BNY MELLON

Digital Assets:
From Fringe to Future

Safety First, Safety Now

Alexander Hamilton founded what is today BNY Mellon 237 years ago with a bold vision: financing the economic success of a new world. At that time, the U.S. had limited access to capital to fuel growth. While most other Founding Fathers struggled to imagine a U.S. economy with a single nationwide currency,[1] the eventual ability of farmers, entrepreneurs and industrialists to build a strong economy demonstrated the strength of Hamilton's vision.

Today, our vision is equally bold: rethinking how the world does business in a financial ecosystem at a moment of fundamental transformation. But in the current moment, the new frontier is digital. Pioneers and digitally native institutions have made significant inroads in creating new ways for financial markets to operate. As we help to usher in this next digital chapter, BNY Mellon is eager to collaborate with clients and others across the industry on digital assets' potential and challenges.

In this overview of digital assets' evolution, we cover:

- The emergence of digital assets;
- Critical events in digital assets' progress toward mainstream interest;
- The ability to apply new technology across asset classes (e.g., tokenization); and
- Imperatives for future digital asset service providers.

"Digital assets are transforming the world and becoming increasingly mainstream in our financial ecosystem. At BNY Mellon, we are committed to leveraging two centuries of trust and innovation in order to build a bridge to the future."

Roman Regelman

Chief Executive Officer of Asset Servicing and Head of Digital

[1] Schweitzer, Mary M., "State-Issued Currency and the Ratification of the U.S. Constitution," The Journal of Economic History, June 1989.

The Emergence of Digital Assets

In 1998, computer scientist Nicholas Szabo developed a novel, decentralized digital currency called "bit gold" based on a system mathematicians hypothesized nearly a decade prior. The development of this system was a precursor of what we know now as blockchain.[2]

Digital assets moved from theory to concept within a little over a decade. In 2008, under the pseudonym Satoshi Nakamoto, unknown developer(s) released a white paper establishing the model for a blockchain. The following year, Nakamoto implemented the first blockchain as a public ledger for transactions made using Bitcoin. This was a watershed innovation as it allowed anyone, anywhere in the world, to transfer value to anyone else without the need for an intermediary.

[2] See Fiorillo, Steve, "Bitcoin History: Timeline, Origins and Founder," The Street, August 17, 2018 for an overview of the pioneering work of Stuart Haber and W. Scott Stornetta.

BLOCKCHAIN EXPLAINED

In general terms, a blockchain is a database that maintains a continuously growing list of ordered records, called "blocks." It is the most familiar application of a broader category called "distributed ledger technology" (DLT). Each block is stored in a ledger, and multiple copies of that ledger exist within a network. The strength of this model is that it makes it more difficult to falsify database changes. In addition, each change to the distributed ledger is time-stamped and cryptographically secured. Predefined and consensus-based rules set the parameters for making changes. Furthermore, past activity is immutable (i.e., it cannot be deleted or modified once it enters the ledger), thus reinforcing data integrity. These features provide a level of reliability that supports financial use cases such as cryptocurrencies and digital assets more broadly because they have the potential to streamline reconciliation of transactions and help prevent fraud, cheating and hacks.

Since Bitcoin's debut just 12 years ago, thousands of digital coins (depending on how the term is defined) have been created, with still more in development.[3] At the same time, the industry has found innovative new uses for blockchain technology. Ethereum now acts as a peer-to-peer blockchain infrastructure supporting a broader range of financial activity in addition to transferring value. For example, that infrastructure makes it possible to write code representing financial instruments such as bonds into the blockchain as smart contracts.

Additionally, the evolution of digital assets has continued with the introduction of stablecoins. They combine the main advantages of digital coins — peer-to-peer transfer, digital wallets and frictionless transactions across borders — with the additional benefit of being pegged to the value of a more traditional asset such as a currency or commodity. As a result, stablecoins have historically demonstrated much less volatility than "pure" cryptocurrencies. Already, stablecoin market capitalization exceeds $100 billion.[4] This space is continuing to evolve with the anticipated launch of central bank digital currencies, tokenized securities and more.

In summary, digital assets have crossed a significant line from a mathematical concept to a full and robust asset class in less than a quarter-century. That phenomenal growth is generating significant changes in the type of demand for services around digital assets.

