and strategies do have some features in common.

One of them is very high entry costs, which can be in the millions of dollars, and another a cumbersome subscription process. An important reason for the high entry costs to the asset class is a high operational burden of working with investors. Creating, distributing, and servicing a fund entail many highly bespoke processes. As the number of investors grows, managing information flow becomes more complicated and costly. Asset managers therefore often find it economically attractive to accept a limited number of large-ticket investments into their funds.

Another common feature is extremely low liquidity, with no industry-wide marketplace, and needing to rely on relationships and intermediaries to source deals. The industry is also highly regulated due to the complex nature of the instruments and the corresponding need for consumer protection. And lastly and partly as the result of the above features, the asset class, though attractive on risk/return metrics, is underbought by individual investors.

Tokenization provides fund managers the ability to distribute shares to individual investors in a more scalable manner. In a tokenized fund, information about share ownership and the rules of ownership are programmed into the share itself. If in a traditional fund, investor management (e.g. KYC, subscriptions, redemptions, reporting, etc.) is a labor-intensive process, in a tokenized fund it can be substantially automated by way of a distributed ledger. The result is the ability to dramatically reduce minimum investment amounts. This, in turn, will open up the asset class to a larger number of investors.

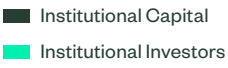
Baseline costs and investor protection still mean a restricted investor class of relatively wealthy individuals. Broad retail participation would carry too big a regulatory burden and would require a different business model. So, for the asset class this is about partial democratization.

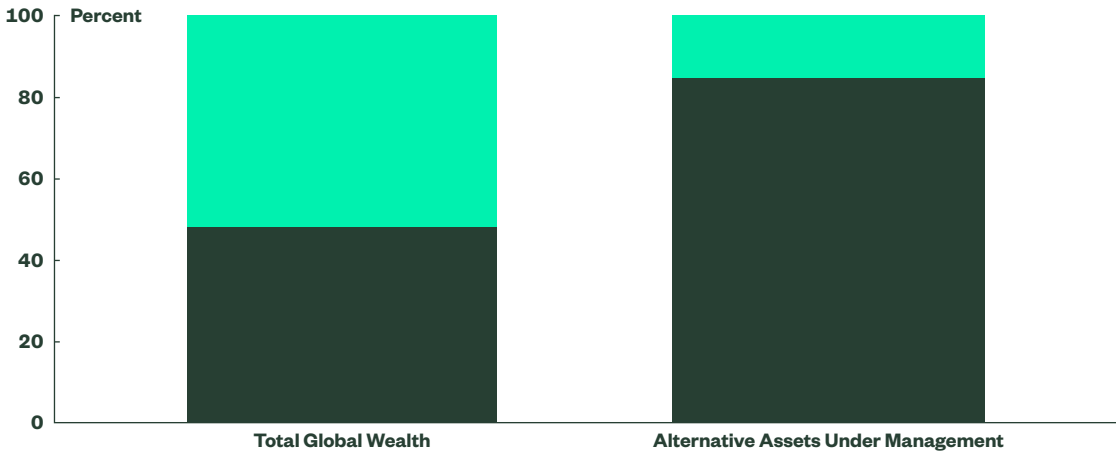
Tokenization could also bring greater liquidity to the market. Simplified ownership records and more seamless settlement will make it easier to sell or borrow against shares. On its own, this does not create a market and still needs willing buyers and a marketplace. But simplified trading and settlement could open up liquidity at scale and facilitate small transactions.

Progress of Tokenization in this Asset Class

Two factors drive the uptake. First, increasing competition among alternative fund managers for institutional dollars. Second, the large unmet demand among individual investors for alternative investments. Earlier, individual investors could only tap into this asset class indirectly by way of shares of a general partner (e.g. Blackstone) or shares in a fund-of-funds. Now they can become limited partners in the fund itself.

Figure 12
Distribution of Global Wealth Versus Alternatives[3]





Source: Bain and Company.

Operationally, thus far we have seen the following approaches:

1) Tokenized Feeder Fund (i.e. a "Digital Twin") The preferred approach today is to create a tokenized feeder fund. Capital raised by this fund is exchanged for tokens that represent share ownership in the feeder fund. The capital that is raised is invested into the main fund by way of traditional shares, and these are held in a trust. This keeps the main fund untouched but imposes additional costs on investors.

2) Hybrid Fund Another approach is to create a hybrid model, whereby a fund that already has traditional share classes issues a new class of tokenized shares. The downside is that existing investors may be spooked by the idea. Although the investment terms for the different share classes are equal on paper, it is uncertain whether this is also true in practice.

3) DLT Native A fund can go completely digital. Such funds are prevalent in the money market fund space (see bonds section), and there are also examples of DLT-native venture capital funds (mainly targeting crypto). Such approaches will eventually become common as comfort with DLT grows.

Implications

Alternative fund structures are a way to catalyze and mutualize the ownership of large and hard-to-own assets. Tokenization is therefore another step in making these assets accessible to a larger pool of investors.

The variety of strategies and products in this asset class ensures that the benefits will be unevenly spread. However, on balance, tokenization offers a clear tailwind to the sector, bringing new capital and with it new opportunities for actors across the alternatives value chain, particularly fund managers and distributors. Intermediaries, among them transfer and payment agents and custodians, face the greatest threat, given the narrowing of the scope of their services.

We expect a transformation in the funding opportunities for SMEs, particularly when considered together with the tokenization of equity. For example, tokenized equities could become a preferred way for private capital, which in turn may be tokenized, to subscribe into the ownership of investee companies. This could change the landscape of companies on the path toan IPO by accelerating capital raising.

Examples			Comments
Sponsor	**Fund Name**	**Type**	
Hamilton Lane	Global Private Assets Fund	Private Markets (credit/equity)	Open-Ended Flagship Fund. In 2022, HL Launched a Feeder Fund with a Minimum Investment Amount of US$5,000. In 2024, it Created a Digital Share Class in the Fund with a Minimum Investment Amount of ca. US$1,000.
	Equity Opportunities Feeder Fund V	Private Unlisted Equities	Feeder Fund Launched in 2022. Minimum Investment Amount: US$20,000.
	Senior Credit Opportunities Feeder Fund	Private Credit	Feeder Funds Launched in 2022. Minimum Investment Amount: US$10,000.
KKR	Health Care Strategic Growth Fund II	Private Equity	Feeder Fund Launched in 2022. Minimum Investment Amount: US$10,000.

Deep Dive: Real Estate

The benefits of DLT to the real estate market are more nuanced than what is commonly advertised. Tokenization in real estate is primarily about passive investment — i.e. tokenizing of real estate *portfolios* (e.g. in fund or trust form) and adoption of DLT for tangential processes (e.g. ownership registration). Widespread tokenization of individual real estate remains a distant prospect.

Figure 13
Real Estate — Benefits of Tokenization

For Fund Managers	For Investors
Potential Expansion of Investor Base	Access to an Exclusive Asset Class
Lower Expenses (in the medium- to long-term)	

Source: State Street Global Advisors.

Real estate is expensive. As tokens can be owned in fractions, the holy grail of tokenization of real estate is the ability to break up assets into much more accessible individual shares.

The challenge is that there are other major barriers to entry issues that DLT does not address. Not least is the non-standard nature of individual real estate and the high information asymmetries between sellers and buyers. Moreover, real estate requires significant management of properties and tenants. This presents governance challenges that are difficult even when there are a handful of owners.

But there are areas where it can work. It is possible to tokenize real estate portfolios such as private real estate funds and public real estate investment trusts (REITs). Other areas that can benefit include processes that are tangential to real estate, such as permits and property registration. The fragmented nature of these is one reason why settlement for real estate is very slow.

Progress of Tokenization in this Asset Class

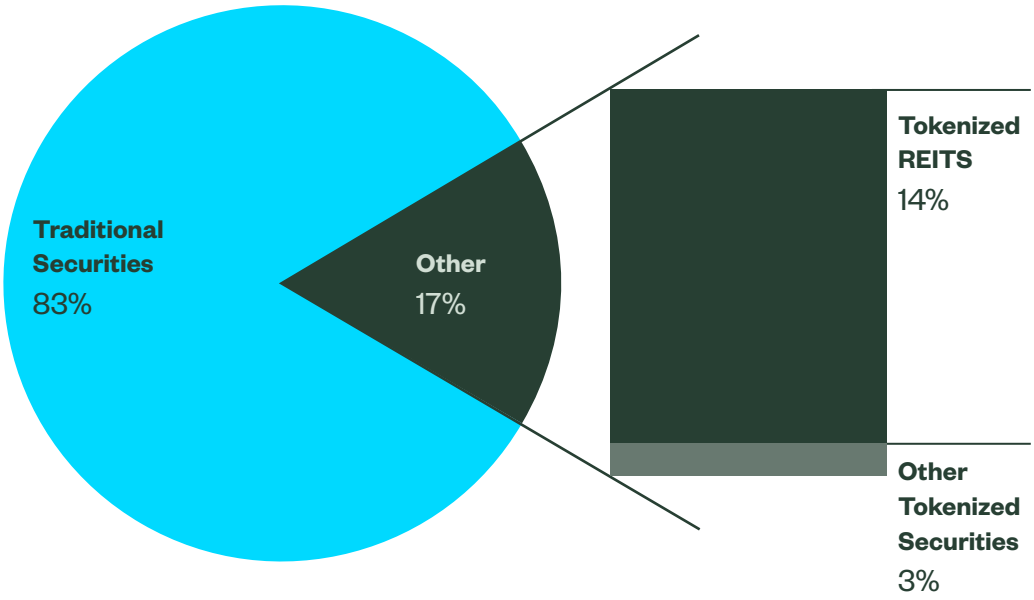
Tokenization of Real Estate Funds

This is the main thrust of real estate tokenization and, in our view, the main one going forward as well. Private real estate funds are essentially private equity funds, except that their portfolio comprises real estate instead of equity shares of investee companies. Tokenization will be driven by the same desire — to tap additional capital, mainly from retail investors. As such, it will focus on where the advantages are greater compared to REITs. REITs are more accessible, because they trade publicly and at relatively low costs, but private funds can be tailored to investor preferences (e.g. investing in a particular neighborhood). Greater secondary market liquidity of private real estate funds will also make them more attractive.