[3] Statista, "Number of Cryptocurrencies Worldwide from 2013 to August 2021."

[4] CoinGecko, "Stablecoins by Market Capitalization," June 17, 2021

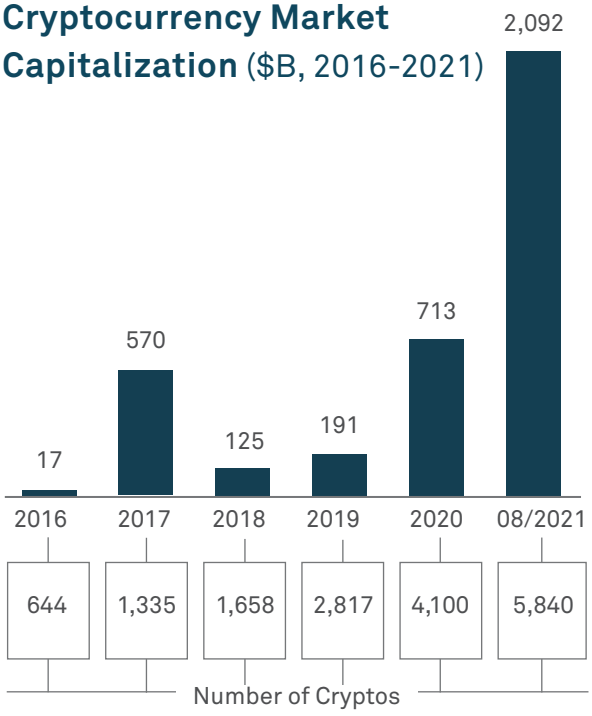
The Evolution of Institutional Interest in Digital Assets

Many financial institutions across the globe have either been working to integrate and expand their offerings and investments related to digital assets, or else they have realized they can no longer take a "wait and see" approach. As they formulate their strategies, they still are seeking the benefits of disintermediation that digital assets offer. But they are also looking for the risk management and secure infrastructure that they have come to expect from mature institutions. Essentially, investors are demanding an infrastructure for digital assets that is comparable to that which exists for traditional assets. Three key considerations are driving this demand:

1. Increasing interest in digital assets

In the first two months of 2021, the global market capitalization of cryptocurrencies more than doubled in value, skyrocketing to over US$2 trillion by April 2021.[5] Cryptocurrencies saw significant volatility over the course of the year, with global market cap dropping to just above US$1 trillion in July, but they crossed the US$2 trillion line again in August 2021.[6] By comparison, gold has served as the reserve asset champion for the world's currencies throughout most of modern history. Yet the global market capitalization of cryptocurrencies was able to reach approximately 20% of gold's US$10 trillion (in August 2021) after just over a decade in existence.

Cryptocurrency Market Capitalization ($B, 2016-2021)



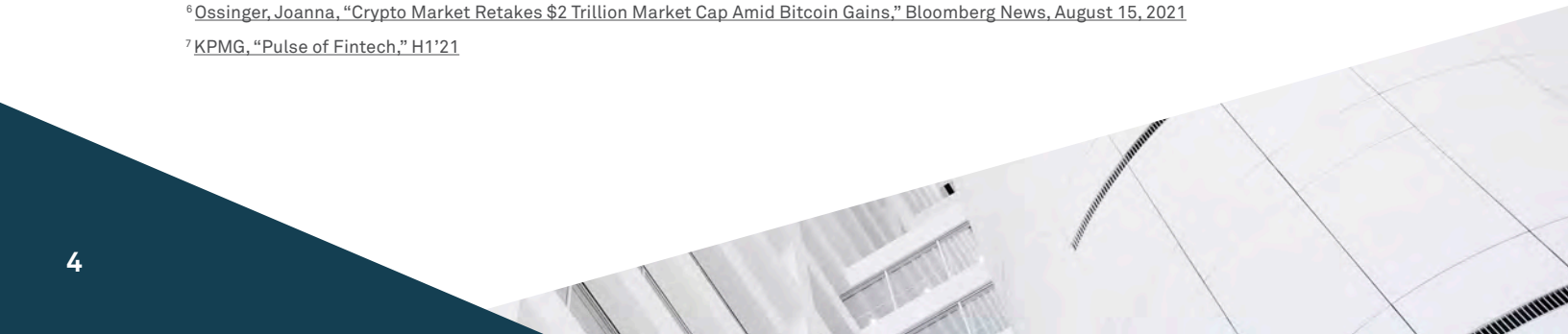
Source: Coinmarketcap.com, Statista, BNY Mellon Analysis