Experiments to Fund Real Estate Projects with Tokens

There are several experiments to fund real estate projects using tokenization. This is, in other words, the crowdfunding of real estate. Property developers love the idea, as it opens up a new source of capital, with the added upside that a large number of small investors wield relatively low influence in the project. One way that this has been operationalized is by way of REITs, which hold the rights to the developer's property and tokens representing beneficiary rights of the trust.[4] This model has become popular in Japan and works for a portfolio of similar properties, commercial or multi-unit residential (Figure 14).

Figure 14
IPOs on the Japanese Stock Market — Share of Tokenized REITs (2023)



Source: Japan Exchange Group, Boostry, State Street Global Advisors.

Parallels in residential real estate are very rare, with existing tokens only offering passive exposure (i.e. the token only represents a claim on a developer or special purpose vehicle, not on the underlying real estate). Major questions over regulatory and legal issues surrounding property rights remain unresolved.

Adoption of DLT into Tangential Processes

There are likewise attempts to address inefficiencies in tangential processes. For example, several governments have looked into ways to apply DLT to land registration. These have been mainly emerging and frontier markets, and the focus has been on reducing corruption. There are also private initiatives to create a blockchain-based loan registry system to speed up mortgage trading among lenders and initiatives to use blockchain as a workflow management tool in real estate transactions.

Implications

In contrast to private equity where the barriers to entry are currently very high, real estate is already widely accessible, either through personal home ownership or via publicly traded REITs. For institutional investors and high-net-worth individuals, there are also existing private real estate funds. The latter space will develop more competition as new supply arises from tokenization and REITs will have to compete or transform themselves into tokenized real estate funds considering the operational benefits.

Consequently, the supply/demand dynamics are likely to evolve more gradually compared to private equity. From an investor perspective, new supply will primarily offer more intra-asset class diversification as specialized funds can be established and distributed more easily.

The holy grail of tokenizing individual, commercial, or residential properties where tokens represent genuine fractional ownership will take longer to develop. It will only happen once tokenization technology is fully established and ensures that yield-bearing instruments can trade smoothly and reliably in bond markets. Furthermore, it will need an evolution in legislation that defines tokenized fractional ownership for real assets.

Examples	Comments
Kenedix	Tokenized Real Estate Trust. This Token Uses the Beneficiary Rights of a Real Estate Trust as Trust Property, Which Consists of Rental Detached Houses.
AspenCoin (Elevated Returns)	US$10k Minimum Investment to Receive Token Ownership of a St Regis Hotel in Aspen. Token Also Confers Hotel Usage Benefits and Revenue from Hotel Operation. Raised US$18 million.
RealT	Property Developer That Offers Crowdfunding for Individual Renter Occupied Homes by Way of Tokens. The Tokens Represent Ownership in an LLC Intermediary.
Coadjute (UK)	Blockchain Based Workflow Solution for the UK Real Estate Market.
SBI, Sumitomo Real Estate (Japan)	Blockchain Based Workflow Solution for the Japanese Real Estate Market.
Figure Lending	Mortgage Lender Registering Mortgages on a Blockchain to Make Them More Tradeable. Figure had Previously Issued Securities That were Backed by Home Equity Loans That were Logged on Blockchain.
National and Municipal Land Registries	a) Peru. 2023. A Property Registry Pilot, Supported by the Inter-American Development Bank. b) Rwanda. 2021. A Land Transaction Platform on Blockchain Called Ubutaka, Which Will be Integrated with Rwanda's Existing Land Registry Infrastructure. c) Mexico. 2019. Municipality of Tulum in Quintana Roo Aims to Develop a Digital Record of Land Ownership.

Endnotes

1 There is some ambiguity about the meaning of the term tokenization. We take the broad definition, which includes the creation of "digital twins" of assets as well as native issuance of assets on a digital ledger.

2 Security Token Market (STM.co).

3 How Tokenization can Fuel a $400 billion Opportunity in Distributing Alternative Investments to Individuals. (December 21, 2023). Bain & Company.

4 In a conceptual sense. We make no judgement on whether this would meet the legal definition of one.

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* Pensions & Investments Research Center, as of 12/31/23.
†This figure is presented as of September 30, 2024 and includes ETF AUM of $1,515.67 billion USD of which approximately $82.59 billion USD in gold assets with respect to SPDR products for which State Street Global Advisors Funds Distributors, LLC (SSGA FD) acts solely as the marketing agent. SSGA FD and State Street Global Advisors are affiliated. Please note all AUM is unaudited.

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