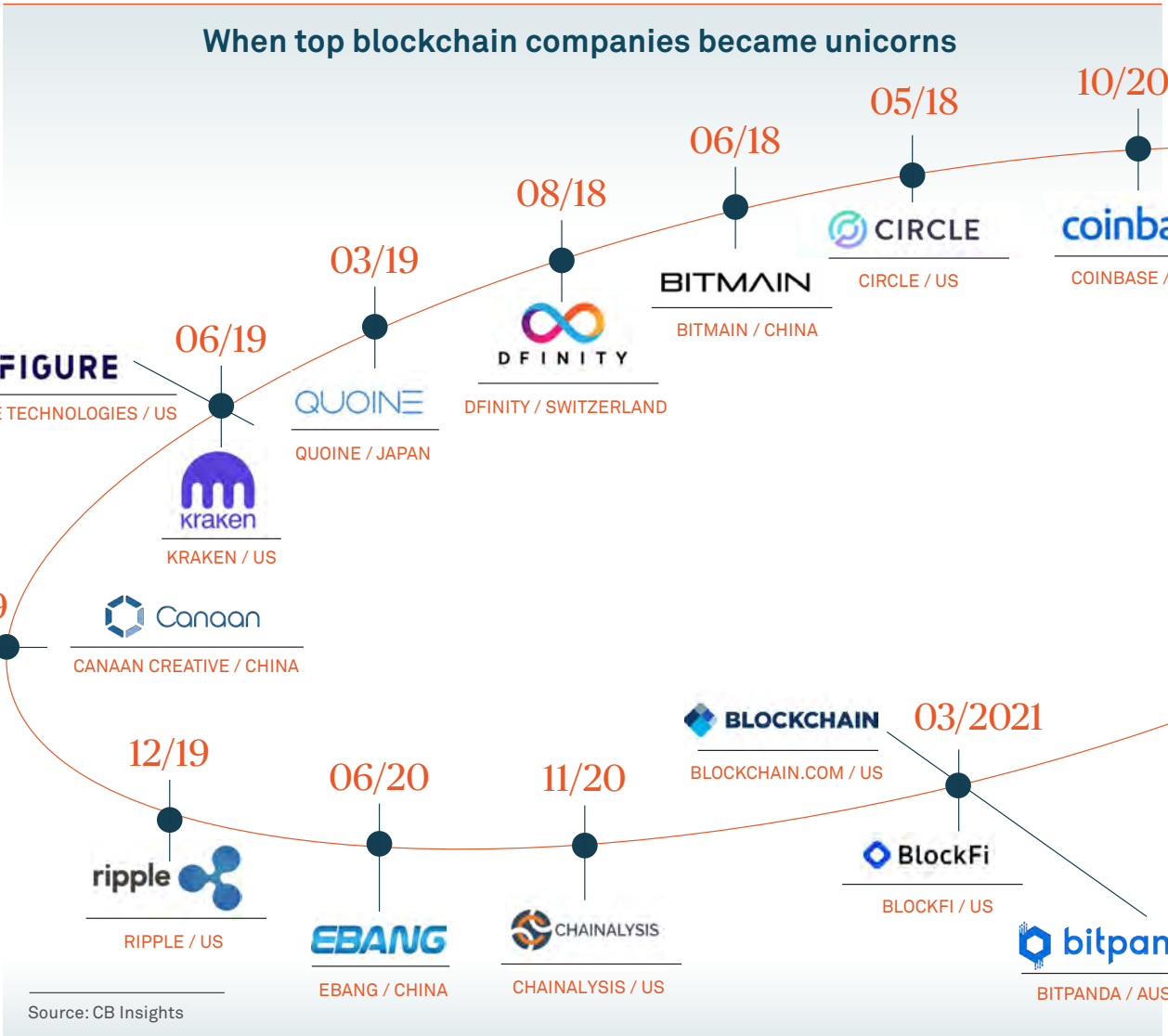
Growing investor demand for cryptocurrencies has also fueled a host of new so-called "unicorn" companies (i.e., privately held companies valued at over US$1 billion) to provide the market with relevant services, protocols and use cases. The increasing need for providers and partners to bring digital assets into the mainstream leaves the industry with significant room to grow. [7]

[5] CKharpal, Arjun, "Cryptocurrency market value tops $2 trillion for the first time as ethereum hits record high," CNBC, April 6, 2021

[6] Ossinger, Joanna, "Crypto Market Retakes $2 Trillion Market Cap Amid Bitcoin Gains," Bloomberg News, August 15, 2021

[7] KPMG, "Pulse of Fintech," H1'21





IN THE NEWS

- One of the best-known fintechs in the industry, the cryptocurrency exchange and wallet provider Coinbase, went public in a historic Nasdaq-direct listing in April 2021 – the first blockchain-based unicorn to list on a public exchange.
- Goldman Sachs announced in March 2021 that it would reopen its crypto trading desk.[8] In addition, a growing consortium of global investment banks is experimenting with increased exposure to the new asset class.
- MassMutual, one of the nation's oldest insurance companies, made a splash in December 2020 with a Bitcoin order of $100 million.[9]
- In December 2020, OSL, a digital asset platform, received the first-ever license from Hong Kong's Securities and Futures Commission to operate regulated brokerage and automated trading services for cryptocurrencies.[10]
- Grayscale's Bitcoin Trust, launched in 2013, reached a peak of more than $41 billion as of April 2021. BNY Mellon will provide fund accounting and other services effective October 1, 2021.

[8] Irrera, Anna, Withers, Iain and White, Lawrence, "Exclusive: Goldman Sachs restarts cryptocurrency desk amid bitcoin boom," Reuters, March 1, 2021

[9] Kharif, Olga, "169-Year-Old MassMutual Invests $100 Million in Bitcoin," Bloomberg, Dec. 1, 2020

[10] OSL Receives License From Hong Kong Regulator, Becomes World's First SFC-Licensed, Listed, Insured & Big-4 Audited Digital Asset Trading Platform," PR Newswire, December 15, 2020

2. Emerging potential of tokenization

Institutional interest in digital assets continues to climb: 72% of institutional asset managers said they plan to develop solutions for asset tokenization in an August 2021 BNY Mellon study, "Asset Management: Transformation Is Already Here."[11] In the same study, 84% of institutional asset managers surveyed said they plan to develop blockchain and distributed ledger technology to synchronize data and processes.[12] Individual players are building institutional-grade infrastructure within specific areas of the digital asset value chain.

Tokenization is the process whereby an underlying asset, tangible or intangible, is converted into a digital "token" that acts as its proxy. It is possible to tokenize a wide range of assets, from cash, equity securities and debt securities to real assets such as real estate, commodities, artifacts, and works of art. Such developments unlock potential innovations in areas including custody, collateral management, cash and liquidity, fund administration, accounting and payments. Faster, cheaper transactions, increased liquidity, transparency, accessibility and scale help explain this shift — the innovation of asset tokenization has the potential to profoundly enhance experiences from all vantage points:

ISSUER

For issuers such as asset managers, tokenization can expand accessibility to investors by reducing investment thresholds and periods, lowering dependency on third-party custodians and increasing the value capture of the asset.

INVESTOR

For investors, tokenization may be an attractive option due to increased mobility, liquidity and utility around assets.

PROVIDER

For service providers, benefits could include more efficient transactions through real-time sharing, smart contracts and significantly shorter settlement periods.

[11] BNY Mellon, "Asset Management: Transformation is Already Here," August 2021

[12] BNY Mellon, "Asset Management: Transformation is Already Here," August 2021

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- USD Coin (USDC) launched on the Ethereum blockchain in September 2018. As its name suggests, the coin is tied to the value of the U.S. dollar and is redeemable on a 1:1 basis.[13]
- The European Investment Bank (EIB) piloted a $121 million bond offering as a security token on the Ethereum network, demonstrating the possibilities and demand in the space.[14]
- In June 2019, a consortium of banks including BNY Mellon formalized its experimentation with using tokenized fiat currency as a settlement asset. The consortium formed an entity called Fnality International to create a new payments system that uses a regulated tokenized cash settlement asset backed on a one-to-one basis by cash deposits at respective central banks. This aims to help transform clearing and settlement while reducing risks.[15]
- HQLAx is using digital ledger technology to streamline securities lending and collateral management, save capital costs, reduce credit risk, lower intraday liquidity requirements and reduce operational risk. It is doing so from the very core of the global financial system, backed by Deutsche Börse and several international banks that also play a key role in their network. BNY Mellon is both a triparty agent and agent lender on this DLT platform. [16]
- In May 2021, DBS issued an SGD$15 million digital bond via DDEx, a security token platform that enables corporates to raise capital by issuing digitized securities. [17]

[13] "About USD Coin," CoinDesk, June 17, 2021

[14] "EIB issues its first ever digital bond on a public blockchain," EIB Newsroom, April 28, 2021

[15] Fnality International, "Utility Settlement Coin (USC) continues to evolve," June 3, 2019

[16] Nicol, Drew, "Building Pipes," Securities Finance Times, January 19, 2021

[17] "DBS First Bank in the Region to Issue Security Token at S$15 Million," Fintechnews Singapore, May 31, 2021

3. An evolving regulatory environment

The regulatory environment for digital assets is rapidly evolving, with regulators working to address gaps and promote consistency. As part of that process, they have been actively engaging external stakeholders.

For example, there currently is no EU-wide framework for the regulation of digital assets. Instead, applicable rules are characterized by a patchwork of different national and EU laws. In 2020, the EU Commission published drafted legislation to create an EU-wide framework for digital assets—the Markets in Cryptoassets Regulation (MiCA). MiCA is nearing the final stages of the EU legislative process (expected to be finalized in Q4 2021 or Q1 2022) and is estimated to become applicable in 2024.

Moreover, in the U.S., the Federal Reserve, Office of Comptroller of Currency and the Federal Deposit Insurance Corporation (FDIC) are engaged in an interagency crypto "sprint" in order to develop a joint framework for crypto supervision.[18] The President's Working Group on Financial Markets (an inter-agency group of heads of U.S. banking and market regulators), intends to issue recommendations on stablecoin regulation in the coming months.[19]

IN THE NEWS

- In December 2020, the Securities and Exchange Commission (SEC) issued a Statement and Request for Comment Regarding the Custody of Digital Asset Securities by Special Purpose Broker-Dealers,[20] seeking input on evolving standards and best practices for custody of digital asset securities.
- In May 2021, the FDIC issued a request for information on digital assets, seeking to gather information and solicit comments about insured depository institutions' current and potential digital asset activity.[21]
- In June 2021, the Basel Committee on Banking Supervision issued a public consultation on preliminary proposals for the prudential treatment of banks' digital asset exposures,[22] seeking feedback from external stakeholders. The Committee is likely to issue a subsequent consultation before adopting final standards.
- In early August 2021, the Monetary Authority of Singapore (MAS) announced its readiness to grant regulatory consent to "several" providers of digital payment token (DPT) under existing payment services license provisions.[23]

[18] https://www.ft.com/content/a2c13ce0-6e66-4751-aa65-6c668d303101

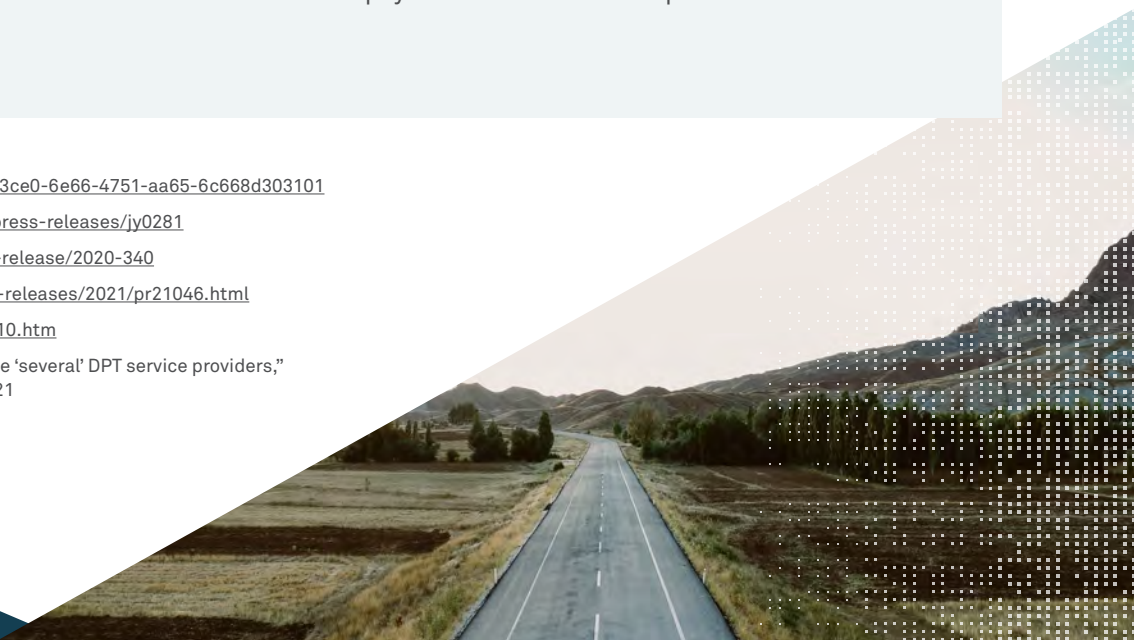
[19] https://home.treasury.gov/news/press-releases/jy0281

[20] https://www.sec.gov/news/press-release/2020-340

[21] https://www.fdic.gov/news/press-releases/2021/pr21046.html

[22] https://www.bis.org/press/p210610.htm

[23] Ng, Kelly, "MAS prepared to license 'several' DPT service providers," The Business Times, August 3, 2021



The Developing Infrastructure for Digital Assets

With the increasing relevance of digital assets clearly established, institutional demand for a global infrastructure to provide stability and safety is evident. Investors have evolving needs around fund administration, accounting and custody to accommodate the representation and storage of value on the blockchain.

For example, smart contracts can define the rules for how asset owners and counterparties can store and exchange that value. They can handle a range of scenarios, from the agreement between a buyer and seller on settlement terms to error checking and compliance. As the word “smart” implies, they run automatically, reducing the need for intermediaries and manual intervention. As a result, institutions are looking for robust controls and risk management.

As illustrated above, asset managers are already including digital assets in their holding and investor-facing products as well. They have the same expectations that they do for traditional assets: the ability to trade, safely transact, hold true, prevent theft, fraud and loss, and report on digital assets in ways that comply with investor expectations, regulatory requirements and sound risk management practices. Therefore, safeguarding digital assets follows the same principles, while requiring specialized skills that are a logical extension of financial custody functions in a digital assets environment.

These fundamental capabilities provide the building blocks for digitizing complex institutional-scale assets:

CRYPTOCURRENCIES: As we describe above, cryptocurrency holdings and transactions exist on the blockchain, which removes much of the friction that exists with traditional assets. However, while cryptocurrency transactions are both immutable and secure, risks remain. One of the most notable risks is that the holder of an asset can lose access if their private key (a type of cryptographic signature needed to initiate transactions) is stolen or lost. They may, in fact, never be able to retrieve what they own.

Custody and administrative solutions help mitigate these risks by providing independent storage and recordkeeping of crypto holdings. Such solutions can maintain private keys in more secure digital formats and even in stored and safeguarded physical formats. They address regulatory expectations, such as the SEC requirements to store holdings with a qualified custodian.[24] They can also provide regular reporting on digital asset value.

STABLECOINS: Stablecoins, which are pegged to fiat currencies or other traditional financial assets, continue to grow in prominence. They can offer a hedge for institutions and investors looking to explore digital assets with less volatility than cryptocurrencies have displayed historically.

Providing the ability to transact and pay, stablecoins can potentially expedite settlement and streamlinie cross-border activity. As such, some institutions are using them as a gateway into and out of the digital world.

CENTRAL BANK DIGITAL CURRENCIES: A central bank digital currency (CBDC) tokenizes a particular nation's or region's fiat currency.[25] The main difference from a stablecoin is that a CBDC is a liability of a central bank, whereas a stablecoin is not.

While efforts remain nascent, more than 80% of central banks are taking an interest,[26] including a digital currency pilot program by the Bank of England and an announcement of China's plans to develop its own digital yuan.

However, CBDCs are unlikely to arrive quickly. For example, in a June 2021 speech to the "Future of Fintech" conference, Tom Mutton, Director of Fintech at the Bank of England, said that "work on CBDC will be a multi-year effort," and indicated that the Bank of England has "not yet made a decision on whether or not one is needed."[27] Within central banks around the world, there are also significant questions and concerns about the material design of CBDCs and their impact on the overall financial ecosystem.

TOKENIZED SECURITIES: Tokenization, in which an underlying asset is converted into a digital "token" that acts as its proxy, may become an important mechanism for investors to hold and trade securities. For example, a security token could represent a share in a securitized asset on a traditional exchange.

However, tokenizing securities only makes sense if it delivers benefits over their traditional analogue, such as enabling real-time trades, expanded trading hours, greater ease in moving assets and opening up secondary markets. Regulatory clarity will also be critical for larger-scale adoption of tokenized securities in the U.S. and across the globe.

[24] https://www.law.cornell.edu/cfr/text/17/275.206(4)-2

[25] Certain CBDCs may utilize a different technology and design architecture, such as an account-based access system.

[26] Akhtar, Tanzeel, "About 80% of Central Banks Are Exploring CBDC Use Cases, Bison Trails Report Says," CoinDesk, May 19, 2021

[27] Mutton, Tom, "Central Bank Digital Currency: An update on the Bank of England's work," (speech) The Future of FinTech Conference, June 17, 2021

The Integration of Digital Assets with the Traditional Finance Ecosystem

Buying, holding and selling digital assets require an underlying support infrastructure to administer them, provide custody and reduce potential risks. While some of the same principles of traditional fund administration and custody apply, new needs and challenges emerge due to the encrypted and digital nature of the assets.

As more and more investors delve into this world, they expect the same institutional level of service as in the traditional space. In addition, institutional stakeholders of all stripes require stable, reliable servicing of the entire asset lifecycle from issuance to custody, trading and settlement to core fund servicing, accounting and payments. Such requirements fall into three categories:

Trust and Financial Soundness

Given the potential of the digital space, institutions are looking for the same level of risk management, focus on regulatory compliance and rigorous safety and security standards that are available for traditional assets.

Institutional Readiness

Clients are looking for scalability, transparency and full-spectrum support levels to help them navigate the risks of the digital assets ecosystem. Multi-jurisdictional regulatory reporting, resilience and experience handling complex institutional scale scenarios will set some providers apart from others.

Seamlessness

Institutions want a one-stop shop to support the expanding use cases of digital assets as well as delivering value across the full financial lifecycle of digital assets (such as trading, safekeeping, collateral management and lending).

Because digital assets and markets are inherently tightly connected, delivering on these requirements takes close collaboration within the industry and with fintech providers. In the world of traditional assets and markets, asset owners, asset managers, institutional investors and service providers already work closely together. Similarly, collaboration will be essential for bringing digital assets to full maturity. If technology developers, financial infrastructure and service providers, and stakeholders along the whole value chain come together to create and deploy integrated solutions, rather than a collection of one-off innovations, the end result will be much more robust.

Questions to Ask on Your Digital Assets Journey

- What are the current and potential risks in the broader digital assets ecosystem?
- What is the risk to your business of not exploring digital assets?
- What are the impacts of cryptocurrencies and tokenization on your business model?
- What opportunities do digital assets provide for adding value to clients and addressing new client needs?
- Where can you start?
- What kinds of operational resources (systems, talent and processes) do you need?
- Who are the players in the market and who among them are best positioned to serve your unique needs?

An Evolving Ecosystem

For many institutions, there is an unease with digital assets that sits alongside the sense of opportunity. Digital assets have emerged over a very short period of time compared to traditional assets and market capabilities. While the Mint Act established the dollar as the standard currency of the United States in 1792, it took 69 years for the federal government to begin issuing paper currency, and a single national paper currency did not emerge until 1914.[2] By contrast, the speed of innovation and decentralized nature of digital assets raise concerns about their f itness for purpose for the trillions of dollars held and managed within the world of institutional investments.

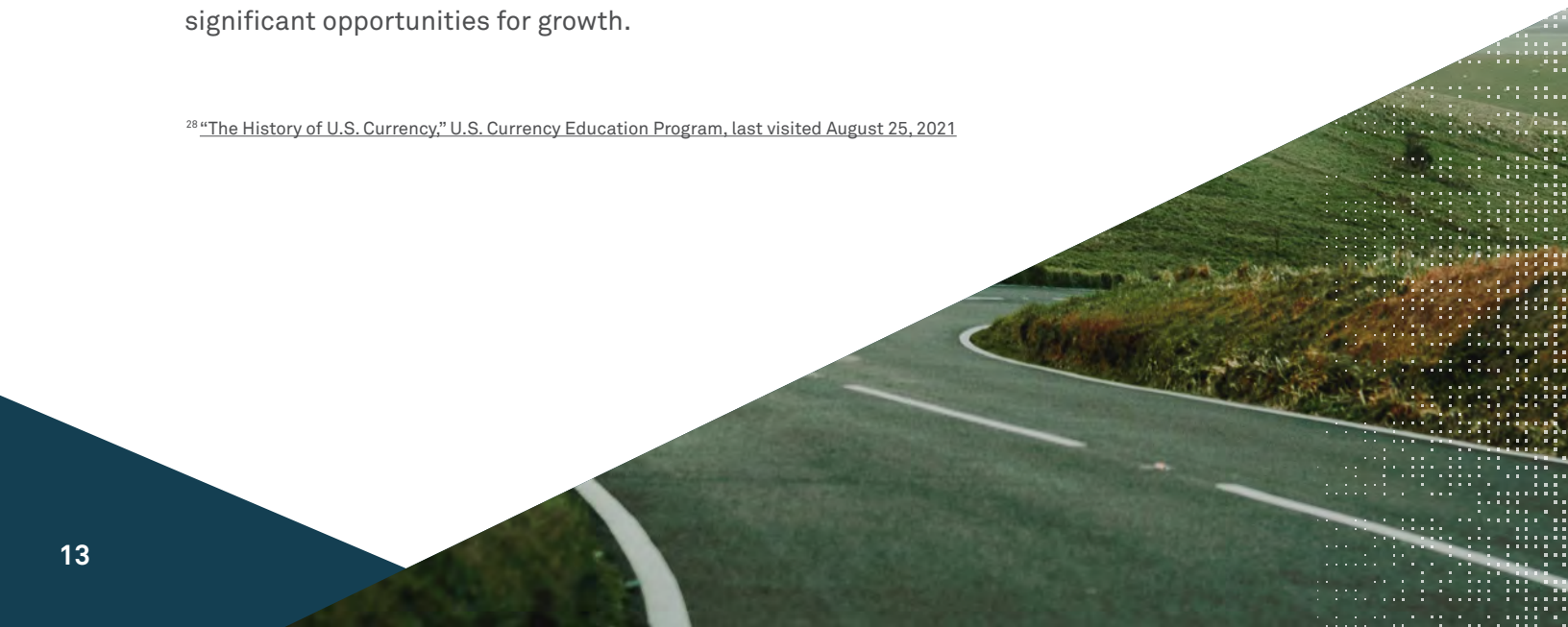
In other words, digital assets create a paradox: global institutions want to evolve quickly in a way that is both future-proof as well as safe and secure.

The market forces described in this overview show an ecosystem of digital assets evolving toward maturity. Yet, many institutions have only just begun their digital assets journey. In some cases, experimentation happens around the edges, but has not yet been formalized into mainstream product and service offerings.

It is also not a guarantee that all of these innovations will coalesce into maturity without conscious efforts to make them stable and reliable enough for the real-world mainstream functioning of financial markets. The risks that must be managed stem from the stability and security of digital assets technology as well as potential responses from market participants, including investors, regulators and central banks.

Just as traditional markets have evolved by means of collaboration among stakeholders, we believe the same must be true for digital assets, albeit more quickly. Decentralization is a built-in feature of the distributed technologies that underly digital assets. As we stand at the cusp of digital assets becoming institutionally ready, we expect the emerging world to be “multi-centered,” with global institutions and their collaborative partners all playing their part. This new ecosystem, which must be grounded in both trust and innovation, will provide significant opportunities for growth.

[28] “The History of U.S. Currency,” U.S. Currency Education Program, last visited August 25, 2021



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